ALTERNATE FARMING SYSTEMS TO ENHANCE FARMERS' INCOME-2017

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Proceedings of the National Conference
Solan, Himachal Pradesh

September 19-21, 2017

EDITORS

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Preface

Conventional farming threatens future food production by reducing biodiversity, and contributing to environmental degradation of the existing system. The alternatives to conventional farming need to be embraced to improve subsistence farmers' yields and to ensure adequate food production for the growing population. According to the International Food Policy Research Institute, the world needs to produce more food with fewer resources. This calls for an urgent need to identify potential alternative farming strategies to achieve long term sustainability and food security.

The Finance Minister in his Budget 2016 Speech mentioned about doubling farm incomes. Later, the Prime Minister of India gave a call to the nation of doubling farm incomes by 2022 by spelling out 6 points strategy. To double the income of farmers by 2022, which do not take inflation into account would require a 15% compounded income growth rate, which is a marginal increase over the achieved increase from 2003 to 2013. However, to increase the income in real terms would imply restructuring agriculture processes & policy interventions. Re-orienting conventional agricultural technologies to new farming modes have now been viewed as the need of the hour. Dr. MS Swaminathan has very rightly quoted as *'If agriculture goes wrong nothing else goes right." and "Younger people will join agriculture if it is technologically driven'*. This will require new approaches and innovations, as well as increasing collaboration between the private sector and other stakeholders in the food system.

The Himachal Chapter of the Indian Ecological Society was constituted during February 2017, based at YSPUHF, Nauni, Solan. With its inception, it joined hand with its parent society to carry forward various scientific events and emphasized to be one of the carriers of national agenda to enhance farmers' income by 2022. Hence, National Conference on '**Alternate Farming Systems to Enhance Farmers' Income**' aimed at focussing our attention on holistic farming systems and the technologies that are safer to the environment, reduce production costs and enhance farmers' self-reliance. The Indian Ecological Society- Himachal Chapter has tried to take account of the exchange between different cultures and disciplines to provide important knowledge resource to stakeholders. This initiative is in the direction to put forth different alternative technologies developed/proposed by different workers around the country and threadbare discussions for their exchange to the stakeholders.

We thank all the participants who have taken the effort of coming to Nauni, a very small but beautiful place in the lap of Himalayan Mountains. The thanks are due to national advisory committee for their advice, conference organising committee for their day and night efforts, the administration of YSPUHF for providing all logistics and other sponsorors from the government, public and private organisations to support this national event in a wholehearted manner. The financial support rendered by National Bank for Agriculture and Rural Development (NABARD) for the publication of this document is duly acknowledged. The financial assistance received from Research and Development Fund of NABARD towards publication of proceedings of the congress and the sponsorship to meet partial expenditure incurred on Farmers-Scientist Interaction is gratefully acknowledged.

Editors

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Solan, Himachal Pradesh

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Theme-1

Hi –Tech Farming Systems to Enhance Farm Income

IESHP/AFS2017/1001

Capital Investment, Input Use Pattern and Economics of Major Crops under Protected Cultivation

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Keywords: Protected Cultivation, Capital Investment, Input Use Pattern

Introduction

Protected cultivation has proved as a boon to enhance the incomes of marginal and small farmers as the crops under protected conditions give several times more yields. The state government of Himachal Pradesh is promoting protected cultivation under "*Pandit Deen Dayal Kisan Bagwan Samridhi Yojna*". Assistance provided under this project for the installation of polyhouse structure with assured irrigation facility and the creation of water sources was to the extent of 80 per cent and 50 per cent of the approved cost, respectively. Since, protected cultivation is purely a commercial agri-business venture with substantial initial investment, it is very important to ascertain the profitability of the venture. Therefore, the present study was undertaken to look into the capital investment, input use pattern and economics of major crops under protected cultivation.

Material and methods

The present study was conducted in Kangra district of Himachal Pradesh. The study was conducted in two blocks viz., Kangra and Bhawarna, both having maximum number of polyhouses. A sample of 60 polyhouse farmers was selected randomly through proportional allocation method. The polyhouse units were then post stratified into small (<250 m^2) and large (≥250 m^2) categories. Primary data were collected through survey method from polyhouse owners. Secondary data were collected from published/unpublished sources. Data were analyzed using appropriate statistical techniques to derive the results of the study.

Results and conclusion

The overall average area under protected cultivation was 197.05m^2/farm. Large category polyhouses made substantial investment of Rs. 3,19,600 while on small farms it was Rs. 1,49,138. Owner's contribution in total investment was 27.8 per cent. Subsidy amount granted for small and large polyhouse units, was Rs. 1,04,983 and Rs. 2,34,026, respectively. Gajanana et al. (2003) reported high capital investment on polyhouses. The total cropped area on small farms was 105.00 m^2 of which capsicum occupied 39.4% of the area followed by cucumber (33.3%) and tomato (27.3%) while on large farms capsicum occupied 37.3% of the cropped area followed by tomato (34.8%) and cucumber (28%). Capsicum was the predominant crop on both the categories of farms. In case of small polyhouses, the productivity per 100 m^2 of area for capsicum, tomato and cucumber was estimated to be 8.95, 8.90 and 11.51 q, respectively, while for large polyhouses, it was 5.75, 6.52 and 9.21 q, respectively. Productivity of different crops on small units was comparatively higher. Pandey *et al.* (2005) reported high productivity of capsicum under polyhouse conditions due to favorable growing conditions and better utilization of vertical space. Seed rate for 100 m^2 area of capsicum, tomato and cucumber hovered around 4.75 grams on small polyhouses, while on large units it was 3.63, 3.37 and 3.96 grams, respectively. Farmers were applying organic composts. Among fertilizers, the use of NPK complex (19:19:19) was the most common in study area. The other fertilizers used in the polyhouses were urea, single super phosphate and muriate of potash. The cost of fertilizers

was highest for tomato followed by capsicum and cucumber. The cost of plant protection materials accounted for the highest proportion among the variable inputs for all the three crops. Human labour incurred a significantly high cost with maximum (Rs. 7,726) for tomato on small farms followed by the other two crops. The total costs per 100 m^2 on small farms turned out to be Rs. 13,939, 13,848 and 11,312, for capsicum, tomato and cucumber, respectively and the gross returns for the same were Rs. 31,325, 22,250 and 17,265, respectively. Thus, the net returns of Rs. 21,800, 11,836 and 8,406, respectively were obtained over variable costs. The net returns on large farms were comparatively less. Output-input ratio of 2.25 was reported for capsicum followed by tomato (1.61) and cucumber (1.53) which indicates the comparative profitability of the crops. It can be concluded that the cultivation of crops under protected conditions is highly beneficial. It has the capacity to enhance the yields of different crops by 3-5 times as compared to open field conditions. It enables more efficient utilization of the scarce resources and thus enhances the gross and net returns per unit manifolds.

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IESHP/AFS2017/1002

Selection of Pollen Hoarding Colonies in *Apis mellifera* L.

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Keywords: Colony Strength, Honey Stores, Brood Area, Pollen Stores

Introduction

The European honey bee, *Apis mellifera* L. is the basis of flourishing bee industry the world over. Since its introduction in India, a lot of need based research has been done on various aspects of its seasonal management, bee flora, bee behaviour. Thakur (1994) selected better honey producing breeder colonies on the basis of biological and economic characters viz. colony strength, honey stores, brood area and pollen stores. It is evident that there are possibilities of improvement of many characteristics of honeybee by means of selection and selecting mating of better bee stock. However, bee breeding and stock improvement remained neglected in India (Singh, 2007). Therefore, selection was greatly needed to identify honeybee colonies possessing desirable traits for further breeding programmes.

Material and methods

Average performance of forty, *A. mellifera* L. colonies were recorded on the basis of colony strength, brood area, pollen stores and honey stores and were ranked on five point scale basis. The ranking was done i.e. 1 was given to least performing colony, whereas the best performing colony was ranked the highest i.e. 5.

Results and conclusion

Significant variations were observed in various colony parameters like colony strength (4 to 7.67 bee frames), brood area (515.67 to 1883.33 cm^2), pollen stores (20.67 to 366 cm^2) and honey stores 50 to 1000g, in the existing stock of 40 colonies**.** The average colony strength was maximum (7.67 bee frames) in colony number C-3 and C-32. Maximum average brood area was in colony number C-32 (1883.33 cm^2). Maximum average pollen stores were in C-36 (320 cm^2). Out of 40 colonies, the colony C-32 stored average maximum honey (1000 g). Ranking were obtained with respect to colony strength, brood area and honey stores as per their performance and the scores for colony strength, brood area and honey stores. Average score ranged from 2.67 to 5 for high pollen hoarding colonies, whereas it was from 1 to 1.33 for low pollen hoarding colonies. Data on seasonal variations in the performance of selected high pollen hoarded and low pollen hoarding *Apis mellifera* L. colonies showed variations in different colony parameters. Significant variations in colony parameters like bee strength, brood area, pollen area and honey stores in *A. mellifera* L. suggest that the existing stock can be improved by selecting colonies with desired trait for further multiplication.

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IESHP/AFS2017/1005

Physico-chemical Attributes of Tomato (*Solanum lycopersicum* L.) under Protected Environment and Mulch Conditions

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Keywords: Mulch, Polyhouse, Physico-Chemical, Quality, Tomato

Introduction

Over the last century, tomato as an important vegetable crop has attained a tremendous popularity because it can be grown in most places all over the world, like growing in open fields, greenhouses and net houses. Protected cultivation of tomato has been gaining importance in Himachal Pradesh from the last 10 years on account of favorable growing conditions inside. Generally consumers do not prefer poor quality vegetable produce, which fetches lesser price in the market. Hence, techniques like use of synthetic mulches in green houses, low tunnels, high density planting are best alternative to raise the high quality vegetables.

Material and methods

The present investigation wascarried out in modified naturally ventilated polyhouse at CSK HPKV, Palampur in RBD with three replications, consisting of nine treatmentsi.e., red colour plastic mulch (M1), yellow colour plastic mulch (M2), blue colour plastic mulch (M3), green colour plastic mulch (M4), transparent plastic mulch (M5), black colour plastic mulch (M6) and double shaded plastic mulch (M7) along with straw (M8) and control (no mulch) (M9).Observations were recorded on the traits viz.,pericarp thickness, polar diameter, equatorial diameter, total soluble solids (TSS), titrable acidity, ascorbic acid and yield/plant.

Results and conclusion

The use of double shaded plastic mulch resulted in significantly higher fruit yield/plant being statistically at par with plants under black colour plastic mulch. Low incidence of insect transmitted viruses also increased yield (Greer and Dole, 2005). M8 straw mulch exhibited maximum titrable acidity and was at par with M6 (black plastic mulch). Maximum ascorbic acid content was obtained in straw mulch which was statistically at par with green (19.4 mg/100g); red (19.2 mg/100g) and yellow colour plastic mulch (19.2 mg/100g). It can be concluded that use of double shaded and black colour synthetic mulch significantly increased yield and quality under the protected environment.

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IESHP/AFS2017/1006

Confirmation Studies on European Foulbrood (*Melissococcus plutonius*) Associated with *Apis cerana* F.

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Keywords: European Foulbrood, *Melissococcus plutonius*, *Apis cerana*

Introduction

The Indian hive bee, *Apis cerana* L. is found almost in all parts of the country, except the cold and hot desert because of non-availability of flora. Beekeeping is a common practice among rural communities. European foul brood disease is one of the important bacterial diseases, prevalent throughout the country in *A. cerana* and *Apis mellifera*). The causal organism of the European Foulbrood diseases is a bacterium, *Melissococcus plutonius* which is non-spore forming, gram positive and lanceolate in shape occurring mostly in chains.

Material and methods

The present study was conducted on European Foulbrood (EFB) in *A. cerana* and confirmation of causal organism of EFB i.e. *Melissococcus plutonius* infecting *A. cerana* through morphological and PCR studies. 100 brood cells in each of selected colony were examined. Larvae and pre-pupae of *A. cerana* morphologically showing symptom of infection of EFB (*M. plutonius*) were collected in vials (up to total 150 larvae during different period). The bacterium was isolated from the mid gut of *A. cerana* and cultured.

Results and conclusion

Monthly data recorded on the incidence of EFB disease indicated 0.44 to 23.00 per cent infection and pre-pupae of *A. cerana*. Two types of colonies were obtained under anaerobic (about 10% added CO_2) conditions at 34°C in 1-6 days. Both types of bacterial isolate colonies were Gram positive, ovoid and lanceolate shape with 0.33-0.50 µm size, arranged in short and long chains. Morphological characteristics of isolated bacteria though resembled *M. plutonius*, but PCR studies using specific primer sequence as well as universal primer could not confirm the presence of *M. plutonius*. PCR studies with universal primer (BCF_1 /BCR_2) indicated the presence of *Enterococcus faecalis*, which was further confirmed by sequencing. *E. faecalis*, previously thought to cause European foulbrood disease is secondary bacteria which rapidly accelerate the death of the infected larvae and is responsible for sour smell encountered with European foulbrood. The amplicons were sequenced with ABI PRISM^{TM} 310 Genetic Analyzer. The presence of *E. faecalis* in large number is a presumptive evidence of the presence of *M. plutonius* as *E. facealis* does not multiply in bee larvae in the absence of *M. plutonius*. According to present study *E. faecalis* can produce symptoms similar to *M. plutonius*, but this needs further confirmation.

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IESHP/AFS2017/1007

Real Time Fertigation in Guava Meadow Orchard

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Keywords: Nutritive fluids, Fertigation, Ultra High Density

Introduction
Hi-tech farming in fruits, focusing on high density plantation and canopy management, proved beneficial in ameliorating productivity. Integrated cropping schedule needs to be developed by concentrating water and nutrient management, since the crop becomes heavy feeder under such conditions. Guava is the most amenable crop to high density (2x1m) and canopy management (50% head back). It sets the crop into bearing phase in one and half years and assures the reaping of at least two crops a year. The outcome of the trial includes, i) the fertigation will save water, nutrients, farm labour, time, and will open new avenue of utilization in the other field crops, ii) the productivity will enhance 3-folds (3.42 t/ha, Fertigation+ meadow plantation), iii) it will lower down the cost of production since its initial years of investment, iv) It will improve the quality of fruit, which may fetch good prices in the international markets.

Material and methods
The experiment was conducted at YSPUHF-RHRTS, Dhaulakuan, Sirmour, HP (28°25' North latitude, 75°48' East longitude, 468 m amsl). The climate of the area is sub-tropical. The winters are cold and summers are very hot with normal annual rainfall is 1100 mm. Frost is also experienced occasionally. Cooler nights and fairly warmer days enriched by deep sandy loam soils rich in humus (forest soils) provide novelty to the fruit crop. The research investigation focused on guava productivity with real time fertigation scheduling (nutrients+ physiological stages+ evapo-transpiration) under ultra high density plantation on 'Allahabadi Safeda' (budded) and 'Lalit' (inarched). Statistical analyses were carried out using GLM of the standard errors of the mean, compared by the LSD tested (p=0.05).

Results and conclusion
The experiment ascertained NPK requirements at a particular physiological growth stage i.e. 20% reduction in dose of 19:19:19 and 00:00:50 at 80% ET (19:19:19+urea (10-15th day, foliage bud sprouting); 13:00:45+00:00:50 at 25-50th day, pre flowering-fruit set); 13:00:45+00:00:50 (60-75th day, fruit set-early fruit development); 19:19:19+00:00:50 (100-145th day, fruit development-ripening) for supplementing and complimenting the nutrient dynamics. The results inferred that in 'Allahabadi Safeda (budded), the fertigation scheduling recorded maximum average plant height (158.7 cm), tree circumference (16.7 cm), tree diameter (124.6 cm), annual shoot extension growth (46.3 cm), no. of primary branches (4) and no. of secondary branches (7), number of flower buds per shoot (27.2), fruit set (70.1%), fruit yield (5.2 kg tree^{-1}) and fruit weight (145.5 g). Similar growth attributes were also recorded with corresponding values of 187.2, 19.2, 132.6, 53.8 cm, 4, 7, 28.4, 73.1% and 5.5 kg tree^{-1}, 161.3 g in 'Lalit' under this fertigation scheduling.

IESHP/AFS2017/1008

Off-season Chrysanthemum Flower Production Technology for Enhancing Farmers' Income in Low Hill Conditions

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Keywords: Chrysanthemum, Cultivars, Off-season, Photoperiod, Short Day

Introduction

Chrysanthemum (*Dendranthema grandiflora* Tzvelev), is one of the commercially important cut flower crop of the world. As cut flower, spray chrysanthemum ranks second and standard chrysanthemum ranks sixth, and as potted plant, it ranks fifth in the world trade (Flora Holland, 2011). Chrysanthemum is a short day plant and cannot normally form flower buds when the day-length exceeds 14.5 hours. However, with simple lighting and blackout systems, day-length (night-length) can be altered and flowering time precisely controlled. In Himachal Pradesh, district Sirmour is occupying maximum area (272.34 hectares) under chrysanthemum. It is being grown for cut flowers on an area of 31.91 hectares and for loose flowers on 240.43 hectares in Nahan and Rajgarh areas of this district. A preliminary survey and interaction with farmers of these areas revealed that there exists ample scope of bringing more and more area under this crop for the benefit of the farming community. This can be achieved with interventions like; providing good quality planting material of commercial cultivars, updating their level of knowledge through trainings, demonstrating new and efficient technologies of flower regulation through photoperiod control etc. The farmers of these areas are more enthusiastic for its commercial cultivation.

Material and methods

Under NHB project, '*Popularization and demonstration of off-season flower production technology of chrysanthemum under low hills of HP*', twenty-four cultivars (Twelve standards and twelve spray) were introduced. Standard cultivars namely; White Star, Yellow Star, Pusa Centennery, Pusa Anmol, Apricot Parasol, Anaestasia White, Pink Cloud, SL Red, Snow Ball, Surf, Poornima, Ajina Purple; spray like DKC-Yellow, Frilly Pink, DKC-Pink, DKC-Button Yellow, Kalpana, Peet Singar, Autumn Pink, Birbal Sahni, White Bouquet, Kundan, Shyamal, Ravi Kiran etc. Maintenance of mother plants in field and pots were done and standard vegetative propagation procedure for multiplying chrysanthemum cultivars was done from March, 2016 onwards in protrays and raised benches in mist chamber. These cultivars were subjected to artificial short days (16 hours dark period with effect from 5.00 pm to 9.00 am) using black out material i.e. High density polyethylene – white outside and black inside till 60-70% flower buds showed colour (1st week of August).

Results and conclusion

Bud formation in cv 'Surf' initiated on 16 Aug, 2016 onwards, colour seen on 10th September, 2016, bud opening on 14th Sep, 2016 and bloom was obtained in the month of September, 2016 onwards in treatment and no flower bud was observed in control up to October, 2016. Bud formation in other cultivars namely, Solan Shringar, Shyamal, Autumn Pink and Peet Singar etc. initiated followed by 'Surf' during third and IV week of August, 2016 (Table 1). Normal flowering season in chrysanthemum under low hill conditions is November end-January first week. But, by providing artificial short day treatments, flowering was enhanced by two months earlier in cv. 'Surf' followed by cv. Pusa Anmol,

Solan Shringar, Shyamal, Autumn Pink and Peet Singar etc. Plants provided with artificial short days bloomed earlier compared to control. This technology, if adopted may fetch good benefit to farmers by getting good price of flowers during off season in addition to normal season of flowering.

Table 1: Mean Performance of Chrysanthemum Cultivars in Low Hill

Cultivar	Number of days taken for bud showing colour	Number of days required for flowering	Duration of flowering (days)
Ajay	104.3	117.5	42.3
Anaestesia White	107.5	120.0	28.5
Autumn Pink	102.0	115.0	35.2
Peet Singar	99.0	112.0	32.3
Purnima	105.6	112.5	26.0
Pusa Anmol	97.2	110.0	28.7
Pusa Centenary	104.3	112.7	24.4
Shyamal	99.7	114.0	36.3
Solan Shringar	99.0	112.0	31.2
Surf	93.5	105.0	32.7
Yellow Star	104.0	111.3	41.8
Tata Century	108.7	120.2	35.4
White Star	105.0	112.0	28.8

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IESHP/AFS2017/1009

Propagation Studies in an Endangered *Sophora mollis* (Royle) Baker Shrub of Western Himalayas

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Keywords: *Sophora mollis,* Rare, Shrub, Western Himalayas

Introduction

Sophora mollis (Royle) Baker is a deciduous perennial small sized, arching and spreading shrub which belongs to family Papillionaceae. The generic name is derived from *sophera*, an Arabic name for a pea-flowered tree. It is commonly known as 'Peeli Sakina'. It is a small deciduous shrub with dense hairy twigs. Leaves are 10-20 cm long. Flowers are bright yellow and pods are persistently silky. Flowering takes place in April to May. It is distributed in Western Himalayas in (Jammu & Kashmir, Himachal Pradesh and Uttarakhand), Pakistan, Afghanistan and China at an altitude ranging from 700-1500 m. It is an endangered shrub. The species is mainly used as fodder by local people which resulted in depletion of its population from wild habitats (Srivastava, 2016). It is found growing in semi-exposed to shaded moist slopes of forest edges. It can be conserved and utilized as specimen shrub in the garden.

Material and methods

Explorations were conducted Himachal and Uttrakhand for the collection of propagules. It was found in the areas of Sahastradhara, located near Robber's Cave, Dehradun, Uttrakhand (30 ^{o} 38'72" N latitude, 78^{o} 13'16" E longitude). The healthy viable seeds collected from forest area, were soaked in hot water for 12 hours for good germination. The species can also be propagated from cuttings in July-August and root suckers. Seed propagation studies were conducted in *Sophora mollis.* Seeds were sown in different media namely; Sand, Cocopeat + sand (1:1), Vermiculite + sand (1:1) during March, 2017 in mist chamber.

Results and conclusion

The results inferred that seeds were early to germinate (27.00 Days) with highest per cent germination (78.40), maximum root and shoot length (20.5 cm, 32.66 cm), number of roots (22.8) and number of leaves (10) in media Vermiculite + sand (1:1) (Table 1)

Table1: Propagation Studies in *Sophora mollis* (Royle) Baker

Parameters/ Media	Days to germinate	Germination (%)	Root length (cm)	No. of roots	Shoot length (cm)	No. of leaves
Cocopeat + Sand (1:1)	35	56.8	16.2	11.6	29.52	9
Vermiculite + sand (1:1)	27	78.4	20.5	22.8	32.66	10
Sand(Control)	42	30.7	10.5	7.3	15.3	3

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Screening of Lettuce Genotypes for Horticultural Traits under Naturally Ventilated Polyhouse Conditions

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Keywords: Genotype, Controlled Environment

Introduction

Lettuce (*Lactuca sativa* L.) is cultivated worldwide and is one of the green leafy vegetables mostly consumed in raw form for its good taste and high nutritive value and mineral input to a diet (Vasquez *et al.,* 2017). The major lettuce growing countries in the world are China, US, Spain, Italy, India and Japan. The profitability of vegetable production depends upon the productivity, quality and timing of growing the crop. Polyhouse cultivation is an alternate over the traditional cultivation, as it ensures high productivity per unit area with the genetic potentiality of the crop being fully exploited, raising of off-season healthy nursery, production of good quality produce free from any blemishes and finally it is easy to protect the crop against pests and diseases as well as extreme climatic conditions.

Material and methods

The present investigation was carried out at Department of Vegetable Science, YSPUHF, Nauni, Solan (HP) during 2011 and 2012. The experiment was laid out in a RCBD. Twenty eight genotypes including check cultivars (Simpson Black Seeded and Great Lakes) were evaluated. The observations were recorded on days to marketable maturity, number of non-wrapper leaves, gross and net head weight, heading percentage, yield per plot, β-carotene, calcium & iron contents, seed germination, seed vigour index-I & II, 1000-seeds weight, head shape index and incidence of diseases. The statistical analysis was performed by using MS-Excel, OPSTAT and SPAR 2D

Results and conclusion

Six genotypes namely UHF-Sel.-06, UHF-Sel.-03, UHF-Sel.-01, CGN-05167, CGN-10944 and CGN-14629 gave higher yield and also performed better for other horticultural traits *viz.* days taken to marketable maturity, gross and net head weight, heading percentage, 1000-seeds weight, seed germination percentage, seed vigour index-I and II. Genotype UHF Sel.-07 performed better than both the checks for β-carotene and iron content. Genotypes Sol. Let.-1, CGN-20721, CGN-05167 and CGN-14651 showed field resistance against *sclerotinia* rot and gray mould disease. Genotypes UHF-Sel.-06 and UHF-Sel.-03 needed further testing to be released as a substitute of existing varieties in HP. Genotype UHF-Sel.-07 gave higher β-carotene and Iron, whereas CGN-19009 was high in Ca content. Genotypes Sol. Let.-1, CGN-20721, CGN-05167 and CGN-14651 showed field resistance *sclerotinia* and *botrytis* disease. Hence, these genotypes can be further used in future breeding programmes.

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Evaluation of Irrigation Strategies on Growth and Productivity of Hazelnut in Dry Temperate Ecosystem

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Keywords: Hazelnut, Irrigation Strategies, Yield, Nut Quality

Introduction

Hazelnut (*Corylus avellana* L.) is one of the most important tree nut crop used in confectionery to make praline, and also used in combination with chocolate for chocolate truffles, Nutella and Frangelico liqueur. Knowledge of the timing of nut and kernel development is important for orchard management, especially irrigation. Lack of water results in reduced nut size, while, during kernel growth it leads to poorly filled and shriveled nuts. Under water stress, photosynthesis decreases, chlorophyll, soluble sugars and starch reduces. Studies revealed that early cessation of growth and early leaf fall was also observed in conditions of insufficient water. Soil water content, physiological, and fruit growth patterns and yield are highly consistent with the amount of water applied by irrigation.

Material and methods

The present study was carried out at RHRTS, Sharbo, Kinnaur, Himachal Pradesh on 10-year old hazelnut trees to investigate the responses of irrigation frequencies. The trial examined the plant responses to 10 irrigation levels, over the period from 2010-11. All the treatments were replicated thrice in a Randomized Block Design. The trial procedure included different irrigation strategies as T_1: 1-3-5-7 (Alternate day basal irrigation), T_2: 1-4-7 (basal irrigation), T_3: 1-5 (basal irrigation), T_4: Weakly (Only basal irrigation), T_5: 1-3-5-7 (Alternate day Sprinkler irrigation), T_6: 1-4-7 (Sprinkler irrigation), T_7: 1-5 (Sprinkler irrigation), T_8: Weakly (Basal irrigation+Sprinkler irrigation), T_9: Only Sprinkler irrigation (Weakly) and T_{10}: Control (No irrigation).

Results and conclusion

Vegetative growth and yield characters were positively affected by irrigation scheduling. Maximum yield was recorded in T_1 (alternate day basal irrigation) followed by T_5 (alternate day sprinkler irrigation). Nuts and kernel weight and size, and percent kernels were slightly increased in the supplemented irrigation frequencies over control. The per cent empty and defected nuts were higher under limited water availability (T_{10} followed by T_9 and T_4). Similarly, maximum plant height and fruit set was recorded in T_1 followed by T_5, whereas, tree spread: east-west; north-south and annual shoot extension was recorded in T_5 followed by T_1. The results inferred that irrigation scheduling have positive effects on vegetative growth traits, yield and yield components of hazelnut. Significantly higher values of plant height and cross-section of a tree was determined on different irrigation levels.

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Stability Analysis of Carnation Varieties using Stability Models

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Keywords: Carnation, Discriminant Analysis, Stability Analysis

Introduction

Carnation (*Dianthus caryophyllus* L.) belongs to the family Caryophyllaceae, is commercially grown in Solan, Shimla, Mandi, Kullu, Chamba and Bilaspur districts of Himachal Pradesh. As per the estimates of Directorate of Horticulture, Himachal Pradesh, carnation occupied 51.71 ha area, out of total area (790.98 ha) under floriculture in the State during 2014-15. The acreage of carnation is still expected to increase because of the favourable climatic conditions for its cultivation in different parts of the State. An attempt was made to divide the varieties into high and low yielder through stability analysis to obtain the stable varieties which can perform consistently in all the environments

Material and methods

The data on growth and flowering characteristics of carnation crop for 50 varieties for three flushes was collected. Various growth and flowering characters namely, number of days for first flower, flower size, number of flower stems per plant, duration of flowering (days) were considered for stability analysis. Fifty varieties were divided into high and low yielder groups by using discriminant analysis and stable varieties for high yielder group were identified by using Eberhart and Russell's stability model.

Results and conclusion

The discriminant function was found as: D = - 44.606 + 0.272X. This equation reveals that the character number of days for first flowering (X) was the most important character that discriminant the two groups (Table 1). Stability analysis was performed for high yielder varieties of carnation crop to identify stable varieties for high yielder group. Variety × Flush interaction was found significant for all the characters in higher yielder group. Therefore stability analysis was performed for all the characters to obtain the stable variety through Eberhart and Russell's stability Model (1966). Master and Rendez Vous satisfied the conditions i.e. $P_{i\,is}$ greater than zero (0.84 and 5.73 respectively), regression coefficient b_i nearly equal to one (0.98 and 0.94, respectively) and lows$^2_{di}$. Thus, Master and Rendez Vous were identified as stable varieties with respect to number of days for first flowering. These two varieties exhibited 'average stability', hence possessed general adaptability i.e. general adapted to all environment conditions as changes in 'varieties mean' go hand in hand with those in environmental mean.' Pink Dover and UHFSCar Col.-13 were stable for number of flowers per stem, UHFSCar Col.-5, UHFSCar Col.-10, UHFSCar Col.-18 and UHFSCar Col.-19 were stable for flower size, Rendez Vous , UHFSCar Col.-1, UHFSCar Col.-13 and UHFSCar Col.-19 were stable for duration of flowering. Thus UHFCar Col.-13 is a most stable variety for the important characters number of flower per stem and duration of flowering.

Table 1: Classification of Varieties of Carnation as High And Low Yielder

High Yielder Varieties				Low Yielder Varieties			
1.	Arka Flame	12.	UHFSCar Col.-10	1.	Aicardi	15.	Marathon
2.	Baltico	13.	UHFSCar Col.-11	2.	Bright Ren.Vous	16.	Nordika
3.	Lady Green	14.	UHFSCar Col.-13	3.	Cindrella	17.	Raggio-di-Sole
4.	Master	15.	UHFSCar Col.-14	4.	Cool	18.	Snow Storm
5.	Pink Dover	16.	UHFSCar Col.-15	5.	Dark Rendez Vous	19.	Tamarind
6.	Rendez Vous	17.	UHFSCar Col.-18	6.	Don Pedro	20.	UHFSCar Col.-2
7.	Tempo	18.	UHFSCar Col.-19	7.	Gaudina	21.	UHFSCar Col.-6
8.	UHFSCar Col.-1	19.	UHFSCar Col.-20	8.	Golem	22.	UHFSCar Col.-7
9.	UHFSCar Col.-3	20.	UHFSCar Col.-22	9.	Happy Golem	23.	UHFSCar Col.-8
10.	UHFSCar Col.-4	21.	UHFSCar Col.-23	10.	Hermes	24.	UHFSCar Col.-9
11.	UHFSCar Col.-5	22.	UHFSCar Col.-24	11.	Kleos	25.	UHFSCar Col.-12
				12.	Liberty	26.	UHFSCar Col.-16
				13.	Madame Colette	27.	UHFSCar Col.-17
				14.	Madras	28.	UHFSCar Col.-21

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Effect of Bee Strength and Queen Cell Cups Spacing on the Acceptance Grafted Larvae on *Apis Mellifera* Colony

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Keywords: *Apis Mellifera*, Queen-Less, Grafted Cups

Introduction

Beekeeping which is a forest and horti-agriculture based industry can play an important role in the development of hilly areas, as it increases economy without changing environmental balance. As a cottage industry it is an important income generating activity for the rural people of hills (Crane 1975). Success of beekeeping depends upon some basic factors such as suitable climatic conditions, bee forage, bee management and bee breeding. The combinations of these factors lead to better honey and beewax production.

Material and methods

The study was conducted at Bee Research Station, Nagrota Bagwan of Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya during 2013 and 2014. *Apis mellifera* Linnaeus colonies of different strength viz. 4, 8, 10, 12 bee frames was assessed by using modified Doolittle method. The larvae of less than 24 hours of age were selected and placed into queen cell cups. The larvae grafted in the cups were inspected on the 3rd day of grafting. When the cup was found sealed, it was considered as 'Finished cell'. The data was analyzed statistically by using CPCS.

Results and conclusion

In queen rearing, 23 queen cell cups placed at a distance of 2 cm spacing and 7 queen cell cups placed at a distance of 1.5 cm spacing with the grafted larvae of less than 24 hours were given to each of the *Apis mellifera* colony. Cell cups placed at a distance of 2 cm and 1.5 cm spacing made on an average 9.67 and 4.00 numbers of queen cells on 12 frames, followed by 6.33 and 3.00 by colonies on 10 frames, 4.33 and 2.33 by colonies on 8 frames & 3.33 and 1.33 by colonies on 4 frames, respectively. Percentage of finished cells was high in cell cups placed at a distance of 1.5 cm in comparison to than at 2 cm.

Table 1: Average Queen Cell Cups (nos.) accepted by *A Mellifera* For Rearing Queens

Colony	Strength of Colony (BF)	Queen Cell Cups finished at Different Spacing	
		2 cm (23 cups)	1.5 cm (7 cups)
QL	4	3.33	1.33
QL	8	4.33	2.33
QL	10	6.33	3.00
QL	12	9.67	4.00
$CD_{5\%}$		2.71	1.80

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Advances in Next Generation Sequencing

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Keywords: DNA Sequencing, Technology

Introduction

DNA sequence represents a single format onto which a broad range of biological phenomena can be projected for high throughput data collection. The first DNA sequence were obtained by academic researchers, using laboratories methods based on 2- dimensional chromatography in the early 1970s followed by the development of dye based sequencing method with automated analysis. Over the time demand for DNA sequence information has never been greater, yet Sanger technology is too costly, time consuming, and labor intensive to meet this ongoing demand.

Material and methods

Near-term challenges include the development of robust protocols for generating sequencing libraries, building effective new approaches to data-analysis, high throughput and often a rethinking of experimental design. Scientific discoveries resulting from the application of next-generation DNA sequencing technologies highlight the striking impact of these massively parallel platforms on genetics. The methods have expanded previously focused readouts from a variety of DNA preparation protocols to a genome-wide scale and have fine-tuned their resolution to single base precision (McKenna *et al.,* 2010).

Results and conclusion

Third generation sequencing has the potential for fast and affordable genome sequencing by enabling numerous applications which include the comprehensive analysis of genomes, transcriptomes, interactomes, sequence variation studies, forensics, diagnostic and applied therapeutics to become inexpensive, routine and widespread, rather than requiring significant production (Munshi 2012) One technology that sits between the SGS and TGS categories is Ion Torrent's acquired by semiconductor sequencer which employs to create a high-density array of micro-machined wells that carry out single base incorporation by sensing the release of hydrogen .This process eliminates the need for light, scanning and cameras to monitor the process, thereby simplifying the overall sequencing process, dramatically accelerating the time to result, and lowering cost to make DNA sequencing more generally accessible to all .

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Effect of Foliar Fertilization on Yield and Economics of Capsicum under Protected Cultivation

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Keywords: Foliar Fertilization, Protected Cultivation, Economics

Introduction

Capsicum is one of the highly remunerative vegetable crops. Despite its economic importance, the growers are unable to produce a good crop due to biotic, abiotic and crop factors. Protected cultivation can not only increase the productivity by manifold but also improve the quality of the produce. Foliar water soluble fertilizers as a spray are an important crop management strategy, which can maximize yield and quality under protected conditions. Keeping in view, the experiment was designed to study the effect of foliar fertilization on yield and economics of capsicum.

Material and methods

On farm trial was conducted in a naturally ventilated polyhouse .The experimental location was approximately 2.5 kilometers from CSK HPKV-HAREC, Bajaura, Kullu, Himachal Pradesh. The experiment included thirteen treatments comprising three different rates of water soluble fertilizer 19:19:19 (N: P: K) applied as a foliar spray at four different time intervals, replicated six times in a randomized block design. The economics of individual treatment was worked out at prevailing input and output rates in the market.

Results and conclusion

Marketable fruit yield was significantly decreased with increasing the concentration of water soluble fertilizer (2.5-7.5 g l^{-1}), applied twice in a week as foliar spray. Yield reduction due to higher concentration (5 g l^{-1} and 7.5 g $^{-l}$) of fertilizer applied twice in a week ascribed to increased nutrient rate that delayed flowering and fruit set. Further, yield was significantly improved with fertilizer concentration of 2.5 g l^{-1} to 7.5 g l^{-1} applied once in a week. The increase in yield due to foliar application of water soluble nutrients using higher rate (5 g l^{-1} and 7.5 g l^{-1}) at weekly interval might be due to the increased uptake of nutrients resulted in more photosynthesis and enhanced food accumulation in edible parts of fruits. The present findings are in conformity with Ali *et al.* (2013) in tomato. The treatment receiving foliar spray of 7.5 g l^{-1} at weekly interval was most profitable, because maximum net returns (49900) and B:C ratio (4.15) was recorded. Similar results in relation to higher net returns were also recorded in tomato (Chaurasia *et al.* 2005).

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Mitigation of Climatic Vulnerability in Snowbound Area through Protected Cultivation

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Keywords: Climate, Mitigation, Protected Cultivation

Introduction

District Chamba represents all four types of agro-climatic conditions found in Himachal Pradesh. The climate in high hills and dry temperate areas is particularly harsh with long & cold winters, low soil moisture and poor fertility. ICAR envisaged a model project in selected Districts of the country with main objective of demonstrating climate smart technologies in selected villages. The activities of National Innovations on Climate Resilient Agriculture (NICRA) project were initiated in village Lagga and six surrounding hamlets. The village comprised of 90 farm families with total cultivable area of 89 ha. The farmers practiced traditional agriculture which was less remunerative. The area was snowbound from November to March and therefore only one growing season was available for crop production. Hence no crop was grown after the month of September. The awareness level of the farmers about the latest production techniques and cultivation of high value crops was limited. All these factors resulted in low farm income and thus the people had poor economic status.

Material and methods

The project work was initiated to demonstrate climate resilient technologies for mitigation of climatic vulnerabilities. Since protected cultivation is one of the most efficient technology under unfavourable conditions it was decided to establish protected structures and demonstrate cultivation of high value vegetable crops to raise farm income. The farmers were made aware about the need and benefits of crop diversification with high value vegetable crops. Twenty two polyhouses in convergence mode were constructed. The experiment was conducted during 2014-15 and 2015-16 to assess the performance of capsicum, the most remunerative crop under polyhouse. Community nursery of capsicum variety Indra was raised in a ploy house in first week of May. The seedlings were transplanted into eight polyhouses in last week of May at a spacing of 45 x 30 cm thereby accommodating 90 plants/ polyhouse of 40 m^2. Irrigation was supplied through drip on a daily basis. The plants were fertigated with 19:19:19 @ 3 gm/square meter. Standard package and practices were followed for raising the crop as per the recommendations of the University.

Results and conclusion

The plants took 32.8 to 36.4 days from the date of transplanting to produce first flowers. The fruits reached picking maturity on an average of 72.62 days. Number of fruits per plant ranged between 13.5 and 18 with fruit weight of 130.3 g. The total yield recorded among various locations varied between 1.82 to 2.36 quintals.

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Influence of Indole Butyric Acid and Urea Phosphate on Rooting of Kiwifruit Cuttings under Zero Energy Polyhouse

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Keywords: Kiwifruit, Cuttings, IBA, Urea-Phosphate, Rooting

Introduction
Kiwifruit (*Actinidia deliciosa*) or Chinese gooseberry is a deciduous, dioecious fruiting vine belongs to family Actinidiaceae and is native to China. Although, it was introduced in Kashmir valley in 1989, but due to lack of technical knowhow and planting material, its cultivation could not gain popularity and is still in infancy stage. With each passing year and awareness among people in Kashmir valley, demand for its plant material is increasing. The use of semi-hardwood cuttings is one of the easiest methods of vegetative propagation. However, the cuttings are hard to root in nature. The study was carried out to investigate the effect of IBA with Urea-Phosphate as a nutrient supplement on the rooting performance of the cuttings.

Material and methods
The study was carried out at Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir in 2015. Cutting material was taken in the month of February, 2015 from 10 year old plants of 'Hayward' cultivar having uniform vigour. Type of cutting was semi-hardwood (leafless) and propagation medium was sand under Zero Energy Polyhouse The size of each cutting ranged between 15 to 20 cm with diameter 8 to 13 mm. Treatments include Control (0 ppm) distilled water, Indole Butyric acid (IBA) levels with Urea-Phosphate. IBA was tried at 3 levels (1500 ppm, 2500 ppm & 3500 ppm) with Urea-phosphate of concentration 2000 ppm.

Results and conclusion
IBA along with Urea- Phosphate have statistically non-significant effect on the days taken to sprouting. Maximum days taken to sprouting (10.60) were observed in control and minimum days (9.61) were recorded in IBA 3500 ppm + Urea Phosphate 2000 ppm. A non-significant effect was observed in cuttings treated with different levels of IBA with Urea- Phosphate as far as callusing percentage is concerned. There was significant variation in cuttings treated with different concentration of IBA with Urea-Phosphate on survivability percentage. Highest survivability (92.77%) was observed in the cuttings treated with 3500 ppm IBA concentration with Urea- Phosphate which is at par with 2500 ppm IBA treatment with Urea-Phosphate (90.55%) and lowest survivability (65.55%) was in untreated cuttings. All the concentrations of IBA with Urea-Phosphate significantly influenced rooting percentage in cuttings. The highest rooting percentage (61.11%) of cuttings was observed at the IBA concentration of 3500 ppm with Urea Phosphate followed by 2500 ppm of IBA with Urea Phosphate (56.66%). However, in untreated cuttings minimum (31.11%) rooting was recorded)..Thus, the best results regarding survivability and rooting percentage of Kiwifruit cuttings were by using IBA at 3500 ppm with Urea-Phosphate.

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Effect of Plant Growth Regulators on Yield and Quality Traits of Kiwifruit (A*ctinidia deliciosa)*

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Introduction

Kiwifruit cultivation in Chamba district of Himachal Pradesh is in its infancy stage. Production of small sized Kiwifruits compared to imported, available in the market becomes a major barrier for its large-scale cultivation and lagging them behind in fruit industry. Production of large sized, good quality Kiwifruit has become essentiality for economic profitability of the crop. Plant growth regulators for the crop management in horticultural crops are being used to improve fruit size and fruit yield. In kiwifruit, the synthetic cytokinin i.e. CPPU (N-(2-chloro-4-pyridyl)-N-phenylurea) has been tested worldwide and has been reported by different researchers to increase fruit size, fruit weight and yield significantly This paper summarizes the effects of applying CPPU, alone at different growth stages as foliar or dipping application, for the improvement of quality attributes

Material and methods

The research cum OFT was conducted in Kiwifruit cv. Hayward during the year 2013-14. Six treatments using PGR's were applied as foliar or dip application at petal fall and/or 15 days after petal fall stage. Trial procedure included T_1: Untreated control; T_2: CPPU @ 5ppm (Dip Application) at petal fall; T_3: CPPU @ 5ppm (Foliar Application) at petal fall; T_4: CPPU @ 5ppm (dipping), 15 days after petal fall; T_5: CPPU @ 5ppm (Foliar Application), 15 days after petal fall; T_6: Biozyme @ 2ml/litre at petal fall, applied. During fruit growth, 25 fruits per treatment per vine were assessed for different quality parameters. The data on fruit firmness, fruit weight, fruit yield and along with quality attributes were recorded at the time of harvesting. At harvest, the fruit weight was measured to determine yield. Standard statistical procedures were followed for data analysis.

Results and conclusion

The effect of the plant growth regulators viz., forchlorfenuron (CPPU) and biozyme on kiwifruit development as a dipping or foliar application at petal fall or 15 days after petal fall have been studied against the untreated control. The application of CPPU @ 5 ppm at petal fall as dipping application observed the highest (51.50 kg) fruit yield per vine, which were significantly higher to untreated control. Similarly, maximum fruit weight (120.50g) was recorded with dipping application of CPPU at petal fall and minimum fruit weight (48.80 g) in untreated control. The fruits treated with CPPU @ 5ppm as dipping application at petal fall also showed highest TSS (17.60 ^{o}B) and firmness (10.30 Kg). The probable reason for the higher fruit weight and yield may be the exogenous application of CPPU which being synthetic cytokinin has a role in faster cell division and cell elongation. The CPPU (N-(2-chloro-4-pyridyl)-N-phenylurea) has been reported earlier to increase fruit size, fruit weight and yield significantly, It is concluded that CPPU @5ppm at petal fall as dipping application improved significantly fruit weight, fruit firmness, TSS and fruit yield in Kiwifruit. Better fruit size and higher yields in Kiwifruit would be helpful for area expansion under Kiwifruit in Chamba district of Himachal Pradesh, which has a huge potential for its cultivation.

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CHIRAYATA-An Important Medicinal Plant for Economic Cultivation in Temperate Himalayas

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Keywords: Critically Endangered, Cultivation, Temperate

Introduction

Chirayata (*Swertia chirayita***)** is a native of temperate Himalayas, high in demand, pluri-annual and critically endangered medicinal plant. The plant is valued for its anthelmintic, hypoglycemic, hepatoprotective and antipyretic properties due to presence of amarogentin, amaroswerin and other compounds. The plant enjoys a good domestic and international market which is increasing at the rate of 10% annually. To fulfill this demand, the only solution is to bring this species under cultivation. Long gestation period, low seed viability & germination, minute seed size, delicate field handlings are the factors discouraging its cultivation. The species has been found suitable for cultivation in temperate Himalayas.

Material and methods

The study was conducted at Medicinal and Aromatic plants Research Farm Shilly, Solan, Himachal Pradesh (altitude 1550 m amsl, latitude –N 300 54' 30" and longitude E 770 07' 30''). Seeds were treated with GA_3 (50 & 100ppm, 12 hour duration) and sown in nursery media enriched with different combinations of biofertilizers (Azotobacter, VAM & PSB). The nursery raised seedlings were transplanted at different spacing (30 x 30 cm, 30 x 45 cm, 45 x 45 cm) and decapitation was performed at different heights (10 to 50 cm).The observations on nursery raised plants was recorded at transplanting stage and in field raised plants at full bloom stage.

Results and conclusion

The seed treatment with GA_3 (100 ppm for 12 hours) and sowing in media enriched with *Azotobacter* and VAM resulted in better germination (75.00%), reduced germination duration (7.33 days) and mean germination time (27.31 days), more number of leaves (14.00), higher leaf length (22.2 cm) and breadth (4.30cm), higher root length (22.28 cm), more fresh shoot biomass (12.40 g), more fresh root biomass (1.36 g) and higher fresh seedling biomass (13.47g). The growing the nursery raised plants at 30 x 30 cm spacing and decapitation of main shoot at 40 cm height resulted in maximum mean plant height (116.7 cm), number of branches (9.33), fresh aerial biomass (57.46g/plant), fresh root biomass (4.287 g/plant), dry aerial biomass (15.08 g/plant), dry root biomass (1.09 g/plant), whole plant fresh biomass (61.75 g/plant) and dry biomass yield (16.18 q/ha).

IESHP/AFS2017/1022

Evaluation of Trellis Training Systems in Pear under Sub-Tropics

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Keywords: Pear, Trellis System, Fruit Yield

Introduction
Among all temperate fruits cultivated in sub-tropics of north-west India, pear is most important in terms of acreage and production. The Asian variety, Patharnakh, occupies bulk of area in Punjab State. However, due to hard textured fruit, this variety does not fetch premium price in market. Several soft fleshed varieties i.e. Punjab Beauty, Punjab Nectar and Punjab Soft have been recommended for general cultivation in state. But long juvenility period and low yield potential is major bottleneck in expansion of area under these varieties. Hence there is need to reduce juvenility period and increase yield per unit area. One of the important techniques to accommodate more number of plants per unit area is to manage canopy of the plants and train them in a specific geometry so as to improve yield efficiency. However, feasibility of these systems has yet to be tested in local conditions.

Material and methods
Various trellis systems such as Espalier, Cordon, Y-trellis have been erected. Recommended pear varieties i.e. Patharnakh, Punjab Beauty, and Punjab Soft were trained on each of these training systems. All the pear varieties are propagated on Kainth rootstock, were planted at distance of 4 x 2 m for Espalier, 2 x 2 m for Cordon and 3 x 3 m for Y-system. To maintain plants geometry, the annual pruning and training was performed during the dormant season.

Results and conclusion
Maximum number of fruits per plant among all the three training systems was recorded in Patharnakh followed by Punjab Beauty and Punjab Soft. Among different trellis training systems, Espalier recorded highest number of fruits per plant followed by Y-system and Cordon system. However, fruit size was recorded highest in Cordon system. Espalier system recorded highest yield per plant while lowest yield was recorded on Cordon system. In all the training systems, the plants bear in 3^{rd} to 4^{th} year with varied fruit number and yield. Plants put up vigorous growth during the growing season. The actual feasibility and performance of these trellis systems would become apparent in coming years at full bearing stage. Restricting the excessive vegetative growth is a major challenge for success of such systems under sub-tropics.

IESHP/AFS2017/1023

Bumble Bee Pollination in Tomato under Protected Conditions

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Keywords: *Bombus haemorrhoidalis*, Pollination, Polyhouse, Tomato

Introduction

Bumble bees are important pollinators and have been pollinating many high value crops. Honey bees also play a vital role in enhancing the productivity but in many crops like tomato, egg, plant, cucumber, etc., the bumble bees are more efficient and reliable pollinators especially under protected conditions. These are more effective than manual pollination or honey bee pollination in terms of quantity and quality of tomatoes produced. The growers benefited from bumble bee pollination because of lower production costs, increased yield and improved fruit quality (Wolf and Moritz, 2008).

Material and methods

The present studies were carried out at Department of Seed Science and Technology, YSPUHF, Nauni, Solan, Himachal Pradesh during 2015. A playhouse (200 m^2) has been divided into two by using insect proof net in the middle. In one part bumble bee colony was placed at the time of 5-10% flowering of the crop, and the second was control (without bumble bee). The spacing was 90 x 30 cm and the cultivar 'Solan Lalima' was raised. The data were recorded on ten randomly selected plants for eight replications from each treatment plot for all the parameters.

Results and conclusion

The effect of bumble bee pollination on the production and quality of tomato were recorded as under: The data revealed significantly higher numbers (6.76) of fruits per cluster in bumble bee pollinated crop compared to control (3.33). In bee pollinated crop, significantly higher numbers of fruits (75.80 fruits/plant) were recorded. Similarly, the days to first fruit harvest was recorded significantly less in bee pollinated crop (67.75) compared to control (75.75). The data also revealed that significantly longer fruits (5.16 cm/fruit) were recorded from plants pollinated by bumble bees as compared to shorter fruits (3.52 cm) in pollinator excluded plants. Similarly, significantly higher fruit breadth (5.75cm) was observed from bumble bee pollinated plants than the control (3.81cm) plants. Significantly, heavier fruits (92.6 g) were recorded in bumble bee pollinated crop as compared to control (59.75 g). Higher fruit yield (12.7 kg/m^2) was recorded in bee pollinated plots as compared to control (6.86 Kg/m^2). Similarly, significantly less percentage of misshapen fruits (9.8) were obtained from bee pollinated plants. Significantly higher percentages of misshapen fruits (22.8) were obtained from control plot. On the contrary, significantly higher percentage of healthy fruits (90.33) was produced from bee pollinated plots as compared to control (76.54).

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IESHP/AFS2017/1024

Impact of Weather Parameters on Seasonal Incidence of Diseases and Enemies in *Apis cerana* F.

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Keywords: Bee Disease, Bee Enemies, Weather Parameters

Introduction

Honey bees, besides providing valuable hive products are essential pollinators of agriculturally important crops. At present four species viz., *Apis cerana* F., *Apis mellifera* L., *Apis dorsata* F. and *Apis florea* F. are known for honey products and pollination in crops. Honey bee diseases like American foulbrood, European foulbrood, Sacbrood, Thai sacbrood virus and *Nosema* are known worldwide. About 100 mostly harmless mite species are associated with honey bees but *Acarapis woodi, Varroa jacobsoni*, and *Tropilaelaps clareae* are the main. The seasonal pattern of disease prevalence and biological cycles of pathogens in honeybees are reported to be temperature dependent (Bailey, 1955).

Material and methods

The present investigation was conducted during 2016-17 in *A. cerana* colonies maintained by the Department of Entomology and Apiculture, YSPUHF, Nauni, Solan, H. P. The data on various weather parameters was obtained from the Department of Environmental Science, UHF, Nauni. Disease incidence at monthly interval in three colonies of 6-8 frame strength each was recorded.

Results and conclusion

European foulbrood disease incidence was maximum (23%) in the month of July 2016 when temperature, relative humidity and rainfall were high. Maximum incidence of Thai sacbrood disease was recorded in May 2016 (2.33%) when humidity was low (46%). No incidence of *Nosema* was observed. European foulbrood had positive non-significant correlation with weather parameters whereas; Thai sacbrood had positive non-significant correlation with temperature and rainfall and negative non-significant correlation with relative humidity. External weather influenced the disease incidence. The incidence of ectoparasitic mite (*Tropilaelaps clareae*) was high September 2016 (10%), whereas, no incidence of *Varroa destructor* was observed. No incidence of wasps was recorded on *A. cerana* apiary, whereas wasps were found visiting *A. mellifera* apiary and maximum incidence (12.54±0.88) was in June month. *T. clareae* incidence was positively correlated with temperature and relative humidity but was negative correlated with rainfall, whereas, wasp incidence was positively correlated with all the weather parameters. Though the hive temperature is maintained constant around 32°C and humidity is also regulated but during nectar and pollen foraging, honey bees are exposed to broad range of ambient temperature and humidity. From the study it can be concluded that the seasonal pattern of disease incidence in brood of honeybees is dependent on climatic conditions particularly temperature and humidity.

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In vitro Propagation of *Saussurea costus* (kuth)-Critically Endangered Medicinal Plant of Himalayan Region

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Keywords: *In Vitro* Propagation, *Saussurea costus*, Medicinal Plant

Introduction

Saussurea costus (kuth), the critically endangered medicinal plant of Himalayan region is well documented to exhibit anti-inflammatory, anti-ulcer, anti-cancer and hepato protective activities etc. Due to over exploitation for different medicinal uses and commercial purposes, *S. costus* is listed in Appendix I of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) for *in situ* and *ex situ* conservation. Conventionally, it is propagated through but the percentage of germination is low. Therefore, the application of alternative reproducible micropropagation strategies has become inevitable for mass propagation and sustainable utilization of this age-old medicinal plant.

Material and methods

The elite seed material of *S. costus* was collected for developing the explant material. Seeds of *S. costus* were used for raising *in vitro* seedlings in order to maintain and protect its endangered natural population without disturbing and extracting the whole plant. Different explants such as cotyledon, leaf, hypocotyl and shoot tip were harvested from *in vitro* seedlings and used for carrying out tissue culture experiments.

Results and conclusion

Different concentrations and combinations of growth regulators had significant effect on proliferation and multiplication of *in vitro* raised shoots. For induction of rhizogenesis in the excised *in vitro* regenerated shoots, shoots were cultured on half strength MS media combinations of different growth regulators. *In vitro* raised plantlets were successfully acclimatized under *e- vitro* conditions. In the present study, efficient and reliable direct and indirect *in vitro* regeneration protocols for *S. costus* (kuth) have been developed. These protocols could be exploited as cultivation technique at the community level in order to help the villagers to generate a sustainable source of income from this high value medicinal plant and to conserve biodiversity.

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Effect of Different Methods of Grafting and Age of Rootstock on Success of Epicotyl Grafting in Walnut under Polyhouse Conditions

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Keywords: Wedge Grafting, Tongue Grafting, Epicotyl Grafting, Rootstock Age

Introduction
The commercial cultivation of walnut is confined mainly to the state of Jammu and Kashmir producing about 85 per cent of total production of the country. Although, the climatic conditions of Himachal Pradesh are congenial for walnut cultivation, yet the area and the production have not increased with the pace as in other temperate fruits. The non-availability of grafted plants of superior cultivars due to lack of suitable propagation technique(s), is the major constraint in extending the area under walnut cultivation in the state as well as in the country.

Material and methods
An experiment on the effect of different methods and time of grafting on epicotyl grafting in walnut under polyhouse conditions in Department of Fruit Science, Dr Y.S. Parmar UH&F Nauni, Solan H.P. during 2015-2016. Day first, when plumule just begin to sprout was taken as reference date for counting total number of days and called as age of rootstocks (15, 30 and 45-days-old rootstocks). The epicotyl grafting was performed on 10th April (15-days-old), 25th April (30-days-old) and 10th May (45-days-old) of 2016 with tongue, cleft and wedge methods using dormant scion.

Results and conclusion
Interaction between methods and age of rootstocks reveal that cleft grafting done on 15-days-old rootstocks produced maximum bud sprouting (94.66 %) and graft-take success (81.27 %), followed by wedge grafting. On the contrary, minimum percentage of bud sprouting and graft-take success was recorded in tongue grafting on 45-days-old rootstocks. The minimum days of 21.33 were taken for bud sprouting in wedge grafting done on 15-days-old rootstocks; however, the maximum days of 31.00 were taken for bud sprouting in cleft grafting on 45-days-old rootstocks. The highest saleable plants (94.65%) were produced by wedge grafting done on 15-days-old rootstocks. The comparatively higher percentage of bud sprouting and graft-take success in cleft and wedge grafting may be due to the fact that stock and scion are interlocked more securely resulting in more intimate contact and lining up of cambial layers of rootstock and scion. The phenolic content increases with the increase in age of rootstocks (Prataviera *et al*. 1983), which interfere in graft healing process and adversely affect on bud sprouting and graft-take. On the basis of the per cent success and growth of plants, it may be concluded that cleft and wedge grafting performed on 15-days-old epicotyls are suitable and may be employed successfully for the production of grafted plants of walnut in a year under polyhouse conditions.

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Comparative Performance of Cherry Tomato and Lettuce Genotypes under Different Protected Structures

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Keywords: Cherry Tomato, Lettuce, Polyhouse, Nethouse, Genotypes

Introduction

Cherry tomato and lettuce are considered as important exotic vegetables, bringing new taste and appearance to Indian dishes. In order to ensure high quality produce with enhanced productivity, these exotic vegetables can be grown under protected conditions, which protect the crops from adverse climatic conditions. Very few reports are available on evaluation of different varieties/hybrids of cherry tomato and lettuce under protected conditions. Therefore, the present study was undertaken to identify suitable varieties/hybrids of cherry tomato and lettuce for protected cultivation.

Material and methods

The present investigation was carried out at RHRTS Jachh, Kangra during *Kharif* and *Rabi* seasons of 2016 in cherry tomato. Five genotypes (Solan Red Round, Red Beauty, Tuptim Rache, Laila and Roja) and lettuce (Baiyoke, Lolla Rosa, Romaine, Garishma and Iceberg) were planted in naturally ventilated polyhouse and nethouse in RCBD at 45×30 cm, accommodating six plants per plot. The standard cultural practices for raising a healthy crop of cherry tomato and lettuce were followed during entire period of investigation.

Results and conclusion

Mean performance of cherry tomato and lettuce genotypes under nethouse conditions was found better compared to naturally ventilated polyhouse. In tomato, highest plant height was recorded in the genotype Laila (174.67, 179.33 cm), while Roja took minimum days to first flowering (32.00 and 31.00) and first harvest (75.33, 75.00). However, Solan Red Round had maximum fruit length (3.57, 3.77 cm), fruit breadth (3.40, 3.60 cm) and average fruit weight (16.20, 18.00 g). Number of flower clusters/plant (24.00 and 24.67), number of fruits/clusters (6.63, 6.90), number of fruits/plant (159.27 and 170.03), yield/plant (2.39 and 2.70 kg) and yield/m^2 (14.34 and 16.18 kg) was recorded maximum in the genotype Red Beauty under naturally ventilated polyhouse and nethouse, respectively. In lettuce, minimum days to first flowering (56.33, 54.00) were taken by Garishma, while the genotype Romaine was found most promising for rest of all the traits viz., plant height (17.50, 19.07 cm), leaf length (16.27, 18.07 cm), leaf breadth (15.23, 16.87 cm), leaf weight (30.33, 14.50 g), number of leaves/plant (30.33, 33.00), leaf yield/plant (357.23, 478.60 g) and leaf yield/m^2 (2.13, 2.90 kg) under naturally ventilated polyhouse and nethouse, respectively. The results concluded that cherry tomato genotype Red Beauty and lettuce genotype Romaine were most promising under both protected structures. Therefore, cultivation of these genotypes can be recommended for protected cultivation in low-hill areas of Himachal Pradesh.

IESHP/AFS2017/1028

Influence of Plant Spacing and GA_3 Application on Seed Yield and Quality of Sweet William

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Keywords: GA_3, Sweet William, Seed Yield, Seed Quality

Introduction
Sweet William is botanically known as *Dianthus barbatus* L.*,* belongs to family Caryophyllaceae. It is native to the mountainous regions of Southern Europe to north-eastern Asia. Sweet William is under cultivation for more than 400 years. Sweet William is commercially propagated by seeds and there are number of factors which affect its seed yield and quality. The quality of seed is very much influenced by the foliar application of Gibberellic acid and plant spacing including other factors too. So, in order to produce good quality seeds, there is an urgent need to standardize optimum plant spacing and application of GA_3 in Sweet William.

Material and methods
The present study was carried out at Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan during 2015-2017. The experiment was laid out in RBD (factorial) with 12 treatment combinations of four levels of spacing *i.e.* S_1 (30 × 30 cm), S_2 (30 × 25 cm), S_3 (30 × 20 cm) and S_4 (20 × 20 cm) and three doses of GA_3 *i.e.* G_0 (0 ppm), G_1 (50 ppm) and G_2 (100 ppm) replicated thrice. Application of GA_3 was done at 40 days and 60 days after planting.

Results and conclusion
The capsules per plant (67.84) was maximum at a spacing of 30 × 30 cm apart (S_1). Similarly, application of GA_3 @ 100 ppm resulted in highest number of capsules per plant (62.67). The interaction resulted in maximum number of capsules per plant (74.67) was with S_1 (30 × 30 cm) × G_2 (100 ppm) The number of seeds per capsule was also showed the same trend. The plant spacing of 30 × 30 cm (S_1) recorded maximum seed yield per plant (4.57 g). The application of GA_3 @ 100 ppm resulted in highest seed yield per plant (4.08 g). The combination of S1 (30 × 30 cm) × G_2 (100 ppm resulted in maximum yield. Seed yield per plot was maximum (107.18 g) with 20 × 20 cm spacing(S_4) and was highest with the application of GA_3 @ 100 ppm (G_2) Maximum seed yield per plot (111.12 g) in the interaction, S_4 (20 × 20 cm) × G_2 (100 ppm). The plant spacing of 30 × 30 cm along with GA_3 @ 100 ppm improved the seed yield per plant as well as various seed quality parameters significantly.

IESHP/AFS2017/1029

Protected Cultivation of Papaya- A Profitable Enterprise under Frost Prone Sub-tropics of Himachal Pradesh: A Success Story

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Keywords: Climate, Protected Cultivation

Introduction

In Himachal Pradesh, the agro-climatic situation differs at every 10-15 km distance and by and large the weather conditions particularly temperature ranges from sub-zero to 43^{o}C. Further, during winters the infrequent frost occurrence in 4-8 year cycle is very common in this warm temperate zone. The severity of frost occurrence generally observed in low lying valley areas, depressions and up to an altitude of 650m above msl. The farmers of this zone are hard working and have enthusiasm towards crop diversification, particularly the protected cultivation. The protected cultivation of vegetables and flowers is labour intensive and the continuous use of the major crops like tomato and capsicum under protected cultivation renders the soil sick and harbour high population of different insect-pests and pathogens. This in turn, leads to manifold increase in cost of cultivation. Consequent upon the rise of cost of cultivation, scarcity of manpower and heavy use of agrochemical inputs, the farmers are looking towards other viable options under these structures as crop diversification. One such grower, Sh Nand Prakash Vohra, approached the Department of Horticulture, District Bilaspur and was referred to the Department of Fruit Science, College of Horticulture & Forestry, Neri, Hamirpur, where he had shown inability to carry forward protected cultivation of Vegetables & Flowers in about 16000 m^2 due to heavy investment on labour management and high cost of production asked for alternatives or any other crop with less labour requirement. Though the area experienced infrequent frost occurrence, but with proper micro-irrigation and protected structures along with smudging, the successful cultivation of papaya was harvested.

Growers Detail	Sh. Nand Prakash Vohra, Village Noa, PO Rajpura, Tehsil Sadar Distt Bilaspur HP. Mobile: +91-98166-14092

Motivation

- The grower approached Dept of Horticulture, District Bilaspur and was referred to the Department of Fruit Science, College of Horticulture & Forestry, Neri, Hamirpur, where he showed inability to carry forward the protected cultivation of vegetables & flowers due to heavy investment on labour management.
- Further he was almost on the verge of dismantling the structure i.e. about 16,000 m^2.
- To address his problems, he was advised to undertake papaya cultivation in polyhouses where only 02 manpower were required for manage the total enterprise under protected structures. Otherwise he needed 02 manpower/500 m^2 structure of polyhouse.
- Further, he was advised to follow the complete technological interventions suggested by the said scientists, particularly on drip fertigation and plant protection measures.
- Though the area experienced infrequent frost occurrence, but with proper micro-irrigation in protected structures along with smudging, the successful cultivation of papaya was harvested.

Material and methods

Nursery Raising	The seed sowing was done on 05 June, 2015. Seeds of hybrid varieties Red Lady and Madhu were procured from Chandigarh market and seedlings were raised in portrays containing garden soil + sand + vermi-compost in 1:1:1 ratio.
Soil Preparation	Deep ploughing was done with power tillers and soil was treated with formalin in the month of May, 2015, because earlier the farmer practiced tomato and capsicum cultivation in the polyhouses.
Transplanting	August, 2015
Spacing	Red Lady (2.0m x 1.5m; 2.0m x 2.0m); Madhu (2.5m x 2.5m)
No. of plants	Red Lady (4000), Madhu (500)
Fertigation Schedule	19:19:19, 13:0:45, Multiple nutrient combination in accordance to soil health status
Plant Protection	• Removal of host plants (Cucurbitaceous and Solanaceous plants) of fruit fly from bunds and channels near the vicinity of poly-houses • Growing of Maize surrounding polyhouses as barrier for fruit fly which is vector of PMV • Use of different agrochemicals 02 sprays of Imidacloprid, miticide, Copper oxychlorite • Sulfex for control of powdery mildew

Results and conclusion

Harvesting & Fruit Ripening	Fruit harvesting commenced in the months of Sept-Oct till May 2017 Ethral was used for uniform ripening of fruits
Marketing	• Mature fruits were marketed by the grower himself in Himachal and adjoining states • Rate: Varied from Rs 10 to 25 per kg • During the months of Feb –May prices were almost stable from Rs 20-25 per kg on wholesale
Yield	Red Lady (50-60 kg/plant), Madhu (70-75 kg/plant)
Net Profit	Rs. 8.0 lakhs
Observations	Close planting: Despite our suggested spacing he planted at closer spacing than the suggested one Green shade nets which were stretched to provide shade for papaya plants in the polyhouse

Due to mis-management on the part of grower, the plants in two of the polyhouses became lanky, long intermodal length and plants attained the height of up to 13 feet near the top of the polysheet. The efforts were made to provide an alternate crop to the said farmer with time to time technical support from the scientists at the College of Horticulture & Forestry, YSPUHF, Neri, Hamirpur so as make his otherwise un-productive venture in to a functional unit. The farmer arranged the conveyance for scientists visits, mostly on holidays, and was able to get good returns out of the structures which he once thought for dismantling. This success story has opened the avenues for such farmers who don't have viable options to continue with protected farming.

IESHP/AFS2017/1031

Production of Disease Free Planting Material of Ginger through *In Vitro* Culture Technique

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Keywords: Ginger*, In vitro* Multiplication, Sub-culturing, Hardening

Introduction

Ginger is one of the oriental spices belonging to family *Zingiberaceae*, used in various medicinal and culinary preparations. Breeding of ginger is handicapped by poor flowering and seed set. Ginger rhizomes are a host of large number of pathogens including fungal, bacterial and viral resulting in the decay of rhizomes during storage. Tissue culture technology can be exploited to multiply disease free clones in large number throughout the year for dissemination of healthy planting material to the farmers for commercial plantations.

Material and methods

Elite clones of Solan Ginger -1156 procured from YSPUHF (Vegetable Sciences) at Nauni. Vegetative buds (0.5-0.8 cm) were taken as explants, surface sterilized and cultured on MS medium supplemented with different concentrations and combinations of BA, Kinetin and NAA for culture establishment. *In vitro* derived microshoots were cultured on various concentrations and combinations of growth regulators supplemented in MS medium for shoot multiplication. Sub-culturing of shoots was carried out after 3 weeks of growth. Rooted plantlets from multiplied shoot cultures were hardened in sterile potting mixture of sand: soil: FYM (1:1:1).

Results and conclusion

Vegetative buds of Solan Ginger-1156 resulted in 82.94 percent uncontaminated cultures after four weeks of incubation following the previously standardized protocol for surface sterilization (Thakur *et al.,* 2014). Maximum bud establishment (74.79%) was obtained in medium fortified with 1.0 mg/l BA and 0.1 mg/l NAA. Vegetative buds sprouted to form shoots after 3 weeks of inoculation which further proliferated into multiple shoots after 5 weeks of culture on the same medium. For sub-culturing, small *in vitro* shoots were separated and transferred to fresh medium. The highest rate of shoot multiplication (1:4) was obtained on MS medium fortified with 0.5 mg/l BA and 0.1 mg/l NAA. Shoot multiplication rate showed an increase with the increase in number of sub culturings which increased to a maximal of 1:7 after fourth passage. Rooting was observed during shoot multiplication after second subculture with an increasing trend from 0 to 80 per cent rooting, in first and fourth sub culturing. Well developed axenic plantlets were hardened in sand: soil: FYM mixture with 90% survival after 3rd passage and plantlets were acclimatized in glass house in which controlled conditions were maintained to minimize uncontrolled foliar water loss. The present study provides a platform for *in vitro* propagation of other varieties of ginger for commercial exploitation and germplasm conservation.

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IESHP/AFS2017/1035

Water Quality and Fertigation Levels Influence Performance of Kinnow Mandarin under High Density Planting

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Keywords: Water Quality, High Density Plantation, Kinnow Mandarin

Introduction

Availability of fresh water for agriculture is reducing due to population pressure and inter-sector competition. This anticipated shortage to agriculture sector in the 21st century is likely to enhance utilization of poor quality water for irrigation. Direct irrigation with saline water and mixed irrigation with freshwater and saline water or irrigation with freshwater and saline water in rotation (conjunctive use) has been used for the utilization of poor quality water. Poor quality irrigation water constitutes about 32-84% of well water surveyed (Minhas, 1996). The use of poor quality water is necessary to meet out crop need. Further, the conjunctive use of saline water through drip irrigation can minimize wastage of water and the harmful effects of saline water. Desalination is another option where brackish water is available. Desalinated water can also be crucial in emergency situations. Therefore, the present study was conducted to evaluate the effect of water quality and fertigation levels on fruit yield and quality of Kinnow mandarin.

Material and methods

The experiment was conducted on Kinnow mandarin at Centre of Excellence for Utilization of Brackish Water for Fruit and Vegetable Production in South Western Punjab at Bathinda. Four water qualities (µmhos/cm*)* viz., canal water (280-300*),* poor quality tube well water (4000*)*, canal+tube well water (2000) and desalinated water (280-320*)* along with fertigation levels (100, 80 and 60%) were applied through drip irrigation. Desalinated water was used from a desalination plant yielding around 10,000 liter desalinated water per hour. The experiment was laid out in split plot design using standard statistical tools.

Results and conclusion

Canal water and desalinated water did not differ for fruit yield of Kinnow mandarin (13.4 tons/ha). However, lesser fruit yield was recorded with tube well and conjunctive use treatments. The interaction between water quality and fertigation level depicted highest yield (16.17 tons/ ha) of Kinnow mandarin with canal water at 100% fertigation. It did not differ significantly from the fruit yield recorded from the trees irrigated with canal water received 80% fertigation. Water quality had no significant effect on the fruit weight, size, juice content, TSS and acidity. However, the lowest peel thickness (3.47 mm) was recorded with canal water. Water quality and fertigation had also significant effect on soil chemical and nutrient dynamics.

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Ex-situ Conservation of Medicinal Plants by Traditional Healers in Tripura

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Keywords: Conservation, Traditional Healers; Herbal Garden

Introduction
India is a hub of wild plant medicine industry in Asia. About 50% of the total flowering plants hail from the region, and 40% of them are endemic (Mao *et al*, 2009). More than 200 tribes have the traditional knowledge about the medicinal plants & their uses. In Tripura, the important medicinal plants are in threat due to over harvesting & habitat destruction. The traditional healers with the help of Centre for Forest Based Livelihood & Extension, Agartala have established herbal garden to conserve the important medicinal plants.

Material and methods
The study was carried out during 2015-16 in different herbal gardens located in North Tripura. Semi structured interview, group discussions and field observation were used to collect data on knowledge and management of medicinal plants. Different questionnaires were prepared to survey and study the medicinal plants performance in herbal garden. The performance score was done by traditional healers. Each herbal garden was visited in different seasons to determine the authenticity of information collected. Identification of different plants was carried out with traditional healers (known as kabiraj, vadhyaraj) and taxonomists. Herbarium was prepared and scientific identification was done.

Result and conclusion
During the study, the number of medicinal plants documented was 134 belonging to 49 families. The plants are used to treat more than 60 diseases. Different species of plants are used daily for different purposes while some are used as a source of vitamin, edible, oil, fragrance & even in house cleaning. The prominent families include Euphorbiaceae (10 species), Rubiaceae (5 species), Apocynaceae (6 species), Fabaceae (7 species), Malvaceae (10 species), Acanthaceae (4 species), Zingibaraceae (7 species), Asteraceae (9 species), Moraceae (6 species) etc. In this study, the performance of wild herb under *ex situ* conservation in different areas was documented for growth parameter, survival rate, health of the plant and hardiness. Some species are grown better in herbal garden (*ex-situ* conservation) than their natural habitat like *Rauwolfia serpentina*, *Trema orientalis* and *Stephania abyssinica.* It was also recorded that leaves were most frequently used for the preparation of medicine solely or mixed with other plant parts. The reason why leaves were used mostly is that they are collected very easily than underground parts, flowers and fruits etc. Internal uses were predominating over external or topical uses and nasal application. It was observed that establishing herbal garden is the easiest way to conserve medicinal plants, whose existences are in danger in wild condition.

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Studies on the Development of Technology for Management of Honey Bee Colonies during winter in Kashmir

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Keywords: Honey bee colonies, Artificial feeding, Winter packing

Introduction
Jammu and Kashmir represent one of the potential area of beekeeping in India which comprises of all agro-climatic zones ranging from low altitude to high altitude zone. There is a tremendous scope of Beekeeping in J&K State due to variety of flora available in different parts of State. The honey produced in the State especially the honey that comes from the wild bushes *Plectranthus rugossus* locally called 'Solai Honey' has its unique color, taste and aroma. However, due to severe winter the beekeepers has to migrate the colonies from Kashmir to other states that costs economic burden on the shoulders of beekeepers. To avoid migration, the studies were carried out for development of technology for winter management of honey bee colonies.

Material and methods
The study was conducted for development of Technology for management of honey bee colonies during winter in Kashmir at the apiary of Research and Training Centre for pollinators, Pollinizers and pollination Management, SKUAST-K, Shalimar during the year 2015-16. For this purpose 20 number of *Apis mellifera* honey bee colonies was selected with equal number of bee frames, brood and store frames. The colonies were randomly selected. There were four treatments including control, each treatment consists of 5 colonies. In first five colonies Thermocol +Paddy Straw Jaggery +Sugar+ Baisan @ 1:4:1 were applied" followed by Paddy straw + News paper Corn Jaggery+ Sugar + flour@1:4:1: to other five colonies followed by *Cashmelon + gunny bags Wheat flour+ Sugar :@ 1:6 to rest of the five colonies.* In control no treatment was applied except sugar.

Results and conclusion
Maximum brood development was found in colonies packed with Thermocol+ Paddy Straw, followed by Paddy straw + News paper. Among artificial diets Jaggery +Sugar+ Baisan @ 1:4:1 gives best results followed by Corn Jaggery+ Sugar + flour@1:4:1. With this study the local beekeepers can avoid the migration of their honey bee colonies to outside the Valley during the severe winter. The migration of bee colonies to outside Kashmir valley causes a huge economic burden to the beekeepers of Kashmir Valley. Therefore, these cost effective studies on the technology development for management of honey bee colonies were carried out so as to overcome the economic loss on the beekeepers which is caused due to migration of colonies to outside the Kashmir Valley when there is dearth period for bees and they can easily manage their *Apis mellifera* bee colonies during winter other than of going for long migration of bee colonies.

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Flower and Bulb Production of Tuberose as Influenced by Different Planting Time and Spacing

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Keywords: Planting Time, Spacing, Prajwal, Flower

Introduction

The tuberose, *Polianthes tuberose,* is native to Mexico, belongs to family Asparagaceae. It can be cultivated both in tropical and sub tropical condition in India. Many factors, like climatic conditions, planting time, plant spacing, and size of bulbs and fertility level of soil affect the yield and quality of flowers. In which planting time and plant spacing is very important factors in tuberose production. It required high humidity and moderate temperature around 30°C especially in North Indian Plains from December onwards for its luxuriant vegetative growth. Temperature exceeds 40°C reduces the spike and rachis length.. In India, tuberose is planted at different dates. In tuberose, the spacing has a great importance for manipulating flower quality and quantity characteristics of tuberose because of small holdings the grower, are trying to produce maximum number of plants per unit area for getting more spikes and bulb yield. The research work was planned to investigate the best planting time and spacing of tuberose for best flower quality and bulb production.

Material and methods

The present investigation was carried out on Prajwal variety of tuberose at Department of Horticulture, CCS HAU, Hisar during 2013-14. Beds were prepared by maintaining plot bed size 1.20 × 1.20 m for planting of bulbs. The experiment was designed in RBD replicated thrice. The planting was done at fortnight intervals starting in last week of March (T_1), second week of April (T_2), last week of April (T_3) and second week of May (T_4). Tuberose bulbs were planted at three different spacing (S_1-20×10 cm, S_2-20×20 cm, S_3-20×30 cm). Ten plants were selected randomly and tagged in each treatment (plot) for data recording and statistically analyzed**.**

Results and conclusion

Maximum number of spikes per plot (84.02) was recorded in last week of April planting which was at par with second week of May planting. Number of spikes per plant increased significantly due to different planting times that ultimately affected on number of spikes per plot. In respect to number of spikes per plot similar results were reported by Padaganur *et al.* (2005). Maximum number of spikes per plot (122.10) was observed in S_1, while wider spacing (S_3) recorded minimum number of spikes per plot (43.76). More plants per unit area were retained under closer spacing compared to wider spacing and hence more number of spikes per plot was obtained. Interaction among different planting time and spacing exhibited maximum number of spikes (135.12) in $T_3 S_1$.

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Promotion of Crop Diversification in Mountainous Areas using Geospatial Technology

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Keywords: Geospatial, Diversification, Web Portal

Introduction

Introducing crop diversification practice(s) in the traditional system of agriculture mainly promotes cultivation of different crops from the same land. The Centre for Geo-informatics Research and Training (CGRT), HPAU, Palampur, India, has an ongoing Crop Diversification Promotion Project, funded by JICA (an international agency) covering 210 project sites in 5 districts of the state. The focus of the project is to use the Geospatial technologies (GIS and remote sensing) for developing the GIS based action plan maps for implementing the domains of new technologies in different AEZ (Bhagat and Singh 2007). Taking into the consideration of the current agro climatic parameters, the urgency of using the geospatial technologies become more pertinent.

Material and methods

Majority of the farmers in the state remain engaged in traditional cultivation of food grains, and only limited number of farmers who have irrigation facilities are able to produce vegetables. Using the ESRI ARC GIS products the project sites were distinguished by overlaying the geospatial data over various Agro Ecological zone (AEZ) GRIDS prepared using satellite imagery and Digital elevation model in ArcMap 10.3.x. The micro agriculture action plans were then prepared and overlayed over high resolution satellite imagery for Geoprocessing. An online solution portal has been developed as tool for spatial information to enhance the geospatial experience using the ArcGIS Server an ESRI technology. The actual action plan and assets (irrigation sources, irrigation channels, distribution networks, etc.) were published alongwith the geo tagged images and other important data attributes, ensuring transparency and better data visualization.

Results and conclusion

The study provides an extensive inventory of the assets being constructed in various project sites which can be accessed and reviewed using the internet on the field and by the beneficiary farmers at the project sites. A web Base GIS portal has been developed using the ESRI Arc server web services technologies which can be updated and queried for any project site and the information can be gathered for any particular asset. The portal thus developed provides transparency and can be used to easily check on the various activities being carried out under each project site. The base line datasets are superimposed over the satellite imageries to identify the immediate changes on the ground. This technology can be used as a tool for impact assessment of the overall change in cropping pattern over the period by estimating area under crop diversification. The portal thus can be used as a tool to improve agricultural infrastructure, such as irrigation facilities and access farm roads, which, along with technical guidance to farmers on vegetable cultivation, can improve farm income when the cultivation of cash crops such as cauliflowers and peas becomes widespread.

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Effect of Irrigation Scheduling on Growth and Yield of Shatavar (*Asparagus racemosus*)

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Keywords: *Asparagus racemosus*, Shatavar, Irrigation, IW:CPE ratio, Galactagogue

Introduction

Asparagus racemosus has been used in Ayurveda as a galactagogue, aphrodisiac, anodyne, diuretic, antispasmodic and nervine tonic since time immemorial. It is mainly known for its phyto-estrogenic properties making this species particularly important. *Asparagus racemosus* commonly known as Shatavar, is a perennial climber found in the tropical and subtropical parts of India upto an altitude of 1500m. Low seed germination coupled with indiscriminate harvesting (tubers) has led to the endangered/threatened status of the species. To increase production of its tuber under cultivation, it is important to standardize the fertiliser and water requirement besides identification of superior line. In this context, an experiment was conducted to standardize irrigation scheduling based on irrigation water depth and cumulative pan evaporation.

Material and methods

The experiment was conducted at, Sher-e-Kashmir University of Agricultural sciences and Technology of Jammu under randomized block design with ten treatments and three replications. In the present study, 3 irrigation water depths i.e., 40mm, 50mm and 60mm were used to achieve IW and CPE ratio of 0.75, 1.0 and 1.25 in each depth. Pan evaporation and rainfall were recorded daily. The seedlings were planted on ridges at a spacing of 1 m, which were at 1m apart making a distance of 1m x1m. Growth and yield characters were recorded after 24 months after planting.

Results and conclusion

The effect of different irrigation schedules on all the characters studied was significant except for vine length. Maximum average vine length of 3.30 m was observed in T_9 (IW_{60mm}/CPE_{60mm}) followed by T_7 (IW_{50mm} CPE_{40mm} =1.25). Minimum average plant height of 2.63 m was recorded under rainfed condition (T_1). Maximum average fresh weight of tubers (3.34 kg) was d in t T_9 followed by 3.21 kg in T_{10} and 3.10 kg in T_8 but all were statistically par with each other. The minimum average fresh weight of tubers (1.68 kg) recorded in T_1 (control) was found statistically at par with T_2 (1.81 kg) and T_3 (1.99 kg). The maximum average dry weight of tubers per plant of 329.86 g was observed in T_9 (IW_{60mm}/CPE_{60mm}) followed by 3.21 g in T_{10} (IW_{60mm}/CPE_{48mm}) and 3.10 g in T_8 (IW_{60mm}/CPE_{80mm}) but trio were found statistically par with each other. Irrigation of 60mm depth given at IW: CPE=0.75 is beneficial to increase tuber yield based upon comparable yield and less water consumption. The crop can be grown as rainfed based on non-significant difference in WUE in different irrigation schedules.

IESHP/AFS2017/1041

Yield Impact Assessment of Managed Pollination by *Apis Mellifera* L. in Dry Temperate Apple Ecosystem

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Keywords: Pollen dispenser, Qualitative traits, Induced pollination

Introduction

Apple is the most important cash crop, constitutes about 85% of the total fruit production of Himachal Pradesh which generating the economy of around 523 million US dollars. In order to maximize fruit production, honey-bee can be used as an important input. The contributions of bees to apple fruit production have been appreciated for a long time. Often, low yield and/or poor fruit quality are attributed to poor pollination performance by bees due to low numbers, unsuitable weather conditions during flowering, low pollination efficacy or combinations of these factors. However, other non-bee related issues such as genetic compatibility among cultivars, orchard and tree nutrition levels also contribute. Quantitative and qualitative production in apple is affected by climatic variations and poor pollination to a wider extent. Between 2013 and 2014, the experiment was carried out to investigate several aspects of apple pollination, including the pollination by *Apis mellifera* L. to increase crop load of apple orchards as a potentially managed pollinator.

Material and methods

Multilocation research cum front line demonstrations were conducted at RHRTS & Farm Science Centre of YSPUHF, Sharbo (Reckong Peo, 31°32'20" N and 78°16'03" E) and Giabong (2812 m amsl) of Kinnaur, Himachal Pradesh, India. According to Kooppen's climate classification, the area experienced the dry temperate environment (annual rainfall of 350-400 mm). To exploit the bees as the potential pollinator for enhancing qualitative and quantitative traits, the bee colonies of *Apis mellifera* L. (at 10 per cent blooming) were placed in apple orchards. Trial procedure included natural pollination (natural insect pollinators), honey bee pollinated flowers (placement of *Apis mellifera* L.) and honey bees plus pollen dispenser (bee colonies fitted with pollen dispenser at the hive entrance).The orchardists were earlier sensitized for the issue through awareness programmes, showed pollination documentaries and organized crop seminars and skill development programmes. The honey bee hives were kept in orchards away from human dwelling. Motivating farmers to spray pesticides to their respective orchards at a common time however, has been found as a herculeous task.

