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Laser capture microdissection and its applications in plants

TESFAKIROS SEMERE • ATUL KUMAR
Received: May 25, 2016, Revised: October 12, 2016, Accepted: October 20, 2016

ABSTRACT Multicellular organisms consist of heterogeneous mixture of different cell types having distinct functions, morphology, physiology, and gene expression programs. This heterogeneity nature of tissues has been a challenge for studying the specific cell types independently and hence it was difficult to uncover the function of each cell type. For the effective analysis of specific cell types, the cell of interest needs to be isolated from neighboring cells or tissues. Even though this can be done using manual dissection, it has several limitations such as contamination and time consuming. To avoid the drawbacks this isolation is preferably performed using laser capture microdissection (LCM). LCM is a powerful tool for harvesting and subsequent molecular analysis of distinct cell populations under direct microscopic visualization. It has been applied for transcriptomics of several plant tissues including: transcriptional profiling of the Arabidopsis thaliana embryo and isolation of RNA from shoot apical meristem of Maize. Careful tissue preparations such as fixation, embedding, and sectioning are essential prerequisites for the success of LCM.

KEYWORDS Laser capture microdissection, fixation, embedding, transcriptional profiling

INTRODUCTION

Multi-cellular organisms, including plants have evolved as complex organisms and their growth and development is carried out in complex cellular environments (Kehr 2003, Day et al. 2005). The overall performance of an organism comes from the different distinct organs. An organ is also composed of different tissues having different cell types and each cell type expresses unique transcriptome (Schnable et al. 2004, Schad 2005, Schmid et al. 2012).

Literatures cited that plant tissue is a complex structure of heterogeneous mixture of different cell types having distinct functions, morphology, physiology, and gene expression programs (Murray 2007, Wang et al. 2012). This tissue heterogeneity has been a challenge for scientists desiring to study specific cell types (Morrogh 2007). Due to these challenges, earlier studies were focused on the whole organ. The analysis of whole tissue and/or organ sample is the average of all cell types in the sample (Kehr 2003, Murray 2007). In this case, the majority of cell types determine