Results and conclusion

The impact assessment of managed honey bee pollination with 'natural pollination', 'honey bees only' and 'honeybees plus pollen dispenser' in terms of fruit set, fruit drop and qualitative attributes of apple orchards was studied. The results showed that maximum fruit set was recorded in 'honey bees plus pollen dispenser' in both the locations. In Reckong Peo, the fruit set percentage recorded was maximum (24.7%) honey bees plus pollen dispenser which was 2.1 times higher than natural pollination, followed at Giabong (22.9%, Table 1). The results also revealed a significant ($p > 0.01$) reduction in fruit drop in honey bee pollinated and honey bees plus pollen dispenser pollinated orchards compared to natural pollination. Through the implementation of the honey bee plus pollen dispenser, the average

apple productivity was 1.19 times higher than the tradition practice (14.7 MT/ha to 17.6 MT/ha). The qualitative characteristics of fruits were observed in terms of average weight, length and breadth of fruit samples. In Reckong Peo, the average fruit weight (185.9 g), fruit length (6.66 cm) and breadth (7.17 cm) was recorded with the input of honey bee plus pollen dispenser. Similar trend with respect to qualitative traits of fruit samples was also observed in Giabong location.

Table 1: Managed Pollination by *Apis Mellifera* L. in Apple Orchards

Location	Fruit Set (%)			Fruit Drop (%)		
	NP	N+HBP	N+HB+PD	NP	N+HBP	N+HB+PD
R/ Peo	11.7± 0.79	21.2±0.77	24.7± 0.47	26.5± 1.41	17.9± 0.78	16.5± 0.73
Giabong	11.4± 0.62	19.9±0.78	22.9± 0.64	23.0± 0.75	14.5± 0.73	13.2 ± 0.63

NP-Natural Pollination, N+HBP-Natural+Honey bee pollination, N+HB+PD-Natural + Honeybee hive+Pollen Dispenser pollination.

Bee colonies of *Apis mellifera* L. with 7 frames bee strength each were placed in the orchard; the pollen dispensers were placed at the hive entrance.

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Integrated Nutrient Management for Higher Growth and Yield in Stevia (*Stevia rebaudiana*)

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Keywords: Stevia, *Stevia rebaudiana*, Fertilizers, Stevioside, Yield

Introduction

Stevia rebaudiana Bertoni, is a perennial shrub belonging to family Asteraceae and commonly known as Sweet herb of Paraguay, Low Calorie Sweetener, Natural Sweetener, Sugar Leaf etc. With increased consumer interest in reducing sugar intake, food products made with sweeteners rather than the sugar have become popular. Stevia, a low calorie sweetener, has become a potential natural alternative to sugar and artificial sweeteners. To bring this exotic species under cultivation in sub-tropical conditions, it is imperative to boost its leaf yield which is possible through use of fertilizers, irrigation and high yielding varieties. Keeping in view, the present experiment was undertaken to study the effect of manures and fertilizers (INM) on growth and yield of *Stevia rebaudiana*.

Material and methods

The experiment was conducted at Sher-e-Kashmir University of Agricultural sciences and Technology of Jammu in randomized block design with eight treatments and three replications. Raised beds of size 1.5m x1.0 m^2 were prepared and seedlings were planted at a spacing of 25cm x 50cm. Growth and yield characters were recorded after 180 days after planting. Recommended dose of Nitrogen was substituted with FYM, Vermi-compost and Azotobacter was also added in two treatments.

Results and conclusion

The present investigation revealed that fertilization significantly influenced the growth and yield characters. The application of organic fertilizers is necessary to achieve good growth and yield. Among the different combinations of fertilizers and manures, application of vermicompost @ 1.5t/ha alongwith ½ of RDN (30kg N/ha) and *Azotobacter* (T_8) significantly increased the growth parameters over control and resulted in maximum plant height (66.17cm), number of branches per plant (24.87), number of leaves per plant (284.68), fresh leaf yield (23.35gm) and dry leaf yield per plant (5.98gm) but is almost statistically at par with T_6 {30 kg N (½T_2) + VC @1.5t/ha}. N, P and K concentrations (%) in plants though increased with the addition of manures and fertilizers but are not significantly different from each other and varies from 1.29-1.44, 0.27-0.32 and 2.23-2.41 per cent, respectively. Manures and fertilizers significantly increased the available nitrogen in soil after the harvest of crop over control. Maximum contents of NPK in soil after harvest of crop were observed in T_3 (FYM @ 12t/ha and *Azotobacter*) followed by T_4 (VC @ 3t/ha alongwith *Azotobacter*). Available P and K in soil are not significantly influenced by fertilization. It may be cocluded that application of vermicompost @ 1.5 t/ha alongwith 30kgN per hectare (half of recommended dose) and *Azotobacter* is beneficial not only to increase the leaf yield but also in maintaining the fertility status of soil.

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Performance and Correlation of Yield and Yield Components in Aloe (*Aloe barbadensis* Mill.)

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Keywords: *Aloe barbadensis*, Accessions, Yield parameters, Correlation

Introduction
Commercial cultivation of *Aloe vera* is not popular among the farming community because of lack of technical know-how on correct ecotype/accession of *Aloe vera* and its package of practices. Though there is much diversity in *Aloe ve*ra, farmers find it very difficult to choose the best ecotype for commercial cultivation. Hence, the aim of the study was to assess the range of variability existing among different *Aloe vera* ecotypes and to correlate the different growth parameters with yield.

Material and methods
The experiment was conducted at SKUAST, Jammu. Eleven aloe accessions, procured from NBPGR were evaluated for growth and yield characters and correlations were worked out among the yield and yield components. The experiment was laid out in randomized block design. Raised beds of 1.8 x 1.8 m were prepared and aloe plantlets, 12-15 cm long were planted at a spacing of 60 x 45 cm accommodating 12 plants bed^{-1}. Growth and yield characters were recorded after 270 days after planting.

Results and conclusion
Among the 11 accessions evaluated, IC111271 recorded the highest significant value for plant spread (75.83 cm), leaf length and width (54.91 and 7.37cm) which was followed by the accessions IC112534 with plant spread (69.50 cm), leaf length and width ((52.58 and 7.20cm). Maximum number of suckers per plant was observed in IC111267 (6.00) followed by IC471884 (5.45), while minimum number was recorded in IC111271 (2.00). Accessions IC111271 and IC112534 recorded the highest spread and number of leaves. The highest number of harvestable leaves $plant^{-1}$ (6.67), leaf weight (150.00g) and leaf yield $plant^{-1}$ (0.96kg) was recorded in the accession IC111271. Dry latex (aloin) yield is an important trait in determining the suitability of accessions to pharmaceutical industry and was also recorded to be highest in IC11127 (1.50 g $plant^{-1}$). The leaves of accession IC111271 gave the highest gel content of 83.50 g $leaf^{-1}$ and 0.56 kg $plant^{-1}$. Leaf yield per plant exhibited a significant and positive correlation with plant spread, leaf length, number of leaves per pant, fresh weight per leaf, wet latex per plant, dry latex per plant, gel yield per leaf and gel yield per plant suggesting that effective improvement in yield can be achieved through selection based on these characters. However, number of suckers per plant showed a negative correlation with leaf yield per plant. The correlation study showed that characters namely plant spread, number of leaves, leaf length, fresh weight per leaf and gel yield per leaf can be considered as selection indices for *Aloe vera* crop improvement programme.

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Effect of Optical Sensor Based Nitrogen Management on Total Nutrient Uptake by Wheat Crop

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Keywords: Total Nutrient Uptake, Optical Sensor

Introduction

Wheat is most important cereal crop of world and it is consumed by 36% of global population. Blanket recommendation of nutrients cannot help in improving nutrient use efficiency beyond a limit. Real time N management using crop canopy reflectance improves nutrient uptake by crop and further increasing the yield.

Material and methods

The field experiment was carried out at Agronomy Research Farm of CCS Haryana Agricultural University, Hisar during Rabi season of 2013-14. There were 12 treatments comprising N application with and without using GreenSeeker (Optical sensor). Treatment one and two comprised of recommended dose of N i.e.150 kg/ha in two and three equal splits, respectively at sowing, CRI stage and 2nd irrigation. One treatment was control. In treatments three to eleven GreenSeeker guided N application was combined with fixed rate (75, 100 and 125 kg/ha) and fixed time N application (nine treatments) as basal and at 25 DAS. N application with Detail of treatments is given in table 1.

Results and conclusion

The different N application treatments significantly influenced the nutrient uptake (NPK) in wheat crop (Table 1). Application of recommended dose of N in three splits resulted in higher uptake of all N, P and K of wheat crop as compared to application of recommended dose of N in 2 split doses; however, the difference in these treatments was not significant. Increase in N, P and K uptake was observed with the increasing the fixed doses of N application, in case of single stage GS guided N application, however, N, P and K uptake decreased at increasing the level of fixed N doses from 75 to 100 kg/ha when GS guided N was applied at two stages i.e. 2nd and 3rd irrigation, however, at further increase in fixed doses led to higher N, P and K uptake in this combination.

Table 1: Effect of Time and Rate of Greenseeker (N Application) on NPK Uptake

Treatment	N application (kg/ha)	Total N (kg/ha)	Nutrient uptake (kg/ha)		
			N	P	K
T_1	75-75-0-0	150	143.3	25.9	176.2
T_2	50-50-50-0	150	156.7	26.9	180.9
T_3	25-50-34*-0	109	131.7	22.0	155.5
T_4	25-50-0-36**	111	123.6	18.3	135.1
T_5	25-50-33*-31**	139	160.1	26.6	174.7
T_6	25-75-29*-0	129	139.7	22.4	169.5
T_7	25-75-0-33**	133	131.8	19.1	149.4
T_8	25-75-28*-23**	151	152.3	24.0	172.6
T_9	50-75-20*-0	145	144.7	22.7	160.2
T_{10}	50-75-0-28**	153	141.5	21.0	153.3
T_{11}	50-75-19*-18**	162	164.6	27.1	173.8
T_{12}	Control	0	51.1	8.9	66.8
CD at 5%			11.6	1.84	10.6

* indicates GreenSeeker guided N application at 2nd irrigation; ** indicates GreenSeeker guided N application at 3rd irrigation

IESHP/AFS2017/1045

Influence of Growth Regulators on Yield and Fruit Quality of Strawberry under Polyhouse Conditions

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Keywords: Fruit quality, Growth regulators, Strawberry yield

Introduction

Strawberry (*Fragaria x ananassa* Duch.) is one of the important soft fruit of the world and has a unique place among the soft fruits due to attractive colour, pleasant flavour and aroma. In Himachal Pradesh, its cultivation is mainly done in the open field conditions, which resulted in poor fruit size and quality fruit production. Keeping in view the scope of strawberry cultivation in near future, it is important for growers to grow it under polyhouse conditions and adopt hormonal manipulations to attain sustainable good yield and fruit quality.

Material and methods

The experiment was laid out in completely randomized block design with sixteen treatments [1 ppm CPPU, 2 ppm CPPU, 4 ppm CPPU, 25 ppm GA_3, 50 ppm GA3, 75 ppm GA_3, 2 ppm promalin, 4 ppm promalin, 6 ppm promalin, 5 ppmGA_{4+7}, 10 ppmGA_{4+7}, 15 ppmGA_{4+7}, 10 ppm NAA, 20 ppm NAA, 30 ppm NAA and control (water spray)] which was replicated three times with thirty two plants per replication in the experimental farm of Department of Fruit Science, UHF, Nauni, Solan in the years 2015 and 2016.

Results and conclusion

Maximum fruit size (length-54.36 mm, 52.90 mm; breadth-37.84 mm, 36.55 mm), fruit weight (24.14 g, 23.25 g) and yield (44.08 t/ha, 42.31 t/ha) was recorded with 15 ppm GA_{4+7} whereas, highest TSS (13.16 $^{\circ}$B, 12.74 $^{\circ}$B) and total sugars (7.63%, 8.17%), reducing sugars (5.47 %, 5.93 %), TSS/acid ratio (16.31, 15.86) was recorded with GA_3 75 ppm in 2015 and 2016, respectively. The highest non-reducing sugars (2.52%, 2.33%) were recorded with NAA 30 ppm and 4 ppm promalin. Lowest acidity (0.81%, 0.79%) was recorded lowest in plants treated with 75 ppm GA_3 and 30 ppm NAA in 2015 and 2016, respectively. Minimum values for all parameters (except acidity) were recorded under control.

Theme 2

Alternate Farming Systems for Sustainable Crop Production

IESHP/AFS2017/2001

Performance of Faba Bean Genotypes for Pod Yield and Yield Contributing Components under Mid-Hills of Himachal Pradesh

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Keywords: Cultivation, Yield component

Introduction

Malnutrition, hidden hunger, climate change, depleting soil fertility and water scarcity problems are the major issues of current agriculture era. To combat such alarming issues, crop diversification is the promising alternative. In this context, underutilized crops, especially legumes can play a major role. In this regard, faba bean is of great importance in world agriculture due to its high yield potential compared to alternative grain legumes and it can be used as break crop where cereal based mono-cropping system is dominated and it replenishes soil nutrients through biological nitrogen fixation (up to 300 kg/ha) and reduced biological pests (Chintlapati 2001)..

Material and methods

The present investigation was taken up at Vegetable Research farm of CSK HPKV, Palampur to evaluate thirty five genotypes for nineteen traits. Observations were recorded on ten randomly selected plants in each replication on days to 50% flowering, node at which 1st flower appears, branches per plant, nodes per plant, plant height (cm), days to maturity, pod length (cm), pods per plant, pod yield per plant (g), pods per node, seeds per pod, seed yield per plant (g), seed size (cm), 100-seed weight, harvest index (%), total soluble solids (^{o}Brix), dry matter (%), ascorbic acid (mg/100g) and protein content (%).

Results and conclusion

The analysis of variance revealed that mean squares due to genotypes were significant for all the traits highlighting the presence of sufficient genetic variability among the genotypes. On the basis of mean performance, 'Local-1-C' was the top ranking genotype for pod yield per plant which significantly outperformed all the genotypes with an increase in yield of 30.83 per cent over check 'Vikrant-B'. Further, genotypes viz., HB-123-B and HB-123-C showed superiority for both pod yield and seed yield per plant over check and other genotypes. The superior performance for pod yield per plant and seed yield per plant was mainly attributed to their superior/comparable performance for pods per node, nodes per plant, pod length, pods per plant, and branches per plant and 100-seed weight. These genotypes could be considered for further evaluation and recommendation for crop diversification programmes.

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IESHP/AFS2017/2003

Soil Moisture Dynamics under Different Tree Species in Arid Region of Haryana

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Keywords: Soil moisture dynamics, Tree species

Introduction

There is an extreme scarcity of water in arid region and ground water is mostly deep and brackish. These regions are characterized by shortage of vegetation due to inadequate rainfall. Stabilization through vegetation is the only solution. The tree species like *Prosopis cineraria* (Khejri) can contribute to higher soil moisture content through the addition of organic matter (Khatri *et al*. 2010). Soil moisture availability is important for the successful growing of agro-forestry crops. The moisture dynamics under different tree species in arid region of Haryana were investigated.

Material and methods

The study was conducted on 6 year old *Prosopis cineraria* (Khejri), *Dalbergia sissoo* (Shisham), *Acacia tortlis* (Israili-Kikar) at Regional Research Station, Balsamand (Hisar). The climate is arid and semi-arid climate with deep and sandy soils. Access tubes were installed at 1m; 2m and 3m spacing from the tree trunk towards north side and control up to 180 cm. Observations were started with Neutron Moisture Meter up to 0-180 cm depth at 15 cm interval during three different periods. Soil moisture was also determined gravimetrically for calibration.

Results and conclusion

Moisture content increased with depth at all the distances in all periods. Maximum moisture was under control followed by *P. cineraria.* The other trees showed much less moisture content at all depths than that of *P. cineraria*. The same pattern is followed in 2m and average up to 3m distance. Comparing the moisture content at various distances, it decreased with the increase in distance from trees. Moisture content under *A. tortlis* was least compared to other tree species at all distances. This is might be due to additive and interactive shadow effect and competitive moisture uptake by adjoining tree. Profile moisture status was highest at 1m distance followed by 2m. Profile moisture status at all times and at all distances followed the order: Control > *P. cineraria* > *D. sissoo* > *A. tortlis* and it Profile moisture status was found maximum during 2nd period under different tree species and all distances and it followed the order: 2nd period > 3rd period > 1st period.

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IESHP/AFS2017/2004

Effect of Poplar Bund Plantation on Soil Properties and Yield of Agricultural Crops in Semi-Arid Region of India

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Keywords: Poplar, Bund plantation, Soil properties

Introduction

Trees provide fuel, fodder and timber, improve soil and prevent its further degradation. Poplar has become popular as it is well suited to the companion crop for ensuring food production and also enhances economic returns. Most of the farmers grow poplar as boundary or block plantation due to which this improves the soil through addition of organic matter, less interference in agricultural operations and also provides alternate sources of income and employment (Singh and Sharma 2007). The study has quantified the effect of poplar bund plantation on the soil properties and yield of agricultural crops.

Material and methods

The study was conducted in 8 years old poplar bund plantation of East-West and North-South directions. The treatments consisted of six distances *viz.* 0-3, 3-6, 6-9, 9-12, 12-15 and 15-18 m at 3 m intervals from poplar tree rows up to 18 m. Along with the height and girth of bund planted poplar, various biometric observations for wheat and sorghum were recorded at different distances from poplar. The various soil properties were analyzed before sowing and after harvest of crops.

Results and conclusion

After 8 years, poplar tree attained average girth at breast height of 99.8 cm and height of 21.9 m in East-West direction whereas, poplar planted in North-South direction had attained mean girth of 70.5 cm and height of 15.0 m. The green fodder yield of sorghum and grain yield of wheat sown in East-West bund planted poplar was affected significantly up to 15 m and 3 m distance from tree line, respectively. The yields of sorghum and wheat on the northern aspect of tree line was significantly less than southern aspect due to higher light intensity and less shade on southern aspect of East-West field bund planted poplar. The yield of both crops also increased significantly with increasing distance from tree line up to 12-15 m distance due to decreased competition for moisture and sunlight. The reduction in grain yield of wheat varied from 36.2 to 45.9 per cent at 0-3 m distance from tree line over 15-18 m distance in north-south and east-west boundary plantation, respectively. The soil pH and electrical conductivity improved near tree line in all aspects, while organic carbon and available N, P and K content were significantly highest in all the aspect at 0-3 m distance and these decreased with increase in the distance from the tree in different aspects.

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IESHP/AFS2017/2005

Volume Equation for *Cedrus deodara* in Kullu, Himachal Pradesh

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Keywords: Volume equation, *Cedrus deodara*, Linear model, Variability

Introduction

Cedrus deodara (Deodar) was selected for development of volume equations. This information can be used as an input for ecosystem modeling, forest growth and yield models. Therefore, volume tables represent a distillation of forest observation and may serve as a reference against which to assess current condition. Volume tables showing the contents of trees of given size according to some unit of measure are essential to most of the forestry work. They are used to estimate standing timber for timber sales, forest management plans and forest surveys, appraisal of damage and forest valuation in general.

Material and methods

All the trees inside the plots were measured for diameter at breast height and height. 100 trees were felled (from 20 plots) for volume study. The diameter at breast height (DBH) for each tree was recorded using Vernier caliper. Breast height was marked by means of a measuring stick on standing trees at 1.37 m above the ground level. It was measured at two sides, right angle to each other and an average of these was recorded as diameter over bark (dob). Height of trees was measured with the help of Ravi multi-meter. Volume estimation of trees was done by taking volume as dependent variable and diameter at breast height (DBH) and height of trees as independent variables.

Results and conclusion

Linear and non-linear functions were tried for the estimation of volume and best fitted function was used for the construction of two way volume table. These models and respective values of coefficient of determination (R^2), Adj. R^2, SE of beta, Root Mean Square Error and Theil's U-Statistic are presented in Table 1. The data revealed that linear model was best fit for the estimation of volume with highest R^2 value of 0.885 and minimum RMSE 0.791 followed by logarithmic model. Thus, volume of deodar can be estimated by using linear model ($V = 1.054 + 3.641\times10^{-5}$).

Table 1: Linear and Non-Linear Functions for Volume Estimation

Models	Equations	SE (β_i)	R^2	$\bar{R}^2$	RMSE	Theil's U stat
Linear	**$V = 1.054 + 3.641\times10^{-5} I$**	**7.6×10^{-7}**	**0.885**	**0.884**	**0.791**	**0.0362**
Logarithmic	$V = -15.858 + 1.825 \ln I$	0.046	0.839	0.838	0.935	0.0507
Inverse	$V = 4.154 - 12636.092/I$	1082.628	0.314	0.311	1.928	0.2158
Quadratic	$V = 0.378 + 6.001\times10^{-5} I - 1.099\times10^{-10} I^2$	1.4×10^{-6} 6.1×10^{-12}	0.844	0.842	0.810	0.0575
Compound	$V = 1.046 \times 1.000^{I}$	6.4×10^{-7}	0.570	0.569	0.665	1.3570
Power	$V = 0.000\ I^{0.850}$	0.011	0.755	0.753	0.814	0.0586
S	$V = \exp(1.356 - 8329.866/I)$	303.690	0.716	0.715	0.740	0.1789
Growth	$V = \exp(0.045 + 1.275\times10^{-5} I)$	6.4×10^{-7}	0.570	0.569	0.665	1.3570
Exponential	$V = 1.046\ e^{0.00001271}$	6.4×10^{-7}	0.570	0.569	0.665	1.3570

IESHP/AFS2017/2006

Physiological Behavior of Crops under Mango Based Agri-Horticulture System in Sub-tropics of Jammu

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Keywords: Agri-horticulture system, Bio-physical domains

Introduction

Fruit based production systems can result in more diversified economies for both short- and long-term products. The integration of trees and crops leads to complex interactions among the components at various bio-physical domains. Generally, intercepted radiation and temperature is reduced and humidity is increased (Chauhan *et al*. 2013). Thus only those crops can be successfully intercropped which have efficient photosynthetic capacity and variation in photosynthetic capacity that has been associated with leaf properties viz., chlorophylls, carotenoids and leaf area. These properties eventually affect the physiological response of the crops to the altered micro-climate beneath the trees. The experiment has evaluated the physiological response of four crops for their performance in the interspace of mango.

Material and methods

The experiment was conducted at SKUAST-J during 2015–2016 (latitude of 32.73^0N and longitude of 74.87^0E, 327m amsl). The climate was sub-tropical with an average annual precipitation of 1200 mm, greater part of which was intercepted during July to October (70 percent). Maximum and minimum temperature is 29.6, 16.7^{o}C, respectively. Summer months were hot (23.5-35.5^{o}C and 53-73.5% of RH). Winter months experienced mild to severe cold conditions with average temperature (6.5-21.7^{o}C). Four intercrops, viz. ginger, turmeric, stevia and Kalmegh (Andrographis paniculata) were grown in inter-row spaces in mango, spaced at 9 x 9 m. Ginger, turmeric, stevia and Kalmegh grown in tree less plots served as control. Variables measured include total chlorophylls, carotenoids, leaf area, plant dry weight and leaf dry weight. RGR, NAR and partitioning coefficient were also calculated.

Results and conclusion

Marked differences in the RGR and NAR values were recorded. Sole crop had higher RGR and NAR than intercrop. Total chlorophylls and carotenoids were more under mango than open. Crops allocated maximum assimilates towards leaf and branch growth both in open and shade. There was almost 1.5-2 times higher distribution towards above ground biomass in intercrops compared to sole crop. Maximum average leaf area was recorded in ginger and turmeric under mango, whereas, in stevia and andrographis, the leaf area expansion was markedly less under mango than in open indicating preferability of these crops to sunlight. High chlorophylls and leaf area of ginger and turmeric under mango showed that these crops are shade loving and can be successfully intercropped. High RGR and NAR values of all crops in open compared to mango shows that these crops prefer full overhead light to grow.

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IESHP/AFS2017/2007

Lamboo Based Agro-forestry System-A Sustainable Production System for Economical Benefit of Farmers of Red and Laterite Zone West Bengal

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Keywords: Agroforestry, Mango, Inter-cropping, Pigeon pea, Maize

Introduction

According to ICRAF, 43% of the planet's agricultural lands have more than 10% tree cover. The potential of trees to bring improvements in nutrition, income, housing health, energy needs, and environmental sustainability in the agricultural landscape, with the presence of trees being the principal component of an "ever- green agriculture". Indian agriculture is facing diverse challenges and constraints due to growing demographic pressure, increasing food, feed and fodder needs, natural resource degradation and climate change. The forest cover in the country is 675,538 sq.km, constituting 20.5% of its total geographical area. Out of this, dense forest constitutes 2.68% and open forest 7.87%. A new approach could help to produce food and wood while conserving the ecosystem. Water is the scarcest commodity limiting to the production potential of red and laterite zone. Location specific models need to be developed involving multipurpose tree species, fruits and arable crops for sustainability.

Material and methods

The study was carried out at RRS-BCKV, Paschim Medinipur, West Bengal. The area is humid sub-tropical with short winter and long hot summer. Annual precipitation varies between 1100 to 1300 mm and temperatures vary between 16.4-38.8ºC (Dhara *et al*. 2015) The experiment was laid out in RBD with tree species viz. *Dysoxylum binectariferrum* (Lamboo) and *Mangifera indica*, and field crops viz. maize and groundnut. The experiment comprised treatments (AF1=Lamboo+Mango+Pigeon pea; AF2=Lamboo+Mango+Maize; AF3= Lamboo+Mango; AF4 =Sole Lamboo; AF5 = Sole Mango; AF6 = Sole Pigeon pea; AF7=Sole maize). Lamboo trees were spaced at 10×10 m while, mango trees were planted between two fruit trees and rows as well as boundary plantation at 5×5 m distance. Data were subjected to standard statistical tools.

Results and conclusion

Total cost of cultivation was recorded higher under mango based agroforestry system compared to sole planting. Annual cost of cultivation in Lamboo+mango, sole Lamboo and sole mango was decreased every year. The gross return was significantly higher under mango based agroforestry system. Highest gross return of Rs. 3,57,443.68 and 4,88,996.67 ha^{-1} were recorded during 2015 and 2016 respectively, under AF1. The sole field crops (groundnut and maize) were showed lowest gross return during both years. The highest and lowest B: C ratio was recorded 7.19 and 1.50 under AF3 and AF6 during 2015 and 10.05 and 1.52 during 2016, respectively. The economic returns were higher in case of intercropping compared to sole cropping, which an important aspect is heading forward towards sustainable development of the farmers.

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IESHP/AFS2017/2008

Impact of Homesteads Bamboo Nurseries on the Livelihood- A Case from North and West Tripura, India

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Keywords: Bamboo livelihood nursery, Homestead bamboo, Propagation

Introduction
Tripura is facing scarcity of bamboo due to large-scale flowering and farmers' preference to take up rubber plantation. Centre for Forest-based Livelihoods and Extension in Agartala has taken up a participatory programme to grow and multiply bamboos in several hamlets of Tripura (Kaushik *et al* 2014). The present study focused on the socio-economic benefits derived from bamboo plantation, by assessing the adaptability of propagation techniques as a livelihood activity and its impact on the growers.

Material and methods
The study was carried out in 2016 in Bamutia and Kanchanpur in Mohanpur and Dasda Tehsil of West Tripura and North Tripura t, respectively. Reconnaissance survey was carried out to identify general feature and existing situation of bamboo production and its market. Direct field observation, questionnaire survey and group discussions were conducted to get general idea about the status of bamboo production, market of bamboo culm and its products and user's socio-economic status. Information about the bamboo nursery activities and many problems related to the activity were collected through spot analysis. The data were analyzed to get the result and were interpreted logically.

Results and conclusion
Bamboo nursery has been taken up as a livelihood option in Noagaon and Kanchanpur by rural communities. It was visualized that bamboo can be regarded as one of the most valuable natural resources available. Considering its diversity, it can provide ample scope for development of rural livelihood for tribal community. It can be as a lucrative business from which rural people with the proper and adequate skills and market value chains that could adopt to come out of the poverty trap. Community Livelihood Nurseries (CLNs) have been initiated by different groups by providing mother plants and training/technical support. Field survey showed that 78.67% rural people have planted bamboo for self-use+selling, 18.67% for processing+selling and 2.67% for self-use+other purposes. This has contributed 57.79% of annual income in poor, 26.27% in medium and 14.28% in rich categories of HHs. With regards to multiplication and cost of maintenance *Bambusa balcooa* performed well followed by *B. tulda*, *Dendrocalamus longispathus* and *B. polymorpha*. In the study area most common method of propagation adopted was macro-proliferation due to large bamboo at a low cost in limited time.

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IESHP/AFS2017/2009

The Effect of *Leucaena leucocephala* Leaves Feeding on Growth Performance of Crossbred Calves

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Keywords: Crossbred calves, Haematological profile, *Leucaena leucocephala*

Introduction

Leucaena leucocephala belongs to family Leguminosae. It is valued as an excellent protein source for cattle fodder, consumed browsed or harvested, in the sub-tropics and tropics worldwide. The leaves of leucaena contain an antinutritional factor known as mimosine which has deleterious effect on the animal body.

Material and methods

The present study was conducted to evaluate low levels of leucaena leaves inclusion in the diets of crossbred calves. Total12 Jersey crossbred calves (6 months-1 year) were selected from the dairy farm and were divided into two groups of 6 animals each on the basis of their average body weight. The animals of treatment group were supplemented with *L. leucocephala* leaves @10% dry matter intake/animal/day. Body weight of individual animals was measured subsequently on fortnightly intervals during the feeding trial of 4 months to assess the live weight change in the period.

Results and conclusion

The total weight gain (32.97 kg) and average daily gain (274.7 6g) was higher in the treatment group as compared to the total weight gain (29.91 kg) and average daily gain (249.49 g) in control group. Mean Hb concentration was higher in crossbred calves of treatment group (10.25 g/dl) as compared to the crossbred calves of control group (10.16g/dl). Mean blood glucose and blood total protein level was significantly higher in the treatment group (45.08 mg/dl and 75.91 g/litre) of animals as compared to the control group (43.69 mg/dl and 73.86 g/litre). While the mean blood creatinine level was higher in control group (118.89 µmol/litre) compared to treatment group (117.85 µmol/litre) and the mean blood urea level was higher in treatment group (4.93 µmol/litre) as compared to the control group (4.89 µmol/litre). The study concluded that *L. leucocephala* leaves feeding @ 10% of dry matter intake/animal/day did not have any adverse effect on the growth performance and haematological profile of the crossbred calves.

IESHP/AFS2017/2010

Nutritional Evaluation of Bamboo Leaf Fodder

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Keywords: *Phyllostachys bambusoides*, nutritional and antinutritional parameters

Introduction

Bamboo (*Phyllostachys bambusoides* Siebold & Zucc.) is a major non- timber forest product whose exploitation provides local people with sufficient food and fodder for their livestock and also contributes to the development of herbal medicines and generates income as well. Bamboo leaves make an important component of ruminant ration and can provide green fodder almost throughout the year. Present study was conducted to evaluate monthly variation in different nutritional and anti-nutritional parameters of *P. bambusoides* leaves and to assess the optimal timing of feeding leaves to the animals.

Material and methods

The composite samples of the bamboo leaves were collected at a regular monthly interval in the month of October 2015 to March 2016 from five different sites within university campus. A composite sample was taken by collecting leaves from the entire clump. Total 5 composite samples were made in each month and each composite sample was replicated in 3 replications. The representative samples were packed in the paper bag and taken to laboratory for the estimation of dry matter content and further analysis of proximate principles and mineral contents.

Results and conclusion

The study revealed that the dry matter (38.20 to 56.14%), crude fibre (18.90 to 25.79%), Neutral Detergent Fibre (66.06 to 71.63%), Acid Detergent fibre (43.77 to 49.95%), total ash (12.09-14.00%), acid insoluble ash (4.10 to 4.49%) and calcium (1.11 to 2.01%) increased with the maturity of *P. bambusoides* leaves from October to March. Whereas, crude protein (17.63 to 14.45%), ether extract (4.67 to 2.17%), nitrogen free extract (46.71 to 43.59%), phosphorus (0.33 to 0.09%), and tannin content (1.39 to 0.71%) decreased with the maturity of *P. bambusoides* leaves from October to March. The study concluded that there was significant monthly variation in the nutritive value of *P. bambusoides* leaves with the maturity of leaves from October to March.

IESHP/AFS2017/2011

Monthly Variation in Nutrient Content of *Morus alba* Leaf Fodder

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Keywords: Mulberry, Nutritional evaluation

Introduction

Mulberry is a multipurpose fodder shrub that plays a very important role in the nutritional security of both animals and human beings. Mulberry belongs to family Moraceae. It is both a sub-tropical and temperate plant reported to occur in the humid, sub- humid and semi- arid areas of the country. The attractive biomass yield, palatability and exceptionally high nutritive value for the ruminants have been the reason behind great interest in mulberry for animal feeding.

Material and methods

The present investigation was conducted in the Department of Silviculture and Agroforestry, YSP University of Horticulture and Forestry, Solan (H.P). Five composite leaf samples of mulberry were collected at a regular monthly interval from March to October during 2016-2017 with the objective to study the monthly variation in the nutritive value of leaf fodder of mulberry leaves. The nutritional parameters recorded were DM, CP, EE, CF, NDF, ADF, Hemicellulose, NFE, OM, Carbohydrates, ash, acid insoluble ash, Calcium, Phosphorus, Phenols, non tannin phenols, total tannin phenols, condensed tannins and hydrolysable tannins.

Results and conclusion

Nutritional evaluation of mulberry leaves from the month of March to October resulted in significant increase in dry matter (25.37-32.28%), ether extract (4.41-6.73%), crude fibre (15.31-18.74%), neutral detergent fibre (46.57-53.24%), acid detergent fibre (28.6-34.29%), hemicellulose (17.97-18.95%), ash (12.27-14.63%), acid insoluble ash (1.26-3.86%), Calcium (1.12-2.77%) and condensed tannins (0.04-0.22%), whereas, decreasing trend was observed in Crude protein (18.81-15.66%), nitrogen free extract (49.19-44.24%), organic matter (87.73-85.37%), carbohydrates (64.5-62.98%), Phosphorus (1.86-0.62%), phenols (1.6-0.5%), non tannin phenols (0.55-0.23%), total tannin phenols (1.05-0.275) and hydrolysable tannins (1.01-0.05%) from March to October. The experimental results revealed that a significant monthly variation was observed in the nutritive value of *Morus alba* leaves with the maturity of leaves from March to October.

IESHP/AFS2017/2012

Role of Poplar Based Agroforestry System for Soil Moisture Conservation in Semi-Arid Region of Haryana

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Keywords: Moisture, Irrigation, *Populus deltoides,* Spacing

Introduction

Sustainable development through scientific agroforestry interventions has a huge potential in meeting the various demands of fuel wood, fodder and timber in conjunction with agricultural crops on non-forests land apart from providing economic and environmental security. However, competition for water between crops and trees in agroforestry systems is one of the main challenges encountered in arid and semi-arid regions. This competition varies in all three spatial dimensions, as well as with time, depending on tree phenology and age (Teixera *et al.* 2003). Poplar (*Populus deltoides* Bartr. Ex Marsh.) based agroforestry system is of prime importance and will provide the numerous direct and indirect output. The present study was conducted to evaluate the soil moisture content under different spacing (5×4 m, 10×2 m and 18×2×2 m) of poplar in semi-arid region.

Material and methods

Soil moisture content was determined by gravimetric method by drawing soil samples at before each irrigation in both the experiments in which different wheat varieties was grown with poplar. Soil samples were taken at different spacing of poplar (5×4 m, 10×2 m and 18×2×2 m) at different soil depths viz., 0-15 and 15-30 cm with the help of locally fabricated post hole augar. Soil moisture per cent was determined by drying the soil samples in oven at 105°C till a constant weight was attained. The loss in soil moisture was expressed as per cent on dry weight basis.

Results and conclusion

Moisture content was higher in poplar (5×4 m, 10×2 m and 18×2×2 m) based agroforestry system as compared to control at all the soil depths. The differences in moisture content in agroforestry system compared to control were clearly visible before first to fifth irrigation during both the years. Maximum moisture (13.3%) was found in 5×4 m spacing at a soil depth of 15-30 cm before 1st irrigation which was closely followed by 10×2 m (12.4%) during 2013-14 and 2014-15. However, the moisture content was significantly less from 1st irrigation to 5th irrigation during both the years of observations. The control plot resulted in less moisture (8.1%) than planting of poplar at 18×2×2 m (8.9%), 10×2 m (9.7%) and 5×4 m (10.4%) spacing at a soil depth of 0-15 cm before 5th irrigation. Among different spatial arrangements of poplar based agroforestry system, 5×4 m spacing was found best for maximum moisture content in both the soil depths (cm) for all the irrigations during both the consecutive years. In control plot (devoid of poplar tree), moisture content was low during all the irrigations as well as all the soil depths due to the presence of maximum sunlight which is mainly responsible for low moisture content in semi- arid region of India.

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Scope of *Parthenium hysterophorus* L. and *Acorus calamus* L. as Biopreservative for Non-Durable Wood Timber Species

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Keywords: Biopreservative, Natural durability

Introduction

Wood is a major preferred structural material and is considered as complex biological composite. Non durable wood are more prone to degradation by biological agents more than durable. Therefore, wood preservation is required after harvesting from wood deteriorating agents. Natural durability depends on amount of extractives in the wood. Extractives from plants are required to be extracted using polar and non-polar solvents as biopreservative.

Material and methods

Herbage and rhizomes of *Parthenium hysterophorus* L. and *Acorus calamus* L. were extracted. Wood samples of *Pinus roxburghii*, *Celtis australis* and *Bombax ceiba* of size 5x2.5x2.5 cm were treated with 0.25%, 0.50%, 1%, 1.50% and 2% concentration and oven dried at temperature 105^0C. Samples treated with distilled water were taken as control. Wood rotting fungus (*Polyporus spp.*) was used to find the effect of extracts on fungus growth on treated wood samples. Percent growth inhibition was calculated according to Vincent (1947) formula and comparative results were analyzed.

Results and conclusion

Maximum growth inhibition of 47.60% and 75.00% was shown in *P. roxburghii* using extract of *P. hysterophorus* and *A. calamus* respectively. Wood fungus colonization decreased with increased extract concentration (2%) has minimum fungus colonization compared to 0.25% in both extract treatments. *Polyporus* decay reduction effect was shown by using methanolic extract of *P. hysterophorus* (whole herbage) and *A. calamus* (rhizome) found mostly near water bodies. The herbal preservatives have safe effects on non durable wood for increasing their life span and act as a good postharvest technique for preservation.

Table 1: Comparative Fungus Growth Inhibition by using extracts of *P. hysterophorus* and *A. calamus* on treated wood samples.

Treatment	Fungus Growth Inhibition (%) using *P. hysterophorus* L.			Fungus Growth Inhibition (%) using *Acorus calamus* L.		
	P. roxburghii (S_1)	*C. australis* (S_2)	*B. ceiba* (S_3)	*P. roxburghii* (S_1)	*C. australis* (S_2)	*B. ceiba* (S_3)
T_1 (0.25%)	5.00	0.00	7.25	16.67	0.00	8.33
T_2 (0.50%)	14.00	9.50	20.00	25.00	8.33	16.67
T_3 (1.00%)	20.00	18.00	27.50	41.67	25.00	25.00
T_4 (1.50%)	39.45	29.80	45.00	50.00	33.33	58.33
T_5 (2.00%)	47.60	39.50	51.62	75.00	66.67	66.67
Control	5.00	0.00	7.25	0.00	0.00	0.00

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Carbon Storage Potential of Agroforestry in Himachal Pradesh

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Keywords: Biomass, Carbon storage

Introduction

Greenhouse gaseous emission has increased considerably over the last century. Among them CO_2 is the prime cause of global warming, resulted from burning of fossil fuels and conversion of tropical forests to agriculture lands. Rising temperatures, higher frequency of drought and floods are the results of increased concentration of CO_2 in the atmosphere. Promoting integration of multiple trees and shrubs in agriculture i.e, 'agroforestry system' has the potential to mitigate CO_2 emission thereby global warming. Therefore, the objective of this review was to discuss the carbon storage potential of prevailing agroforestry systems in Himachal Pradesh.

Carbon Storage Potential of Agroforestry Systems

Over a billion ha of agricultural land, almost half the world's farmland, have more than 10% of their area occupied by trees. India is estimated to have 111,554 sq km area under total tree green cover in the agroforestry which is 3.39% of country's geographical area. Himachal Pradesh is mountain locked state situated in the North-Western part of the Himalayas with a geographical area of 55,673 sq km. It has altitudinal range varying from 350 m to 6975 m amsl. Due to the increasing demographic pressure and industrialization coupled with the landforms, shortage of cultivable land has become very common. In order to meet the diverse needs of people tree based mixed farming systems i.e., Agroforestry in place of monocultures are preferred by the farmers. Different agroforestry systems present in the state are: Agri-Silviculture, Agri-horticulture, Agri-Silvi-Horticulture, Agri-Horti-Silviculture, Silvipasture, Homegardens and Horti-agricullture. The important tree species most prevalent in various agroforestry systems are *Grewia optiva, Celtis australis, Toona ciliata, Bauhinia variegata, Morus alba, Prunus domestica, Pyrus communis, Prunus persica, Prunus armeniaca*,etc. Agriculture crops like *Zea mays, Lycopersicon esculentum, and Capsicum annuum* dominated in kharif season, while *Triticum aestivum, Pisum sativum, Brassica sps* in rabi. The understory vegetation in silvipasture and grassland comprised of *Berberis lycum, Indigofera pulchella, Myrisine agricana, Chrysopogon montanus, Themeda anathera, Urochloa panicoides, Heteropogon montanus*, etc. Total biomass carbon storage of different agroforestry system varied from 3.4 t/ha to 61.66 t/ha as reported by different researchers (Table 1). The difference in storing carbon in agroforestry systems depends on the agroforestry system being practiced, tree species, system management, environment and socio-economic aspects. Compared to carbon storage potential of biomass of forest (54.50-202.15 tC/ha), grassland (1.2-3.43 tC/ha) and agriculture (3.82-10.01 tC/ha), agroforestry system has the potential to store 3.4-61.66 tC/ha total carbon in the biomass. Thus, it can be concluded that carbon storage potential of agroforestry system in Himachal Pradesh is less compared to natural system like forest. However, it is substantially greater than agriculture and grassland. Hence, establishment and management of agroforestry could potentially enhance sequestration of carbon in the terrestrial biosphere and thus, is a viable alternative to prevent climate change.

Table 1: Biomass Carbon Storage Potential of Agroforestry Systems

Land use system	Elevation (m)	Biomass carbon (t/ha)	Reference
Agroforestry	468, 1250	22.0-39.97	Minj (2008)
	1100-2300	49.05-61.66	Rajput (2010)
	338	9.27-20.70	Khaki and Wani (2011)
	1600	48.92-52.92	Toppo (2012)
	900-2100	3.4-14.8	Goswami *et al*. (2014)
	900-2100	30.29-44.62	Matber (2014)
	365-914	15.34-46.06	Rahul (2014)
Grassland	468 & 1250	4.74	Minj (2008)
	338	2	Khaki and Wani (2011)
	1600	10.82	Toppo (2012)
	900 - 2100	1.2	Goswami *et al*. (2014)
	900-2100	2.46	Matber (2014)
	1200	1.39-2.13	Rahul (2014)
	1300	3.43	Gupta *et al*. (2015)
Agriculture	468, 1250	8.63	Minj (2008)
	1100-2300	10.01	Rajput (2010)
	1600	3.82	Toppo (2012)
Forest	1100-2300	202.15	Rajput (2010)
	1300	54.50-57.18	Gupta *et al*. (2015)

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Remunerative Farmers' Cropping Systems for Crop Diversification in Shiwalik Foothills

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Keywords: Cropping system, Case study, Intercropping, Niche agriculture

Introduction

Agriculture is performing the way below potential. This was the revelation made during the 'Participatory Rural Appraisal (PRA) conducted in 2014. The very purpose of the exercise was to unravel the villagers' problems and catering apriori based solutions. But, the perseverance efforts of the farmers unleashed astonishing innovations, which could prove remunerative to other fellows, if adopted in true letter and spirit. Our endeavour was to promote and rejuvenate niche agriculture.

Material and methods

PRA was conducted in 86 revenue villages of 26 Panchayats of two blocks of district Sirmour, H.P. Topographically, the study area was as diverse as the valley area, the terraineous hills. The altitude was ranging between 400 m and 2174 m amsl, experiencing tropical to temperate climate. The existing cropping patterns were cereal based with the inter-culture of horticultural (fruits/ vegetables/floriculture) crops. The wheat-maize rotation was still in practice since the era of civilization. It formed the baseline of the study. Different cropping systems (crops rotations and inter-cropping patterns) were studied. The economical gross returns were deduced by ignoring all kind of costs involved in the production. All calculations have been restricted to per bigha (800 sq.m.) units.

Results and conclusion

a) **Tropical villages-**18 panchayats inhabiting in the sub-tropical/ tropical area were plain in topography but with undulating fields. These fields were cultivated with sugarcane (52%), paddy (24%), maize (15%), ginger (6%) and other sundry crops during the *kharif* season, while, wheat (46%) or ratooned sugarcane (45%), garlic and peas (3% each) and miscellaneous crops (3%) in *rabi* season. The most remunerative system followed by the farmers was sugarcane-tomato rotation, which could fetch Rs.50, 000/- per bigha (Table 1).

b) **Temperate villages**-08 panchayats inhabiting in the temperate regions were comprised of terrace (ladder) type fields. Ginger (36%), maize (30%), tomato (24%) and miscellaneous crops (10%) were the main *kharif* crops, while garlic (50%), peas (23%), wheat (22%) and *sarson* (5%) were cultivated in *rabi* season. The most remunerative cropping system unleashed by the farmers, in Kando-Charna village, was tomato+rajmash-garlic + early pea, in harnessing maximum returns up to the extent of Rs. 1,32,000/- per bigha (Table 2). The farmer's cropping systems, though remunerative, yet remains confined to few farmers. These are niche- specific, hence, needs the intervention of government agencies for further dissemination.

Table 1: Prevalent Cropping Systems in Tropical Villages *(Ascending order)*

Crop rotation	Returns	
	q/bigha	Rs. Per bigha
Maize-wheat	2-3	2800+ 3600 =6,400
Paddy-wheat	4-3	5600+3600=9,200
Cucurbits-wheat	15-3	15000+3600=18,600
Paddy-tomato	4-20	5600+20000=25,600
Sugarcane-*Toria*	150-0.5	30000 + 450= 30,450
Wheat-sugarcane	3-150	4200+30000=34,200
Sugarcane-tomato	150-20	30000+20000=50,000

Table 2: Prevalent Cropping System in Temperate Villages *(Ascending order)*

Crop Rotation	Returns	
	q/ bigha	Rs. Per bigha
Maize-wheat	2-3	2800+3600=6,400
Ginger-*sarson*	3-1.5	18000+3000=21,000
Ginger+coriander-*sarson*	3+0.5-1.5	18000+2600+3000=23,500
Tomato-wheat	40-3	80000+3600=83,600
Garlic-French bean	10-13	35000+26000=6,10,006.
Ginger+maize+-Potato-coriander (*Sathee*)	4-3	32420+3000=37,420
Tomato+Rajmash-wheat	40+0.5-3	80000+5000+3600=88,600
Tomato-Garlic	40-10	80000+35000=1,15,000
Tomato-pea	40-12	80000+24000=1,04,000
Tomato+Rajmash-Garlic+Pea (E)	40.0+0.5-10.0+6.0	80000+5000+35000+12000 =1,32,000

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Morphometric and Chemical Variability in Open Pollinated Seed Orchard of *Grewia optiva*

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Keywords: Fodder quality, Progeny evaluation, Heritability, *Grewia optiva*

Introduction

Grewia optiva (*Beul*) belongs to Family *Tiliaceae*. It constitutes 44 genera and 400 species, distributed globally throughout the tropical, subtropical and temperate regions of the world, with more representatives on the southern hemisphere. *G. optiva* is a moderate sized tree, with a spreading crown, reaching height up to 12 m with clear bole of 3-4 m and girth 80 cm, when fully grown. It grows well on sandy loam soils with adequate moisture. *G. optiva* is one of the most important fodder trees of northwest and central Himalaya. It is very important for the farmers for feeding their productive animals throughout the western Himalaya.

Material and methods

A Seedling Seed Orchard of 60 families of *G. optiva* has been established by Department of Tree Improvement and Genetic Resources, at Nauni Campus of YSP University of Horticulture and Forestry during 2000 under three replications at spacing of 2m x 2m. These different families have been raised after collecting seed from various districts of Himachal Pradesh which cover Sirmour, Solan, Chamba, Bilaspur, Mandi, Hamirpur, Kangra and Shimla, district.On the basis of performance, 20 families were selected. To observe tree to tree variation, three replications from these families were marked. From each marked tree, seeds were collected from three parts, viz. top, middle and bottom by using circular systematic sampling and these parts were considered as replication to know variation within individual tree of the family i.e. Genotype.

Results and conclusion

Extent of variation among the different families was quite large. The families significantly differed among themselves for the various morphometric traits and fodder parameters. Progenies of family KA-3 (Varal) and CH-5 (Rajpura) were found the best among family and Genotype III of family KA-3 (Varal) , Genotype II of family CH-5 (Rajpura) was found maximum results within family for morphometric parameters . Regarding fodder parameters of the 20 families, it can be concluded that KA-3 (Varal) and KA-1 (Dharamshala) excelled as the best ones. Genotype II of family KA-1 (Dharamshala), Genotype I of KA-2 (Bhalun), Genotype II of family MA-2 (Bachhwan) were found to be best within family. Studies suggested family KA-3 (Varal), HA-2 (Pata Bhalaker), KA-2 (Bhalun) and SO-10 (Jaunaji) as best families for further breeding programme. Traits with high heritability and genetic gain, like fodder quality, seed size and some others indicate high genetic control. This variability can be exploited in tree improvement programmes through selection and breeding approaches for development of advanced generations. Juvenile Mature correlation may be used for selection of families at seedling stages to get higher quality and more yield of fodder for mass propagation of families of *G. optiva*. Variability studies suggested that variation can be exploited for any breeding programme of *G. optiva* on the basis of its important characteristics to obtain heterotic vigour through hybridization.

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Evaluation of Hardwood and Softwood Biomass as a Best Substrate for the Production of Industrially Important Enzymes

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Keywords: Cellulase, *Myceliophthora thermophila* SH1, Xylanase

Introduction

Lignocellulosic wastes are causing environmental pollution. Since a prominent carbonaceous constituent of forest plants is cellulose which is the most abundant organic compound on earth. Degradation of forest waste by cellulase and subsequent fermentation of saccharified biomass to ethanol can become not only an ecofriendly solution but also a boon in an era of dwindling fossil fuels and their skyrocketing prices. Industrial attention towards cellulase and xylanase production has consistently increased over the years. Lignocellulosic biomass was used for cellulase and xylanase enzyme productions by fungus *Myceliophthora thermophila SH1* i.e. a thermophillic fungus under solidstate fermentation (SSF).

Material and methods

M. thermophila SH1 explored for cellulase and xylanase enzymes production under solid state fermentation. Lignocellulosic materials are renewable, low cost and are abundantly available. We used forestry waste viz., *Dandracalamus strictus*, *Eucalyptus sp*., *Populus deltoides*, *Pinus roxburghii*, *Pinus wallichiana and Cedrus deodara.* All these substrates were pretreated with $NaOH+H_2O_2$ solution. Enzymes were extracted by repeated extraction method. Enzyme assays: The subunits of cellulase i.e. CMCase and FPase were estimated by Reese and Mandel method, while β-glucosidase activity the reaction mixture was measured by Berghem and Petterson method. On the other hand xylanase assay was performed by using DNSA reagent.

Results and conclusion

To make the biomasses easily accessible for enzymatic hydrolysis they were pretreated with physical pretreatment i.e. grinding as well as chemical pretreatment i.e. alkali + hydrogen peroxide. The results in terms of enzyme production from alkali + hydrogen peroxide pretreated forest wastes by *M. thermophila* SH1 revealed that pretreated *P. deltoides* gave maximum cellulase and xylanase production of 35.32 U/g and 203.20 U/g respectively, while very less activity of cellulase and xylanase giving only 9.50 U/g of cellulase and 48.56 U/g of xylanase in ***P. roxburghii***. Effect of alkaline peroxide treatment on substrates is measured in terms of enzyme units released by *M. thermophila SH1*. Alkaline hydrogen peroxide pretreatment of lignocellulosics digests the lignin matrix and makes cellulose and hemicellulose available for enzymatic degradation and cause the swelling of cellulose. Crystallinity of cellulose is decreased due to swelling. The advantages of this pretreatment are the use of reagents with low environmental impact. Overall, it has been observed that lignocellulosic forest waste can act as a suitable substrate for cellulase and xylanase production, though; different physico-chemical/biological pretreatments are prerequisite to enhance the yield of enzyme. The use of forest biomass can be recommended as cheap raw material for the production of various industrially important enzymes.

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Wood Anatomical and Genetic Studies in *Populus deltoides*

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***Keywords*:** Genetic variation, Juvenile wood, Heritability

Introduction

Poplar, belongs to the family Salicaceae, are trees with many valuable characteristics which have led to multiple beneficial uses for society and the environment since the dawn of history. Silviculturally the most important poplars, *Populus deltoides* is commonly known as Eastern Cottonwood. These are multipurpose tree species, as demanding for paper and pulp, plywood, matchwood, quality pencils, packing cases and light constructional timber. The wood is versatile and widely used by farmers, crafts people and forest products industries.

Material and methods

Ninety six *Populus deltoides* clones were raised through cuttings. In second year, material was taken up for anatomical studies of the juvenile wood. Sample of wood was removed from the basal portion of the stem. Observations on moisture content, bark thickness, wood bark ratio, bark percentage, wood percentage, specific gravity, wood density and fiber length were recorded.

Results and conclusion

Wood anatomical characters were recorded on 3 competitive plants in each entry for every replication in second year. The data of mean moisture content exhibited significant variation. The maximum moisture content was 151.22% in PD100 clone and minimum (66.74%) was observed in PD35 clone. The maximum bark thickness was 0.47cm in PD35 clone and minimum (0.06cm) was observed in PD30 clone. The wood bark ratio (43.99) was highest in PD76 clone and minimum (3.41) was observed in PD35 clone. Maximum bark percentage was 47.24% in PD35 clone and minimum (6.07%) was observed in PD30 clone. Maximum wood percentage was 93.93% in PD30 clone and minimum (52.76%) was observed in PD35 clone. Maximum specific gravity was 1.13 in PD73 clone and minimum (0.28) was observed in PD24 clone. Maximum wood density was 1131.64 kg/m^3 in PD73 clone and minimum (279.67 kg/m^3) was observed in PD24 clone. Maximum fiber length was 1.15mm in PD35 clone and minimum (0.72mm) was observed in PD48 clone.

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Production Performance, Nutrient Utilization Pattern of Sheep in Semi-Arid Ecology

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***Keywords*:** Production, Nutrients, Grazing

Introduction
By nature sheep is a grazing animal that thrives on fallow, barren and waste land where other animals cannot maintain themselves. In spite of these hardships, this species of livestock has the capacity to sustain themselves on resources even found beneath the soil cover, during the scarcity period these animals literally dug the soil cover and unearth the shoots and succulent portion of perennial plant species and consume them. It has been observed that they are able to maintain their requirement for DM and nutrients from the available resources. Sheep population especially in the arid region of the country needs special attention since feedstuffs are scarce and an inherent mechanism of their survival and production needs scientific studies.

Material and methods
The study was conducted in three months in season's viz., monsoon, autumn and winter during the dry and pregnancy stages of the ewes. Pastures grazed by the ewes were monitored and representative samples were collected. Chemical composition of grazing pastures and diet were determined in the above months. Thirty ewes and five rams were selected, were maintained solely on grazing pasture for at least eight (8) hours a day per season. No concentrate mixture was supplemented to the experimental animals. Live weight changes of ewes were also recorded. Average body weight of the ewes was 25.8, 25.7 and 29.9 kg in the month of August, October and December, respectively. Three digestibility trials were conducted on 10 ewes and 5 rams, respectively employing chromic oxide techniques to assess nutrient digestibility monthly.

Results and conclusion
The pasture yield was higher ($P<0.001$) in the monsoon (40.70 Q DM/hector) than that of October (24.65 Q DM/hector) and December (10.76 Q DM/hector). Dry matter in the pasture sample was 46.52, 54.39 and 82.95% in August, October and December, respectively, which was lowest ($P<0.001$) in August and highest December. Crude protein content was also higher ($P<0.001$) during the monsoon (11.71%) and lower in October (6.12%) and December (6.01%). Neutral detergent fibre in the pasture sample ranged from 64.05 to 76.87% and increased ($p<0.01$) in December (76.87%) with increasing maturity of the plant species. The cellulose content in the pasture samples was 21.60, 26.58 and 29.16% in August, October and December and it increased ($P<0.05$) with advent of winter. Preference of the ewes toward selective feeding is reflected in the dietary composition. Dry matter in the diet samples was 29.91, 40.69 and 45.26% in August, October and December, respectively, which was lower ($p<0.002$) in the monsoon diet sample. An increase ($p<0.01$) in the dietary fibre (NDF and ADF) in the diet sample of grazing ewes was evident in the month of December but intermediate values was observed in October. The content of lignin was also higher ($p=0.008$) in the December (19.03%) diet sample *versus* the lignin content of August (5.94%) and October (10.26%) diet samples. Apparent tract digestibility were 54.67, 40.85 and 50.76% for DM, 54.11, 37.10 and 50.16% for OM, 60.59, 47.25 and

47.73% for CP, 56.47, 37.46 and 21.34% for NDF and 59.30, 51.60 and 34.61% for ADF in August, October and December, respectively. These values were higher (P<0.001) during the monsoon season i.e. during August, when the nutrient content of the pasture grasses and plants are highest, with the change in the seasons i.e. October and December (advent of winter) the digestibility decreases (P<0.001), this findings can be correlated with the composition of the pasture and diet.

Table 1: Seasonal Changes in Digestibility (%) of Nutrients in Sheep under Grazing

Digestibility	Months				
	August	October	December	*P*-value	SEM
Body weight change	25.8^{b}	25.7^{b}	29.9^{a}	0.001	0.531
Dry matter	54.67^{a}	40.85^{c}	50.76^{b}	0.001	1.233
Organic matter	54.11^{a}	37.10^{b}	50.16^{a}	0.001	1.478
Crude protein	60.59^{a}	47.25^{b}	47.73^{b}	0.001	1.495
NDF	56.47^{a}	37.46^{b}	21.34^{c}	0.001	3.306
ADF	59.30^{a}	51.60^{b}	34.61^{c}	0.001	2.057

Decrease (P<0.001) digestibility of fibre fractions (NDF and ADF) in December suggests lower availability of utilizable nutrients to the animals for optimum performance. With the change of seasons from monsoon to winter the pasture grasses and plants also attain maturity and the proportion of higher fibres increases abruptly causing lowering of digestibility and availability of nutrients for production purposes, Hence need supplementation to harvest optimum production.

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Traditional Agroforestry Systems and Socio-economic Status of Farmers in Kangra Valley of North-West Himalaya

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***Keywords*:** Agroforestry, Socio-economic, Western Himalaya

Introduction
There are different types of agroforestry mixed farming systems are practiced in western Himalayas but, now-a-days few are being replaced and are in danger of disappearing due to socio-economic and demographic conditions. The awakened rural farmer in the hills of district Kangra have witnessed many changes in farming, livestock rearing, traditional agroforestry and in plantations of horticultural crops. Keeping this in mind, the present study was to investigate the existing agroforestry systems in relation to socioeconomic status of the farmers in study area.

Material and methods
The study was carried out in the Kangra district of Himachal Pradesh, India. A total number of 220 farmers were selected randomly from four group's viz., marginal, small, medium and large based on landholding capacity by dividing the district into three altitudinal zones namely zone-I (<500 m amsl), zone-II (500-1000 m amsl) and zone –III (>1000 m amsl) for survey and data collection. The survey data were collected with a pre-structured questionnaire in personal interviews with household heads and data for family structure, education status of heads of households, literacy rate of family; status of off farm employment, land use statistics was recorded.

Results and conclusion
Irrespective of different categories of farmers and altitudinal zones, a total of six agroforestry systems types existed in the studied area. The agroforestry systems predominant in Kangra district were Agri-silviculture (AS), Agri-silvi-horticulture (ASH), Agri-horticulture (AH), Agri-silvi-pastoral (ASP), Pastoral-silviculture (PS) and Silvi-pastoral (SP). These systems may be attributed to agro-climatic conditions of the area and need of the farmers i.e. food, fodder, fuel wood and timber *etc*. From the present study it was found that the overall sex ratio of three altitudinal zones found to be in line with the sex ratio of state and national averages of 968 and 933 respectively which shows that there was no gender biasness in the study area. Adult population constituted 79.45, 76.70 and 73.73 per cent of the total population among three altitudinal zones suggesting, thereby, greater availability of the family labour. The average family size was 6.33, 6.06 and 6.22 in three altitudinal zones, respectively. The majority of the family heads were found literate among three altitudinal zones. In terms of educational status, males were found to be more literate in comparison to females in all farmers' categories of three altitudinal zones. Hence, the study represents the clear picture of socioeconomic status of farmers and existing agroforestry systems which will help the researchers to understand the agroforestry system of study area in order to make improvement and develop technologies that will help local people/farmers to fulfil basic needs and overcome the existing constraints.

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Advances in Organic Vegetable Farming Research

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***Keywords*:** Organic farming, Production

Introduction

Organic farming promotes biodiversity, biological cycles, soil biological activity, minimizes the use of off-farm inputs and uses cultural practices that restore, maintain or enhance ecological harmony. The ultimate aim of organic vegetable farming is to grow healthy vegetables, while protecting the natural environment and biodiversity. It is based on building organic matter through crop rotation, green crops, manure, and organic amendments. The productivity of different vegetables in our country is comparatively lower than the world's average productivity. Vegetable crops can solve the problem of food security in our country as they are rich source of minerals, vitamins, fibre and contain a fair amount of protein as well as carbohydrates. Keeping an eye towards the population explosion and to feed the future generation we should develop a holistic approach to produce more vegetables from less land, less water, less pesticides and with less detrimental effect to soil and environment as well.

Results and conclusion

From a meta-dataset of 362 published organic–conventional comparative crop yields, de Ponti *et al.* (2012) reported that organic yields of individual crops are on average 80% of conventional yields, but largely vary for different regions (84% North America; 88% Central Europe; 89% Asia). A survey indicated that lower yields in organic farming were not related to nutritional status of organic crops but these were due to pest or disease infestation. According to the USDA pesticide data program (1993–2002), pesticides were found frequently in organic vegetables (18%). For example, organic tomato was much less likely to contain detectable pesticide residues (0–28%) than is conventionally grown tomato (62–64%) or IPM grown tomato (7–80%). Organo-chlorine pesticide residues have been detected on tomato fruits grown on organic soils to which pesticides had never been applied. Organic foods are perceived by consumers as more nutritious, tastier and richer in healthy components than conventional products. It is well documented that organic vegetables have few antibiotic resistant bacteria, lower nitrate and higher vitamin C and phenolics than conventional ones. In a large proportion of analyzed fruits and vegetables, vitamin C was found to be on average 27% higher than in conventionally grown vegetables. Similarly, Fe, Mg and P were, respectively, 21%, 29% and 14% more abundant in organic crops (Worthington 2001). The high concentration of arbuscular mycorrhizal fungi in organic soils may explain the higher concentrations of Ca, Cu and Zn and the lower concentration of Mn reported for some organic vegetables..

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Biomass Production in Poplar Agroforestry Systems in Haryana

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***Keywords*:** Biomass, Poplar, crops, Agroforestry

Introduction

The present study was, planned to estimate growth and biomass of poplar trees of 2,3,4,5,6 and 7 years old and the associated crops in Kurukshetra district of Haryana. Poplar based agroforestry systems are the most viable in north -western India fulfilling the high demand of plywood in this region. Due to its fast growth, compatibility with agricultural crops, and high industrial requirements, poplars have been widely grown in Indo-Gangetic region of the country. The wood of the tree is mainly used for manufacturing of plywood. The branches and roots are also used by plywood industries as fuel, which help to reduce dependence on fossil fuel.

Material and methods

Fields were selected in Lakhmadi village of Kurukshetra, Haryana for having 2-, 3-, 4-, 5-, 6-, 7-year old poplar (*Populus deltoids*) trees. For the measurement of trees, 30 trees out of 400 trees/ha were randomly selected and the girth at a height of 1.37 m was measured. For the estimation of litter fall 10 quadrats of 1 x 1 m each were laid down and litter fall of poplar trees was measured till all the leaves were fallen on the ground.

Results and conclusion

Litterfall increased significantly with age of tree. In 2- year plantation, litterfall in November was 139 g/m^2 while in December it was 165 g/m^2. Maximum litter fall was recorded in 7-year old plantation being 246 g/m^2 in November and 307 g/m^2 in December. The total litterfall ranged from 318 g/m^2 in 2 years old plantation to 553 g/m^2 in 7 years old. At the age of 2 years, biomass into bole was estimated 17.91 kg/tree and in branches 26.81 kg/tree. Total weight of bole and branches in trees increased from 44.73 kg/tree in 2 years old plantation to 187 kg/tree in 7 years old plantation. Total weight of bole and branches in trees increased from 16.99 t/ha in 2 years old plantation to 71.08 t/ha in 7 years old plantation; bole constituted 57 per cent in 7 years old plantation. At 5-year age, *P. deltoides* could be potentially used for mitigation of climate change due to their promising growth and higher C sequestration. Growing of poplar trees with sugarcane during first two years followed with wheat during winter and fodder during summer or turmeric round the year is the best suited for proper utilization of interspaces of trees Poplars trees build significant biomass to be considered as mean of carbon sequestration. They also generate adequate amount of litter *in situ* which is extremely useful for soil fertility in wheat cropping systems which have been suffering as deficient of soil carbon due to intensive cultivation.

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Effect of Growing Media and Arbuscular Mycorrhizal Fungi on Seedling Growth of *Leucaena leucocephala* (Lam.) de Wit

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***Keywords*:** AM fungi, Growing media, Seedling quality

Introduction

Leucaena leucocephala is an important multipurpose and fast growing agroforestry tree species as fodder, fuel wood, pulp, small timber and reclamation of degraded lands etc. When the nursery raised seedlings are transplanted, they may face transplantation shocks in the fields and consequently plants become weaker and poorly established. Early inoculation with AM fungi under nursery conditions can be beneficial for stronger growth of the seedlings, and better fields' performance. Thus, a study consisted of two factors viz. growing media and AM inoculation, was carried out with *L. leucocephala* under nursery to evaluate the effect on growth traits.

Material and methods

Six growing media viz., T1- soil (1), T2- soil + sand (2:1), T3- soil + vermicompost (2:1), T4- soil + perlite (2:1), T5- soil + sand + vermicompost (1:1:1) and T6- soil + perlite + vermicompost (1:1:1), and AM fungi viz., *Acaulospora scrobiculata* (individual), *Rhizophagus irregularis* (individual), *A. scrobiculata* + *R. irregularis* (combined) and a control (un-inoculated). The study included 24 treatments and each treatment was replicated 10 times in root trainers (volume: 300 cc). Mycorrhizal treatments were imposed with growing media and filled in root trainers, and the seeds of *L. leucocephala* (accession: K636) were sown. After 75 days of sowing, plants were harvested and analyzed growth traits. Seedling quality index was calculated by using the formula given by Dickson (1960).

Results and conclusion

Plants grown in soil + vermicompost mix recorded maximum values for different growth parameters. Vermicompost mixed with the soil might have affected the physical, chemical and biological properties of the media, as the organic matter acts as glue for soil aggregation and is a source of nutrients. AM inoculant based treatments significantly enhanced all parameters, due to more volume of soil explored for available nutrients and water by mycorrhizal plants than non-mycorrhizal plants. Further, dual inoculation of *A. scrobiculata* + *R. irregularis* resulted in higher growth parameters than individual inoculations, which showed that AM species used under the study worked synergistically with each other.

Table 1: Main and Interactive Effects on Growth of *L. Leucocephala*

Treatment	Collar diameter (mm)		Shoot length (cm)		Shoot dry weight g)/plant		Root dry weight (g)/ plant		Seedling quality index	
	F	P	F	P	F	P	F	P	F	P
GM	17.69	0.00	36.08	0.00	31.17	0.00	30.11	0.00	23.43	0.000
AMI	5.22	0.002	7.99	0.00	7.86	0.00	9.00	0.00	5.31	0.001
Interaction	3.16	0.00	4.49	0.00	3.92	0.00	2.65	0.01	2.55	0.002

GM-Growing Media; AMI-AM Inoculations; F-F ratio; P-P ratio

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Variability, Heritability, Genetic Gain, Genetic Advance & Correlation in Morphological & Seed Characters in *Toona ciliata*

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***Keywords*:** Genetic advance, Heritability, Correlation, Phenological studies

Introduction

Toona ciliata belonging to family Meliaceae, is the best known Indian timber species, popularly known as toon and red cedar. The other timber yielding species of the genus occurring in India are *Toona febrifuga*, *T. microcopa* and *T. serrata*. Meliaceae is in fact the backbone of forest industries in many countries (Bahadur, 1988). Success of tree improvement generally depends upon the combination and expression of characters in the new genotypes which holds the key for boosting the productivity and yield of the economic product. In this context, regulation of variation through reproductive system forms the basic approach which is dependent upon the information pertaining to reproductive biology as the biological process.

Material and methods

The present investigation was carried out during 2010 in YSPUHF-TIGR at Nauni, Solan HP. Seed study need to cover an extended vast stretch of species distribution; hence, ten seed sources of *Toona ciliata* were selected. Three locations were randomly selected for study of phenological such as leafing, flowering, fruiting and morphological studies such as floral morphology, floral biology and breeding system of *Toona ciliata*.

Results and conclusion

Population extended from subtropical foothill of Solan district continuing from Jaunaji, Kandaghat, Renuka, Palampur, Mandi, Rajgarh, Parwanoo, Nagni, Nainikhad till Bilaspur district. Maximum GCV (%) was in seed germination (80.20%), while, it was minimum in number of flower (7.86%). Maximum heritability (Broad Sense) was found for inflorescence length (0.62). Maximum genetic advance was obtained for fruit setting (26.9), while, it was minimum for seed weight (0.63). Genetic gain was highest for seed weight (43.26%). Genetic estimates for number of flowers, inflorescence length, fruit setting calculated revealed the heritability values (broad sense) of 0.41, 0.62 and 0.48, respectively. The leaflet size was under strong genetic control (0.57). The expression of a character is sum total of the contribution of so many other character and therefore, screening/selection should be done on the basis of components contributing towards that character. The biometrical tool for helping this is correlation which gives the nature and degree of association between various traits. Positive and significant correlation coefficients among various floral characteristics namely inflorescence length and flower number 0.94 was recorded.

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Performance of Willow (*Salix* species) Families at Close Spacing

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***Keywords*:** Willow, Family, hybrids, Growth, Biomass

Introduction

Willows (*Salix* species) are known for its multifarious uses and short rotation, but most of indigenous willow species found in India lack quality wood characters suitable for industrial uses such as cricket bat, plywood, furniture etc.(Sharma *et al*. 2011). Keeping in view its importance, about 200 clones introduced from many countries were screened in the nursery as well as field conditions and wood samples of selected clones were tested by different industries. The growth and biomass of hybrid families developed from selected superior clones was analyzed in close spacing.

Material and methods

The experiment was raised with stem cuttings of 13 families along with 6 check clones in three replications in Randomized Block Design in February 2014 following standard nursery practices. Plant to plant distance was 30 cm x 30 cm. These hybrid families were harvested after three years of growth in December 2016 and evaluated for growth and biomass characters. The data was statistically analyzed with the statistical package for social sciences (SPSS), version 16.0.

Results and conclusion

Plant height was recorded maximum in check clone Kashmiri willow which was statistically at par with check clones SI-64-017, NZ1002, AUSTREE, J795 and clones of families PN227 x *S. tetrasperma*, PN227 x NZ1140, PN227 x SI-64-007, PN227 x 131/25, PN227 x AUSTREE, J799 open and *S. tetrasperma* X *S. tetrasperma*. Check clones Kashmiri willow, AUSTREE, SI-64-017, clones of families PN227 x *S .tetrasperma* and PN227 x SI-64-007 recorded statistically at par values for basal diameter and volume. Green biomass of 2 meter stem and whole biomass per hectare was obtained at par in the clones of family PN227 x NZ1140, PN227 x *S. tetrasperma*, PN227 x SI-64-007, PN227 x 131/25, PN227 x AUSTREE, J799 open and check clones SI-64-017, NZ1002, AUSTREE. Heritability in broad sense was obtained highest in basal diameter. The clones within family should be identified for further study.

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Seed, Pod Variations and Germination Studies in *Dalbergia sissoo* from Different Seed sources of Uttrakhand

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***Keywords*:** Germination studies, Seed sources, Variations

Introduction

Dalbergia sissoo (Indian rosewood tree) belongs to family Fabaceae and subfamily Papilionoideae, is widely distributed on the river beds in sub-Himalayan tract including Uttrakhand. It is the timber species of India, grows naturally and is planted on alluvial soil.It is an important multipurpose tree frequently used in afforestation programmes.

Material and methods

Healthy pods were collection from different sites of Uttrakhand *viz*. Babu Gate, Thano, Rani Pokhri, Lal Kuan and G B Pant Nagar. Observations were recorded for variation in different pods and also from manually extracted seeds for seed parameters including their germination studies.

Results and conclusion

Pod collected from sources showed maximum weight in Thano and minimum in Lal Kuan source. Babu Gate source showed maximum pod width and minimum in Thano with maximum pod length in Babu Gate and minimum in GB Pant Nagar source.Maximum number of seeds/pod from Babu Gate and inimum from Rani Pokhri source. Seed volume was maximum from Thano source and minimum from Babu Gate source, seed length was highest in Thano and lowest in Babu Gate source. Seed width value was maximum in Babu Gate and minimum in G B Pant Nagar source and seed thickness was maximum in G B Pant Nagar and minimum in Babu Gate. Germination studies showed highest germination percentage in seed source from Thano lowest in Lal Kuan source, germination value being highest in Rani Pokri source and showing lowest value in Thano. Germination energy index was highest in Babu Gate and lowest in Lal Kuan seed source. Germination speed was highest in Babu Gate and lowest in Lal Kuan with germination period varying similar i.e. highest in Thano or Lal Kuan to lowest in G B Pant Nagar.Germination period was maximum in sources i.e. Lal Kuan and Thano with minimum value in G B Pant Nagar source also germination speed was maximum in Babu Gate and minimum in Lal Kuan source.

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Prospects and Challenges of Organic Vegetable Farming in India

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Introduction

Organic agriculture has developed by the conscious efforts of inspired people to create the best possible association between the earth and men. It aims at sustaining and increasing the productivity by improving soil health and overall improvement of agro-ecosystem. The total area under organic certification in India is 5.71 M ha with a production of 1.35 MMT of certified organic products (APEDA 2015-16). Green Revolution in the post-independence era has shown path to developing countries for self-sufficiency in food but sustaining agricultural production against the finite natural resource base demands has shifted from the "resource degrading" chemical agriculture to a "resource protective" biological or organic agriculture. Organic Farming is a production system which avoids or largely excludes the use of synthetic fertilizers, growth regulators. To the maximum extent, viable organic farming systems rely on crop rotations, crop residues, animal manures, legumes, green manures, off farm organic wastes and aspects of biological pest control. These practices result to maintain soil productivity and tilth to supply plant nutrients and to control insect pest diseases and weeds. Thus, the organic farming implies recycling of waste and residue to the local soil itself, replenishing the nutrients exhausted from the soil during the crop growth, encouraging the development of microorganisms. So, it's the need of the hour to adopt the organic farming practices in vegetable production system to maintain the quality and production of vegetable produce.

Results and conclusion

In India, a major component of food security comes from the irrigated areas and it is estimated that adoption of organic farming in these areas may reduce the production. India with a total area of 142 million ha under cultivation, has 68 per cent area under rain fed cultivation. In these areas, the use of fertilizers not only enhances water demand but also reduces water holding capacity of already light soils. The rate of fertilizer application is very low in these areas as compared to national average. In these regions, farming systems are highly diversified with crops, trees and animals etc. There are about 2-5 farm animals for each family and 10-30 trees per ha (Faroda *et al.,* 2008). So, diversified farming systems and low fertilizer use make a strong point for organic vegetable cultivation in these areas which not affect the national food security. Restoration of soil fertility and pest control traditionally in these areas further strengthens and provides strong infrastructure for organic system. In Indian, 74 per cent of farmers own less than 2 ha land. These small and marginal farmers can adopt the organic farming easily as well as can manage the organic inputs and labor more efficiently. The crops of rain fed areas like many vegetable crops, cumin, fennel, ajwain, fenugreek, etc are in demand in organic food market. Almost entire forest produce and 80 per cent of horticulture are contributed by the un-irrigated ecologies. Approximately 50 per cent of the net sown area will continue to remain rain fed, even if full irrigation potential of the country is realized. Thus in the light of food security to the Indian population and non-availability of organic manures in required quantities, the organic farming is neither desired nor practicable as a state policy but can be practiced in specific areas and specific

crops like vegetable crops which require higher doses of chemical fertilizers, vegetable crops having high export potential in International markets and local varieties of various vegetable crops with high quality and export potentials. There are various challenges associated with the organic farming in India like lack of premium price for the organic products, lack of proper marketing network, price expectations are too high in relation to quality, less efforts to develop domestic markets, lack of regular supply of organic products, time consuming and complicated paper work while dealing with export authorities and branding of organic products etc. The unfavorable effects of modem agriculture have not appeared all of a sudden and repetitive use of agro-chemicals was not predictable at the time of their introduction. Intensive cultivation of land without protection of soil structure and soil fertility would lead eventually to the springing up of deserts. Irrigation without arrangements would result in soils alkalinity or salinity. The environment safety can adequately be taken care of by adopting Good Agricultural Practices (GAPs). So there is a need to develop some mechanism and GAP certification does propose a viable alternative.

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Studies on Diameter, Bark Thickness and Wood per cent of different *Salix* Clones

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***Keywords*:** *Salix*, Diameter, Bark thickness, Wood

Introduction

Salix alba is one of the most important willow tree among 33 species reported from northern part specially Himalayan region, in India. In order to diversify the plantation of tree species with integration of agriculture crops, willow is most eco-friendly and farmer's choice. The cricket bat and artificial limbs industry is solely depending on the wood of *S. alba* and there is ready made market for willow based wood industry. The performance of *Salix* when made into products is related to its physical and mechanical properties.

Material and methods

Diameter of the tree was measured in cm with the help of tree caliper. It was measured at two axes which were at right angle to each other and mean value was taken as dbh (diameter at breast height). Bark per cent or bark thickness was measured after the procurement of logs from the site, calculated as, Bark (%) = [(D.O.B.-2 x Bark thickness)/ D.O.B.] x 100, and Wood (%) = (D.O.B. – D.U.B) x 100.

Results and conclusion

Mean d.b.h. ranged from 9.40-17.50 cm. The highest value of 17.50 cm was recorded in *Salix babylonica*. Lowest d.b.h. was noticed in *S. tetrasperma* (9.40 cm), whereas, the d.b.h. of 13.17 cm was observed in Poplar. The maximum bark per cent or thickness of 24.98 (5.08) was found in *S. tetrasperma*. The minimum bark per cent was recorded in clone Kashmiri-6 [4.42 (2.32)]. In Poplar, the bark per cent of 7.10 (2.84) was noticed. The highest wood per cent of 95.58 (9.83) was found in clone Kashmiri-6 and the lowest wood per cent of 75.02 (8.72) was observed in *S. tetrasperma*. A wood per cent of 92.90 (9.69) was recorded in Poplar.

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Growth and Yield Performance of Maize, Tomato and Soil Physico-Chemical Properties under *Grewia optiva* Drummond Based Agroforestry System

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***Keywords*:** Yield performance, Agroforestry systems, *Grewia optiva*

Introduction
Agroforestry is a unique and common practice in the sub-temperate mid-hills of Himachal Pradesh, India. Agri-silviculture is one such system where agricultural crops are grown in association with trees. *Grewia optiva* Drummond is an important multipurpose tree species of North-Western Himalayas distributed throughout the sub-Himalayan tract found upto an altitude of 1800 m (Brandis, 1972). *Grewia optiva* is an extremely common multipurpose tree grown on the farmers' field under traditional agroforestry design on terrace bunds along with all crop combinations. The study is aimed to analyse the effect of *Grewia optiva* Drummond based traditional agroforestry system on crop production ans soil physico-chemical properties.

Material and methods
The study was conducted in Pacchad region of district Sirmour, Himachal Pradesh during 2016-2017 on farmer's fields practicing traditional agroforestry. The crown spread of trees was categorised into three classes *viz.* crown class I (< 3m crown spread), crown class II (3-6m crown spread) and crown class III (>6m crown spread) for quantifying its effect on the growth and yield performance of maize and tomato and soil physico-chemical properties. Data was analysed by using RBD (factorial) design at 5% level of significance.

Results and conclusion
Maize showed better growth and yield under tree with lesser crown spread and outside the tree canopy zone. Highest grain yield (43.17 q/ha), biological yield (103.29 q/ha) and harvest index (41.77 %) were found under controlled condition (open) and reduction of 19.90 % in grain yield and 14.31 % in biological yield at 1m distance from tree trunk. Crown classes affected growth of tomato to lesser extent. Further, highest no. of fruits per plant (25.00) and fruit yield (45.54 t/ha) was found under open condition while a reduction of 32.88 % in no. of fruits per plant and 45.52 % in fruit yield at 1m distance from tree trunk was observed. Bulk density, particle density, moisture content, soil pH, electrical conductivity, soil organic carbon, available nitrogen, available phosphorus and available potassium were found to be enhanced under tree canopy zone as compared to outside canopy zone. The results obtained from the present study indicate that crown classes of tree affected growth parameters of crops to lesser extent but the yield of the crops was influenced greatly. It is distance from tree trunk that had a much significant effect on growth and yield parameters. Although not reflected from growth and yield of crops, soil physico-chemical properties were improved under tree canopy..

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Germination and Germination Energy of *Parkia roxburghii* G. Don Seeds as Influenced by Storage Temperature and Container

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Introduction

*Parkia roxburghii*is a lesser known nutritious, leguminous tree, grows in North East India. It is valued for its subsistence products and as an important source of cash income (Rocky and Sahoo, 2002). Despite a variety of uses, unfortunately the tree bean is overharvested by the local people resulting in scarcity of seeds for its regeneration. Conservation of this highly economical species is imperative as they are not only potential pillars of sustainable agroforestry in the region but also as a valuable non timber forest produce catering huge income to the changing needs of the rural people.

Material and methods

Seeds were stored at ambient temperature (T_1), 5°C (T_2) and -5°C (T_3) in pottery pots (C_1), airtight plastic containers (C_2) and canvas bags (C_3) in the lab for undertaking germination test. Storage was done for 6 months and germination test was carried out in RBD (factorial) by sowing the seeds in the polybags containing potting mixture of sand and soil (1:1) at nursery. The testing period was 28 days from the day of sowing.

Results and conclusion

The storage temperature and container had significant effect on germination. T_2 resulted in highest germination of 30.86 %. Lowest germination of 12.22% was in T_3. T_2 resulted in highest germination energy of 16.91%. The lowest of 6.30% was at T_3. Highest germination at T_2 could be due to low temperature as at low temperature the rate of respiration reduces which enhances the longevity and storability of seeds. Lowest germination at T_3 could be due to the freezing injury of the seeds.Similar results have also been reported by Bhardwaj *et al*. (2001) in *Ulmus laevigata*. Container C_2 gave maximum per cent germination (29.88%) and the lowest germination (18.1 % m was in C_3. Maximum germination energy of 16.91% was recorded in C_2 container. The better performance of C_2 ascribed to the preservation of moisture content and prevention of contamination by fungi and microflora. Lower performance of C_1 and C_3 might be due to the exchange of gases and moisture which reduces the seed longevity. *Parkia roxburghii* seeds can store for a longer period at a low temperature of 5□C. Airtight plastic container proved the ideal storage container for longevity of seeds.

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IESHP/AFS2017/2035

Effect of IBA on Rooting and Shooting of Bougainvillea

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***Keywords*:** Bougainvillea, IBA, rooting, shooting, varieties

Introduction
IBA is the best executor for the species that are difficult to propagate and root. IBA is widely used for rooting of many horticulture species. The efficacy of IBA for producing roots, promoting rooting percent and survival of rooted cuttings is well-known. Keeping in view, the present investigation studies the effect of IBA on shooting and rooting of different bougainvillea varieties.

Material and methods
The experiment was carried out under screen house condition in CAZRI, Jodhpur. The experimental material consisted of 15 cm long hardwood stem cuttings of 11 varieties of Bougainvillea treated with IBA (1000, 2000 and 3000 ppm). Observations on total number of cutting sprouted, sprouting success (%) after two months of planting and rooting success of cutting (%) after six months of planting was recorded.

Results and conclusion
Total 803 cuttings survived out of 2200 cuttings planted irrespective of varieties and treatments. Maximum survival of seedlings was in Theema variety i.e. 138 cuttings (17%) and maximum number of cuttings survived with the 2000 ppm IBA treatment. The significant differences were recorded for sprouting percentage in different treatment of IBA and also among the different varieties. Maximum sprouting percentage was exhibited by the cuttings treated with 2000 ppm concentration of IBA (73%) followed by 3000 ppm IBA treatment and least sprouting was in control treatment. In Theema variety maximum cuttings (99%) sprouted when treated with 2000 ppm IBA concentration compared to other treatments. In similar lines, Singh *et al.* (2013) observed maximum sprouted cuttings when treated with 3000 ppm IBA in Torch Glory variety. The rooting percentage with both 2000 ppm and 3000 ppm IBA was 41% in all the varieties. The theema variety exhibited highest rooting percentage and was maximum (84%) with 2000 ppm of IBA concentration. It confirms the effect of IBA on Theema variety observed by Sahariya *et al.* (2013) that increase in the concentration of IBA from 1500 ppm to 2000 ppm showed a significant effect in rooting and growth.

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Effect of Seed Treatments on Germination Behaviour of *Rhododendron arboreum* Smith

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***Keywords*:** Pre-sowing, Germination behaviour

Introduction

Rhododendron arboreum (Ericaceae), an associate of sub-tropical pine forest, found from Kashmir to Bhutan and in the hills of Assam, Manipur and Himachal Pradesh has been exploited for various medicinal purposes apart from aesthetic and sacred values. Deforestation and unsustainable extraction of rhododendrons has led to severe pressure on their availability. So far no attempt has been made to develop suitable germination and large scale production of rhododendron species. Though studies have been conducted on other aspects, scanty information is available on seed germination parameters of this species. The aim of this study is to investigate the effects of growth regulators on germination behaviour of *R. arboreum* seeds under laboratory conditions.

Material and methods

The study was conducted on mature seeds (capsules), collected from vigorous, middle aged and good form trees from sub temperate forest of (Shilli) Solan and surrounding area. 100 numbers of seed in each sample were taken. The experiment was laid out in completely randomized design with three replications. Various parameters were studied *i.e.* germination percent, germination capacity, energy, speed, value and index by using standard methodologies after imposing different pre-sowing treatments.

Results and conclusion

The seeds were subjected to different treatments *viz.* T_0-Control, T_1-Cold water soak (24 hours at room temperature), T_2-Warm water soak (80^0C, allowed to soak in the water as it cools for 12 hrs), T_3-Warm water soak (80^0C, allowed to soak in the water as it cools for 24 hrs), T_4-GA_3 treatment (100 ppm) 3 hrs, T_5-GA_3 treatment (100 ppm) 6 hrs, T_6-GA_3 treatment (100 ppm) 12 hrs, T_7-GA_3 treatment (150 ppm) 3 hrs, T_8-GA_3 treatment (150 ppm) 6 hrs, T_9-GA_3 treatment (150 ppm) 12 hrs, T_{10}-Kinetin (100 ppm) 6 hrs and T_{11}-Kinetin (150 ppm) 12 hrs. Different seed treatments significantly affected the germination behaviour of *R.arboreum*seeds and improved it to the considerable extent. Among all the pre-sowing seed treatments, GA_3 treatments of different concentration for different time periods were found to be very effective. The studies concluded that T_9 (150 ppm GA_3 x 12 hrs) as the most effective treatment for improving germination (87.33%) and germination capacity (88%), germination speed (4.54), germination value (17.19), germination index (4.53). The pre-sowing treatments with various chemicals improved the percent germination and reduced the germination time. This might be due to altered physiology of embryos, the breakdown of physiological or morphological dormancy, increased hydrolase enzyme synthesis or the augmentation of metabolic rate during germination process.

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Blueberry–An Option for Crop Diversification under Mid-hills

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***Keywords*:** Cropping behaviour, Fruit diversification

Introduction

The blueberry (*Vaccinium corymbosum*) is widely cultivated in North America and the European regions. Besides a table fruit, blueberries have high nutritive value. It is rich in vitamins, minerals, antioxidants and also a rich source of ellagic acid, imparting potent anti-carcinogenic properties. The fruits are processed into juice, jams, jellies, sauces, pies, cakes, toppings and pastries. Its cultivation in India is in fancy and is more or less at trial stage.

Material and methods

The present study was conducted to explore the possibilities of blueberry cultivation as a new fruit for diversification in mid-hills. Adaptation trials were conducted between 2015 and 2017 under mid-hill conditions (Solan) of Himachal Pradesh. Seven blueberry varieties namely Biloxi, Bluecrop, Misty, Sharpblue, Arlene, Legacy and Reveille were introduced from Michigan, USA. These varieties were evaluated for growth, floral and physico-chemical characteristics.

Results and conclusion

The blueberry variety, Revellie was the first to break leaf bud during first week of February. Maximum growth was recorded in Misty. Only Misty and Arlene varieties were able to initiate flowering and fruiting, recorded fruit set of 62.06 and 54.16 per cent, respectively. Fruit length of 11.83 mm and 11.04 mm and the fruit breadth of 13.70 and 14.36 mm were observed in Misty and Arlene, respectively. Fruit weight among two varieties ranged from 1.41-1.49 g. Maximum total soluble solids, titratable acidity, total sugars, reducing sugars, non-reducing sugars and Vitamin C was observed in Arlene compared to Misty. The results concluded that the varieties, Misty and Arlene adapted well under sub-temperate conditions and have potential for further commercialization.

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Natural Regeneration Status under *Acacia Catechu* Bearing Forest Types in Low Hill Conditions of Himachal Pradesh

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Keywords**:** *Acacia catechu,* Regeneration, Forest type, Plantation, Low hills

Introduction

Acacia catechu Willd. is a multipurpose moderate sized deciduous tree foundwidely distributed in Mandi, Hamirpur, Kangra, Solan, Sirmaur, Una, Chamba, Shimla and Bilaspur districts below 1300 m elevation in Himachal Pradesh. It is exploited commercially for katha and cutch (tannin). It is significant for the rural communities as they are dependent on this tree for fuel, fodder, building material etc. Khair has become an integral part of socio-economic and cultural life of the people inhabiting the lower hills, so, an attempt was made to assess the regeneration status of *A. catechu* with reference to different forest types.

Material and methods

The present study was focused on different *A. catechu* bearing forest types *viz.* Dry Shiwalik Sal forest, northern dry mixed deciduous forest, dry deciduous scrub forest, lower Shiwalik chirpine forest, dry riverine forest and *A. catechu* plantation in four forest divisions *viz*. Kangra, Hamirpur, Una and Nahan. For regeneration studies, in each forest type, 4 sites were taken. Total regeneration as well as regeneration of *A. catechu* was specifically studied. The composite soil samples were also collected for studying the different soil parameters in all forest types.

Results and conclusion

The total regeneration, higher number of recruits was present under Lower Shiwalik chirpine forest and Dry Deciduous Scrub forest. However, higher number of *A. catechu* recruits was observed under Dry Riverine forests. Although soil nitrogen levels were higher at dry Shiwalik Sal forest, poor light availability due to thick crown cover of *Shorea robusta*, higher biotic pressure like grazing, fire *etc.* were responsible for less regeneration. Available potassium and Available phosphorus were higher under *A. catechu* plantations and dry deciduous scrub forest respectively. Organic carbon per cent under dry Shiwalik Sal forest and lower Shiwalik chirpine forest was slightly higher. The total regeneration percent was higher under lower Shiwalik chirpine forest as higher organic carbon levels indicate presence of more organic matter which in turn favours regeneration. The regeneration percent (total as well as *A. catechu* regeneration) was higher in case of natural forests as compared to plantation.

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Effect of Diameter Classes on Growth Parameters of Sub-tropical Plantations under Mid-hills of Himachal Pradesh

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***Keywords*:** Crown characters, Diameter, Stem volume

Introduction

Forests are the most demandable natural resources throughout the world. As the area of natural stands has decreased in recent decades, tree plantations have become increasingly important. Multi-purpose plantations reduce pressure on natural forests, restore some ecological services provided by natural forests and mitigate climate change. *Quercus leucotrichophora*, *Pinus roxburghii*, *Eucalyptus tereticornis*, *Melia azedarach* and *Ulmus villosa* are some of the important tree species of Western Himalayas which are used for one or the other purpose by the native people of the region. Since these species are economically and ecologically important, studies related to different growth parameters, productivity and variation were undertaken.

Material and methods

The study was conducted on 24 year old selected plantations of *Quercus leucotrichophora* A. Camus, *Pinus roxburghii* Sargent, *Eucalyptus tereticornis* Smith, *Melia azedarach* Linnaeus and *Ulmus villosa* Brandis ex Gambleraised at the experimental site of Department of Silviculture and Agroforestry, YSPUHF, Nauni, Solan. Only 30 per cent representative samples were selected for each species. The randomly selected trees were segregated into four diameter classes *viz*. 5-10 cm, 10-15 cm, 15-20 cm and >20 cm.

Results and conclusion

The data on 40 randomly selected trees by grouping 10 trees in four diameter classes and different growth parameters was recorded. The different tree growth parameters increased with increase in diameter in all the species. Dbh was higher under *P. roxburghii* followed closely by *M. azedarach*. Tree height was higher under *U. villosa* compared to other species. Specific gravity of wood varied from minimum 0.45 in *P. roxburghii* (5-10 cm) to maximum 0.72 in *Q. leucotrichophora* (>20 cm diameter class). Average basal area increased from lower to upper diameter class in all the species. Maximum volume production was observed for *M. azedarach*. Maximum volume/ha was observed in >20 cm diameter class for *P. roxburghii*, *E. tereticornis*, *M. azedarach* and *U. villosa* since the trees were bigger in size. Whereas, for *Q. leucotrichophora* it was maximum in 10-15 cm diameter class which was due to the presence of comparatively more number of trees. Crown area, crown height and crown length showed statistically significant differences within four diameter classes. Crown parameters were highest for *M. azedarach* and *U. villosa*.

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Selecting Wild Apricot (*Prunus armeniaca* L.) Genotypes with Better Fruit Quality Attributes

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***Keywords*:** Germplasm, Fruit quality, Selection, Wild apricot

Introduction

Apricot (*Prunus armeniaca* L.) cultivation in India is restricted to mid hills at an elevation beyond 1200 m amsl. Commercial growing of apricots is marred by monoculture owing to predominance of very few cultivars like New Castle, Royal etc. However, there is a wide array of germplasm of apricot growing wild in north-western Himalayas. The ever changing environment and consumer preferences demand genetically improved apricots with wider adaptation, better yield and fruit quality. This is necessitated more from crop diversification point of view, and also in view of the widespread use of apricot in processing, thus enhancing farmer's income.

Material and methods

The present studies were conducted to select superior genotypes from wild apricots in Shimla during 2015-16. The region opted for research particularly falls under high hills wet temperate zone with elevation ranging from 1411- 2535 m amsl. The selection was based on fruit size and TSS as well as feedback collected from local people and farmers in the form of questionnaire. On the basis of pre selection survey about 250 genotypes were selected, out of which 42 genotypes were taken for further analysis.

Results and conclusion

Maximum fruit length (41.54 mm), fruit breadth (38.41 mm) and weight (35.34 g) was recorded in SRB2 under Rampur.TSS in fruits ranged from 11.75 in SCK1 in Chirgaon to 21.40˚ B in STB2 in Theog. Titratable acidity was highest (2.55 %) in SCK6 and lowest (0.67 %) in SCD1. Most of the genotypes were free stone except SRB3, SRB4, SR4, SCK1, SCK5, SKK1, SKK2, SKuM2, SKuM4 and STB3. Pulp to stone ratio was observed maximum (23.54) in SCJ1 and minimum (4.75) was in SRB4. Kernels were sweet in SRB2, SRB3, SRB6, SR2, SCJ2, SCK2, SKK2 and SKuM1. Maximum oil content (54.08 %) was in SCJ3 and SJM3 whereas, minimum (37.15 %) in SKuM3. Genotypes SRB1, SRB2, SRB5, SRB6, SR2, SCJ1, SCJ2, SM2, SCK2 and SKuM2 were found promising having higher fruit size, weight, pulp to stone ratio, TSS and oil content.

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Comparison of Organic Manures on Growth & Yield Parameters of *Ocimum sanctum* in Peach based Agroforestry System

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***Keywords*:** Jeevamrut, FYM, Growth, Yield

Introduction

Long term use of inorganic fertilizers without organic supplements damages the soil physical, chemical & biological properties and causes environmental pollution (Albiach *et al*. 2000). This scenario has encouraged scientists towards using organic materials for improving soil properties and profitable crop production. *Ocimum sanctum*is very much useful for increasing memory power and has many other medicinal and aromatic properties. So studies were conducted on comparison of different organic manure doses on growth and yield parameters of *O. sanctum* under peach based agroforestry system.

Material and methods

The experiment was conducted at DYSPUHF, Nauni, Solan in RBD with seven treatments viz., T_1, T_2: and T_3 with FYM 15, 20 and 25 t ha^{-1}, T_4: T_5 and T_6 Jeevamrut (180, 300 and 420 ml/plant) and T_7: control (no manure) and three replications. FYM was evenly spread and mixed with the soil before transplanting. Thereafter, Jeevamrut (5%) is applied as soil drench @ 30, 50, 70ml per plant after the 30 days of transplanting than at 15 days interval till final harvesting. Then, growth and yield parameters were calculated.

Results and conclusion

Out of seven treatments, all the growth and yield parameters were highest in T_6 (420 ml/plant Jeevamrut). Maximum plant height (103.82 cm), number of leaves per plant (1815.85) and leaf area (5.95 cm^2) at harvesting stage was obtained when Jeevamrut was applied @ 420 ml per plant followed by T_5, T_3, T_2, T_4, T_1 and T_7. Fresh and dry weight of leaves shoots and roots of *O. sanctum* were significantly influenced by the presence of peach trees in addition to the application of organic manures. Maximum total yield of *O. sanctum* was with the application of highest dose of Jeevamrut resulting in 18.27 q ha^{-1} total fresh weight and5.55 q ha^{-1} total dry weight under peach based agroforestry system. Organic manures influence the growth and yield parameters of *O. sanctum* in terms of plant height, number of branches, number of leaves, leaf area, LAI and fresh as well as dry weight of leaves, shoots, roots and total herb. Higher dose of organic manures i.e. 25 t ha^{-1} FYM and 420 ml/plant Jeevamrut was more effective in improving growth and yield attributes of medicinal plant intercropped under peach.

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IESHP/AFS2017/2043

Climate Resilient Traditional Crops of Himachal Pradesh-A Treasure for Food and Nutritional Security

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***Keywords*:** Climate Resilience, Millets, Nutritional Security, Pseudocereals

Introduction

Himachal Pradesh is an agrarian state with 76% population securing their livelihood from agriculture and contributes 9.4% to total GDP of the state. Traditional agriculture in the past was for subsistence where millets and pseudocereals were important components of farming and were source of balanced nutrition. With the passage of time, cash crops were included in the cropping system and acreage under traditional crops reduced to 9,346 ha in 2010 in comparison to 39,660 ha in 1960. The present paper describes the nutritional importance of these crops and their ecological adaptability and resilience to changing climatic conditions.

Material and methods

The temporal data on acreage and production of millets (finger millet: *Eleusine coracana*; proso millet: *Panicum miliaceum*; foxtail millet: *Setaria italica* and barnyard millet: *Echinochloa frumentacea*) and pseudocereals (amaranth: *Amaranthus* spp.; bathu: *Chenopodium album* and buckwheat: *Fagopyrum esculentum*, *F. tataricum*) was collected from Directorate of land records, Shimla. Literature from various sources was collected on the nutritional and medicinal values, health standards and malnutrition of people of Himachal Pradesh. It was reviewed and information is presented in the paper.

Result and conclusion

With the popularization of cash crops and fine cereals, area and production under finger millet decreased from 16003 ha, 8205 MT in 1960 to 1552 ha, 1996 MT in 2010, respectively. Other millets and pseudocereals also followed a similar trend. Cultivation of traditional crops is now restricted to sporadic locations. Lesser availability of these valued grains deprived the population from nutritional and livelihood security. Data on health standards of Himachal Pradesh (2015-2016) reveals that 89% children below 2 years do not get adequate diet. Children under 5 years are malnourished and a significant population is exhibiting stunted growth (26.3%), underweight (21.2%) and anaemic (53.7%). Adult men (20.0%) and women (53.6%) are anaemic and a significant population is suffering from hypertension and high blood sugar. Millets and pseudocereals are rich source of energy, protein, micronutrients and essential amino acids, and have hypoglycemic effect because of high level of dietary fibres. Realizing the nutritional values of these grains, these are now considered as nutricereals and the market demand for processing industries and value added products are increasing. These underutilized crops also ensure sustainable production under adverse climatic conditions because of their endurance to drought, adaptability to low soil fertility and resilience to biotic and abiotic factors. There is a need to strengthen R&D organizations to develop new varieties, production packages and profitable cropping systems. The government should frame a buy-back policy after fixing minimum support prize and inclusion of these grains in public distribution system. Private sectors should also be encouraged to establish food processing industries to develop diversified food products and supplements from these traditional crops.

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Effect of Root and Shoot Pruning on Growth and Biomass Production in aonla (*Emblica officinalis* Gaertn.)

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***Keywords*:** Biomass, Shoot pruning, Root pruning

Introduction

Root pruning has long been used as an accepted technique and solution for such type of problems to encourage fibrous root formation in the seedlings. It has generally been observed that seedlings of the most forests species had relatively poor root system and root-shoot ratios, resulting in unsatisfactory establishment and poor survival in the field. The increased root-shoot ratio and light root pruning stimulates initiation of roots while, shoot pruning conserves moisture by reducing transpiration loss. Root pruning especially when plant is young, encourage fibrous root system in the seedlings,). The aonla (*Emblica officinalis* Gaertn.) belonging to family Euphorbiceae is one of the most important wild fruit crop of India. Its fruit have its medicinal properties and also used in tannin and dyeing industries.

Material and methods

The experiment was conducted in polyhouse at Department of Silviculture and Agroforestry, YSPUHF, Nauni, Solan. After sowing the seeds (February), the root and shoot pruning was done (August, 2013). The seedlings were transplanted in nursery area in the month of August 2013 and the observations were recorded eight months after planting i.e. April, 2014 as per the following treatments i.e. Shoot pruning (above collar), S_1 (Control no cut) , S_2 (5cm shoot) and S_3 (10 cm shoot cut) and Root pruning (below collar), P_1 (Control no cut), P_2 (7 cm root), P_3 (10 cm root) and P_4 (13 cm root).

Results and conclusion

The combination S_3P_4 and S_2P_4 produced highest survival (83.33%). Minimum survival of 60.00 per cent was however, found in S_1P_1. The treatment combination which was subjected to shoot pruning and root pruning at 10 cm and 13 cm, respectively (S_3P_4), exhibited significantly maximum dry shoot weight (2.31 g), dry root weight (1.59 g) and seedling weight (3.91 g). Minimum survival (60%) was obtained in S_1P_1, whereas, significantly minimum height increment (3.79 cm) was registered in S_1P_4. The results are in agreement with the findings of Siriri *et al.* (2010). Nayital and Sood (2000) revealed that proper root and shoot pruning greatly aids in reducing transplanting shock and promotes successful plant establishment who also reported maximum root weight, aerial biomass and total biomass in the seedlings subjected to root and shoot pruning in *Bauhinia variegata.*

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IESHP/AFS2017/2047

Seaweed Extract: Potential organic Manure for Sustainable Fruit Production

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***Keywords*:** Organic Manure, Seaweeds

Introduction
Environment friendly farming or organic farming is an expanding interest and deserves to be explored. The current global scenario emphasizes the need to adopt eco-friendly agricultural practices for sustainable agriculture. Excess use of fertilizer application has made an adverse impact on the soil health, beneficial soil microbes and the plants cultivated in these soils. This eventually has lead to a high demand for organic produce because they preserves the reproductive and regenerative capacity of soil, good plant nutrition sound soil management and produces nutritious food rich in vitality which has resistance to diseases. In this context, application of seaweed extracts, new generation organic manure may represent a promising strategy to reduce the use of phyto-chemicals leading to a sustainable fruit production.

Material and methods
The study is conducted through systematic review. Scholarly work of different scientists was consulted from research journal and monograph.

Results and conclusion
Seaweeds have been shown to exhibit many bioactivities that include bio-stimulant, fertilizer and antimicrobial properties. Seaweeds or marine macro-algae are important renewable organic plant resources occurring in the seas, brackish waters and lagoons across the globe. Application of liquid extract from these organisms as foliar spray or seed treatment showed positive result on enhancement of vegetative growth and yield of several fruit crops. Seaweed extracts are considered an organic farm input to be used under organic and integrated nutrient management farming as they are environmentally benign and safe for the health of animals and humans. Their applications increase the root and shoot growth, berry yield and rhizosphere microbial diversity and physiological activity (Alam *et al.* 2013) and also serve as an environmental-friendly substitute of Fe chelates in strawberry production (Spinelli *et al.* 2015) Thus, an increasing concern for sustainable agro-ecosystems has evoked keen interest in crop production using eco-friendly products which are easily bio-degradable and do not leave any harmful toxic residues besides conserving nature. So, it is necessary to use natural products like seaweed extract which are capable enough to conserve fertigation and consequently increasing their fertility and fertilizers use efficiency in low-input organic farming as a final goal.

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Utilization of Barren Land Weeds As Sheep Feed Resources: Effect on Nutrient Utilization, Rumen Fermentation and Plane of Nutrition

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***Keywords*:** Chaulai, *Blepharis sindica,* Digestibility, Microbial protein synthesis

Introduction

Lack of adequate year-round feed resources is probably the most important factor contributing to low animal production in arid and semiarid regions (Kawas *et al.* 2010), and raising of livestock is difficult in these areas because of low, unpredictable rainfall, infertile soil and low primary production. As a result there remains an acute shortage of dry matter for feeding to animal during the rest of the year. Under such situation there is need to develop strategies to use the monsoon feed resources, pasture species and ecotypes and optimizing the potential use of these unconventional feedstuff in livestock feeding using suitable technologies. With this objectives in mind two barren land weeds which grow in abundance during monsoon and after monsoon period respectively in semi arid region were explored in the feeding of sheep. Chaulai (*Amaranthus spp*) is one of the local green biomass that grows very fast after first monsoon showers with dry biomass yield of approximately 10-15 Q/ha is not being harvested or utilized. This plant is quite rich in protein (CP 10-14%) with succulent leaves and tender stems and has varying palatability in sheep, goat and cattle. Another plant is *Blepharis sindica* T. Anders which is well adapted to sandy soils and grows luxuriantly from January to March in arid and semi arid region when there is shortage of grazing resources, due to spine growth on leaf and small stems sheep, goat find difficult to graze. These plants were harvested afresh, chaffed and dried in shade and added in complete feed block at different level to study their feeding and nutritive value in adult sheep.

Material and methods

Chaulai was harvested afresh from the field and dried and then chaffed and used at 0, 20 and 40% levels for making feed block. Similarly *Blepharis sindica* was also harvested, chaffed and used at 30 and 45 percent level in complete feed block. Thus, the overall composition of CFB was concentrate 35, roughage 65 and molasses 5 percent. Feeding experiments were conducted on twenty seven adult ewes and thirty six rams of Malpura breed respectively for Chaulai and *Blepharis sindica* roughage respectively divided into three groups in each. These were fed *ad libitum* CFB in individual pen for 45 days with provision of ample supply of drinking water round the clock. Daily feed intake and weekly body weight of each ewe was recorded. A metabolic trial with four days adaptation and six days collection period was conducted on six ewes from each treatment groups after 35 days of experimental feeding. Rumen liqueur samples were collected at the end of the experiment from each ewe at 0 and 4 hour post feeding for studying the rumen metabolites. Urine samples were analyzed for purine derivatives as a measure of microbial protein synthesis.

Results and conclusion

Inclusion of Chaulai at 13 and 26 % replaced 45 and 100% of oil cakes in the CFB. It had 10.2% CP and contributed to a total of 16.6 and 33.3 % CP in the feed blocks having an average of 11.1% CP. *Blepharis sindica* roughage consisted of 7.71 percent crude protein

which is higher than that in cenchurus hay and as a result the protein content was slightly increased with its incorporation. The Feed blocks contained an average of 10.3 to 11.1% CP which is considered enough for maintenance of adult sheep (ICAR 2013). Chaulai incorporation revealed that animals consumed CFB (1047 and 1095 g/d). There was similar DM and OM digestibility between the groups. All the ewes were in positive nitrogen balance and no significant difference was observed between the groups. With *Blepharis sindica* roughage incorporation no effect on daily weight change of rams fed different feed blocks was observed ($P<0.05$). Plane of nutrition revealed lower ($P<0.05$) daily dry matter intake in lambs fed 45 and 30 percent of *Blepharis sindica* compared to control. Rumen fermentation pattern revealed lowering of rumen pH, total nitrogen, TCA precipitable N and rumen ammonia level with the increased level of Chaulai hay in CFB. Excretion of purine derivatives and microbial protein synthesis revealed non-significant difference between the groups. The tendency towards better microbial protein synthesis with relatively higher efficiency (microbial N/kg DOMI) was observed in Chaulai fed groups. With *Blepharis sindica* herbage incorporation dry matter, organic matter, crude protein digestibility increased ($P<0.05$) whereas ADF, cellulose decreased ($P<0.05$) and percent nitrogen balance was higher ($P<0.05$). Higher ($P<0.05$) total nitrogen, TCA precipitable nitrogen, ammonia level and lower values of total volatile fatty acids were recorded in rumen liqueur of lambs fed *Blepharis sindica* and microbial protein synthesis / kg of DOMI was higher ($P<0.05$). The inclusion of Chaulai up to 40 percent in the complete feed block promised usage of unutilized monsoon herbage biomass in the feeding of sheep during scarcity by storing in the form of CFB. *Blepharis sindica* herbage can also be used up to 45 percent in complete feeding system of small ruminants in arid and semi-arid region after processing.

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Allelopathic Influence of Leaf Aqueous Extract and Leaf Litter of *Melia azedarach* L. on Germination, Growth, Biomass and Grain Yield of Green Gram and Black Chickpea

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***Keywords*:** Biomass, Leaf extract, Leaf litter, Yield

Introduction
Melia azedarach L. is a multipurpose fast growing tree, preferred in alley cropping system of agro-forestry and ornamental purpose (Hanif and Bari 2013). Studies on allelopathic effects of leaf litter on test crops are limited to laboratory bioassays. However, studies till crop maturity in soil or natural conditions considering the amount of litter fall are meagre. The present investigation to investigate the allelopathic effect of leaf aqueous extracts and leaf litter of *M. azedarach* in laboratory bioassay and in pots till crop maturity was undertaken.

Material and methods
Leaf litter chemical compounds of *M. azedarach* used in present study, were determined through Gas Chromatography-Mass Spectrometery (GC-MS). The allelopathic effect of leaf litter aqueous extract (0, 25, 50, 75, 100 per cent concentrations and leaf litter quantities (0, 5, 10, 15 and 20 g/pot) was assessed on germination traits, initial growth and biomass of green gram and black chockpea in laboratory and pot culture bioassays. To understand the allelopathic effect of leaf litter on growth, biomass and yield of test crop, separate pot experiment was conducted till crop maturity.

Results and conclusion
Gas Chromatography Mass-Spectrometry studies revealed that leaf litter of *M. azedarach* contained 18 phytochemicals. Petridish and pot culture bioassays revealed that, the aqueous leaf extract concentrations and leaf litter quantities of *M. azedarach* significantly inhibited the germination traits, initial growth and biomass of test crop, compared to control. The inhibitory effect gradually increased with increase in extract concentrations or litter leaf litter amount, over the control. Although we identified alleged allele-chemicals in *M. azedarach* through GC-MS analysis, the leaf litter did not exhibit inhibitory or stimulatory effect on final growth and biomass of both the test crops. It is attributed to faster mulch decomposition, leaching out of allelo-chemicals due to frequent irrigation done to maintain the moisture in the pots, ephemeral nature of allele-chemicals, loss from soil through volatilization, especially phenolics (Narwal *et al*. 2011).

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Potential of *Acacia Senegal* for Gum Arabic Extraction

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***Keywords*:** Biomass, Gum arabic, Bore-hole tapping, *Acacia Senegal*

Introduction

Gum Arabic is the oldest and best known tree gum exudates obtained from *Acacia senegal*, or closely related species of Acacia which occurs in a wide belt of arid & semi-arid regions of North-Western India (Dwivedi 2007). Gum Arabic is used in confectionary, dairy, bakery products, soft drinks and in pharmaceutical as a binding agent in tablet it is also used as a suspending and emulsifying agent (Robbins 1988). Every effort should therefore be made to improve the collection and post-harvest handling of gums arabic. However, the potential of this species is still untapped in most of the areas because of unproductive and interest less effort in gum tapping. Traditional method is laborious, causes more injuries to trees with very low quantity of gum, sometimes negligible. To increase gum production, an improved technique of gum tapping is devised. The improved method is not only simple, but also causes very less injuries to the tree and leads to a very large quantity of gum production as compared to traditional method.

Material and methods

Trees were selected having dbh >25cm from natural stands. Two tapping methods were tried for extracting gum (Bore hole and V shaped blazed). In borehole method, 5 cm deep hole is made with borer of 1.5-2.0 cm diameter. Each hole is made 1 meter above the ground. One hole in each tree was marked .V shaped blaze is made 1.25 cm deep and 3-4 cm wide .Each arm of the V shaped rill should be 6-7 cm in length. Two chemicals viz., Ethephon (200, 300 and 400 mg/ml, whereas, sulphuric acid conc. @ 0.8, 1.0, 1.2%) have been applied.

Results and conclusion

Bore hole method of tapping of 5 cm hole registered the highest gum yield of 93.44 g/tree. Ethephon injection at 400 mg/ml also recorded maximum arabic gum production of 126.5 g/tree in *Acacia senegal*. Chemical spray did not show any adverse effect on the health of the tree. After collection of natural gum, the products are sun dried for 3-4 days to remove moisture, particles of dust and bark. Grading is based on color and purity of gum. This technique is simple and safe ensure sustainable yield, regeneration and survival of the tapped trees. In addition plants also respond very well to the natural healing to the injured portion. Gum tapping should be done in summer months (April-May) for good economic return.

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Diversity Assessment Based on Agro-morphological Traits in Buckwheat (*Fagopyrum* spp.)

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***Keywords*:** Buckwheat, Variability, Morphological characterization

Introduction

Buckwheat is a multi-utility pseudo cereal crop grown extensively in the higher hills and is a catch crop in foot hills. It is staple diet of various ethnic communities of himayalays. The crop is well adapted to the higher land farming system due to easiness of cultivation. It is grown in marginal land and well adapted to harsh climate and natural calamities besides being pest and disease resistant. The crop has wider genetic diversity in the Himalayan region. For effective utilization of germplasm, it is important that it should be characterized and evaluated for both qualitative and quantitative agro-morphological traits, which would help in the identification of superior genetic stocks and subsequently for their utilization in breeding programme.

Material and methods

The experimental materials comprised of 144 accessions of buckwheat (122 indigenous and 22 exotic) were characterized and evaluated for various agro-morphological traits. The field experiment was conducted in 2016 Augmented Block Design (ABD) using four checks (PRB-1, Himpriya, VL-7 and Shimla B-1) at NBPGR, Shimla. Each accession was planted in 2.5 meter row length with row-to-row and plant-to-plant distance of 50 cm and 10 cm, respectively. Two border rows were also planted to avoid the border effect. Morphological data was recorded on five randomly selected plants from each accession in the field according to NBPGR minimal descriptor.

Results and conclusion

Germplasm showed variations for quantitative and qualitative traits studied. Out of 144 accessions, highest yield was recorded in IC26598. Plant height (PH, cm) was 147.49 cm (68.4-244.1 cm), no. of Infl./plant 15.42 (5-24), no. of seeds/infl. was 3.29 and ranged from 1.66 to 8. Accessions IC107973, EC99948, IC107979 IC49669, IC42416 and IC109552, IC109692, IC109311, IC107969, IC37269 were found superior for plant height and no of infl./plant, respectively (Table 1).

Table1: Promising Accessions Identified for Economic Traits

Character	Range	Mean	Promising accessions
PH	68.4 - 244.1	147.4	IC107973, EC99948, IC107979, IC49669, IC42416
No of Infl.	5 – 24	15.4	IC109552, IC109692, IC109311, IC107969, IC37269
Maturity days	81 – 148	124.5	IC26755, IC37279, IC37270, IC109233, EC125357
No of Seeds	1.66 – 8	3.2	IC26598, IC26755, IC37277, IC37304, IC109233
Seed yield	0.13 - 2.8	0.9	IC26598, IC37277, IC37304, IC109233, EC125940

Highest percent coefficient of variations was observed for the traits viz; seed yield/plant (g), length of cyme (cm) and no. of seed/infl. It is suggested that selection for better plant characters in buckwheat can be achieved through days to maturity, leaf length, leaf width, 1000 seed weight, no. of leaves, no. of internodes and no. of seeds/cyme.

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Diversity Assessment of French bean Germplasm for Agro-Morphological and Anthracnose Resistant Traits

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***Keywords*:** Diversity, Morphological traits, Anthracnose

Introduction

French bean (*Phaseolus vulgaris* L., *Rajmas*) is a multipurpose crop grown in kharif season as vegetable and pulses. It is an important source of protein for human consumption. It is predominantly self pollinated annual true diploid crop (2n=2x=22). Genetic diversity assessment is a preliminary step in future crop improvement programme. Broader genetic base will require for selection and breeding improving yield and its component traits. Hence it is important to know the extent of variability present in existing germplasm.

Material and methods

The study was conducted at ICAR-NBPGR, Shimla in 2016. 414 accessions represent both indigenous as well as exotic collection and also represent various agronomic adaptation were grown in Augmented block design (Federer, 1956). Agro-morphological data were recorded such as Days to 50% flowering, Pod length, No. of pods per plant, days to maturity, 100 seed weight and seed yield per plant. The location is hot spot for bean anthracnose caused by fungus, *Colletotrichum lindimuthianum.* The germplasm was screened for resistant against *C. lindimuthianum* both in field and controlled condition.

Results and conclusion

The variability with respect to agro-morphological traits as explained by range, mean and coefficient of variance is shown in Table 1, and also resistant reaction against race 3 of *C. lindimuthianum.* Further, some accessions were found promising such as ROD6, EC75298, EC755348 (Early type), EC271558, EC755556, WB183 (Longer pod), IC73041, EC370660, EC271529 (High yielding type) and 36 lines were found resistant against race 3 of *C. lindimuthianum.* These promising germplasm accessions can be exploited for future French bean improvement programme.

Table 1: Mean, Range and Coefficient of Variance of French bean Accessions

	Days to flowering	Pod length	Pod (no.)	80% maturity	Seed/ Pod	Seed weight	Seed yield
Mean	54.45	11.85	10.73	97.04	5.13	29.75	16.40
Max	124	25.6	27.5	159	8.5	103.4	60.82
Min	42	4.3	2.5	73	2.5	4.13	1.09
CV%	23.20	21.88	45.98	13.82	19.62	40.80	66.49

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IESHP/AFS2017/2053

Integrated Farming Systems for Income Enhancement

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***Keywords*:** IFS, Dairy, Vegetable, Horticulture, Agro-forestry

Introduction

The integrated farming system is an economically viable option to enhance the farm productivity, reduce the environmental degradation, for nutritional security and upliftment of resource poor farmers. Farming System is the favourable and adequate combination of crops, livestock, aquaculture, agro-forestry, agri-horticulture so as to ensure sustainability, profitability, balanced food availability and employment generation. In addition, farming system is the resource management strategy for sustained production and to meet diverse requirements of farm households to make the agriculture cost-effective, remunerative and above all to ensure livelihood security of the farming community.

Material and methods

A field experiment was carried out for five years (2011-12 to 2016-7) and compared with the most predominant cropping systems of Punjab viz., rice-wheat cropping system in central Punjab. The Punjab Agricultural University, Ludhiana based on long-term research, has come out with 2.5 acre model of integrated farming system for small farmers with the following components:

Component	Area (kanal)
Field crops	7.0
Fodder	4.0
Oilseeds/pulses	1.0
Fruit trees +intercropping of seasonal vegetables	4.0
Agro-forestry	1.0
Dairy (2 cows/buffaloes) shed with composting/vermicomposting unit	0.5
Fishery (high density boundary planting of fruit trees+Napier bajra)	2.0
Kitchen gardening	0.5
Bund planting of turmeric around field crops	-
Boundary plantation of *karonda* and *galgal* (optional)	-

Results and conclusion

One (1.0) ha model developed for marginal and small farmers gave gross returns of Rs 7,21,120, costs incurred of Rs. 3 20,250 and the net returns by deducting all variable costs of Rs. 4,00,870 which were about three times more than the prevailing rice- wheat cropping system. Upon recycling, IFS model generates N, P and K amounting Rs. 346, Rs. 989 and Rs. 1,628. In nut shell, it recycles fertilizer amounting Rs. 2,963 which upon recycling will improve soil health also. IFS involving crop+ dairy + kitchen gardening and other secondary components along with location specific agri-based enterprises can be included after acquiring proper training. The model IFS has been found to be highly remunerative as compared to conventional rice-wheat cropping system.

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Performance of Wheat Crop with Boundary Plantation of Poplar Based Agroforestry System in North-West India

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***Keywords*:** Boundary plantation, Productivity, Wheat

Introduction

Diversification of existing farming systems with suitable agroforestry models is need of the day (Dhillon *et al.* 2012). There is a growing interest among farming communities to integrate fast growing multipurpose trees in agroforestry systems to obtain early and good economic returns. *Populus deltoides,* is one such promising species recognized as important tree component in agroforestry system to prevent land degradation and obtain biological production on sustainable basis (Pandey, 2007). Wheat is one of the most important winter crops of poplar growing region and therefore farmers are usually reluctant to leave it. Poplar being deciduous in nature is more favourable for winter crops when shading is comparatively very lesser problem and sunlight is available to the under storey crops. Although the growing of intercrops with trees was started about a decade or so ago, no effort has been made so far to analyze the effect of different ages of poplar boundary plantation on the productivity of wheat.

Material and methods

This study was carried out in Bhiwani district in Haryana, to obtain base line data on wheat yield under different ages (3-4 year old) of poplar boundary plantation. Wheat crop was sown during November in row to row distance of 22.5 cm with 100 kg/ha seed rate in 2014 and 2015. The recommended dose of fertilizer (150 kg N, 60 kg P_2O_5 and 60 kg K_2O ha^{-1}) was applied. Full P and K and half N were applied at the time of sowing. The remaining half N through urea was top dressed at Crown Root Initiation (CRI) stage. Same procedure was followed for 2015. Wheat crop was estimated in terms of yield (grain yield) at a time of harvest in different row direction (E-W, N-S) and the grain yield was extrapolated (t/ha).

Results and conclusion

There was a significant reduction in the grain yield of wheat as intercrops in bund planted poplar as compared to control. In both of row directions, wheat showed higher grain yield (4.9 and 4.6 t/ha) in N-S compared to E-W. The yield in N-S direction was more than E-W direction due to more solar radiation and photosynthetic activity resulted in fast growth and thereby high grain yield. Maximum net return from wheat were recorded in N-S direction (Rs. 19,938 and 18,377 /ha) during 2014 and 2015, respectively. It can be concluded wheat production in both sides of E-S and N-S bund plantation suggested the reduction in wheat production with maximum in E-S row direction, however, it was lower in the N-S direction.

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IESHP/AFS2017/2055

Organic Farming and Approach to Sustainable Agroecosystems

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***Keywords*:** Soil health, Environmental quality, Systems approach, Sustainability

Introduction

India is one of the agricultural based nation, with more than 58% of the population out of 1150 million pertains to agricultural sector. Even though large number of farmers and farm labours are migrating from this sector, survey indicates that 52% of the people are still in farming contributing only 13% to GDP. This reveals clearly that there is no chance to have growth in income of farmers and farm labours. The existing farming practice is called conventional farming CF (chemical farming) using chemical fertilizers, pesticides, herbicides, mechanical implements for various processes and modern agricultural science and holds 98% of share in farming. Prior to 1965, our country followed 100% natural farming or organic farming (OF) practice without chemical fertilizers and pesticides. OF practice is less than 2 percent since government, Agricultural Universities and Research Institutes are not prepared to support OF in whole heartedly. To overcome these problems, research is needed to determine locally adapted and economically viable management practices that conserve resources and are associated with environmental, social, plant and animal health.

Material and methods

The study is conducted through systematic reviews, scholarly work of different scientist were consulted from research journals, monograph and relevant websites https://www.nature.com, https://www.omicsonline and www.mdpi.com.

Results and conclusion

Organic systems perform especially well during drought. This performance may be attributed to greater soil organic matter (SOM) in organic systems Soil samples from the organic treatments had higher soil carbon and nitrogen concentrations, higher B vitamin levels, micronutrient content and crude and total proteins. Increases in soil organic matter make agro-ecosystems more resilient against climatic variability because SOM holds water (Hudson 1994; Johnson *et al.* 2005) and stimulates biological activity to form soil aggregates which keep water in the root zone. Because of precipitation pattern, it is likely that nitrate and phosphate fertilizers applied in the spring to the conventional treatment ran off the field and low soil moisture content later in season reduced nutrient flow which contributed to drought stress. Soil healthy was also linked to the nutritive quality grains illustrating that organic systems produce healthier soil and food.

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Diversification and Intensification of Rice Based Cropping Systems for Higher Productivity, Profitability and Resource Use Efficiency under Irrigated Ecosystem of Jharkhand

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***Keywords*:** Diversification, Cropping system, Irrigation

Introduction

Agricultural diversification towards high-value crops can potentially increase farm incomes, especially in India, where demand for high-value food products has been increasing more quickly than that for staple crops. This price related economic incentives play key role in crop choice and also pave the way for next stage of agricultural revolution, where growth originates more and more from value-added production. Hence, choice of the component crops needs to be suitably maneuvered to harvest the synergism for efficient utilization of resource-base (Anderson, 2005), enhancing and stabilizing productivity, providing income and economic security for sustainable agricultural development of Indian agriculture.

Material and methods

A field experiment was undertaken at Agronomy Research farm, BAU at Kanke, Ranchi during 2013–14 and 2014–15. The experiment was laid out in RBD. Seven rice-based cropping systems *viz*. rice–wheat, rice–mustard–green gram, rice–linseed–green gram, rice–potato–green gram, rice–wheat + mustard (5:1)– green gram, rice–wheat + linseed (5:1)–green gram and rice–potato + wheat (1:1)–green gram were evaluated for production potential, nutrient uptake, resource use efficiency and economics.

Results and conclusion

Rice–potato + wheat (1:1)–green gram cropping system recorded highest rice equivalent grain yield of system (24,319 kg/ha), land use efficiency (94.25%), system productivity (66.63 kg REGY/ha/day), apparent nutrient use efficiency (46.77 kg grain/kg NPK) and employment generation efficiency (58.36%) compared to other cropping systems. Crop sequences with potato resulted in significantly higher NPK uptake. Maximum net profit (137 $\times 10^3$ Rs/ha), B:C ratio (1.19) and monetary efficiency (374.2 Rs./ha/day) were recorded in rice–potato + wheat (1:1)–green gram crop sequence. Rice-linseed-green gram gave the lowest rice equivalent grain yield of system (6543 kg/ha), system productivity (17.93 kg REGY/ha/day), N uptake (116.71 kg/ha), P (17.63 kg/ha) and K (98.39 kg/ha), nutrient use efficiency (20.45 kg grain/kg NPK), net return (24627 Rs/ha), B:C ratio (0.46) and monetary efficiency (67.47%). Crop sequences (300% cropping intensity) produced significantly more rice equivalent grain yield, land utilization efficiency and water expense efficiency than traditional rice–wheat sequence. It is inferred that rice–potato + wheat (1:1)–greengram was found to be the most productive, resource-use efficient and remunerative cropping system under irrigated conditions and can be followed in place of rice–wheat system for higher profitability.

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Performance of Rice Based Cropping Systems under Different Modes of Nutrient Management

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***Keywords*:** Cropping system, Nutrition, Rice

Introduction

Growing concerns about human health, soil quality and environmental safety, the need has been felt to rethink over the existing agricultural practices especially, the nutrient management. Organic farming largely focused on low external input such as green manuring, recycling crop residues and animal manure and inclusion of legumes in rotation (Paikaray *et al.* 2002). Organic farming is a consistent system approach based on perception of that tomorrow. There is need to diversify high value input efficient crops under organic nutrient management to be more remunerative and sustainable.

Material and methods

Long term experiment at Agronomy Research Farm, BAU, Ranchi was conducted during 2004-05 to 2012-13 in strip-plot design with horizontal strip treatments viz., organic, inorganic and integrated mode of nutrient management and four vertical strips consisted of cropping systems (CS) (Basmati rice-wheat, Basmati rice-potato, Basmati rice–lentil and Basmati rice–linseed). Crops were fertilized with recommended dose of fertilizers (RDF, kg NPK/ha) for rice (120:60:40), wheat *(*120:60:40), potato (120:60:40), linseed (120:60:40) and lentil (25:60:40) supplemented by Urea, SSP and MOP, while, in organic and integrated plots, FYM+vermicompost+karanj cake was applied .

Results and conclusion

Highest system productivity was obtained with recommended dose of chemical fertilizers, while, organic treated plots showed the lowest. After 2 years, the organic management being similar to inorganic but integrated management resulted higher production than organic and chemical farming up to 5^{th} year. From 6^{th} year onwards, organic plots surpass other management practices, given highest system productivity followed by integrated nutrient management and the lowest system productivity was recorded with chemically fertilized plots. Different mode of nutrient management failed to cause significant variation in system productivity, net return, B:C ratio and nutrient uptake of NPK during the initial conversion period. During the organic production period, organic nutrient management recorded significantly higher system productivity, net return, B:C ratio and nutrient uptake of NPK than chemically fertilized plots Rice-potato CS resulted in higher system productivity, net return and B:C ratio than other CS exploring the possibility of replacing rice-wheat with rice-potato CS under organic farming.

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IESHP/AFS2017/2058

Validation of Organic Nutrients on Growth and Yield of Elephant Foot Yam cv. Gajendra under Jharkhand condition

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***Keywords*:** Elephant Foot Yam, Organic nutrients

Introduction

Organic cultivation is a method of farming which primarily intended at cultivating the land and raising crops in such a way, as to keep the soil breathing and in good health by use of organic sources of nutrients and other biological materials. Elephant foot yam is a potential new cash and money spinning crop because its tuber contains high starch (O'hair and Asokan, 1986). The main objective of the experiment was to assess the effect of organic sources on growth, yield and economic feasibility of elephant foot yam cv. Gajendra.

Material and methods

The experiment was laid out in RBD with three replications and ten treatments at the experimental site of AICRP on tuber crops, at BAU, Ranchi during 2008-11. Ten treatments comprising of nine organic nutrient sources (vermicompost, FYM, Poultry Manure, PSB, *Azospirillum*, AMF and Ash single and in commination, T_1- T_{10}) along with a control viz. Recommended package of practice & full RDF (Both organic & inorganic) (100: 60: 80 Kg NPK/ha alongwith 10t FYM / ha) replicated thrice.

Results and conclusion

Mean pseudo stem height (79.77 cm), girth (22.54 cm), canopy spread (E-W, 103.60 cm; N-S, 100.47 cm) was maximum in treatment having full RDF and package (T_{10}). However, treatments having organic sources of nutrition viz. T_4 (vermicompost @ 5t/ha + *Azospirillum* @ 5kg/ha+AMF @ 5kg/ha+ ash @5t/ha) and T_5 (vermicompost @ 5t/ha+ *Azospirillum* @5kg/ha+PSB@5kg/ha+ash@5t/ha) were found statistically at par with T_{10} for various vegetative parameters. Likewise vegetative data, highest yield of 59.37 t/ha obtained with the treatment having full RDF and package both in terms of organic and inorganic fertilizers. However, among organic treatments, highest tuber yield of 43.91 t/ha was obtained in T_4 receiving vermicompost ($5tha^{-1}$)+ash ($5tha^{-1}$)+AMF (5kg/ha) + *Azospirillum* (5 kg/ha) [pseudo stem height of 74.11 cm, pseudo stem girth of 21.10 cm, canopy spread (N-S, 98.36 cm; E-W, 102.06 cm] closely followed by T_5 [pseudo stem height of 70.66 cm, pseudo stem girth of 19.99 cm, N-S canopy spread of 96.03 cm & E-W canopy spread of 99.12 cm] receiving vermicompost ($5tha^{-1}$) + Ash ($5tha^{-1}$) + PSB ($5kgha^{-1}$) + *Azospirillum* (5kg/ha) with 42.41 t/ha tuber yield. The treatment vermicompost @ 5t/ha + Azospirillum @ 5kg/ha+AMF @ 5kg/ha+Ash@5t/ha), Poultry manure@5t/ha+ *Azospirillum* @5kg/ha+AMF@5kg/ha+ash5t/ha and vermicompost @ 5t/ha+ *Azospirillum* @5kg/ha+PSB@5kg/ha+ash@5t/ha which fetched B:C ratio of 2.79:1, 2.69:1 and 2.69:1, respectively emerged as vital organic combination for EFY production.

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Green Fodder Production under Hydroponic Conditions to Digestibility of Nutrients and Milk Production in Lactating Animals

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***Keywords*:** Hydroponic, Fodder, Economics

Introduction

Animal husbandry is integral part of subsistence farming for small holder farmers but non availability of good quality fodder for feeding to the livestock is major hurdle for dairy industry. The major concern in developing a sustainable dairy sector is to ensure availability of green fodder throughout year and to feed the animals (Naik *et al*. 2012) for better productivity. However, the scarcity of green fodder particularly during lean period of fodder production in Punjab is affecting the productivity of animals. Hydroponic fodder production aims as providing green fodder during lean without compromising nutritive values and milk yield.

Material and methods

The study was conducted as at present, Punjab alone faces a net deficit of 31.1% green fodder which affects the health and production of animals severely. However, deficiency of green fodder is much more particularly in water logged and *Kandi* area of Punjab. The ever increasing cultivation of cereals like Rice-Wheat in state resulted in shrinking the land for fodder cultivation which is the major constraints in production of green fodder. Due to above said constraints; the hydroponic technique of fodder production is coming as alternative way for supplying fodder to animals throughout the year.

Result and conclusion

Hydroponic fodder is produced in greenhouse under controlled environment condition within short period. In Indian conditions maize is best option for hydroponic fodder due to its fast growth, good biomass production and due to easy availability of seed (Naik *et al.,* 2012). The cost of complete hydroponic green fodder production unit with daily production potential of 6 quintal fodder or Green house (25ft. x 10ft. x 10ft.) will be around 20 Lakh. Most of the commercial units recommend seed rate of 6-8 kg/m^2. The cost of seed contributes about 90% of the total cost of production of hydroponics maize fodder. In comparison to conventional green fodders, hydroponics green fodders contained more crude protein (13.6 vs 10.7; %) and less crude fibre (14.1 vs 25.9; %). Intake of hydroponics green fodder by dairy animals was up to 24 kg/animal/day. The fodder is ready to harvest just over 7 days from seed germination to fully grown plant of 25 – 30 cm height. One kg seed can provide 8-10 kg green fodder in 7 to 10 days interval. Biomass conversion ratio is as high as 7-8 times to traditional fodder grown for 60-80 days. This unit can provide efficient fodder to minimum 50 milch animals that can produce at least 250 liter milk per day.

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Integrated Farming Systems: Alternative to *Jhum* and Other Indigenous Farming Systems of North Eastern Himalayas

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***Keywords*:** Alder System, Panikheti, Zabo System

Introduction

North Eastern region comprised of seven sister states and Sikkim represents varied agro ecological niches for vast biodiversity and makes the region one of the eight mega-biodiversity regions of the world. Agriculture and its associated activities are the main source of livelihood. Some of the indigenous farming systems are prevalent in NER for achieving sustainable food production and resource conservation representing skill and ingenuity of different ethnic groups. Shifting cultivation locally known as Jhumming practiced on 16.72 lakh ha land by 4,92,000 farmer families is responsible for degradation of fertile lands.

Material and Methods

Literature on indigenous farming systems practiced by different ethnic groups of NER and jhumming has been reviewed. The deleterious effects of jhumming and alternative farming systems to replace jhumming have been discussed.

Results and conclusion

Rice-fish farming System of Apatani Plateau: It is a rice based farming system which integrates land, soil and water conservation, drainage system for irrigation of paddy-cum-fish culture practiced by ethnic tribe 'Apatani' of Arunachal Pradesh. Broad bunds are utilized for cultivation of millets.

Zabo Farming System: It is practiced in Kirkurma area in Phek district of Nagaland. It comprised of protected forest land towards the top of hill, water harvesting tanks in the middle for irrigation, cattle yards below the water tanks and paddy field in the lowest areas.

Alder Based Farming System: It is practiced in Khonoma village near Kohima (Nagaland) in which *Alnus nepalensis,* a non leguminous nitrogen fixing tree is used to build soil fertility. The ethnic tribes Angami, Chakhesang chang: Yimchanger and Konyak practice this system for cultivation of multiple crops.

Panikheti System: The system has been developed to grow paddy in terraced fields with excellent technology of water harvesting, regulated drainage and maintenance of soil fertility by organic means. The system is prevalent in Nagaland, Manipur and Sikkim. A small water pond in the centre of the field is used for rearing the common carp fingerlings and broad bunds for cultivation of other crops.

Shifting Cultivation/ Jhumming): In this system land is cleared by cutting of forest, bushes up to stump level keeping the cut material for drying and final burning to make the land ready for dibbling of seeds of rice mixed with 9-10 other crops. After 2-3 years land is abandoned resulting in degradation of more than 90lakh ha land.

Integrated Farming System: In IFS, different components like, crops, livestock, fisheries, forestry, horticulture are integrated in a complementary way. Soil and in situ water conservation is most important which provides sustainable production with economically viable and environmentally friendly technologies as an alternative to jhum practice.

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Statistical Investigation on Volume Tables for *Eucalyptus tereticornis* in Mid-Hills of Himachal Pradesh

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***Keywords*:** *Eucalyptus tereticornis*, Regression, Volume table

Introduction

Eucalyptus is most planted around the world because of its large number of species, its ability to adapting in many different sites, and the possibilities of producing wood for many different uses. Mensurational activity in forest is done to estimate quantity of wood. The volume may be calculated after the tree has been felled or when it is standing. For the volume estimation of standing trees, statistical models are more suitable. Keeping in view the present investigation was carried out to provide the handy tool for foresters/scientists to know rough estimate of wood volume without using any destructive method.

Material and methods

Data on dbh and height of high density plantation of *Eucalyptus tereticornis* raised at four sites viz. Khaltoo, Ucchagaon, Kharkog and Pandah of Nauni-Solan, Himachal Pradesh, were collected. Bartlett's chi-square test was also applied for testing the homogeneity of several independent estimates. Two volume tables were constructed *i.e.* one way volume table based on dbh and two way volume table in which dbh and height were combined together to form a new variable D^2H. These variables were subjected to regression analysis. Models obtained from regression analysis were tested for their goodness of fit. The best fitted model was used for the preparation of volume tables.

Results and conclusion

Four sites viz. Khaltoo, Ucchagaon, Kharkog and Pandah were selected. 150 trees of *Eucalyptus tereticornis* from each plantation site were selected for variability analysis. Bartlett's chi-square test showed that there is no significant difference for variances among four sites w.r.t. diameter, height and volume. The pooled data were used to estimate the volume on the basis of diameter by using various linear and non-linear functions. Quadratic model was best fit for the estimation of volume on the basis of diameter at breast height with highest R^2 value of 0.97, and the least RMSE value of 0.0010. Thus, thevolume can be estimated by using quadratic model ($V = 0.0044 - 0.2574D + 9.3784D^2$). These findings are supported by Jain *et al*. (1996) who also used diameter as an independent variable for the prediction of volume. Linear model was best fit for the estimation of volume on the basis of diameter with highest R^2 value of 0.96, and the least RMSE value of 0.0282. Thus, the volume of can be estimated by using linear model ($V=0.0003+0.7842D^2H$). Dogra and Sharma (2003) suggested combined variable (D^2H) for construction of volume tables.

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Diversification and Development of Mountain Agriculture – A Case Study of Himachal Pradesh

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***Keywords*:** Diversification index, Growth rates, Mountain diversification

Introduction
Diversification in agriculture has become necessary for developing countries since growing of basic staples such as cereals alone cannot support economic development, notwithstanding the need to ensure food security to the people. Diversification with commercial crops is now a key strategy that can increase agricultural incomes and minimize risks due to crop failures and further help in poverty alleviation, employment planning and environmental conservation. Diversification of hill agriculture has occurred both across and within crop, livestock, and forestry sectors. The present study was undertaken to probe into region wise changes in cropping pattern, levels and determinants of diversification over a period of time.

Material and methods
Two types of analysis were carried out i.e. macro-level analysis carried out at the state and regional level with the help of secondary data and micro-level analysis for studying diversification with the help of primary data collected from 400 sample farms from four agro-climatic zones of Himachal Pradesh for the agricultural year 2013-14. The districts as well as state level data for a number of agricultural development indicators for the period 1972-73 to 2009-10 were analyzed through compound annual growth rates, diversification index, and coefficient of variation and regression analysis.

Results and conclusion
The ongoing process of crop diversification becomes evident from rising proportion of gross cropped area under fruit and vegetable crops. The household survey data from four different agro- climatic zones of the state further show that even small households, owning up to one hectare of land, have devoted more than 50% of their gross cropped area. The cultivation of high value crops yields high net returns and has made a significant impact on the income and employment levels of all the categories of cultivating households in the state. The analysis further suggests that explicit consideration of mountain specificities in formulating and implementing developmental strategies was the single most important factor that set into motion the whole process of agricultural transformation through crop diversification. The focus on overcoming inaccessibility resulted in the creation of basic infrastructural facilities which linked the interior areas with the markets. The emerging challenges like rapid depletion of soil fertility, changing weather and climatic conditions, increasing erosion of comparative advantages, increasing competition from cheaper imports, inadequate infrastructural facilities and old age of crop bearing apple plantations pose a serious threat to the economic viability and ecological sustainability of the process of crop diversification in the state. The efforts/policy incentives are thus needed to maintain farmer's interest in farming and also for leaning younger generations into farming by easing various constraints and making farming are lucrative and respectable avocation for the vast majority of people of the State.

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Shifting Cultivation in North-East India-A Bane for Ecology and Boon for Organic Horticulture in Benefiting Livelihoods of Farming Community

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***Keywords*:** Diversification, Organic horticulture, Livelihood

North East is sixth mega centre of rich plant biodiversity in the world and hence is a natural home of origin of many important horticultural crops. Wild relatives of Apple, Kiwi, temperate fruits and nuts are found growing in natural forms in the forests of North East, reflecting scope of wide adaptability of various kinds of temperate horticultural crops. It is estimated that approximately 47000 sq Km is alpine and rain shadow while 33,500 sq Km is in temperate zone in North East covering areas of Tawang, Sela Pass, Dirang, Bomdila, West Kemang in Arunachal; Lacham, Laichung, Chhangu, adjoining Nathu La Pass areasof Sikkim; Upper Shillong, Mahlang, Mairang of Khasi Hills Meghalaya; Mao, Maram and Ukhrool of Manipur; Blue Hills of Mizoram; Tueusang, Upper Mokokchuing in Nagaland. In Tawang, West Kemang and Ziro districts in Arunachal Pradesh, exotic fruit diaspora has added new dimensions in production of Apple and Kiwi. The Kiwi fruits with more superb quality and size have found prominent place in the zone. The preliminary results indicate that these areas are suitable for export oriented Red Fuji and Red' Chief cultivars of apple. Low chilling Pears have found place for crop diversification in Sikkim where, Apple is not doing well due to scab disease. Strawberry has been taken up in the polyhouses in Meghalaya and as intercrop in the fields of Passion Fruit, as seen in the preliminary trials at Central Agricultural University, Andro Research Farm, Imphal, Manipur. Temperate fruits and other horticultural crops like spices and medicinal plants and nut crops hold a high promise for commercialization in the North East Region. The natural endowments offer a tremendous scope in the hilly region, should concerted efforts be made to develop temperate and sub-alpine horticulture into economic mainstay of the majority ofthe hill farmers who are still primitive jhum cultivators. The roadmap for quality plant material production with hi-tech horticulture like high density plantations and precision farming needs to be adopted, especially for Arunachal depending on the local needs of the jhum cultivators presently engaged in deforestation whereas intensive fruit cultivation in the specified areas will result into manifold increase in profits over subsistence farming as evidenced in case studies of some of the State's growing fruits in the Northeast Himalayas. The studies conducted under ICRAF project at CAU, Imphal, Manipur have given sufficient evidence to improve livelihoods of jhum land farming community using different agro-silvi-horti models.

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Economics of Various Legume-Vegetable Based Cropping in Mid Hill Region of Himachal Pradesh

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***Keywords*:** Cropping system, Economics, Legumes

Introduction

The cropping system of pulses and vegetable crops can be very helpful for meeting the requirement of vegetables in the system as pulses will fix their own nitrogen, leaving available nitrogen in the soil for the following crop. Pulses have wider adaptability can be grown on different conditions. They are helpful for checking the soil erosion and weed growth as they have more leafy growth and close spacing.

Material and methods

The study was conducted during 2013-14 at CSK HPKV, Palampur, kangra. The experimental site was situated at 32°4′ N latitude and 76°3′ E longitude at an altitude of 1224 m. The soil of the experimental site was silty clay loam in texture and acidic in reaction. The experiment was laid out in factorial RBD design with three replications. The experiment consisted of nine cropping sequences *i.e.* soybean-onion, cowpea-onion, mash-onion, soybean-garlic, cowpea-garlic, mash-garlic, soybean-potato, cowpea-potato and mash-potato.

Results and conclusion

Among all the cropping sequences, the sequences with garlic crop in *Rabi* season were the highest producer of soybean equivalent yield followed by the cropping sequences combinations with onion crop and the lowest production of soybean equivalent yield was recorded in cropping sequences followed with potato crop in the *Rabi* season. The extent of increase in soybean equivalent yield in mash-garlic cropping was 151.2 per cent over cowpea-potato cropping sequence. The gross returns and benefit: cost ratio of 4.84 was obtained in mash-garlic cropping sequence which was followed by soybean-garlic (4.72) and cowpea-garlic (4.49).

Table 1: Soybean Equivalent yield and economics of Legume based Cropping systems

Cropping sequence	Yield (q/ha)			Net returns (Rs/ha)	B:C ratio
	Kharif	*Rabi*	Eq. Yield		
Soybean-onion	14.87	61.00	45.37	110480	1.55
Cowpea-onion	10.98	56.48	39.22	85880	1.20
Mash-onion	10.88	63.40	48.02	121080	1.70
Soybean-garlic	16.20	68.37	101.66	335650	4.72
Cowpea-garlic	11.30	68.98	97.52	319100	4.49
Mash-garlic	11.00	69.80	103.75	344000	4.84
Soybean-potato	16.57	75.74	44.97	108890	1.53
Cowpea-potato	10.75	81.48	41.30	94220	1.32
Mash-potato	10.43	76.20	44.22	105880	1.49

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Nutritional Evaluation of Ban Oak Leaf Fodder

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***Keywords*:** *Quercus leucotrichophora*, Nutrition

Introduction
The ban oak, *Quercus leucotrichophora* is the most important species of genus *Quercus* found in sub tropical or temperate region, which is utilized in lean period. Feeding of oak leaves at high levels produce toxic effects which is mainly due to the presence of plant secondary compounds, *i.e.,* tannins.

Material and methods
The present investigation was conducted in the Department of Silviculture and Agroforestry, YSP University of Horticulture and Forestry, Solan (H.P). Five composite leaf samples of ban oak were collected at a regular monthly interval from October 2014 to March 2015 with the objective to study the monthly variation in the nutritive value of leaf fodder of ban oak leaves. The nutritional parameters recorded were DM, CP, EE, CF, NDF, ADF, Hemicellulose, NFE, OM, Carbohydrates, ash, acid insoluble ash, Calcium, Phosphorus, Phenols, non tannin phenols, total tannin phenols, condensed tannins and hydrolysable tannins.

Result and conclusion
The range of nutrients observed were: dry matter (57.82 to 64.36%), ether extract (4.83 to 6.32%), crude fibre (34.53 to 41.80%), neutral detergent fibre (59.83 to 65.30%), acid detergent fibre (43.61 to 49.91%), total ash (4.20 to 4.79%), acid insoluble ash (0.21 to 0.36%), Calcium (1.03 to 1.18%) and condensed tannins (30.10 to 38.70 g/kg) and they significantly increased with the maturity of leaves from October to March, whereas, crude protein (11.90 to 9.68%), hemi-cellulose (16.22 to 15.39%), nitrogen free extract (44.91 to 37.40%), organic matter (95.80 to 95.21%), total carbohydrates (79.44 to 78.30%), phosphorus (0.13 to 0.07%), total phenols (78.72 to 69.04 g/kg), non-tannin phenols (6.62 to 5.84 g/kg), total tannin phenols (72.12 to 63.21 g/kg) and hydrolysable tannins (42.02 to 24.51 g/kg) decreased with the maturity of ban oak leaves from October to March. The study concluded that there was significant monthly variation in the nutritive value of ban oak leaves with the maturity of leaves. The leaves of ban oak are nutritious and have a high potential to meet nutrient requirements of livestock.

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Agroforestry Approaches for Rehabilitation of Saline Ecologies

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***Keywords*:** Rehabilitation, saline, irrigation, *Melia*, landuse, livelihood security

Introduction
The inland salinity area is continuously expanding depending on natural underground salt, unsustainable agricultural cultivation, low quality irrigation, industrial waste and human induced salinization. It can directly link with the significant yield losses from existing land uses. The total area of saline soils in the world is 397 m hectares out of which 2.92 m hectares exist in India. The development and maintenance of agro-ecosystems with perennial plant species on saline soils is effective and economical strategy. Agroforestry approaches are alternatives to rehabilitate saline lands which will be a step ahead to increase farm income with low inputs.

Material and methods
The study was conducted at ICAR-CSSRI, Karnal, Haryana, where soil was saline with poor quality ground water. Soil EC and pH ranged from 4 to >30 dS/m and 7.21 to 9.25, respectively. The plantations of *Melia composita* was done under line geometry in 6x3 m spacing. Pearlmillet in Kharif and mustard in rabi season were sown as intercrop under two year old tree plantations. Five irrigation regimes (I) (ECiw: I_1-<1 ds/m-best available water, I_2-4 dS/m, I_3-8 dS/m, I_4-12 dS/m and I_5-control) in plantations and four in intercrops were applied in alternate mode with best available water. Observations on establishment & growth in plantations and yield parameters in intercrops were recorded and analyzed in accordance to the applied treatments. The soil salinity levels in plots compared to initial status with the final harvest of the intercrops to assess the rate of soil reclamation.

Results and conclusion
Melia plantations showed good growth under the influence of irrigation regimes and land uses. Survival and growth parameters showed invariable non-significant response to the irrigation regimes but showed higher values when irrigated with low salinity water and as sole component. The study reveals that the application of four irrigation regimes showed clear difference in terms of yield of Pearl millet and mustard. Higher yield (7.89 q/ha) of Pearl millet was obtained with ECiw<1 dS/m and low (5.42 q/ha) with ECiw 12 dS/m saline water in *kharif* season. Mustard yield was maximum (13.38q/ha) in low salinity in *rabi* season. Yield of both the crops was higher under plantations compared to open conditions. The higher inter crops yield under plantations may be ascribed to the synergistic effect of trees with crops. Soil salinity analyzed on the basis of electrical conductivity and pH values at the time of sowing and harvesting of intercrops gave invariable response to the irrigation regimes. The soil conditions improved in plots irrigated with low saline water and vice-versa there was salt build up in both the seasons. It was found that pH and EC_2 value of the plots with crops were lesser than fallow plots. The study recommends that *Melia* based agroforestry approaches would be beneficial for rehabilitation of saline landmasses for ecological and livelihood security of the region. The consumptive irrigation with low salinity water (I_1: ECiw <1 dS/m) and land use gave better outcomes in reference to the growth of tree plantations, yield of intercrops and remediation of saline soils.

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Pollination Enhancers: Hang-Around flora for Pollinators of Kashmir

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***Keywords*:** Pollinator, Flowering calendar, Floral advertisement

Introduction

The Kashmir valley is known as the 'Apple Bowl' of India. Total apple orchards area in Kashmir is 140156 hectares, out of 1,58,898 ha. Apple the significant cash crop among all the fruits grown in Kashmir shows the gametophytic self-incompatibility giving birth to the need of pollination service in the apple-orchard system of Kashmir valley. In apple-orchard system, three componential systems define the significance of main variety, Pollinizer and Pollinator. Our study qualifies the documentation of diversity, reward efficacy, flower phenology of hang-around flora, first flowering plants or hang-around plants for pollinators at the crucial time, just after the advent of death period i.e. winter (December and January).

Material and methods

The study was conducted in Kashmir Himalaya during 2012-15 to display the current floristic diversity pertaining to food source for pollinators. Ocular observations were taken by two different approaches, visit-centered approach and visitor-centered approach. Flower-pollinator interaction was photographed and documented. Plants as well as pollinators were collected for identification purposes. Floral investigation was carried out by ocular observation to document flower colour, flower shape, nectar reward access and corolla tube depth.

Results and conclusion

Pre-apple bloom flora analysis depicts 28 species of flowering plants pertaining to 22 genera and 16 families. Among flora, 15 herbs, 12 trees and 01 shrub were documented. Sixteen plants were found as exotic, whereas, 12 plants were native to the valley. Pollinator genus *Apis* visiting 27 plants were generalized followed by *Xylocopa* (12), *Pieris* (10), *Eristalis*, *Vanessa* (06), *Lasioglossum* (04), *Andrena* and *Halictus* (02). Floral calendar suggested that *Viburnum grandiflorum* was the first plant found to bloom in mid January. Pollinator diversity, health, population and reproductive success are the reflection of flora they utilize as food. Pollinators need feeding resource for survival, shifts in local pollinator community. 28 species of flowering plants pertaining to 22 genera and 16 families were serving as hang around flora for early emerged pollinators after the onset of winter in Kashmir valley. With this study the local bee keepers can check the availability of food for their bees at a particular season of the year when there is dearth period for bees and they can easily migrate to these sites than of going for long migration of 600kms outside Kashmir Himalaya.

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Value Addition in *Cymbopogon s*pp. to Enhance the Financial Flows from *Cymbopogon-Melia dubia* Based Silvi-Medicinal and Sole Cropping Systems

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***Keywords*:** Cropping pattern, Horti-sivi system

Introduction
New framing systems have to be economically sound so that peasants adopt that and replace with the existing one. Studies indicated economic viability with B:C ratio ranging from 1.01 to 4.17 from agro-forestry systems in different agro-climatic regions of the country (Thakur *et al*. 2017). Recently it has been advocated that medicinal and aromatic plants (MAPs) are more profitable and compatible under storey components in agroforestry since they are growing in wild in association with trees and shrubs under shade. This paper presents the financial flow from *Melia dubia-Cymbopogon* based silvi-medicinal and sole cropping system and effect of value addition, on account of fresh herbage and essential oil production, on economic returns.

Material and methods
The present study reported the economics of two *Cymbopogon flexuosus* and *C. martinii*, grown under 2-year old *Melia dubia* based silvi-medicinal (*M. dubia* + *Cymbopogon* spp.) and sole cropping systems under, Scenario-I on account of sale of fresh herbage of *Cymbopogon* spp. and *M. dubia* wood and II-on account of sale of essential oil and *M. dubia* wood. The effect of value addition due to fresh herbage and oil production was also analyzed.

Results and conclusion
Under scenario-I and Scenario-II, maximum total net return Rs. 88,034/ha and Rs. 5,12,402/ha were accrued from *M. dubia* (3×2 m)-*C. martini* silvi-medicinal system, benefit cost ratio (BCR) of 0.83 and 4.33, respectively. Among all land systems, maximum BRC (5.44) was from 3X3 m sole *M. dubia* plantations. Highest value addition (net returns from essential oil subtracted from net returns from fresh herb) of ` 427761/ha, was registered from *C. martinii* under *M. dubia* (3×3 m)-*C. martini* silvi-medicinal system followed by *M. dubia* (2×2 m)-*C. martini* silvi-medicinal system. The economic analysis pointed out that *M. dubia-Cympobopogon* spp. silvi-medicinal systems are more remunerative compared to either of sole *Cymbopogon* or *M. dubia*. The analysis expressed that financial flows can be enhanced if essential oil extraction is opted over fresh herbage production.

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Seed and Seedling Database for Large Scale Production of Seedlings in *Sterculia Urens* Roxb.

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***Keywords*:** Seed traits, Seedling establishment, *Sterculia urens*

Introduction

Sterculia urens Roxb. (*Gum Karaya,* Family: Malvaceae) is a native of dry deciduous forests of dry rocky hill lands having tropical climate. Gum and resin (phlobatannin) is main commercial part of this species. Purified Gum Karaya is used in foodstuffs as emulsifiers, stabilizers and thickeners. Annual world production of Gum Karaya is estimated to be 5500 tons and India's share is around 3000-3500 tons. The present potential of this gum is estimated around 3000 tons per annum. Source of raw materials is mainly from natural forests. In view of present demand and conservation of species in its natural habitat, there is a need to establish large scale conventional plantation in the country. In the present study, preliminary database on seed traits, requirement for seed germination and seedling vigour have been generated for large scale seedling production in *S. urens.*

Material and methods

The present study was undertaken at ACHF, NAU, Navsari during 2015-16. Seed materials were collected from *Sterculia urens* population situated at Vansda National Park, Vansda, Gujarat (Bhuva, 2016). Sufficient quantities of fruits were collected from identified population during April. Fruit and seed traits were recorded by drawing samples from collected seedlots. Germination trial was conducted in the germination tray containing sterile sand. Total 14 replications with 75 seeds each were used. Germination count was made upto 21 days from sowing date and seedlings were transplanted to polybags of size 6x8 cm filled with potting media (Black Soil: Sand and FYM @ 2:1:1). Various growth and dry biomass was recorded among seedling raised in the study.

Results and conclusion

Number of fruits varied from 1-9 fruits per inflorescence. The overall fruit length, thickness and weight were 36.9 mm, 17.7 mm and 2.05 g, respectively. The number of seeds per fruit was 4.12 and it ranged from 1.0 to 6.0. The weight of smallest and largest seed was 0.02 and 0.4 g and the overall 100 seed weight was 24 g. Single seed length, thickness and weight were 10.0 mm, 6.29 mm and 0.24 g, respectively. Seed germination ranged from 40 to 100 per cent with mean of 81.43 per cent. At the age of six months, seedlings attained the height of 35.7 cm (23 to 48 cm), basal diameter of 8.2 mm (3 to 18 mm), root length of 27.5 cm (9 to 61 cm), leaf area of 179.86 cm^2 (75 to 318 cm^2) and dry weight of 20.32 g (4 to 80 g). The height and diameter increment within six months was about 21 cm and 5 mm, respectively in *Sterculia urens.* The overall result showed that the germination in *Sterculia urens* was early, quicker and better compared to other deciduous forest species. Based on these observations, it is estimated that 1 kg weight of seed lot contains about 4000 seeds. Total quantity of seeds required for raising 1 lakh seedlings is 30.5 kg (80% germination and 2% seedling mortality).

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Germination and Seedling Growth Dynamics in *Calophyllum inophyllum*: Implication for Large Scale Seedling Production

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***Keywords*:** *Calophyllum inophyllum,* Germination, Seedling growth

Introduction

Calophyllum inophyllum L. is a littoral tree of the tropics, known for multiple uses namely, fuel wood, seed oil and has medicinal value. Among them, seed oil economically supplements livelihood of local communities living along the coasts, where seed oil is used as preservative for boats and burning home lamp. Moreover, this seed oil can be used in the conventional diesel engines (without any alterations) in its pure form or as a blend with mineral oil. Conventional plantation has been planned to supply raw materials for biodiesel extraction. The present study was carried out to provide some life-history of seed and germination traits with seedling growth dynamics in *Calophyllum inophyllum* under nursery condition.

Material and Method

Fruits were collected from different trees of *Calophyllum inophyllum* located in Alappuzha, Kerala (9^0 24' 07.00"N and 76^0 26' 44.04"E). Matured fruits were collected from different trees. Fruit and seed traits were recorded. Hard seed-coats were break opened and kernels were used for germination trial. Kernels were sown in polythene bags filled with potting mixture of black soil, sand, and FYM in the ratio 2:1:½. Daily germination count was made up to 60 days and germination per cent and its associated parameters were calculated using standard formula. Various seedling growth and biomass parameters were recorded.

Results and conclusion

Calophyllum inophyllum generally flowers during Apr-Jun and set fruits during May to Aug. However, in Kerala, fruit maturation occurred during Sept.-Oct. Healthy fruits collected were used for fruit and seed observation. The overall fruit length, fruit width and fruit weight of collected seed-lot was 34.61 mm, 30.52 mm and 13.06 g, respectively. For seed observation, fruits were soaked in water for 48 hrs and later depulped. These depulped seeds were air dried for 24 hrs under room temperature. Mean seed length was 26.02 mm with 23.24 mm width and 5.46 g weight. Seed volume, seed density, shell weight and kernel weight was 7.28 cm^3, 0.75 g/cc, 2.54 g and 2.59 g, respectively. Germination result showed that seed germination started in between 14 to 16 days after sowing and completed within a period of 38 to 57 days. Overall germination was 93.2 per cent recorded in collected seed lot. Mean germination time was 51.89 with germination rate index of 3.90. Initial shoot height, collar diameter and number of leaves were 9.6 cm, 3.3 mm and 3.3, respectively; whereas after 6 months, these parameters increased to 15.7 cm, 4.4 mm and 8.0, respectively. Periodic change in the seedling growth is depicted in Fig. 1. Root length, leaf area per plant, dry biomass and seedling vigour index were 17.84 cm, 6.69 cm^2, 1.54 g and 3142.7, respectively. It is concluded that *Calophyllum inophyllum* seedlings can easily be germinated using kernels (decoated seeds).

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Biodiversity Conservation Potential of Different Agroforestry Systems Vis-À-Vis Agriculture and Forest Land Uses

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Keywords: Shannon-Weiner Index (H'), Simpson diversity Index (D)

Introduction

Agroforestry systems provide a number of ecosystem services; however, till now evidence in literature supporting these perceived benefits has been scarce. Different land use systems of mid hill and sub-humid land-scape of Himachal Pradesh are playing an important role in biodiversity conservation. Hitherto, no attempt has been made to quantify the role of different agroforestry land use systems of mid hill and sub-humid zone-II in biodiversity conservation vis-à-vis agriculture and forest. Therefore, the present study was undertaken to access the plant biodiversity of different land use systems of mid hill and sub-humid zone-II of Himachal Pradesh.

Material and methods

The present study was carried out in three districts falling in mid hill and sub-humid zone-II of Himachal Pradesh at two altitudinal range, A_1 (914-1200 m amsl) and A_2 (1201-1500 m amsl), each. Land use systems investigated were, agri-silviculture, agri-hort., silvi-pastural, agri-horti-silviculture, horti-culuture, agriculture, grassland and forest. For collecting data on tree main sample plot of 50×20 m size were laid down in each land use systems. In each sample plot, two sub-plots of size 10×10 m were marked to study shrubs and 3 quadrates, each of size 1×1 m were taken for study of herbage and vegetation.

Results and conclusion

Maximum value (3.65) of Shannon Weiner Index (H') was displayed by forest land use system, which was closely followed by horticulture (3.27), grassland (3.24), agri-silviculture (3.15), silvi-pastural (2.78), agri-horti-silviculture (2.51), agri-horticulture (2.41) and agriculture (1.47) system, respectively in descending order. Higher Shannon Weiner Index (H') of forest ecosystem can be owed species composition and complexity in food webs and efficiency in conservation of site resources. Simpson diversity Index of vegetation varied from 0.31 to 0.71, which is lower than the values in home gardens of Kerala (0.44-0.86). Table 1 also showed that Shannon Weiner Index (H') for vegetation (Trees, shrubs and herbs) of different land use systems declined with increasing altitudinal range from A_1 to A_2. It can be owed to the fact that elevation gradients create varied climates along with resultant soil differentiation that promote the diversification of plant species. From this present study, it may be concluded that forest and silvi-pastural are the best land use system for biodiversity conservation point of view, but among the agroforestry systems, agri-horticulture land use system showed best result and grassland displayed least biodiversity. Along the altitudinal range, biodiversity showed increasing trend with increasing altitude.

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Evaluation of Seabuckthorn Population for Oil Traits under Different Major Gene Pool Areas of Spiti Valley

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***Keywords*:** Seabuckthorn, *Hippophae rhamnoides,* Seed Oil, Deoiled Cake, Gene Pool

Introduction
Seabuckthorn (Genus *Hippophae*) is a berry-bearing, hardy bush of the family Elaeagnaceae, naturally distributed in Asia and Europe and also introduced in North and South America. It includes 4 species (*H. rhamnoides, H. salicifolia, H. tibetana* and *H. neurocarpa*) and 9 sub-species of *H. rhamnoides* are reported so far from the world, of which the most important species is *H. rhamnoides* (Linn). *Hippophae*, commonly called Seabuckthorn and locally known as Chharma, Sutz or Sarla, occupies an important position as a valuable bio resources in the cold desert of Himachal Pradesh, Jammu and Kashmir, Uttarakhand, Sikkim and Arunachal Pradesh. It possesses outstanding qualities such as nitrogen fixing (60-180 kg/ha/yr), as soil binder, reduce top soil erosion by 30 per cent and retains soil moisture up to 80 per cent. Its oil has significant anti-atherogenic and cardioprotective activity. Seabuckthorn extracts proved also anti-radiation lesion properties. Oils from both fruits and leaves are also used in cosmetic industries. During early winter (September-November) farmers in Lahaul-Spiti and Kinnaur districts of Himachal Pradesh and Ladakh region of J&K feed their livestock on the leaves of this plant.

Material and methods
Spiti Valley of Himachal Pradesh was surveyed for *H. rhamnoides* plant species. Nine major gene pool areas and three growing conditions were finally selected for further study. Nine major gene pool areas from Spiti Valley were Rangreek, Kaza, Sheigo, Schilling, Poh, Tabo, Lari, Mane and Hurling while three growing conditions among each major gene pool area were Pure Stand, Mixed Stand and Crop Land. Five plants were selected for morphogenetic variation.

Results and conclusion
Maximum plant height (124.40 cm), 100 fruits weight (18.54 g), 100 seed weight (2.99 g), percent seed oil (5.23%), acid value (4.77 mg KOH/g), saponification value (231.51 mg KOH/g), crude protein (31.51%), starch (53.99%) and total sugars (59.99 %) were recorded for GPA-3 (Sheigo) major gene pool area, while minimum plant height (97.60 cm), 100 fruits weight (11.36 g), 100 seed weight (1.61 g), percent seed oil (4.25%), acid value (3.96 mg KOH/g), saponification value (184.79 mg KOH/g) of oil samples, crude protein (28.34%), starch content (51.3%) and total sugar content (57.03%) of deoiled cake recorded for GPA-9 (Hurling) major gene pool area. All traits showed significant variations among different major gene pool areas and within different growing conditions except physical traits (refractive index and specific gravity) of oil. GPA-3 (Sheigo) major gene pool area was the best for further utilization. Over all, GC-3 (crop land) was found superior for all traits among different growing conditions among different major gene pool areas. Seabuckthorn showed best performance in crop land so it can be consider as a good agroforestry crop. Large variability exists in the population of *H. rhamnoides* growing under different growing conditions among different major gene pool areas in Spiti valley.

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Evaluation of the Effect of Urea Molasses Mineral Block Supplementation on Milk Production in Indigenous Cattle

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***Keywords*:** Milk, Urea Molasses, Livelihood

Introduction
This study was designed to view the socio-economic status of the villagers and the persistent shortage of feeds and fodders, in terms of both quantity and quality, which is a major problem in rainfed irrigation. The unpredictable pattern of rainfall and recurring droughts also adversely affect agronomy and livestock. It is here the dairy farming plays a crucial role in supporting the farm economy acting as a cushion during the environmental vagaries. Low milk yield, poor reproductive performance and low growth rate characterized the cattle population in the village.

Material and methods
The study was designed to evaluate the effect of UMMB (Urea Molasses Mineral Block) supplementation on the milk yield of the animals. It was conducted in the NICRA village (Said-Sohal) over a period of 90 days. 60 lactating indigenous cattle were selected based upon their stage of lactation. The cattle were divided into 4 clusters of 15 animals each. UMMB were fed to each animal daily in the morning @ 320-380 g along with their daily ration. Average milk yield data was recorded weekly by visiting at the farmers' field.

Results and conclusion
Milk production of cows was 8.58±0.22 litre/day pre-treatment and it reached up to 9.68±0.34 litre/d post treatment. It clearly indicated that average per day milk yield was increased by 1.10 litre (11.36%). Average consumption of urea molasses mineral block per cattle was 350 g/ d and net profit from sale of extra milk was Rs. 28/d. Supplementation with the UMMB further lead to the improvement in the body weight gain and improved the reproductive potential of the animals. It further led to improvement in the weight gain and reproductive performance of the animals over the period of time. The increment in the average milk production led to the economic upliftment of the farmers.

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Development of Allometric Equations of Estimation of Above Ground Biomass of *Eucalyptus tereticornis* in Punjab

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Keywords: Allometric equation, Diameter, Sub-tropics

Introduction

There is a significant need globally to develop equations that estimate forest biomass and carbon for national measuring, reporting, and verification systems. The literature on allometric equations developed to estimate biomass for tropical forests is sizable. However, there is limited literature and allometric equations for sub-tropical forests of *Eucalyptus tereticornis* despite covering extensive areas in tropical Southeast Asia. To date, there are only a few general pantropical equations, but due to the range of diverse forest types with different characteristics in this region, there is a need to develop more specific biomass equations.

Material and methods

The study was undertaken at Punjab Agricultural University, Ludhiana during 2014-15 to develop allometric equations for the estimation of above ground biomass of *Eucalyptus tereticornis* with a varied range of diameter especially diameter above 50 cm under Punjab conditions. DBH and height (H) were measured on sample trees prior to felling.

Results and conclusion

Forty-six (46) *Eucalyptus tereticornis* trees with diameter range of 10-72 cm were harvested and different tree component biomass was estimated. Different responsive models were used to find the best fit to predict the above ground biomass from different growth parameters. Results indicated that DBH and DBH^2 based polynomial functions were most appropriate for predicting total biomass in *Eucalyptus tereticornis*. Using H, as an independent factor for predicting total green and dry biomass of tree, the linear equation was found best fit with adjusted R^2 value of 0.72 and 0.74 respectively. It can be concluded that DBH and H can be used as an independent factor for a non destructive method for determining above ground biomass of standing growing stock of *Eucalyptus tereticornis*.

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Nitrogen Fertilization Response on Willow Nursery Stock

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Keywords: *Salix* spp., N fertilization, Planting stock vigour

Introduction

Willows (*Salix* spp.) have exceptional potential for biomass production because of their rapid growth rates, coppicing ability, and large genetic variability in comparison with most other forest tree genera. Substantial efforts have been made in developed world to pursue research for improved short rotation forestry plantation with willow. The use of inorganic N fertilizers have been used extensively for several decades, in attempts to promote the successful establishment and growth of planted willow but, the reported growth response of numerous willow varieties to added fertilizer N when grown under field conditions has been inconsistent, thereby precluding definitive relationships between applied fertilizer N rates and subsequent willow biomass yields from being developed and applied universally. Nursery stock of good quality is essentially required, so that it can be provided to farmers of Punjab for better willow timber production. In easy to root species, any type of cutting can be raised. Therefore, a study was conducted to check the impact of nitrogen doses on planting stock vigour and relation with nutrient content.

Material and methods

The study was conducted in Randomized Block Design (Factorial) with two cutting sizes (0.5-1.50cm and 1.51-2.50 cm) and five nitrogen treatments (0 kg, 50 kg, 100 kg, 150 kg and 200 kg N/ha) in three replications. The relationship was worked out among important growth and biomass parameters, and the nutrient status of the cuttings.

Results and conclusion

Linear relationship was obtained when **s**tock parameters and nutrient contents with increasing nitrogen level. Cuttings of higher grade had comparatively better growth than small size cuttings and these require more nutrition for their vigour index. Simple correlation analysis was assessed between various important growth/biomass parameters (plant height, collar diameter and total stock biomass) with nitrogen, phosphorus and potassium content in *Salix*. The high and positive correlation suggested that with increase in level of nitrogen, the growth of the stock increased substantially in *Salix*. The Phosphorus uptake was negatively correlated with increasing level of nitrogen may be due to antagonistic effect. This study indicates that appreciable changes in stock quality can be made thigh nursery cultural practices by adopting appropriate cutting size and fertilizer application. *Salix* species is an important introduction in Punjab for diversified uses but required concerted research efforts for desired changes in stock quality.

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Impact Assessment of Fruit Based Farming Systems on Crop Production, Biological Diversity and Soil Fertility Indicators

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***Keywords*:** Farming System, Microbial Biomass, Soil Indicators

Introduction

Sustainable development in agriculture must include integrated farming system with efficient soil, water crop and pest management practices, which are environment friendly and cost effective. Concerns regarding environmental safety and the sustainability of land productivity are increasing among scientists and environmentalists. It is doubted whether the strategy adopted during the green revolution era could be continued any longer under the challenging conditions of this new century. Already, a section of people in the world is questioning the propriety of conventional agriculture, and a few of them are advocating alternative practices that are perceived to lay foundation for sustained production. On these lines, systems like alternative farm agriculture, natural farming, organic farming etc. were proposed at various conventions. However, the scientists harping on the success of green revolution continue to doubt whether such a system can really be functional, productive and meet the growing demands for agricultural products in this e-age. These emphasize the need to develop new strategy of living with the nature and nurturing it for sustainable production.

Material and methods

The study was conducted in farm sequencing system at the 'Integrated Horticulture Model Farm' of YSPUHF Solan, Himachal Pradesh, India. The research monitored the agro-ecosystem of different farm management practices (Conventional and Sustainable) for cropping behavior, soil productivity and the promotion of soil biodiversity structure. The potential of two different fruit based sequencing systems including i) Pomegranate based cereal-pulses, ii) walnut based peach/ nectarines-vegetables-ornamentals over monoculture under rainfed ecosystem has been demonstrated. Individual character datasets were subjected to ANOVA, and were differentiated by DMRT at the 0.05 level of probability.

Results and conclusion

Our study revealed that Pomegranate-Urd-Pea farming system is a more sustainable and economic viable alternative to pomegranate monoculture resulting in increased soil fertility indicators. When the residues were retained, the zero tillage showed the higher microbial biomass, micro-flora activity and improved physical, chemical and biological indicators. Similarly, Walnut-Nectarines-Sunhemp-Chrysanthemum-Tomato-Marigold cropping system influenced cropping behavior, residue management to build and improve the soil fertility in terms of physico-chemical and microbiological diversity at both surface and subsurface soil. The culture and management system have produced some rapid changes in soil properties such as microbial biomass carbon and nitrogen content that are sensitive indicators for crop management regimens and indeed to be monitored on longer term to quantify cumulative effects of various cropping interventions eventually to make recommendations for wider dissemination and for each cropping system in other to enhance soil fertility and sustain food production in the rural farming communities in mid hill agro-climatic zone conditions of north-west Himalayas.

Theme 3

Natural Resource Management

IESHP/AFS2017/3001

Monitoring and Management of Fruit Borer Infestation in Tomato with Pheromone Trap

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Keywords: Pheromone traps, Management modules, Fruit borer

Introduction

Tomato fruit borer, *Helicoverpa armigera* Hubner is causing extensive damage to the fruits of tomato to an extent of 50-70 per cent economic losses. Generally, the farmers are applying 7-9 sprays of hazardous insecticides to its control (Sharma and Bala 2011). The indiscriminate use of insecticides has created several problems, deleterious effects on parasites and predators, residual hazards and development of resistance. The use of pheromones is gaining importance for monitoring, mass trapping and mating disruption of the key insect pests. The pheromone based monitoring system against *H. armigera* population build up to facilitate the proper timing of insecticidal spray for its management warrants immediate attention. The present studies were undertaken for monitoring *H. armigera* and to initiate control measures based on pheromone trap data.

Material and methods

The present study was conducted at farmer's fields in Kullu, Naggar and Banjar during kharif 2013 and 2014. Seedlings of 'Himsona' cultivar of tomato were transplanted on an area of 400 m^2. Pheromone traps (funnel traps with Helilure) were installed @ 12/ha in the field after transplanting. Foliar spray was initiated with the 1st spray of lambda cyhalothrin 5EC @ 0.8ml/l after 10 days of appearance of the moths (35 days of transplanting) followed by 2nd spray with quinalphos (Ekalux @5 EC) @ 2 ml/l after 15 days of the first spray followed by 3rd spray with malathion 50EC @ 2ml/l after 15 days of the second spray.

Results and conclusion

First moth catch was obtained during 16th standard week (3rd week of April) from Kullu (Bajaura and Kalheli), 18th standard week (1st week of May) from Naggar (Malahaar and Kais) and 20th and 21st standard week (3rd and 4th week of May) from Banjar block (Targali and Mamjan) at 30-40 days. The peak moth catch during 21st to 23rd standard weeks coincided with well distributed rains during this period. A total number of 379, 323 and 236 male moths of *H. armigera* were collected from Kullu, Naggar and Banjar, respectively. A gradual increase in the larval population in demonstration plots was observed from the 17th standard week (0.33 larvae/10 plants); attained the peak in the 23rd standard week (6.0 larvae/10 plants); and declined thereafter as the crop matured. Yield ranged from 522.3-679 q/ha in demonstration plots and 402.1-495.2 q/ha in farmers practice with an average yield of 568.3 q/ha in the demonstration plots and 441.76 q/ha in the farmers practice plots. The yield loss ranged between 6.77 and 9.62% in the demonstration plots, while, in the farmers practice it was 21.4-29.3 per cent.

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Effect of Dates of Sowing on Thrips and Bollworms on Cotton

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Keywords: Dates of sowing, Thrips, Spotted bollworms, Pink bollworms

Introduction

The study was conducted in department of Entomology of CCS HAU, Hisar during 2016. The main aim of the study was to reduce the use of pesticides, these pesticides increases pest resurgence, environmental pollution and toxic residue in food. Efforts were being made to encourage those pest management practices which are ecofriendly. The manipulation of planting time helps to minimize pest damage by producing asynchrony between host plant and the pest. Due to staggered sowing, pests are able to complete 1-2 additional generations in the season. In order to avoid these generation, sowing dates of the crop can be adjusted.

Material and methods

The cotton variety, HD-432 (*desi*) was taken for the study. First date of sowing was on 27 April, second on 17 May and third on 2 June during 2016. The population of thrips adults was recorded from three leaves, each one from top, middle and bottom canopies on five randomly selected plants per plot and observations were recorded at 10 days interval starting from 10 days after sowing. To record incidence of spotted bollworms in fruiting bodies of cotton, 50 fruiting bodies (intact as well as damaged) per plot in each treatment were examined randomly for bollworms damage at 20 days interval starting from 45 DAS. To record pink bollworm incidence 50 fruiting bodies per plot were plucked at 90, 110 and 140 days after sowing.

Results and conclusion

Maximum attack of thrips was recorded in late sown (2.79 three leaves per plant) followed by normal and early sown (2.52 and 2.21 three leaves per plant). Early sowing was best to minimize the effects of thrips. Maximum average number (3.02) was found on bottom followed by medium (2.42) and top (2.08). Early sown crop had low infestation of thrips as compared to late sown (Giri *et al*. 1993). The damaged caused by spotted bollworm was maximum on late sown compared to normal and early sowing (Table 1). Normal sowing was not differ significantly from early and late sowing, while, late sowing was differ significantly from early sowing.

Table 1: Effect of Dates of Sowing on Spotted Bollworm and Pink Bollworm in Fruiting Body and Opened Bolls in Cotton

	Spotted Bollworm Damage (%)	Pink Bollworm Damage (%)
Early	12.47	11.68
Normal	15.46	12.81
Late	19.92	14.36
$CD_{0.05}$	5.21	N/A

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Earthworms: An Indicator of Soil Health

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Keywords: Organic agriculture, Soil productivity

Introduction

Nowadays farmers use inorganic sources of nutrients more frequently as compared to organic ones. Tough this indiscriminate use of chemicals (like fertilisers, pesticides and herbicides) has increased the crop yield but has exerted a long term can bring about unintentional harm to soil health which has deteriorated soil fertility and productivity. Besides, the toxic chemical residues entering the farm growth food also raise a serious health concern among human being. Organic production of food material has turned up as a great solution of this problem which not only ensures chemical free food to public but also brings sustainability in soil health. Earthworms are a major component of soil fauna communities and comprise a large proportion of macro fauna biomass commonly found in the tilled soils, grasslands and other agro ecosystem. Its density in the soil is considered to be a good indicator of a healthy soil.

Material and methods

The study is conducted through systematic review. Scholarly work of different scientists was consulted from research journal, monograph and relevant website (www.biologydiscussion.com, http://extension.psu.edu).

Results and conclusion

The role of earthworms on soil biological activities and fertility level differ in ecological categories. They have tube like structure who vigorously work to turn the earth from lowest strata to earth's top. Worms form deep tunnel in the soil, which is helpful in mixing the subsoil with top soil as well as facilitate infiltration of water into subsurface, reduce runoff, help in harvesting rainwater. These tunnels last long even after the earthworms are dead. The main activity of this organism is to consume large quantities of soil and fresh or partially decomposed organic matter from the soil surface and deposit it as faecal matter on surface or in the lower soil horizons thereby helping in uniform distribution of nutrients in soil. *Lumubricus terrestris* is an important one of known for decomposition of organic matter and minerals cycling. Moreover, when mixed with organic farm and home waste matter earthworms act as a good waste manager by converting them into compost, well known as vermin compost. So preservation of such beneficial soil organism should be farmer's first priority to ensure a healthy soil and food

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Role of Grafting Techniques in Vegetable Production

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Keywords: Climate change, Grafting, Vegetable production

Introduction

Nowadays, limited availability of arable land, climate change stress and high demand for vegetable around worlds, need some efficient and promising techniques that counteract both biotic and abiotic stress along with enhancing the productivity of the crops. In this way, Grafting technology considered as an alternative tool to conventional breeding methodology targeted at increasing environmental-stress tolerance of fruit vegetables (*viz*. tomato, brinjal, watermelon, melon and cucumber). This technique is already used for more than 50 years in many countries. This review is an effort to summaries all the current works and possible scope of this wonderful technique in Indian context.

Material and methods

The study is conducted through systematic review. Scholarly work of different scientists was consulted from research journal, monograph and relevant website (www.icar.org.in, www.iivr.org.in, www.bausabour.ac.in).

Results and conclusion

Scion of Solanaceous plants (tomato, egg plant and pepper) and cucurbits (cucumber, watermelon and melons) crops can readily be grafted onto different inter-specific rootstocks provides a new and quickly implemented option to incorporate important characters such as disease resistance and rootstock vigor. Grafting also has other advantages, such as reducing adverse effect of soil chemical and physical conditions including soil salinity, soil pH (alkalinity) stress, nutrient deficiency and toxicity of heavy metals and soil borne pathogens. One of the primary benefits of grafting is used to make water logging tolerance in early stage establishment of tomato crop, mostly arising during South-West monsoon (July-September) in North Indian plains. Scientist reported that tomatoes can be successfully grafted over water logging tolerant rootstocks brinjal and save the tomato crops from water logging stress up to 7 days. In contrast, non-grafted or self-grafted plants could not survive for more than 2 days under such situation. In addition, bottle gourds and other cucurbita species has successfully used as rootstock to manage soil-borne diseases particularly Fusarium wilt of watermelon. Scientist have also been reported that tomatoes could be successfully grafted over water logging tolerant rootstocks brinjal and save the tomato crops from water logging stress up to 7 days in early growth stage. In contrast, non-grafted or self-grafted plants could not survive for more than 2 days under such situation. Thus, Vegetable grafting technology has immense possibilities and scope in India by eliminating the necessity for a prolonged breeding programme of high value vegetable crops.

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Effect of Seed Rate, Row Spacing and Nitrogen Levels on Growth, Yields and Economics of Malt Barley

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Keywords: Two-rowed barley, Seed rate, Nitrogen, Yields, Economics

Introduction

Barley is an important cereal grain and considered fourth largest cereal crop in the world (Pal *et al*., 2012). Seed rate, row spacing and nitrogen levels are the most important factors for realizing potential yield of barley. Sowing of seeds in optimum quantity influences economic grain yield of barley. Growth, yield attributes and yield of malt barley are affected by row spacing and nitrogen levels. The work undertaken on these aspects in two rowed barley is very meagre. Therefore keeping this in view a study was conducted on effect of seed rate, row spacing and nitrogen levels on growth and yields of malt barley.

Material and methods

A field experiment was conducted during *rabi* 2014-15 at CCS HAU, Hisar (India). The experiment consisted of two seed rates (87.5 and 100 kg/ha) and three row spacings (22, 20 and 18 cm) in main plots and four nitrogen levels (60, 75, 90 and 105 kg N/ha) in sub plots. The 24 treatment combinations were tested in split plot design with three replications. The sowing of two rowed malt barley variety BH-885 was done on 28 November 2014 by pora method at 5-6 cm depth using different seed rate and row spacing as per treatments. Recommended dose of P and K and ½ dose of N as per treatments were applied at the time of sowing and remaining half dose of nitrogen as per treatments was top dressed at 1st irrigation.

Results and conclusion

Plant height, dry matter accumulation, leaf area index, yield attributes (number of effective tillers m^{-2}, spike length, number of grains per spike), yields (grain and straw yield), harvest index and net returns were significantly higher with seed rate of 100 kg/ha as compared to 87.5 kg/ha. Most of the growth parameters increased consistently with the decrease in each level of row spacing from 22 cm to 18 cm. Spike length, test weight and harvest index were not significantly influenced by various row spacing. The maximum number of grains per spike, grain and straw yields and net returns was recorded with the row spacing of 18 cm which was at par to 20 cm (except net returns) but significantly higher than 22 cm row spacing. The maximum plant height was recorded with 105 kg N/ha at maturity followed by nitrogen level 90 and 75 kg N/ha and minimum with 60 kg N/ha. Dry matter accumulation and LAI increased significantly with the increase in nitrogen level upto 90 kg N/ha as compared to 60 and 75 kg N/ha. However further increase in nitrogen level to 105 kg N/ha did not significantly improve values of these parameters as compared to 90 kg N/ha but was significantly superior to 75 and 60 kg N/ha.

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Effect of Foliar Application of Plant Growth Regulators and Nutrients on Productivity and Quality Traits of Pomegranate

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Keywords: Fruit quality, Growth regulators, Nutrients, Yield

Introduction

Pomegranate (*Punica granatum* L.) is one of the oldest known edible fruits and is capable of growing in different agro-climatic conditions ranging from the tropical to sub-tropical (Jalikop 2007). Recently its cultivation has been taken up on a large scale in Kullu valley, where the summer season is long and dry and irrigation facilities are available. The importance of synthetic plant growth regulators and nutrients in achieving higher yield and better quality of horticultural crop has been well recognized in recent time. However, practically, there has been very little work done on use of plant growth regulators and nutrients in pomegranate crop. The present study was therefore carried out to find the effects of plant growth regulators and nutrients on the production and quality parameters of pomegranate.

Material and methods

The experiment was conducted at village Hurla of Kullu district during 2011 and 2012 on six years old pomegranate cv. Kandhari Kabuli, spaced at 12 ft ×10 ft. The experiment was laid out in a RBD with four replicates. The treatments comprised T_1-Spray of GA_3 (10 ppm), T_2-IBA (10 ppm), T_3-Boric acid (0.1%) + KNO_3 (1.0%), T_4-Boric acid (0.1%) + KNO_3 (1%) + $MgSo_4$ (1%), T_5-Multiplex 2.5 ml/litre of water and T_6-Control (Water foliar application). These plant growth regulators and nutrients were sprayed after full bloom. Rest of the cultivation practices were as per the university package of practice. For recording data on fruit set, yield and quality parameters the standard procedure was followed.

Results and conclusion

Highest fruit set (26.40%) and yield (20.82 t/ha) were observed in T_4 followed by T_2. This may be due to better supply of water, nutrients and other compounds necessary for their proper growth and development. These results are in line with Anawal *et al.* (2015) in pomegranate cv. Bhagwa. Application of IBA 10 ppm resulted in better quality traits in terms of fruit weight, diameter, TSS, acidity and total sugar etc. followed by Boric acid 0.1% + KNO_3 1.0% + $MgSo_4$ 1.0% but superior to the rest of the treatments applied. It can be concluded that application of Boric acid 0.1% + KNO_3 1.0% + $MgSo_4$ 1.0% was effective to increase fruit set, yield and quality traits.

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Effect of Pro-Hexadione-Ca 10% on Shoot Growth, Fruiting and Fruit Quality of Apple

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Keywords: Prohexadione Calcium, apple growth, fruiting and quality

Introduction

Proper tree growth management is a major concern in commercial pome fruit production. Excessive vegetative growth if not appropriately controlled could influence many aspects of fruit production including flower bud formation, fruit set, fruit quality, physiological disorders and pest management. There are various method of growth control like summer pruning, dormant pruning and use of dwarfing rootstock. Different cultivar may also show significant differences in shoot vigour. However, any of these methods is cost intensive and/or bear a high risk of failure. Ragalis Prophexadione- Ca is a plant bio-regulator that effectively regulates the shoot extension growth of apple and other fruit crops. Prophexadione- Calcium offers a unique possibility to create an improved balance between shoot growth and fruit production by diminishing the vigour of shoots, more of the tree assimilates may be shifted to fruit production. To achieve maximum growth control, it must be applied as soon as sufficient foliage has emerged to allow for foliar penetration.

Material and methods

The trial was conducted at experimental farm of Regional Horticulture Research and Training Station, Shimla situated at 2286 amsl on apple cv. Starking Delicious during the year 2011-2012. The experiment was laid out in a randomized block design, with seven treatments which were replicated three times. Prohexadione Calcium was applied at 3-5 new leaves/shoots and was repeated 4 weeks after 1st application. The data for vegetative parameters were recorded at the harvest time of the fruits, as per treatments, T_1, Single spray @ 0.4g/L at 3-5 new leaves/ shoot; T_2, Single spray @ 0.5g/L at 3-5 new leaves/ shoot; T_3, Single spray @ 0.6g/L at 3-5 new leaves/ shoot; T_4, 1st spray at 3-5 new leaves/ shoot @0.3 g/L followed by 0.4g/L 4 weeks after 1st application; T_5, 1st spray at 3-5 new leaves/ shoot @0.4 g/L followed by 0.5g/L 4 weeks after 1st application; T_6, 1st spray at 3-5 new leaves/ shoot @0.5 g/L followed by 0.6g/L 4 weeks after 1st application, and T_7, Untreated (control).

Results and conclusion

Terminal current season shoot length was significantly reduced by Regalis treatments. Least growth (23.0cm and 15.0cm during 2011 and 2012) was recorded with application of Regalis @ 0.5/L at 3-5 new leaves per shoot stage, followed by 2nd application @ 0.6g/L 4 weeks after 1st application. Regarding the development of shoots per branch, it was found that single application of Regalis @0.6g/L at 3-5 new leaves /shoot and two applications of Regalis @ 0.5/L at 3-5 new leaves per shoot stage, followed by 0.6g/L 4 weeks after 1st application was effective in controlling the shoot growth and no lateral shoot development was recorded with theses two treatments during the year 2011. The treatments T3, T5 and T6 had statistically less number of laterals as compared to control and T6 (Regalis @ 0.5/L at 3-5 new leaves per shoot stage, followed by 0.6g/L 4 weeks after 1st application) recorded least (1.7) lateral shoots whereas untreated trees had 6.3 number of lateral shoots per branch.

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Climate Smart Village: A Model for Sustainable Agricultural Development

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Keywords: Climate change, Food security, Mitigation, Resilience

Introduction

Over the past few decades, climate change has adversely affected both physical and biological systems in most continents across the globe and lead to decrease in agricultural production by 1–5% per decade. Its effects are also predicted to manifest in severe consequences for the global agricultural sector, especially in tropical and sub-tropical regions. To mitigate these changes a new concept that is climate smart village come in existences in South Asian country. The term climate smart village (CSV) become more popular to mitigate climate change and its adverse effect at grass root level.

Material and methods

Major criteria of selecting climate smart village are based on its location of climate risk profile, alternate land-use options, and on the enthusiasm of local people to participate in the project. Involvement of local people or local community is integral to the success of a Climate-Smart Village. Researchers conduct a participatory rural appraisal (PRA) baseline study to collect the current situation village households. To promote the local people stakeholder conduct regular training sessions for farmers on climate smart agricultural practices. They maintain the record of all activity finally the results are digitized and analysed by researchers at the end of every season (*Rabi* and *Kharif*).

Results and conclusion

The climate smart team in climate smart village directly associated with farmers and working as consult agency for farmers. The major objective of climate smart village (CSV) model is ensuring food security, increase adaptive capacity and mitigate adverse effect of climate change. A climate smart village should be weather smart, water smart, carbon smart, nutrient smart, energy smart and knowledge smart. Recent days agricultural system need a climate resilient and sustainable agricultural practices so that CSV is a mean of sustainable development at grass root level and it is also a demand of future to mitigate climate change.

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Combining Ability Studies for Yield and Yield Contributing Traits in F_1 and F_2 Generations of Cucumber

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Keywords: *Cucumis sativus* L., Combining ability, Yield traits

Introduction

Cucumber (*Cucumis sativus* L.) is a leading cash crop grown commercially in open and protected conditions. It is grown from April-October and brings profitable returns to the hill farmers during July-October being off season, when it is not produced in the plains. To develop new parents and desirable crosses with good fruit traits, combining ability analysis is one of the powerful tools available which give the estimates of combining ability effects and aids in selection of new genotypes. The present investigation were conducted to study the combining ability and to identify new inbred lines and crosses both in F_1 and F_2 generations for yield and yield contributing traits.

Material and methods

The present investigation was conducted at Department of Vegetable Science, YSPUHF, Nauni, Solan, HP during 2013 and 2014. The experimental material was comprised of 18 crosses, developed by crossing six lines and three testers (Kempthorne 1957). Nine parents (6 lines and 3 testers) and 18 crosses (F_1 and F_2) along with check cultivar Pusa Sanyog were evaluated in RCBD with three replicates. The observations were recorded on days to first female flower appearance, node number bearing first female flower, days to marketable maturity, fruit length (cm), fruit breadth (cm), average fruit weight (g), fruit color, number of marketable fruits per plant, harvest duration (days), marketable yield per plot (kg) and per hectare (q). Statistical analysis was done using MS-Excel, OPSTAT and SPAR 2.0 packages.

Results and conclusion

General combining ability effects (GCA) for earliness revealed that parent CGN-20515, LC-1-1 and LC-2-2 among lines and Poinsette and K-75 were found best combiners both in F_1 and F_2 due to their significant negative GCA effects for earliness. The marketable yield and yield contributing traits, the same line and testers exhibited the highest positive GCA effects. Out of 18 cross combinations, four cross combinations viz., CGN-20256 x Japanese Long Green, LC-1-1 x K-75, LC-2-2 x Poinsette and LC-12-4 x Poinsette were consistently best specific combiners. Similarly for marketable yield and other yield contributing traits, CGN-20515 x Japanese Long Green, CGN-20256 x Japanese Long Green, LC-1-1 x K-75, LC-2-2 x Poinsette and LC-12-4 x Poinsette both in F_1 and F_2 were found good specific combiners**.** Majority of the crosses exhibiting good SCA effects had at least one of the parents as good or average general combiners. The experimental results revealed that five parents viz., LC-1-1, CGN-20515, LC-2-2, Poinsette and K-75 were found good general combiners and cross combination viz. LC-1-1 x K-75, LC-2-2 x Poinsette, CGN-20515 x Japanese Long Green, LC-12-4 x Poinsette and CGN-20515 x Poinsette were found as best specific combination for yield and yield contributing traits. These parents and hybrids can be released as a substitute for the existing varieties and hybrids. Moreover, the hybrid combinations can be exploited to isolate transgressive segregants in the early generations.

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Assessment of Control Methods against Insect Pest of Ber

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Keywords: Fruit fly, Defoliating beetles, IPM

Introduction

Ber (*Zizyphus mauritiana* Lamk) has been grown for hundreds of years all over the country. Its cultivation requires the least inputs and care. The fruit is quite nutritious, richer than apple in its dietary constituents and contain a high amount of protein, phosphorus, calcium, carotene and vitamin C and A (Bakshi and Singh 1974). Therefore, is rightly called the 'poor man's apple' or the 'desert apple'. But unfortunately in spite of having all these points in favour, the growers are not able to exploit the full yield potential of trees due to damage caused by a number of insect pests and diseases. The losses caused are so high that it has now proved to be a limiting factor in successful cultivation. The present study was thus, undertaken to evaluate various methods of control against insect pest to find out the most suitable method that can reduce the losses caused to improve yield with better quality fruits.

Material and methods

The experiment was conducted at Regional Research Station of CCS HAU at Bawal (Rewari), Haryana during 2014-15 to 2016-17. Integrated management (chemical + cultural + mechanical)) and chemical alone were undertaken. IPM components included collection and destruction of infested fallen fruits at three days interval, digging the soil under the tree canopy during summer, spreading of polythene sheet under tree canopy and mixing methyl parathion dust (2%), foliar application of quinalphos 25 EC 0.05% for controlling defoliating beetle during rainy season and spraying of effective chemicals, dimethoate 30 EC 0.03% @1 ml/l, two spray (One each in November & December) and malathion 50 EC 0.05% @ 1 ml/l (January). There were three treatments including the control. 100 fruits from each treatment were randomly collected for ovipositional punctures to ascertain the infestation of fruit fly. Data were statistically by t-test.

Results and conclusion

Two species of fruit fly (*Corpomyia vesuviana and Dacus spp)* and three species of defoliating beetles (*Holotrichia consanguinea, Anomala dimidiate and Maladera insanabilis)* were recorded. The incidence of fruit fly (1.45%) was significantly low due to application of IPM compared to chemical control (3.62% infestation). Maximum infestation (33%) was recorded where no control measure was adopted. Minimum infestation of defoliating beetle on leaves was also recorded in IPM (13.09%) compared to chemical control (16.57%) and untreated block (44.42%). Furthermore, maximum yield was recorded in IPM (40.14 kg/tree). The study concluded that IPM was the best method over other method to control the fruit fly and defoliating beetles in ber.

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Soil Meso-Faunal Population in Rainfed Maize Ecosystem Influence by Increased Inorganic Fertilizer Dose

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Keywords: Collembola, Cryptostigmatids, Non-cryptostigmatid mites, Soil mesofauna

Introduction

Soil is both resource and habitat for plants and animals. Long-term and large number of soil inorganic fertilizer applications can affect negatively soil fertility, soil biodiversity and crop products quality. As a part, the interaction of inputs such as organic manures, fertilizers and other agrochemicals with the above and below ground arthropod population should be known because such relationship would be more useful in the utilization of organic manures and fertilizers as tools of integrated pest management as well as integrated soil fauna management. With this background, the present investigation has been undertaken.

Material and methods

The study was carried out at GKVK campus of UAS Bangalore during *kharif* season of 2012-13 under rain fed condition. The field experiment was laid out in RCBD. The maize hybrid 'Hema' was shown on 5th August 2012. Soil samples were collected pruor to execution of trial and 10, 20, 30, 45, 60, 75, 90 and 105 days after germination. Soil fauna was extracted using Rothamsted modified MacFadyen high gradient funnel apparatus. For the apportionment of soil arthropods, Lewontin (1972) technique was adopted. The data were 'arc sine' transformed.

Results and conclusion

Higher soil mesofaunal population (26.88/400 g of soil) was observed in soil application of 123.74:48.91:55.59 kg NPK /ha +20.76 t of FYM/ha treatment compared to higher doses of inorganic fertilizer alone (13.81 mesofauna /400g soil) during cropping season. Fertilizer alone treated plots recorded lower mesofauna compared to treatment with FYM. Collembola was dominant in all treatments, followed by other acari, other invertebrates and cryptostigmatids. Fertilizer alone recorded lower collembola and cryptostigmatids compared to organic manure applied. However, non-cryptostigmatid mites were dominated in inorganic fertilizer treated plots.

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Performance of Mole Drain System for Soybean-Wheat Cropping System of Madhya Pradesh

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Keywords: Drainage, Mole drainage, Wheat, Soybean

Introduction

Mole drainage is a temporary method of drainage. It offers a good solution to drainage problems in clay soils. Mole drains are unlined cylindrical channels which function like clay or plastic pipes and are formed using an implement called a mole plough. Dhakad *et al.* (2016) concluded that the mole drains are best option for the water logged vertisols and is most appropriate, profitable and productive practice in clay soils. The study was conducted for wheat and soybean to assess the effect of mole drainage system on growth characters and yield of wheat & soybean crop.

Material and methods

The study area is located in the village Duglay, Tilabadgoving and Chhapri in Shajapur district of Madhya Pradesh during *kharif* 2016. The dimensions of the mole plough designed and developed at CIAE include a leg with 1250 × 250 × 25 mm and a foot of 63 mm with 75 mm bullet or expander diameter. With a 3-point linkage, the plough mounted on a four wheeled drive 75 HP tractor. The mole drains formed at 2 m spacing with 0.6 m depth along with 50 m length and soil moisture content was 22.8% at time of mole drain formation at moling depth.

Results and conclusion

Higher productivity of 4513 kg/ha observed in mole drains at 2 m spacing with 0.6 m depth. Higher net return (Rs, 43,256 per ha) and B: C ratio (2.66) was recorded mole drainage system, whereas, the lower net return (Rs. 38,006 per ha) and B:C ratio (2.51) per ha was recorded in control plot wheat crop. The increase in plant growth parameters and yield might be due to proper aeration in mole drains. Root nodules/plant, number of pods/plant, number of seeds/pod and yield were found significantly better in mole drainage system compared to control for soybean crop. Root is a major part of the soybean crop which provides anchoring and active participation in nutrient, moisture uptake and play effective role in fixation of atmospheric nitrogen. Root characters of soybean were significantly higher in mole drainage system in which number of root nodules/plant was 67.7% more in mole drainage. Higher productivity of 1683 kg ha^{-1} was recorded in mole drainage system for soybean. Net return is the best index of profitability of soybean crop production and higher net return (Rs 37516 per ha) and B: C ratio (2.75) was recorded under mole drainage system. Dhakad *et al.* (2016) also reported similar findings on mole drainage technology.

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Evaluation of Indian Bean Genotypes against Pod Borer, *Helicoverpa armigera* Based on Plant Morphological Characters

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Keywords: Indian bean, Pod borer, *Helicoverpa armigera*, Genotypes

Introduction

Indian bean (*Dolichos lablab* L.) syn. *Lablab purpureus* L is important pulse vegetable crop of South Gujarat. Major constraints affecting yield are insect-pests, wherein, pod borer *Helicoverpa armigera* (Hubner) is the major constraint (Vyas and Kumar, 2005). Plant morphological characters are responsible for host plant resistance to insect pests. Limited information is available pod borer. Thus, present study was undertaken to screen Indian bean genotypes against pod borer in relation to morphological characters.

Material and Methods

The field experiment was laid out at NUA, Navsari during *Rabi* 2012-2013 to evaluate 114 Indian bean genotypes against pod borer damage. The damage was assessed by counting total and bored pods in each selected plant and was later compared with growth habit (branching/erect), leaf area, trichome (presence/absence), pod characters (colour, shape and area) and pod yield using correlation coefficients. Non measurable parameters were compared using numerical ratings.

Results and conclusion

None of the Indian bean genotype free from pod borer damage indicating lowest pod damage in NIB-46 (0.96%) showing resistant/tolerant reaction. Highest pod damage was observed in Gujarat Papdi-1 (40.46%) indicating highly susceptible reaction. Field bean genotypes viz., DA-15, 36, 39, 44, 63 and 65 showed resistant reaction indicating pod damage of 0-9.42 per cent. The resistant/tolerant genotypes viz., NIB 46, 28, 103, 86 and 25 had erect and semi erect, while, highly susceptible Gujarat Papdi-1 possessed spreading type growth habit exhibited significant correlation (r=0.2878) with pod damage. Leaf area remained significantly lowest (49.84 cm^2) in highly susceptible Gujarat Papdi-1 and higher in tolerant NIB-46 (60.84 cm^2) indicating significant correlation (r=-0.2030) with pod damage. NIB-25 had trichomes on leaf surface indicated lower pod damage (4.1%) while Gujarat Papdi-1 had no leaf trichomes exhibited significant correlation (r=- 0.1904) with pod borer damage. Tolerant genotype NIB-46 possessed dark purple while highly susceptible Gujarat Papadi-1 had light green pods indicated significant correlation (r=- 0.2460) with pod damage. Tolerant NIB-46 possessed straight pods, while, highly susceptible Gujarat Papdi-1 had curved pods. Gujarat papdi-1 had lower pod area (3.66 cm^2) compared to tolerant NIB-46 (17.25 cm^2). It can be concluded that morphological characters induced significant resistance or susceptibility in Indian bean genotypes against pod borer *H. armigera*.

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Bioefficacy of Different Insecticides against Major Insect-Pests on Tomato

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Keywords: Insecticides, Yield, Whitefly, Leaf Miner, Fruit Borer

Introduction

Tomato, *Lycopersicon esculentum* Mill is the most widely grown vegetable crop next to potato. Andhra Pradesh contributes maximum production (1453.5 MT) and Maharashtra, maximum productivity (28.2 t/ha). Insect pests cause considerable losses in tomato, of which the fruit borer, *Helicoverpa armigera* (Hubner), whitefly, *Bemisia tabaci* (Gennadius) and leaf miner, *Liriomyza trifolii* (Burgess) are important. Farmers apply old spurious insecticides on alternate days leading to resurgence and resistance. Bioefficacy studies of new selective and eco-friendly insecticides against major insect-pests of tomato were carried out in field condition.

Material and methods

The experiment was carried out in tomato var. GT-2 during *Rabi* 2014-15 at Navsari Agricultural University Navsari, Gujarat. One month old seedlings were transplanted, spaced at 60 x 40 cm. The experiment was laid out in RBD with 8 treatments including control. Each plot was separated by a gap of 1 m so that drifting of chemicals during spraying was minimized. The sprays were given during reproductive stage when *H. armigera* causing highest economic damage.

Results and conclusion

All the insecticide treatments were found significantly superior over control indicating lowest whitefly population (adults) in imidacloprid 0.005 per cent (2.18/leaf) followed by dimethoate 0.03 per cent (2.22) and highest in control (13.23). Imidacloprid 0.005 per cent and dimethoate 0.03 per cent indicated significantly lower leaf miner damage (12.43 and 13.20% plant). Lambda-cyhalothrin 0.003 per cent indicated lowest fruit damage (5.11%), while, it was highest in control (15.89%). Yield was highest in indoxacarb 0.005 per cent (275.18 q/ha). Overall, imidacloprid 0.005 per cent due to long residual toxicity provided longest crop protection against fruit borer in particular, thus found most effective. Next superior, Indoxacarb was very effective against sucking and lepidopteran pests, provided early protection against these herbivores. Aazadirachtin @3000 ppm though effective against whitefly and leaf miner was not effective against fruit borer. HaNPV targeted only *H. armigera* (at the end of the crop) therefore, was not effective. Raghuraman and Birah (2011) recorded maximum yield (1188.8 kg/ha) in imidacloprid (80g a.i./ha.

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Response of Chemical Thinning, Gibberellic Acid and Pruning on Thinning, Fruit Size and Quality of Nectarines

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Keywords: Nectarine, Thinning, Gibberellic acid, Pruning, Fruit quality

Introduction

Nectarines (*Prunus persica* (L.) Batsch var. *nucipersica*) are fuzzy-less peaches or shaven peaches due to the lack of fuzz or short hair on the fruit surface. Thinning is one of the important agro techniques that can improve fruit size, colour and quality, besides reducing limb breakage and promoting general tree vigour. Pruning can be looked upon as an "early" fruit-thinning practice. Gibberellins have been widely studied for use in reducing flower numbers in both stone and pome fruit. Gibberellin application is thought to inhibit flower bud development during the inductive period (late May through July in stone fruit), however, only the higher concentration of GA_3 was effective in reducing the floral to vegetative bud ratio and decreasing the return bloom in peach.

Material and methods

Experiment was conducted on 12-year-old trees of nectarine cultivar May Fire raised on wild peach seedling rootstocks at the Farmer's orchard at Kotla-Barog in District Sirmour during 2014 and 2015. Trees at these sites were spaced 3×3 m apart and trained as open centers. Fifty one uniform trees were selected at each location and subjected to seventeen treatments with three replications in a Randomized Block Design.

Results and conclusion

The results inferred that fruit thinning was significantly influenced by treatments. During 2014, fruit thinning varied from 15.06-50.42 per cent. Maximum fruit thinning (50.42%) was recorded in NAA 40ppm, which was however, statistically at par with Ethrel 300 ppm. Minimum fruit thinning (15.06%) was recorded in pruning to retain 40 fruiting shoots $tree^{-1}$ + GA_3 100 ppm. During 2015, Maximum fruit thinning (43.54%) was recorded in NAA 40 ppm application. Fruit thinning was lowest (12.77%) in treatment application of pruning to retain 40 fruiting shoots $tree^{-1}$ + GA_3 100 ppm. In the present study, different chemical thinning treatments exerted a significant effect on per cent fruit thinning. The results *w.r.t.* NAA effects on fruit thinning are in line with the earlier findings of Rimpika *et al*. (2015).

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Copper Substituted Nano-Phosphate Mineral for Its Use as a Novel Micronutrient Fertilizer in Corn

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Keywords: Apatite, Attrition, Copper, Nano-Scale

Introduction

Copper (Cu), a naturally occurring transitional metal exists in four different oxidation states. It is one of the vital plant nutrients required for chlorophyll formation. Cu availability to plants is a function of soil pH and soil texture. Alkaline soils particularly Punjab soils are exhibiting considerable Cu deficiency (Sharma *et al.,* 2015). Due to its low use efficiency calls for developing novel Cu-fertilizer formulations.

Material and Methods

Cu-apatite nano-composite was fabricated by wet chemistry technique. The synthesized bulk apatite was converted to nano-scale form by top-down mechanical attrition technique. The attrition grinded nano-form apatite receptacles were reacted with copper (Cu^{2+}) to prepare Copper-substituted nano-apatite (n-HA-Cu) nanocomposite. All products were characterized by spectro- (EDS, X-ray diffraction, FT-IRS) and microscopy (SEM, TEM) tools. Cu-nHA product(s) were tested for a possible Cu-micronutrient delivery in corn in hydroponic culture. The test seeds were cultured on modified Hoagland's nutrient medium for two weeks. The copper content of the test plants was determined by atomic absorption spectroscopy.

Results and conclusion

Cu based products obtained by reacting apatite receptacles in nano-scale with copper (Cu^{2+}) exhibited variability in morphology and surface elemental composition. SEM analysis of aggregates depicted occurrence of rectangular to square rhomboidal structures. However, the particulate morphology varied from roughly spherical, oval, oblong to cylindrical/ tubular for the nano-apatite samples by TEM. SEM-Energy Dispersive Spectroscopy (EDS) detected perceptible adsorption of Cu on apatite and confirmed occurrence of 6.69 atom % of Cu on nHA receptacles. Cu adsorption on nHA receptacles, the SEM-EDS mapping exhibited substitution of the c-plane Ca^{2+} due to smaller ionic radius (0.073 nm). The vibrational spectroscopy depicted the occurrence of characteristic symmetric and asymmetric valence oscillations of the phosphate bond. The HAp showed strong X-ray reflections with peaks appeared (2θ ~ 12.4 to 40º). Further, characteristic 2θ peaks for HA, nHA and Cu-nHA NC confirmed nano-cyrstalline nature of samples. On evaluation of the characterized samples in an *in vitro* hydroponic based corn-seed germination test, the potential of the nano-composite to supply Cu micronutrient to corn and support plant growth was tested. The n-HA-Cu NC exhibited highest uptake and growth at more than 26 times lower dose over conventional $CuSO_4$ supplementation.

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Effect of Elevated CO_2 and Temperature on Leaf Damage Caused by *Spodoptera litura* and Infestation of Green Peach Aphid in Bell Pepper

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Keywords: *Capsicum annuum* L., Aphids, Insects, Leaf damage

Introduction

Climate change is a major concern today. Temperature, which impacts the development time, longevity and fecundity of insects has a direct effect while elevated CO_2 has an indirect host-mediated effect on growth and development of insect pests (Yadugiri, 2010). Vegetable cultivation in Himachal Pradesh has gained significant importance on account of favorable agro-climatic conditions for growing quality off-season vegetables. The tobacco caterpillar, *Spodoptera litura* and aphids during outbreaks, causes extensive defoliation and also cause huge damage to plant which affects yield of bell pepper. The present studies aimed to understand the effect of elevated CO_2 and temperature on per cent leaf damage caused by *S. litura* and infestation of green peach aphid, *Myzus persicae* Sulzer in bell pepper.

Material and methods

The present investigation was conducted in bell pepper at YS Parmar UHF, Nauni, Solan in 2014 and 2015. Circular type open top chambers of 4 x 4 m^2 dimension were used to raise the crop under elevated CO_2 and temperature conditions. The treatment included i.e.T_1: elevated CO_2 (550±10 ppm), T_2: elevated CO_2 and temperature (CO_2:550±10 ppm, temperature: 1°C elevated than T_1), T_3: ambient temperature and T_4: natural air and temperature. Damage caused by *S. litura* in leaves was recorded. The population of aphids was recorded on three leaf basis; from each plant and mean aphid population was counted.

Results and conclusion

The tobacco caterpillar caused damage to leaf as well as fruit of bell pepper. It is evident from Table 1 that during 2014, per cent leaf damage by *S. litura* was recorded maximum under elevated CO_2 (14.78 %) which differed statistically with elevated CO_2 and temperature (11.52 %), ambient CO_2 and temperature (8.78 %) and natural condition (1.88%) Similar trend was found in year 2015 and pooled data too. In the present findings, lower foliar nitrogen content under elevated CO_2 caused increase in food consumption by *S. litura* in order to compensate the nutritional requirement and hence resulted in more infestation as compared to ambient CO_2 and temperature and natural condition. Similarly, higher number of aphids were observed on plants grown under elevated CO_2 and temperature (17.08 aphids/plant) which was statistically different from elevated CO_2 (10.50 aphids/plant), ambient CO_2 and temperature (9.83 aphids/plant) and natural condition (4.58 aphids/plant).

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Effect of Host Plants on Biology of Invasive Leaf miner, *Tuta Absoluta* (Meyrick)

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Keywords: Reproduction, Solanaceous Plants, Survival, Tomato Leaf miner

Introduction

The tomato leaf miner, *Tuta absoluta* is one of the most important insect pests of tomato capable of causing100 per cent crop loss under severe infestation. The pest invaded India in 2014 and has now been spread to almost all parts of the country. Though, tomato is the preferred host of the pest, it can infest other solanaceous plants. These alternate host plants can play important role in its survival, spread and overwintering. The present study was, therefore, carried out to study the effect of hosts on biology of *T. absoluta.*

Material and methods

Developmental biology of *Tuta absoluta*was studied on tomato (*Solanum lycopersicum* L.) leaves, fruits, potato (*Solanum tuberosum* L.) leaves, potato tuber, brinjal (*Solanum melongena* L.) leaves and pepino (*Solanum muricatum* Aiton) leaves under laboratory conditions. *Tuta absoluta* culture was obtained from the laboratory maintained stock culture and reared on respective host. Observations on the development time of egg, larva, pupa, adult longevity, pre-reproductive period, reproductive period, post-reproductive period, survival and sex ratio were recorded. One way ANOVA was performed to separate the significant means.

Results and conclusion

Tomato leaves were the most suitable host for the development of leaf miner followed by potato leaves and tomato fruits. Potato tuber was the least suitable host for the development of the pest. The incubation period was shortest (3.3 days) for individuals reared on tomato leaves, followed by potato leaves (4.3 days), tomato fruits (5.09 days), brinjal leaves (5.89 days), pepino (6.39 days) and potato tuber (6.94 days). Similarly, larval development was fastest (15.1 days) on tomato leaves and the slowest on potato tuber (37.4 days). Pupal period ranged from 10.4 days on tomato leaves to 16.1 days on potato tuber. Pre-oviposition period of the adult female developed on different hosts varied from 1.44-2.33 days. The fecundity was highest (175.38 eggs/female) in females reared on tomato leaves followed by tomato fruits (112.5 eggs/female), potato leaves (71.44 eggs/female), brinjal leaves (47 eggs/female), pepino leaves (27.16 eggs/female) and potato tuber (20.66 eggs/female). Immature survival was 83.3, 63.3, 50, 50, 53.3 and 23.3 per cent on tomato leaves, potato leaves, brinjal, pepino, tomato fruits and potato tuber. Sex ratio(female: male) of the pest on respective hosts was 1.08:1, 0.9:1, 0.88:1, 1.5:1, 1.16:1 and 1:1. The study concludes that tomato is the most preferred and suitable host for the development, survival and reproductive fitness of the pest, yet, it can develop, survive and reproduce on other alternate hosts like potato, brinjal and pepino which can play an important role in the survival and carryover of the pest.

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Ecofriendly Management of Cabbage Aphid, *Brevicoryne Brassicae* in Cabbage under Mid-Hills of Himachal Pradesh

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Keywords: Cabbage Aphid, Ecofriendly, Botanicals, Management

Introduction

Cabbage (*Brassica oleracea var. Capitata* L.) is an important cash crop grown for culinary and seed production. It is mostly grown in winter but in the mountainous region of the country but also can be grown during summers. The crop is attacked by sundary of insect-pests at one or the other stage of crop causing hindrance in successful cultivation. Cabbage aphid, *Brevicoryne brassicae* (L.) is a pest of economic importance since it arrests crop growth seriously and has a tendency to contaminate the crop rendering it unattractive.

Material and methods

The present investigations were carried out during 2015 and 2016 at YSP University of Horticulture and Forestry, Solan, Himachal Pradesh. One month old cabbage seedlings (cv. Bharti) were transplanted in November of 2014-15. The crop was raised by following all the recommended agronomic practices (Anonymous, 2009). There were eight treatments : T_1 – Neem seed powder extract 4%, T_2– Pulverized neem seed kernel extract 5%, T_3–Neem soap 1%, T_4– Pongamia soap 1%, T_5–Diafenthiuron 50 WP @ 1g/l, T_6–Spinosad 2.5 S C @ 1.5 ml/l, T_7– Rynaxpyr (Chlorantraniliprole) 18.5 S C @0.1 ml/l, T_8–Control.

Results and conclusion

The cabbage aphid population persisted throughout the cropping season. Treatment, T_5 recorded minimum number of aphids/plant (11.36) which was statistically at par with T_7 (12.09). After first spray, minimum number of aphids (5.60 aphids/plant) were recorded with T_5 which was at par with T_7 (5.96 aphids/plant) and T_6 (5.92 aphids/plant). Significantly minimum number of aphids/plant (6.88) was recorded on day-3 followed by day-7 (8.38) and day-10 (11.15). After second spray, minimum number of aphids/plant (17.11) were recorded in T_5 which was statistically at par with T_7 (18.22) and differed statistically with rest of the treatments. Significantly minimum number of aphids/plant (16.69) was recorded on day-3 followed by day-7 (23.38) and day-10 (29.02). Significantly higher yield (245.44 q/ha) was recorded in T_5 which was statistically at par with T_7 (222.83 q/ha), T_6 (222.77 q/ha), T_2 (220.28 q/ha), T_4 (216. 22 q/ha) and T_3 (212.17 q/ha). Highest benefit cost ratio (1.64:1) was recorded with T_5 which was statistically at par with T_7 (1.59:1). The spray of Difenthiuron 50 WP @ 1g/litre and/or Rynaxpyr 18.5 SC @ 0.1ml/litre were equally effective for the management of cabbage aphid which resulted in high yield as well as B:C ratio in cabbage.

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Variable K Fertilization along with Recommended N and P through Fertigation Affects Cropping Behaviour of Pomegranate

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Keywords: Climate Change, Fertigation scheduling, Nutrient distribution

Introduction

Pomegranate (*Punica granatum* L.) belongs to Punicaceae family and is one of the oldest known edible fruit widely grown in tropical and sub-tropical World. Its cultivation is extending in the sub- tropics to sub-temperate zone of Himachal Pradesh. Due to climatic variability, the marginal apple growing area has been receding to higher altitude and thus, pomegranate cultivation has been found promising crop up to an altitude of 4500 feet. The cultivars 'Kandhari Kabuli' is a leading cultivar of mid-hills and sub-tropical regions. The area under cultivation is increasing enormously in spite of higher cost of fertilizers, leaching losses and washing away of nutrients by runoff, low fertilizer use efficiency and low productivity under conventional irrigation and fertilizer application methods. Fertilizers and irrigation are the significant inputs which directly affect cropping behaviour of the crop. Application of fertilizers through drip system, provide nutrients to the active root zone at different time intervals in accordance to growth stages, and thus preventing losses of expensive nutrients, which ultimately improves productivity and quality traits.

Material and methods

Field trials were executed in the Experimental Pomegranate Block of Department of Fruit Science of YSPUHF, Nauni, Solan, HP, India (30° 50' 45" latitude, 77° 88' 33" longitude) on 11-year-old pomegranate cv. Kandhari Kabuli. The experiment consisted of the following treatments viz; T_1: 0% K and RD of N and P through fertigation, T_2: 50% K and RD of N and P through fertigation, T_3: 75% K and RD of N and P through fertigation, T_4: 100% K and RD of N and P through fertigation, T_5: 125% K and RD of N and P through fertigation and T_6: Conventional method of soil application with recommended dose of fertilizers.

Results and conclusion

The results inferred that maximum shoot extension growth, increase in tree height, increase in tree spread was recorded for the treatment T_4 (100% RD of NPK). Highest fruiting characteristics (fruit set, retention, fruit weight and yield) and physico-chemical fruit characteristics were recorded in T_5 (125% RD of P and RD of N and K). Leaf macro nutrient (N and P) and micro nutrient was recorded for T_4 (100% RD of NPK), whereas, the highest Leaf K content was recorded in T_5 (125% RD of P and RD of N and K). Concerning to the horizontal movement of available N, P and K, it was observed that under fertigation all the individual nutrient concentration (0-15 cm) followed by 15-30 cm soil layer. Under conventional method, only N was recorded in 15-30 cm surface layer and minimum in 30-45 cm soil layer. The lateral movement of available N, P and K showed similar trend with respect to individual nutrient, and mostly concentrated about 10 cm away from the emitter, irrespective of fertilizer application method. The study concluded that fertigation improves fertilizer use efficiency than the conventional method; T_5 recorded excellent fruiting and qualitative traits.

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Effect of Grafting Height on Softwood Grafting in Mango

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Keywords: Mango, Success Percentage, Growth Parameter

Introduction

Agro-climactic conditions prevailing in Gujarat is very congenial for mango cultivation. However, the lack of availability of elite planting material is one of the important drawbacks for expanding its cultivation further. The softwood grafting is generally followed which is easy to handle and quite efficient as well as grafts can normally rose within a year, thus reducing cost of raising the grafts. The present investigations were under taken to standardize the height of seedling rootstock on success of softwood grafting in mango.

Material and methods

The present investigation was carried out at Fruit Research Station at Sakkarbaug, Department of Horticulture, JAU, Junagadh during 2015-16. The experiment was laid out in CRD (factorial). Mango stones of local variety were sown in black polyethylene bag in 1st June 2015 and seedling are ready for grafting between 15th August 2015 and 30th October 2015. The grafting at different height i.e. 20 cm (H_1), 40 cm (H_2) and 60 cm (H_3) on rootstock were practiced. Mature scion from healthy terminal shoots of more than 3 month of age and 10-15 cm length from 'Kesar' cultivar were selected. Observations were recorded two month after grafting operation at 30 days interval until 120 days after grafting.

Results and conclusion

Data revealed the variation due to treatment like different grafting height was found unable to create significant influence on days to shoot emergence. Minimum days taken for sprout initiation when grafting at 40 cm was carried out. It might be due to well established, vigorous shoots and root, more food reserved in rootstock seedlings. Furthermore, too young and old tissues were not fit for complete union (Mandal *et al.* 2012). Maximum success (59.44 %) was recorded at 60 cm (H_3), whereas, it was least (49.44%) at 20 cm (H_1). Similarly, survival percentage was also significant when grafting was done at 60 cm on rootstock (H_3). Highest survival (49.44%) was noted at 60 cm grafting height, while, it was least (42.22%) at 20 cm grafting height (H_1) during 120 days after grafting. This could be ascribed to higher cambial activity of softwood in the rootstock (Kumar *et al.* 2000).

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Comparative Evaluation of Different Pesticides Residue Analysis Methods for Cleanup of Forty One Pesticides in Apple, Cabbage and Cauliflower Food Matrix.

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Keywords: Residue Analysis Methods, Cleanup, QuEChERS, CDFA

Introduction
Many innovations have been developed in the analytical processes applied to prepare food samples for the extraction and determination of pesticide residues. Our study was designed and undertaken to work out the cleanup efficiency and sensitivity of two multiresidue methods *viz.* SPE and CDFA and compared with the QuEChERS technique.

Material and methods
Samples of apple, cabbage and cauliflower were collected from market and extracted and cleanuped as per the method of solid phase extraction, QuEChERS and CDFA. After standardization of methods and instruments, injected to GC equipped with ECD/NPD detector. Three different analytical methods namely, solid phase extraction (Florisil and C18), QuEChERS and CDFA were evaluated for cleanup effeciency by adding and recovering forty one pesticiceds namely, α- HCH, β - HCH, γ- HCH, δ - HCH, Aldrin, Chlorpyrifos, α - endosulfan, pp-DDE, op-DDD, β- endosulfan, pp-DDD, endosulfan sulfate, diazinone, op-DDE, dicofol, pp-DDT, cyhalothrin, cypermethrin, fenpropathrin, deltamethrin, fenvalerate, phorate, chlorpyrifos-methyl, methyl-parathion, fenitrothion, malathion, fenthion, quinalfos, profenofos, ethion, anilophos, phosalone, chlorfenvinfos, chlorothalonil, fluchloralin, alachlor, pendimethalin, fipronil, butachlor, fenazaquin and hexaconazole.

Results and conclusion
SPE (Florisil) was most effective method for maximum recovery of pesticides (92.08% with 0.65% RSD) followed by 91.35% with 0.60% RSD in QuEChERS (PSA+GCB), 90.12% with 0.59% RSD in QuEChERS (Florisil), 89.10% with 1.73% RSD in SPE (C18) and 82.68% with 3.15% RSD in CDFA. QuEChERS method was found the most economic method with cost of sample processing as Rs.157.00 with >90 % recoveries. In SPE method, using Florisil and C18 cartridges, the cost of a sample processing was Rs. 850.23 and Rs. 949.67, respectively while the time used in processing in both these methods was 3.30 hours. The recovery of pesticides was >90% when Florisil was used as cleanup material while the recovery was <90% with C18. The sample processing was found to be the most expensive (Rs.1001) in CDFA besides more time consuming (6.30 hrs). The overall comparison thus revealed that QuEChERS method with Florisil as cleanup material is the best method for reduced interferences and good recoveries, savings of both materials and sample preparation time compared to traditional methods and better expected reproducibility due to the straightforward procedure with fewer manual preparations.

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Assessing Integrated Nutrient Management on Sweet Pepper for Productivity and Microbiological Properties of Soil

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Keywords: Bio-Fertilizer, Enriched Compost, PGPR, Soil Health

Introduction

Bell pepper (*Capsicum annuum* L.) is a high value solanaceous vegetable crop originated in newwWorld tropics and subtropics and was introduced to India by the British in the in the 19th century in Shimla hills of Himachal Pradesh). Boosting yield, quality, reducing production cost and improving soil health are three inter-linked components of the sustainable triangle. Therefore, suitable combination of chemical fertilizer and organic manures cultures need to be developed for particular integrated plant nutrient system. Accordingly, the present study was aimed to evolve integrated plant nutrient system for cultivation of sweet pepper in the mid hills of Himachal Pradesh.

Material and methods

The experiment was carried out during 2015 at YSP University of Horticulture and Forestry, Nauni Solan, to evolve INM system for higher productivity, improved quality and enhanced soil status. The experiment was laid out in RBD with three replicates comprising 15 combinations of inorganic and organics including PGPR. Recommended dose of FYM and the other manures (vermicompost) and enriched compost) as per treatments were incorporated. The data were recorded on yield, quality, disease incidence and microbiological properties of soil.

Results and conclusion

The integrated module 75% NP + VC and EC@ 2.5 t/ha + PGPR with yield of 371.01 q/ha statistically superior to the recommended practice (230.60 q/ha) as well as all the other integrated modules. Maximum TSS (4.94 ^{0}B) and ascorbic acid content (180.54 mg/100 g) was with integration of 75 % NP with 2.5 t/ha of combined VC and EC along with *Bacillus* inoculation. The incidence of *Phytophthora* spp. was less than 6.5%. The incidence of fruit rot, the leaf blight was also low (less than 5%). The different integrated modules observed significant variations in bacterial population. The module comprising of 75% NP + VC and EC @ 2.5 t/ha + PGPR recorded maximum microbial count (2.94×10^7 cfu/g soil) closely followed by 75 % NP + VC@ 2.5 t/ha + PGPR (2.79×10^7 cfu/g). The rate of CO_2 evolution was maximum (0.87) under 75% NP + VC and EC@ 2.5 t/ha + PGPR, while, minimum (0.28) with RDF (100 N: 75 P: 55 K kg/ha) + FYM 20 t/ha after 24 h of incubation period. This might be due to increase in microbial population by conjoint application of bacterium with chemical fertilizers and organic manures.

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Zero-Tillage with Residue Mulching in Maize Hybrids: Influence on the Yield Parameters and Economics

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Keywords: Economics, Grain Yield, Maize, Residue, Zero Tillage

Introduction

Maize (*Zea mays* L), being a C_4 crop, is one of the most vibrant food grain crops in different parts of the world like tropical, subtropical, temperate and high hill ecologies under diverse edaphological conditions. In place of rice, maize may be a viable option in the rice-wheat system with interventions of resource conservation technologies like zero-tillage (ZT) and furrow irrigated raised bed system. This will promote sustainable cropping systems in the Indo-Gangetic Plain (Jat *et al*., 2013). Hence, this experiment was planned to study the impact of ZT and residue mulching on *kharif* maize.

Material and methods

The experiment was conducted at Regional Research Station, Karnal of CCS Haryana Agricultural University, India during *kharif* 2015. The experiment was laid out in split plot design with three replications. Four planting methods *viz*., raised bed with residue, raised bed without residue, zero tillage with residue and zero tillage without residue was comprised in main plot. Three maize hybrids *viz*., HQPM-1, HM-4 and HM-10 in combination with two weed control treatments *viz*., atrazine 750 g/ha pre-emergence (PRE) followed by (*fb*) 1 hand weeding (HW) at 30 days after sowing (DAS) and unweeded check were kept as sub-plots.

Results and conclusion

Maize was sown in zero tillage (ZT) with residue recorded significantly highest yield attributing parameters (cob weight and number of grains/cob), grain yield and net returns as compared to other methods. However, ZT in general was statistically similar to raised bed in respect of grain yield. Residue retention resulted in improved yield attributing parameters, grain yield and net returns as compared to without residue. ZT recorded higher yield attributing parameters, grain yield and net returns than raised bed. The hybrid HM-4 produced maximum yield attributing parameters, grain yield and net returns than other hybrids. In weed control treatments, higher yield attributing parameters, grain yield and net returns were observed under atrazine 750 g/ha (PRE) *fb* 1 HW at 30 DAS than unweeded check. Conclusively, zero tillage sown maize with wheat residue as mulch resulted in improved productivity and profitability.

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Screening of Gene Bank for Major Diseases and Morpho-Physiological Characterization in Capsicum Under Mid Hill Conditions of Himachal Pradesh

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Keywords: Bacterial wilt, Capsicum, Fruit rot, Genotypes

Introduction

In Himachal Pradesh, Sweet pepper enjoys the status of off-season vegetable, as during summer-rainy season it is transported to the distant markets in the plain areas which lift the economic conditions of the small farmers of the state. However, its cultivation in mid hills has suffered due to bacterial wilt and fruit rot incidence causing 70 to 100 per cent losses. Reports on control of these diseases through single approach are null to limited. Therefore, Integrated pest management through identification and development of resistant cultivars with desirable Ideotype could be considered best to boost the production and productivity of crop.

Material and methods

The present investigation was carried out at, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur during February-September kharif, 2014 and 2015. The experimental material consisted of twenty seven diverse sweet pepper genotypes. The bell pepper genotypes included in the study were tested for their reaction to diseases under natural epiphytotic conditions. Data were recorded on bacterial wilt and fruit rot incidence in addition to morpho-physiological traits in capsicum. Morphological characterization was done as per Srivastava *et al*. (2001).

Results and conclusion

All the genotypes were resistant to bacterial wilt except California Wonder which was highly susceptible. In case of fruit rot incidence, eighteen genotypes were moderately resistant and nine were highly susceptible. On the basis of morpho-physiological characterization, nine genotypes were showed intermediate (compact) plant growth habit, twenty two have blocky fruits, three have dark green colour, all genotypes showed red colour at maturity, twenty have lobate fruit shape at pedicel attachment, seven have sunken and pointed fruits and twenty genotypes have pendent fruit position as that of California Wonder. The genotypes having desirable ideotype traits along with resistance to bacterial wilt and fruit incidence could be exploited for developing multiple disease resistant superior cultivars.

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Effect of Different Modes of Pollination on Yield and Quality Parameters of Pumpkin, *Cucurbita moschata*

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Keywords: Pumpkin, Fruit set, Open pollination, Fruit weight

Introduction
Utilization of pollinators, especially honey bees, in pumpkin crop which is long-running vine is monoecius in nature is considered as one of the cheapest eco-friendly approaches in maximizing the yield of the cross-pollinated crops The pollinators, especially honey bees, play an important role in the increase in yield as duration and frequency of visit of the pollinators are correlated positively to pollination rate, which itself is number of fruit produced and the dimensions of the fruit. Bee pollination also significantly reduced the number of mishappen fruit.

Material and methods
The studies were carried out at CCS HAU, Hisar during, 2013 on two cultivars of pumpkin viz., C-1076 and C-1106. To study the effect of different mode of pollination, the treatments- without insect pollination (WIP),Open pollination (OP),Hand pollination (HP) and Hand pollination + Open pollination (HP +OP) were taken. For comparing the effect of different mode of pollination on fruit set, yield and quality parameters of pumpkin,ten female flower buds about to open were enclosed with butter paper bags to exclude the insect pollinators (WIP). Likewise, ten female flower buds were tagged for OP, HP and HP+OP. The per cent fruit set, weight of the individual fruit fruit length girth of the fruit Number of seeds per fruit after picking of the fruit and the weight of the 1000 seeds was taken. To record the seed germination percentage, 100 seeds of each treatment were placed on sufficiently moistened rolled germinating papers (Between the papers) at 20^0C in the seed germinator. The data on shoot length, root length and dry weight of the seedlings were recorded on 10 seedlings randomly selected from 8 days old seedlings. After recording the data on shoot and root length in cm, the seedlings was kept in the oven at 85^0C till their dry weight stabilized. The data was expressed as dry weight (g) per seedling.

Result and conclusion
Maximum fruits set was in HP+OP. Mean fruit quality traits were maximum HP+OP in cv. C-1076. Likewise in C-1106, maximum fruit set was recorded in OP + HP. Mean fruit weight, fruit length, fruit diameter, number of seeds per fruit, seed test weight, seed germination percentage, seed vigour I and seed vigour II was maximum) in open-pollination + hand-pollination followed by open-pollination and hand-pollination in C-1106 cultivars. Irrespective of different treatment, among the quantity parameter, fruit diameter was highest in C-1106 cultivars due to round in shape. Hence in both cultivars of pumpkin, open-pollination + hand-pollination were the best treatment followed by open pollination and hand pollination. It is therefore concluded that open pollination by honey bees and wild pollinators should be ensured particularly in low pollinator activity areas to enhance the yield and quality of summer squash fruits. Thus in low natural pollinators activity area greater revenues can be generated by using hive bees.

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Studies on Variability, Heritability and Genetic Gain in Cucumber

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Keywords: Genetic Variability, GCV, PCV, Heritability

Introduction

Cucumber (*Cucumis sativus* L.) is one of the most important cucurbitaceous vegetable crops grown extensively in tropical and subtropical parts of the country. It is grown for its tender fruits, which are consumed either raw as salad, cooked as vegetable or as pickling cucumber in its immature stage. (Kumar *et al*. 2013). The success of any breeding program depends to a large extent on the amount of genetic variability present in the population. Therefore, the present study has been undertaken to estimate the extent of variability, heritability, coefficients of variation, genetic advance and genetic divergence in thirty genotypes of cucumber.

Material and methods

The present study was conducted at the Experimental farm of the Department of Vegetable Science, UHF, Nauni, Solan (HP). The experiment comprised of thirty genotypes was laid out in Randomized Complete Block Design with three replications of each genotype in the month of June, 2016. The observations were recorded from five randomly selected plants in each replication for all characters except for fruit characters for which observations were recorded on ten randomly selected fruits per replication. The statistical analysis was carried out for each observed character under the study by using MS-Excel, OPSTAT 16.0 and SPSS 16.0 packages.

Results and conclusion

Wide range was observed for node number bearing first female flower (2.83-9.67) and days to marketable maturity (42.47-67.67). Range of Fruit length, breadth and weight were recorded (13.10-25.42 cm, 4.36-6.00 cm, 141.50-341.67 g, respectively). Tremendous variations with respect to number of marketable fruits per plant (4.04-8.49), harvest duration (15.33-29.93 days), yield per plot (11.43-28.71 kg) and yield per hectare (142.84-358.92) were obtained. Genotypes showed wide variations for fruit colour (Light green and green) and total soluble solids (2.53-3.19 ^{0}B). Significant differences were observed with respect to seed germination (80.67-100.00 %), seed vigour index-I (1440.11-2829.07) and seed vigour index-II (698.28-1735.93). Genotypes respond differently to the attack of different diseases viz. powdery mildew (6.33-18.83 %), anthracnose (3.33-27.07 %) and angular leaf spot (4.00-29.00 %). The phenotypic coefficients of variability (PCV) and genotypic coefficients of variability (GCV) were high for severity of angular leaf spot (53.53%, 51.80%) and anthracnose (41.59%, 39.06%). High heritability along with high genetic gain for severity of anthracnose and angular leaf spot suggested predominant additive genetic control for these traits. Moderate to high heritability with moderate genetic gain for node number bearing first female flower, number of marketable fruits per plant, fruit length, days to marketable maturity, harvest duration, seed vigour index-I, seed vigour index-II, severity of powdery mildew, yield per plot and yield per hectare indicated additive genetic control for these traits hence, selection will be less effective in these traits.

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Comparative Study on Drought Tolerance of Rice (*Oryza Sativa* L.) Genotypes at Different Locations of West Bengal

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Keywords: Stress Susceptibility Index, Genetic Advance

Introduction
Rice is considered the main staple food for more than 50% of the world's population the recent scenario of global climate change and unpredictable rainfall patterns lead to severe drought spells in rain-fed areas causing high yield decline in rainfed rice growing areas. To ensure the food security a major challenge in rice production now is to achieve the dual goal of increasing food production and saving water. The main objective is to identify and develop suitable and efficient varieties with drought tolerance traits in West Bengal.

Material and methods
Twelve rice genotypes were planted in kharif season in the year 2013 in randomized block design) with three replications in plot size of 1m x 1m with spacing 25 x 20 cm under optimum irrigation and drought stress conditions at Gangetic Alluvial Zone and Red and Lateritic Zone in the district of Nadia and Paschim Medinipur respectively of West Bengal, India. The recommended agronomic practices were followed up to reproductive stage. At 50% flowering stage irrigation was withheld for 10 days in one set of experiment to impose artificial drought. Twelve yield attributing characters were recorded in both hydrological regimes.

Results and conclusion
Drought tolerance indices like stress susceptibility index (SSI), drought tolerance efficiency (DTE), stress tolerance index (STI) and stress tolerance (TOL) were employed in screening of the genotypes. Drought stress at reproductive stage caused reduction in grain yield ranged between 7 to 41per cent in Gangetic alluvial zone and 13 to 49 percent in red lateritic zone. Based on screening, rice genotypes Dular, Jaldi Dhan 13, Kalinga III and Heera showed low SSI and TOL and high DTE and STI values, they were identified as drought tolerant genotypes. According to Chauhan *et al.* (2007) genotypes with low SSI values (less than I) can be considered to be drought resistant because they exhibited smaller yield reductions under water stress compared with well-irrigated conditions. These drought tolerant genotypes also showed superior performance with respect to grain yield and desired yield attributing traits in the varied environmental regions. Significant positive correlation was found between grain yield with spikelet fertility %, harvest index and biomass yield in both Gangetic alluvial and red lateritic zone. Genotypes Dular, Heera, Jaldi Dhan 13 and Kalinga III are drought tolerant and can be adopted for cultivation in large area in rain-fed lowland ecosystem where drought is frequent, particularly during reproductive stage or can be used as parent variety suitable for improving the grain yield in rice through breeding programs targeting drought.

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Effect of Integrated Nutrient Sources on Vegetative and Fruiting Characters of Apricot

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Keywords: Farm Yard Manure, Calcium Nitrate

Introduction

New castle, is the commercially accepted cultivar of apricot for the mid-hills of Himachal Pradesh, owing to excellent quality attributes, ripens towards the end of May when no other fruit is available in the market and is a source of good income to the orchardists of mid-hill regions. Continuous use of chemical fertilizers has degraded the soil health and also causes environmental and water pollution. INM is the most efficient and practical way to mobilize all the available, accessible and affordable plant nutrient sources in order to optimize the productivity of the crops and economic return to the farmer.

Material and methods

The experiment was conducted in the experimental orchard at Horticultural Research and Training station and Krishi Vigyan Kendra (HRTS & KVK), Kandaghat, Solan (H.P.) on fully grown 20 years apricot trees of New Castle cultivar, planted at a distance of 5 × 5 m. The experiment was laid out in RBD. The experiment consisted of 14 treatments and each treatment was replicated thrice. Chemical fertilizers, Biofertilizers, FYM, Vermicompost were purchased from the market and Jeevamrut was prepared at experimental site.Data were statistically analysed according standard tools.

Results and conclusion

The results revealed that the application of different integrated nutrient sources in apricot trees significantly influenced the plant vegetative and fruiting characters. Maximum increase in tree height (31.73 %), tree spread (34.22 %), tree volume (38.84 %), annual shoot extension growth (93.91 %) was recorded with the application of treatment T_{11} consisting of 75 % N (CN) + 25 % N (Urea) + Azotobacter + PSB + Vermicompost. Maximum increase in tree trunk girth (6.82 %), highest leaf chlorophyll content (3.00 mg/g fresh weight), leaf area (58.29 cm), fruit set (61.00 %) and the lowest fruit drop (29.33 %) was recorded in treatment T_{12} consisting of 50 % N (CN) + 50 % N (Urea) + Azotobacter + PSB + Vermicompost. Hence T_{12} [50 % N (CN) + 50 % N (Urea) + *Azotobacter* + PSB + Vermicompost] was found to be the best treatment than all other treatments in respect of vegetative and fruiting characters. The observed increase in vegetative characters, good fruit set and less fruit drop of apricot might be due to the combination of different forms of nitrogen sources used in the experiment. On hydrolysis urea released NH_4^+ and calcium nitrate released nitrogen in nitrate form a form which is readily available for longer period. Further the use of biofertilizers also helped in increasing the availability of fertilizers to the plant, which results in improved growth, good fruit set and less fruit drop of apricot plants.

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Conservation Agriculture towards Management of Plant Genetic Resources from Cold Desert Region of India

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Keywords: Community Seed Bank, Farmers' varieties

Introduction
Natural resources in general and plant genetic resources in particular are in extinction where cropping patterns are changing at alarming rate. Cold desert is one such region where onslaught of cash crops/off season crops has made big impact, thereby replacing unique plant genetic resources adapted to harsh environments. The proposed study was focused on the conservation and utilization of locally adapted and traditional plant genetic resources through conservation agriculture.

and methods
Field work and germplasm collection was conducted in Leh, Jammu and Kashmir, and Kinnaur and Lahaul & Spiti districts of Himachal Pradesh. Structured questionnaires and group discussion were conducted to complete the field work. An exploratory approach, which was not based on preliminary hypotheses was also followed, which allowed farm households to employ their own values and standards of measurements. Training-cum-awareness programs were organized in selected villages and community seed banks were also established. The documentation of elite farmers' varieties was also done.

Results and conclusion
Total land area under cultivation of the traditional crops of cold desert region viz. naked barley, finger millet, buckwheat and apricot was 185 bigha (60% of the total cultivated land). Total production was estimated 1149.53 quintals. Seed samples of different plant genetic resources were procured and kept in the community seed bank at Sangla valley. Maintenance work following standard operating procedures is being carried out to ensure regular and even supply of these traditional plant resources. Simultaneously, 2 elite farmers' varieties (land races) viz. buckwheat (Sangla valley in Kinnaur) and naked barley (Lossar in Spiti valley) were documented through Sustainable Development Society, Sangla and Gram Panchayat Lossar, respectively. The traditional crops of cold desert region have lot of potential in the down town markets which can help in uplifting livelihoods. Therefore, social awareness programmes on importance of agro-diversity will certainly aid in economic improvement. Management of plant genetic resources will certainly be beneficial for long term sustainability of cold arid agro-eco systems which is otherwise highly fragile and changing fast in the light of cropping patters and climate.

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Leaf Nutrient Effects, Crop load and Fruit Russeting as a Function of Foliar Nutritive Fluids in 'Gale Gala' apple

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Keywords: Dry Temperate, Foliar Nutrient Fluids, Russeting

Introduction

Apple is the most important cash crop of Himachal Pradesh, constitutes about 49% of the total area and 85% of the total fruit production, generating an economy of around 523 million US dollars. Apple farming in Kinnaur district has tremendously resulted for amelioration and transforming the economy of the tribal district in a big way. Apple growers primarily use NPK fertilizers and FYM as traditional orchard fertilization. However, the increasing fertilizer cost and scarce availability to meet out the real crop demand for specific nutrients indicated low productivity (69.5 q/ha) of the orchards. Customized fertilizers (CFs) are multi-nutrient carriers designed as the alternative solution, satisfying the crop's nutritional needs, specific to its site, soil and stage; validated by a scientific crop model. In order to have an optimum utilization of plant nutrients with minimum environmental pollution, it is desirable to reorient agricultural producers to the use of environment safe and appropriate foliar nutritive feeding.

Material and methods

The experiment was conducted at RHRTS & Farm Science Centre of YSPUHF at Sharbo (Reckong Peo), Kinnaur, Himachal Pradesh, India (31°32'20" N and 78°16'03" E), typically a dry temperate region, with annual rainfall between 350-400 mm. The 'Gale Gala' apple orchard established in the valley area, included the trans-Himalayan belt on the northern side of the western Himalayas (Kooppen's climate classification). The study exploited the clonal rootstocks for the bio-efficacy of water soluble customized nutrient (WSCN), K_2O:S:Mg:Ca:Zn:B (6:11:5:0.3:0.3:0.4 w/w) on agronomic performance, qualitative and quantitative traits. The trial procedure included tree fertilization four levels of NPK soil fertilizers (100, 80, 60 and 40% of RDF-NPK, 70:35:70, one-year-old tree basis were supplemented along with WSCN foliar formulation. Statistical analyses were carried out using GLM of the standard errors of the mean, compared by the LSD tested (p=0.05).

Results and conclusion

Application of 60% RDF-NPK+75g WSCN+25 g urea at 15 DAPF followed by 75 g WSCN at 30 and 45 DAPF improved growth traits, fruit coloration, fruit yield and quality attributes. The phenological observations in relation to the initiation of the flowering lasting for 19 days were also recorded. The pest management programme was adopted as per the standard recommendations to manage the apple pest complex. All applied concentrations of WSCN reduced russeting significantly. The effects of the integrated fertilizers schedules with WSCN on russet control were also evaluated. Between the different schedules with foliar WSCN, the differences were also recorded in amount of russetted fruits on EMLA.111/EMLA.7 rootstocks compared to control. The schedules with foliar WSCN on a wet canopy noticed less russetted fruits. The study also identified the relationship yield and productivity related traits to know the direct and indirect effects of independent variables on managerial ability using path coefficient analysis of 'Gale Gala' apples. Besides, PCA of

fruit quality traits revealed the differences on dwarfing rootstock clones at WSCN formulations tested which accounted 100% of the cumulative variance (prin4).

Table 1: PCA (Pearson, n) and Factor Loadings in Fruit Quality Traits at Various WSCN Formulations in 'Gale Gala' Apple on EMLA Clonal Rootstocks.

Parameter	Principal Component			
	prin1	prin2	prin3	prin4
Eigen value	12.1	1.76	0.69	0.45
Variability (%)	80.7	11.7	4.5	2.9
CV (%)	80.7	92.4	97.0	100.0
Fruit quality traits	Factor loadings			
	F1	F2	F3	F4
Fruit length	0.93	-0.14	-0.34	0.01
Fruit breadth	0.93	0.28	-0.01	-0.22
Fruit weight	0.98	0.15	0.03	0.10
Fruit volume	0.92	0.37	-0.05	0.09
Fruit firmness	0.97	-0.09	0.11	0.21
Juice pH	0.54	-0.70	0.35	0.31
Total soluble solids	0.89	0.05	0.36	-0.28
Acidity	-0.51	0.73	0.39	0.22
TSS: acid ratio	0.83	-0.46	0.25	-0.20
Reducing sugars	0.95	0.32	-0.01	0.03
Non-reducing sugars	0.98	0.17	0.04	0.05
Total sugars	1.00	0.08	-0.01	0.05
Fruit colouration	0.93	-0.25	-0.24	0.12
Ascorbic acid	0.98	0.05	0.09	-0.19
Russeting	-0.96	-0.22	0.16	-0.11

Factor scores					
Rootstock	FT	F1	F2	F3	F4
EMLA.111/ EMLA.7	T_1	-0.83^{d}	1.56^{a}	-1.26^{d}	0.33^{b}
	T_2	1.71^{c}	-0.06^{c}	0.88^{a}	1.08^{a}
	T_3	1.97^{b}	1.33^{b}	0.75^{a}	-0.91^{d}
	T_4	3.52^{a}	-1.95^{e}	-0.65^{c}	-0.30^{c}
	T_5	-6.38^{e}	-0.88^{d}	0.27^{b}	-0.20^{c}

CV, Cumulative variance; FT, Fertilizer treatment; Mean followed by same letter within columns are not significant; F1, factor-1; F2, factor-2; F3, factor-3; F4, factor-4

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Impact of Nitrogen Sources on Cropping Behavior of Royal Delicious Apples in Temperate Ecosystem

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Keywords: Nitrogen, Vegetative Growth, Yield

Introduction

Optimal mineral nutrition has an important role in growth and productivity of apple. To ensure a regular crop, the application of manures and fertilizers is a common orcharding practice. However, NPK are the commonly deficient nutrients occurring in the orchards in sloppy hilly terrains. The soil application of calcium ammonium nitrate (CAN) is presently recommended for apple orcharding. Due to its scarcity and non-availability in market has led to the use of other easily available alternative nutrient sources. Therefore, the present study was focused and planned with the objective to find out the response of plants to N soil fertilizer inputs on cropping behavior of 'Royal Delicious' apple.

Material and methods

The study was conducted at Denwari in Shimla district of Himachal Pradesh. The experiment was arranged as RCBD (factorial) with four replicates. Different factor levels of NPK fertilizers included as i) urea alone ii) calcium nitrate alone; iii) NPK-19:19:19 along with urea; iv) NPK-12:32:16 along with urea; v) CAN alone. NPK fertilizers sources referred were adjusted with urea (46%N), calcium ammonium nitrate (CAN, 25% N), calcium nitrate (15.5% N), water soluble NPK-19:19:19 and 12:32:16. Three levels of N fertilizers (840 g $tree^{-1}$-120% RDF, 700 g $tree^{-1}$-100% RDF and 560 g $tree^{-1}$-80% RDF) of the blanket RDF-NPK fertilizers (70:35:70) were adjusted.

Results and conclusion

CAN application registered maximum height (7.28 m) followed by calcium nitrate and urea with corresponding values of 6.21 m, 6.18 m, compared to 12:32:16 + Urea (5.98 m). Among different N applied levels, maximum plant height (6.34 m) was recorded in 700 g N $tree^{-1}$. Similarly, maximum tree spread (5.55 m) was exhibited in calcium nitrate and CAN application. Among N rates, maximum (6.01 m) and minimum (5.04 m), tree spread was recorded in 700 and 560 g N/tree respectively. Concerning leaf area, maximum (44.83 cm^2) and minimum (39.75 cm^2) was observed at 700 and 560 g N/tree, respectively. Among interactions, maximum (50.74 cm^2) and minimum (37.33 cm^2) leaf area was observed with CAN (700g N/tree) and urea (560 g N/tree), respectively. Maximum tree girth (63.02 cm) was recorded in 840g N/tree. The nitrogen source of 12:32:16 + urea recorded maximum shoot extension (56.07 cm) and urea registered minimum shoot extension (43.67 cm) in apple trees. Among nitrogen levels, maximum (50.16 cm) and minimum (48.13 cm), annual shoot growth was observed at 700 and 560 g N/tree, respectively. The reason ascribed to the presence of both nitrate and ammonical forms of nitrogen, which led to quick N availability due to NO_3^- and uptake for longer period due to NH_4^+. Similarly, total leaf chlorophylls were also significantly influenced with N fertilizer sources applied.

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Studies on Genetic Divergence in Cucumber (*Cucumis sativus* L.) under Subtropical Conditions of Garhwal Himalaya

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Keywords: Genetic, Genotype, Divergence, Mahalanobis and Cluster

Introduction

Cucumber (*Cucumis sativus* L.) is one of the most important cucurbitaceous vegetables grown throughout the world in tropical and sub-tropical climatic conditions. It is an ideal summer vegetable crop chiefly grown for its edible tender fruits, preferred as a salad ingredient, pickles and as a cooked vegetable. The uses of Mahalanobis D^2 statistic for estimating genetic divergence have been emphasized because it permits precise comparison among all the possible pair of populations in any group before effecting actual crosses. For the selection of parents for hybridization, genetic divergence among the population is necessary for heterotic effect.

Material and methods

The experiment was conducted with 13 genotypes during *zaid* season 2015, at Horticultural Research Centre and Department of Horticulture, H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand (India). The genotypes were collected from different regions of India and evaluated in randomized block design for 25 different characters. The genetic divergence analysis (Mahalanobis 1936), clustering of genotypes (Rao 1952) and inter and intra clustering (Singh and Choudhary 1977) was carried out.

Results and conclusion

Genotypes were grouped into 4 clusters based on Mahalanobis D^2 statistics using Tocher's method. The clustering pattern of genotypes revealed that among the 4 clusters, maximum numbers of genotypes were found in cluster I and III which comprises 5 genotypes each, while clusters IV was mono-genotypic. Intra clusters distance was highest in II (70.365), while lowest in cluster I (49.748). The inter cluster D^2 values were maximum between cluster II and IV (93.131), whereas, minimum distance observed between cluster I and II (66.512) cluster III was the most diverse as many clusters showed high inter cluster distances with it. From the present studies, cluster I secured first rank indicating presence of most promising genotypes in them and these can be extensively used for further breeding programmes to generate new material.

Table 1: Cluster Composition of 13 Genotypes of Cucumber

Cluster	Genotype (no.)	Genotypes
I	5	K-90, SPP-63, PB-Naveen, Seven Star and HP-2
II	2	Mandal and RAJ-1
III	5	Swarna Purna, New Manipur, New Manipur, HP-1,GP-1
IV	1	RAJ-2

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Evaluation of Genetic Diversity in Bitter Gourd under Sub-tropical Conditions of Garhwal Himalaya

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Keywords: Genetic, Diversity, Mahalanobis, Tocher's and Cluster

Introduction

Bitter gourd (*Momordica charantia* L.) is one of the most important commercial crops in the point of economic and medicinal value. The knowledge of nature and degree of divergence in existing germplasm is the basic pre-requisite in breeding programme. Mahalanobis D^2 statistic is based on multivariate analysis of quantitative traits for the assessment of degree of divergence to help plant breeder in choosing suitable parents for hybridization.

Material and methods

The experiment was conducted in 2015 at H.N.B. Garhwal University, Srinagar (Garhwal), Uttarakhand (India). 20 strains of bitter gourd collected. The strains were evaluated in RBD for 37 different characters. Genetic divergence analysis was carried out using Mahalanobis (1936), clustering (Rao 1952) and inter and intra clustering.

Results and conclusion

The results indicated that there is large genetic diversity between the genotypes use in present study. The genotypes were grouped into 5 clusters based on Mahalanobis D^2 statistics using Tocher's method. The grouping pattern of genotypes revealed that among the 5 clusters, maximum numbers of genotypes were found in cluster III which comprises 6 genotypes, while, clusters I and II comprises two genotypes each. The maximum intra clusters distance was observed in cluster IV and lowest intra cluster distance was recorded in cluster I. The cluster IV and V were strikingly diverse from rest of the clusters, the divergence between these two clusters was high as evident from their high inter cluster D^2 value. Therefore, the genotypes falling in these clusters were genetically more divergent. The most important traits contributing to divergence were germination percentage, seed diameter and seed length. The cluster V secured first rank indicating the presence of most promising genotypes. The selection of parents for hybridization should be done form different clusters with wider inter-cluster distance.

Cluster	Number of Genotype	Genotypes
I	2	PDM, VRBTG-1
II	2	VRBTG-2 and VRBTG-3
III	6	VRBTG-4, VRBTG-5, PSPB-14, VRBTG-6, GP-1, VRBTG-8
IV	5	VRBTG-9, MP-1, KVS-7, HP-1 and HP-2
V	5	VRBTG-7, RAJ-1, RAJ-2, MN-1 and JP-1

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Climate Change Trends in Mid-Hill Sub-Humid Zone of HP

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Keywords: Genetic, Climatic pattern, Mid-hills, Linear regression analysis

Introduction

The impact of climate change is not evenly distributed across the world. India as a whole mean annual temperature shows a significant warming trend of 0.51 degree Celsius per 100 years during the period 1901-2007 (Kothawale *et al.* 2010). In the present study Kullu district of Himachal Pradesh has been selected to assess the changes in climatic pattern of mid hill region of Himachal Pradesh.

Material and methods

The present study was undertaken in the Kullu district of Himachal Pradesh which comprises the major apple belt in the state. The data on rainfall, maximum and minimum temperature were collected for last thirty years i.e. 1985 to 2014 from the regional office of India Meteorological Department, Shimla, for Bhunter meteorological station situated at Kullu district of Himachal Pradesh. Linear regression analysis of last thirty years data (1985-2014) was done and regression equations were generated.

Results and conclusion

Trend analysis of mean annual maximum temperature showed an increase of 0.028 °C per year for the period of 1985-2014. Mean annual minimum temperature showed an increasing trend of 0.026 °C increase per year for the period of 1985-2014. Mean annual average temperature followed an increasing trend of 0.027 °C increase per year during the period of 1985-2014 as per the regression equation $y = 0.027x + 17.69$. The mean annual total rainfall showed a decrease of 4.165 mm per year during the period 1985-2014. Hence climate change and effect of global warming has directly evident from the study in the region as there was an increase in maximum, minimum, average and diurnal temperature since last thirty years while rainfall followed a decreasing trend in the valley.

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Effect of Different Sources of Sulphur on Marketable Yield and Quality of Cauliflower in Wet Temperate Zone of Himachal Pradesh

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Keywords: Sulphur, Sources, Yield, TSS

Introduction

Sulphur is the fourth important plant nutrient after nitrogen, phosphorus and potassium. Sulphur deficiencies in India are widespread and scattered. Deficiency of sulphur in Indian soils is on increase due to intensification of agriculture with high yielding varieties and multiple cropping coupled with the use of high analysis sulphur free fertilizers along with the restricted or no use of organic manures leading to depletion of the soil sulphur reserve. Removal of sulphur by crops in India is about 1.26 MT, whereas, its replenishment through fertilizers is only about 0.76 MT. Cole and oilseed crops have been observed to be more responsive as these crops have a significant requirement for sulphur. Whereas, limited supply of sulphur results in the reduction of crop yield, storage life and marketable quality.

Material and methods

The study was conducted at CSK HPKV, Palampur during *rabi* 2014-15. The experimental soil was acidic, silty and clay loam. Treatments comprised all possible combinations of three levels and four sources of sulphur with one control under RBD, comprised 13 (3*4+1=13) treatments. Different sulphur sources applied were: S_1 -Sartaj Natural Gypsum, S_2-Locally available agricultural grade gypsum, S_3-Elemental Sulphur and S_4-Single Super Phosphate.

Results and conclusion

Maximum percent marketable curds 96.3% were found where sulphur was applied @ 37.5 kg ha^{-1}. These were significantly higher in comparison to that observed with the application of 12.5 kg S ha^{-1} (92.2%) and 25 kg S ha^{-1} (94.3%). The minimum percentage of marketable curds 81.3 % was observed in control where no sulphur was added. Number of percent marketable curds increased with increased level of sulphur. In case of sulphur sources the maximum percent marketable curds were achieved where sulphur was applied through Sartaj gypsum which was significantly superior over rest of the sources. The overall mean of sulphur sources (94.3 %) was significantly higher in comparison to control (81.3%). This might be due to better crop growth and yield with the application of sulphur. Different levels and different sources of sulphur had significant effect on harvest index. Harvest index increased significantly with increased level of sulphur. Minimum value of harvest index 28.1% was found in control, whereas, maximum value of harvest index was observed where sulphur was applied @ 37.5 kg ha^{-1} (31.6 %). Also various sources of sulphur had significant effect on total soluble solids (TSS). TSS content was found to be more in all the treatments where sulphur was applied through different sources as compared to control. Loose curds were observed in control and semi-compact in 12.5 kg S ha^{-1}.

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Bionomics of *Aeolesthes holosericea* (Coleoptera: Cerambycidae) on Apple and Stone Fruits

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Keywords: Stem Borer, Bionomics

Introduction
Himachal Pradesh has great diversity of fruit crops like apple, peach, plum, apricot, walnut, pear etc. The cultivation of these fruit crops is directly connected to the economic prosperity of the people. About 20-30 per cent loss is caused by different insect pests on these fruit crops. Among these, *A. holosericea* is one, which causes severe damage but there is a lack of knowledge about the biology, extent of damage and management of this species. Therefore, studies were carried out to know its bionomics, nature and extent of infestation on apple, walnut, peach and plum etc. in Himachal Pradesh.

Material and methods
Survey work was conducted during 2015-2017 in Solan, Sirmour, Shimla, Mandi, Kullu, Kinnaur and Lahoul and Spiti districts of Himachal Pradesh. Infested and collected logs were kept in plastic jars to observe the emergence of adults and record other related observations about larval stages, feeding behaviour and egg laying capacity of the female beetles. Morphometric measurements were recorded for all life stages of *A. holosericea*. Dyar's law was applied to confirm the number of larval instars of *A. holosericea*.

Results and conclusion
In the present investigation, the insect was found to cause extensive damage to the main stem and shoot system of apple, peach, plum, apricot, walnut, pear etc. The severity of infestation by *A. holosericea* in different fruit plants was observed to be maximum at Solan (34.7%), followed by Sirmour (33.6%), Kinnaur (22.5%), Shimla (18.5%), Mandi (13.4%), Kullu (5.7%) and Spiti (0.0%). The emergence of *A. holosericea* adults began during the first week of April and continued till June. Eggs were laid in the crevices of twigs in series but singly, very few eggs in cluster comprising of 2-3 in numbers. Eggs were creamy white in the beginning but changed to pale yellow, later. Eggs were oval in shape and measured 2.70 ± 1.16 mm in length and 1.11 ± 1.04 mm in width. The incubation period of eggs was observed to range between 8-16 days with an average of 9.46 ± 0.55 days. There were seven larval instars which took about 16.38 ± 1.16 months and 15.45 ± 2.31 days to develop from first instar to mature larva. This period included the overwintering period of 5-6 months. Adult longevity for male and female were 23.64 ± 15.09 and 15.44 ± 12.93 respectively. The pest has a total life span of two years (24.19 ± 1.23 months). Distinct Sexual dimorphism was observed as males were smaller in size than females and possessed very long antennae, almost double the length of body size.

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Long Term Effect of Integrated Nutrient Management on Yield of Maize and Wheat

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Keywords: INM, Maize, Wheat, Yield

Introduction

In India, maize and wheat contributing 44.4 % in food grain production and are major crops of irrigated areas in northern parts of the country. Maize and wheat require huge amount of nutrients for producing more yields as both are exhaustive crops. Therefore, raising the viability of this important cropping sequence holds the key to the transformation of agricultural scenario in India. Integrated nutrient management helps in mitigating soil and low yield problems to some extent. Application of organo-inorganic combination is very effective in realization of high yield and high responses to added nutrients.

Material and methods

The investigation was carried out in the ongoing long-term fertilizer experiment initiated during 1972 at experimental farm of Department of Soil Science, CSK HPKV, Palampur and the yield of maize and wheat for 2014-15 was recorded. The experimental soil was classified taxonomically as 'Typic Hapludalf'. The recommended dose of N, P_2O_5 and K_2O for wheat was 120, 60 and 30 kg ha^{-1} and for maize 120, 60 and 40 kg ha^{-1}, respectively.

Results and conclusion

Highest grain yield of maize and wheat was obtained in 100 per cent NPK + FYM, which was at par with 100 per cent NPK + lime. The continuous application of N alone through urea (100% N (T_7)) for forty three years resulted in zero yields of maize and wheat. Except 100 per cent N treatment the lowest grain and stover/ straw yield was obtained in control due to zero fertilization and continuous cropping in this treatment. Imbalanced application of nutrients in 100 per cent NP and 100 per cent NPK (-S) resulted in significant reduction in maize and wheat production as compared to 100 per cent NPK with sulphur. This showed the significance of sulphur and potassium in nutrition of maize and wheat. The addition of FYM results in the release of organic acids that can complex Al and Fe, thereby, reducing P retention and inducing greater P availability. Moreover, sulphur was also added through the application of FYM (30 kg S ha^{-1}) which also contributed in increasing maize and wheat production. Application of lime with 100 per cent NPK also resulted in increasing the maize and wheat yield as lime increased the soil pH (6.27). Continuous application of 100 per cent NPK + FYM recorded the highest productivity of both the crops which was at par with 100 per cent NPK + lime, whereas the lowest or zero productivity was recorded with continuous application of 100 per cent N alone in both the crops.

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Effect of Soil Test Based Fertilizer Application under Integrated Nutrient Management on Soil Available Nutrients Status in an Acid Alfisol

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Keywords: Prescription Based Fertilizer Recommendations

Introduction

'Prescription Based Fertilizer Recommendations' substitutes the exact values for soil available N, P and K (Rao and Srivastra 2000) has been well recognized as a better approach than the existing practice of general fertilizer recommendation. Soil fertilizer management can positively or negatively affect the availability of soil nutrients. Therefore, the objective of the present experiment was to study the changes in soil available nutrients under STCR approach of fertilization.

Material and methods

A field experiment was conducted during *rabi* 2014-15 at Department of Soil Science, CSK HPKV, Palampur. Three doses of lime (0, 1/10 and 1.0 LR) designated as L_0, L_1 and L_2 and four doses of fertilizer; F_1-general recommended dose, F_2- soil test based, F_3- Target yield 30 q ha^{-1} (IPNS), F_4- Target yield 40 q ha^{-1} (IPNS) were tried in twelve combined treatment in randomized block design. The equations used: F N = 5.27 T – 0.25 SN–1.06 ON; F P_2O_5 = 4.13 T – 0.38 SP– 0.98 OP; F K_2O = 2.87 T – 0.15 SK – 0.55 OK

Results and conclusion

Addition of lime and FYM in treatments of targeted yield 30 and 40 q ha^{-1} significantly enhanced available NPK. A significantly depressive effect by the application of lime was recorded on the status of DTPA extractable micronutrients over no lime treated plots except Zn (Table 1). The application fertilizers for targeted yield treatments with organic manures (FYM) recorded significantly higher values of DTPA extractable micronutrients over general recommended dose and soil test based treatments. It can be concluded that application of lime and FYM under prescription based fertilizer application was effective and improved available macro nutrients status in soil.

Table 1: Micronutrients (mg kg^{-1}) availability in Prescription Based Fertilization

Treatments	Fe	Mn	Zn	Cu
Recommended Dose	21.4	19.1	1.28	0.82
Soil Test Based	21.9	20.9	1.29	0.84
Target yield 30 q ha^{-1} (IPNS)	25.3	23.2	1.36	0.87
Target yield 40 q ha^{-1} (IPNS)	27.9	25.1	1.39	0.91
General Recommended Dose + 1/10 LR	17.9	17.0	1.31	0.80
Soil Test Based + 1/10 LR	18.8	18.2	1.34	0.82
Target yield 30 q ha^{-1} (IPNS) + 1/10 LR	19.3	19.4	1.37	0.85
Target yield 40 q ha^{-1} (IPNS) + 1/10 LR	19.9	20.5	1.41	0.86
General Recommended Dose + 1.0 LR	16.0	16.5	1.33	0.75
Soil Test Based + 1.0 LR	16.6	17.2	1.35	0.76
Target yield 30 q ha^{-1} (IPNS) + 1.0 LR	17.4	17.5	1.39	0.78
Target yield 40 q ha^{-1} (IPNS) + 1.0 LR	18.3	18.3	1.43	0.80
CD (P=0.05)	0.55	0.88	0.03	0.02

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Management of Sucking Pests of Chilli

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Keywords: Whitefly, Spirotetramat, Thrips, Mite

Introduction

Chilli, also called red pepper belongs to the genus Capsicum, under the Solanaceae family. Chilli is considered as one of the commercial spice crop. It is the most widely used as an universal spice, named as *wonder spice*. Different varieties are cultivated for various uses like vegetable, pickles, spice and condiments. It is raised over an area of 1832 thousand hectares in the World, with a production of 2959 thousand tons. The pest profile of chilli is complex with more than 293 insect and mite species debilitating the crop in the field as well as in storage. Chilli crop is infested by many insect pests, among which, sucking pest complex viz., thrips, *Scirtothrips dorsalis* and mites, *Polyphagotarsonemus latus* and pod borers, viz, *Helicoverpa armigera* and *Spodoptera litura* are prominent (Reddy *et al.* 1989). The pest population dynamics fluctuates with the agro meteorological parameters which can be vividly analysed to manipulate the synchrony of sowing time and pest infestation to overcome the crop loss (Singh *et al*. 2011). Indiscriminate use of pesticides causes the development of genetic resistance in the insects and makes the sprays ineffective. The pesticide sprays also tilt the ecological balance in favour of pests by killing the natural enemies. So, sustainable management of the pests needs an innovative approach by introduction of new molecules.

Material and methods

A field experiment was carried out in 2015-2016 at BCKV, Nadia on Chilli variety, Bullet. The number of motile stages of the aphids, thrips, whiteflies and mites on 5 apical leaves per plant and 5 randomly selected plants per replication were counted before and after 3rd, 5th, 7th day of application. Population of thrips, whitefly yellow mites was calculated. The data on infestation and yield were subjected to analysis of variance after making necessary transformation. The percent reduction or increase (+) of important predators such as Coccinelids like *Menochilus spp*, *C. septumpunctata* and Neuropteran ant such as *Chrysoperla spp.* was worked out.

Results and conclusion

The results showed that Spirotetramat (BYI 08330) 150 OD @ 90g a.i./ha provided excellent control of sucking pests viz., thrips, whiteflies and mites, along with significant increase in yiel. The same chemical @ 75 g a.i./ha gave highly satisfactory control of these two pests. It did not produce any phytotoxic symptoms on chilli and was very soft to major predatory groups.

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Evaluation of Different Insecticides and Botanicals against White Stem Borer, *Scirpophaga fusciflua* Hampson

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Keywords: Kharif, Dead hearts, White ears

Introduction

Rice (*Oryza sativa* L.), is the most important cereal crop of the world. More than 90 per cent of the world's rice is grown and consumed in Asia, where 60 per cent of the earth's people live. The rice crop provides host to over 800 species of insect herbivores from nursery to harvest but only a few of them are of potential threat and have gained the major importance as far as loss in yields caused by them are concerned. Stem borers are key group of insect pests of rice. The yield losses caused by insect pests in rice have been reported to the tune of 25 per cent.

Material and methods

The field experiments were conducted on paddy at farmer's field in the Kangra district, during *Kharif* 2015 and 2016. Application of various insecticides *viz*. (flubendiamide 48% SC @ 50 ml ha^{-1}, rynaxypyr 20 SC @ 150 ml ha^{-1}, dinotefuran 20 SG, monocrotophos 36 SL @ 850 ml ha^{-1} and biopesticides *viz*. melia 5%, eupatorium 5% @ 2.5 Lha^{-1}, were tested along with untreated control. The data was analyzed statistically in RBD (Singh *et al.* 1991).

Results and conclusion

All the insecticidal treatments were significantly superior to untreated control. Fame 480 SC @ 50 ml ha^{-1} and rynaxypyr 20 SC @ 150 ml ha^{-1} were found most promising with minimum dead heart and white ears. The data on dead heart, white ear incidence, grain yield showed that all the insecticides effectively control the stem borer on basmati rice. Considering the efficacy data and very low dose Fame 480 SC proved to be better and economically viable option for management of rice white stem borer.

Table 1: Efficacy of Insecticides and Biopesticides against White Stem Borer

Treatments	Prior to spray	First spray (% DH)		Second spray (% DH)	Second spray (% WE)	Yield (q/ha)
		7 DAFS	15 DAFS	7 DASS	15 DASS	
Flubendiamide	8.98 (17.38)	9.19 (17.56)	10.47 (18.75)	10.56 (18.84)	2.74 (9.52)	41.83
Rynaxypyr	9.04 (17.40)	9.32 (17.67)	10.00 (18.31)	11.33 (19.52)	3.58 (10.90)	41.16
Dinotefuran	8.23 (16.60)	8.54 (16.90)	10.27 (18.53)	11.99 (20.19)	5.52 (13.57)	38.96
Monocrotophos	8.74 (17.15)	9.21 17.63)	11.33 (19.62)	13.61 (21.62)	6.73 (15.03)	37.27
Melia	7.92 (16.29)	9.67 (18.07)	13.58 (21.55)	15.49 (23.11)	10.85(19.22)	33.90
Eupatorium	8.13 (16.42)	9.80 (18.14)	12.78 (20.83)	14.99 (22.68)	9.56 (17.99)	34.57
Control	8.75 (17.16)	2.05(20.28)	5.23 (22.95)	16.96 (24.30)	12.20(20.44)	31.97
CD(0.05)	NS	1.61	1.65	1.56	0.62	1.86

Figures in the parentheses are the arc sin transformed values; DAFS: Days after first spray and DASS: Days after second spray; DH= dead hearts, WE= white ears

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Leaf Nutrient Content of Cauliflower as Influenced by Organic and Inorganic Fertilizers Application

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Keywords: INM, Macronutrients

Introduction

Green revolution with high use of inorganic fertilizers has reached a plateau with falling dividends. The long term and imbalanced use of these inorganic fertilizers may pollute soil, water and environment. The nutrient management paves the way to overcome these problems by conjunctive use of chemical fertilizers and organic manures to sustain crop yield & quality as well as maintenance of soil health. Moreover, increasing cost of chemical fertilizers stresses need to substitute a part of the nutrient requirement through organic sources of nutrients to make crop cultivation an economically viable proposition for sustainable crop production.

Material and methods

The present investigation was carried out at Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, during 2014-15 and 2015-16 with cauliflower cv. Pusa Snowball K1. The experiment was laid out in a randomized complete block design with three replications comprising seven treatments viz.T_1(100% NPK + FYM), T_2(100% NPK + FYM+ PGPR),T_3(100% NPK+ 50% FYM and 50% VC on N equivalence basis + PGPR),T_4 (75% NPK+50% FYM and 50% VC on N equivalence basis), T_5 (75% NPK+50% FYM and 50% VC on N equivalence basis+ PGPR), T_6 (50% NPK+ 50% FYM and 50% VC on N equivalence basis) and T_7 (50% NPK+ 50% FYM and 50% VC on N equivalence basis + PGPR).Composite samples were collected from the most recently fully matured leaves at curding stage of crop.

Results and conclusion

Effect of conjoint application of inorganic and organic sources on leaf N P K was significant. Highest NPK in leaf was (2.81%, 0.46% and 1.74%) under T_3. The growth and fruitfulness be considered as an index of nutrient status of the leaf so addition of appropriate measures to ensure optimum nutrient status will go a long way in maintaining cauliflower in vigorous state which will ensure optimum levels of productivity. Soil application of different organic and inorganic sources had an appreciable influence on leaf macro nutrient status. The increased availability of macro and micro nutrients in cauliflower leaves with the addition of FYM, vermicompost and PGPR might be due to acceleration of microbial nitrogen fixation, improved physical condition of soil, more moisture retention and thus increased absorption of water and nutrient. The increase in leaf nutrient content in different treatments receiving organic manures and microbial fertilizers also suggest that these microbial fertilizers solubilse the available nutrient pool in the soil and improves the uptake of macro nutrients (Yildirim *et al* 2011).

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Assessment of Microbial Biomass and Microbial Activity under Integrated Nutrient Management in Cauliflower

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Keywords: Integrated nutrient module, PGPR, Chemical fertilizers

Introduction

Soil harbours a dynamic population of microorganisms; their abundance in rhizosphere gives an indication of their possible role in decomposition of organic matter, fixation of atmospheric nitrogen, phosphate solubilization, transformation of nutrient elements, etc. Cauliflower (*Brassica oleracea* var. *botrytis* L.) is grown as a commercial winter crop for table purpose and as a seed crop in Himachal Pradesh. Nutrient management in cauliflower cultivation is an important aspect and these are mainly supplied through chemical fertilizers which has accelerated soil deterioration. In the present era, Integrated Nutrient Management (INM) technology consisting of effective inoculum of plant growth promoting rhizobacteria (PGPR's) and optimum doses of N and P fertilizer is the key to achieve higher crop productivity and also to sustain soil health. So, the present investigations were undertaken to study the effect of integrated nutrient module on soil microbiological properties without degradation of soil health.

Material and methods

The field experiments were conducted at Ghaluwal (Una), Lalsingi (Una) and UHF-Nauni (Solan). The treatment combinations viz.:T_1 (RDF), T_2 (MK_5+75% NP), T_3 (SB_{11}+75% NP), were arranged in RBD design and replicated seven times. Soil microbiological parameters viz. microbial biomass and microbial activity were analyzed from rhizospheric soil of cauliflower crop. Microbial biomass–C was determined by soil fumigation-extraction method detailed by Vance *et al*. (1987) and soil microbial activity was determined by the CO_2 evolution method described by Parmer and Schmidt (1964).

Results and conclusion

Microbial biomass–C ranged from 38-70.1 mg MB-C/100 g soil at Ghaluwal, 28.5-50.5 mg MB-C/100 g soil at Lalsingi and 26.7 to 56.5 mg MB-C/100 g soil at UHF- Nauni. The rate of CO_2- evolution increased with incubation time *i.e.* from 24 to 48 hours then followed a decreasing trend in all the three treatments at all the locations. Integrated application of PGPR isolate (s) and chemical fertilizers recorded maximum CO_2 evolution than the sole application of chemical fertilizers. Among the treatments, the application of MK_5 isolate at 75 per cent NP increased CO_2-evolution at Ghaluwal and UHF-Nauni, whereas, SB_{11} isolate at 75 per cent NP increased CO_2-evolution at Lalsingi. Thus, the conjoint application of MK_5 or SB_{11} isolate at 75 per cent doses of N & P has good prospects for enhancing the soil microbiological properties thereby sustaining soil health.

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Effect of Orchard Floor Management Practices on Fruit Quality in Nectarine cv. Snow Queen

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Keywords: **Colour, Graded Yield, Nectarine, Orchard**

Introduction

The peach [*Prunus persica* (L.) Batsch] is an important stone fruit crop of the sub-temperate mid hill regions of Himachal Pradesh. Nectarine [*P. persica* var. *nucipersica* (or var. *nectarina*)] has a non pubescent skin due to lack of fuzz or short hairs. Moisture stress and erratic rainfall in Himachal Pradesh during the fruit growing period, as such it becomes essential to develop strategies to conserve the soil moisture during the growing period in nectarine orchard.

Material and methods

The present investigation was carried out to study the effect of orchard floor management practices on fruit quality in nectarine cv. Snow Queen during the years 2016 and 2017**.** The experiment was laid out in a Randomized Block Design replicated four times. The experiment consisted of seven treatments viz., black polythene mulch (T_1), bicolour polythene mulch (T_2), nylon mulch mat (T_3), grass mulch (T_4), chemical weed control (T_5), hand weeding (T_6) and control (T_7).

Results and conclusion

The results revealed that the bicolour polythene mulch recorded maximum fruit size (length- 52.85, 57.27 mm; breadth- 51.21, 55.04 mm**)**, weight **(**77.86, 89.41 g**),** volume (81.01, 92.49 cc**),** pulp to stone ratio (14.69, 15.52**),** ground colour (Yellow green group 149 C and Yellow green group 145 B) and surface colour **(**Red 46 A group and Red 46 A) , TSS (12.78, 12.92 º Brix), TSS acid ratio (24.66, 25.74), total sugars (9.25, 9.37 %), reducing sugars (4.06, 4.13 %), non-reducing sugars (4.94, 4.98 %), ascorbic acid (11.70, 11.90 mg/100 g fruit), proportion of "A" grade fruits (64.72, 68.97 %) and minimum titratable acidity (0.52, 0.50**%)** during 2016 and 2017 respectively. Minimum value of fruit quality traits were recorded under control in both the years of study.

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Effect of Foliar KNO_3 on Yield and Fruit Quality of Apple

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Keywords: **Yield, Foliar nutrition**

Introduction

Apple is grown over an area of 12375 ha in Chamba district of Himachal Pradesh accounting for 5501 MT production annually. The average productivity of apple in the district is only 2.25 MT/ha, which is far behind the potential of the crop. Although a number of factors such as low density orchards, poor soil fertility & irrigation facilities, steep slopes, inclement weather conditions and poor orchard management practices have been found to be associated but improper nutrition of the plants is still the most important factor. Foliar nutrition has been used successfully in order to avoid deficiencies, to control growth and to improve quality and storability of apple fruits. Beneficial effects of foliar fertilizers measured by yield quantity and quality could be confirmed by these applications. Therefore the present study was undertaken to assess the effect of foliar application of KNO_3 on yield and quality of apple.

Material and methods

Four treatments viz. injudicious fertilization (Farmer's practice as control), 700g K_2O+0.50% KNO_3 at pea stage, 700g K_2O+KNO_3 @ 0.50% at walnut stage and 700g K_2O+KNO_3 @ 0.50% at pea and walnut stage were applied to uniform trees at three locations. Each treatment was replicated five times. The experiment was conducted at three different sites at altitudes between 1800 to 2200 m above mean sea level. Three orchards were selected at each location and uniform trees of cultivar Royal Delicious were applied with the treatments. All the foliar fertilization treatments enhanced the size of fruits over untreated fruits.

Results and conclusion

Highest fruit length (5.94 cm), diameter (5.37 cm) and fruit weight (97.4 g) was recorded in the treatment T_4 which confirm the beneficial effect of foliar fertilization. The treatment T_3 and T_4 significantly increased the fruit yield whereas T_2 was statistically at par with untreated plants. The increase in fruit size directly reflected in enhancement of total yield (96.4 q/ha) in the treatment T_4. Treatments with KNO_3 increased the proportion of large grade fruits. The proportion of a grade fruits was highest in treatment T_4 (33%) as compared to 21 % in control. The proportion of medium and large fruits was enhanced by the foliar fertilization treatments which enhanced the net returns. The B:C ratio was highest (3.15) in T_4 against (2.32) in control.

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Regional Land Use/ Land Cover Change Dynamics and Drivers for Mid-Hills of Himachal Pradesh

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Keywords: Climate change, Land use change, Remote sensing

Introduction

Land use and land cover changes are one of the main factors affecting the ecosystem integrity. Globally area under traditional crops is decreasing, however it is increasing under cereals, vegetable, fruit and oil crops. Like other parts of the world, India is also experiencing land use changes. In the recent past, Solan district of Himachal Pradesh has undergone tremendous transformation in land uses due to changes in agricultural cropping pattern, urbanization and industrialization. A study was undertaken to identify and quantify dominant land use changes and its drivers in mid hills of Solan district.

Material and methods

The study was conducted in Kandaghat and Solan Blocks of Solan district of Himachal Pradesh falling in mid hills (between 650 to 1800 masl). Spatio-temporal land use changes were analyzed with remote sensing technique using Landsat imageries of 1989 and 2016. Four major land uses *viz.* agriculture, orchards, forests and built up were classified through supervised classification using ERDAS Imagine 14 software. Results were further verified through secondary and primary data collected by detailed questionnaire based survey of 100 households and drivers for such changes were also identified. The primary data was analyzed by using SPSS v 20.0.

Results and conclusion

Land use/ land cover map of 1989 and 2016 indicated that during last 27 years, the built up area has increased to the extent of 131.49 % followed by agriculture (38.74%), whereas area under orchard and forest was decreased by 12.73% and 3.79%. Primary data revealed the decrease in area under traditional agriculture by 81.70%, whereas vegetable cultivation per household in the region exhibited a sharp rise by 291.43% followed by built up (30.77%). Orchards per household showed a decreased by 47.62% in the region. The primary data also revealed that farmers are abandoning the wheat, paddy, maize, barley and fruit crops and pursuing cultivation of vegetable crops. Increased economic returns from highly remunerative cash crops emerged as the major drivers for the land use changes in as perceived by 58% of the respondents, followed by climate change (14%).

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Effects of Saline Irrigation on Yield Attributes in Chickpea

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Keywords: Salinity, Chickpea and Yield

Introduction

Salinity is one of the most serious factors limiting the productivity of agricultural crops, with adverse effects on germination, plant vigour and crop yield. Worldwide, more than 45 million hectares of irrigated land have been damaged by salt, and 1.5 million hectare are taken out of production each year as a result of high salinity levels in the soil (Munns and Tester, 2008).

Material and methods

A pot experiment was conducted in year 2015-2016 and chickpea were grown in dune sand soil. With this in mind, the effects of saline irrigation on yield and yield attributes in two chickpea (*Cicer arietinum* L.) genotypes viz. HC-3 and CSG-8962 with close phenology but differing in their sensitivity to salinity was investigated under natural conditions of screen house. At the vegetative stage (40-45 DAS) plants were exposed to single saline irrigation (Cl^-dominated) of levels 2.0, 4.0 and 6.0 dS m^{-1}. The control plants were irrigated with distilled water. Sampling was done at the flowering stage (85-90 DAS).

Results and conclusion

The results of investigations showed that saline irrigation led to a considerably percent reduction in number of seed pod^{-1} was 18.3 - 21.7% in HC-3 and 18.3 – 22.4% in CSG-8962 from 2 to 6 dS m^{-1} with respect to control. The yield and yield attributes like number of pods $plant^{-1}$, 100 seed weight and biological and seed yield $plant^{-1}$ also decreased with increasing saline irrigation from control to 6.0 dS m^{-1}. The reduction is more in CSG-8962 as compared to HC-3. Hence, the mechanism of salt tolerance is relatively better in HC-3 than in CSG-8962 as found from physiological and yield attributes studied. The genotype HC-3 can further be used in crop improvement programmes of chickpea for salt tolerance.

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Maintenance of Gynoecious Lines of Cucumber through Induction of Staminate Flower using Silver Thiosulphate

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Keywords: Silver thiosulphate, Gynoecious lines, GYNO-1

Introduction

Cucumber (*Cucumis sativus* L; 2n = 2x = 14), is one of the most economically important members of the family cucurbitaceae. It is an annual creeping vine that can be grown round the year. It is grown as summer and rainy season crop in mid and low hills of HP. However, the induction of staminate flowers on plants is dependent on concentration of chemical, growth stage at which applied and method of application. The present study aims to evaluate the effects of different concentration of silver thiosulphate to identify the best treatment for male expression in cucumber. The best selection could be important with respect to longer male flowering period, high numbers of male flowering and thus increasing the feasibility of large scale seed production of gynoecious x gynoecious cucumber hybrids.

Material and methods

The present investigation was carried out at Dr. YSPUHF Nauni during Kharif, 2016. The experimental material comprised of two gynoecious lines of cucumber viz., GYNO-1 and GYNO-2. The experiment was laid out in a RCBD with three replications. Row to row and plant to plant spacing of 100 cm × 50 cm was kept in a plot having size 3.0 m × 3.0 m. Silver thiosulphate were sprayed in concentration of 250, 500 and 750ppm and 10 plants were included in each treatment for spray and control (distilled water) at 2-4 true leaf stage. The number of male flowers appeared after sprays were counted to determine the shift in sex expression of gynoecious lines and compare it with the control

Results and conclusion

Silver thiosulphate spray increased the number of staminate flower whereas no male flower has been recorded in control. Mean number of male flowers induced through silver thiosulphate at 500 ppm (56) were more and significantly higher than other two concentrations of silver thiosulphate applied at 250 ppm (39.17) and 750 ppm (44.77). Among cultivars, GYNO-2 produced significantly more number of male flowers (36.18) than GYNO-1 (33.79). Interactions (concentrations × varieties) had significant effect on the induction of male flower through silver thiosulphate. It ranged from 0.00 – 57.60. Maximum number of male flowers induced through $Ag_2S_2O_3$ was recorded in GYNO-1 at 500 ppm (54.4) and no male flower was in control). Similarly in GYNO-2, mean number of male flower induced through $Ag_2S_2O_3$ at 500 ppm (57.60) was more and no male flower observed in control. The gynoecious lines GYNO-1 and GYNO-2 used in the present study behaved as strong female lines under the given environment. These lines, therefore, were designated as gynoecious lines. Spray of chemical silver thiosulphate on these gynoecious line increased the number of staminate flowers by 500 per cent by just one spray at two true leaf stages. Silver thiosulphate was found to be best in induction of male flowers at 500 ppm concentration. Longer availability of male flowers on GYNO-1 and GYNO-2 lines induced with the help of silver thiosulphate would, thus, allow synchronization with other monoecious lines for a longer period.

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Effect of Zinc and Sulphur on Growth, Yield and Economics of Cluster bean

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Keywords: Growth, Yield, Economics

Introduction

Clusterbean popularly known as 'guar' is a drought hardy and deep rooted legume crop grown for feed, fodder, green manure and vegetable purpose. Being a legume crop, it has the capacity to fix atmospheric nitrogen by its effective root nodules (Kumhar *et al.* 2012). The potential yield of most of the varieties ranges from 18-20 q/ha but the average yield productivity of the country is less than potential average. This may be ascribed to many reasons but inadequate and imbalanced fertilization is the major factor. Sulphur plays an important role in synthesis of S containing amino acid and thus not only increases the crop yield but also improves the crop quality. The micronutrient in general and zinc in particular. Zinc (Zn) is required for plant growth, as an activator of several enzymes and is directly involved in the biosynthesis of growth regulators such as auxin. The work undertaken on these aspects in Clusterbean is very meagre. Therefore, keeping this in view a study was conducted on effect of zinc and sulphur on growth and yields of Clusterbean.

Material and methods

A field experiment was conducted during *Kharif* 2015 at Research Station, Sirsa, CCS HAU, Hisar (India). The soil of the experimental field was loamy sand, slightly alkaline in reaction, low in organic carbon and nitrogen, medium in phosphorus, low in zinc and sulphur. The experiment was conducted in RBD with three replications. The experiment consist of 16 treatments in which N and P were applied as per recommended dose, RNP (N= 20kg/ha, P2O5= 40kg/ha) along with different doses of Zn (10, 20 and 30kg/ha) and S (20, 30 and 40kg/ha) and their combinations. The sowing of clusterbean variety HG-2-20 was done on 14th July, 2015 using seed rate of 15 kg/ha.

Results and conclusion

Growth parameters *viz.* plant population; plant height and dry matter accumulation were maximum in RNP+$ZnSO_4$@30kg+S@40kg/ha. Yield attributes *viz*. no. of pods/plant, no. of grains/pod, Yield *viz*. grain, straw and biological yield were also recorded highest, while maximum harvest index was observed in RNP+$ZnSO_4$@10kg+S@20kg/ha and highest 1000 grains weight (test weight) was observed in RNP + $ZnSO_4$ @20 kg + S @40 kg/ha compared to other nutrient treatments.

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Integrated Nutrient Management System for Productivity and Profitability of Cabbage-Capsicum-Radish Cropping Sequence in Sub-Temperate Climate

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Keywords: INPS, PGPR, Soil health, Crop sequencing

Introduction
Population growth and urbanisation are creating increased demand of food and there is growing concern of malnutrition. Boosting yield, reducing production cost and improving soil health are three inter -linked components of the sustainable triangle (). Therefore, suitable combination of chemical fertilizer and organic manures cultures need to be developed for particular cropping system and soil. Cabbage- capsicum- radish is one of the remunerative cropping sequences prevalent in mid hill areas of the Himachal Pradesh. Accordingly, the present study, had therefore, been aimed to evolve integrated plant nutrient supply system for cabbage-capsicum-radish based cropping systems on sustainable basis.

Material and Methods
Experiment was carried out for two years (2014-2016) at YSPUHF, Nauni Solan, (HP) to evolve *INPS* system for higher productivity and soil health. The experiment was laid out in RBD with 03 replicates comprising 15 integrated combinations of inorganic and organics including PGPR viz., T_1: (RDF (NPK)+ FYM), T_2: 75%NP + VC@ 2.5t/ha, T_3: 50% NP+VC@2.5t/ha, T_4: 75% NP+ EC@2.5t/ha, T_5: 50%NP+EC@2.5t/ha, T_6: 75%NP+PGPR, T_7: 50%NP+PGPR, T_8: 75%NP+VC@2.5t/ha+PGPR, T_9: 50%NP+VC@2.5t/ha+PGPR, T_{10}: 75%NP+EC @2.5t/ha+PGPR, T_{11}:50%NP+EC@2.5t/ha+PGPR, T_{12}: 75%NP+VC and EC@2.5t/ha, T_{13}: 50%NP +VC and EC@2.5t/ha, T_{14}: 75%NP+VC and EC@2.5t/ha+PGPR, T_{15}: 50% NP+VC and EC@2.5 t/ha+PGPR. Cabbage cv. Pusa Mukta, capsicum cv. Solan Bharpur and radish cv. Chinese Pink were used.

Results and conclusion
The module T_{14} recorded highest yields (47.24, 36.77 and 25.24 q/ha), earned highest net returns of Rs 4.22, 4.71 and Rs 2.31 lacs/ha with the corresponding B: C ratio of 2.75, 2.73 and 1.57 for cabbage, capsicum and radish, respectively. Accordingly, the annual net return over the cropping sequence (cabbage - capsicum - radish) was also significantly higher (Rs 11.24 lacs per hectare) with a B: C ratio of 2.35 as compared to any of the other integrated module including recommended practice. This module also enhanced soil health as envisaged through the increased post harvest availability of N, P and K by 51.25, 152.03 and 13.79 per cent, over the initial content. Concluding, the integrated module T_{14} along with full recommended potash and FYM as basal application which resulted in saving of 25 % fertilizers (NP), higher yield along with enhanced soil health, can be suggested as a cost effective combination under sub-temperate climatic conditions of north-western Himalayas, on sustainable basis.

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Integrated Nutrient Management in Sweet Pepper Grown in Subtropics of Himachal Pradesh

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Keywords: INM, Capsicum

Introduction

Intensive agricultural system with the consistent and indiscriminate use of inorganic fertilizers have caused serious damage to the soil health, ecology and caused decline in the vitamin and mineral content of the fresh fruits and vegetables (Worthington, 2001). The addition of farm organic wastes, manures and vermicompost etc. are of utmost importance in maintaining the fertility and productivity of agricultural systems. Organic manures and biofertilizers have ability to mobilize the nutritionally important elements from non-unusable form to usable form through biological processes and are known to increase yield in many vegetable crops.

Material and methods

The study was conducted during 2014 and 2015 at College of Horticulture & Forestry, Neri to study the effect of integrated nutrient management on growth, yield and quality of capsicum cv. California Wonder under subtropical conditions of Himachal Pradesh. The experiment was laid out in a randomized block design with three replications. The treatments consisted of T1 - Control, T2- 100% NPK, T3 - FYM @ 20 t ha -1, T4 - Vermicompost @ 10 t ha^{-1}, T5 - 50% NPK + 50% FYM, T6 - 50% NPK + 50% Vermicompost, T7 - 50% NPK + 50% FYM + Biofertilizers, T8 - 50% NPK + 50% Vermicompost + Biofertilizers.

Results and conclusion

Organic manures and biofertilizers either alone or in combination significantly increased the growth, yield and quality of capsicum as compared to control. The maximum plant height (42.36 cm), number of leaves $plant^{-1}$ (35.31), leaf area (50.95 cm^2), number of fruit $plant^{-1}$ (10.32), average fruit weight (62.27 g), fruit length (8.32 cm), fruit diameter (5.52 cm), fruit yield (206 q ha^{-1}) and TSS (8.77^o Brix) were with the conjoint application of 50% NPK + 50% vermicompost + Biofertilizers followed by application of 50% NPK+50% FYM + Biofertilizers which produced fruit yield of 196.8 q ha^{-1}. Available nutrient (N, P, K) have significantly affected by different sources of organic manures either alone or along with inorganic fertilizers and also able in sustaining the soil quality. There is a significant build up of organic carbon in the soil after harvest of the crop with 50% NPK + 50% FYM + Biofertilizers. These results suggested that the optimum production of capsicum can be obtained with integrated application of 50% NPK + 50% vermicompost + Biofertilizers and 50% NPK + 50% FYM + Biofertilizers.

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Effect of Botanical Formulation in Microbial Population Count on Apple Fruit Surface during Storage

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Keywords: Botanical formulation, Microbial count, Storage

Introduction

Among different factors responsible for affecting quality of apple fruits, presence of micro-flora on fruit surface is also one of the important factors which directly responsible for the fruit health. Twelve plants were evaluated for their *in vitro* efficacy in inhibiting the growth of white rot pathogen of apple (Golden delicious) and out of these six effective plants (*Karu*, *Artemisia*, *Neem*, *Bana*, *Tulsi* and *Darek*) were selected for making two botanical formulations (BF1 and BF2). These botanical formulations and most effective fungicide (Score) were further evaluated for presence of microbial population count on apple fruit surface during storage.

Material and methods

Microflora on fruit surface was enumerated by dilution plate technique (Downes and Ito 2001) and count on surface of the fruits was done by taking 1 cm diameter bits with the help of cork borer from four sides of the fruits in different treatments and then these bits of apple skin were dipped in 10 ml of sterilized distilled water. This solution containing population of different microbes was further diluted 10^3 to 10^5 levels to have a clear count of fungi and bacteria. Sampling of surface micro-flora was done at 10, 20 and 30 days of storage.

Results and conclusion

All treatments had lower level of microbial load in comparison to control treatment. Fruits treated with fungicide (Score) had minimum fungal count (4.58×10^3 cfu/ml) followed by BF2 i.e cow urine based botanical formulation (6.33×10^3 cfu/ml). Similarly, apple fruits treated with BF2 had minimum count of bacterial population (22.74×10^3 cfu/ml) followed by Score (24.91×10^3 cfu/ml). Fruit dip treatment with Score was most effective with reduction of 76.1 per cent in fungal micro-flora and 65.6 per cent reduction in bacterial micro-flora. Botanical formulation 2 (BF2) was next in efficacy with 67.0 per cent reduction in fungal micro-flora and 68.8 per cent reduction in bacterial micro-flora. Thus, apple fruits treated with the BF2 were better due to lower surface micro-flora than untreated apple fruits in control.

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IESHP/AFS2017/3055

Potential of *Bacillus amyloliquefaciens* for Biocontrol of Bacterial Canker of Tomato Incited by *Clavibacter michiganensis* ssp. *michiganensis*

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Keywords: Optimization, Biocontrol, Antibiotic sensitivity

Introduction

Bacterial canker is the most contagious and destructive disease of tomato caused by *Clavibacter michiganensis* ssp. *michiganensis*. Biological control through the use of beneficial microorganisms or by consortia of multiple antagonists has emerged as a promising alternative to chemical pesticides. This study aimed to evaluate biocontrol potential of beneficial microbes against tomato canker *in-vitro* and *in planta*. The study also intended to optimize cultural conditions for the antibacterial activity of most efficient bacterial isolate against *C. michiganensis* and testing its antibiotic sensitivity.

Material and methods

The cultural conditions of *B. amyloliquefaciens* strain S1 effective as biocontrol agent against *C. michiganensis* were optimized. The effect of incubation period (24, 48, 72, 96, 120h), temperature (30, 35, 45, 50° C), inoculum size (1, 2, 3, 4, 5, 10%) and pH (5.0, 6.0, 7.0, 8.0, 9.0) were optimized by measuring zone of inhibition. Antibiotic resistance pattern of most efficient selected strain was determined by testing their tolerance to intrinsic levels of different antibiotics using disc diffusion method (Bakthavatchalu *et al.* 2012).

Results and conclusion

Antagonistic activity was monitored for 24, 48, 72, 96 and 120h in nutrient broth containing 1% inoculum. Viable count and antagonistic activity increased with increase in incubation period (0-48h) and after that decrease in the antagonistic activity was observed. The effect of different temperatures (30, 35, 45, 50ºC) on antagonistic activity was measures for the potential antagonist S1. The optimum temperature for antibacterial activity was 35 °C. Effect of inoculum size i.e. 1, 2 3, 4, 5 and 10 percent of the isolate on the antagonistic activity was observed after 48 h of incubation and at 2% inoculum size antagonistic activity was best. Antagonistic activity was also checked at pH between 5 and 9. With the increase in pH of medium (5.0 to 7.0) antagonistic activity increased, but with further increase in pH the antagonistic activity declined. The antagonistic activity was best at pH 7. It was observed that most of the antibiotics used inhibited the growth of isolate *B. amyloliquefaciens* strain S1. But, the strain was resistant to the antibiotic penicillin G.

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Non-Parametric Rainfall Time Series Analysis of Madar region, Udaipur

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Keywords: Rainfall Time Series, Gumbel's Method, Weibull's Method

Introduction

Rainfall is the principal phenomenon driving many hydrological extremes such as floods, droughts, landslides, debris and mud-flows; its analysis and modeling are typical problems in applied hydrometeorology. Rainfall exhibits a strong variability in time and space across the globe. Hence, its stochastic modeling is necessary for the prevention of natural disaster. Understanding the rainfall distribution is equally necessary for future planning. The distribution pattern of rainfall rather than the total amount of rainfall within the entire period of time is more important for studying the pattern of rainfall occurrence.

Material and methods

Madar is a Village in Badgaon Tehsil in Udaipur District of Rajasthan State, India. The project area lies between $73^0$35' to $73^0$36' E longitude and $24^0$40' to $24^0$42' N latitude. The study area falls under agro climatic zone-IV A of Rajasthan i.e. "Sub humid Southern Plains of the Aravalli hills". Location map of study area are given below in figure 1. In the present study, Weibull's and Gumbel's method has been used to study the rainfall pattern of Madar region.

Results and conclusion

The rainfall data of 30 years (1986-2015) for the study were collected from Agro-Meteorological Observatory, CTAE, MPUAT, Udaipur. These data were analyzed for probability distribution at different levels using Weibull's (1939) technique and Gumbel's method. The results from this study revealed that Gumbel's method fits and predict the rainfall of this region with coefficient of determination of 0.97. From the analysis, it can be concluded that for this region the maximum rainfall of 1065 mm, 1092 mm, 1152 mm and 1167 mm has recurrence interval of 50 years, 60 years, 90 years and 100 years respectively. It can also be concluded that keeping in view the calculated probable rainfall extreme rainfall, hydraulic structures in this region can be designed.

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Study of Local Climatic Variations by Using Meteorological Parameters in Alaknanda Valley of Garhwal Himalaya

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Keywords: AWS, Climate Change, Data logger, Ethernet

Introduction

Climate Change is a change in the statistical distribution of weather over periods and can be a change in the average weather or a change in the distribution of weather events around a specific region. Climate change is potentially the biggest challenge in front of humankind this century, not so much because global arrears, energy security, food shortages and ecological degradation are less imperative, but because climate change is inextricably linked with these phenomena and has the potential to intensify existing crises

Material and methods

Meteorological Automatic Weather Station (AWS) is situated in the department of Rural Technology, HNB Garhwal University. Height of tower is 2.5 m. It measures the 21 parameters fundamental meteorological parameters. However, only the wind speeds, temprature, RH and rainfall. Meteorological data were collected from AWS by 2 types (data logger and Ethernet). The data are stored in data logger memory card. The stored data is transferred from memory card to laptop via transfer device.

Results and conclusion

The lowest mean temperature was in 11.17 ^{0}C in 2011 and highest mean temperature in 29.81 ^{0}C in 2010. This corresponds to the monsoon season in the valley of Srinagar Garhwal Uttarakhand. The average temperature between July and September (2010-2015) varied from 28.77 ^{0}C to 25.55 ^{0}C, whereas, in Dec- Feb vary between 18.10 ^{0}C to 11.17 ^{0}C. There is more variability in wind speed at different levels in July-September. On the other hand, the wind speed at all four levels have a similar pattern in Dec-Feb. The variability is expected, as these months are known to experience high and variable speeds in this valley. The mean wind speed is, however, less than 0.43m/s in December 2011. In Dec-Feb, wind variability between different levels has reduced. The maximum wind speed over the entire period are less than 8.98m/s in the month of April 2012. There is more variability from April to July. Maximum wind speeds are less than 8.98 m/s. Further analysis of these data can be used in air pollution modeling application.

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Effect of Organic Amendments on Chemical Properties of Soils of District Solan

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Keywords: Organic Amendments, Farm Yard Manure, City Waste Compost

Introduction

Farm yard manure, city waste compost and vermicompost are known to be effective organic amendments for improving soil health, provide macro and micronutrients, reduce the burden on natural resource exploitation and simultaneously reduce environmental pollution. For effective use of composts, it is important to understand the relationship between compost properties and their effect on soils. There are very few studies in which the effects of different amendments on soils of different texture were compared. The aim of this study was to access the effect of amendments on properties and nutrient release pattern of soils of different texture.

Material and methods

Four types of soil samples collected in bulk from selected locations of Solan district (Himachal Pradesh) on the basis of soil texture from the depth of 0-15 cm were air dried and sieved. In this laboratory incubation experiment organic amendments (farmyard manure, vermicompost, city waste compost and one control) were added on dry weight basis @3% w/w in plastic pots containing 2.0 kg of processed soil samples and maintained at 55-60% of WHC by weighing method. The pots were arranged in completely randomized design having 32 treatments with three replications and total period of incubation is 120 days.

Results and conclusion

Soil sampling was done from each treatment at an interval of 30, 60, 90 and 120 days of incubation for determination of micronutrients. Available micronutrient cations Zn, Fe, Cu, and Mn were influenced significantly by the application of different organic amendments. City waste compost was more effective as compared to farmyard manure and vermicompost in increasing micronutrient content of soil. Micronutrient content also varied with the passage of time, it exhibited increasing trend with increase in incubation period and it was lowest at 30 days of incubation and highest at 120 days of incubation. Increase in Zn content may be attributed to the pH reduction and the greater organic matter degradation, as the soil pH is the most important factor controlling Zn availability, which decreases with the increase of pH. High content of extracted Mn with DTPA can be due to the dissolution of Mn precipitates (carbonates, hydroxides and phosphate) caused by microbial activity that changes soil pH (Jordao *et al*. 2006). Water soluble Ca and sulphate were significantly influenced with the use of organic amendments whereas water soluble Mg, K, Na, chloride, carbonate and bicarbonate were not affected significantly with the use of organic amendments. City waste compost was more effective in increasing water soluble calcium content as compared to farm yard manure and vermicompost.

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Effect of Nature of Explants and Orientation on Shoot Establishment in 'Kufri Bahar' and 'Kufri Surya' Varieties of Potato for Micropropagation

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Keywords: Surface Sterilization, Micropropagation, Sprouts, Nodal Cuttings, MS Media

Introduction

The yield of potato crop depends upon numerous factors like environmental conditions during growth, agronomic practices, genetic yield potential and health of seed tubers. Among all the above mentioned reasons, use of healthy seed tubers is the most vital factor, because potato crop is being propagated asexually. However, all the conventional potato seed production systems are characterized by low multiplication rate and progressive accumulation of degenerative viral diseases during clonal propagation. Low multiplication rate can be adjudged by the fact that it involves 6-7 years for adequate multiplication from indexed tubers to certified seed. Potato has been reported to be affected by about 30 viruses and virus like agents. As, these pathogens are systemic in nature, they are spread through seed tubers and pose a grave threat to potato seed production. Thus, non-availability of quality and disease free seed tubers in adequate amount is the major hindrance in potato cultivation. Use of tissue culture technique, namely, micropropagation can be used for production of micro-tubers *in vitro*. Keeping the above points in mind the experiment was conducted to study the effect of nature of explants and its orientation on shoot establishment under *in vitro* conditions.

Material and methods

The experiment was conducted at CCSHAU, Hisar. Various types of explants were used for studying the establishment of the plantlets on the MS media and the characters studied were per cent of explants established, number of shoots/explants, number of nodes/explants and shoot length (cm).

Results and conclusion

The results indicated that a combination of 0.4% Bavistin (25 min) + 0.1% $HgCl_2$ (30 sec) provided the maximum number of sterilized explants (73.33 %). The results have shown that sprouts, when used as explants in case of Kufri Bahar 69.18 % of explants have responded by producing shoots and also the number of shoots was higher as compared to the other explants i.e., multiple and single nodal cuttings. While in case of Kufri Surya, out of the six different explants used maximum percentage of explants which have responded to the media were 90.00 by Sprout's Bits, and sprouts have produced more number of shoots/explants (6.00), average number of nodes/explants (5.12) and average shoot length (6.38 cm). The explants of both the varieties were placed horizontally and vertically over the media surface to study the effect of orientation of explants on in vitro shoot establishment. The orienting of explants vertically significantly increased the per cent establishment of explants (75.68% in Kufri Bahar and 70.78% in Kufri Surya).

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Effect of Integrated Nutrient Management on Growth and Yield of Broccoli under Garhwal Conditions

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Keywords: Bitter gourd, Genetic, Diversity, Mahalanobis, Tocher's and Cluster

Introduction

Sprouting Broccoli *(Brassica oleracea* var. italica) is an important winter season vegetable crop, belonging to the family Brassicaceae.. Being a newly popularized crop in India, there is an urgent need for standardization of integrated nutrient management packages having locally available organic sources integrated with chemical fertilizers. Keeping this in view, the research was carried out with the objectives to study the effect of integrated application of inorganic and organic manures on growth and yield of broccoli.

Material and methods

The research was conducted during the winter season 2016 at H.N.B. Garhwal University, Srinagar (Garhwal). The experiment was laid out in RBD with three replications with 19 treatments i.e. four inorganic, 12 organic and inorganic combinations along with recommended treatment and two controls. Data were recorded on different vegetative, reproductive and yield attributing characters for different treatments.

Results and conclusion

There were significant differences in all the vegetative, reproductive and yield attributing characters of broccoli. Treatment application of 200:100:100 kg NPK ha^{-1} showed maximum number of leaves (20.37), plant spread (53.40 cm), days to curd initiation (64.17 days), days taken to 50 % curd maturity (86.73 days). Maximum plant height (54.80 cm), leaf length (48.27cm) and days to 50 % curd initiation (74.17 days) with 37.5 Kg N through vermicompost + 112.5:75:75kg NPK ha^{-1} through inorganic). Maximum curd weight (305.5 g) was obtained with the application of 50 Kg N through karanj cake + 150:100:100 kg NPK ha^{-1} through inorganic whereas, the application of 50 Kg N through vermicompost + 150:100:100 kg NPK ha^{-1} through inorganic recorded yield (96.66 q/ha). Hence, for farmers with high investment capacity, maximum application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented through vermicompost can be recommended for obtaining maximum profit.

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Evaluation of Fungal Bio-Agents and Plant Water Extracts against *Colletotrichum gloeosporioides* causing Anthracnose in Mango

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Keywords: Bio-Agents, Plant Water Extracts, Efficacy, Anthracnose

Introduction

Anthracnose caused by *Colletotrichum gloeosporioides* Penz. and Sacc. (teleomorph *Glomerella cingulata*) is a major constraint in successful cultivation of mango. Though, the pre-harvest and post-harvest fungicides successfully controlled this disease but excessive use of fungicides pollutes environment resulting in soil, water pollution and also posing the residual problem. There exists an urgent need to develop research work that overcomes the limitation of using fungicides. Among the various alternatives, bio-resources that are biodegradable, bio-efficacious, economical, and environmentally safe are drawing the attention of scientists. Keeping in view, the present investigation was carried out to evaluate the efficacy of plant water extracts and bio-control agents against *C. gloeosporioides* using post-harvest treatments.

Material and methods

Plant water extract and bio-control agents were integrated with a view to evaluate the combined effect on control of anthracnose on mango fruit during 2015-16 under laboratory conditions in the department of plant pathology in YSPUHF, Nauni. Liquid formulations of fungal and bacterial antagonists were applied @ 5 per cent along with compatible botanical extracts. Mango fruits of cv. Dashehari were dipped separately in the different combination solution, these fruits were then air dried by keeping them apart on news paper sheets spread on the table. Each treatment was replicated thrice. Thereafter, the treated fruits were inoculated with the test pathogen by pin prick method and stored at room temperature (25-28^{0}C). Disease index and decay reduction index were also calculated.

Results and conclusion

Data recorded on the evaluation of seven different combinations of individually most effective plant water extracts and bio-control agents revealed that combined treatment of *Azadiracta indica* (10%) + *T. harzianum* (5%) was most effective and provided DRI of 80.07%. It was followed by treatment *A. indica* + *Bacillus Subtilis* with DRI of 78.56 per cent. Next best treatments in order were *A. indica* + *T. virens* and *Emblica officinalis* + *B. Subtilis* and provided DRI up to an extent of 77.19 and 76.61%, respectively. However, *E. officinalis* (10%) + *T.virens* (5%) were least effective (68.49 DRI). Lakshmi *et al.* (2013) reported that minimum anthracnose disease index of 17.3 per cent was recorded in mango fruits treated with combination of *T. viride* + salicylic acid + *Eucalyptus* oil followed by salicylic acid+ *Eucalyptus* oil (19.6%).

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Persistence and Dissipation Pattern of Chlorpyrifos and Ethion in Tomato

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Keywords: Good Agricultural Practices, Maximum Residue Limit, Ethion

Introduction

India is the second largest producer of vegetables in world, but its share in exports of vegetables is only about 2% of total agricultural exports. Vegetable crops may be affected by different pests causing serious damages to plants and, consequently resulting in reduction of yield. Tomato crop is attacked by different species of insect pests of Himachal Pradesh and could be managed as per CIBRC recommendation. Several insecticides are applied to tomato crops to control pests. Chlorpyrifos and ethion are non-labelled pesticides used by the farmers in this crop. Since, these non- approved pesticides were used on tomato by the growers, therefore, present studies were contemplated to generate residues data as per Good Agricultural Practices data for the fixation of maximum residue limit at national level to safeguard the interest of consumers.

Material and methods

The experiment was carried out on 'Solan Lalima' variety of tomato at Department of Entomology, YSPUHF Nauni, Solan (H.P.) during 2014. Chlorpyrifos and ethion were sprayed twice at the recommended rate (X dose=300 g *a.i.* ha-1) and double recommended (2-X) rate at 10 days interval near the fruit formation stage. Chlorpyrifos was sprayed at 300 g *a.i.* ha-1 (X) and 600 g *a.i.* ha-1 (2-X) and concentration of ethion was 500g *a.i.* ha-1 (X) and 1000 g *a.i.* ha-1 (2-X), respectively. After the second foliar application, fruit samples (2 kg) from each replication were collected randomly at 0 (2 hours after spray), 1, 3, 5, 7, 10, 15, 20 and 25 days intervals and transported for pesticide residue analysis. The residue estimation was undertaken using QuEChERS technique and the recovery studies were done by spiking matrix at different spiking levels viz. 0.05, 0.25, 0.50 and 1.00 mgkg^{-1}. After second application of respective pesticides on the crop, soil samples (1 kg) were also collected at 0, 3, 7 and 10 days interval and processes as per QuEChERS technique. Samples of fruits and soil prepared as per QuEChERS were injected into gas chromatograph to study persistence and dissipation pattern.

Results and conclusion

Recovery of chlorpyriphos from fruits and soil samples fortified at five levels were 91.20-109 and 90.13-108 per cent, respectively. The recovery of ethion at five levels ranged between 89.60-110.37 and 92.93-109.33 per cent, from fruits and soil, respectively. Chlorpyriphos persisted up to 5 and 7 days with the initial deposits of 0.981 mg kg^{-1} when sprayed @ 300 g a.i. ha^{-1}, and 1.884 mg kg^{-1} when sprayed @ 600 g a.i. ha^{-1}, respectively. In ethion, the initial residues were recorded as 0.861mg kg^{-1} when sprayed @ 500 g a.i. ha^{-1} and 1.637 mg kg^{-1} when sprayed @ 1000 g a.i. ha^{-1} which persisted up to 5 and 7 days, respectively. The initial deposits of chlorpyriphos reduced to their half in 1.50-1.52 days whereas, 1.58-1.64 days required by ethion deposits to reduce their half. In soil, the initial residues of chlorpyriphos were 0.115 mg kg^{-1} and 0.221 mg kg^{-1} when sprayed @ 300 g a.i. ha^{-1} and 600 g a.i. ha^{-1}, for ethion the initial residues in soil were 0.108 mg kg^{-1} and 0.211 mg kg^{-1} when sprayed @ 500 g a.i. ha^{-1} and 1000 g a.i. ha^{-1}.

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Evaluation of Exotic Apples on M9T337 for Growth and Quality Attributes under Kashmir Conditions

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Keywords: M9T337, High Density, Quality, Yield

Introduction
Apple is the most ubiquitous of temperate fruits and has been cultivated in Europe and Asia from antiquity. For the temperate zone to prosper in apple, it is imperative to shift to new varieties which have both high yield potential as well as good marketability. In order to solve the problems of low productivity, poor quality, less colour and irregular bearing habits in current apple plantations in Kashmir valley, two apple varieties namely Super Chief Sandidge, Gala Red Lum, Fuji Zehn Aztecwere evaluated for various morphological and fruit characteristics with the objective to study the performance of newly introduced apple varieties for growth and quality attributes under high density conditions.

Material and methods
Two exotic varieties of apple grafted on M-9 T337 rootstock were introduced by SKUAST-Kashmir in spring 2013 from an Italian nursery, GRIBA, Italy. The plant material was one year old with 3 plus feathers. Trees of uniform size, vigour and bearing capacity were selected for experimentation located at Shalimar campus of SKUAST-Kashmir and were evaluated for various morphological and fruit characteristics. All the trees received uniform cultural practices during the year under study as per the package of practices of SKUAST-Kashmir. The experiment was laid in Randomized Complete Block Design () with five replications and two trees per treatment as plot size.

Results and conclusion
Apple variety, Super Chief Sandidge showed a minimum tree height (1.31m) compared to Fuji Zehn Aztec (1.96 m). Trunk cross sectional area was more in Fuji Zehn Aztec (4.70cm^2) than Super Chief Sandidge (3.72 cm^2). The first flower opening and end of flowering was observed earlier in Super Chief Sandidge (45.35DARD and 57.28 DARD respectively) than Fuji Zehn Aztec (47.85DARD and 60.36 DARD). Fruit set percent was highest in Super Chief Sandidge (62.55%) and lowest in Fuji Zehn Aztec (57.48%). Maximum yield was alsoin Super Chief Sandidge (2.45 kg/tree) compared to Fuji Zehn Aztec). Fruit weight was recorded maximum in Super Chief Sandidge (193.99g) than Fuji Zehn Aztec (157.62g). Fuji Zehn Aztec appeared to be more flat in shape (0.77) and Super Chief Sandidge round (0.87). Super Chief Sandidge showed high TSS (14.12 °Brix) and low acidity (0.20%), while variety Fuji Zehn Aztec showed TSS of 12.40 °Brix and acidity (0.32%). The study revealed that both the varieties performed well under Kashmir conditions; however the variety Super Chief Sandidge showed better performance in terms of both yield and quality attributes compared to Fuji Zehn Aztec. The varieties may be recommended for research, mass multiplication and further adoption by the orchardists of the valley.

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Evaluation of Bell Pepper Genotypes for Yield and Yield Contributing Traits under Mid-Hills of Himachal Pradesh

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Keywords: Genotype, Mean performance, Traits, Yield

Introduction
Bell Pepper (*Capsicum annuum* L. var. *grossum* or Sweet Pepper is a potential high value solanaceous vegetable. Considering its economic importance and demand as a high value crop and also as an off- season crop there is a continuing need to develop and identify varieties with improved production potential, nutritional quality and disease resistance and tolerance. Proper screening and evaluation of germplasm lines would provide an estimate of their potential value as suitable genotypes for utilization in varietal development.

Material and methods
The present investigation was carried out at Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan during Kharif 2013. 35 genotypes of bell pepper were evaluated. The experiment was laid out in RCBD. The observations were recorded on days to first flowering, days to first marketable picking, number of fruits per plant, fruit length (cm), fruit breadth (cm), average fruit weight (g), pericarp thickness (mm), plant height (cm), harvest duration (days), number of seeds per fruit, number of lobes per fruit, ascorbic acid content (mg/100g), capsaicin content (mg/g) and fruit yield (kg/plant, kg/plot and q/ha).

Results and conclusions
Minimum days to first flowering werein genotype CP-40 (35 days). Minimum days to first marketable picking were observed in genotype PRC-1 (52.67 days). Maximum number of fruits per plant fruit length breadth was recorded in California Wonder (6.06 cm). Further, average fruit weight was found maximum in HACAV-271 (63.33 g). Maximum pericarp thickness was observed in check cultivar California Wonder (5.98 mm). Plant height was found maximum in Kt-1 (68.26 cm). Harvest duration was observed maximum in ACC-16 (62 days). Maximum number of seeds per fruit was observed in UHF-1 (304.13) and minimum in UHFBP-27 (115.00). Maximum number of lobes per fruit was observed in check cultivar California Wonder (3.87). Maximum ascorbic acid content was VLCP-3 (176.07 mg/100g). Maximum capsaicin content was in UHFBP-8 (0.30 mg/g) and minimum in DARL-72 (0.07 mg/g). Fruit yield was maximum in DARL-72 (301.23 q/ha. Mean performance revealed that genotypes CP-40, PT-12-3 and PRC-1 observed minimum days to first flowering while genotype PRC-1took minimum days to first marketable picking. These genotypes can be incorporated in breeding programmes to develop early cultivars in bell pepper. Further, in the present study, the genotypes DARL-72, HACAV-271, Kt-1 and Yolo Wonder recorded higher yield, good average fruit weight, fruit length, fruit breadth and pericarp thickness, which can be utilized for trait specific breeding and improving yield in newly bred cultivars of bell pepper.

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Anther Culture Using F_3 Segregants of Three Way Cross of Rice

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Keywords: Anther Culture, F_3 Segregant, Three Way Cross

Introduction

For many years *in vitro* plant breeding is being used in many plants for different traits improvement .The plant varieties can be improved for drought, disease, pest resistance, salt tolerance etc. through many tissue culture techniques. One of the advantages of tissue culture techniques is that, variants not easily obtained by conventional breeding practices can be obtained. Among all techniques haploid production by anther is quite popular. Androgenesisis a rapid approach to attain homozygosity that shortens the time required for the development of new cultivars as compared to conventional methods, which require at least 6-7 generations. Taking into consideration its importance the present study was done using anthers of F_3segregant of three-way cross of rice.

Material and methods

The experiments were conducted at Birsa Agricultural University, Kanke, during 2014-15. F_3 Progeny of three way cross (PA6444 X IR 36), grown at B.A.U., Ranchi for anther culture. The selected panicles were cold pre-treated at 4^0 C for 6 and 9days.Basal callusing media (CM) was prepared for inoculation of the cold treated anthers after isolation. CM is a callus inducing media which is a modified form of N_6 media (Chu *et.al.* 1975). Later, after the callus formation it was put to Plant Regeneration Media (PRM) for embryogenesis containing various hormonal regimes. The callus and regenerated plants were incubated in the culture room at 25^0 C ± 2^0 C at 16/18 hrs day and night hours and at 55-60% RH. The plants regenerated were hardened in the green house for 45 days at >80% RH and later it was transferred to the pot and fertilized with NPK. The callus induction and plant regeneration percentage were calculated as: Callus induction frequency (%) = Number of anthers producing calli / anther plated X 100, Total regeneration frequency (%) = No??. of plant regenerated / calli cultured X 100 and Anther culturability (%) = No?. of green plants / anther plated X 100

Results and conclusion

12 petriplates were inoculated containing 100 anthers each. Out of all anthers only 1 anther responded to callusing and the the anther induction frequency was 1 per cent. Three green plants were regenerated giving total regeneration frequency of 13.04 per cent and anther culturability of 3%.?The regenerated plants were hardened in the green house for 45 days prior to transfer in the pot. The experiment shows the use of anther culture which aids in reducing the breeding cycle. The technique might help in developing homozygous lines in a short duration. The commercial hybrid (PA6444) was used for anther culture a superior homozygous line might develop, giving uniform, stable and high yield.

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Diversity Assessment among Groundnut Genotypes Using RAPD Markers

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Keywords: Diversity, RAPD, PIC

Introduction

Groundnut (*Arachis hypogaea* L.) 2n = 4x = 40 belonging to genus *Arachis* of family *Fabaceae*, is a native of South America and originated from duplication of two diploid AA and BB, wild type species. Genetic diversity present among different genotypes is necessary before undertaking any crop improvement programme but diversity analysis using morphological markers differ among environment, species, genus and varieties of plants, while molecular markers offer plant breeder a set of genetic tools that are abundant, non-deleterious and reliable so present study was carried out to assess the genetic diversity among groundnut genotypes using RAPD markers.

Material and Methods

30 genotypes including three checks were evaluated in randomized block design with three replications during *kharif* 2014 at Maharana Pratap University of Agriculture and Technology, Udaipur. Observations were taken on thirteen morphological traits and diversity analysis of which was resulted into five clusters. Five representative genotypes from each cluster were evaluated at molecular level using RAPD primers.DNA Isolation and quantification was done using CTAB method (Doyel and Doyel, 1990) with few modification and cluster analysis for the genetic distance was carried out using UPGMA (Unweighted Pair Group Method with Arithmetic Mean) clustering method. The genetic distances obtained from cluster analysis through UPGMA were used to construct the dendrogram, depicting the relationships of the genotypes using computer program NTSYSpc version 2.02 (Rohlf 2004).

Result and conclusion

Among representative genotypes UG-160 and UG-179 were most distant while UG-163 and UG-175 were highly similar. for the evaluation9 polymorphic RAPD markers were used and a total 33 amplification products were obtained, out of which 28 alleles were polymorphic (84.37%). Among these markers, OPA-10 was highly informative showing highest amplification (7) with maximum PIC value (0.499).

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Screening of Walnut Germplasm Maintained in Field Gene Bank for Quality Traits

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Keywords: Accessions, Kernel, Oil Content

Introduction

The walnut, *Juglans regia* L., 2n = 2x =32) belongs to family Juglandaceae, is native of Iran and its surrounding area such as Asia Minor. Almost all parts of walnut are utilized for various purposes but the fruit and timber have been put to maximum use by mankind. There are total of 157 accessions (36 exotic + 121 indigenous) of 5 different species *viz.*, *Juglans regia, J. nigra, J. mansdurica, J. ailantifolia*and *J. cordiformis* are maintained at Field Gene Bank (FGB) of ICAR-NBPGR Regional Station Shimla. Screening of elite walnut accessions can be utilized for further promotion of germplasm.

Material and methods

A total of 30 walnut accessions (18 indigenous and 12 exotic) available at field gene bank (FGB) of ICAR-NBPGR RS Shimla, were characterized on the basis of various horticultural and quality parameters. Same set of accessions were evaluated for oil content at Biochemistry lab, Division of Evaluation, NBPGR, New Delhi. Data recorded for the qualitative and quantitative characters and further subjected to statistical analysis.

Results and conclusion

The data revealed that there is a substantial variability with respect to various horticultural traits in exotic as well as in indigenous collection as explained by range, mean and coefficient of variance (Table 1). Accessions, IC014618 and IC538531 were identified promising for multiple traits *i.e.,* early harvesting, nut weight, kernel weight and percent oil content. These promising germplasm can be further utilized as elite material for commercial cultivation.

Table 1: Mean, Range and Coefficient of Variance in 30 Different Walnut Accessions

Particular	Days to harvesting	Nut weight (g)	Kernel weight (g)	Oil (%)
Max	164	16.00	6.80	72.65
Min	101	1.10	0.20	59.95
Mean ± SE	138.02 ± 2.49	9.50 ± 0.56	3.40 ± 0.22	67.97 ± 0.57
CV%	11.16	36.90	40.30	4.66

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Integrated Nutrient Management for Sustainable Production of Cabbage in Sub-tropical Climate

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Keywords: INM, Sustainable agriculture, Sub-tropics

Introduction

Present day vegetable farming is mainly relying on the use of chemical fertilizers and pesticides. However, the excessive use of both fertilizers and pesticides has adversely affected the human health, environment and destruction of the soil properties. Increasing levels of nitrate in water and farm produce, pesticide residues, deteriorating keeping quality and physiological imbalances in food have forced us to seek for alternate sources of nutrients. Use of organics is being advocated so as to restrict the application of chemical fertilizers. Thus, there is an urgent need to develop a judicious alternative to chemical fertilizers so as to provide an ideal nutrition for plants in a cropping system within the ecological, social and economic possibilities. Cabbage (*Brassica oleracea* var. *capitata L.)* is one of the most popular and widely grown vegetable in our country. Its cultivation in hilly areas has increased manifold as the produce fetches lucrative returns during off-season.

Material and methods

The experiment was conducted at RHRTS, Jachh, Kangra, HP to ascertain the effect of organic sources of nutrients namely: green manure, organic manure and non-edible neem cake and their combinations with each other as well as with chemical fertilizers on growth and yield of cabbage variety Pride of India. Recommended NPK fertilizers (60 kg N, 60 kg P and 30 kg K/ha) were substituted completely or partially (50% or 66.6%) with organic sources i.e. sunhemp, FYM (5.2% N, 0.6% P and 0.5% K), neem cake (5.2% N, 1.07% P, 1.4 % K) and rapeseed cake (5.2% N, 1.8% P and 1.3% K). The trial procedure (first set of treatment) included, 100% FYM (20 tonnes /ha), neem cake (1.44 tonnes/ ha), rapeseed cake (1.44 tonnes/ ha) and their combinations i.e. 50% FYM + 50% neem cake and 50% FYM+ 50% rapeseed cake. In the second set of treatment, 50% NPK fertilizers was supplemented through 50% each of FYM, neem cake and rapeseed cake. In the third set, 66.6% NPK fertilizers were supplemented through 33.3% combinations each of FYM +neem cake and FYM+ rapeseed cake separately in two treatments, each contributing one third of the requirement. Forty five days green manure crop of sunhemp was incorporated into the field 28 days before transplanting along with FYM and cakes.

Results and conclusion

Sole application of 100% NPK through chemical fertilizers resulted in bigger sized head (17.3x14.9 cm), which was statistically at par with the treatment having one third each of chemical fertilizer (NPK), FYM and rapeseed cake (17.1x14.9 cm) and 50% NPK +50% rapeseed cake (16.9x14.5 cm). The weight of the head was also higher with recommended NPK. Similar trend was noticed in total marketable yield of cabbage. Application of sole organic sources recorded lower yield of cabbage .However, organic source in combination with chemical fertilizers gave higher yield than with sole organics. Application of 33.3% NPK +33.3% FYM +33.3% rapeseed cake recorded 280.1 q/ha yield and was at par with 100% NPK treatment (284.9 q/ha). Similarly, higher yields was obtained in 50% NPK (30 kg N, 30 Kg P and 15 kg K/ha) +50% rapeseed cake (0.72 tonnes/ha) treatment (Table 1). The treatment where 66.6% chemical fertilizers were replaced with organic sources gave the

highest net returns. In addition, incidence of black rot was found minimum under organic based treatments. The result suggests that rapeseed cake and farm yard manures can substitute up to 66.6% NPK fertilizers in cabbage.

Table 1: Performance of Cabbage Influenced by Conjoint Nutrient Sources

Treatment	Size of head (cm)	Weight of head (g)	Marketable yield (q/ha)
Farmyard manure	13.7x12.1	608	182.3
Neem cake (NC)	14.8.x13.6	678	221.6
Rape seed cake (RC)	15.2x14.2	702	233.4
50% FYM+50% NC	15.3x14.1	726	235.3
50% FYM+50% RC	15.6x14.4	780	241.3
100% NPK(RDF)	17.3x14.9	840	284.9
50% NPK+50% NC	16.8x14.4	806	259.6
50% NPK+50% RC	16.9x14.5	823	276.6
50% NPK +50% FYM	16.0x14.3	796	248.1
33.3% NPK +33.3% FYM+33.3%NC	16.9x14.8	815	268.3
33.3% NPK +33.3% FYM+33.3%RC	17.1x14.9	830	280.1
Control	12.3x10.4	480	102.3
CD (P=0.05)	-	17.6	9.4

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Response of Mango Cultivar 'Dashehari' under INM Module in Sub-tropical Conditions of Himachal Pradesh

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Keywords: INM, Organic nutrients, Sub-tropics

Introduction

In the subtropics of Himachal Pradesh, mango is the leading commercial fruit crop in terms of area and production. Dashehari is cultivated successfully in the subtropical, submontaneous and low hill areas of Zone-1 of the state and is the most important and leading table variety of mango due to prolific bearing and high yielding capacity. Application of inorganic nutrients plays an important role on the yield attributes as well as uptake of nutrients. Further, the inorganic fertilizers are expensive and their continuous use leads to the problem of soil health. To maintain soil health and productivity, it is essential to adopt integrated nutrient management (INM) approach. Integration of inorganic fertilizers with manures and biofertilizers in proper proportions can improve tree health besides improving physical condition of soil and the yield of the crop. The present study was, therefore, conducted to know the response of mango cultivar Dashehari w.r.t. growth, yield and fruit quality to integrated use of FYM, inorganic fertilizers and biofertilizers (Azotobacter , VAM and PSB) in order to find out the ideal treatment combination(s). To study the effect of integrated nutrients, a field experiment was conducted at the experimental farm of Regional Horticulture Research and Training Station, Jachh (H P) for two years.

Material and methods

The experiment was laid out in RBD included treatments viz., T_1-100% NPK (250g:160g:600g) and FYM (100 kg); T_2-75% NPK (197.5g:120g: 450g) and FYM (75 kg) + Biofertilizers (*Azotobacter* and PSB @ 100 g each/tree), T_3-75% NPK (197.5g:120g: 450g) and FYM (75 kg) +Biofertilizers (*Azotobacter* and VAM @ 100g each/tree), T_4-75% NPK (197.5 g:120g: 450g) and FYM (75 kg) +Biofertilizers (*Azotobacter*, PSB, VAM @ 100g each/tree), T_5-50 % NPK (125g:80g: 150g) and FYM (50 kg) +Biofertilizers (Azotobacter and PSB @ 100g each/tree) , T_6- 50 % NPK (125g: 80g: 150g) and FYM (50 kg) +Biofertilizers (*Azotobacter* and VAM @ 100g each/tree) and T_7-50 % NPK (125g: 80g: 150g) and FYM (50kg) +Biofertilizers (*Azotobacter*, VAM and PSB @ 100g each/tree) in various combinations.

Results and conclusion

The treatment, T_4 recorded maximum trunk girth (0.98 m), tree height (6.0 m), tree spread in NS (5.3 m) and EW (5.1 m). This superior combination also recorded significantly highest fruit yield of 94.6 kg/tree. Maximum fruit size, length (13.4 cm) and breadth (8.1 cm), fruit weight (334.3 g), pulp weight (275.7 g), stone weight and pulp/stone ratio (5.0) was recorded in T_4 treatment. Biochemical parameters like TSS, acidity, reducing sugars and total sugars were not affected significantly in various treatment combinations. T_3 had maximum TSS content (18.8 ^oB) and total sugar (15.6 %) with least (0.35%) acidic fruits. T_4 was also recorded the highest (2.9%) reducing sugar content. Maximum gross income (Rs. 1636.35), net income (Rs. 1186.78) and benefit cost ratio (2.64) was observed with T_4 followed by T_5 with corresponding values of Rs. 1289.46 (gross income), net income (Rs. 862.87) and 2.02 (B:C ratio).

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Eco-friendly Agriculture in Mitigating Effects of Climate Change

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Keywords: Green House Gases, Climate change, Sustainability

Introduction
Climate change now a days is a matter of concern as changes in global temperature, precipitation, etc, due to natural or human drivers are in return affecting the ecological scenario and agriculture scenario of the world. The climate plays an important role in defining farming of a region.

Material and methods
The present study has been carried out to review the role of agriculture in Green House Gas emissions (GHG's).

Results and conclusion
From the report 'State of Punjab Agriculture-2015-16', it has been elucidated that major source of emission in agriculture sector are enteric fermentation (63.4 %), rice cultivation (20.9 %), agricultural soils (13.0 %), manure management (2.4 %) and on field burning of crop residues (2.0 %). Thus, it may be concluded that more carbon intensive farming adopted by Indian farmers' may be the cause for the change in climate through GHG's. Seconding, the climate smart cropping systems involving C_4 will help to reduce the GHG's than rice crop. It is concluded that agriculture can play a fundamental role in mitigating the adverse effects of climate change by adopting less carbon intensive farming practices, substituting rice crop with the alternate one's, stop burning of on- field crop residues to achieve great resilience in production systems, food security and sustainability in agriculture in a eco- friendly manner.

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Management of European Red Mite, *Panonychus ulmi* in Apple with Acaricides and Horticultural Mineral Oil

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Keywords: Acaricides, HMO, Protection

Introduction

The European red mite, *Panonychus ulmi* (Koch) has become a serious pest of apple since 1995 and causing serious loss to apple crop by imbibing cell sap from leaves. At present 80% apple orchards have been found infested with this pest. In present studies, efforts have been made to manage this pest with acaricides alone and half dose of recommended acaricides in combination with Horticultural Mineral Oil (HMO). In India, no work has been reported for the use of combination of acaricide with HMO for the control of European red mite whereas little work was reported abroad. The objective of using combination of half concentration of the standard recommended doses of acaricides with HMO is to minimize the use of toxic acaricides and to check resistance problem against European red mite without compromising effectiveness of mite mortality.

Material and methods

The comparative performance of four acaricides (fenazaquin, fenpyroximate, spiromesifen and hexythiazox) and HMO against *P. ulmi* was evaluated at Cheog (The. Theog), Shimla, Himachal Pradesh. Plants supporting nearly homogeneous population of *P. ulmi* were selected and treated with desired concentration during. Experiment comprising ten treatments including control was laid out in randomized block design and each treatment was replicated four times with single tree serving as replicate

Results and conclusion

Data recorded 7,14 and 21 days after treatment revealed that minimum mite count of 1.00 per leaf was observed in fenpyroximate (0.0025%) + Mak all season HMO (1.0%), followed by fenazaquin (0.00125%) + Mak all season HMO (1.0%), spiromesifen (0.0035%) + Mak all season HMO (1.0%), fenpyroximate (0.005%), fenazaquin (0.0025%) and hexythiazox (0.0025%) + Mak all season HMO (1.0%), recording mite population ranging from 1.23 to 2.08 per leaf. All these treatments were statistically at par and significantly superior to the remaining treatments. However, among the acaricides, HMO and combination treatments, maximum mite population was recorded in hexythiazox (0.005%) with 3.13 motiles per leaf followed by spiromesifen (0.007%) with 2.20 motiles per leaf. In the control treatment, a much higher population of 33.17 mites per leaf was recorded. Comparatively all the combination treatments (half concentration of recommended doses of acaricide with HMO (1.0%) remained more effective up to 28 days and motile population remained below economic threshold level (4 mites/leaf). The effect of test acaricides, HMO and combination treatments observed 28 days after treatment indicated that fenpyroximate (0.0025%) + Mak all season HMO (1.0%) with 1.33 motiles per leaf was the most effective treatment, which was statistically at par with fenazaquin (0.00125%) + Mak all season HMO (1.0%) and spiromesifen (0.0035%) + Mak all season HMO (1.0%), recording mite population 2.00 and 2.10 per leaf, respectively. However, hexythiazox (0.005%) proved least effective treatment recording 6.20 motiles per leaf.

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Practicing Conservation Agriculture in Teak Based Agroforestry System: An Innovative Idea for Climate Resilience and Improved Productivity

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Keywords: Agroforestry, Conservation Agriculture, Carbon sequestration

Introduction

Bundelkhand region is prone to severe droughts due to undulating topography, shallow soil depth, low water holding capacity and high evapo-transpiration owing to intense radiation. Here very little or no residue is available for surface application due to its competing uses as fodder. Agroforestry is the only option, where biomass generation can be integrated along with crop production. Recent conservation agriculture efforts are focusing on smallholder farming systems in sub-Saharan Africa and South Asia. Development of agroforestry based suitable location specific CA systems is more appropriate and holistic for efficient utilization of natural resources for sustainability.

Material and methods

The experiment on teak based agroforestry system (AFS) initiated during July, 2014 at ICAR-CAFRI, Jhansi. The teak based AFS experiment included, Min. tillage-Black gram-Mustard; Min. tillage-Green gram-Barley; CT-Black gram-Mustard and CT-Green gram-Barley and 03 subplot treatments (with crop residue; without crop residue and with *Leucaena* (K-636) residue).Treatments: 12; Replications: 03; Design: Split plot design. Main plot size: 36m x 12m; Sub plot size: 18m x 12m. Teak spacing: 9 m x 4 m. Green gram (PDM-139), black gram (Azad-2), mustard (RH 749) and barley (RD 2552) were crop varieties sown.

Results and conclusion

Seed yield of black gram depicts variation of 226.7 (Conventional tillage) to 219 kg/ha (Minimum Tillage), though non-significant. Residue management had significant effect on seed yield. More or less similar trend was found in yield of green gram. Growth and yield attributes of black gram were better under CT over MT, though the effects were non-significant and the residue management effects showed significant effect on yield attributes of black gram. Seed yield of mustard as influenced by tillage practices varied in the range of 1275 to 1310 kg/ha. Among residue management options, seed yield varied from 1173 to 1365 kg/ha and it was observed that the *leucaena* residue had significant influence on seed yield as compared to crop residue and without any residue. The straw yield of mustard varied from 4400 to 4498 kg/ha though non-significant. In barley, tillage and residue practices had similar trend as to that of mustard. Further, the growth and yield attributes of mustard and barley varied significantly with residue management practices, however the effects were non-significant with tillage practices. The changes brought in by CA practices in AF may, in turn, affect the delivery of ecosystem services, including climate regulation through carbon sequestration and greenhouse gas emissions and regulation and provision of water through soil physical, chemical and biological properties.

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Effect of Dual Inoculation of *Glomus fasciculatum* and *Bacillus amyloliquefaciens* with Chemical Fertilizers on Growth, Nutrient Uptake and Biomass Production in Sweet Cherry

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Keywords: AM fungi, PGPR, *Glomus* species, Growth

Introduction

Many studies on horticultural plants such as cherrymoya, walnut, guava, citrus and banana have utilized arbuscular mycorrhizae to increase the growth rate, nutrient uptake and also helped in their subsequent acclimatization in that soil. AMF fungi modify the root system that enhance the mobilization, nutrients uptake and also protect plants from pathogens. Synergistic interactions of AMF with other plant growth promoting rhizobacteraia *i.e* nitrogen fixers and P-solubilizer in the mycorhizosphere mediate important physiological changes especially towards stress tolerance. Therefore, microbial activity (PGPR, AMF alone or as consortia) in the rhizosphere is a primary determinant of plant health and soil fertility.

Material and methods

Most efficient species of AM fungi (AMF II *i.e. Glomus fasciculatum*) and PGPR isolate (P7 *i.e. Bacillus amyloliquefaciens*) was isolated from rhizospheric soil of sweet cherry from Kullu district of Himachal Pradesh and economic dose of N and P along with blanket application of K were selected for the dual inoculation pot culture study. The dual/single inoculated pot mixtures were analyzed for plant parameters, chlorophyll content, total and available N, P and K and micronutrients (Fe, Cu, Mn and Zn content), phosphtase enzyme, total microbial count in soil and roots and AM fungal spore count and root colonization (Giovannetti and Mosse 1980).

Results and conclusion

Dual inoculation was superior to enhance root length (35.38 cm), shoot length (83.40 cm), number of leaves (45.50 no/plant), leaf area (128.88 cm^2) , root shoot ratio (1.23), total chlorophyll content, (4.93 mg/g fresh weight), phosphatase enzyme activity (37.4 µg/ml), plant biomass (62.45 g), total NPK content (2.88, 0.24 and 1.83%, respectively) and their uptake (179.54, 14.83 and 114.44 mg/plant, respectively) over uninoculated plants. Application of microbial consortia leads to higher absorption of nutrients, enhanced cell division, elongation and thus concomitant increase in metabolic activity resulted in extensive root system, and hence, nutrient uptake. The concentrations of micronutrients and heavy metals were also influenced by AMF and PGPR treatment. AMF root colonization, spore numbers and bacterial population in rhizospheric soil significantly increased in AM fungi inoculated treatment and its combination with PGPR. Thus, utilization of microbial consortia is a viable alternative to organic fertilizers, preserved the environment in the spirit of an ecological agriculture.

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Effect of Organic and Inorganic Sources of Nutrients on Productivity of Cauliflower

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Keywords: Nutrients, Organic culture, Neem

Introduction

Cauliflower is a heavy feeder crop, thus nutrient management play an important role for influencing the productivity and its quality. Nutrient removal by crops from soil sometimes exceeds replenishment with fertilizers causing a negative balance of nutrients in the soil and ultimately resulted in multi-nutrient deficiencies. Further, the indiscriminate use of chemical fertilizers has simultaneously resulted in degradation of soil productivity, environment pollution and depletion of non-renewable sources of energy. Thus, attention is now being shifted towards the alternate sources of nutrients from the organic ones. Use of organic manure, farmyard manure, compost, green manures, oil cakes and crops residues etc. as nutrient source is being advocated so as to restrict the chemical fertilizers application (Bhardwaj *et al.,* 2000). Application of organic**s** along with inorganic nutrient in combination will minimize the use of costly fertilizer inputs and also improve**s** the fertilizers use efficiency (Sharma *et al.,* 2008).

Material and methods

The present investigation was carried out during 2014-16 at Department of Vegetable Science, YSPUHF, Nauni, Solan, Himachal Pradesh. Trial procedure included sole application of organic sources (Vermicompost, FYM and Neem Manure), bio-fertilizers (Azotobacter and Phosphate Solubilizing Bacteria) and inorganic fertilizers (N, P and K) and their combinations. The experiment was laid out in RCBD. The recommended dose of NPK fertilizers (125 kg N, 80 kg P and 60kg K ha^{-1}) was substituted completely or partially (50% or 33.3%) with organic sources of NPK from vermicompost, FYM (5.2% N,0.6% P and 0.5% K) and neem cake (5.2% N, 1.0% P and 1.4% K).

Results and conclusion

The results revealed that treatment combination consisting of 100% RDF + *Azotobacter* (5.0 kg/ha) + PSB (5.0 kg/ha) recorded higher growth and yield attributing characters (curd size, curd yield). The treatment comprising : RDF (33.3%) + FYM (33.3%) + Neem manure (33.3%) + *Azotobacter* (5.0 kg/ha) + PSB (5.0 kg/ha) recorded higher quality, nutrients uptake, available primary nutrient element status and gave highest B:C ratio. The treatment comprising a combination of inorganic fertilizers, organic manure and bio-fertilizers resulted in higher vitamin A content (23.78Ug/100g). The severity of black rot was also found least (2.74%) in the above treatment. Maximum available N (340.18 kg/ha), P (53.82 kg/ha) and K (201.80 kg/ha) were recorded. The uptake of macro and micro nutrients was also found optimum in these treatments. The application of organic, inorganic and bio-fertilizers in combination gave higher benefit: cost ratio (3.21:1) compared to sole application of nutrients from different sources. Thus, balance integration of nutrients viz., organic manures and bio-fertilizers with reduced dose of inorganic fertilizers sustains yield potential as well as maintains the soil health and fertility with minimum severity of black rot.

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South American Tomato Pinworm, *Tuta absoluta*: A New Threat to Tomato Cultivation in Himachal Pradesh

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Keywords: Pinworm, Tomato, Cultivation

Introduction

Tomato is the second most important vegetable crop next to potato in the world. In India it is one of the most important vegetables and occupies an area of 880 thousand hectare with a production of 18.2 MT. It is an important cash crop in Himachal in general and Mandi district in particular where it is cultivated under protected as well as open conditions covering an area of 900 ha with production of 30000 MT. The crop fetches handsome returns to the farmers of the region. However, like other crops, this is also prone to the ravages of many insect-pests & diseases which hinder the optimum returns of the crop. A new invasive pest, South American tomato pinworm, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) also known as the tomato leaf miner, tomato borer and South American tomato moth was observed for the first time infesting tomato crop in tropical region of south India with its incidence ranging between 0.08 and 14.08% during October 2014 (Sridhar *et al.* 2014). The pest has been classified as the most serious threat for tomato production worldwide. It is a neo-tropical oligophagous and one of the most devastating pests capable of causing up to 90-100% damage in tomato yield and fruit quality under greenhouses and field conditions (Miranada *et al.* 1998). The pest was later observed in Himachal during 2015 in Solan area under open conditions, however in Himachal Pradesh it was only recorded as a minor pest with low to moderate damage (Sharma and Gavrekar 2016).

Material and methods

Survey was undertaken during 2016-17 in eight tomato growing areas at random and eight polyhouses with tomato crop of the district to collect mined leaves and larvae. Collected larvae were then reared in the laboratory at 25 ± 0.5 _C and 70 ± 5% relative humidity to get pupae and adults for identification. The insect was identified on the bases of described keys for the pest. The damage to the crop was recorded in terms of percent leaf mines (blotch) and percent fruit damage.

Results and conclusion

The survey studies revealed that the pest was prevalent in epidemic form in tomato crop grown under protected conditions in Mandi district of Himachal Pradesh. No such epidemic of the pest from North India was earlier reported. The damage was very severe under protected conditions. The studies revealed that the pest caused complete failure of the crop under protected conditions where percent leaf infestation (blotch) varied from 70-100 with fruit damage to the tune of 80-90% in tomato crop in different areas. Under open conditions, the percent leaf infestation (blotch) varied from 1.7 to 18 % in summer tomato with fruit damage of 0.5 to 9.8% at different tomato growing areas of the district . The weekly trap catch at different locations studied also revealed an average catch of 39.4 to 70.8 adults per trap per week. As tomato is an important crop of the region, the epidemic of this invasive pest is a serious concern especially due to its peculiar damage and failure of control measures for its management. The spread of pest under open conditions especially in

summer tomato may pause serious threat to tomato crop. There is urgent need to keep close vigil for the pest in different tomato growing regions of the state to establish its status and look for suitable modules for its effective management.

Table 1: Survey on *Tuta* infestation in Tomato in Mandi District

Place	Situation	Leaf mine (blotch) (%)	Fruit Damage (%)
Maloh	Open	70-80	80-85
	Protected	7.5-12.0	5.0-7.5
Rajgarh	Open	6.4-11.5	6.0-9.5
Plauhta	Open	4.5-12.0	1.0-2.0
Khandla	Open	1.7-3.2	0.5-1.0
Jugahan	Open	6.3-9.5	2.0-5.5
Bateda (Hatgarh)	Open	7.5-18.0	6.5-9.8
	Protected	90-100	85-90
Byla	Open	2.1-4.0	0.5-1.5
Bajaura	Open	4.5-9.7	2.5-4.0

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Forecast and Need Based Fungicide Sprays for Effective Management of Late Blight of Potato

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Keywords: Potato, Late Blight, Fungicide

Introduction

Potato is an important cash crop in north western hills of Himachal Pradesh. Being grown during off- season, potato from Shimla hills fetches a premium price in the market, thus ensuring high returns to the farmers of the region. However, late blight of potato, which is caused by *Phytophthora infestans* (Mont) de Bary is the major bottleneck in potato production in the hills of Shimla district, where the crop is grown under rainfed conditions. Disease appears every year in the epiphytotic form in the area. In the present studies, cultural practices are the first line of defense i.e. use of healthy seed, seed treatment, proper spacing and hilling with forecast based targeted application of fungicides for effective management of the disease.

Material & methods

During 2011, a survey was conducted to record the disease status in potato crop. To layout demonstration trials, ten fields at Chirgaon (2 nos.), Jubbal (5 nos.) and Rohru (3 nos.) blocks of district Shimla, Himachal Pradesh were selected. For the disease management, prophylactic spray of Dithane M45 (Mancozeb) was applied before the onset of rainy season. A spray of Curzate (Cymoxanil 4% + Mancozeb 64%) was applied immediately after the climatic conditions became conducive for disease development (based on alert received from CPRI Shimla). Need based sprays of Dithane M45 (Mancozeb) and Curzate (Cymoxanil 4%+Mancozeb 64%) were followed at 10 days interval. Farmers' practice i.e. sprays of Mancozeb or Matalaxyl 4%+ Mancozeb 64% irrespective of disease and climatic condition, was kept as control. For awareness among farmers, field visits and training programme were also conducted for the management of different potato diseases.

Results and conclusion

Forecast based targeted application of fungicides i.e. Dithane M45 and Curzate [(Prophylactic Spray of Mancozeb (0.25%), after disease appearance spray of Cymoxanil 8% + Mancozeb 64% (0.25%) and need based sprays (Based on disease forecasting) of Mancozeb (0.25%) and Cymoxanil 8%+ Mancozeb 64% (0.25%)] resulted in 92.17 and 90.93 percent disease control compared to farmers practice with increased yield (24.75 and 25.13 t/ha)). also observed that based on need and weather forecast, applications of fungicides effective control of late blight in potato was achieved *(Mynit et al.* 2001).

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Integrated Management of Collar Rot (*Phytophthora cactorum*) in Apple by Using Agrochemicals and *Trichoderma viride*

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Keywords: Collar rot, *Trichoderma viride*, integrated management

Introduction

Dry temperate zone of Himachal Pradesh cultivates apple over 12,506 ha with an annual production of 59,473 MT. Though, cultivation of apple has revolutionized the socio-economic status of tribal farmers of Himachal Pradesh, but soil borne diseases, especially collar rot caused by *Phytophthora cactorum* is a major threat in the successful cultivation of crop. The incidence of disease is upto 50 per cent in the orchard of Shimla and Kinnaur districts of Himachal Pradesh (India).

Material and methods

On farm trials were conducted to assess and refine the existing technology for management of the disease by integrating agrochemicals with *Trichoderma viride* which included three drenching in rainy season with following treatments T_1 (Matalaxyl (8%) + Mancozeb (64%) @0.5%), T_2 (Mancozeb (75%) @ 0.5%), T_3 (three drenching with *Trichoderma viride* @0.5%) T_4(One drenching with Matalaxyl (8%) + Mancozeb (64%) @0.5% followed by two drenching with *T. viride*), T_5 (one drenching with Mancozeb (75%) followed by two drenching with *T. viride*) T_6 (Control/farmers' practice) during 2009-10 and 2010-11 in farmers' field.

Results and conclusion

Data presented in Table 1 revealed that T_4 has shown maximum percent healing of the lesion (60.77) after second year of progress, this was followed by T_1 (58.69%). Least effective treatment was T_3 (28.44% in 1st year and 46.23% in second year). Further demonstrations were conducted on farmers field with most effective treatment i.e. T_4 in the year 2011-12 and 2012-13. Similar results have been observed by Bhardwaj and Kumar (2002).

Table1: Individual and Combined Effect of Agrochemicals on Management of Collar Rot of Apple

Treatment	Percent Healing of lesion	
	2009-10	2010-11
T_1	36.26	58.69
T_2	32.61	48.81
T_3	28.44	46.23
T_4	37.65	60.77
T_5	31.20	52.69
T_6	0.00	0.00
$CD_{0.05}$	(1.53)	(2.09)

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Potential of Entomopathogens in Managing Potato White Grubs in Himachal Pradesh

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Introduction

White grubs are quite serious problem in hilly states where potatoes are grown during summer season as rain-fed crop (Chandel *et al*. 2015). In these areas rainfall is high and potato cultivation is done on sloppy lands with light and loose textured soils which are highly conducive for multiplication of white grubs. In Himachal Pradesh, *Brahminacoriacea* (Hope) is the most wide spread and destructive species (Pathania and Chandel, 2017) and the tuber damage often exceeds 50 per cent in endemic areas. The white grubs are difficult to control with conventional insecticides; therefore studies on field efficacy of different entomopathogens having potential against white grubs were undertaken.

Material and methods

The experiment was conducted in potato fields at Kheradhar in plots of $12m^2$. The formulations of *Metarhiziumanisopliae*, *Beauveriabassiana, Heterorhabditisindica,* and *Bacillus cereus* were mixed with FYM and added into furrows at earthing up. In a separate experiment, *Galleria mellonella* cadavers infected with *H. indica* supplied by FARMER Ghaziabad were tested. Total 14 cadavers were used per plot by digging 3-4 cm deep hole near the plant, and in each hole one cadaver was gently placed and covered with soil. Data on per cent tuber damage and number of grubs per 10 plants/ plot were recorded at harvest.

Results and conclusion

H. indica @ 10 kg/ha was highly effective with tuber damage ranging from 12.5 - 12.7 per cent. In *M. anisopliae* and *B. bassiana* treatments, 15.74 and 14.7 per cent damage was recorded, respectively. Dual application of *H. indica+B. bassiana* or *M. anisopliae* showed comparatively better results. The grub population was almost half (2.1 grubs/ $feet^2$) in this treatment in comparison to control (4.7 g/ $feet^2$).When *G. mellonella* cadavers infected with *H. indica* were put in soil, there was 44.62 to 51.25 per cent reduction in tuber damage over control. The grub population was recorded 1.71 - 2.34 times higher in untreated plots. The results clearly indicate that EPN saved greater potential to control infestation of white grubs. The combination of *B. bassiana+H. indica* has proven to be more effective method for decimating white grub population. The technology involving direct use of *G. mellonella* cadavers infected with nematodes has shown better efficacy compared to powder formulation. When cadavers are used, the infective juveniles show greater activity dispersing uniformly in all directions to seek their host.

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Population Dynamics of Citrus Butterfly, *Papilio demoleus* L. in Kinnow as Influenced by Abiotic Factors

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Keywords: Abiotic factors, *Papilio demoeus,* Population dynamics

Introduction

Citrus is the largest cultivated group of fruits in the world, belongs to the family Rutaceae and is widely cultivated fruit plant in tropical and subtropical regions. In India, mandarin is mostly grown in Maharashtra, Andhra Pradesh, Punjab and Haryana. The area in its cultivation is 107.8 lakh ha in India, and 1.9 lakh ha in Haryana with an annual production of 111.47 and 2.35 lakh tonnes, respectively, whereas, mandarin grown in an area of 33 lakh ha with an annual production of 34.31 lakh tonnes of fruits and productivity of 10.4 Mt/ha in Haryana (Anonymous 2014). Among the various factor of lower yield in India pest problem is one of the major constraints in the production of citrus. Citrus plants are attacked by more than 250 insect pests alone at all stages of growth right from budding and seedlings in nurseries. 165 species are important in India causing an estimated loss of 30 per cent in yield. The citrus butterfly, *Papilio demoleus* L. is a regular pest of nurseries, young seedlings and flush of full grown up trees. Severe infestation results in defoliation of tree and retarding plant growth and decreasing fruit yield. Keeping in view, the study has been carried out for population dynamics of citrus butterfly, *P. demoleus* on kinnow mandarin.

Material and methods

The experiment on population dynamics was carried out in the Department of Horticulture, CCS HAU, Hisar during 2016. Population density was determined at weekly interval and recorded on the basis of number of larvae per plant. Correlation among abiotic factors (*i.e.* temperature, relative humidity, rainfall and sunshine hrs) and larval population were determined.

Results and conclusion

Population density was at the peak during August to October i.e. in rainy season. The maximum population density was recorded with an average of 21.85 larvae/ Kinnow plant in the month of October (41^{th}) Standard Meteorological Week (SMW) followed by 20.19 larvae/ 5 replicates in 40^{th} SMW and minimum was observed in 18^{th} and 20^{th} SMW i.e 0 larvae/5 replicates. The population density declined gradually till the end of October. The first appearance of *P. demoleus* was observed 0.57 larvae on 16^{th} SMW when average temperature was (max.-min) 40^0C-21^0C and RH (M-E) varied from 56-23 per cent. Correlation coefficient between the larval population and relative humidity (M-E) was found positively (r = 0.112 to 0.837) which showed that increase in RH (%) then increase the larval population. The negative correlation was found between temperature, rainfall, and sunshine (hrs) and larval population (r = -0.614, -0.639 and -0.561), respectively.

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Water Management through Farm Pond and Utilization of Conserved Water for Sustainable Vegetable Production

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Keywords: Water Management, Farm Pond, Sustainable, Vegetable

Introduction

Light textured well-drained soils in North Eastern Ghat provide scope for cultivation of vegetables during rainy season. The intermittent dry spells and terminal drought affect the performance of those high value crops in most of the years. About 25% of the rainfall is lost as run-off. Harvesting of this run-off water in farm pond with proper lining will conserve the run-off water and recycling of this water for life-saving irrigation will protect the crop from drought grown in 90% of land area. Soil structure and organic matter status decide the water holding capacity of the soil. The present experiment involving two water management systems (no pond and pond) has been designed. Ex-situ water management is one type of management of land and conservation of rainfall excess which not only helped the havoc at the lower side but also provides life saving irrigation for a second crop. Many authors have focused on 'On Farm Reservoir' (OFR) with lined and unlined system for increasing the yield and economic condition of the farmers'.

Material and methods

10% of the cropped area was dug for construction of the pond in Lined and Unlined pond treatments. Size of the pond is 7m top widths, 1m-bottom width, 3m heights, and 1:1side slope. The water harvested in pond was reutilized for the pumpkin crop, which was sown only in Lined pond treatment, as there was no water available in unlined pond so the crop was not sown there.

Results and conclusion

Mean yield was highest (7.51 t/ha) in lined pond and water loss was lowest (235.8 lit/day) (17.06 lit/day/m2) in lined pond. Mean *rabi* radish yield in lined pond was 23.7 t/ha .The mean yield in last three years shows that the yield of vegetables in lined pond is highest (7.51 t/ha) which is 19% higher than the unlined pond due to more number of irrigation was given to unlined pond (6.33t/ha) and 42 % higher than the no pond (5.29 t/ha) as no irrigation was given in no pond. The seepage loss in unlined pond was highest (28.6 m^3/day) (831 lit/day/m2). The cost of lined pond was Rs 9.967 and that of unlined pond was Rs 2,993/-.). The water use efficiency was highest in lined pond (8.6 kg/ha/mm).The cost of lining per square meter was Rs 88.5. Water loss in lined pond is in increasing trend where as the water loss in unlined pond is decreasing trend may be due to siltation. It is observed that tomato yield was better than the cauliflower yield. The rich farmers or farmers can dug pond can go for this technology as higher cost: benefit ratio (2.25) is obtained in lined pond compared to 2.12 in unlined pond and 1.97 in no pond treatment plots. Water balance study for lined pond showed that 21.6% of the total flow into the pond is lost due to over flow, 74.5% due to seepage and evaporation. Only 3.9% of the total inflow was utilized for irrigation to crops. Biometric shows the lined pond got highest plant height and spread compared to others due to more number of irrigation was applied to them. It is observed that the runoff percentage is 15.4% of rainfall. Only 3.9 % of is used for irrigation purpose.

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Genetic Studies for Marketable Fruit Yield and Horticultural Traits Involving Bacterial Wilt Resistant Genotypes of Brinjal

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Keywords: Bi-parental Mating, Correlation, Path analysis

Introduction

Brinjal (*Solanum melongena* L.) belongs to family Solanaceae. Inspite of considerable improvement in yield of brinjal, the commercially grown cultivars almost reached a plateau in their production. The improvement in yield have become relatively difficult through conventional breeding methods, In brinjal, the general breeding procedures have been to select desired segregants in F_2 population and make plant to row selection in the subsequent generations. The routine breeding procedures are inadequate to explore the existing genetic variability for complex characters. To overcome these limitations, another breeding method which involves crosses in the populations having maximum genetic variability can be followed. Therefore, the investigation was carried out to study genetic variability generated through biparental mating to gather the information on genetic architecture of horticultural traits.

Material and methods

The experimental material consisted of 48 biparental progenies (BIP's) developed in F_2 generations *viz*., Swarna Pratibha x Hisar Shyamal (SP x H-8) and Arka Keshav x Bhola Nath (AK x BN) and sixty F_3 progenies developed by selfing of plants used in the biparental mating in each cross, respectively. The BIP's and F_3 progenies were then planted and evaluated along with corresponding original parents, F_1's and F_2's in two different experiments relating to two different crosses. The observations were taken on yield potential and quality traits. The phenotypic coefficient of correlation and path coefficients (Dewey and Lu 1959) were computed.

Results and conclusion

The BIP's *viz*., M_4 x F_{46}, M_3 x F_{41} and M_1 x F_{18} in cross Swarna Pratibha x Hisar Shyamal (SP x H-8) and M_4 x F_{45}, M_2 x F_{38} and M_2 x F_{23} in cross Arka Keshav x Bhola Nath (AK x BN) recorded high marketable fruit yield, quality traits and yield contributing components over the respective parents, F_1, F_2 and F_3 generations of both the crosses, respectively. The association studies revealed that marketable fruit yield was positively and highly significantly correlated with fruits per plant, plant height and fruit weight in BIP's and F_3 progenies of both crosses. Genetic analysis revealed the prevalence of non-additive genetic variance for marketable fruit yield, days to 50% flowering, days to first picking, fruit length, fruit weight, pedicel length and bacterial wilt incidence, whereas the additive genetic variance was pre-dominant for plant height and branches per plant in both the crosses and for fruit diameter, TSS in Swarna Pratibha x Hisar Shyamal (SP x H-8) and fruits per plant and average fruit diameter in Arka Keshav x Bhola Nath (AK x BN). Bacterial wilt incidence was comparatively lower in BIP's due to preponderance of more heterozygosity.

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Estimation of Kinnow Production through Standardized Sampling Technique

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Keywords: Stratification, Production, Estimation

Introduction

Kinnow mandarin (*Citrus nobillis* ×*C. deliciosa*) was developed by H.B. Frost in 1935 at California, USA. It occupies a place of pride in the horticultural wealth and economy of the country. In Himachal Pradesh, kinnow/orange crop occupies an area of 8609 hectare with production of 11010 MT. It has been observed that there exists discrepancy in the estimates of area and production of citrus fruits made by different state agencies; viz., Directorate of Land Records and Department of Horticulture of the state. Proper assessment of area and production is a pre-requisite for long term horticultural planning as the accuracy of basic statistics has direct bearing on success of various horticultural development plans. The present study attempts in standardization of statistical methodology that will help in developing a reliable data base on production of kinnow in the state.

Material and methods

Kangra and Sirmour districts of Himachal Pradesh were purposely selected as there are prominent kinnow producing areas in the state. Multistage sampling was employed for the selection of orchardists. The primary data on area and production were collected on well designed pre-tested schedule by adopting a personal interview method from the selected households in the study area during the year 2013-14. Area under Kinnow which was highly correlated with the study variable was considered as stratification variable. Equalization of strata total, equalization of cum $\sqrt{f}$, equalization of cum $\frac{1}{2}\{r(y) + f(y)\}$ and equalization of cum $\sqrt[3]{f}$ were tried for the construction of optimum strata boundaries for varying number of strata. Comparison was also made among three types of allocation method (Equal allocation, Proportional allocation and Neyman allocation) for obtaining precision based estimators of area and production of apple.

Results and conclusion

The variance term worked out to be least in Neyman allocation and hence this allocation method was retained for further investigations. Critical examining of the results revealed that for varying sample size, the method namely equalization of cum $\sqrt[3]{f(y)}$ provided the least variance. The Table 1 and Table 2 reveal that there was considerable gain in efficiency due to stratification. Maximum gain in efficiency was observed when the strata were constructed through equalization of cum $\sqrt[3]{f(y)}$. Hence the study suggests that precise techniques based on stratified random sampling method, together with equalization of cum $\sqrt[3]{f(y)}$ method can be successfully employed for estimating the production of kinnow in Kangra and Sirmour districts in particular and the state in general.

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Table 1: Percentage Gain in Efficiency due to Stratification (Neyman allocation) in Kangra

Sample size	Equalization of strata total			Equalization of cum $\sqrt{f(y)}$		
	2	3	4	2	3	4
12	46.22	58.34	86.92	101.59	115.02	163.67
24	70.73	95.53	95.72	108.72	142.35	198.46
36	112.90	116.79	117.49	126.31	233.64	236.18
Sample size	Equalization of cum $\frac{1}{2}\{r(y) + f(y)\}$			Equalization of cum $\sqrt[3]{f(y)}$		
	2	3	4	2	3	4
12	226.23	231.44	250.81	336.11	370.71	406.46
24	234.12	270.26	312.41	366.58	469.08	549.56
36	266.61	326.46	367.64	552.60	605.00	1183.10

Table 2: Percentage Gain in Efficiency due to Stratification (Neyman allocation) in Sirmour

Sample size	Equalization of strata total			Equalization of cum $\sqrt{f(y)}$		
	2	3	4	2	3	4
12	493.36	494.05	494.43	497.73	497.91	498.08
24	506.99	507.77	509.08	512.15	512.45	512.97
36	519.98	521.43	521.97	525.25	525.51	556.67
Sample size	Equalization of cum $\frac{1}{2}\{r(y) + f(y)\}$			Equalization of cum $\sqrt[3]{f(y)}$		
	2	3	4	2	3	4
12	505.61	584.61	650.97	637.78	638.77	641.91
24	519.69	599.64	656.60	656.43	657.60	659.65
36	570.86	648.21	676.37	676.62	677.15	681.05

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Studies on *Parthenium hysterophorus* L. Extract Against Wood Rotting Fungi

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Keywords: Wood Bio Preservative, Fungus Colonization

Introduction

Major problem in use of wood is its dimensional instability due to moisture, breakdown of wood polymers by UV light, and its decay by micro-organisms. Present work was carried out on *Pinus roxburghii*, *Celtis australis*, and *Bombax ceiba*. Different concentrations of *Parthenium hysterophorus* extract were analysed for variation in weight gain of wood, fungal growth and fungal inhibition. The maximum variation in oven dry weight of wood was recorded in *Celtis australis* and the lowest in *Bombax ceiba*. Maximum fungus colonization was recorded in control for all the species whereas highest fungus growth inhibition was recorded for *B. ceiba*.

Material and methods

Wood samples of *P. roxburghii*, *C. australis*, and *B. ceiba* were procured from the local market, whereas whole plant of *P. hysterophorus* was powdered and extracted with methanol. Different concentrations (0.25%, 0.50%, 1.00%, 1.50% and 2.00%) were prepared by dissolving the extract in 5% methanol. Wood samples were dipped in the extract solution and dried. Wood rotting fungus was isolated from sporophore of *Polyporus* sp. growing on the dead wood. The solidified medium was inoculated with fungus culture. Fungus colonization index and growth inhibition was also calculated (McKinney 1923).

Results and conclusion

The maximum variation in oven dry weight of wood was recorded in (0.071g) *C. australis* and the lowest variation (0.054 g) was observed in *B. ceiba*. The treated wood samples have shown an increase in weight gain over control and there is an increase in weight gain with the increase in concentrations. Maximum fungus colonization (100%) has been recorded in control for all the species and 0.25 % concentration for *Pinus roxburghii* . Minimum fungus colonization in *B. ceiba* has been found at 2 per cent concentrations (48.38%). The extract of *P. hysterophorus* was found inhibitory against *Polyporus* sp. and could protect the treated wood samples at high concentrations. The variation in weight of treated wood samples has shown increase as compared to control. Among the species *C. australis* had maximum values. Fungal colonization has decreased with the increase of *P. hysterophorus* extract concentration *i.e.* 2.00% concentration have minimum fungus colonization as compared to 0.25% concentration. The extract of *P. hysterophorus* have been found inhibitory against *Polyporus* sp. at all the test concentrations from 0.25 % to 2 %. Plant extracts have been reported to inhibit the growth of many fungi *in vitro* as such or on that treated wood samples. However, further studies are needed for the exploitation of plant extracts for eco-friendly preservation and treatment of the wood on commercial scale.

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Yield and Phosphorus Use Efficiency of Maize as Influenced by Residue Retention and Phosphorus Fertilization in Inceptisol

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Introduction

Phosphorus is an essential element of metabolically active compounds present in plants. In order to meet the rising demand, reduced tillage, use of cover crops and appropriate use of fertilizers are some of the conservation agriculture (CA) practices being promoted for improvement in soil and water quality and crop productivity. Maize (*Zea mays* L.)-wheat (*Triticum aestivum* L.) is the third most important cropping system after rice-wheat and rice-rice cropping system in India. Due to its poor mobility, application of P fertilizers becomes inevitable to improve crop growth and yield.

Material and methods

Field experiment on maize-wheat cropping system was initiated in 2013 at IARI, New Delhi using split-plot design. Main-plot treatments varied in crop residue retention i.e., T_1: Residue removal (No-residue), T_2: 25% crop residue, T_3: 50% crop residue, T_4: 75% crop residue, whereas, sub-plot treatments were S_1**:** No-Phosphorus, S_2**:** 50% Recommended Dose of Phosphorus (RDP), S_3**:** 100% RDP, S_4:150% RDP, S_5**:** 50% RDP + PSB & AM Maize (*cv.* PHM-1) was sown in first week of July and harvested during end of October, 2015. Previous wheat was harvested manually from ground level and aboveground biomass/residues were retained in the plots. Maize was raised under assured irrigated condition, and prescribed weed and pest control measures were adopted. Plot-wise grain and plant samples were collected at the time of harvesting of maize.

Results and conclusion

Crop residue retention and P fertilization either alone or in combination enhanced the grain yield of maize over control (4.33 t ha^{-1}). Maximum grain yield of 5.88 t ha^{-1} was recorded with crop residue retention @ 75% CR. Average grain yield of maize increased significantly from 5.42 t ha^{-1} (No-CR) to 5.88 t ha^{-1} (75% CR) with increasing rates of crop residue retention. 100% RDP and 50% RDP + PSB & AM were statistically at parin terms of average grain yields, but they differed significantly with higher yield over 50% RDP. Integrated use of 50% CR + 150% RDP and 75% CR + 100% RDP resulted in similar grain yield of 6.37 t ha^{-1} and 6.34 t ha^{-1}, respectively. Maximum total P uptake (23.7 kg ha^{-1}) was recorded with crop residue retention @ 75% CR followed by crop residue retention @ 50% CR (23.0 kg ha^{-1}) and least P uptake (20.7 kg ha^{-1}) in control (No-CR). Mean maximum total P uptake (26.6 kg ha^{-1}) was recorded in 50% RDP + PSB & AM. Maximum agronomic efficiency of P in maize (34.7 kg grain kg^{-1} P) was recorded in crop residue retention @ 25% CR. Interestingly, mean maximum agronomic efficiency of P (51.2 kg grain kg^{-1} P) was recorded under 50% RDP+PSB & AM, whereas, it decreased significantly with increasing rates of P fertilization rates. Crop residue retention increased P use efficiency (PUE) of maize from 17.2 (control) to 18.1 percent (in plots under 75% CR). PUE increased up to application of 100% RDP, thereafter PUE in maize decreased significantly in plots under 150% RDP. So application of 50% of recommended P along with AM+PSB inoculation proved superior over other P supplying strategies.

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Effect of K, Zn and B Levels on Uptake, Yield and Potassium Use Efficiency in Wheat in an Acid Alfisol

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Keywords: Potassium, Zinc, Boron, Wheat Yield, Potassium Use Efficiency

Introduction

Interactions among nutrients are important as the supply of one nutrient affects the absorption, distribution or function of another nutrient. Interactions between two or more nutrients can be positive (synergistic), negative (antagonistic) or even absent. Identification and exploitation of positive interactions hold the key for increasing returns in terms of yield, quality and nutrient use efficiency. The deficiency of zinc and boron is increasing and it may affect the potassium use efficiency. Hence, understanding interactive effect of micronutrient and potassium is essential that can lead to efficient use of chemical fertilizers and increased production. The information on effect of zinc and boron on potassium use efficiency is hardly available in wheat crop in the region hence the investigation was undertaken.

Material and methods

The field experiment was conducted on wheat crop at Department of Soil Sciencem CSKHPKV, Palampur during *rabi* 2010-11. 16 treatment combinations including, four levels of potassium (0, 50, 100, 150% of RD-K), two levels of zinc (0, 10 kg ha $^{-1}$) and two levels of boron (0, 1 kg ha $^{-1}$) were taken. Plant samples were collected at maximum tillering stage. Dried samples were ground with steel grinder and stored in paper bags for subsequent analysis. Potassium, zinc and boron concentration in grain and stover were determined by standard methods. The uptake of each nutrient was calculated by multiplying the per cent concentration of the nutrient with yield of the crop. The different indices of potassium use efficiency were also calculated (Surekha *et al*. 2003).

Results and conclusion

Highest grain (42.52q ha^{-1}) and straw (66.80 q ha^{-1}) yield was recorded under 150 per cent of recommended dose of wheat. Application of 150 percent of RD-K increased grain and straw yield by 43.7 and 46.9 per cent, respectively. Zn (10 kg ha^{-1}) increased grain and straw yield by 10.9 and 9.8 per cent, respectively. The increase in grain and straw yield with the application of B (1 kg ha^{-1}) was 5.6 and 6.3 per cent, respectively. Application of K increased K, Zn and B significantly at tillering and harvesting. Application of Zn increased Zn and B contents significantly at both the stages. However, B increased the contents of Zn and B only at maximum tillering stage and at harvesting (grain and straw). Almost similar effects of K, Zn and B application on total nutrient uptake were observed. Application of Zn increased partial factor productivity, physiological efficiency, agronomic efficiency and apparent recovery. Boron application increased partial factor productivity and apparent recovery only.

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Status and Distribution of Sulphur in Cultivated Soils of Himachal Pradesh

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Keywords: Sulphur Fractions, Organic Sulphur, Textured Soils

Introduction
Sulphur (S) is one of the essential elements for for the synthesis of the amino acids like cystine, cysteine and methionine, a component of vitamin A and activates certain enzyme systems in plants. Removal of sulphur by crops in India is about 1.26 mt whereas its replenishment through fertilizers is only about 0.76 mt.Available S content in the soil is used as an index to evaluate soil S fertility status and its contribution towards plant nutrition. However, knowledge of different forms of S is of much relevance in assessing the long-term availability of nutrients and in formulating strong fertilizer recommendations.

Material and methods
Himachal Pradesh has different kinds of soil due to variations in climate, parent material etc. and different textured soils have different effect on sulphur fractions. Owing to these variations, soil samples from almost all the agro climatic situations across the state had been used for carrying out the study.One hundred ten soil samples (0.0-0.15 m depth) were collected randomly across different districts.Out of these collected samples, twenty soil samples (0.0-0.15 m depth) varying in pH, OC, CEC and clay content, in each characteristics were separated out for Sfractionations study purpose.

Results and conclusion
Distribution of S in its different fractions in coarse, medium and fine textured soils was estimated. Available, water soluble, heat soluble, organic and total S content ranged from 7.8 to 22.3, 6.3 to 21.5, 9.1 to 23.1, 141 to 230 and 151 to 242 mg kg^{-1}, respectively. The content of available, water soluble, heat soluble, organic and total S was the highest in fine textured soils with an average of 15.56 ,14.4419.14[1], 201and216 ± 19.99 mg kg^{-1}followed by medium textured and coarse textured soils. Higher concentration of available sulphur in some soils might possibly be due to a greater plant and microbial activities resulting in the subsequent accumulation of organic matter. The reason for having higher amount of water soluble S in fine textured soils can be explained on the basis that this fraction of S is adsorbed specifically onto clay surface and higher the clay content more will be the water soluble sulphur. Low to moderate heat-soluble S in study suggests that most of the organic S may be in the form that cannot be removed by heat treatment. Organic sulphur accounted for 91 to 93 percent of total S in all the different textured soils. Generally total S showed similar trend as that of organic matter content in different textured soils.It may be concluded that the mean values of all the sulphur fractions was higher in fine textured soils as compared to medium and coarse textured soils because fine textured soils contained more content of organic matter which might have led to more availability of sulphur.

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In Vitro Efficacy of Bio-Control Agents against Papaya Anthracnose

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Keywords: Anthracnose, Bioefficacy, Biological control

Introduction

Papaya (*Carica papaya* L.) belongs to family caricaceae, is a popular and economically important fruit grown in most of the tropical and subtropical countries of world (Teixeira *et al.,* 2007). The ripe fruit is prone to many diseases incited by fungi, bacteria, nematodes and viruses leading to heavy loss in yield, of which papaya anthracnose caused by a fungus *Colletotrichum gloeosporioides* (Penz.) Penz. & Saccis the most wide spread and destructive disease worldwide. In general, approximately 40-100% post-harvest losses have been generally reported in papaya in developing countries. Postharvest losses due to anthracnose of papaya is a major limiting factor in India particularly when attempting to extend the transit and storage life of the fruit. Biological control agents are emerging as safer alternatives to conventional fungicides for the control of plant diseases and thereby reducing their risk to the environment.

Material and methods

The experiment was conducted in the Fruit Pathology Laboratory at YSPUHF in Nauni, Solan (H.P.), India during 2016-17. *C. gloeosporioides* was isolated from papaya fruits showing anthracnose lesions. The bits were then surface sterilized, washed twice with sterilized water and subsequently transferred to PDA medium, then incubated in BOD incubator at a temperature of 28 ±2°C. The antagonistic potential of fungal bio-agents were assessed against *C. gloeosporioides* by dual culture technique was studied according to (Stack *et al.* 1986). The colony diameter of the test fungus was also recorded and the per cent growth inhibition was calculated (Vincent, 1947). Antagonistic activity of bacterial bio-control agents *against C. gloeosporioides* was also evaluated by streak plate method.

Result and conclusion

Seven different fungal biocontrol agents (*Trichoderma* spp.) were evaluated using dual culture technique to see the antagonistic potential against *C. gloeosporioides* causing papaya anthracnose. The results revealed that all the antagonists were effective in inhibiting the mycelial growth of *C. gloeosporioides,* but with varied extent. After measuring the colony diameter of *C. gloeosporioides,* it was noticed that maximum reduction in colony growth was observed in *T. harzianum 1 (90.10*% MGI**)** followed by *T. viride* (88.28% MGI) and *T. virens* (87.96% MGI), respectively. Least mycelium reduction was noticed in *T. polysporum (*78.63% MGI). More or less similar results were obtained by Deshmukh and Raut (1992)and SanthaKumari (2002) in case of *C. gloeosporioides.* Among the seven bacterial biological agents tested by dual culture technique indicated that all the bio-control agents were effective in inhibiting the mycelial growth of *C. gloeosporioides*, but with varied extent. *B. subtilis* isolate 2 was significantly effective over other antagonists and exhibitedmaximum growth inhibition up to an extent of viz., 77.01 per cent followed by *B. subtilis* 3 (75.04% MGI) and *P. fluorescens* (72.02% MGI), respectively. Least mycelium reduction was recorded in case of *P. putida* (69.32% MGI).

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Effect of Integrated Nutrient Management System on Sustainable Production of Okra

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Keywords: Integrated Nutrient Management, Horticultural Traits

Introduction

Population growth and urbanization are creating increased demand of food especially in semi-urban areas. To meet the full dietary needs of common man and to eliminate malnutrition deficiency diseases and to relieve overstress on cereals, there is greater need for enhanced vegetable production. For enhancing the yield of vegetable crops, soil health is crucial factor. Whereas, continuous solo use of inorganic fertilizers has brought loss of vital soil fauna and flora. Thus, the study was designed to see the effect of integrated nutrient management on growth and yield of okra.

Material and methods

The study consisted of seven treatments in different combinations of inorganic fertilizers (NPK), vermicompost (VC), farm yard manure (FYM) and biofertilizers (BF) viz., T1: (100% NPK + FYM); T2: (75% NPK + VC (25% on N equivalence) + BF + FYM; T3: (50% NPK + VC (50% N eq.) + BF+ FYM; T4: (25% NPK + VC (75% N eq.) + BF+ FYM; T5: (75% NPK + (FYM + PM)- 25% on N eq. + BF+ FYM; T6: (NPK + (FYM+PM)- 50% N eq. + BF+ FYM; T7: (25% NPK + (FYM + PM) – 75% N eq. + BF+ FYM. The data were recorded for different growth and yield parameters.

Results and conclusion

The data revealed that treatment T2 (75% NPK + VC (25% on N equivalence) + BF + FYM) performed the best for most of the growth traits in okra and resulted in 174.63 g fruit yield per plant, however, it was statistically at par with T1,T3 and T5 (Table 1).

Table1: Effect of Various Treatments of Fertilizers on Growth and Yield on Okra (P-8)

Trt	Days taken to 50% flowering	Plant height (cm)	Number of fruiting nodes	No. of marketable fruits per plant	Harvest duration (days)	Fruit length (cm)	Fruit breadth (cm)	Average fruit weight (g)	Fruit yield/ plant (g)
T1	52.0	136.6	15.9	14.5	58.7	12.1	1.7	13.9	163.2
T2	51.0	140.0	17.2	15.9	60.8	13.1	1.8	14.9	174.6
T3	52.0	132.0	15.7	14.2	58.4	12.0	1.7	13.7	161.1
T4	55.3	128.0	12.5	10.7	53.5	9.6	1.3	11.0	135.0
T5	51.3	144.3	16.3	14.9	59.4	12.4	1.7	14.2	166.3
T6	54.6	124.0	13.1	11.4	54.2	10.1	1.4	11.5	139.4
T7	57.0	125.6	11.9	10.0	52.1	9.2	1.4	10.6	130.8
CD_5	2.48	5.07	2.18	2.40	3.49	1.60	0.22	1.80	19.0

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Characterization of Mango Cultivars for Fruit Set and Yield

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Keywords: Mango, Fruit Drop, Fruit Set, Yield

Introduction

Mango (*Mangifera indica* L.) belongs to family Anacardiaceae, comprises 69 species of genus *Mangifera* distributed throughout the world is an important nutritious fruit grown in the tropical and subtropical regions. The edible portion of mango fruit consists high amount of β carotene (20%), potassium and antioxidants.In spite of sustained research efforts for increasing the production and productivity, India is still low as 7.2 tonnes/ha (Lal*et al.* 2017) due to high incidence of fruit drop at initial stages of fruit development, low fruit retention and fruits per tree. Therefore, the present experiment was carried out to determine the fruit set, fruit drop and fruit yield of different mango cultivars.

Material and methods

The experiment was carried out with twelve cultivars of mango as treatment in 3 replications during 2014-15, each plant was of six years old with all the orchard management practices implies at the same level for every cultivar. The observations were recorded on eight different traits for fruit set and yield. Fruit drop was recorded at 15 days intervals.Mean difference were tested by'F' test at 5 per cent level of significance. Critical difference (CD at 5 per cent level of probability was used for comparison among treatments.

Results and conclusion

There was significant variation among the different cultivars of mango for the traits. Higher percentage of fruit set was found in cv. Sensation (9.50%) followed by Pusa Surya (6.06%) and Amrapali (5.86%). Maximum fruit drop was seen during the initial 15 days after fruit set as compare to 2nd and 3rd fortnight. During the course of development, there was a gradual reduction in the drop. The cumulative fruit drop percentage varied from 84.29 to 93.62 percent. Lower percentage of fruit drop was observed in Pusa Surya (84.29) while higher in Pant Chandra (93.62). Higher fruit retention was noticed in Pusa Surya (15.71%) while the lower in Pant Chandra (6.38%). Maximum fruit yield was in Mallika (24.76 kg) which was statistically at par with Pusa Arunima (22.83 kg) and Langra (22.74 kg).

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Genetic Divergence in Forage Sorghum

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Keywords: Forage Sorghum, Cluster Distance, Character Contribution

Introduction

Sorghum bicolor (L.) Moench is one of the gifted genera of the tropical regions that provide food, feed, fodder and fuel to millions of poor farmer families and their livestock because of its wide adoption, rapid growth, and high green fodder yield with high drought tolerance.To select the suitable parents for hybridization programme for development of superior hybrids and desirable transgressive segregants and to sustain level of high productivity, information on the genetic diversity among germplasms is essential. Therefore, the present investigation was conducted to study the genetic divergence in forage sorghum.

Material and methods

126 diverse genotypes of forage sorghum along with two checks i.e. SSG-59-3 and SMU-1 was planted in a Randomized Block Design (with three replications at Rajasthan College of Agriculture, MPUAT Udaipur. Observations were taken on eleven traits including protein content which was calculated by determining the Nitrogen content using Nessler's reagent colorimetric method. Genetic diversity analysis was done using Mahanobis D^2 statistics (1936), and clustering of genotypes was done by Tocher's method described by Rao (1952).

Results and conclusion

The composition of ten various distinct non-overlapping clusters varied from 2 to 29. Clustering pattern revealed the distribution of genotypes belonging to the same origin in more than one cluster indicating non-parallism between geographic and genetic diversity. Genotypes from cluster VII and IXwere found highly diverse as these clusters showed maximum inter-cluster distance. Hence, genotypes belonging to these clusters can be used as parents for developing high fodder yielding sorghum in hybridization programme. Genotypes belonging to cluster VII, III, IV and VIII having higher mean values for green fodder yield I cut, green fodder yield II cut, for stem juiciness and early vigor, respectively. Genotypes IS3192×SSG59-3 6-2, IS3192×SSG59-3 6-4, IS3304×SSV84 1-1, IS3304×SSV84 1-1 and IS3192×SSG59-3 13-3 belonging to cluster-VII,VII, I, and VII, respectively having higher mean values for green fodder yield I cut, green fodder yield II cut and early vigor and genotypes IS3192×SSG59-3 and IS3192×SSG59-3 belonging to cluster VII having higher mean values for stem juiciness. Therefore, these genotypes can be used directly for these characters or crossing between these genotypes belonging to different clusters may throw transgressive segregants having higher mean values together for green fodder yield, stem juiciness and early vigor.

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Seasonal Abundance of Aphids on Fruit Crops in Punjab

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Keywords: Alate, Aphid, Fruit Crops, Nymph, Species

Introduction

Aphids (Hemiptera: Aphididae) are interesting group of phytophagous insects because of their polyphenism, host alternation behaviour and reproductive habits. Aphids cause serious losses to agricultural and horticultural crops not only by sucking their sap but also by acting as vectors of several viral diseases and secreting honey dew which leading to the reduction of photosynthetic capacity of the host plant. About eight aphid species have been reported on different fruit crops in Punjab, but their proportion especially on citrus, peach and pear are wanting. Therefore, the present study was undertaken to elucidate these aspects.

Material and methods

The studies on proportion of six aphid species, viz. *Toxopteraaurantii* (Boyer de Fonscolombe), *Aphis gossypii* Glover, *Myzuspersicae* (Sulzer), *Brachycaudushelichrysi* (Kaltenbach), *Schizaphis* spp. And *Toxoptera* spp. on citrus, peach and pear were conducted in the College Orchard, Punjab Agricultural University, Ludhiana during 2014-15. One-hundred individuals consisting of alate and apterous forms appeared on the different fruit crops were sorted out and identified on the bases of morphological keys. The individuals of a particular species were counted and proportion ofeach species was calculated. Any specimen found at variance was sorted out and kept in separate vial for further studies.

Results and conclusion

The proportion and activity period of fourth instar nymph of different aphid species on leaves and flowers of different fruit crops namely peach, pear and citrus during 2014-15 revealed that *Myzuspersicae* (92.61%) was predominantly active during spring season followed by *B. helichrysi* in peach whereas *Toxoptera* spp. was observed maximum on flowers (96.52%) than that on leaves (9.46%) of pear as compared to *S. piricola.* In citrus, the spring population of *T. aurantii* was higher than autumn whereas *A. gossypii* (71.46%) was predominant during autumn season, which could be due to its presence on several host plants like cotton, vegetables and some ornamental plants (Atwal and Dhaliwal, 2015). The proportion and activity period of alate adult aphid species observed on leaves of different fruit crops during 2014-15 revealed that *B. helichrysi* and *M. persicae* had alate forms on peach during first fortnight of April with a proportion of 12.96 and 31.13 per cent, respectively. No alate forms of *T. aurantii* were observed on citrus during both the seasons. Similarly, no alate forms of both the species namely *Toxoptera* spp. and *S. piricola* on pear were found. *Toxoptera* spp. was completely different from *T. aurantii* and could be a different species onpears which needs confirmation. *Schizaphispiricola* is reported as new species on pears in Punjab. The scan of literature revealed that there is no such report of alate forms of these aphid species on fruit crops in Punjab.

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Effect of Deficit Irrigation on Chlorophyll Stability Index, Relative Water Content and Anatomical Characteristics of Kiwifruit Cultivars

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Keywords: Water Stress, Xylem, Anatomical Characteristics

Introduction
In kiwifruit, there is heavy water requirement for its cultivation, thus, there is a need to screen out various cultivars which can be easily adaptable to those areas where water availability is very less.

Material and methods
The study was undertaken at Dr. Y. S. Parmar University of Horticulture and Forestry, Solan, HP, India during the years 2011 and 2012. Five cultivars viz., Allison, Hayward, Abbott, Monty and Bruno were subjected to two irrigation levels viz., irrigation at 80 per cent and 60 per cent FC with four replications, in randomized block design.

Results and conclusion
The number of primary xylem and length of secondary xylem under standard irrigation were highest in cultivar Hayward and the least in cultivar Bruno. The deficit irrigation treatment significantly reduced the number of primary xylem and length of secondary xylem during the course of study. The per cent reduction in the number of primary xylem and length of secondary xylem due to deficit irrigation was highest in cultivar Bruno and the least in cultivar Hayward. The distribution of vessel size varies with variety and the sizes often result in higher sensitiveness to embolism under drought conditions. The deficit irrigation resulted in a marked increase in CSI and decrease in relative water content of all these cultivars. The CSI was being highest in 'Hayward' and the least in 'Bruno'. These findings are in congruence with the findings of Thakur (2004) in strawberry, Patil*et al*. (2005) and Kadam *et al*. (2005) in grapes, who observed that the CSI was lower in drought tolerant cultivars and higher in drought sensitive cultivars.

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Effect of Environmental Heat on the Performance of Female Farm Workers for Agriculture Operation

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Keywords: WBGT, Oral temperature, Heart rate, Discomfort rate, Heat stress

Introduction

The climate of India comprises a wide range of weather conditions across a vast geographic scale and varied topography. The hottest of all seasons, summer extends in Rajasthan from April to June. At Udaipur maximum temperature in April varies from 34.5 to 41.1°C, in May it varies from 35 to 43.2°C and in June it varies from 41.9 to 45.9°C. During these times wet bulb globe temperature (WBGT) outdoor varies from 28°C to 32°C, which is the indication of heat stress according to ACGIH norms. Heat stress occurs when the body's means of controlling its internal temperature starts to fail. When female farm workers are working under hot environment there may be chances of effect of heat stress like heat stroke, heat exhaustion, heat cramps, heat collapse, heat rashes, heat fatigue or skin problem.

Material and methods

Harvesting of wheat was selected for this study (27th March to 15th April) at Instructional Farm, CTAE, Udaipur. The study was conducted on 10 female farm workers. For the assessment of effect of environmental heat on the performance of female farm workers, three WBGT conditions as independent parameters were selected *i.e.* 28, 29 and 30°C and four dependent parameters oral temperature, mean skin temperature (Liu *et al* 2010), heart rate and overall discomfort rating were considered.

Results and conclusion

Effects of environmental heat on the performance of female farm workers for agriculture operation were assessed for harvesting operation of wheat. The study revealed that WBGT induces heat stress on human body during farm operations. The mean skin temperature and oral temperature, resting and working heart rate and overall discomfort rate of female farm workers increased with the increase in WBGT.

Table 1 Mean values of Oral Temperature (OT), Mean Skin Temperature (MST), Heart Rate (HR) and Overall Discomfort Rate (ODR) at different WBGT

S. No.	WBGT	OT (°C) at Rest	OT (°C) at Work	MST at rest (°C)	MST at work (°C)	HR at rest	HR at work	ODR at rest	ODR at work
1	28 ºC	36.67	37.11	29.25	32.85	76	92	1.5	4.9
2	29 ºC	36.72	37.19	30.05	33.21	78	96	1.6	5.8
3	30 ºC	36.75	37.26	30.39	34.55	81	102	1.8	6.7
	Mean	36.71	37.19	29.89	33.54	78	97	1.6	5.8

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Genetic Variability in *W*ild Pomegranate

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Keywords: Genetic traits, *Punica granatum,* Variability

Introduction

Punica granatum (wild pomegranate) is one of the oldest known edible fruits and is a deciduous tree of dry sites and is ecologically for stabilization of degraded sites. It is commonly used as condiments/spices for giving sour taste and for quick digestion. It grows wild in warm valleys and outer of Himalaya. It is an economically species for the farmers of mid-hills who are mainly engaged in collection of its fruit, extraction and drying of seeds and getting good return to sell as condiments. The future of wild pomegranate depends upon the selection of good genotypes with desirable seeds and the use of existing stock will be more effective by preserving local genotypes. The present work was conducted in Himachal Pradesh to study the variation among different seed sources of wild pomegranate.

Material and methods

Variation study of *Punica granatum* (wild pomegranate) was conducted in Himachal Pradesh. Multistage random sampling technique was used to select the seed source. In first stage four district viz., Sirmour, Solan, Mandi and Kulu were selected randomly and from each selected district three seed sources and from each seed source ten trees of approximately same age and height were selected randomly. Then from each selected tree 10 fruits were collected. Seeds collected from each seed source were sown in nursery of Department of Tree Improvement and Genetic Resources in two media Soil: Sand: FYM (Media 1) and Soil: FYM (Media 2). Data on germination, height, collar diameter, number of branches and number of leaves were collected at the stage of three month in nursery stage. Also genotypic and phenotypic coefficient of variability, heritability, genetic advance and genetic gain were also estimated for these traits.

Results and conclusion

There was significant variation for germination percentage, height, collar diameter, number of leaves among different seed sources of wild pomegranate. Maximum germination percentage (97.33 %), seedling height (33 cm), collar diameter (3.37 cm), number of branches (6.50) and number of leaves (61.17) were recorded in Jaunaji seed source of Solan district, whereas, minimum value were observed for all traits in Sarkaghat seed source of Mandi district. It was also observed that more value was recorded in Soil: FYM mixture as compared to soil: sand: FYM. High genotypic and phenotypic coefficient of variability for height, number of branches and number of leaves has been found suggesting for wide genetic diversion for these traits. High GCV, heritability and genetic advance for height and number of leaves indicated that selection can be carried out directly on phenotypic basis and were important for successful improvement through selection. High heritability and low genetic advance for crown diameter implies that heritability was mostly due to non-gene effects.

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Efficacy of Some Bio-Pesticides Vis-À-Vis Insecticides against Aphids Infesting *Brassica Napus* L.

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Keywords: Aphids, Bio-pesticides, *Brassica napus,* Efficacy, Insecticides

Introduction

Brassica napus L. popularly known as *gobhi sarson* in India belongs to the rapeseed-mustard group of oilseed crops. Among various insects associated with rapeseed-mustard, aphids are the most important pest responsible for tremendous yield losses. For the management of aphids, use of chemical insecticides is the most common practice among farmers which has many side effects. Therefore, emphasis is being given on the development of eco-friendly management practices involving the use of bio-pesticides and new insecticidal molecules.

Material and methods

Field experiments with 9 treatments replicated thrice were conducted at Palampur and Kangra to study efficacy of biopesticides *vis-a-vis* insecticides against aphids (*Myzus persicae* (Sulzer), *Lipaphys erysimi* (Kaltenbach) and *Brevicoryne brassicae* Linneaus) infesting *B. napus*. Observations on aphid population were recorded from 10 randomly selected plants/plot one day before the spray and after 5 and 10 days of application of treatments. Per cent reduction in aphid population over control (PROC) was calculated by Henderson and Tilton (1955) formula.

Results and conclusion

Among 8 insecticidal treatments, acetamiprid (0.02%), imidacloprid (0.005%), dimethoate (0.03%), NSKE (5%) and *V. lecanii* (2×10^8 CFU/ml of spores) were significantly superior to untreated check in reducing aphid population. At Palampur, these treatments showed reduction in aphid population over control (PROC) between 88.83 and 78.39, 81.11 and 71.11, 78.85 and 68.43, 39.25 and 40.35, 26.57 and 33.39 per cent at 5 and 10 days after treatment, respectively. At Kangra PROC was between 91.50 and 83.10, 88.04 and 80.83, 84.42 and 79.05, 50.94 and 38.09, 33.08 and 45.07 at 5 and 10 days after treatment, respectively. The remaining treatments comprising *B. bassiana*, *Eupatorium* leaf extract and *M. azedarach* seed kernel extract were ineffective against aphids. It can be inferred that among different treatments, acetamiprid followed by imidacloprid and dimethoate proved the best treatments in reducing the aphid population at significantly lower levels. Among biopesticides, NSKE and *V. lecanii* proved the best treatments.

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Effect of Insecticides and Bio-Pesticides on Biological Control Agents of Aphids Infesting *Brassica Napus* L.

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Keywords: Aphids, Biological control agents, Bio-pesticides, *Brassica napus*

Introduction

Brassica napus L. is an important oilseed crops. Aphids have been reported as their key pests. Chemical insecticides used for the management of aphids has negative effects on their biological control agents, which also play important role in maintaining the aphid population at low levels. Therefore, present study was undertaken to find out insecticides and biopesticides that are relatively safe to important biological control agents of aphids infesting *B. napus.*

Material and methods

Field experiments were conducted in RBD at two locations, Palampur and Kangra for the control of aphids infesting *B. napus* in which nine treatments (including control) comprising insecticides and bio-pesticides were applied. Data were recorded on per cent change in parasitization by *Diaeretiella rapae*, population of Coccinellids (larvae and adults/plant) and syrphids (larvae/10 cm apical twig) 7 days after application of treatment. The per cent parasitisation was worked out by the formula given by Root and Skelsey (1969).

Results and conclusion

Per cent parasitism of aphids by *D. rapae* was significantly reduced in acetamiprid (0.02%) and dimethoate (0.03%) treated plots as compared to untreated check. Maximum reduction in per cent parasitism was observed in case of dimethoate treated plots, where per cent parasitism reduced by 98.80 and 99.07 per cent at 7 days after treatment at Palampur and Kangra, respectively. In case of bio pesticides, the per cent parasitism of aphids remained at par with the untreated check at Kangra. Dimethoate (0.03%) was the most toxic treatment for the predator, *C. septempunctata* at both the locations.The population of syrphids decreased significantly in plots treated with dimethoate and acetamiprid as compared to untreated check. In case of bio pesticides, the population of syrphids remained at par with the untreated check at both the locations. Dimethoate was found to be the most toxic treatment for predators and parasitoid in comparison to acetamiprid and imidacloprid which were found to be relatively safe to them.

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Efficacy of *Euphorbia Royleana* Boiss against Cabbage Butterfly, *Pieris Brassicae* (Linn) Under the Field Conditions

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Keywords: *Euphorbia royleana*, Thor Pieris Brassicae, Cabbage butterfly, Efficacy

Introduction

The increasing realization on magnitude of hazards and environment pollution due to insecticides, has intensified the research for an alternative of insecticides for the pest management. Several workers have shown interest in botanicals. The plant species belonging to family Asteraceae, Fabaceae and Euphorbiaceae have been reported to possess pesticidal properties. The family Euphorbiaceae contains about 7000 species distributed over temperate and subtropical regions of the world. The field efficacy of *Euphorbia royleana* was tested against the First, Second, Third and Fourth instars of cabbage butterfly, *Pieris brassicae. Euphorbia royleans Boiss* is commonly known as 'Thor' and is found on dry slopes with a Southern aspect in outer ranges of North-Western Himalaya. *P brasscae* is an important insect pest of cole crops in Himachal Pradesh.

Material and methods

Euphorbia royleana is abundantly available around University campus. For extraction of latex, a longitudinal cut was made in the main stem of the plant with the help of a sharp blade knife. The latex oozed out of the cut in the form of profuse drops and the same was collected in glass tubes and brought to the laboratory. Working concentrations were made from the crude extract with water. Each treatment was replicated five times. Spraying was done with the help of hand sprayer. Before spraying, pre count observation on the number of cabbage butterfly cater pillars per plant of each instar, was taken. The observation on larval mortality were recorded after 24 hours of treatment

Results and conclusion

To evaluate the latex of *E. royleana* for its efficacy against *P brassicae* in the field, the infested plants were marked and treated with various concentrations of latex. The field efficacy of *E. royleana* was tested against the first, second, third and fourth instars of cabbage caterpillars *P brassicae*. The per cent mortality observed was 24.35, 39.49, 66.09 and 76.23 at 0.5, 1.0, 2.0, 4.0 per cent conc. of latex in first instar caterpillars; 28.40, 40.83, 54.42 and 66.54 at 1, 2, 4 and 6 per cent conc. of latex in second instar caterpillars; 46.42, 50.78, 53.20, 62.93 in third instar caterpillar at 4.0, 6.0, 8.0 and 10.0 per cent, and 32.56, 39.68, 43.51, 48.41 at 6, 8, 10 and 12 per cent in fourth instar caterpillars. Per cent mortality in control in first, second, third and fourth instar caterpillar 11.60, 5.03, 3.55 and 0.0 per cent, respectively.

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LGP Zoning and Trend Analysis over NW India under Changing Climate Using GIS

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Keywords: LPG, PET, trend, North-west India, zoning, GIS

Introduction

The concept of length of the crop growing period (LGP) was introduced by the UN Food and Agriculture Organization and described by Kunkel *et al*. (2014) The concept of the growing period is essential to fruit ecological zoning and provides a way of including seasonality in land resource appraisal. Changes in the length of the growing season can have both positive and negative effects on the yield and prices of particular crops.

Material and methods

Daily maximum and minimum temperature data (1980-2014) of twenty two meteorological stations of north-west India located approximately between latitude $26^0 40'$ to $37^0 10'$ N and longitudes 72^0 50′ and 81^0 00′ E was used for PET calculation using Thornthwaite method (1948). The LGP is the period in days during a year when rainfall exceeds half the potential evapotranspiration plus a period during which half of PET is met by assured estimated stored moisture as LGP = d($P \geq$ PET/2) + 2ASM/PET. Statistical measures of LPG were calculated and LGP maps were prepared in the GIS environment using Arc GIS 10.1.

Results and conclusion

The annual normal LGP was 299.5 days for hills, 151.9 days for plains and 191.9 days for north-west India and was than 300 days for Manali, Palampur, Solan and Ranichauri, 300-200 days for Srinagar, Shimla, Jammu, Chandigarh, Patiala and Saharanpur, 200 to 100 days for Ambala, Delhi, Karnal, Ludhiana, Rohtak, Bathinda, Bawal and Narnaul and less than 100 days for Sirsa, Ganganagar and Jaipur. The annual normal LGP was 299.5, 151.9 and 191.9 days with coefficient variation of 17.5, 38.3 and 45.4% for hills, plains and north-west India, respectively. During the effective growing period of temperate fruits the normal LGP was 184, 73 and 103 days with coefficient variation of 45.5, 60.2 and 25.4 per cent for hills, plains and north-west India, respectively. Corresponding values of LPG for dormant season were 116, 78 and 89 days with coefficient variation of 25.4, 42.3 and 40.4 per cent for hills, plains and north-west India, respectively. Based on the spatial variability in water availability to meet the half of the crop water demands the study area was divided into four LGP zones i.e. <120 days, 120-180 days, 180-240 days and >240 days. Growing period increased from 3 to10 months toward center both from south and north end of the study area.

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Soil Health Cards: An Initiative to Balanced Fertilizer Use

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Keywords: Soil health card, Imbalanced fertilizer use, Non-judicious fertilizer use

Introduction

One of the main reasons for the low yields and poor soil health in India is the imbalanced and non-judicious use of chemical fertilizers. It is therefore, important from farmer's point of view to use this input up to the level where the net income can be maximized and the gap in the efficient use of fertilizers can be minimized by use of balanced fertilizers and manure at right time in right quantity. In order to promote balanced fertilization, government of India has launched 'Soil Health Card Scheme' which aims at collecting soil samples and testing them in laboratories to generate soil health cards for every farmer in the country. Soil Health Card is a printed report card issued to farmers once in three years indicating the status of soil in terms of 12 parameters namely pH, EC, OC, macronutrients (N, P, K, S) and micronutrients (Fe, Mn, Cu, Zn and B) accompanied by crop wise recommendations of nutrients and fertilizers required to help farmers to improve productivity through judicious use of inputs.

Material and methods

Scholarly work of different scientists was consulted from research journals, monographs and relevant websites (www.arthapedia.in, www.soilhealth.dac.gov.in *etc*.).

Results and conclusion

Preliminary reports on soil health card scheme shows that there is some reduction in fertilizers use especially in nitrogen and increase in biofertilizers and other micronutrient uses. Crop yields have also increased for majority of the crops, although moderately. Patel and Chauhan (2012) concluded that majority of farmers had neutral to strongly favourable attitude towards soil health card programme. Makadia *et al.* (2017) reported judicious use of fertilizers by the farmers having soil health cards in Navsari and Surat districts of Gujarat as per recommendations of soil health cards as compared to those without soil health cards. Soil health cards ensure that farmers do not spend money unnecessarily on purchase of fertilizers by adding more than required. So, it can be concluded that the soil health cards enable the farmers to apply appropriate recommended doses of nutrients to realize improved and sustainable soil health and fertility status and also higher per unit yields.

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In Vitro Antagonistic Activities of Endophytic Bacteria against White Root Rot Pathogen in Apple

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Keywords: Endophytic bacteria, Apple roots, Antagonism, White root rot

Introduction

White root rot of apple is a very serious and destructive soil borne disease in apple orchards of Himachal Pradesh. The pathogen causing white root rot disease heavily affects all age group of plants and results tremendous losses in the yield. The increasing use of chemicals in agriculture is still a subject of interest to both public health authorities and environment. For the successful management of this disease, chemical control is proven as uneconomical and hazardous to environment. All these problems underline the necessity to develop novel and effective methods for controlling this disease. Endophytes as biological control agents are emerging and safer alternatives over conventional fungicides for the control of this disease. Therefore, the present study carried out for *in vitro* evaluation of native antagonistic endophytic bacteria against white root rot disease of apple.

Material and methods

Survey in different apple growing areas of Shimla, Kullu and Kinnaur districts of Himachal Pradesh was done for collection of root samples from healthy and diseased plants for isolation of endophytic bacteria. The surface sterilized root segments were surface sterilized in 70 % alcohol for 3 minutes and again washed three times in deionized water. These dried roots were macerated with a sterile pestle mortar. Tissue extracts were serially diluted in 9 ml autoclaved distilled water blanks and 100 µl were plated on pre poured nutrient agar plates in triplicate to recover any bacterial endophytes present in the root tissue. Phenotypic characteristics such as microscopic features, gram reaction, endospore staining, motility, catalase, and oxidase activity of all the isolates were determined by using standard procedures. All the endophytes were tested for antagonistic activity against white root rot pathogen by dual culture technique.

Results and conclusion

Twenty one endophytic bacteria were isolated from root samples collected from Shimla, Kullu and Kinnaur districts of Himachal Pradesh. Nutrient agar media has been used for the isolation of endophytic bacteria and different colonies have been recovered in the culture plate. These isolated colonies were preserved in nutrient agar slants. On the basis of morphological characterization, 14 isolates were Gram +ve and 7 were Gram –ve. 14 endophytic bacteria were positive for endospore staining. Among all the bacterial endophytes, six isolates showed antagonism against white root rot pathogen. Maximum per cent inhibition of 75.0 % was observed in EK_6 isolated from Kinnaur district followed by ES_8 (63.88%) from Shimla district. Minimum inhibition was observed in EA_6 i.e. 22.78%. Bioformulations of these six endophytic bacteria can be further exploited for the management of white root rot pathogen in the field.

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Effect of Biofertilizers (*Azotobacter* and *Sphingobacterium)* on Guava Seedlings under Nursery Conditions

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Keywords: *Azotobacter*, Bio-fertilizers, Guava, Nursery, *Sphingobacterium*

Introduction

Quality planting materials is one of the most important factor contributing towards high productivity of fruit crops. Shortage of planting material is a major problem in the production of horticultural crops. Perennial fruit crops are heavy feeders of plant nutrients and high yields can only be sustained through the application of optimal doses in balanced proportion. Continuous use of chemical fertilization leads to the deterioration of soil health and productivity. Biofertilizers have emerged as an important component of the integrated nutrient supply system and have great potential to improve crop yields through environmentally better nutrient supplies. Keeping these points in view, the present experiment was carried out to study the effect of *Azotobacter* sp. and *Sphingobacterium* sp. on vegetative growth parameters of guava under nursery conditions for the development of healthy planting material.

Material and methods

The standard culture of *Azotobacter* sp. and *Sphingobacterium sp.* was obtained from Department of Microbiology, Punjab Agricultural University, Ludhiana, Punjab, India. The liquid formulations of microbial inoculants were prepared by supplementing 2% PEG in basal medium. The three months old guava seedlings of uniform size were given dip treatment for 30 mins with liquid microbial inoculants and transplanted in nursery bed and observations were recorded after one year. There were three treatments, T_1: Control, T_2: *Azotobacter* sp., T_3: *Azotobacter* sp. and *Sphingobacterium* sp. replicated four times with 50 plants/replication in RBD.

Results and conclusion

The results of experiment showed that treated guava seedlings showed very good response to *Azotobacter* sp. and *Sphingobacterium* sp. treatment (T_3) followed by *Azotobacter* sp. (T_2). The data revealed 4.28 per cent increase in height, 4.41 per cent in collar diameter, 14.55 per cent in root length, 3.85 per cent in root numbers, 9.33 per cent in number of main branches/plant, 7.95 per cent in number of leaves, 6.95 per cent in fresh weight of shoot, 8.27 per cent in dry weight of shoot, 15.08 per cent in fresh leaf weight,14.08 per cent in dry weight of leaves, 12.60 per cent in fresh weight of root and 12.69 per cent in dry weight of root was obtained by *Azotobacter* sp. and *Sphingobacterium* sp. inoculation over control. The use of biofertilizer offers better options for enhancing the vegetative growth of horticultural crops under nursery conditions in an increasingly eco-conscious world thus, increase the success rate of vegetative propagation in healthy plants with well developed root and shoot system.

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Susceptibility of *Holotrichia longipennis* (Blanchard) grubs to *Bacillus cereus* and its compatibility with insecticides

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Keywords: *Holotrichia longipennis*, *Bacillus cereus*, Susceptibility

Introduction
Holotrichia longipennis (Blanchard) is an important species of whitegrubs causing widespread damage to potato, vegetables, cereals and forest nurseries throughout north-western Himalayas. It is most predominant species in mid hills constituting 14.3-20.1 per cent of total beetle catch. The current methods to control whitegrubs are through insecticides; however, their reduced efficacy has increased the need to develop alternative approaches against whitegrubs. *B. cereus* isolated from whitegrubs at Almora was found to be effective against *Anomala dimidiata* and *H. seticollis*. Therefore, the present study was undertaken to study the bioefficacy of *B. cereus* against grubs of *H. longipennis*.

Material and methods
B. cereus was tested against different instars of *H. longipennis*. The adults of *H. longipennis* were collected from *toon* trees at Palampur and maintained in laboratory. First instar grubs were maintained on maize seedlings and second/ third instars were fed on potato tubers in paper cups individually. The graded concentrations of *B. cereus* were prepared and maize roots/tubers were dipped in them and the grubs were allowed to feed on these treated roots/tubers. Mortality data were recorded at weekly interval and LC_{50} values were calculated. To study the interactions of *B. cereus* with insecticides, imidacloprid, chlorpyriphos and clothianidin were also tested alone and in combination with *B. cereus.*

Results and conclusion
In the present study, first instar grubs were highly susceptible to *B. cereus* treatment followed by second and third instars. LC_{50} values were 7.8 X 10^8, 1.04 X 10^9 and 1.7 X 10^9 spores/ ml and 95 % fiducial limits of LC_{50} values were 0.43 - 2.6 x 10^9, 0.51 - 4.7 x 10^9 and 0.91 - 8.3 x 10^9 spores/ ml, respectively. The LC_{90} values were 6.60 x 10^9, 1.20 x 10^{10} and 2.30 x 10^{10} spores/ ml with fiducial limits ranging from 0.27 – 1.60 x 10^{10}, 0.45 – 3.30 x 10^{10} and 0.81 – 6.61 x 10^{10} spores/ ml, respectively. In first, second and third instars, imidacloprid, chlorpyriphos and clothianidin produced mortality ranging from 51.6 – 66.8 %, 48.8 – 63.6 % and 44.4 – 61.4 %, respectively. When these three insecticides were used in combination with *B. cereus,* the mortality ranged from 61.6 - 69.8, 48.8 - 59.6 and 41.4 - 51.4 per cent against first, second and third instar grubs, respectively. The per cent mortality in combined application was on lesser side with all insecticides irrespective of the instars. To find interaction effects between insecticides x *B. cereus,* $\chi 2$ values were calculated which ranged from 5.02 – 7.41, 3.94- 5.02 and 3.42 – 3.61, for imidacloprid, chlorpyriphos and chlothiadin in different instars of *H. longipennis*, respectively. The calculated χ^2 values for imidacloprid and chlorpyriphos were on higher side as compared to tabulated values which indicate antagonistic interaction effects of *B. cereus* with all tested insecticides while in clothianidin the calculated χ^2values were on lower side which indicates the additive interaction effect.

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Effect of Elevated Night Temperature on Potato Tuberization

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Keywords: Potato, Heat stress, Tuberization

Introduction

Potato is the third largest global food crop after wheat and rice. It can be taken up as a short duration crop between the traditional wheat paddy cycle or in the lean season and can contribute significantly to the income of the farmers. However potato cultivation in warmer areas and seasons is constrained by sensitivity of potato to high temperature. Most potato genotypes fail to tuberize if night temperature exceeds 18°C. To popularize potato cultivation to subtropics and tropics and in view of the apparent negative effects of global warming, early maturing cultivars tolerant to heat need to be developed. For this, robust methods for phenotyping are required as well as molecular basis of tuberization with respect to high temperature need to be understood. In the present study the effect of moderately elevated temperature on tuber formation and transcriptional expression of flowering gene *Flowering locus* T, encoding the putative tuberization signal was elevated.

Material and methods

Tuberization in Potted Plants and Leaf Bud Cuttings: Potato genotypes, Kufri Surya, CP4398, CP4054 (heat tolerant) and Kufri Chandramukhi (heat susceptible) were grown under non inducing conditions for 30 days and then were subjected to heat stress (24/18°C day/night), (24 /24°C day/night for 21 days). Tuber formation was observed on day 21 after temperature treatment. Leaf bud cuttings planted in sand were also observed for axillary tuber formation under stress conditions. In vitro micro-tuberization: Axenic cultures were established from single node cuttings first in semisolid MS medium followed by sub culturing in liquid MS media. Plants were then subjected to micro-tuber formation in dark at 18°C and 25°C, in MS medium with 8% sucrose and 10 mg L^{-1} BAP. *RNA isolation and real time PCR:* Leaf samples were collected at 0 and 21 days after stress. RNA was isolated and cDNA was synthesized which was used for real time PCR analysis.

Results and conclusion

All the genotypes formed tubers in pots and leaf bud cuttings at 24 °C except heat sensitive genotype KCM. However, microtubers were formed in KCM even at elevated temperature suggesting that mixotropic culture media overcome the effect of high temperature in the inhibition of tuberization. Therefore, to develop a reliable in vitro assay system, culture media devoid of hormones needs to be standardized. This is desirable as most of potato germplasm is maintained in *vitro*. However, tuber formation in potted plants and leaf bud cuttings in controlled growth chambers can be used for screening heat tolerant potato genotypes. Expression analysis of FT gene revealed that it was down regulated in KCM during heat stress as compared to heat tolerant genotypes suggesting its role in potato tuber formation.

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Effects of Continuous Stover Removal on Soil Physical Properties under No-Till Corn in the North Applachian Region

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Keywords: Residue removal; Soil organic carbon, Bulk density; Water stable aggregates

Introduction

Concerns about global warming have increased focus on energy production from renewable sources so as to reduce over-reliance on fossil fuels and emission of greenhouse gases. The US Energy Independence and Security Act of 2007 requires 36 billion US gallons of ethanol for biodiesel by 2022. Crop residues like corn (*Zea mays* L.) stover are among the few sources perceived to be available in sufficient quantity and quality as potential feedstock for bioethanol production due to high cellulose content. However, use of corn residues as feedstock has raised concerns about potential risks of soil degradation and jeopardizing agricultural and environmental sustainability. Thus, there is a need to strike out a balance between amounts of stover removal for biofuel production and that to be retained on soil surface to prevent any adverse effects on soil quality.

Material and methods

The present study was conducted at the USDA-ARS North Appalachian Experimental Watershed, Coshocton, Ohio, in the ongoing experiments (established in 2004 and 2011) to quantify the effects of residues removal on soil physical properties. The experiment included five residues retention rates (0, 25, 50, 75, and 100% of the previous years residues) and a sixth treatment of added residues for 200% (T0, T25, T50, T75, T100, and T200, respectively). The T200 plots were supplied with the entire residue from T0 plots. Soil organic carbon (SOC), bulk density, macro-aggregates and micro-aggregates were determined using standard methods and the data subjected to analysis of variance using a general linear model in the statistical software R.

Results and conclusion

Ten years of continuous residues removal significantly ($p < .05$) decreased SOC in the 0-5 cm layer where the concentration ranged from 12.9 g kg^{-1} in no residue retention plots (T0) to 22.5 g kg^{-1} in 100% residue retention plots (T100); with a significant ($p < 0.05$) increase to 30.8 g kg^{-1} in the treatment with residue addition (T200). Two years of residues removal, though not statistically significant, showed a trend of decreasing SOC. Surface layer bulk density (ρ_b) was also significantly ($p < 0.05$) increased by 13% with a decade of residues removal, while macro-aggregates (8-4.75 mm) reduced and micro-aggregates (< 0.25 mm) increased significantly ($p < 0.01$). The stratification ratio (SR) for SOC ranged from 1.5 in no residue retention plots (T0) to 3.1 in the treatment with residue addition (T200) after ten years.

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Integrated Management of White Root Rot of Apple through Physical and Chemical Methods

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Keywords: Apple, Soil borne pathogen, White root rot, Integrated disease management

Introduction

White root rot of apple caused by *Dematophora necatrix* Hartig{*Rosellinia necatrix* (Hart.) Berl.} is a serious soil borne disease amongst all the soil borne diseases. The fungus is widely distributed and has a wide host range amongst cultivated and wild plants. In Himachal Pradesh, the disease has become a serious problem in the entire apple growing areas of Shimla, Kullu, Kinnaur, Mandi and Lahaul Spiti. The incidence of the disease is increasing gradually and every year 20-35 per cent trees are wiped out at the suffering sites. Hence, it is very difficult to manage the disease at the affected sites as well as establish new plantations only through fungicide applications. Therefore, the present study was planned to integrate physical and chemical management practices for developing integrated disease management strategy for established orchards suffering from white root rot.

Material and methods

Eight treatment combinations were evaluated at white root rot affected apple orchard site of Theog block of Shimla district. These include isolation trenches at variable distances from the tree trunk (4, 10 m), width (1, 1.5 feet) and depth (1, 1.5 feet) around diseased and nearby healthy trees. The treatment combinations were; T_1-4x1x1, T_2-4x1x1.5, T_3-4x1.5x1, T_4-4x1.5x1.5, T_5-10x1x1, T_6-10x1x1.5, T_7-10x1.5x1, and T_8-10x1.5x1.5. Surface drenching/application (volume of solution varied as per age of the tree) in the basin of the tree with combination of three chemicals (carbendazim 0.1% + calcium cynamide 100g/plant + mancozeb 0.3%) at 1:1:1 was done three times at an interval of 2 months (March and August, 2016). The soil microbial population was monitored at pre and post application stages. The data on recovery of treated plants/infection of nearby healthy plants, emergence of new shoots in the diseased plants were recorded at the end of the growing season (Oct.-Nov. 2016).

Results and conclusion

The bacterial count was in the range of 29-67 x 10^{-6} cfu/g of soil at dilution after first application and 24-78 x 10^{-6} cfu/g after second application. There was no significant effect on change in the bacterial population whereas the fungal population started decreasing after each cyclic application of chemical application. Maximum fungal count of 15 x 10^{-3} cfu/g was observed after first application, which reduced to 8 x 10^{-3} cfu/g in T_3 after second application. The actinomycetes population increased after second chemical application due to pH variation from acidic to neutral. The new emerging shoots were recorded in the range of 11.29-80.0, 8.65-75.55 and 11.29-59.21 per cent among 10, 20 and 30 years apple tree respectively. Maximum increase of 80.00 percent was recorded in T_8 of 10 year old apple tree. Overall, it was concluded that the white root rot affected apple tree started recovering after three chemical applications. Isolation trenches both at 4 and 10 m distance and 1.5 feet wide and depth were effective in preventing the progress of disease to the nearby trees.

IESHP/AFS2017/3116

Prevalence of Banded Leaf and Sheath Blight of Maize caused by *Rhizoctonia solani* f. sp. *sasakii*

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Keywords: Banded Leaf and Sheath Blight, Incidence, Severity Index, Survey

Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops in the world. Bacterial stalk rot, turcicum blight, head smut and banded leaf and sheath blight of maize are the major diseases causing economic losses. Banded leaf and sheath blight, caused by a destructive and versatile pathogen *Rhizoctonia solani* f. sp. *sasakii* (teleomorph: *Corticium sasakii*, syn. *Thanatephorus cucumeris*), causes losses in grain yield ranging from 11.0 to 40.0 per cent. Keeping in view the significance of losses caused by this disease an attempt has been made to ascertain the prevalence of this disease in maize growing area of Himachal Pradesh.

Material and methods

To assess the occurrence of Banded Leaf and Sheath Blight of maize in Himachal Pradesh, an extensive survey was conducted during the month of August, 2013. Five districts of Himachal Pradesh viz., Kangra, Mandi, Hamirpur, Una and Bilaspur were surveyed to record the incidence and severity index of the disease from farmer's field. At each location, five maize growing fields were selected for disease indexing. In each field, populations of fifty plants were assessed for incidence, from which twenty infected plants were assessed for severity level. Disease severity index was assessed using 1-9 scale suggested by Ahuja and Payak (1983). Data were pooled at the end to work out per cent incidence and severity index. The cultural and sclerotial characteristics of different isolates collected from different locations were recorded.

Results and conclusion

The results revealed that the disease occurred throughout the state with maximum incidence of 58.8 % at Bilaspur followed by Una (52.8 %), Kangra (38.4 %), Mandi (34.3%) and Hamirpur (30.0 %) with average severity index of 61.0, 66.5, 45.9, 41.3 and 42.2 % respectively. The pure culture of isolates (maintained on PDA medium and incubated at 25±1°C) from Palampur (Rs_1), Ghatasani (Rs_5) and Nadaun ($Rs_{2)}$ had hyphoid mycelium with creamish brown to pale brown colony colour having smoky brown sclerotia in ring pattern. Whereas, Berthin (Rs_4) and Amb (Rs_3) had dense and thin mycelium with pale brown colony colour having uniform sclerotial distribution. Thus, the morphological and cultural characteristics with sclerotial formation confirm the casual fungus as *R. solani* f. sp. *sasakii* to cause BLSB of maize.

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Population Dynamics and Comparative Efficacy of certain Chemicals and Biopesticides against Okra Sucking Pests

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Keywords: Biopesticide, Okra, Sucking pest

Introduction
Okra is one of the most important vegetables grown throughout the tropics and warmer parts of the temperate zone. The nutritional value of 100g of edible okra is characterized 1.9 g protein, 0.2 g fat, 6.4 g carbohydrate, 0.7 g minerals and 1.2 g fibers. Okra has a good potential as a foreign exchange crop and accounts for 60% of the export of fresh vegetables. It is cultivated in 0.349 M ha area with the production of 57.84 lakh tons and productivity of 11.6 tons/ha. Among all the pests that attack okra, sucking pests like whitefly (*Bemesia tabaci)* and leafhopper (*Amrasca biguttula biguttula)* are quiet serious. Considering the limitations of using chemicals alone the present study was conducted to find out the efficacy of the chemicals and biopesticides and their combinations to minimise the hazardous effects of the chemicals and the biopesticides to be given preference as a component of IPM along with a brief study of the population dynamics of the pests as well.

Material and methods
The present investigation was conducted to study population dynamics and efficacy of certain chemicals and biopesticides against sucking pests of okra *Abelmoschus esculentus* (L.) Moench, cultivar i.e. VRO-6 (Kashi Pragathi). The treatments included Neemoil@3%, Spinosad 45%SC @0.005ml/L, *Metarhizium anisopliae* @4g/L*, Verticilium lecanii* @4/L, Dimethoate 30EC @2ml/L, Cypermethrin 10EC @2ml/L, Dimethoate + Neemoil, Cypermethrin + Neemoil, and untreated control.

Results and conclusion
The occurrence of whitefly (*Bemesia tabaci)* and leafhopper (*Amrasca biguttula biguttula),* commenced from 35th standard week (August third week) with an average population of 1.51 (whiteflies/3 leaves) and 0.55 (leafhoppers/3 leaves) respectively and then the population gradually increased and reached to its peak level by 41st standard week (October second week) with an average population of 17.67 (whiteflies/3 leaves) and 14.36 (leafhoppers/3 leaves) respectively. There after declined trend was observed as temperature decreased. It was found that population of whitefly and leafhopper increased with increasing maximum temperature and positively correlated with maximum temperature. The population of whitefly (*Bemesia tabaci)* and leafhopper (*Amrasca biguttula biguttul,* after two sprays revealed that the treatments Dimethoate30EC is found to be superior with a least population of 2.77 (whiteflies/3 leaves) and 2.45 (leafhoppers/3 leaves) respectively, followed by Spinosad 3.20 (whiteflies/3 leaves), 3.34 (leafhoppers/3 leaves), Cypermethrin 4.16 (whiteflies/3 leaves), 3.57 (leafhoppers/3 leaves) Dimethoate+Neemoil 5.07 (whiteflies/3 leaves), 5.11 (leafhoppers/3 leaves), Cypermethrin+Neemoil 5.93 (whiteflies/3 leaves), 5.33 (leafhoppers/3 leaves), Neemoil 8.27 (whiteflies/3 leaves), 6.87 (leafhoppers/3 leaves), *Verticilium lecanii* 8.52 (whiteflies/3 leaves), 7.06 (leafhoppers/3 leaves) and *Metarhizium anisopliae* 8.81 (whiteflies/3 leaves), 7.49 (leafhoppers/3 leaves), all the treatments are found to be superior over the control.

IESHP/AFS2017/3118

Sustainable Crop Production and Soil Health in Relation to Continuous Use of Fertilizer, Lime and Manure in an Acid Soil

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Keywords: Manure, LTFE, Acid soil, Soil health

Introduction
Intensive cropping invariably results in heavy withdrawal of nutrients from soil, which has to be replenished. The success of this process largely depends upon judicious application of plant nutrients. The sustenance of soil health depends on an understanding of how soils respond to agricultural use and practices over time. For food security, a balance among crop productivity, soil health improvement and ecological sustainability is required. This paper examines the impact of continuous cropping, fertilizer, manure and lime (as ameliorant for acid soil) application on crop productivity, sustainability and changes in soil quality and tries to identify the most suitable indicators for assessing soil health from the on-going long term experiments at Ranchi, Jharkhand, India.

Material and methods
Two on-going permanent experiments viz., Permanent Manurial Trial (PMT) (since, 1956) and AICRP on Long Term Fertilizer Experiment (LTFE) (since, 1972) with maize-wheat and soybean-wheat cropping system, respectively under a range of different nutrient management practices were used. Of the above on-going permanent experiments, eight treatments each from the two long term experiments were selected for identification of indicators and development of index to assess soil health. Statistical analysis for Analysis of variance (ANOVA) and Principal Component Analysis (PCA) was carried out using SPSS windows version.

Results and conclusion
Imbalanced and continuous use of N alone produced the highest decline in crop yields and had deleterious effect on sustainable yield, indicating that other major and micronutrients were becoming limiting and adequate response of N could not be obtained unless those yield limiting factors were taken care of. Application of FYM benefitted acid soils through its buffering action. Perusal of data on soil properties reveal that application of lime/FYM along with recommended dose of fertilizers was effective in sustaining availability of essential plant nutrients. Integrated use of nutrient inputs led to greater farm profits by curtailing excess and unwanted expenditures on costly fertilisers. The most sensitive indicators in descending order of importance as revealed by PCA and correlation studies were as follows: *soil pH>dehydrogenase>potentially mineralizeable N>soil microbial biomass nitrogen>soil microbial biomass carbon>available S*. The index for assessing soil health was computed using additive model. The index developed varied from 0.18 to 0.72. The higher index values and sustainable yield index in balanced and integrated nutrient supply system suggest that, these nutrient management options are good to maintain better soil health. Therefore, sustained efforts are needed to improve and maintain this most important natural resource base –the soil through judicious integration of chemical fertilizers, lime, organic and green manures, crop residues and bio-fertilizers so that it nourishes intensive cropping without being irreversibly damaged in the process.

IESHP/AFS2017/3120

Assessment of character contribution to the divergence in rice (*Oryza sativa*.L) germplasm for yield and yield attributing traits

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Keywords: Rice, Genetic diversity, D^2 analysis, Cluster

Introduction
Genetic diversity is a pre-requisite for the crop improvement program as it helps in establishing the genetic relationship in germplasm collection, identifying diverse parental combinations and superior recombinations for further selection and introgressing desirable genes from diverse germplasm. Information on the nature and degree of genetic divergence would help the plant breeder in choosing the right parents for breeding programme (Joshi *et al*., 2017). The D^2-statistics developed by Mahalanobis (1936) had been found to be potent tool in quantifying the degree of divergence in rice germplasm. Therefore, the present study was undertaken to assess the extent of genetic diversity among 52 rice germplasms which will help to select prospective parents and also the extent of diversity among germplasms.

Material and methods
The study comprised of 52 rice cultivars, evaluated in a randomized block design (RBD) with three replications during *Kharif* 2015 at Institute of Agricultural Sciences, BHU, Varanasi. Observations were recorded on ten randomly selected plants for ten quantitative traits in each replication. Genetic divergence amongst different genotypes was assessed based on the D^2-statistics of Mahalanobis (1936) and the genotypes were grouped into a number of clusters by Tocher's method.

Results and conclusion
The results from the analysis of variance revealed that the cultivars differ significantly for all the traits under study. The germplasms were grouped into eight clusters. Clustering pattern indicated that 11 out of fifty two germpalsms belong to the same cluster V followed by cluster IV with 10, cluster VIII with 7, cluster VII with 6, and cluster I and VI with 5 each and cluster II and III with 4 germplasms. The highest intra cluster distance was observed in cluster IV (20.385) and the highest inter-cluster distance was found between cluster VIII and II (153.579). The genotypes belonging to clusters I, II and VIII could be used in hybridization programme to obtain better recombinants and also quiet promising for many of the traits under study.

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IESHP/AFS2017/3121

Extent of Yield Losses caused by Rice Leaf Folder, *Cnaphalocrocis medinalis* (Guenee) at Various Release Levels

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Keywords: Rice leaf folder, Pest population density, Leaf damage, Incidence

Introduction

Insect-pests incidence is one of the major constraints in obtaining the yield potential from the newly evolved varieties and the instances of crop failure due to outbreaks of insect-pests have been reported worldwide. Among various pests of paddy, rice leaf folder is the most serious pest causing 11.18 per cent losses in India (Shanmugam *et al*. 2006). Under epidemic situations, the yield loss varied from 30 to 80 per cent (Nanda and Bisoi 1990). The yield loss depends on pest population density and plant growth stage. Thus, it is very important to understand the relationship between pest population density and yield loss.

Material and methods

The experiments to assess the yield losses caused by rice leaf folder were conducted in RBD during 2015 and 2016 in the plots of 4 m x 3 m each with six treatments including control and replicated five times. Different levels *i.e.* 0, 2, 4, 6, 8 and 10 larvae per hill were released at panicle intitiation stage of paddy crop in each treatment. Data on damage caused by leaf folder at various release levels were recorded by counting the total number of leaves and damaged leaves on a day immediately after the removal of net followed by 10 days after the second reading *i.e.* at 60 and 70 DAT. Yield data was recorded and the avoidable yield losses were worked out at different release levels.

Results and conclusion

The leaf damage and losses inflicted to paddy due to different release levels of *C. medinalis viz.,* 2, 4, 6, 8, and 10 larvae per hill released at panicle initiation stage revealed that the per cent damaged leaves varied from 5.10 to 25.30 per cent during 2015. Whereas, in 2016, it varied from 5.80 to 27.22 per cent. The avoidable losses varied from 0.60 to 31.50 and 1.30 to 27.15 per cent during 2015 and 2016, respectively, with the minimum and maximum values corresponding to release levels of 2 and 10 larvae per hill. The linear regression equation worked out between grain yield and release levels of rice leaf folder larvae revealed that a unit increase in leaf folder infestation during 2015 and 2016, resulted in reduction in yield to the extent of 0.499 and 0.454 g per hill, respectively.

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Effect of Water Stress on Growth, Physiological and Biochemical Characteristics of Coriander

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Keywords: Canopy, Physiological indices, Water Deficit

Introduction

In semi-arid regions particularly during winter months, the evaporative demand and lesser or no rain result in significant drought stress in many crop plants, which is one of the most severe environmental stresses and affects almost all plant functions. In these conditions, water stress causes serious reduction in growth, yield and quality attributes in many plants. Severity of water stress has a great impact on the physiological and biochemical processes of plants. Plants under water stress are normally affected by different constraints such as osmotic and nutrition imbalance. The study was performed to study the effect of water stress on plant growth and physio-biochemical properties.

Material and methods

An experiment based on a CRD with four treatments having four replications each was conducted to assess the effect of water stress on growth and physio-biochemical properties of *Coriandrum sativum* plants which were subject to 0, 25, 50 and 75 percent water deficit conditions for 15 days in the field and laboratory during the Rabi season. Water stress conditions were imposed by withholding watering, at flower forming phase. Samples were collected and analysed in laboratory to determine the effect of different water stress regimes on physiological and biochemical processes.

Results and conclusion

Coriander plants respond differently to imposed water stress particularly physiological and biochemical level. The quantum efficiency of photo system II (Fv/Fm i.e. ratio of variable to maximum fluorescence) was significantly influenced by different water stress treatments. Significantly lower quantum efficiency was registered by leaves of 75% water stressed plants as compared to the control. Canopy temperature depression significantly differed among different water stress levels. The maximum canopy temperature depression (3.23^{o}C) was observed in unstressed plants, however, minimum canopy temperature depression (1.21^{o}C) was observed in plants subjected to highest magnitude of water stress i.e. 75% water stress level. Hereby, revealing the cooler canopies in unstressed plants as compared to stressed plants. Leaf water potential is a major attribute indicating the internal water status of the plants at any particular time in the plant system. It is a prominent indicator to elucidate the drought tolerance of various species. The data shows that the maximum water potential i.e. -9.58 bars was recorded for unstressed plants, whereas, minimum water potential i.e.-12.33 bars was observed in plants subjected to 75% water stress level. Our studies indicate that the water potential reduced as the level of water stress increased as compared to the unstressed plants. The study can pave the way for coriander grower that the crop must not suffer from water stress of higher magnitude during the flowering stage.

IESHP/AFS2017/3123

Studies on Effect of Different Growth Regulators on Tree Growth and Leaf Area of Apricot (*Prunus armeniaca* L.) cv. New Castle

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Keywords: Forchlorfenuron, Pro-Cal, Brassinolide, Growth regulation, Annual shoot growth

Introduction

Apricot (*Prunus armeniaca* L.) is one of the most important stone fruit crops of mid-hills region of Himachal Pradesh. A low-moderate chilling "New Castle" is the most commercial cultivar of apricot in this region as it bears abundant crop regularly and is the most demanded variety for both table as well as processing purpose. Plant growth regulators have key role in different physiological processes related to growth and development of crops. Changes in the level of endogenous hormones due to stress factors alter the crop growth and exogenous application of growth substances would help for growth and yield improvement.

Material and methods

The study was carried out in the experimental orchard of Department of Fruit Science, Dr. YS Parmar University of Horticulture and Forestry during the years 2013 and 2014 on 18-year-old trees of apricot cultivar New Castle raised on wild apricot seedlings under Completely Randomized Block Design (CRBD) with 10 treatments each having 3 replications. The spray solutions of forchlorfenuron (CPPU), prohexadione-calcium (Pro-Ca) and brassinolide of desired strength were sprayed at petal fall and pit hardening stage. The Data recorded were analysed with the help of data analysing online software program OP-STAT.

Results and conclusion

Pre harvest application of different plant growth regulators exerted a significant influence on annual shoot growth, increase in the tree height and spread measurements, tree volume, trunk girth and leaf area of apricot. The annual shoot growth values under various treatments ranged from 69.7 to 112.9 cm. Foliar spray of CPPU at 10 ppm applied at petal fall stage induced maximum shoot growth (112.9 cm) whereas, the minimum annual shoot growth was noticed in the tree treated with Pro-Ca at 200 ppm at pit hardening stage (69.7 cm). The annual increment in tree parameters (increase in the tree height and spread measurements, tree volume, trunk girth) was found to be lowest following the application of Pro-Ca at 200 ppm, whereas this increment in tree growth parameters was found to be higher with the treatments of CPPU and brassinolide. The highest increase in leaf area (57 cm^2 and 56.8 cm^2 in 2013 and 2014, respectively) was found under the treatment of CPPU at 5 ppm.

IESHP/AFS2017/3124

Changes in Fruit Peel and Stone Nutrient Concentration during Fruit Development in Mango

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Keywords: Mango, Macronutrients, Peel, Stone

Introduction
Mango (*Mangifera indica* L.), a member of *Anacardiaceae* family, is the most popular and commercially important fruit crop in tropical and sub-tropical regions of world. The concentrations of various nutrients undergo different changes during development of fruit. The objective of the present investigations was to study the seasonal accumulation of the nutrient contents in fruit peel and stone of mango fruit.

Material and methods
The present studies were undertaken in the Department of Fruit Science, PAU Ludhiana during 2016. The sampling was done from 35 DAFS to 95 DAFS at 10 days interval for the estimation of macronutrients viz. N, P, K, Ca and Mg. The samples were dried in hot air oven till constant dry weight and nutrients were estimated using standard procedures.

Results and conclusion
Result showed that the N concentration in stone of the fruit declined with advancement of fruit maturity. The maximum (1.61%) and minimum (0.63%) nitrogen content in the stone of the fruits was recorded on 35 DAFS and 95 DAFS, respectively. N content in peel of the fruit initially increased from 35 DAFS to 45 DAFS and thereafter showed a declining trend till 95 DAFS. Maximum (1.71%) content of nitrogen in fruit peel was recorded on 45 DAFS and minimum (0.62%) on 95 DAFS. P and K content in the stone and peel of the fruit did not show any consistent trend. The maximum mean P content (0.34%) in the peel of fruits was recorded on 35 DAFS and the minimum P content (0.21%) in the peel was recorded on 95 DAFS. The maximum mean P content (0.27%) was recorded in the crop harvested on 35 DAFS, which was significantly higher among all harvesting dates while the minimum P content (0.17%) was recorded on 95 DAFS. The concentration of K in the fruit peel was maximum on 35 DAFS (1.61%) and minimum on 55 DAFS (1.19%). The maximum concentration of K in fruit stone was recorded on 35 DAFS (1.167%) and minimum on 95 DAFS (0.837%). The Ca content of fruit peel increased continuously with the advancement of season. However, the Mg content of fruit peel declined initially and subsequently increased till maturity. The maximum concentration of fruit peel Ca (1.99%) and Mg (0.87%) was recorded on 95 DAFS, but the minimum Ca (1.48%) on 35 DAFS and Mg (0.49%) on 45 DAFS. The Ca content of fruit stone increased continuously with the advancement of season but magnesium content did not follow a consistent trend. The maximum (1.99 %) concentration of stone Ca was recorded on 85 DAFS and minimum (0.97%) on 35 DAFS while the minimum Mg (0.419%) in fruit stone was recorded on 35 DAFS and maximum (0.63%) Mg was recorded on 95 DAFS.

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Effect of Plant Growth Regulators on Growth and Yield of Pomegranate (*Punica granatum* L.) cv. Kandhari

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Keywords: Plant growth regulators, Auxin, Gibbrellin, Benzyl adenine, Growth, Yield,

Introduction

Pomegranate (*Punica granatum* L.) is one of the oldest known edible fruit and is capable of growing in different agro-climatic conditions ranging from the tropical to temperate. In Himachal Pradesh, pomegranate is mainly cultivated under rainfed conditions, therefore, its yield and quality is adversely affected during drought and rainfall conditions. Plant growth and development, as well as the responses to the environmental factors, are highly regulated by complex and coordinated action of the endogenous hormones. Plant growth regulators are used to improve fruit size and quality, extend the storage life and to increase the profitability in some fruits. They have a key role in different physiological processes related to growth and development of crops. It is obvious that changes in the level of endogenous hormones due to biotic and abiotic stress alter the crop growth and any sort of manipulation including exogenous application of growth substances would help for yield improvement.

Material and methods

The experiment was laid out on seven years old pomegranate cv. Kandhari planted at a spacing of 4m x 2m in the Randomized Block Design having 15 treatments and each treatment replicated thrice. The experimental trees were subjected to different treatments of Naphthalene acetic acid (20ppm and 30ppm), Gibberellic acid (50ppm and 75ppm) and Benzyl adenine (5ppm and 10ppm) to study their effect on fruit quality. The required amounts of NAA, GA_3 and 6-BA were dissolved in 80 per cent absolute alcohol by adding 2-3 drops of 0.1 N HCl and the latter (6-BA) in 0.1 N NaOH solution. Before spraying, 0.5 ml of wetting agent (Indtron-AE) per litre of solution was added as surfactant to reduce surface tension and to facilitate the absorption of solution was sprayed.

Results and conclusion

The maximum shoot growth (31.92 cm) was observed in the plants treated with GA_3 75ppm in June, and the minimum shoot growth (23.78 cm) was observed in 6-BA 5ppm when applied in May. Canopy volume (3.44 m^3) was recorded maximum with treatment GA_3 75ppm when applied in June while, the minimum canopy volume (2.44 m^3) was registered in 6-BA 10ppm when applied in June. The maximum leaf area (18.34 cm^2) was recorded with 6-BA 10ppm when applied in May whereas, the minimum leaf area (13.63 cm^2) was observed in GA_3 75ppm when applied in May. Plant growth regulators had non-significant effect on chlorophyll content. However, the maximum chlorophyll content was recorded with 6-BA 10ppm when applied in May and minimum chlorophyll content was registered with GA_3 50ppm when applied in May. Pomegranate responded significantly to different treatments with respect to fruit yield and produced maximum fruit yield (19.93 kg $plant^{-1}$) in NAA 30ppm when applied in May whereas, the minimum fruit yield (10.06 kg $plant^{-1}$) was found in 6-BA 10ppm when applied in June. Return bloom (136.56%) was recorded maximum with 6-BA 5ppm when applied in June while, the minimum return bloom (111.57%) was registered in control.

IESHP/AFS2017/3126

Crop Wild Relatives: What can they Contribute toward Breaking Yield Barriers- A Case Study in Grain Legumes

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Keywords: Crop wild relatives, Chickpea, Lentil, Genetic diversity

Introduction

The world food production experienced a substantial growth during the last five decades due to the adoption of high yielding cultivars. However, the current global food supplies are inadequate to meet the growing demand posing a serious challenge to food and nutritional security, particularly in underdeveloped and developing countries. The human population has passed seven billion and there is forecast to reach nine billion by 2050 (UN, 2017). The amount of food we produce by today will not be sufficient for all. Further, majority of the staple food crop species have been exploited fully to reach to a desirable level of productivity. To attain further breakthrough in enhancing yield and improving stability in future crop varieties, new sources of genes and alleles need to be identified in crop wild relatives (CWRs) and incorporated into elite genetic background. CWRs contain invaluable wealth of alleles and that is a great potential in developing new genetic materials through pre-breeding approach. In the face of climate change, this great resource may prove to be instrumental for future food and nutritional security. Therefore, it is imperative to motivate crop breeders to search for new source of variation in wild gene pool, identify those traits of interest using appropriate tools and techniques in order to make the selection more efficient and reliable.

Case study in chickpea and lentil

Chickpea and lentil are among the prominent legume crops in South Asia including India. Both the crops, however, have intrinsically narrow genetic diversity limiting further increase in productivity. The existing genetic diversity available in the indigenous germplasm has been exploited fully by breeders to develop the improved varieties. However, to broaden the genetic base of elite gene pool, new sources of genes/alleles need to be targeted in unadapted wild/weedy crop species and introgress them into the background of cultivated varieties. The wild species of chickpea and lentil have contributed traits of interest for the genetic improvement of cultivated varieties. More recently, wild *Cicer* species (*C. reticulatum* and *C. echinospermum*) have contributed cold and fungal disease resistance, and genes for higher yield. The use of genetically incompatible wild *Cicer* species for the improvement of cultivated chickpea is still a challenge. In the recent past, ICAR-NBPGR took initiative for diversification of cultivated gene pool of both chickpea and lentil crops, and introduced all available global wild annual *Cicer* and *Lens* genetic resources, characterized, evaluated and used them to introgress genes of interest into the cultivated varieties. Inter-specific crosses were attempted in chickpea to transfer the target traits like earliness, shorter internode, pod number and resistance against ascochyta blight and botrytis gray mold (Singh et al. 2015) and pod number, earliness and resistance against rust, powdery mildew and Fusarium wilt in lentil (Singh et al. 2013). The F_5 wide cross populations developed from *C. reticulatum* for pod number has also been used to scan the major genomic region (s) underlying QTL(s) governing pod number using next generation sequencing (NGS) based multiple QTL sequencing strategy (Das et al. 2015). Further, utilization of mined SNPs led QTL analysis narrowed down into two genomic regions

harboring pod number on chromosome 4. The strategy has profound efficacy in rapid genome wide scanning of potential candidate gene(s) for genomic-assisted breeding and genetic enhancement of chickpea. Further molecular characterization of wild *Cicer* species for understanding the genetic structure and linkage disequilibrium (LD) pattern by large-scale genotyping of informative microsatellite and single nucleotide polymorphism (SNP) markers was conducted to facilitate chickpea improvement. We identified 82489 high-quality genome-wide SNPs from 93 wild and cultivated Cicer accessions through integrated reference genome- and de novo-based GBS assays. We also studied, RNA-sequencing followed by de-novo transcriptome assembly identified 11621 genes differentially xpressed in roots vs. shoots of a wild perennial *Cicer microphyllum*. Comparative analysis of transcriptomes between *Cicer microphyllum* and cultivated desi cv. ICC4958 detected 12772 including 3242 root- and 1639 shoot-specific *Cicer microphyllum* genes with 85% expression validation success rate. The multilocation agronomic evaluation of lentil and chickpea interspecific derivatives showed better results for earliness, desirable seed yield and Fusarium wilt resistance under varied agro-ecological regions of north-western India.

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Effect of Different Nutrient Sources on Growth and Quality of Chinese Cabbage (*Brassica rapa* L.var. *pekinensis*)

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Keywords: Chinese cabbage, Bio-fertilizers, Organic manures, Growth

Introduction

A few innovative farmers, at small scale in J&K, are cultivating Chinese cabbage. With increase in people's preference towards diversified vegetable consumption, Chinese cabbage is also gaining attention in the Kashmir valley. However, the production package of Chinese cabbage is not much known in the valley.

Material and methods

The present investigation was carried out at SKUAST-Kashmir, during *rabi* 2015.The experiment comprising of two organic manures [Sheep manure (SM) and Vermicompost (VC)], three types of bio-fertilizers [*Azotobacter* (AZ), PSB and KSB] and inorganic fertilizers in the form of Urea, DAP and MOP. The treatments were divided into three sets *viz*. (i) Complete nutrients through organic manures (OM) plus bio-fertilizers (BF) ($T_2 - T_3$), (ii) Half of the nutrients through inorganic fertilizers (IF) and half through OM ($T_4 - T_5$), and (iii) Half of the nutrients through IF and half through OM plus BF ($T_6 - T_7$). Recommended dose of nutrients (RDF, NPK @ 100:50:30 kg/ha) through IF was taken for comparison (T_1). The experiment was laid in a randomized complete block design with three replications. Data was statistically analyzed using OP-Stat software.

Results and conclusion

Results revealed significant differences among treatments (Table 1). Maximum plant height (30.33), fresh weight of whole plant (1170), dry weight of whole plant (65.43) and head weight (613.33) were found in T_3 and minimum plant height (25), fresh weight of whole plant (615), dry weight of whole plant (38.27) and head weight (323.33) were recorded in T_1. Thus, It can be concluded that VC along with BF (T_3) showed superior results in growth parameters as compared to other treatments.

Table 1. Effect of Various Sources of Nutrients on Growth Parameters

Treatments	Plant height (cm)	Fresh weight of whole plant (g)	Dry weight of whole plant (g)	Head weight (g)
T_1 (RDF)	25.00	615.00	38.27	323.33
T_2 (SM@16.6t/ha+AZ+PSB+KSB)	29.67	943.33	62.39	505.00
T_3 (VC@6.6t/ha+AZ+PSB+KSB)	30.33	1170.00	65.43	613.33
T_4 (50% NPK+50% VC)	26.33	645.00	49.44	371.66
T_5 (50% NPK+50% SM)	26.00	628.33	43.25	358.33
T_6 (50%NPK+50%VC+*AZ*+PSB+KSB)	29.00	851.66	53.49	440.00
T_7 (50%NPK+50%SM+*AZ*+PSB+KSB)	27.00	695.00	52.35	395.00
CD(P≤0.05)	**3.58**	**101.66**	**0.97**	**47.79**

Amount of organic manures was calculated on Nitrogen equivalent basis

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Genetic Variability Studies in Tropical Cauliflower (*Brassica oleracea* (L.) var. botrytis.) in Chhattisgarh

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Keywords: Genetic variability, Heritability, Yield, Indian cauliflower

Introduction
Cauliflower (*Brassica oleracea (*L.*)* var. *botrytis* is widely grown in India. In Chhattisgarh, it is grown in 19.57 thousand ha with production of 341.99 thousand metric tonnes and productivity is 17.5 mt/ha. Work on development of open pollinated variety and/ or hybrid in tropical cauliflower under Indian conditions has been limited, specially in extra early and early group. To bring improvement in this group, the knowledge of magnitude of genetic variability and the extent of heritability of desirable characteristic is essentially important. Therefore, an attempt was made to collect and study the genetic variability, heritability and genetic advance among various horticultural traits of cauliflower genotypes.

Material and methods
The experimental material consisted of 23 genotypes of Indian cauliflower collected from different places *i e* Chhattisgarh, Bihar, UP and Rajasthan. The experiment was conducted at IGKV, Raipur during *kharif* 2016 using Randomized Block Design (RBD) with three replications. Observations were recorded from five randomly selected plants of each genotypes of each replication for horticultural characters. We also estimated phenotypic and genotypic variance, heritability and genetic advance.

Results and conclusion
In the present study, significant differences were observed among the genotypes for all the characters. High magnitude of genotypic as well as phenotypic coefficient of variations were recorded for traits such as net curd weight (23.92 and 42.26), harvest index (6.79 and 36.20), yield (t/ha) (17.18 and 37.17), marketable curd weight (17.18 and 37.81), gross curd weight (12.63 and 31.47), leaf length (11.47 and 12.24) and stalk length (11.09 and 20.18). Selection for these traits may be given importance in improvement programme. Phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the traits indicating that environmental factors were influencing their expression. The traits, which showed high PCV and GCV, are of economic importance and there is scope for improvement of these traits through selection. To estimate heritability in broad sense it was categorized as low (<50%), moderate (50%-70%) and high (>70%). High magnitude of heritability was recorded for the characters like marketable curd weight (96.95), leaf width (95.6), plant height (94.4), days to 50 % curd initiation (92.38), leaf length (87.9), no. of leaves per plant (87.84), curd width (87.39), curd depth (80.93), curd size index (80.93), gross curd weight (78.08), net curd weight (74.85) yield (t/ha) (78.09). Maximum marketable curd weight was observed in IGC-1 (769.73) followed by IGC-9 (742.93), Ramnagar Late Kunwari (716.93). It was noted that all genotypes were creamy white in appearance. Pusa Paushja, Rajasthan late Kunwari, Ramnagar Early Kunwari, Pusa Meghna were medium compact and rest of the genotypes was having compact curd. It can be concluded that selection of IGC-1, IGC-9, Ramnagar Late Kunwari genotypes and the characters mentioned above may be utilized for further breeding programme.

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Quantifying Carbon Stocks in Agricultural Land-Use System in Sub-Tropics of Jammu & Kashmir

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Keywords: Carbon Stocks, Carbon Sequestration, Kandi, Agriculture Land-Use

Introduction

Land-use systems are critical in stabilizing CO_2 concentration in the atmosphere besides providing multiple sustainable benefits such as biodiversity conservation, watershed protection, increased crop and grass productivity for stakeholders. The agriculture land-use system contributes to the net out flux of methane, nitrous oxide and carbon dioxide generated from the terrestrial biosphere. Of late, such fluxes have substantially increased mainly due to catering of large human and cattle populations, increased incidents of stubble burning and rampant use of nitrogen fertilizer. In the area under study, the crops grown in *kharif* season were Maize, Bajra, Mash, Til and Moong whereas in *rabi* season, the main crop was wheat; both pure as well as a mixed crop with mustard. The literature on carbon stocks of agriculture land-use systems in *kandi* belt of Jammu region is largely scarce. Therefore, in the present study an attempt has been made quantify carbon stocks in biomass of agriculture land-use system of *kandi* areas of J&K.

Material and methods

In all, 15 sample plots in each land use were laid across the study area covering all three districts viz., Jammu, Samba and Kathua. The location of sample points was recorded in reference to their geo-coordinates and elevation. The total biomass was estimated using 1m x 1m quadrates. Carbon stock in different plant component was obtained by multiplying the dry weight of different plant components by their average carbon concentration. The carbon stock in different plant components was then summed up to obtain total carbon stock.

Results and conclusion

The total herb biomass occurring within the quadrate was cut at the ground level. The collected samples were weighed, sub-sampled and taken to the laboratory for oven drying at $65^0 \pm 5^0$ C to obtain the constant dry weight. Carbon partitioning of different components and carbon concentration in plants was calculated.

Table 1: Carbon Stocks and Partitioned Carbon Concentration

District	Crop	Biomass (Mg/ha)	Carbon in AGB (MG/ha)	C in BGB (MG/ha)	C stock (MG/ha)	CO_2 equivalent (MG/ha)
Jammu	Maize	5.915	2.633	0.958	3.592	13.183
Jammu	Wheat	4.864	2.136	1.367	3.503	12.856
Jammu	Bajra	3.911	1.735	0.632	2.367	8.687
Samba	Maize	6.923	3.088	1.124	4.212	15.458
Samba	Wheat	5.12	2.25	1.44	3.69	13.542
Samba	Bajra	4.258	1.891	0.688	2.579	9.464
Kathua	Maize	6.049	2.69	0.979	3.67	13.469
Kathua	Wheat	5.822	2.710	1.734	4.444	16.309

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Impact of Improved Production Technologies in Productivity Enhancement of Chickpea in Sub-mountane Punjab

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Keywords: Bio-fertilizer, Chickpea, FLDs, Sowing method, Improved Variety, Yield

Introduction

Pulses are the good source of protein and for majority of the population in India they are only source of dietary protein. India is the largest producer, consumer and importer of the pulses in the world. It is premier legume crop in India being cultivated during *rabi* season, covering an area of 9.92 m ha with production of 9.88 m tonne and productivity of 9.95 q/ha. The pulse crops are generally cultivated on marginal lands having low soil fertility and under rainfed conditions in the region. Moreover, poor agronomic practice, selection of suitable variety, nutrient management, weed management and irrigation management etc. are responsible for low productivity of pulses in the state. Keeping all above into considerations, frontline demonstrations on chickpea (on farmer's fields) were conducted to demonstrate the production potential and economic benefits of improved varieties, bio-fertilizer application in legumes and sowing method to the farmers and convincing the farmers to adopt the improved production technologies of chickpea.

Material and methods

Ninety six frontline demonstrations (FLDs)/on farm trials were conducted during *rabi* season from 2011- 2012 to 2014-15 on farmers' fields under rainfed conditions in villages of district Rupnagar and Hoshiarpur of Punjab to demonstrate the effect of improved varieties, bio-fertilizers and sowing methods on the productivity of chickpea. Each demonstration was conducted on an area of 0.1 ha and adjacent plot to the demonstration plot was kept as farmers practices. The demonstrations were sown in second fortnight of October to first fortnight of November with the seed rate of 45 kg/ha and row spacing of 30 cm. All the crop management practices as per the package of practices for *rabi* crops by Punjab Agricultural University, Ludhiana were followed for raising the crop. The average yield of the individual improved/ local practice for the five years has been taken for interpretation of the results.

Results and conclusion

It was observed that the productivity of chickpea in the FLDs ranged between 1430 kg/ha to 700 kg/ha, 1120 kg/ha to 680 kg/ha and 880 kg/ha to 730 kg/ha with a mean yield 924 kg/ha, 873 kg/ha and 795 kg/ha for improved varieties, bio-fertilizer application and sowing method, respectively (Table 1). The per cent increase in yield was 28.3, 24.2 and 22.1 per cent, respectively for improved varieties, bio-fertilizer application and sowing method over farmer practices. The variation in the productivity was caused mainly due to sowing under rainfed conditions, delay in sowing due to late winter rains, prolonged dry spell during the early growth period in the month of October to December and variation in soil fertility in the farmer fields. Extension gap is the difference in the yield of the demonstration and farmers practices which varied from 144 to 204 kg/ha with a mean value of 173 kg/ha for different technologies demonstrated through FLDs. The above extension gap emphasized the need to educate the farmers through various means for adoption of improved agricultural production technologies to reduce this extension gap. The technology gap shows the gap in the demonstration yield over potential yield and it ranged between 676 kg/ha to 805 kg/ha with

average of 736 kg/ha (Table 2). The observed technology gap may be due dissimilarity in the soil fertility status, weather condition and other management practices. FLDs recorded higher mean net returns i.e. Rs. 18,644 with higher B:C ratio of 2.08 in comparison to Rs. 11,475 with B:C ratio of 1.69 for farmers practice. The results from the present study clearly brought out the potential of improved production technologies in enhancing chickpea production and net returns under rainfed farming situations.

Table 1: Seed Yield of Chickpea in Farmer Fields

Technology	Demonstration (No.)	Yield (kg/ha)			Farmer practise (FP)	% increase in yield	Ext. Gap (q/ha.)	Gap (q/ha.)
		Improved Technology (IT)						
		Max	Min	Average				
Improved	54	1430	690	924	720	28.3	204	676
Bio-fertilizer	24	1120	680	873	703	24.2	170	727
Sowing	18	880	730	795	651	22.1	144	805
Average	32	1143	700	864	691	25.0	173	736

Table 2: Cost of Cultivation (Rs/ha), Net return (Rs/ha) and B:C of Chickpea

Technology	Cost (Rs/ha)		Netreturns (Rs/ha)		Additional cost (Rs./ha)	Additional net returns (Rs./ha)	B:C Ratio	
	IT	FP	IT	FP			IT	FP
Improved	18745	17213	22374	12931	1532	9443	2.23	1.76
Bio-fertilizer	19261	19024	15659	9123	237	6536	1.81	1.47
Sowing	16270	16114	17900	12372	156	5528	2.20	1.85
Average	18092	17450	18644	11475	642	7169	2.08	1.69

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Variability Studies in Wild Grapes (*Vitis Vinifera* L.) in Leh, Jammu and Kashmir

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Keywords: Accessions, Variability, Correlation

Introduction

Grape (*Vitis vinifera* L.) is an economically important and widely cultivated fruit crop in the world and is cultivated to produce table fruits, dry fruits, juice and wine. It is grown under a variety of soil and climatic conditions in three distinct agro-climatic zones namely mild humid tropical region, sub-tropical region and dry temperate region. Under dry temperate region of Jammu and Kashmir the maximum area is in lower belt of Leh district. The present investigation was carried out to generate the vital information on grape vine cultivation and presence of its germplasm in the Leh district.

Material and methods

Thorough surveys of Leh district was carried out and out of a large population of wild grape only fifty accessions were selected from five different villages. Data on various vegetative, fruit physical and fruit chemical characters were taken. Data collected on various parameters were statistically analysed. The genotypic coefficients of variation, heritability (in broad sense) and genetic advance were calculated.

Results and conclusion

High GCV and PCV were recorded for yield (21.73 and 22.81), yield efficiency (41.19 and 52.73), bunch weight (21.07 and 21.23), number of berries per bunch (22.31 and 25.28), berry length (21.69 and 22.07), berry weight (21.13 and 21.28) and total sugars (22.69 and 22.70). Thirteen characters registered high heritability estimates while five recorded moderate heritability estimates and number of seeds per berry and acidity showed low estimates. It revealed that the characters viz. yield, bunch length, bunch weight, number of bunch per vine, berry weight, number of berries per bunch, total soluble solids and total sugars are the most important traits for selecting grape accessions.

Table 1: Genetic Variability Studies in Grape Accessions

Characters	CV (%)		Heritability (%)	Genetic advance	Genetic Gain (%)
	GCV	PCV			
Cane length (cm)	18.69	18.94	97.4	59.40	38.01
Leaf area (cm^2)	10.73	11.22	91.5	31.43	21.15
Yield (kg/vine)	21.73	22.81	90.8	5.68	42.61
Yield efficiency (kg/cm^2)	41.19	52.73	61.0	0.05	62.50
Bunch length (cm)	15.16	15.95	90.3	5.43	29.67
Bunch breadth (cm)	16.93	18.77	81.3	3.05	31.51
Bunch weight (g)	21.07	21.23	98.5	43.16	43.08
No. of bunches/vine	6.94	8.14	72.8	16.39	12.20
No. of berries/bunch	22.31	25.28	77.9	27.18	40.56
Berry length (cm)	21.69	22.07	96.5	0.49	43.75
Berry breadth (cm)	15.96	16.31	95.7	0.34	32.38
Berry weight (g)	21.13	21.28	98.6	0.59	43.07
Number of seeds/ berry	19.83	32.74	36.7	0.30	24.79
Total sugars (%)	22.69	22.70	99.9	5.11	46.75
TSS/acid ratio	16.53	21.23	60.6	25.81	26.51

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Faunistic Survey of Insect-Pests associated with *Agaricus bisporus*

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Keywords: Mushroom, Collembola fauna, Insect pests

Introduction

Mushroom production represents one of the most significant indoor commercial enterprises towards diversification of agriculture based on microbial technology for large- scale recycling of agro-wastes and their transformation into edible biomass, accepted as highly nutritive food with royal flavor and palatability. The important commercially cultivated mushrooms in the nation are, white button mushroom, *Agaricus bisporus* (Lange) Imbach (85.0 per cent), oyster mushroom, *Pleurotus* spp. (24.1%). Most of the cultivation in the country is undertaken by marginal farmers under unhygienic conditions in improvised mushroom farms, which prove to be the hot beds for multiplication of various pests and pathogens. Most abundant and menacing are small to medium size delicate dipteran flies.

Material and methods

The insect and Collembola fauna associated with cultivated edible mushrooms were collected from the mushroom units growing *Agaricus* spp. and /or *Pleurotus* spp. located in various districts of Himachal Pradesh. Dipteran insects were collected with help of yellow traps. The beetles and their grubs were collected from individual sporocarp and the mean number of beetles/grubs per sporocarp was calculated. Springtails were extracted with plastic funnel with a piece of rubber tube (10 – 12 cm) bearing a glass vial of 5 ml capacity attached to its distal end. The substrate sample with expected fauna was placed over the wire net gently. A table lamp was fixed over the sample enabling prevalent fauna started to move downwards and was collected in the glass vial.

Results and conclusion

Compost/substrate and/or casing samples were collected from the cropping bags of various distantly located mushroom units. Sporophore samples were also picked up from wherever visible insect fauna was observed damaging the fruiting bodies. In all, 9locations of three mushroom growing districts viz., Shimla, Sirmaur, Solan were covered during the survey.. The insects belonging to two orders viz., Diptera and Coleoptera were significant by their presence/ abundance in the mushroom units cultivating white button mushrooms. Order Diptera was represented by the flies belonging to two families viz., Sciaridae and Phoridae. Three genera of beetles belonging to different families of Order Coleoptera were noticed in the cropping bags/ rooms. Besides, springtails (Class and Order Collembola) and mites (Class Arachnida) were found to be of common occurrence in the units under survey. Insects, nematodes, mites and springtails constitute the important groups of mushroom pests. Of these, insects belonging to orders viz., Diptera and Coleoptera are of paramount significance. Order Diptera is represented by the flies belonging to six families viz., Sciaridae, Phoridae, Cecidomyiidae, Scatopsidae, Drosophilidae and Sphaeroceridae.

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Bioecology of Rice Leaf Folder, *Cnaphalocrocis medinalis* (Guenee) in Mid-Hills of Himachal Pradesh

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Keywords: Bioecology, Rice leaf folder, Instar, Fecundity, Adult longevity

Introduction
The rice leaf folder, *Cnaphalocrocis medinalis* is one of the most common insect-pests of rice prevalent in Himachal Pradesh which was earlier a pest of minor importance but has now gained the status of an important major pest. It is well established fact that the biology of a pest provides vital information about weak links in its life cycle which is helpful for devising an effective control strategy against the pest. The biology of rice leaf folder is likely to vary under different agro-climatic conditions. Therefore, a regional approach for studying its biology is useful in evolving management strategies.

Material and methods
The field collected larvae were reared on paddy plants under laboratory conditions till the adult emergence. The emerged adults were sexed on the basis of wing pattern and kept for oviposition in caged potted plants provided with 20 per cent honey solution as food. On alternate days, the potted plants with eggs were shifted to another cage for hatching and further development. After the completion of developmental stages, freshly emerged adults were collected daily, paired and kept for oviposition. The observations on biological parameters were recorded.

Results and conclusion
The investigations revealed that females laid eggs singly or in batches of 2-6 along the midrib of leaves. The length of eggs ranged between 0.77 to 0.98 mm (mean 0.88 mm) and width varied from 0.31 to 0.45 mm (mean 0.37 mm). The duration of incubation period in first generation varied from 3 to 4 days (mean 3.70 days) followed by second and third generations having almost equal duration *i.e.*4.40 and 4.50 days, respectively. The larva passed through five instars to complete the larval development. The average body length of first, second, third, fourth and fifth larval instars was 2.29, 4.33, 7.14, 12.85 and 16.65 mm with body width of 0.32, 0.56, 0.77, 1.45 and 2.17 mm, respectively. The average duration of first instar was 4.10 days in first generation followed by second and third generation with 3.40 and 3.50 days, respectively. The duration of second instar varied between 3 to 4, 2 to 4 and 3 to 4 days during first, second and third generation, respectively. The third larval instar took 3 to 5 days in different generations. However, almost equal duration of 4.50 days was recorded in both first and third generation of fourth instar larvae while it was found to be 4.30 days during second generation. The fertility parameters worked out for first, second and third generation resulted in the net reproductive rate (R_0) of 29.16, 17.94 and 17.72 female eggs per female with the corresponding true generation time of 37.06, 37.99 and 39.38 days, respectively. Under laboratory conditions, *C. medinalis* completed three generations from August to mid-December. Field collected adults of last generation failed to lay eggs under laboratory conditions. However, a few individuals of *C. medinalis* larvae survived in winter till January on paddy plants and weeds and a limited feeding was observed during this period.

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Effect of Integrated Nutrient Management on Plant Growth and Soil Properties of peach (*Prunus persica* L. Batsch)

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Keywords: Peach, INM, Plant growth, Leaf nutrients, Soil properties.

Introduction

Peach (*Prunus persica* L. Batsch) is an important fruit crop of temperate regions of the world. Nutrient management is an important component of orchard management for improving production, productivity and quality of fruits. The application of chemical fertilizers tremendously boost the fruit production but indiscriminate and continuous use of these fertilizers due to their ready availability and quick yield response, degrade soil health, pollute underground water and disturb the ecological balances. Organic manures along with inorganic fertilizers are effective means for improving soil physical properties (aggregation, structure and water holding capacity), fertility and microbial diversity. Among the organic manures, vermicompost and neem cake are rich sources of nutrient elements, which improve soil physico-chemical properties, microbial action and plant growth regulating substances.

Material and methods

The experiment was carried out on 9-years-old trees of peach cultivar July Elberta raised on wild peach seedling rootstock and planted at 4.0 × 2.0 m spacing and trained to open centre system. The experiment was laid out in a Randomized Block Design with 11 treatments viz., RDF (Recommended dose of fertilizers) i.e. 500g N + 250g P + 700g K + 40 kg FYM, 75 % RDF + Wild Apricot cake (WAC) 2.5 kg/tree, 50 % RDF + WAC 5.0 kg/tree, 75 % RDF + Neem cake (NC) 2.5 kg/tree, 50 % RDF + NC 5.0 kg/tree, 75% RDF + Vermicompost (VC) 15 kg/tree, 50 % RDF + VC 30 kg /tree, 75 % RDF + Jeevamrut (JA, one application at full bloom), 50 % RDF + JA (one applications at full bloom), JA (4 applications at monthly intervals starting from full bloom) and 25 % RDF + WAC 1.25 kg + NC 1.25 kg + VC 15 kg + JA (one application at full bloom). Statistical analyses of recorded data were carried out using GLM of the standard errors of the mean, compared by the LSD tested (p=0.05).

Results and conclusion

Results revealed that integrated nutrient management practices significantly influenced the plant growth, leaf nutrient contents and soil properties. The trees subjected to 75% RDF + VC 15 kg/tree had significantly higher increase in trunk diameter (18.01%), tree height (26.69%), spread (15.46%) and volume (52.72%). Similarly, annual shoot growth (52.32 cm) and leaf area (32.17 cm^2) were also recorded maximum in trees treated with 75% RDF + VC 15 kg/tree. Leaf N (2.46%), K (1.35%), Mg (0.57%), Cu (11.54 ppm), Fe (224.20 ppm) and Zn (26.14 ppm) contents were significantly increased in trees treated with 75% RDF + VC 15 kg/tree, whereas, leaf Ca (1.67%) was observed significantly higher with 50% RDF + VC 30 kg/tree. Available soil N (279.96 kg/ha) was significantly increased by 75% RDF + VC 15 kg/tree, however, organic carbon (1.96%), available P (73.39 kg/ha), bacterial count (43.99×10^{-7} cfu g^{-1}) and fungi (7.96×10^{-4} cfu g^{-1}) in orchard soil were observed significantly higher with the application of 50% RDF + VC 30 kg /tree. On the basis of results obtained, 75% RDF + VC 15 kg/tree was proved to be an ideal dose of fertilizers for improving plant growth and nutritional status of plant and soil.

Theme 4

Value Addition, Economics and Marketing System

IESHP/AFS2017/4001

Enzymatic Studies in Aonla (*Emblica officinalis* G.) at Different Storage Temperatures

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Keywords: Aonla, Catalase, Enzymes, Storage, Temperature

Introduction

Aonla, commonly known as Indian Gooseberry (*Emblica officinalis* Gaertn syn. *Phyllanthus emblica* L.), finds a special place in India as it has got tremendous medicinal values. Temperature management is one of the most important tools for extending the shelf life of fruits, because it regulates the rate of all associated physiological and biochemical processes. Lower temperatures may cause chilling injury and higher ones can reduce the storage life of the product. The influence of storage temperature on the changes in enzymatic activities of aonla cultivar was investigated at different storage temperatures.

Material and methods

Present investigation was carried out at CCS Haryana Agricultural University, Hisar. Fully mature aonla fruits of *cv*. Chakaiya, of uniform size, color and free from blemishes were harvested. Two kilogram of aonla fruits were packed in cardboard boxes with newspaper as cushioning material and stored at 10^0C, 25^0C and room temperature (15-17^{0}C). Each box was treated as one replicate and all the treatments were replicated four times. Catalase, ascorbate peroxidase and peroxidase activity was measured using methods described by Aebi (1983), Nakano and Asada (1981), and Dias and Costa (1983), respectively.

Results and conclusion

Ascorbate peroxidase activity in fruits of aonla increased with increase in storage temperatures and duration. Fruits of aonla stored at 10^0C had minimum ascorbate peroxidase activity i.e. 210 nmol whereas at 25^0C showed maximum activity of ascorbate peroxidase i.e. 229 nmol. Peroxidase activity in fruits of aonla was lowest on 0 day of storage i.e. 276 nmol in all storage temperatures. Fruits stored at 25^0C had maximum peroxidase activity followed by fruits kept at room temperature) and fruits kept at 10^0C had minimum peroxidase activity. Increasing trend in catalase activity was also observed with advancement in period of storage at all storage temperatures. Catalase activity was highest in fruits of aonla stored at 25^0C nmol whereas fruits of aonla kept at 10^0C had lowest activity of catalase followed by fruits stored at room temperature.

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Zero-Till Wheat Yield and Attributes along with Profitability affected by Sowing Dates

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Keywords: Zero-till, Number of spikes, Grain yield, Net returns

Introduction

The investigation was carried out to study the effect of different sowing dates on the yield of the Zero- till wheat along with its profitability after harvesting of direct seeded rice in rice-wheat cropping system during the *Rabi* season of 2014-15 and 2015-16, at Central Soil Salinity Research Institute, Karnal.

Material and methods

A field experiment was laid out with four sowing dates *viz.* 1st November, 10th November, 23rd November and 6th December of zero-till wheat *cv*. HD 2967 under Split plot design with three replications. Data on yield attributes was recorded at the time of harvest (per square metre). After threshing with the help of mini plot thresher, the grain yield was measured for each net plot area.

Results and conclusion

Results revealed that highest number of spikes/m^2 was recorded with earlier sowing *i.e.* 1st November *i.e* (388, 396) followed by 10th November (380, 384), 23rd November (356, 362) and the minimum with the sowing date of 6th December (344, 348) consecutively during both the experimental years. Grain yield was recorded highest when crop sown on 1st November *i.e.* (5497 and 5572 kg/ha) followed by 10th November (5394 and 5497 kg/ha), 23rd November (4322, 4659 kg/ha) and the minimum with the sowing date of 6th December (3338, 3944 kg/ha) consecutively during both the experimental years. Gross returns, Net returns (Rs/ha), and B:C was recorded highest when crop sown on 1st November followed by 10th November and 23rd November. Lowest gross and net returns, B:C ratio was recorded when crop sown on 6th December. From our experiment of DSR-ZTW system, it can be concluded that when wheat crop is sown on 1st November we get the maximum yield and profit.

Table 1: Effect of Sowing Dates on Yield (kg/ha) and Profitability of Zero-Till Wheat

Sowing dates	Spikes/m^2		Grain yield		Gross returns		Net returns		B:C ratio	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
1 November	388	396	5497	5572	105305	110835	82745	88275	3.67	3.91
10 November	380	384	5394	5497	103490	109173	80930	86613	3.58	3.84
23 November	356	362	4322	4659	84478	94556	61918	71996	2.75	3.19
6 December	344	348	3338	3944	66370	80281	43810	55721	1.94	2.55
CD5%	12.73	14.49	181	187	-	-	-	-	-	-

IESHP/AFS2017/4003

Bioefficacy of Some Botanicals as Grain Protectants against *Callosobruchus maculatus* (F.) Infesting Stored Blackgram

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Keywords: Botanical grain protectants, Pulse bruchid, Black gram

Introduction

Blackgram (*Vigna mungo* L.) constitutes the major source of dietary protein for majority of the South Indians. The cowpea weevil, *Callosobruchus maculatus* is the most destructive pest of stored grain legumes and causes substantial reduction in quantity and quality, within 3-4 months of storage. Owing to the environmental hazards and development of resistance in insects, the usage of several synthetic insecticides is restricted for the control of stored grain insect pests. Traditionally farmers used to mix ash, dried leaves of neem with the stored seed for the control of stored grain pests. Many plant products such as essential oils, crude extracts have been explored for their insecticidal properties against various stored grain pests.

Material and methods

An experiment was conducted during 2015-16 to evaluate the efficacy of some plant powders *viz*. *vasaka*, *murraya*, holy basil, tobacco, neem, black pepper, red chilli, sweet flag, turmeric, clove and asafoetida as grain treatment at 0.4% (*w/w*) for protection against pulse beetle in stored black gram under no-choice and free-choice conditions in completely randomized design. The samples were observed for the number of insects in each test chamber, oviposition, adult emergence and grain damage. The data recorded were subjected to statistical analysis.

Results and conclusion

Among the botanicals, tobacco, sweet flag (and clove) powders recorded significantly less adult emergence compared to other treatments under no choice condition. The mean adult emergence was significantly higher under murraya (381.0) followed by red chilli (during 80 days of storage, but was significantly low as compared to untreated control. Under free choice condition, the insects responded variedly to the headspace volatiles of the treated grain in the each test chamber. Although, all the treatments showed some degree of repulsion to *C. maculatus* as indicated by the negative values of Excess Proportion Index (EPI), clove, sweet flag and tobacco powders (-0.91, -0.82 and -0.80 respectively) showed strong repellency followed by turmeric (-0.65), black pepper (-0.55) and holy basil (-0.55). Overall, there was no adult emergence from clove powder treatment and it was at par with tobacco and sweet flag powders with negligible adult emergence (and grain damage). As many as 306.0 adults were emerged from untreated grain in 80 days and inflicted 90.67 per cent grain damage. Based on the results obtained in both no-choice and free-choice tests, it can be concluded that clove and sweet flag rhizome powders at 0.4% were effective as grain treatment for controlling pulse bruchid in stored blackgram.

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Economics of Poplar Based Agroforestry Models Adopted by Farmers in Haridwar, Uttarakhand

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Keywords: Boundary plantation, BCR, IRR, NPV, Poplar

Introduction

Analyzing the economics of agroforestry practices is more complicated because firstly they are complex as they involve both trees and crops and secondly there is a period of several years between the time the trees are established and the impact of agroforestry practices can be measured. In different agro-climatic conditions around the world, various agroforestry models are developed representing different agroforestry practices. Economics of these tree-crop combinations evaluates optimum input and output that a model can possibly utilize and generate within a rotation period. This in turn, solves not only of economic theories in agroforestry but practical implementation of these agroforestry models in farming systems.

Material and methods

Agroforestry adopters were surveyed to gain knowledge on detail of tree crop combinations. Information upon total costs incurred and returns acquired from both summer (kharif) and winter (rabi) crops were also collected for previous years. Cost-benefit analysis (CBA) (Kumar *et al*. 2004) with discounting factor technique was used to account economics. The most commonly used criteria in CBA are Net present value, Benefit-cost ratio and Internal rate of return. The model project period was assumed to be six years for poplar because this rotation age is more common among the farmers to harvest/sale the poplar trees.

Results and conclusion

Under poplar + wheat + millet boundary plantation model in agri-silviculture, average 488 ETPs per hectare were planted by farmers, which after 89.54% survival rate remained 437 trees/ha. An expenditure of Rs. 2.77 lakh/ha was done on establishment; management and harvesting of components and Rs.7.92 lakh/ha were received from model. After applying discounting at 10% interest rate NPV has come as Rs. 3.34 lakh/ha. BCR for this rate was 2.61:1 and IRR was 58.37%. Under Poplar + mustard + maize boundary plantation model in agri-silviculture system, ETPs were 300/ha. Farmers invested Rs. 4.88 lakh/ha and earned Rs. 7.85 lakh/ha when trees and crop combinations were grown together for a period of six years. After applying discounting at 10% interest, NPV was Rs. 1.98 lakh/ha, BCR was 1.55:1 and IRR was 85.21%. Results have confirmed that the NPV of studied models at 10% interest rate is greater than zero, the value of aggregate benefit is greater than the value of aggregate costs. BCR is also positive which confirms their economic applicability. IRR for each model was higher than that prescribed by world bank (10%). Since both of these poplar based agroforestry model provided higher NPV, BCR and IRR, they are profitable to the farmers.

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Measurement of Tribal Dairy Farmer's Awareness towards Climate Change: A Procedural Approach

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Keywords: Likert's type scale, Reliability and validity

Introduction

Major occupation of tribes is dairying, which contribute to economic, social, infrastructural and nutritional security and is most vulnerable to climate change. So, there is an urgent need to sensitize the tribal dairy farmers regarding global warming and climate change. Strategic action is required both from individuals and the private/public sector to prevent harmful loss from climate change. To address all these issues effectively, it is essential to assess awareness regarding climate change.

Material and methods

Collection of the statements and editing were done as per the 14 informal criteria enunciated by Likert (1932) and Edwards (1969). Response to raw statements was taken from judges on five point continuum i.e. Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (DA) and Strongly Disagree (SD). The t-values were worked out in order to discriminate the responses of high and low groups for the individual statements. Reliability and content validity of the scale was tested.

Results and conclusion

The t-value calculation procedure for response statements was same and only frequency column value changed, which determined the overall t-value. In this way, twenty-four statements were subjected to t-value calculation but only twenty statements were retained in the final scale as their t-value was ≥2.10 (n1+n2-2=18 df at 5 % level of significance). There were 20 statements; 10 each in high and low group and thus 10+10-2=18 df, two-tailed test, indicated that the average response of high and low groups to a statement differs significantly. Consequently, 2.10 served as a cut-off for all the statements. The statements with t-value ≥2.10 would be selected and statements below it would not be selected.

Table 1: Reliability and Validity Statistics of the Scales Developed

Cronbach's Alpha	Part 1	Value	0.865
		N of Items	10
	Part 2	Value	0.861
		N of Items	10
		Total N of Items	20
Correlation between forms			0.790
Spearman-Brown coefficient		Equal length	0.882
		Unequal length	0.882
Content validity		S-CVI value	0.884

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Synthesis of Approaches among Stakeholders to Combat Antibiotic Resistance

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Keywords: Antibiotic Stewardship, Policy-Makers, Surveillance, Policy-Formulation

Introduction

Antibiotic resistance is spreading rapidly irrespective of geographical, legal, economic difference and boundary between the countries in which it is present and can be transmitted to other countries. Inappropriate use of antibiotics in dairy cows continues to occur on farms resulting in negative consequences for animal and human health. Antibiotic resistance issue calls for surveillance, antibiotic stewardship and policy formulation and synchronization of efforts by integrating all the stakeholders. The antibiotic conservation practices demands the strategies, which should be consistent with scientific and professional agenda to ensure its sustainability. Collaboration between social scientists and policymakers in designing and evaluating attempts to introduce behavioral change strategies is lacking co-ordination and holistic approach.

Material and methods

The information collected to establish surveillance are mostly based on the expressed responses and perception of the respondents to the issue, their ability to recall and on the opinion expressed by them after being approached by the surveyor. Farmers might not maintain record books or update various records regarding antibiotic usage.

Results and conclusion

Antibiotic use is influenced by farmer's demand for antibiotics, ineffective or less effective treatment by veterinarians or paravets, the farmer's expectation from the veterinarians and farmer's confidence in veterinarian's diagnosis. The contribution of social science to combat the antibiotic resistance has not been well recognized at present because of the resistance being a biological issue. In this condition, if extension agents and policy makers conduct significant package of practices aimed at publishing a corpus of research could be insufficient and ineffective in the absence of ground level surveillance. Concepts and theories like antibiotic stewardship, prudent use of antibiotics and one-health approach have already borne fruit thus forming the basis for the sought interventions. The mounting call for behavioural and social science integrated research is unavoidably going to bring more attention of the extension researchers and policy makers into the field of antibiotic research, which is the demand of the scenario. In addition to veterinarians, it should also include pharmacist and farmers in modelling decision making which has the carry-over effect on each other's decision regarding the antibiotic usage. Interventions in Policy making regarding the practices in veterinary hospitals followed by diagnostic approach and clinical practices influenced by farmer's demand and economic condition of farmers' seek a valid veterinary-client relationship.

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Post-Harvest Techniques to Improve Shelf Life of Strawberry

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Keywords: Calcium chloride, Carboxymethyl cellulose, Chitosan

Introduction

Strawberry (*Fragaria* x *ananassa* Duch.) fruits are a fair source of vitamin C, low in calories and high in fibre with antioxidant property. Strawberries are extremely perishable due to their susceptibility towards mechanical injury, physiological deterioration, water loss and microbial decay. Calcium maintains the cell wall structure in fruit by interacting with the pectic acid in the cell walls to form calcium pectate. Edible coatings and films act as an effective semipermeable barrier to respiratory gases and water vapor. Chitosan coatings have been reported to limit fungal decay and delay the ripening of several commodities.

Material and methods

Freshly harvested, uniform maturity size and quality fruits of strawberry were treated with different concentrations of $CaCl_2$ (1%, 2% and 3%), CMC (1%, 2% and 3%) and CH (1%, w/v). Observations were recorded at 3 days interval during the storage period of 12 days. PLW was calculated by weighing the fruits on physical balance, spoilage was calculated on % basis, TSS measured by the "Erma" Hand Refractometer (0-30), acidity by titrating against standard alkali solution (0.1N NaOH), pH of the sample by a glass electrode pH meter (Martini) and ascorbic acid by method as described by Ranganna (1997).

Results and conclusion

On the 12th day the maximum PLW was observed in control due to high rate of respiration and transpiration whereas minimum in CMC 2% + Chitosan 1% which could be due to the fact that composite coatings serves as a semi-permeable barrier thus reducing respiration, water loss and oxidation reactions. Reduction in spoilage with the use of CMC and Chitosan was probably due to the anti-microbial activity of chitosan which induces chitinase that catalyze the hydrolysis of chitin, a common component of fungal cell-walls. The probable reasons for the slow increase in TSS content in the coated could be due to the lowered rate of respiration and other metabolic reactions. The fruits coated with CMC 2 % + Chitosan 1 % showed the least increase in pH due to the ability of coatings to retard respiration and corresponding decrease in acidity during storage. The acidity of the fruit was highest at the start of the storage and it decreased due to the fact that, the strawberries were harvested at red stage, when accumulation of organic acid was over followed by rapid utilization of acid of the fruit pulp in respiration process. The rate of decrease in ascorbic acid was significantly higher in untreated fruits due to rapid conversion of L-ascorbic acid into dehydro-ascorbic acid in the presence of enzyme ascorbinase.

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A Skeleton of Vegetable Delivery Management at Chhota Bhangal in Kangra, Himachal Pradesh

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Keywords: Supply, Vegetable, Channel, Producer, Farmer, Management, Market

Introduction
Vegetable Delivery Management refers to the management of the entire set of production, distribution and marketing processes. It is the process of planning, implementing and controlling the operations of the Supply Chain Management as efficiently as possible. Poor efficiency in the marketing channels and inadequate marketing infrastructure are believed as the cause for high and fluctuating product prices, but also too little of the consumer rupee realized by the farmer. It is imperative that all the parties involved in the production, packaging, storage, transport, distribution and marketing of products perform every activity correctly. Therefore, Delivery Management is important for agricultural produce, which involves different levels of intermediaries making exorbitant margins.

Material and methods
The study was conducted in Chhota Bhangal area of Kangra district of HP. Two-stage random sampling technique was employed for the selection of vegetable growers. In the first stage, 5 villages were selected randomly and in second stage, a sample of 60 growers was drawn by proportional allocation method. All the farmers were arranged in ascending order on the basis of area under vegetables. A sample of 30 market intermediaries was also drawn randomly from the markets. The primary data were collected through survey from vegetable growers and market intermediaries while the secondary data were collected from the offices of market committees in different studied markets, internet and reports.

Results and conclusion
The adoption of various Delivery Management process was at higher level on large farms as compared to small farms. The distance of the main markets where the major proportion of the produce was sold ranged from 60 km (Jogindernagar) to about 197 km (Jassur market). The major criteria for choosing a particular marketing agency were the geographic location of the producing area, risk associated with the marketing and the margins of the middlemen. The majority of the small farmers (> 40% of the farmers) sold their marketed surplus through local traders (channel-I) at the farm place. Among the large farms, channel-III (involving FMGs, commission agents, retailers and consumers) was very famous followed by channel-IV (involving FMGs, retailers and consumers). The producer's share in consumer's rupee was found to be maximum in channel-VI (direct sale to consumer) and ranged from 87 to 95%. The retailers earned the exorbitant margins ranging from 14.70% in radish to 19.28% in cabbage. The marketing efficiency indices were highest for channel-VI (direct sale to consumer) and ranged from 6.9 to 20.81, however, the most profitable was the channel-IV followed by channel-III and channel-I. The pertinent marketing problems pinpointed by the farmers were the poor road connectivity, road blockade during the peak marketing season, long distance between farm to markets, large number of intermediaries.

IESHP/AFS2017/4009

Technology for Processing and Value Addition of Noni Fruits

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Keywords: Cheese fruit, Vomit fruit, Juice extraction, Shelf life

Introduction

Noni *(Morinda citrifolia* L) fruit tree belongs to family Rubiaceae. It starts bearing fruits in about 18 months and yields 6–8 kilograms of fruit every month throughout the year. It possesses pungent odour upon ripening and hence also known as cheese fruit or vomit fruit. However, despite its strong smell and bitter taste, the fruit/juice is nevertheless used as a famine food to treat several ailments like arthritis, cancer, joint pains, headaches, diabetes, hypertension, asthma, immune system failure, indigestion etc. Fruit juice works at a cellular level to treat the ailment. Extraction of the juice from the ripe fruits is very difficult and the recovery of the juice by pressing is very less. Therefore, present investigation was undertaken to standardize suitable method for extraction of juice to enhance juice recovery and, nutritional qualities for further value addition.

Material and methods

The experiment was conducted to study the effect of enzymatic treatments on the recovery of noni juice. Sixteen different enzyme treatments (Pectinase, cellulose and their combinations) were used for extraction of the 'Noni' fruit juice. The juice after extraction was filtered, heat pasteurized and packed in glass bottles followed by processing (96±1^{o}C) for 30 min. The juice was stored for 12 months to study the storage stability. The analysis of parameters was done as per standard methods. The juice obtained from best treatment was also used for blending with mango pulp with 12 treatments for preparation of blended Noni mango nectar.

Results and conclusion

The treatment of crushed fruits with 0.1% Pectinase for 3 hours gave maximum (50.52%) juice recovery by manual pressing against manual pressing without enzyme (31.71%). Results shows significant differences in ascorbic acid of noni juice when extracted using different treatments at '0' month, with maximum ascorbic acid (120.10mg/100g) in juice extracted using 0.10% pectinase and minimum in control. During storage period of 12 months there was slight decrease in the ascorbic acid. After 12 months of storage significant differences were observed in ascorbic acid of juice, with maximum ascorbic acid (108.15 mg/100g) in juice extracted using 0.10% pectinase and minimum pooled ascorbic acid (92.05 mg/100g) in juice extracted using without enzymes. Colour, body and overall acceptability of noni juice was observed to be significantly affected by extraction methods. Maximum colour, body and overall acceptability score (9 point Hedonic scale) were observed when juice was extracted using 0.15% pectinase at par with 0.10% pectinase. During storage also significant differences were observed for colour, body and overall acceptability. The blending of noni juice (5%) with mango fruit pulp (15%) found to mask the effect of the pungent odour to great extent and so possess potential for preparation of 'Noni Mango Nectar'.

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Effect of UV Light, Preservative and Heat Treatment on Quality of *Aloe vera* Based Blended Nectar

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Keywords: UV Light Treatment, Evaluation, TPC, Quality

Introduction

According to the WHO, non-communicable diseases (NCDs) are the leading cause of mortality in the world, representing over 60% of all deaths; out of which 30% deaths are due to cardiovascular diseases. In the light of this, the tenet "Let foods be your medicine and not medicine be your food". Therefore, a preventive food is required to avoid the necessity of taking medication. Processed food drinks deteriorate in quality due to a wide range of reactions in food. Thermal processes such as blanching, pasteurization or heat sterilization are being employed for food preservation. However, in most cases thermal energy induces various chemical reactions, leading to quality deterioration in certain foods causing undesirable changes in sensory and nutritional qualities. In addition, the food preservatives which are being used for preservation of the processed foods possess several health ill effects and even some time deteriorates nutritional and sensory qualities of foods. So, now a days, people are becoming health conscious and demanding food products having better nutritional quality with low or even no food preservatives. Therefore, some alternative methods like UV light exposure need to be evaluated for the preservation of the foods to develop the consumer's confidence towards safety.

Material and methods

The experiment was conducted to study the effect of UV light, preservative and heat treatment on quality of *Aloe vera* based blended nectar. Eleven different treatments were used for experimentation. Produce juice/ pulp after extraction and filtration was blended in ratio of 12:2:2:4 (*Aloe vera*: Bitter gourd: Aonla: Guava) with TSS level of 15°B and maintained with 0.30% acidity. The prepared nectar was filled into pre-sterilized glass bottles of 200 ml and sealed air tight with crown caps. The product was then processed using various treatments followed by cooling and storage for six months at room temperature and analyzed at regular intervals for physico-chemical as well as sensory attributes.

Results and conclusion

The results of the present investigation indicate that blended nectar can be preserved for long time by adding 75ppm KMS (50% of recommended chemical preservative) followed by 30 minutes UV light treatment on the basis of higher sensory score as well as nutritional composition. Overall findings revealed that blended nectar can successfully be stored for 6 months in glass bottles with minimum changes in chemical, sensory and microbial quality. The Benefit cost ratio (BCR) of blended nectar was observed 1.20 at 20 per cent profit margin and 1.74 at minimum market sale price of Rs. 10.00 per bottle (200 ml). Thus, UV light treatment of blended nectar for 30 minutes containing 75ppm KMS can be utilized more beneficially for its preservation by food processing industry for a period of six months to ensure minimum changes in nutritional as well as sensory quality. Thus, the developed technologies can commercially be explored by food processing industry for the production of quality health oriented blended nectar.

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Utilization of Mango Peel and Kernel for Preparation of Fibre Rich Biscuit ("*Nankhatai*")

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Keywords: Mango peel, Mango kernel, Biscuits, Nankhatai

Introduction

Mango (*Mangifera indica* L.) is one of the most important fruit crop in India with a total production of 18 million tons per annum from an area of 2.5 million hectare. India is the largest producer of mango in world with the share of 45.1 per cent. To enhance availability of mangoes during off season; mangoes are being processed into different products. India is also largest processor of mangoes with the share of 20 per cent. Due to such a huge mango processing share, the mango processing industry generates a large quantity of waste (40-45%) in the form of peel and kernel. These processing waste, if not handle properly, cause environmental pollution problems. The fruit of mango comprised of about 20 to 30 per cent of peel and about 10 to 25 per cent kernel. However, the processing waste of mango (peels and kernel) being very rich source of important nutrients can be used to care certain degenerative diseases. Mango peel and kernel possessing very good nutritive value especially in term of dietary fibre can be utilized for preparation of the mango peel and kernel based biscuits. The present investigation was undertaken for utilization of mango peel and kernel for preparation of fibre rich biscuits "Nankhatai".

Material and methods

The experiment was conducted for preparation of biscuits (*Nankhatai*) using sixteen different formulation combinations of mango peel powder (0, 5, 7.5 and 10%), kernel powder (0, 5, 10 and 15%) and wheat flour "Maida" [100%-peel powder and kernel powder (%)] along with different ingredient such as wheat flour "*Rava*" (10g), sugar (100g), fat (50g), milk powder (3g), baking soda (4g) and small cardamom (1g). Biscuits were prepared by mixing the entire ingredients. The dough (firmness of 0.5 to 0.6 kg/cm^2) was moulded into round shaped ball (20 to 22g having 25 to 30 mm diameter) and placed on trays. Then baking was done in hot air oven at 175±5°C for 15 to 20 minutes. After baking, the biscuits were cooled, packed in 200 gauge polypropylene bags (100g capacity having 12cm x 20cm sizes) and stored at ambient temperature for three months for periodical analysis.

Results and conclusion

The biscuits prepared by the formulation of 5% mango peel powder, 7.5% kernel powder and 87.5% maida were found shelf stable based on nutritional as well as sensory quality during three months storage. During six month storage, biscuits prepared by the formulation of 5% mango peel powder, 7.5% kernel powder and 87.5% maida observed minimum increase in moisture and peroxide value while minimum decrease in carbohydrates, proteins, fibre, oil, carotenoids, total phenols, ash and sensory quality parameter. These samples remained free from microbial contamination upto three months storage. The cost of production per 100g pack of biscuits was worked out to be Rs. 11.83 and had net profit of Rs. 3.32 with BCR of 1.27 (27% profit) for formulation of 5% peel powder, 7.5% kernel powder and 87.5% maida when sold at market price of Rs 15.00 per 100 g.

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Preparation of *Aloe vera* Based Blended Nectar to Enhance Sensory Acceptability

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Keywords: Bitter gourd juice, Aonla juice, Guava pulp, Blending ratio

Introduction

Food commodities like Aonla, Guava, Bitter gourd and medicinal herbs like *Aloe vera* are known from centuries for being used to care degenerative diseases. However, commonly occurring problem in consumption of these commodities in fresh from is due to its bitter (*Aloe vera*, bitter gourd) and highly acidic/astringent taste (aonla). Guava fruits, besides having medicinal importance, also possess good flavour and acceptability, thus having positive attribute for blending purpose. Therefore, development of blended nectar by making a judicious combination of such commodities having hypoglycemic properties appears to be one of the best alternatives to develop nectar in the form of healthy drink suitable for consumers of various age groups.

Material and methods

The experiment was conducted to study the effect of blending proportions on the quality of blended Aloe vera nectar. Juice/ pulp from *Aloe vera*, bitter gourd, aonla and guava were extracted by grating the slips/fruits following extraction by using crusher & screw type juice extractor and pulper. The juice/pulp after filtration were blended in ratio of 2:2:12:4, 2:12:2:4, 4:4:8:4, 4:6:6:4, 4:8:4:4, 6:4:6:4, 6:6:4:4, 8:4:4:4 and 12:2:2:4 (*Aloe vera*: Bitter gourd: Aonla: Guava) with TSS level of 16°B and maintained with 0.30% acidity followed by heat pasteurization at 95°C for 5 min. Immediately after pasteurization, the nectar was packed in 200 ml pre-sterilized glass bottles followed by processing in boiling water for 30 min at 96±1°C. The labeled samples were stored for 6 months and analyzed at regular intervals for physico-chemical as well as sensory attributes.

Results and conclusion

The results indicated that drink prepared from 12% *Aloe vera* juice, 2% Bitter gourd juice, 2% Aonla juice and 4% Guava pulp having 16.00°Brix TSS and 0.30 per cent acidity (B_9) was extremely liked on the basis of 9 point Hedonic scale and found best on the basis of nutritional composition. Six month storage of drink prepared by using 12% *Aloe vera* juice, 2% bitter gourd juice, 2% aonla juice and 4% guava pulp having TSS 16°Brix and 0.30 per cent acidity exhibited minimum changes in nutritional as well as sensory attributes. The B:C ratio of drink was observed 1.20 at 20 per cent profit margin and 1.75 at minimum market sale price of Rs. 10.00 per bottle (200 ml). It can be concluded that blended nectar can be prepared and stored for 6 months in glass bottles after 30 min processing at 96±1°C by using 12% *Aloe vera* juice, 2% Bitter gourd juice, 2% Aonla juice and 4% Guava pulp having 16°B TSS and 0.30% acidity. Thus, the developed technologies can be explored by processing industry for the production of health oriented blended nectar. Therefore, profitable utilization of *Aloe vera* slips, bitter gourd, aonla and guava fruits grown in India by processing can ensure better returns to the growers and processors.

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Waste Utilization of Banana Peel for Processing into "Sev"

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Keywords: Banana Peel, Waste Utilization, Value addition, Pre-treatment

Introduction
Huge quantity of banana peel as a waste material is generated during the preparation of the banana puree in banana processing plant. This waste material poses serious problem of its disposal. Even now days, the pollution control agencies have started questioning the unorganized disposal of processing wastes as it affects the surrounding environment and causes nuisance. However, dietary fibre of banana peel has been reported to possess beneficial effects in the prevention of several diseases, such as cardiovascular diseases, constipation, irritable colon, colon cancer, and diabetes. Thus, the experiment was conducted to utilize banana peel for the preparation of *sevian*.

Material and methods
Banana peel was pre-treated with 16 different combinations of ascorbic acid and salt (NaCl) to control enzymatic browning prior to blanching at 85±5ºC for 3 minutes. After blanching, the peel was milled in grinder followed by mixing peel paste (0, 10, 20, 30, 40, and 50%) with gram flour (100, 90, 80, 70, 60, 50%) along with other ingredients in powder form viz. 1.5g red chilli, 0.75 g white pepper, 1.0g turmeric, 2.5g coriander and 2.5g common salt to prepare the dough, which was passed through the cold extruder to form the "sev" followed by deep frying in sunflower oil, draining of oil and packaging. A total of six treatment formulations were used in the experimentation using CRD with three repetitions.

Results and conclusion
The results of the study revealed that dipping of banana peel in 2% Salt (NaCl) solution along with 100 ppm ascorbic acid prevented enzymatic browning significantly. The lowest enzymatic browning was observed with OD (490 ppm) of 0.017. No differences were observed in TSS and fibre content as a result of pre-treatments. The formulation of banana peel based dough possesses significant differences on the yield of the banana peel based Sev. The yield of the Sev significantly varied from 77.65% to 130.19%, with maximum yield in Sev prepared directly from the gram flour and minimum prepared from the formulation containing 50% banana peel. The fibre content among different formulations varies from 7.51 to 11.14%, with minimum fibre in Sev prepared directly from the gram flour and maximum prepared from the formulation containing 50% banana peel. Maximum sensory score were obtained in Sev prepared directly from the gram flour, while minimum in formulation containing 50% banana peel. The results of the study revealed that immediate dipping of the banana peel after peeling in the solution of 100 ppm ascorbic acid along with 2% salt solution followed by blanching at 85-90^{o}C for 3 minutes prevent enzymatic browning of the peel. After pretreatment, 30% of the banana peel can be utilized along with gram flour for preparation of fibre rich sevian. The prepared product possesses better quality as well as organoleptic attributes. Thus, in this way the technology would help to save environment and important nutritional component i.e. fibre of banana.

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Technology for Processing and Value Addition of Watermelon Pulp and its Rind

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Keywords: Candy, Rind, Waste Utilization, Nectar

Introduction

Watermelon (*Citrullus lanatus*) is a widely cultivated cucurbitaceous crop especially on the river beds in India. The sweet and juicy flesh of ripe fruit is being eaten fresh throughout India and known for refreshing and cooling effect in the summers. It contains 95% water, 3.3% carbohydrates and 0.3% minerals besides being rich in vitamins and proteins. However, no processed watermelon products are available in the market. So the experiment was conducted for preparation of watermelon nectar and utilization of rind left after juice extraction for candy preparation which otherwise causes disposal problems.

Material and methods

Watermelon nectar was prepared using different levels of pulp (P_1-20% and P_2-25%), TSS (T_1-15^{o}B, T_2-16^{o}B and T_3-17^{o}B) and acidity (A_1-0.25%, A_2-0.30% and A_3-0.35%). The prepared nectar was filled in pre-sterilized glass bottles of 200 ml and sealed airtight with crown caps, processed at 96±1° C in boiling water for 30 minutes followed by cooling & storage at room temperature. Rind candy was prepared using combinations of osmotic treatments (O_1-50g sugar/100 g rind, O_2-75g sugar/100 g rind, O_3-100g sugar/100 g rind, O_4-100g 60^{o}Brix syrup/100 g rind and O_5-100g 70^{o}Brix syrup/100 g rind) and acidity (A_1-0.10%, A_2-0.20% and A_3-0.30%). The cuboids were left overnight in syrup. After 24 hours, syrup was drained out, TSS and weight of syrup was recorded. Then, TSS of drained out syrup was raised 10˚ Brix by adding table sugar and cuboids were again kept in syrup for overnight. The process was repeated till the TSS of syrup reached to 70˚Brix. Then candy cuboids were rinsed in boiling water for 5 to 10 seconds, air dried in cabinet drier at 60˚C for 8 hours. Thereafter, 50g rind candy was packed in polypropylene bags (300 guage), sealed airtight and stored at room temperature. Processed products were stored for 6 months and analyzed for various physico-chemical and sensory attributes at interval of 2 months.

Results and conclusion

The results of the present investigations indicate that watermelon fruits can be recommended for processing into water melon nectar and rind candy. Water melon nectar prepared from 25% pulp having 16°Brix TSS and 0.30 per cent acidity was rated as the best treatment on the basis of higher sensory score as well as nutritional composition. Further, watermelon rind candy prepared by mixing 100 g sugar per 100 g watermelon rind along with 0.20 per cent acid from was rated as the best treatment on the basis of higher sensory score as well as nutritional composition. Overall findings of investigation revealed that water melon nectar and rind candy can successfully be stored for 6 months after packing in glass bottles and polypropylene bags, respectively with minimum changes in chemical, sensory and microbial quality. The Benefit cost ratio (BCR) of water melon nectar and rind candy was observed 1.44, if left over syrup after candy preparation used to prepare nectar whereas the BCR for water melon nectar and rind candy was only 1.20, if products prepared separately.

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Utilization of Kiwifruit Enzyme in Food Industry

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Keywords: Kiwifruit enzyme, Characterization, Purification, Cottage cheese, Tenderization

Introduction

The Kiwifruit, *Actinidia deliciosa* is native to China and is very popular in human diet due to its pleasant taste and high content of vitamin C, minerals and low calorific value. It is also known to contain highly active proteolytic enzymes (Kaur *et al.* 2010), that are widely used as technological aids in several food processes. Proteolytic enzymes are multifunctional class of enzymes. Thus, present study was conducted for utilizing kiwifruit enzyme in food industry as milk clotting enzyme, for reducing fermentation time and as a meat tenderizer.

Material and methods

The present investigation was conducted during 2014-16. Kiwifruit enzyme was extracted at various stages of fruit maturity followed by partial purification with ammonium sulphate, characterization with RSM and optimization of enzyme for development of multigrain buns, cottage cheese and tenderization of spent hen chicken on the basis of leavening activity, milk clotting activity and TPA, sensory characteristics respectively. Data for sensory evaluation were analysed using RBD while chemical analysis was done using CRD.

Results and conclusion

The maximum protein content and enzyme activity was observed at immature stage of fruit maturity followed by mature and ripened stage (Table 1). Partial purification with 40-60 per cent ammonium sulphate precipitation showed highest enzyme activity, yield and purification fold. Characterization of enzyme shows highest enzyme activity at pH 8.0 and temperature 45^{o}C. It was concluded that by employing the kiwifruit enzyme at the rate of 3, 0.5 and 10 per cent for multigrain buns, cottage cheese and tenderization of spent hen chicken was found optimum for reducing fermentation time in bakery, replacing animal origin rennet in dairy and improving spent hen chicken quality in meat products respectively.

Table 1: Protein Content and Enzyme Activity of Kiwifruit (Mean±SE)

Stage	Protein (mg/gm)	Enzyme activity (µg/gm)
Immature (TSS<6.5 ^{0}B)	0.42 ± 0.20	200.32 ± 0.20
Mature (TSS=6.5 ^{0}B)	0.28 ± 0.10	131.50 ± 0.20
Ripened (TSS<14 ^{0}B)	0.25 ± 0.20	130.25 ± 0.20

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Joint Forest Management for Livelihood Generation in HP

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Keywords: Forest Management; Employment; Alternative Income

Introduction

The forest management by the people has helped in the sustainable use of the forest resources by the common people along with becoming an alternative source of income for them. Such programmes while ensuring the conservation of flora and fauna, also provided stability for the agriculture, horticulture, animal husbandry, and local cottage industries and thus helps in all round economic development (Bhatia 2000).

Material and methods

The study was conducted in 18 JFMCs of 6 forest development agencies (FDAs) of the state. Further from each selected JFMC, minimum of 10 respondents were selected randomly thus making a total of 206 respondents. The primary data were collected with the help of a questionnaire by personal interview. Secondary data on various aspects of JFM and other parameters was collected from forest department and other government offices.

Results and conclusion

About 336 ha of the area has been brought under plantation with an overall survival rate of 66.67 per cent in the study area. Apart from this 69 check dam/ retaining walls, 26 water harvesting structures, 21 *tialas*, *kuhls*, path construction, road repair work etc., 10 vermicomposting pits and 3 nurseries were set up during 2005-06 to 2015-16. The employment of 23463 mandays has been generated in the selected JFMCs during the period. The expenditure of Rs. 41.95 lakh has been made in the selected JFMCs. The gini ratio of the household income was found to be 0.39, 0.45 and 0.23 from the farm, non-farm and forests. At the overall level gini ratio was found to be 0.31 showing that the income derived from the forests reduced the level of income inequality in the study area. The study also revealed that the annual income from community forest is higher for small and marginal, and poor households compared to rich households. Thus joint forest management helped in generating alternative income for local people and has also helped in meeting the forest conservation goals. The forest products collected by the households are given in table 1.

Table 1: Average Annual Collection of the Forest Products per Household

Fuelwood (quintals)	Fodder/ Grasses (quintals)	Leaf Litter/ Animal Bedding (quintals)	Humus (quintals)	NTFPS Like *Gucchi*/ Wild Vegetables (Rs)
14.31	16.65	1.50	0.70	242.72

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Conceptual Framework for Holistic Development of *Himachali* Villages

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Keywords: Matrix analysis, MGNREGA, PRA, resource mapping, time line, transect walk

Introduction
Detailed Project Reports (DPRs) were prepared under IWMP through interactive participation with a focus to reveal the village problems, prioritizing and catering solutions. The aims were to i) up-grade agriculture based artisan skill(s) to make it a remunerative venture, ii) rejuvenating the traditional agriculture or diversifying with remunerative crops. *Promoting niche agriculture* and iii) creating works opportunity for MGNREGA.

Material and methods
PRAs were conducted with the participation of at least 15 persons from each village stratified in a panchayat, to have an appraisal of the problems of the natives and further developing apriori. The problems were enlisted and preferential choice was exercised between the two problems. The preferred one was scored in the corresponding cell in the upper half diagonal chart. The row was converted into column for filling the other half of the diagonal. The frequency of each problem that appeared in different cells was counted to take the final score. The problem with the highest score was ranked No. 1 and others were ranked in descending order. Matrix analysis as proposed by Chambers (1994) was adopted, which has earlier been used by Joshi *et al*. (2015). Further, the problem with maximum cumulative score over 08 panchayats was ranked No. 1, the others were put in the descending order in the a table of pooled problems for ranking. Taking the cognizant view of the villagers, finally the actions for holistic development of the natives were designed into the approaches for the holistic development of the panchayat.

Results and conclusion
HAD (Holistic Approach for Development) It Been (for any Village)*:*
Increase in Area under commercial crops

- Fallow and Shamlat land to be brought under cultivation, with the niche-crop.
- MGNREGA work field to be expanded with the revigoration of fallow/shamlat land.
- Plantation and introduction of improved species of grasses (napier, steria, ginni,) and tree species (*beul, kachnar, shahtoot, sain* on the abandoned land) will certainly strengthen the fodder bowl of the village.

Livestock

- Milk productivity ought to be improved with the introduction of cross-bred cows.
- Flesh is the fancy food of the area. Goatry and piggery, as business, will certainly fetch handsome remuneration for the farming community of the village.

New Avenues
Diversification of crops

- Round the year cultivation of radish, marigold and cauliflower.
- Orchard floor farming with different vegetable crops is to be brought in practice.

Precision farming

- Introduction of new high yielding varieties.
- Adoption of refined technology in the existing cropping pattern.
- Hi-tech farming like adoption of poly culture/ low cost protected structures.

Non-Farming Avenues

- Meat production by rearing goat (He), pig, poultry etc.
- Mushroom culture particularly *dhingri* or *shitake* mushroom (high temperature tolerant).
- Catching pace with the Goatry by-products.

Community Avenues as usufruct rights

- Shamlat land, if brought under cultivation, will raise the economic status of the farmers.
- Wasteland development into community orchard of citrus, guava and mango (pickling) or even the introduction of forest species of economic use viz. drake, willow, and poplar.
- Introduction of fodder tree species viz. *beul, kachnar, shahtoot, leucaena* in the pastures.
- Harnessing sun energy.
- Entrepreneurship in Mineral mixture production.
- Establishment of composting pits in every household at personal level and in every shamlat at community level.
- Management of dung, cattle litter, household waste etc. with renovation of cowshed, kitchen and washroom.
- Disposal of carcase into remunerative venture.
- Power generation in *gharats* by managing the run-off- of water.

The roadmap for each and every village should be developed catering to each specific problem. Hence, the technology be extended to every Gram Panchayat of the State.

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Utilization of Bitter Gourd for Developing Antioxidant Rich Low Calorie Functional Beverages

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Keywords: Bitter Gourd, Functional Beverages, Alternative Sweeteners

Introduction

Over the last few decades, the world has become increasingly aware of the role of added sugars, particularly in beverages, as a major driver of increased weight gain, obesity, hypertension and diabetes. Further, sedentary lifestyle along with a high level of mental stress has led to an increase in the prevalence of these non-communicable diseases. Use of non- nutritive sweeteners has been explored as an alternative. These sweeteners are zero- or low-calorie alternatives to nutritive sweeteners, such as table sugar. Further, fruits and vegetables such as bitter gourd and aonla have been reported to contain many nutraceutical compounds and possess antioxidant and hypoglycaemic activities. Therefore, in the present study, efforts were made to utilize bitter gourd for preparing antioxidant rich, low calorie functional beverages by blending with aonla juice and replacing sugar sweetness with the sweetness of non-nutritive sweeteners *viz*. stevioside and sucralose.

Material and methods

Different combinations of bitter gourd juice and aonla juice were tried for optimization of a suitable combination for the preparation of palatable antioxidant rich bitter gourd based functional squash. Best product formulation was further used for developing low calorie beverages by replacing the sucrose sweetness with equi-sweetness of stevioside and sucralose at different proportions. The beverages were evaluated for their physico-chemical, nutritional and sensory characteristics as per standard methods. The data pertaining to physico-chemical characteristics were assessed by applying CRD, whereas, sensory parameters were analyzed by RBD using OPSTAT software.

Results and conclusion

Out of various combinations tried, the blended squash prepared by using 70 per cent bitter gourd juice and 30 per cent aonla juice with 30 per cent fruit part and 45^{o}B TSS was found the best on the basis of physico-chemical, nutritional and sensory characteristics. The best rated blended bitter gourd squash contained higher amounts of ascorbic acid (39.75mg/100g), total phenolics (33.11mg/100), antioxidant activity (74.19%) and also showed strong antimicrobial activity against human pathogen *E. coli* and *Staphylococcus aureus* as compared to standard bitter gourd squash. Further, among non-nutritive sweeteners, use of stevioside at 65 per cent and sucralose at 75 per cent level of sucrose substitution was found suitable without compromising sensory qualities, hence optimized to prepare low calorie bitter gourd squash. The bitter gourd: aonla blended squash having 65 per cent stevioside and 75 per cent sucralose brought about 62.36 per cent and 74.26 per cent reduction in calories over 100 per cent sucrose sweetened squash, respectively. The beverages remained shelf stable during storage period for six months. The availability of these in the market will definitely benefit the 'at risk' as well as health conscious people.

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Optimization of Low Alcoholic Bitter Gourd Grape Beverage by Applying Response Surface Methodology

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Keywords: *Momordica charantia*, wine, grapes, low alcoholic

Introduction

Bitter gourd (*Momordica charantia*) is traditionally used as a medicine. The fruit has several medicinal uses in the traditional methods of medicine and therefore used as a medicinal herb as anti- HIV, anti-ulcer, anti-inflammatory, antileukemic, anti-microbial, anti-diabetic and anti-tumer (Kalra et al., 1988). Recently, its antidiabetic property is under intensive investigation. A very little work has been done to prepare beverage/juice including alcoholic beverages. There is no documentation of preparation of bitter gourd wine as such or in combination of other fruit juice. Optimization of process of preparation of a low alcoholic beverage has been reported here.

Material and methods

Bitter gourd juice was extracted by addition of water and must is prepared by adding grape juice. The higher and lower concentration of nitrogen source, inoculum concentration and grape juice used for the wine preparation were as designed by Response surface methodology (RSM). Fermentation for all the treatments was carried out at room temperature (20-22^{o}C). Bitter gourd grape wines were further filled in 200 ml bottled capacity glass bottles. Statistical analysis of the quantitative data of chemical parameters obtained from the experiments was carried out by RSM.

Results and conclusion

Based on the results of RSM, among different concentrations of grape juices, bitter gourd based wine having 40% grape juice concentration had the highest TSS, rate of fermentation, ethanol, reducing sugars, total sugar and total phenols. With 0.15% DAHP as a nitrogen sources, bitter gourd based wine had the highest TSS, titratable acidity, ethanol, total and reducing sugar content and lowest volatile acidity and higher alcohols. Among different concentrations of innoculum level used, for most of the parameters there was non-significant difference. Must inoculated with 2.5% *Saccharomyces cerevisiae* var. *ellipsoideus* for the preparation of bitter gourd based wine had the highest fermentability and ethanol content. Bitter gourd based wine having 40% grape juice concentration as a sugar source, 0.15% DAHP as a nitrogen source and fermentation with 2.5% *Saccharomyces cerevisiae* var. *ellipsoideus* scored the highest score for overall acceptability. On the basis of physico-chemical and sensory characteristics, runs having 40% grape juice concentration, 0.15 % DAHP and 2.5 % inoculum level were rated as the best.

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Effect of Bael (*Aegle marmelos* L.) Coating on Shelf Life and Quality of Tomato (*Solanum lycopersicum*) during Storage

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Keywords: Bael, Shelf life, Perishability, Quality, Storage

Introduction

Bael (*Aegle marmelos* L.), an important plant with medicinal value, belongs to the family Rutaceae. Leaves, fruits, stem and roots of *A. marmelos* have been used in ethno medicine to exploit its medicinal properties which is a good source of vitamin C and proteins, alkaloids, aegeline, alkaloid coumarine, and marmine, sterol sitosterol, and essential oils δ-limonene. The leaves are bitter and are used as a remedy for ophthalmia, ulcers, dropsy, cholera and beri-beri. The present study was planned keeping in view the perishability of tomato and its importance in world agricultural trade.

Material and methods

Tomato (Hisar Arun) samples and leaves of bael were collected and all the biochemical parameters *viz.* physiological loss in weight, total soluble solids, titrable acidity, ascorbic acid content, crude protein content, lycopene content, total phenolics and total flavanoids were evaluated using the standard biochemical procedures.

Results and conclusion

Bael leaf extract in aqueous solutions of 2 and 5% were applied as a coating to mature green tomatoes, which were stored at 25±1˚C. Physiological loss in weight increased with increase in the period of storage in coated and uncoated control tomatoes. Coated and uncoated tomatoes crossed the different stages of ripening and attained the red colour at the end of storage. Fruits coated with 5% bael leaf extract delayed the decay process by slowing down the rate of respiration and ethylene production and also maintained total soluble solids, titrable acidity, ascorbic acid content, crude protein content, lycopene content, total phenolics and total flavanoids during storage as compared to the uncoated control and fruit treated with different concentration of bael leaf extract. Cell wall components *viz*. cellulose, hemicellulose and pectin decreased with increase in the period of storage. Activities of cell wall degrading enzymes *viz*. cellulase, pectin methyl esterase and polygalacturonase increased linearly with the advancement of storage period. The cellulase activity increased upto 6th and 12th day in control during storage at 25±1˚C whereas in coated tomatoes it increased upto 12th and 18th day of storage and then declined on 15th and 21st day of storage. Activities of all the cell wall hydrolyzing enzymes were higher in control tomatoes as compared to that in coated tomatoes. Coating of tomato fruit with bael leaf extract has been found to delay the decay process and maintain the tomato quality.

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Constraints Faced in Production and Marketing of Apple in Shimla, Himachal Pradesh

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Keywords: Apple, Production constraints, Marketing constraints

Introduction

Apple belonging to family Rosaceae, accounts for 50 per cent of the world's deciduous fruit production. In Himachal Pradesh, Shimla and Kullu account for nearly 60 per cent of the total area and 82 per cent of total production. Apple production is commercial in nature as almost the entire harvest is sold. Therefore, the prospects of increased production depend upon the prospects of markets. As the productivity increased, it gave rise to several marketing problems viz. shortage of trained graders, lack of adequate storage and processing facilities etc. Keeping this in view, an attempt was made to study the constraints faced by apple grower in Shimla district of Himachal Pradesh.

Material and methods

Shimla was purposely selected due to its highest concentration of apple plantation. Multistage random sampling technique was employed for the selection of units. Four blocks namely Rohru, Jubbal-Kotkhai, Theog and Narkanda were selected randomly. Finally a sample of 400 growers was selected. On the basis of the nature of the data, budgeting technique and various economic tools were used to identify the constraints of production and marketing of apple.

Results and conclusion

Farmers faced various constraints during production, marketing and value addition stages. Non-availability of improved apple varieties was reported by 66 per cent growers. Spurious pesticides and fungicides (85.25%), non-availability of desirable brand of chemical fertilizer (55.50%), high price of chemicals (53.75%) were the main problems faced by sampled orchardists. Lack of FYM availability was faced by 45.50 per cent of sampled orchardists. Shortage of skilled labour for training and pruning of plants and plant protection measures were reported by 73.25 per cent of orchardists. Most serious constraint during marketing was too many middle men involved as reported by 88.25 per cent of orchardists, followed by lack of proper transportation (72%), misleading information (47.75%), commission agent monopoly (39.75%), part payment (28%) and late information (22.5%). Lack of proper grading (76.5%) and lack of proper cold storage (64.25%) was also reported. Serious problem for traders was high transport cost (89%) followed by lack of grouping market (69.25%) and lack of market for third grade apple (54.75%). There were also problems regarding the policies viz; Dual inter-state taxation (79.25%), lack of brand promotions by government (65.75%), lack of registered trademarks (57%), lack of soft loans for cooling vehicles (50.50%), lack of transport and storage subsidies (39.50%) etc.

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Effect of Edible Coatings and Plant Extracts on Storage Quality of Persimmon fruit

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Keywords: Persimmon (*Diospyros kaki L.),* Ebenaceae, Edible coating

Introduction

Persimmon belongs to family Ebenacea. Unlike other climacteric fruits, it is not edible at the early maturity stages and has very firm texture with low sugar and water content. These characteristics give the opportunity to store fruits for lengthy periods with minimum loss, whereas ripe persimmon are very soft and mushy and high in sugar and water and can be easily bruised. Plant extracts or coatings are effective against microorganism and have been successfully used to increase the shelf life of different fruits. Herbal extracts are used as edible coatings and they prevent water loss, control respiration and ripening, reduced microbial load, and delay oxidative browning in fruits and vegetables.

Material and methods

Persimmon cv. Fuyu fruits were procured from Kullu, and healthy, disease free and firm fruits were selected and washed with water and treated with commercial edible wax emulsion i.e. Starlight (30%, 40% and 50%) and plant extracts of *Aloe vera* (10%, 20% and 30%), Neem leaf extract (1.0%, 1.5% and 2.0%) and Tulsi leaf extract (10%, 20% and 30%) for 5-10 minutes and control (untreated fruits). The treated fruits were dried properly and then stored in brown paper packets in refrigerated (0±2℃) and ambient condition with RH of 85-90 per cent. Quality parameters were analyzed every 10^{th} day up to three month.

Results and conclusion

All fruits treated with plant extracts and a coating had more shelf life as compared to the control fruits. Fruits treated with 50 per cent Starlight wax emulsion was the best treatment out of all, followed by *aloe vera* (30 %), Starlight (40%), neem leaf extract (2.0%). The fruits coated with starlight (50%) showed minimum physiological losses (11.93 %), TSS ($16.50\ ^0$B), highest overall acceptability, whereas, control fruits showed highest PLW (15.93 %), firmness and TSS. Initially the sugar level increases up to2nd month and then decreased. The treated fruits showed shelf life of 84-120 days with good sensory scores in refrigerated conditions. The respiration rate increased from 9.89 to 11.23 ml CO_2/hr. The plant extract and wax emulsion coatings were proved to be good to increase the shelf life of persimmon fruit with minimum quality changes. Commercially used starlight wax emulsion and *aloe vera* extract coating increase the appearance and gloss of the fruit. Thus preventing fruits from decay and attack of microorganism. The fruits treated with neem and tulsi leaf extract showed less disease incidence. The control or untreated fruits were more prone to disease, fungal attack and rotting.

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Development and Storage Quality of Seedling Mango Pickle

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Keywords: Seedling mango, Pickle, Recipe, Packaging material, Storage

Introduction

Seedling mango (*Mangifera indica* L.) fruits are widely utilized for the culinary purpose as well as for the pickle preparation and are found in the vast tract of lower hills of Himachal Pradesh. Although seedling mango has been used for the preparation of oil pickle in India, but there are only few records available regarding its use for pickle making. Because of the greater variation in its physico-chemical characteristics, it is not clear that all seedling mangos available in HP are suitable for pickle making or not. So studies were conducted on development and storage quality of seedling mango pickle from different locations.

Material and methods

The fruits of seedling mango at mature green stage were harvested from different locations namely Ghumarwin (Bilaspur), Bhoranj (Hamirpur), Gopalpur, Pandoh (Mandi), Sulah, Bhawarna (Kangra), Una Sadar, Amb (Una), Nahan and Ponta Sahib (Sirmour). The fruits were washed and cut into pieces and stored in 20 per cent brine solution. The different recipes were tried for the recipe standardization and best recipe was followed for the preparation of mango pickle from brined seedling mango samples. The pickle was further packed in glass and PET (Polyethylene terephthalate) jars and storage studies were carried out for six months under ambient conditions.

Results and conclusion

Out of four recipes, recipe containing brined fruit slices-100 g, fennel-6 g, nigella-5 g, fenugreek-3 g, red chilli powder-2 g, black pepper-1 g, cumin-2 g, cinnamon-1.5 g, clove-1 g, turmeric powder-3 g, mustard oil-80 ml, citric acid-4 g, ratanjot-0.75 g, bishop's seeds-1.5 g, deggi mirch powder-2 g and jaggery (*Gur*)-10 g was found most suitable for pickle preparation. The fruits from eight locations (Bhoranj, Ghumarwin, Gopalpur, Sulah, Bhawarna, Una Sadar, Nahan and Ponta Sahib) out of ten locations were found suitable for the preparation of pickle on the basis of their higher sensory scores and some chemical characteristics. Pickle from two locations (Pandoh and Amb) was rejected due their poor texture scores (4.20 and 4.18). During storage a significant decrease was observed in various physico-chemical characteristics like titratable acidity, chlorophyll, starch, ascorbic acid content and total phenols. Among all the locations, the locations with higher initial values of various quality attributes retained higher contents during storage period. Pickle could safely be stored for a period of six months without much change in sensory characteristics (appearance, texture, taste and overall acceptability). Both the packaging materials viz. PET (Polyethylene terephthalate)) and glass jars were found suitable, with comparatively less changes occurring in glass jars during storage.

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Standardization of Enzymatic Treatments for Juice Extraction from Wild Prickly Pear (*Opuntia dillenii* Haw.)

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Keywords: Wild prickly pear, enzymatic treatment

Introduction

The cactus (*Opuntia spp.*) - a xerophytic plant has about 130 genera and 1500 species and belongs to family cactaceae and grows mainly in arid and semi-arid climate. One of the important species reported in HP is *Opuntia dillenii* Haw. which has got edible fruits containing sugars and antioxidant compounds like ascorbic acid, phenolics, betalains, flavonoids along with amino acids and minerals. The main problem associated with fruit is presence of glochids and mucilaginous pulp, which makes it difficult to extract juice. So, the present study was carried out for extraction of juice from fruit using various enzymes.

Material and methods

The mature fruits of *Opuntia dillenii* Haw. were procured from Vaknaghat area of Solan district of HP and were used for various physico-chemical analysis using standardized methods as given by Ranganna (1997). Fruit pulp was extracted and treated with various enzymes (Pectinase, Viscozyme and Viscozyme+Pectinase in 3:1 ratio) of varying concentrations at 50° C for different time intervals. The data of physico-chemical analysis was analyzed by Completely Randomized Design (and Randomized Block Design for sensory evaluation of extracted juice.

Results and conclusion

Out of different enzymatic treatment the enzyme combination of Viscozyme and Pectinase in the ratio of 3:1 (0.1% for 120 minutes) was best for juice extraction on the basis of various physico-chemical characteristics. After enzymatic treatment a significant increase was found in juice yield, sugars, titratable acidity and blue TCU in extracted juice as compared to control, which might be due to the breakdown of complex polysaccharides and pectin like substances by polysaccharides degrading and pectinolytic enzymes. A significant decrease was observed in case of apparent viscosity, total phenols, betacyanins, betaxanthins, pectins and ascorbic acid, which might de due to the degradation, polymerization, precipitation and oxidation reactions of these compounds by enzymes and subsequent heat treatment during the process of treatment. There was non-significant effect on colour, taste and aroma scores while body and overall acceptability scores increased significantly after different enzymatic treatment. It was concluded that out of various enzymatic treatments, the enzymes in combination at low concentration were found more efficient in breakdown of mucilage and pectin for juice extraction from cactus pear fruit as compared to individual enzyme treatment.

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Evaluation of Physical and Physiological Parameters of Ginger (*Zingiber officinale* L.) during Drying and Storage

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Keywords: Ginger, Ambient storage, Cold storage

Introduction

The hot-testing ginger, botanically known as *Zingiber officinale* L. belongs to family Zingiberaceae. It is a very important cash crop and one of the principle spice crop of India and the world. It is available in different forms such as raw ginger, dry ginger, bleached dry ginger, ginger powder, ginger oil, ginger oleoresin, gingerale, ginger candy, ginger beer, brined ginger, ginger squash, flakes, etc. It is used as flavourant in tea, tastemaker in curry and even in medicines due to its anti-inflammatory activity. The major pungent compounds in fresh ginger are gingerol.

Material and methods

The present investigation was carried out at Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during 2015-16. The experiment was laid out in completely randomized design with three replications. The treatments consist of LDPE 100 gauge, OPP 100 gauge, HM HILM 100 gauge, and cellophone bags packaging. The rhizomes were stored in two storage conditions viz. ambient and cold storage (10°C).

Results and conclusion

Among the different storage conditions, cold storage at 10^{o}C maintained significantly higher quality and shelf life of ginger over ambient storage. The packaging of ginger in HM film bags and stored under cold storage at 10^{o}C was recorded the minimum PLW, ethylene evolution rate and respiration rate, increased retention of moisture content and decreased sprouting and rotting, thus extended shelf life of ginger rhizomes.

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Comparison of Different Drying Modes for Asian Carrot

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Keywords: *Daucus carota* L, Solar tunnel drier, Mechanical cabinet drier

Introduction

Carrot (*Daucus carota* L), a root vegetable, is mainly consumed as raw, converted to juice beverages and cooked as vegetable dish. Before drying it can be converted into different forms like roundels, sticks and shreds. After pretreatment this can be dried using different modes. Solar tunnel drier is a natural energy based drying mode and being cheaper can be compared with mechanical cabinet drier and open sun drying. Although various works has been carried out for drying of carrot roots with mechanical cabinet drier but not much efforts has been made to compare these drying modes. So, present investigations were conducted to standardize the drying technology for the pre-treated forms of Asian carrot.

Material and methods

Carrot roots procured from local market of Solan were washed, peeled and three forms like roundels, sticks and shreds were prepared. These forms were further steam blanched i.e. roundels and sticks for 3 min and shreds for 2.5 min and pretreated with 2000 ppm KMS (60 min) dipping. These pretreated forms were further dried using drying modes like mechanical cabinet drier, solar tunnel drier and open sun. Best drying mode was selected on the basis of physico-chemical and sensory characteristics scores of these dried forms of carrot.

Results and conclusion

While comparing the different drying modes it was revealed that the carrot forms i.e. roundels, sticks and shreds dried in mechanical cabinet drier took least time to dry 9.25, 8.50 and 7.15 h, had lowest moisture 10.68, 10.12 and 9.10 per cent and water activity as 0.278, 0.231 and 0.169, respectively. Sufficient amount of reducing sugars as 20.70, 21.00 and 21.40 per cent and total sugars as 34.80, 35.20 and 35.90 per cent were recorded in dried carrot roundels, sticks and shreds, respectively. Maximum carotenoids as 30.10, 31.70 and 32.50 mg/100g and total phenols as 97.50, 100.80 and 102.00 mg/100g were found in mechanical cabinet dried roundels, sticks and shreds. The highest rehydration ratio as 8.00, 8.50 and 10.50 and ash content as 3.40, 3.50 and 3.80 per cent and fiber as 4.40, 4.50 and 4.90 were recorded in mechanical cabinet dried roundels, sticks and shreds, respectively. Maximum scores for sensory characteristics like colour as 8.40, 8.30 and 8.10 and texture as 8.00, 8.00 and 7.80 and taste as 7.30, 7.50 and 7.50 and overall acceptability as 8.00, 8.10 and 8.20 were awarded to the carrot roundels, sticks and shreds, respectively dried in mechanical cabinet drier. On the basis of various quality characteristics of dried forms of carrot, mechanical cabinet dryer at temperature 60 ± 2°C was found to be the best as compare to solar tunnel drier and open sun drying modes.

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Extraction of Pectin from Ripe Pumpkin (*Curcita moschata* duch ex. Poir) Using Eco-Friendly Technique

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Keywords: Extraction condition, Pectin yield, Characteristic of pumpkin pectin

Introduction

Pectin is a multifunctional polymer occurring naturally in cell wall of all non-woody plants. Pectic polysaccharides consist of linear polymer rich in galacturonic acid, containing significant amount of rhamnose, arabinose and galactose as well as other different monosaccharides and are now being used successfully from many years in food and beverage industry as thickener, emulsifier, texturizer, stabilizer and gelling agent. It has also been used as a fat substitute in spreads, ice-cream and salad dressings. At present, commercial pectin is almost exclusively derived from citrus peel or apple pomace. Pumpkin contains 1.2 per cent pectin. The increasing world market demand for pectin has been in excess of 30,000 tones annually, with a growing trend of about 4-5 per cent per annum. Thus, searching for new pectin containing raw material is an important task of science and industry.

Material and methods

Pumpkin pulp was mixed with water in a ratio of 1:3 in a conical flask and pectin was extracted using two different heating method *i.e.* atmospheric pressure at 95ºC for 60 and 120 min and autoclaving at 121ºC and 15 psi for 5, 10, 15, 20, 25 and 30 min. The pectin from pumpkin was analysed for moisture, ash, equivalent weight, methoxyl content, anhydrogalacturonic acid, degree of esterification, acetyl value and jelly grade.

Results and conclusion

The yield of pectin varied from 3.56 to 6.32 per cent depending on the extraction type and time. The moisture content of extracted pectin varied from 5.17 to 8.95 per cent with ash content of 2.19 to 3.11 per cent. Equivalent weight of pectin from pumpkin increased with increase in extraction time and higher increase was found in autoclaving method. With the increase in extraction time the methoxyl content of extracted pectin decreased significantly. Significant decrease in anhyrogacturonic acid content of pumpkin pectin was observed with increase in extraction temperature. The AGA content of pectin from pumpkin varied between 33.42 to 45.67 per cent. Further, autoclaving for 20 min yielded pectin with high degree of esterification, i.e. 70.59 per cent while autoclaving for 5 min produced pectin with low degree of esterification (50.09 %). The acetyl value of obtained pectin ranged from 0.48 to 0.66. The jelly grade of pectin isolated from pumpkin ranged from 51 to 117. Jelly grade decreased significantly with increase in extraction time above 20 min.

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Studies on Development and Storage Quality of Appetizer from Wild Pomegranate (*Punica granatum* L.) fruits

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Keywords: Wild pomegranate, Appetizer, Storage, Packaging material

Introduction

Wild pomegranate (*Punica granatum* L.) is an important wild fruit of Himachal Pradesh, having enormous potential for therapeutic use, which has never been utilized commercially for value addition except in the form of *anardana*. The arils of wild pomegranate are rich source of organic acids besides having appreciable amount of sugars, anthocyanins, phenols, ascorbic acid and good amount of minerals. Various beverages including appetizer can also be developed from this fruit. Therefore, keeping in view its availability and its abundance nutritive value including highest amount of natural organic acid present studies were undertaken with the objective to develop appetizer (spiced squash) from this wild fruit and retention of its quality during storage.

Material and methods

Wild pomegranate fruits harvested at optimum maturity were procured from Narag area of Sirmour district of HP and extraction of juice was done by food processor. Different combinations of juice (30, 35, 40 and 42 %) and TSS (40 and 45 ^{o}B) were tried to standardize proper combination for the development of appetizer keeping in mind the natural source of organic acid. The appetizer prepared by following the selected recipe was packed in glass and PET (polyethylene terephthalate) bottles and stored for six months under ambient (20-25 ^{o}C) and refrigerated temperature (4-7 ^{o}C) conditions. The physico-chemical and sensory characteristics of selected product were estimated at zero, three and six months of storage. The data of physico-chemical analysis was analysed by completely randomized design and randomized block design for sensory evaluation of products.

Results and conclusion

The appetizer prepared with 42 % juice, 40 ^{o}B TSS, 1.51 % acid and with a (10 %) spice extract of cardamom (1 g), cumin (2.5 g) black pepper (2.5 g), common salt (5 g), mint juice (1 %) and ginger juice (1.5 %) had highest sensory characteristics scores, which could be stored safely for a period of six months under both storage conditions and also in both packaging materials like PET and glass bottles. Overall effect shows that TSS, reducing and total sugars of appetizer increased from 40.00 to 40.71, 21.33 to 25.60, 37.60 to 38.73 and other chemical characteristics like acidity, ascorbic acid, anthocyanins, total phenols and overall acceptability score decreased from 1.51 to 1.34, 7.22 to 3.83, 8.99 to 3.36, 50.52 to 43.31, 8.15 to 6.68, respectively, during storage. The overall effect of packaging materials on colour, TSS, reducing and total sugars, ascorbic acid, anthocyanins and on total phenols content of the appetizer was significant. The best quality of this beverage could be maintained in glass bottle stored under refrigerated storage conditions as compared to PET bottle.

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Share of Income from Forest Development Programs: A Study in Nainital, Uttarakhand

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Keywords: Forest Development Programmes, Lorenz Asymmetric Coefficient

Introduction
Forest has been the source of mineral and nutrients since time immemorial. Nainital was the first district where JFM, a programme under National Afforestation Programmes in Uttarakhand was implemented. People dependent on the forest sector for their livelihood were either remaining unemployed or less paid for new job. The involuntary unemployment of forest dependent population, other than in peak farming season, peaked up. Keeping this in view, a study in Nainital was taken to estimate the share of income derived from FDPs in total household income among different income groups of beneficiaries.

Material and methods
From the Nainital district, Bhimtal block was selected randomly and further three villages, which were completely covered under FDPs were selected. From each village, 20 beneficiaries were selected, constituting a total sample size of 60 respondents. The primary data were collected with the help of pre-structured schedule through personal contact for two separate years; one just before gestation period of FDPs (2008) and another, latest year after the implementation of FDPs programme (2013). The head of the family was interviewed to obtain the details. Results were drawn with the help of *Lorenz* curve and its related tools like, *Gini* coefficient, *Lorenz Asymmetry Robin-Hood* index, *Herfindahl* index and coefficient of variation.

Results and conclusion
Results revealed that the curve was little away from line of equality, showing persistence of level of inequality among beneficiaries of FDPs. Although, the Lorenz curve for annual family income of the beneficiaries after implementation of FDPs was nearer to line of equality than Lorenz curve before FDPs which showed that the inequality in the income distribution decreased after FDPs.

Table 1: Distribution of Respondents According to Source of Income

S.N.	Source of income		Income Share Before FDPs (Rs)	Income share After FDPs (Rs)
1.	Agriculture		10023.33 (28.20)	4341 (4.21)
2.	Livestock		9966.33 (28.04)	14733.33 (14.41)
3.	FDP benefit	Forest produce	9832.5 (27.66)	52808.83 (51.65)
		Labour/ FDP Labour	4120 (11.59)	28700 (28.07)
4.	Others		1600 (4.5)	1600 (1.56)
Total Average income			35542.5 (100)	102233 (100)

Note: Figures in parenthesis indicate percentage to total

IESHP/AFS2017/4033

Trends in Mango Cultivation in Himachal Pradesh

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Keywords: Mango, Area, Production, Productivity

Introduction

Mango is an important fruit crop commercially grown in India with tremendous export potential and plays a significant role in the economy. There has been ever-increasing demand for mango in domestic and export market. The level of growth in output is determined by the growth rate in area and yield. The purpose of this analysis is to examine the performance of mango cultivation in the Himachal Pradesh. This would help in finding out the underlying factors responsible for such performance and thereby permit a broad judgment about the overall production possibilities in times to come.

Material and methods

The study used the secondary data on area, production and productivity of mango in India and Himachal Pradesh for the period from 2004-05 to 2015-16, collected from National Horticultural Board and Directorate of Economics and Statistics, Shimla. The compound growth rates for different variables were computed by fitting the power function.

Results and conclusion

The area under mango cultivation in the state has increased from 36215 thousand hectares in 2004-05 to 41523 thousand hectares in 2015-16. Area under mango registered a growth of 1.1 per cent per annum, whereas, production and productivity have shown significant negative growth during this period, which indicates that the poor management of mango orchards in the state. Moreover, the procurement price for the crop under market intervention scheme is also low with limited number of procurement centers and processing units in the mango growing areas. The maturity of the crop coincides with the onset of rainy season, which results in the low yields.

Table 1: Area, Production and Productivity of Mango in India and Himachal Pradesh

Year	INDIA			HIMACHAL PRADESH		
	Area ('000ha)	Production ('000 M.T)	Productivity (t/ha)	Area ('000ha)	Production ('000M.T)	Productivity (t/ha)
2004-05	1970.4	11829.7	6.0	36215	59739	1.64
2005-06	2080.7	12663.1	6.1	37408	63091	1.68
2006-07	2154.0	13734.0	6.4	38370	40159	1.04
2007-08	2201.0	13997.0	6.4	37840	29252	0.77
2008-09	2309.0	12750.0	5.5	38444	38751	1.00
2009-10	2312.3	15026.7	6.5	38681	24162	0.62
2010-11	2297.0	15188.0	6.6	39194	31463	0.8
2011-12	2378.1	16196.4	6.8	39568	28972	0.73
2012-13	2500.0	18002.4	7.2	39928	50001	1.25
2013-14	2516.0	18431.3	7.3	40298	25408	0.63
2014-15	2217.0	18506.0	8.3	41105	47612	1.15
2015-16	2209.0	18643.0	8.4	41523	37628	0.90
CGR (%)	**1.30****	**4.30***	**3.00***	**1.10***	**-3.10****	**-4.10****

Note: * 1% level of significance; **5% level of significance

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Public Private Partnership: A Way Forward to Enhance the Farmers' Income

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Keywords: Sustainable agriculture, Market extension, Public Private Partnership

Introduction

Sustainable agriculture production is possible only with ensuring remunerative price to the farmers, value to the consumers, reasonable return to the industry and stakeholder. An efficient supply chain and value addition through Public Private Partnership (PPP) is one of the key approaches that can make agriculture as sustainable farm enterprises. The difficult issue of efficient supply chain management in agriculture and various strategies for value addition of agricultural product open the avenues for PPP. Production, processing and marketing in agriculture is dynamic in nature due to continuous change in consumer's demand and expectations, so an innovative approach is needed to meet the current challenge of agriculture.

PPPs a Way to Enhance Farmers' Income

The good impact of PPP in any field depends on involvement of institution and industries in seeking collaboration and combining all available public and private skills. PPP has made positive change in market linkage of farm produce, capacity building of farm families, reduction of risk and uncertainty, social mobilization and economic empowerment of farmers. In Kerala as well as Assam, there was 5-10 percent rise in employment due to PPP.

Limitations of PPP Model in Agriculture

The officials at different levels did not act upon to have a better PPP model and money sharing schemes for the benefit of farmers. Successful partnerships in agricultural biotechnology especially between public and private sectors are still rare because of several constraints, *viz.* different objectives of each sector, high transaction costs of operationalizing and coordinating partnerships, mutual mistrust and negative perceptions as well as uncertainty about actual benefit and outcome from PPP. Non-involvement of various government departments led to failure of PPP. Another important constraint of PPP is mistrust and lack of transparency and non-adherence to agreement among partners.

Conclusion

Successful replication of PPP models across various production hubs for key commodities can change the agriculture from inefficient, supply driven, low value business scenario to an organized, high-tech, demand-led and high-value orientation and essential to incorporate learning's of previous PPP experiences. PPP would be successful if the government policies provide a level playing field to all the stakeholders. Viability gap funding under the scheme to support PPP in infrastructure to attract private investment should be extended to irrigation, terminal markets, and common infrastructure in agriculture markets and capital investment in fertilizer sector. The few successful PPPs and their successful collaborations have shown their contributions to gender mainstreaming, food security, poverty reduction and economic growth. PPP is projected to address the constraints of farmers through offering a fair price for commodities, risk sharing, capacity building and timely payment.

IESHP/AFS2017/4035

Pre-Harvest Application of Gibberellic Acid to Enhance the Storage Life of Peach Fruits

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Keywords: Peach, GA_3, storage and quality

Introduction

Peach is an important temperate fruit, which is grown successfully in sub-tropical conditions of the northern Indian. Its low chill varieties are grown commercially in Punjab. Peach is a climacteric & highly perishable fruit and high temperature & low humidity during its harvesting period leads to heavy post-harvest losses. Keeping it in view, present study was planned to reduce the post-harvest losses of peach fruits by pre-harvest application of gibberellic acid.

Material and methods

Healthy plants of peach *cv.* 'Shan-i-Punjab' were sprayed with GA_3 @ 25, 50, 75 ppm, physiological mature, uniform and healthy fruits of peach *cv.* 'Shan-i-Punjab' were harvested from treated plants, washed and dried under shade before packaging. Treated and untreated (control) fruits were packed in in CFB boxes and kept at 0-1^{o}C and 90-95% RH for further storage studies. Fruit samples were analysed for various physico-chemical characteristics after 2, 4 and 5 weeks of storage.

Results and conclusion

A significant reduction in weight loss was recorded in all the treatments with storage. Minimum loss in weight was recorded in GA_3 @ 75 ppm treated fruits. Maximum weight loss was found in control. Sensory quality of fruits improved during the initial period of storage, but afterwards a decline was registered and at the end of storage maximum sensory quality rating was recorded in GA_3 @ 75 ppm treated fruits. Fruit spoilage increased significantly with the prolongation of storage period and maximum was recorded after 5 weeks of storage. No fruit spoilage was recorded in GA_3 @ 75 ppm treated fruits after 5 weeks of storage, but in control and GA_3 @ 25ppm treated fruits spoilage was recorded after 4 weeks of storage. Total soluble solids in the fruit juice increased with storage and at the end of storage maximum TSS were recorded in GA_3 @ 75 ppm treated fruits. A decline in TSS was recorded in control fruits after 4 weeks of storage. A gradual decline in fruit acidity was noticed during the storage studies, but this decline was found minimum in GA_3 @ 75 ppm treated fruits. At the end of storage maximum acidity was recorded in GA_3 @ 75 ppm treated fruits and minimum in control fruits.

IESHP/AFS2017/4036

Role of Value-Addition in the Agrarian Farming System in Enhancing the Farmer's Income

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Keywords: Value addition, Food processing industry, Cold chains

Introduction

India is the largest producer of fruits and second largest producer of vegetables and also has a rich story of processing which is evident in many past narratives, where the use of techniques likes drying, fermentation, use of salt, sugar, spices etc. have been mentioned and are so commonly integrated in our daily life. Value addition is more about the consumer pull than the suppliers push. Customer value reflects the relationship between the benefits customers receive from and the price they pay for a given product. Combining the all factors of production together with the agricultural products, value addition can fetch the primary producers an additional income.

Role of Value Addition in Diversification

Diversification plays a vital role in the minimization of the risk associated with the farming. Besides giving a good return on the investment, these are best suited even for smaller farmers with limited resources. Value chain includes the full range of activities required to bring a product or service from conception, through the different phases of production, delivery to final consumers and final disposal after use with the concern and utility of the consumers given due care.

Economic Viability and Challenges

Over all, different enterprise and different agro products have different challenges which have perishability, seasonality, price fluctuation, shorter shelf life, high labor requirements, input credibility and maintaining and managing with the modern technology are some, which has found the common say.

Opportunities and Way Forward

Vast geo-graphical area, range of agro-climatic zones and the resources at our disposal promises the bright future for the agro-based industry to flourish and expand. Improvement over the infrastructure, research base, grass root connection with the farmers, understanding of the basic problems, and timely availability of credits and utilization of that credit in desired area would further strengthen the farmer's position. Their share in the consumer price can be enhanced only when they themselves would participate in the whole process and this will eliminate the unnecessary middle-men in the whole value chain of the processed food.

IESHP/AFS2017/4037

Impact of Government Subsidy on Micro Irrigation Adoption vis-a-vis Challenges in Adoption in Himalayan States of India

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Keywords: Micro irrigation, adoption, problems, subsidy

Introduction

Out of 141 m ha of net area sown in India, about 75 million hectare (46%) is presently under rainfed condition. Substantial dependency on rainfall makes cultivation in unirrigated area a high risk, less productive profession. Micro irrigation technologies constitute one such intervention, which uses water more efficiently. In India, micro irrigation is being promoted through Pradhan Mantri Krishi Sinchai Yojana. Apart from this, in Himachal Pradesh, Rajiv Gandhi Micro Irrigation Scheme (RGMIS) is also being implemented with subsidy of 80%.

Material and methods

Different schedules/structured questionnaires were prepared to solicit data/information from both primary and secondary sources and structured interview with the Senior Officials of the Implementing Agency and 30 beneficiaries in each district adopting micro irrigation was conducted. The evaluation methods i.e., (i) 'with' and 'without' and (ii) 'before' and 'after' approach were used to analyze the impact of the scheme depending on the suitability to various parameters. Technical assessment of the micro-irrigation scheme was carried out based on the status of data/information collected from the beneficiaries/system suppliers.

Results and conclusion

Out of 360 farmers surveyed, 100% farmers reported growing maize and 73% farmers reported growing wheat in the pre-development scenario. In post-development scenario, there was a significant increase in area under high value vegetables viz potato, tomato, capsicum, cauliflower, peas, etc (Table 1). The farmers' perception in Lahaul & Spiti and Kinnaur was positive as compared to areas having excess water as they endorsed the increased yield, crop quality improvement and water saving by agreeing 100 per cent to the benefits from MI. In HP, the RGMIS has brought definitive changes in farmers' life throughout the State, though some glitches need to be sorted out through extension services, training to the officers, ensuring right material etc.

Table 1: Pre and Post Development Maximum/Minimum Crop Productivity

Crop	Pre Dev. – Productivity (qha^{-1})	Post Dev. Productivity (qha^{-1})	% Increase
Wheat	15.22	19.55	28.40
Maize	18.00	19.00	5.70
Peas	91.15	104.38	15.00
Potato	86.67	102.50	18.00
Tomato	257.22	290.74	13.00
Cauliflower	206.43	208.95	1.00
Capsicum	204.62	226.75	11.00
French Bean	70.00	84.00	20.00
Okra	90.00	90.00	0.00
Cucumber	200.00	206.67	3.00

IESHP/AFS2017/4038

Development of Herbal Apple-Whey Blended Functional Beverage

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Keywords: Apple, Whey, Blending, Functional Beverages

Introduction

Foods are now being consumed not only for essential nutrients needed for life but also for other bioactive compounds which are useful in health promotion and disease prevention. Apple juice is considered as an important part of the human diet due to presence of various bioactive compounds. But, it contains insignificant amount of protein and is a poor source of minerals such as potassium and calcium. Dairy beverages are considered important products for development of functional beverages. Whey is a nutritious by- product of dairy industry produced during preparation of cheese, channa and paneer. It contains various biological compounds like proteins, minerals, vitamins and has proven its effects in the treatment of several chronic diseases like cancer, cardiovascular etc. Therefore, efforts were made to develop apple-whey blended herbal beverage for the benefit of health conscious people.

Material and methods

In the present study, apple juice was blended with different proportions of whey i.e. 90, 80, 70, 60 and 50 % with TSS of 10, 13 and 15^{o}B for the preparation of apple-whey beverage. Varying concentrations of cumin extract (1-3.5%) were used in order to increase overall acceptability of beverage. The acidity (% citric acid) was kept constant (0.30 %) in all the treatments. No artificial colour was added, whereas stabilizer viz. carboxy methyl cellulose (CMC) @ 0.1 per cent was used. The beverages were prepared as per standard method and specification of FSSA-2006. The beverages were evaluated for their physico-chemical, nutritional and sensory characteristics as per standard methods.

Results and conclusion

Combination of 75 per cent apple juice blended with 25 per cent whey with 13^{0}B TSS was found to be the best for preparation of apple-whey blended beverage on the basis of sensory evaluation for colour, body, flavour and overall acceptability. The best combination was further used for the preparation of herbal apple-whey blended beverage. The beverage prepared with 2 per cent cumin extract had significantly ($p<0.05$) higher score for colour, flavour and overall acceptability compared to that of control sample (without cumin extract). Besides, the best herbal apple-whey beverage was also found to contain good amount of total phenols (29.75 mg/100g), total protein (0.29 %), calcium (15.68 mg/100g) and lactose (1.21 %). The developed product was found to have higher antioxidant activity (27.86 mg/100g) and showed strong antimicrobial activity against *E. coli.* There were non-significant changes in the physico-chemical and nutritional quality attributes of the product and it remained well within the acceptable limits of sensory quality (> 7.00 score) during storage for two months at refrigerated temperature (4-7 ^{0}C). Hence, it emerged that blending apple juice with whey provide an effective way of delivering health benefits of apple and whey in the form of a palatable and nutritious beverage.

IESHP/AFS2017/4039

Role of Medicinal Plants in the Local Economy of Dodra-Kawar Area in Shimla, Himachal Pradesh

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Keywords: Medicinal plants, Local economy, Marketing

Introduction

Medicinal plants are an integral part of health care systems both in developed and developing countries occupying an important position in the socio culture, spiritual and health arena of rural and tribal life. The collection of medicinal plants is one of the traditional income generating activity of the people. The present study was carried out in Dodra-Kawar area of Shimla District in Himachal Pradesh, which is rich in floral diversity and is a store-house of many high value medicinal plants of commercial importance.

Material and methods

Socio-economic survey of medicinal plants of the study area was carried out to gather information on trade, marketing and economic analysis of important medicinal plants. Stratified random sampling design was followed for the farmer selection. The data were collected on pre-tested schedules and questionnaires. Emphasis was laid on farmers engaged in the collection of medicinal plants. Semi-structured interviews with village merchants, local agents, forest officers etc were also held. Simple statistical tools were used for data interpretation.

Results and conclusion

The contribution of the medicinal plants to the total farm income was 14.90 per cent on the sampled households and ranked third after horticulture and other farm activities (Table1). The local inhabitants are traditional collectors of the medicinal plants and serves as a source of supplementary income to the farmers. The total farm income per household per annum was Rs 43,846 as against the non-farm income of Rs 18,566. Among medicinal plants, *Aconitum heterophyllum, Jurinea dolomiaea* and *Picrorhiza kurrooa,* more than 40 per cent of the collected produce is sold through local traders. The local medical practitioners also serve as a traditional marketing channel for the local farmers where a significant proportion of different medicinal plants are used in the preparation of local medicines.

Table 1: Source Wise Income of Sampled Farm Households

Particulars	Per cent share to the respective sub head	Per cent share to the total income (Farm & Non- Farm)
Farm income		
Agriculture crops	21.91	15.39
Horticulture crops	58.83	41.33
Dairy	2.02	1.42
Bee keeping	2.34	1.64
Medicinal and aromatic plants	14.90	10.47
Non- Farm income		
Service	59.61	17.73
Business	14.36	4.28
Wage employment	26.03	7.74
Total	-	100

IESHP/AFS2017/4040

Factors Motivating Farmers to Practice Organic Farming among Pigeon Pea Growers of Gulbarga, Karnataka

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Keywords: Organic farming, Motivating factors

Introduction

Among the alternate farming systems, organic farming can be seen as the best option pioneered by our farmers before the onset of green revolution in the country. Organic farming system depend mainly on crop rotation, crop residues, animal manures, legume, green manures, off farm organic residues, mineral bearing rocks and biological pest control to maintain soil productivity and supply of nutrients. Organic agriculture is described by the FAO as "a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity.

Material and methods

In order to delineate the motivating factors behind adoption of organic farming of pigeon pea, sixty organic farmers were selected using random sampling from four villages of Aland taluk and Gulbarga taluk of Gulbarga district in Karnataka, where more organic farmers were practicing pigeon pea based cropping systems. Twenty factors were finalized for interpretation and discussion. The factors were grouped as economic, ecological, philosophical, and propaganda factors

Results and conclusion

The factors motivating organic farmers to convert from conventional farming were arranged according to their means' rank order, and grouped into four categories; *Economic Factors:* Reduction in cost of cultivation, enhancement of net income and profit and internal dependency of farm produced inputs for adopting organic farming. *Ecological factors:* Reduction in pesticide poisoning cases, diversification of agriculture, increase in productivity and improvement in soil health and sustainable use of resources. *Philosophical factors:* Sustainable development, self-dependence and freedom in farming, and *'Live and Let Live'* philosophy of life. *Propaganda factors:* Lure of *'Krishi Pundit'* awards, promotional schemes and advertisements of government, awareness campaigns of NGOs and success stories of organic farming. From this study, it was concluded that *'reduction in cost of cultivation'* (1st rank), *'enhancement of net income and net profit'* (3rd rank), *'internal dependency on inputs*', *'sustainable use of resources'* and the philosophy of farmers for a *'sustainable development*', *'living in harmony with nature*', and *'live and let live philosophy'* were the major motivating factors that pushed farmers towards practicing organic farming. In addition to these push factors, the pull factors of incentives in terms of *'Krishi Pundit' awards* (2nd rank), *'promotional schemes of government'* (4th rank), *'awareness campaigns of NGOs'* (5th rank), *'success story of other organic farmers'* (7th rank), '*better price for organic produce'*, and '*safe and nutritious food'* were also acting as motivating factors for practicing organic farming by these pigeon pea farmers.

IESHP/AFS2017/4041

Organic Farming in Kerala: Motivating Factors that Favoured the Shift

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Keywords: Motivation, Organic farming, Agro-ecosystem, Organic market

Introduction

Agriculture scenario across the country is rapidly changing from bad to worse. There has been a deceleration in agricultural growth leading to stagnation in productivity, declining factor productivity and distress among the farming community in the recent decades. In Kerala too, the situation in agriculture has worsened resulting in shortage of all agricultural produce. The need for providing safe food has been felt, as most of the food from conventional farming was laced with pesticide residues. Many ecologically sensitive farmers have come forward for organic farming, with considerable success. A shift towards organic farming in Kerala was witnessed and this study attempts to analyse motivation behind this.

Material and methods

Assessment of factors behind the move from conventional farming to organic farming practices is important to confirm the initial beliefs about the need for the organic farming in Kerala. The study was conducted in four districts: Thiruvananthapuram, Thrissur, Palakkad and Wayanad in Kerala. Eighty organic farmers were interviewed for the study. Eight motivating factors behind the shift to organic farming were identified: *a) High price of organic produce, b) Organic farming produces chemical free food, c) Organic farming reduces the environmental pollution, d) Organic farming lowers the cost of cultivation, e) Increasing domestic market for organic produce, f) High demand of organic produce in the export market, g) Financial support from government,* and *h) Organic farming enables group farming and marketing.*

Results and conclusion

The study on the factors that prompted farmer to shift from conventional farming to organic farming revealed four major factors. The first ranked among them was: *'organic farming reduces environmental pollution'*. The increasing concern about the conservation of their agro-ecosystem pushed farmers to shift to organic farming. The second set related to positive factors that pulled them towards organic farming: *'high price, chemical-free safe food'* and *'increasing domestic market for organic produce*'. The third set of factors was the *'lure of exports'* that prompted them for group farming and marketing of organic produce. The least ranked factor was the 'financial support from government for organic farming. The most significant factors behind the move from conventional farming to organic farming were the concern of farmers for reducing environmental pollution and restoring the agro-ecosystem (soils, water and the surroundings) from pesticide poison residues. It was an interesting finding that farmers had an awakening for ecological concerns, which was a 'push factor' for this shift to organic farming. On the other hand, the 'pull' factors like the positive aspects of organic farming that it would produce *chemical-free safe food* and fetch '*higher prices* in both *domestic* and *international markets'* were playing a significant role in pulling farmers towards shifting to organic farming. Both these 'push' and 'pull' factors may be exploited in devising strategies for promoting organic farming in the state.

IESHP/AFS2017/4042

Alternate Farming Systems: Non-pesticidal Management of Crops in Andhra Pradesh through Community Managed Sustainable Agriculture

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Keywords: Non-Pesticidal Management, NPM, Andhra Pradesh, CSA, SERP

Introduction

Responding to the ill effects of pesticides on agro-ecosystem and human health, a new alternative approach, IPM was initiated in paddy cultivation through farmers' field schools. Though IPM debates that pesticides are harmful, it still believes that pesticides are inevitable, at least as a last resort. An altogether new and unique alternate approach, which came to become popular as "Non-Pesticidal Management" (NPM), was developed by Centre for Sustainable Agriculture (CSA) where no chemical pesticides are used. NPM is a 'system that maintains the pest populations at levels below those causing economic injury, by raising healthy crops and managing the pest population dynamics in the crop ecosystem".

Material and methods

The study was conducted in two districts, Khammam (now in Telangana) and Anantapur of Andhra Pradesh. From each district two villages were selected. About sixty farmers were selected, who have been practicing NPM for the last three years. The data on actual costs and incomes were collected.

Results and conclusion

Over the period of 3 years, the farmers were able to come out of their debts by reducing the costs and reaping benefits of NPM practices, yet maintaining the crop yields. All the farmers of the village Ramachandrapuram, have taken back their mortgaged lands from money lenders and transformed their lives. A gist of the achievements is given here:

Profits earned by NPM farmers in the 1st year – 40 acres		
1. Investment difference gained per 1 acre	Rs. 3895×40=Rs.1,55,800	
2. Net income earned per 1 acre	Rs. 8095×40=Rs.3,23,800	
Profit earned in 2nd year – 120 acres of cotton under NPM practices		
1. Investment difference per 1 acre	Rs. 3895×120=Rs.4,67,400	
2. Net income earned per 1 acre	Rs. 9825×120=Rs.11,79,000	
Profit earned in 3rd year – 164 acres		
1. Investment difference per acre	Rs. 3895×164=Rs.6,38,700	
2. Net income (7q/acre) per acre	Rs. 5825×164=Rs.9,55,350	
Additional Benefits		
1. Amount of money saved in reduction in fertilizers use by using 48 truckloads of tank silt in 6 acres of land	Rs. 9,000/-	
2. Costs and income in cotton and paddy Total Fertility Management cost in NPM fields Total Pest Management Costs Net income gain in the crops	**Cotton** 1500/- 300/- 6000-8000/-	**Paddy** 1250/- 150-250/- 5000-6000/-
3. Land mortgaged by 68 farmers in 2004 Land taken back from them in 2005 Land taken back from them in 2006 Land leased in by 9 poor tribal landless families from resource-sick families since 2007	147 acres 62 acres 85.5 acres 15 acres	

IESHP/AFS2017/4043

Production Economics of Rapeseed-Mustard: Appropriate Choice of Marketing Channel for Enhancing Farmer's Income

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Keywords: Marketing channel, Break even analysis, Cost-benefit ratio

Introduction

Usually farmers sell their crop produce to local village merchants who give them ready cash. But farmers get exploited easily as the local village merchants offer very low prices. Thus farmers resort to distress sale and incur losses. In order to enhance farmer's income, farmers need to wait, verify prices from different marketing channels and assess their profits before actually selling their crop produce through any one marketing channel, that would help to get higher margins from consumer's price of rapeseed-mustard. Patel *et al.* (2012) reported that, in marketing of mustard crop, the producers could get up to 87.54 per cent of consumer's price. The wholesalers enjoyed the margin of 3.44 percent of consumer's price.

Material and methods

The study was carried out in Morena district in Madhya Pradesh. The market, *Krishi Upaj mandi,* Morena was selected on the basis of highest rapeseed-mustard arrivals. Rapeseed-mustard growing farmers, selected for the study, were divided in to three size groups, *viz.,* small (less than-2 ha), medium (2 to 4 ha) and large (more than 4 ha) based on their size of farm holdings. In each group, five farmers and a total of fifteen farmers from each village were selected at random, making a total of 225 cultivators in fifteen selected villages.

Results and conclusion

Farmers of the study villages were found to sell away their rapeseed/mustard to the village merchants, the marketing channel easily available locally some farmers were found to sell their crop produce at whole sale markets and some sold to oil processors directly. The results revealed that a large percentage of small farmers sold their rapeseed-mustard to village merchants at very low prices. Regarding producer's share in consumer rupee, it was highest at 96 percent in the third marketing channel (Producer-Processors), about 88 percent in the second channel (Producer-Wholesaler-Processors) and 85 percent in the first marketing channel (Producer-Village Merchant-Wholesaler-Processors), Price spread was Rs.250, Rs. 200 and Rs. 60 in the three marketing channels with maximum in lot marketing channel. The estimates of the input-output ratio show that rapeseed-mustard production was farmers: small, medium and large farmers. At overall cost, it gave as return of Rs. 3.94 on an investment of one rupee. Thus the cost-benefit ratio was 1:3.94, which was quite encouraging. Thus it can be concluded that rapeseed-mustard growers were able to reap better returns if they had sold their crop produce directly to oil processors.

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IESHP/AFS2017/4044

Methodology for Preparation of Fruit Rolls Fortified with Oat Flour and Optimization of Conditions for their Storage

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Keywords: Dehydration ratio, Free radical scavenging activity, Sensory evaluation

Introduction

Making fruit rolls can enhance the nutritive and functional value of the fruits. Fruit rolls were prepared from apple, peach, pear and persimmon fruit pulp with skin along with the oat flour to increase their nutritive and functional value.

Material and methods

The prepared fruit rolls were dried in dehydrator (60±2^{o}C) to 20 percent moisture contents with dehydration ratio of 14:1, 13:1, 11: 1 and 15: 1, respectively for apple-oat, peach-oat, pear-oat and persimmon-oat. The rolls were further analysed for different physico-chemical characteristics and the rolls prepared with oats showed maximum retention of ascorbic acid, total phenols, free radical scavenging activity, crude fibers, proteins and fats during storage under refrigerated conditions in laminated pouches.

Results and conclusion

Among different treatments, fruit-oat rolls (90:10) was found best on basis of sensory evaluation and among fruit rolls peach-oat rolls (6.67) performed best on basis of overall acceptability followed by apple-oat rolls (6.63). The developed rolls are rich source of phenolics corresponding to high free radical scavenging activity and thus the developed technology can be a profitable venture which can be commercially explored at industry level for the production of quality fruit rolls for ensuring better returns to the growers.

IESHP/AFS2017/4045

Utilization of Wild Apricot Oil for the Development of Apricot Massage Cream

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Keywords: Apricot massage cream, Botanical ingredients, Pharmaceutical industries

Introduction

Apricot oil extracted through cold extraction process at different extraction stages has been found to have non-significant effect on the quality parameters and has been reported for its anti-microbial, anti-septic, anti-oxidant, anti-bacterial and emollient characteristics. Oil found to be rich in Vitamin E content due to all these characteristics in the present study apricot oil has been used for the development of the different formulations of apricot massage cream having variable percentage of apricot oil. These formulations were evaluated on the basis of quality characteristics and the formulations having 10 per cent and 15 per cent oil were found better.

Material and methods

Oil phase (Apricot oil, stearic acid, shea butter, GMS and emulsifying wax) and water phase (Water, EDTA and glycerine) were heated separately till 70 degree celsius. Both phases were properly blended and then addition of cooled down phase (Methyl paraben, phenyl paraben and sodium benzoate. Blending was then continued till proper emulsion formed.
Five treatment formulations T_1 to T_5 with 5, 10, 15, 20 and 25 per cent oil were prepared.

Results and conclusion

The reference product was found to have pH 6.52 whereas different treatments T_1 to T_5 had pH of 6.42, 6.51, 6.61, 6.70 and 6.79, respectively. According to BIS, pH values should be 4 to 9 and all the values were found within the range. The moisture and residue matter for the reference product were observed 69.80 per cent and 30.20 per cent, respectively, but moisture content was 75.40 to 55.90 per cent and the residue matter from 24.60 to 44.10 per cent for the different treatments. Total residue matter should be atleast 10 per cent as per the BIS. Viscosity recorded for the reference product was 26560 cps whereas for different treatments were 21090, 28001, 37350, 44000 and 52400 cps. With the increase in oil per cent, increase in viscosity was found among the different treatments. The acceptable range for BIS for viscosity is 25000-39000cps. The spread ability was 4.15 cm for reference and was in the range of 4.500 to 2.900 for treatments. The decrease in spread ability was due to the increase in the viscosity of treatments. Total fatty matter and vitamin E content for reference was 14.50 per cent and 40.39 mg/100g respectively whereas the total fatty matter for different treatments was in the range of 12.50-17.90 per cent and vitamin E content was in range of 29.25 to 41.037 mg/100g. The 10 per cent of oil (T_2) and 15 per cent of oil (T_3) containing massage cream were found comparable with the BIS standards as well as reference product.

IESHP/AFS2017/4046

Varietal Influence on Post-Harvest Weight Loss and Bio-Chemical Changes Under Ambient Storage of Guava Fruits

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Keywords: Guava**,** L-ascorbic acid, Organoleptic, Post-harvest quality

Introduction

Guava (*Psidium guajava* L.) is one of the most important protective fruit in tropical parts of the world because of its medicinal and therapeutic properties, appealing taste and nutritive value (Tiwari *et al*. 2016). However, fresh guava has short shelf life of around one week owing to its high moisture content, which leads to post-harvest losses in guava to the tune of about 22% (Bons and Dhawan 2006). Various types of post-harvest methodologies are available but, as in guava peeling is not practiced before consumption generally, so most of these are not suited for this handsome fruit. A more convenient method is to select the better germplasm having superior post-harvest measures, better shelf life with least deterioration in quality.

Material and methods

The experiment was conducted at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi comprising five cultivars of guava *viz.,* Lucknow-49, Allahabad Safeda, Lalit, Shweta and Gorakh Bilas Pasand in complete randomized design with three replication. Ten n fruits are considered as a unit in each replication. Data on physiological weight loss (%), decay loss (%), ascorbic acid (mg/100g), titratable acidity (%), total soluble solids (°brix) and organoleptic acceptability were taken.

Results and conclusion

The cultivar Lucknow- 49 has maximum shelf life (8.30 days) with minimum deterioration in fruit weight, ascorbic acid, total soluble solids and titratable acidity. Organoleptic acceptability was also high in the same cultivar during 8 days of storage period. Acidity and TSS followed increasing trend, while ascorbic acid and organoleptic acceptability showed decreasing trend as experiment advances. On the basis of the findings, it may be concluded that Lucknow- 49 was superior among the cultivars, which was taken in experiment for their post-harvest shelf life and quality.

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Reaching the Unreached through Extension Teaching Methods

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Keywords: Awareness, Interest, Evaluation, Trial, Adoption

Introduction

Adoption of a farm technology is not an instant act, rather it is decision making process that takes places mainly five stages viz; Awareness, Interest, Evaluation, Trial and Adoption. Despite concerted efforts by the extension system, still a wide gap exists between the technology generated at the research station and its adoption by the farmers.

Extension methodology

In order to reach the farming community particularly residing in remote and far flung areas of the country, and extension workers needs to update his/her knowledge about the improved/ modern extension methods. So that the same can be properly utilized in the task of transfer of farm technology. Today's farmers is just like an entrepreneur who needs recent information on various aspects of agriculture and allied fields. In the present era of globalization, the farmers will have to transform themselves from mere producers in domestic markets to sellers/exporters in the global markets with focus on high productivity high quality produce and low cost of production. The revolution in information and communication technology has made this task very easy and hence, the technical information can now be provided quickly by the extension workers in a cost effective manner even without visiting the farmers personally. Various cost effective and extension methods like Expert System, E-mail, Internet Browsing, Audio-Video Conferencing, Kisan Call Centres, Agri-clinics, Agri-business centres, Community Radio, SATCOM Networks etc. have been discussed along with a conceptual model which may be quite useful for the effective and efficient transfer of farm technology to the man behind the plough.

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Effect of Ripening Stage, Slice Thickness and Drying Temperature on Quality of Freeze Dried Sapota Fruits

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Keywords: Freeze Drying, Sapota Slices

Introduction

The sapota is one of the important fruit crops of India. Ripening of sapota is uneven and problematic for supply-chain stakeholders. It ripens within 36-72h and have shelf-life upto 4-6 days, thus perishable. Sun-dried slices are not good in quality. Freeze-drying is considered to be the most efficient in maintaining original characteristics even after drying and rehydration. Factors affecting quality of freeze dried sapota slice are thickness and drying temperature. Correctly ripened fruits should be processed for best quality products.

Material and methods

An experiment was conducted to study the effect of ripening stages (D) – 4days, 5days and 6days; slice thickness (S)- 3mm, 5mm and 7mm; freeze drying temperatures (T)– 40°C, 50°C, 60°C and 70°C on quality of freeze dried fruit using RSM with factorial CRD analysis. Well mature sapota fruits were placed for ripening. At particular ripening stage, it was sliced and frozen. The frozen slices were shifted to freeze dryer for drying. Dried slices were analyzed for quality parameters as per standard methods.

Results and conclusion

The results indicated that, the TSS, total sugar and reducing sugar increased significantly from the value about 19.5 to 23°Brix, 15 to 20% and 8 – 10% whereas, fruit firmness and initial moisture content decreased from 5 to 1.5kgf/cm^2 and 87.8 to 86.3% respectively between 4 to 6 days of ripening respectively. The final moisture content as well as drying time of freeze dried sapota slices at lowest and highest points of predicted value near 4.3% and 5%, 5.4% and 6.2% and 7.0 and 8.0% as well as near 6h and 18h for sapota slice prepared from fruits utilized after 4, 5 and 6 days of ripening stage respectively. The freeze drying rate as well as recovery of sapota slice at lowest and highest designed points of predicted values near 400g/h and 1400g/h as well as about 12.7% to 14.7% for sapota slice prepared from fruits utilized after 4, 5 and 6 days of ripening stage respectively. The variations in drying parameter with regard to other two factors were observed to be less than 0.5%. The surface curvature and slope were observed to be same for all the level of factor (D). The freeze drying recovery was higher for ripe fruit compared to unripe fruits as result of sugar percentage. The colour and flavour score of freeze dried sapota slices increase from lowest to middle point of days of ripening stage and freeze drying temperature factors. The area for 8 score was highest for 50°C. The texture and overall acceptability score of freeze dried sapota slices increased with increase in freeze drying temperature and it was reflected by increase in the area for score 8. The maximum area was covered after 5days of ripening stage and the score reduce with increase in slice thickness except in (D). The overall acceptability was developed at 5 days of ripening stage with 3mm thickness slice which was dried at above 50°C.

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Utilization of Agri-horticultural Crops/Wastes for Making Dry Flowers and Value-Added Products for Employment Generation

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Keywords: Agri-horticultural crops, Dyeing, Dry flower, Value added products

Introduction

The 'dry flowers' or everlastings are rapidly gaining popularity for decoration since these are less expensive, long-lasting, eco-friendly and are available throughout the year. Apart from cultivated flower crops, a large number of native plants and agricultural crops/waste like maize, sesamum, linseed, wheat etc can be utilized for making dry flower products. The dried flowers do not require very large area for cultivation. It can be started by those farmers who have limited land holdings and can be a remunerative business for the unemployed youth, women folk and even the disabled persons. There is an urgent need to disseminate the dried flower technology among the common people so that their living standard could be raised and employment can be generated.

Material and methods

Various Agri-horticultural crops like Bajra, Sorghum, Maize, Coconut, Sponge gourd, Cotton pods, Leek, Alsi, Til, Citrus slices and Bael etc. can be used for making dry flower products. Dyeing provides the materials with a more uniform colour, long lasting quality and enhances the appearance of the material and increases the salability. Different types of dyes like fabric dyes, indicator dyes, food dyes and biocolours can be used to dye the flowers, leaves and grasses. Nowadays use of natural and organic colours for dyeing from the parts of dye yielding plants like from the peel of *Punica granatum* var nana (darhu), flowers of *Butea monosperma* (palash), *Indigofera* sp., roots of *Beta vulgaris* (beet root), leaves of *Impatiens balsamina* (gulmehndi*),* Arjun *(Terminalia arjuna),* Annato (*Bixa orellana*), Marigold (*Tagetes patula*) etc., then dried, powdered and colour was extracted by boiling the sample in water. Apart from these coffee, henna powder and curcuma can be also used. Colour from Lilium pollens are extracted with acetone.

Results and conclusion

Studies on the identification of suitable dyes for dyeing of agrihorticultural crops: Four different types of dyes were used for dyeing of Bajra like, indicator dyes, fabric dyes food dyes and biocolours were tested on various agricultural crops. It was found that fabric dyes like dark green, yellow, violet and pink were the best for dyeing of bajra followed by indicator dyes i.e brilliant green, eosin yellow, metanil yellow and crystal violet. Out of the biocolours dyeing with turmeric was quite satisfactory. Food dyes in case of bajra was not satisfactory at the time of colouring except yellow and orange food dyes. Among biocolours used only turmeric gave good results. Various types of value-added products like dry flower sticks, arrangements, bouquets, urns etc. were made out of the dried as well as dyed spikes. Food dyes had good quality but the colours fade very fast and retention is poor even after ten months. Among bio-colours, turmeric and lilium pollen are satisfactory, whereas other colours like henna powder, gulmehndi (wild henna), coffee, butea, punica, beet root are very poor in performance, thus cannot be recommended for dyeing.

Table 1: Effect of Dyeing with Various Dyes/Colours on *Pennisetum glaucum*

S.N	Type of dye	Colour intensity		Colour Absorption		Colour (RHS Colour Chart)	
		0 hours	After10 months	0 hours	After10 months	0 hours	After10 months
I	**Fabric dyes**						
1.	Dark Green	High	High	Good	Good	Green group 127A	Green group 127A
2.	Yellow	Very high	Very high	Excellent	Very good	Yellow group 12A	Yellow group 12A
3.	Orange	Low	Low	Poor	Poor	Yellow orange group 20A	Yellow orange group 20A
4.	Violet	Very high	High	Very Good	Good	Violet blue group 89A	Violet-blue group 89B
5.	Pink	Very high	Very high	Very good	Very good	Red-purple group 64A	Red-purple group 64A
6.	Red Maroon	Low	Low	Poor	Poor	Greyed Orange group 176A	Greyed Orange group 176A
II	**Food Dyes**						
1.	Orange	High	High	Medium	Medium	Orange red group 30A	Orange red group 30B
2.	Yellow	High	High	Good	Good	Yellow group 12A	Yellow group 12A
3.	Green	Medium	Medium	Medium	Medium	Yellow green group 144B	Yellow green group 144B
4.	Red	Low	Low	Poor	Poor	Greyed Purple group 187D	Red group 42B
III	**Indicators dyes**						
1.	Brilliant Green	Very High	Very high	Excellent	Good	Green group 126A	Green group 126B
2.	Eosin Yellow	Very High	Very high	Excellent	Good	Red group 41A	Orange red group 34A
3.	Methylene Blue	High	High	Medium	Medium	Blue group 1023A	Blue group 102A
4.	Crystal Violet	High	High	Good	Medium	Violet blue group 89A	Violet blue group 89 B
6.	Metanil Yellow	High	High	Good	Medium	Greyed Orange group 163A	Greyed Orange group 163B
8.	Methyl Orange	Low	Low	Poor	Poor	Greyed orange group 164C	Greyed orange group 164D
IV	**Biocolours**						
1.	Coffee	Low	Low	Poor	Poor	-	-
2.	Lilium with acetone	Low	Low	Poor	Poor	Yellow orange group 22A	Yellow orange group 22A
3.	Punica	Low	Low	Poor	Poor	Greyed orange group 165 B	Greyed orange group 165 B
4.	Turmeric	Medium	Medium	Medium	Medium	Yellow orange group 15A	Yellow orange group 15B

***** *Colour does not match to any of the colors of RHS Colour Chart*

Different Value Added Products like Pot pourries, dry flower sticks, flower arrangement, wall pictures from dried flowers, wall hangers, wall pictures, ornaments, dolls, rakhi, greeting cards and file covers can be prepared from dry flower.

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Economic Viability of Sustainable Farming Systems

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Keywords: Farm income, Livelihood, Farm resources

Introduction
In recent years, food security, livelihood security, water security as well as natural resources conservation and environment protection have emerged as major issues worldwide. Developing countries around the world are promoting sustainable development through sustainable agricultural practices, which will help them in addressing socio-economic as well as environmental issues simultaneously. Within the broad concept of sustainable agriculture, farming systems can be proved as viable approach in specific farming situation to address the problems of sustainable economic growth of Indian farming communities. This approach not only increases income and employment opportunity but protect the environment through recycling of the crop and animal wastes within the farm itself.

Material and methods
The entire Himachal Pradesh has been divided into four agro-climatic zones. Depending upon the availability of resources the zone-I (low hills sub-tropical) and zone-II (mid-hills sub-humid) were selected for the present study. Three – stage stratified random sampling technique was employed to select the sample. A sample of 160 respondent farmers was selected. The primary data were collected on well-designed pre-tested schedule by personal interview method, whereas, the secondary data were collected from various offices and publications. The primary data were collected from respondent farmers, progressive entrepreneurs, traders, scientists, veterinary officers, revenue officials and officers, other officials of Government of Himachal Pradesh. To achieve the objectives of the present study various simple mathematical and statistical tools were used.

Results and conclusion
The optimized resource-use enhances the farm income by employing them gainfully. It also reduces the disguised unemployment on the farms. The commercial crops if properly grown can give five to ten times more returns than cereals. Farmers attain food, nutritional and livelihood security by diversifying their farm business. The agricultural production being biological process is affected by physical, biological factors and uncertain market conditions. The physical factors include weather events, such as rainfall, temperature, humidity, evaporation, frost, hailstorms and strong winds. All these factors are responsible for the biological hazards like the incidence of diseases, attack of insect-pests and consequently uncertain market situations. Therefore, farmers experience sharp fluctuations in their income from season to season and year to year. The lack of know-how about such changes and fluctuations has adverse effect on production and marketing. The decisions for making optimal use of all farm resources are difficult, unless correct predictions of yields, prices and resource availability are made.

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Efficacy of Technology Module: New Varieties for Enhancing the Productivity of Wheat under Farmer FIRST Project

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Keywords: Farmer FIRST project, Wheat varieties, Cost benefit ratio

Introduction
Enhancing wheat productivity is the key objective of the Technology Module of introducing new wheat varieties among the selected farmer experiments of the villages of Palwal district in Haryana. The Farmer FIRST Programme (FFP) is an ICAR initiative to move beyond the production and productivity, to privilege the smallholder agriculture and complex, diverse and risk prone realities of majority of the farmers through enhancing farmers-scientists interface. The Farmer FIRST project enables farmers to experiment with new technology modules through continuous interaction with scientists throughout the crop period.

Material and methods
Farmer FIRST project was initiated in three villages: Katesara, Amarpur and Dadhotaof Palwal district of Haryana. Through rapport building and interviewing the farmers, few farmers were selected who have exhibited some research aptitude for conducting experiments in the villages. These farmer-experimenters were provided training and technical guidance on improved cultivation practices of wheat by the scientists of the Institute. Farmers were appraised of the scientific importance of the technologies being disseminated among them for enhancing wheat productivity. Scientists-farmer interactions took place many times during the crop season and adequate technical guidance was given at appropriate times. Here, comparisons were made between three new wheat varieties of IARI in farmers' fields. Growth parameters of the wheat and the yield data were recorded.

Results and conclusion
Scientist-farmer interface through the crop season was ensured for providing technical guidance. Sixty farmers were selected as farmer experiments to promote the technology module of introduce two new wheat varieties among the farmers. The results revealed that under timely sown irrigated conditions, HD 3086 performed better than the local check PBW 343. Under late sown restricted irrigation conditions, HD 3059 performed better than the local check HD 2285. The results revealed that the average yield of new wheat varieties was 52.40q/ha, whereas, under the farmer's practice, it was 43.66q/ha. The demonstrated plots recorded 20.02 per cent increase in yield over the farmer's practice. The cost-benefit ratio of improved technologies varied between 1:3.30 for HD 3086 and 1:2.95 for HD 3059. This may be due to higher yields obtained under improved technologies including new varieties compared to local check or farmer's practices. Thus the new varieties of wheat were better performance.

IESHP/AFS2017/4053

Managing Agri-business Enterprises for Increased Resource-Use Efficiency and Effectiveness: Key to Enhancing Farmers' Income

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Keywords: Agri-business Enterprise Management, Resource-use efficiency, Effectiveness

Introduction
A rural entrepreneur is someone who is prepared to take risks for self-betterment, but is also willing to give of himself for the community by staying and creating local wealth in rural society. Thus, a rural entrepreneur attempts to demonstrate, in varying degrees of success, the key attributes necessary to start and run a rural enterprise successfully. Most important among these key attributes are: risk taking ability, social achievement motivation, urge for excellence, organizing abilities, management skills, and a constant strive for growth and excellence. Success in enterprise is an outcome of the efforts put in by the entrepreneur in terms of running the enterprise efficiently. Hence managerial skills assume great importance.

Material and methods
This research investigation was conducted in one block each in West Delhi (Delhi), Sonepat, and Gurgaon districts (Haryana) of National Capital Region (NCR) of Delhi. Thirty villages were selected. Among the rural youth, about 33 successful entrepreneurs, and about 17 unsuccessful entrepreneurs were selected for this study from each block, through snowball sampling technique. About 20 different agri-business enterprises were selected for analyzing the managerial practices of rural entrepreneurs. Entrepreneurial success parameters were also recorded for all the rural entrepreneurs. Comparisons were drawn between successful and unsuccessful entrepreneurs on their management practices.

Results and conclusion
The successful entrepreneurs were practicing *strategic planning* process and had clear realistic goals for their enterprise; they resorted to *operational planning* activities to achieve both short term and long-term goals. But unsuccessful entrepreneurs were not aware of any planning. The successful entrepreneurs were practicing appropriate *decision-making* in their enterprises; they may have understood the significance of taking right decision at the right time in efficiently managing their enterprises. On the contrary, the unsuccessful entrepreneurs paid scant attention to decision making in managing their enterprises. The successful entrepreneurs were able to monitor the effectiveness of their planning, organizing and taking appropriate actions in their enterprises in order to realize the objectives of earning profits and running the enterprise well. They were also able to take necessary corrective actions to steer clear of any obstacles in reaching enterprise goals without getting derailed midway. The successful entrepreneurs were resorting to *book keeping* of the accounts of their enterprise for guiding them make appropriate decisions and improving efficiency. But unsuccessful entrepreneurs did not practice any book keeping of accounts. But unsuccessful entrepreneurs had a large gap in the financial management practice.

IESHP/AFS2017/4054

Effect of Honey bee (*Apis mellifera L.)* Migration on Colony Development and Honey Production

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Keywords: Colony migration, Honey production, *Varroa destructor* mite

Introduction

Bee keeping is an old industry in the state of Jammu and Kashmir and counts back to 1470 A.D. It offers great potentialities of bee-keeping due to its rich bee flora found in abundance in different agro-climatic regions. Kashmir in particular is known for its floral gaieties where numerous varieties of cultivated crops and wild plants bloom from early spring till late fall. This provides sufficient raw material (nectar and pollen) to the honey bees for production of honey and wax for industrial purposes. But due to severe winter in Kashmir, most of the bee-keepers from Kashmir valley migrate their colonies to sub-tropical region of Jammu and other parts of northern India. The adoption of migratory bee-keeping by some bee-keepers from Kashmir valley during the winter season has proved very successful. Therefore, keeping in view the popularity of migratory bee-keeping among the bee-keeping community, the present study was conducted to analyze the effect of migration of honey bee colonies on honey production and colony development.

Material and methods

During winter season, 500 colonies of *Apis mellifera* were migrated from SKUAST-Kashmir, Shalimar to sub-tropical region of Jammu at Miran Sahib and Purmandal during the year 2012-2013 and 2013-14 by the Research and Training Centre for Pollinators, Pollinizers and Pollination Management of SKUAST-K, Shalimar campus, Srinagar. Around 300 colonies were migrated to Miran Sahib and 200 colonies were migrated to Purmandal. The colonies were multiplied and the effect of migration on production of honey, bees wax and colony development was studied at the end of winter season.

Results and conclusion

The results revealed that an average of 32 kg honey/colony and 32.57 kg of bee-wax from the colonies was harvested at the place of migration in Miran Sahib Jammu and an average of 33.5 kg honey/colony and 33.75 kg of bee-wax from the colonies was harvested at the place of migration in Parmandal, Jammu. 500 colonies were transported and maintained at Miran Sahib Jammu and Purmandal, which increased to 921 in one migratory cycle. There was an average increase of 1.84 times. The total honey production from the sample lot of 500 colonies was 7952 kg. The average honey production per colony was 15.90 kg/colony. The results revealed that 80 per cent bee-colonies produced 15-20 kg honey per colony and the remained 20 per cent produced more then 10 kg per colony. Besides 33.75 kg of bee-wax was produced from the colonies. The results further revealed that we harvested still low production of honey and attributed this low production of honey to *Varroa destructor* mite. The results concluded that migration of bee-keeping with *A. mellifera* from Kashmir valley to Jammu region proved successful and economically viable to the bee-keepers.

IESHP/AFS2017/4055

Externalities of Horticulture based Land Use Systems in Kandi Areas

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Keywords: Horticulture, Carbon sequestration, Externalities

Introduction

Rainfed agriculture has many complexities and in the current scenario of climate change, the assessment of real economics of different land use systems become crucial prevailing in the rainfed areas. India is the second largest producer of fruits after China, contributing around 10 per cent share in global fruit production. The horticulture land based systems are prevailing in India in all the agro-climatic zones, including tropical, sub-tropical, intermediate and temperate. The rainfed areas known as *kandi* areas are mainly exists in subtropical zones, where majority of rains received during the monsoon period. The present paper attempts at assessing the externalities of horticulture based land use system to acknowledge the intangible role played by the fruit trees in these *kandi* areas.

Material and methods

Farms were selected in Kathua, Samba and Jammu districts, as the majority of *kandi* area of Jammu region of J&K state falls in these three districts. The vegetation under horticulture based land use system were studied and samples were collected to analyse the biomass and quantity of carbon sequestered in this particular land use system. In addition to the normal economic parameters like Net Present Value and Profitability index, net positive externalities were also estimated to find out the real economics of horticulture based land use system in *kandi* areas.

Results and conclusion

The major fruit trees found in the *kandi* areas include *Citrus sinensis, Grewia asiatica, Litchi chinensis, Mangifera indica, Phyllanthus emblica*, *Prunus persica, Psidium guajava* and *Ziziphus mauritiana.* The species wise total biomass, above and below ground carbon and total carbon sequestered is presented in Table 1. The horticulture based land use system in *kandi* areas possess net positive externalities which highlights the inherent fact of villages in these areas for having fruit trees alongwith traditional field crops required for sustenance.

Table 1: Value of Carbon Sequestered by Horticulture Land Use System In Rainfed Areas

Species	Total Biomass (Mg/ha)	Above Ground Carbon (Mg/ha)	Below Ground Carbon (Mg/ha)	Total Carbon sequestered (Mg/ha)	CO_2 equivalent	Positive Externalities (Rs.)
Citrus sinensis	3.603	1.053	0.647	1.700	6.239	20588.7
Grewia asiatica	1.229	0.425	0.157	0.582	2.136	7048.8
Litchi chinensis	11.220	3.225	2.014	5.239	19.227	63449.1
Mangifera indica	11.134	3.723	1.516	5.239	19.227	63449.1
Phyllanthus emblica	8.154	2.614	1.437	4.051	14.867	49061.1
Prunus persica	5.117	1.567	0.854	2.421	8.885	29320.5
Psidium guajava	7.091	2.536	0.776	3.311	12.151	40098.3
Ziziphus mauritiana	10.213	3.392	1.436	4.828	17.719	58472.7

IESHP/AFS2017/4056

Economics of Cropping System with Varietal Replacement for Mitigating Climate Change in Rainfed Areas

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Keywords: NDR-97, drought tolerant

Introduction

Said-Sohal village of district Kathua has been adopted by KVK Kathua to demonstrate and facilitate adoption of climate resilient technologies for sustaining and increasing agricultural productivity. The selected village is ecologically vulnerable to the vagaries of climate variability such as droughts. In the baseline survey, farmers of the village demands such rice varieties that are resistant to moisture stress and can yield well under drought conditions. Keeping, the farmers demand into consideration, Krishi Vigyan Kendra Kathua introduced NDR-97 variety of rice in the village under the NICRA intervention of drought tolerant and short duration varieties.

Material and methods

The data on yield and economics of different crops in the existing cropping system and newly system with introduced variety of NDR-97 were collected from demonstrated and nearby local plots to assess the economic impact of frontline demonstrations. 15 farmers who cultivated the new variety on 2.5 hectares of land, were interviewed for assessing the economic performance of new variety and its social impact. The yield of demonstrated and local plots was compared using Independent sample '*t*' test.

Results and conclusion

The NDR-97 variety of rice was introduced by KVK in Said-Sohal village of Kathua district. The main traits related to the introduced variety as perceived by the farmers of the village include short duration and less water requirement. The economic impact of the introduced variety of rice in comparison to the existing rice varieties has been presented in Table 1. Farmers are enthusiastic about the traits of the varieties.

Table 1: Descriptive Statistics of Paddy Yield

Particulars	Kharif 2015	
	FLD plots (NDR-97)	Local check (Jaya)
Area covered (ha)	15.00	-
Mean	30.40	20.20
Standard Error	0.57	1.27
Standard Deviation	2.20	4.92
Sample Variance	4.83	24.17
Kurtosis	-0.10	-1.15
Skewness	-0.50	0.48
Range	8.00	15.00
Minimum	26.00	14.00
Maximum	34.00	29.00
Count	15.00	15.00
C:B ratio	1.94	1.29
Difference in mean yield	10.20***	

IESHP/AFS2017/4057

Diversification through Vegetable Cultivation under Shah Nehar Command Area for Income Generation and Nutritional Security

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Keywords: Diversification, Socio-economic status

Introduction

The 45 km long Shah Nehar is the first canal irrigation project for hill areas in the country, which will deliver 2,000 cusec water to the fields. The Beas water from Talwara barrage will pass through tunnels and 12-km-long aqua-ducts of the Shah Nehar before reaching the fields. The canal has been designed to extend irrigation facilities to 93 villages of Indora and Fatehpur block, covering an area of 15,287 hectares. The present study is funded by the Shah Nahar Project, IPH Dept. of Govt. of HP with the aim to diversify the agriculture through vegetable cultivation to enhance the socio-economic status of the farmers of command area of Shah Nahar through the optimum use of the canal water.

Material and methods

A benchmark survey in command area of Shahnehar was conducted to know the socio-economic status of the farmers and the various problems faced by them in crop production during the first year of the project. 25 farmers were selected from the Shahnehar catchment area for the dissemination of technology pertaining to diversification of agriculture through vegetable cultivation.

Results and conclusion

From the survey it was found that most of the selected farmers were raising cereals and their socio-economic status was also low. So to enhance the socio-economic status selected farmers underwent training at RHR&TS, Jachh. Many field days were also organised in the area. In the trainings and field days, the seedlings of improved varieties/hybrids for high yield and disease resistance were distributed to the farmer. Demonstrations were laid on their fields for popularization of vegetable cultivation in the Shahnehar catchment area. These demonstrations were monitored from time to time and the problems pertaining to vegetable production were taken up and farmers were educated to grow vegetables on the scientific lines to enhance their nutritional security and to increase their income by utilizing water resources efficiently. Awareness was created to the other farmers of the area about importance of vegetable cultivation to improve their socio-economic and nutritional status.

Author Index


BAYER
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नेटिवो
मेरा वृद्धिमित्र
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NABARD

With best compliments from:

NATIONAL BANK FOR AGRICULTURE AND RURAL DEVELOPMENT

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MISSION:

Promotion of sustainable and equitable agriculture and rural development through effective credit support, related services, institution development and other innovative initiatives.

MAJOR ACTIVITIES

Credit Functions : Refinance for production credit (Short Term) and investment credit (Medium and Long Term) to eligible Banks and financing institutions Development Functions : To reinforce the credit functions and make credit more productive, development activities are being undertaken through

Research and Development Fund
Micro Finance Development and Equity Fund (MFDEF)
Financial Inclusion Fund (FIF)
Financial Inclusion Technology Fund (FITF)
Farm Innovation and Promotion Fund (FIPF)
Farmers' Technology Transfer Fund (FTTF)
Watershed Development Fund (WDF)
Rural Infrastructure Development Fund (RIDF)
Tribal Development Fund (TDF)
Cooperative Development Fund (CDF)
Rural Innovation Fund

Supervisory Functions: NABARD shares with RBI certain regulatory and supervisory functions in respect of Cooperative Banks and RRBs. Provides consultancy services relating to Agriculture & Rural Development (nabcons@vsnl.net)

Committed to Rural Prosperity

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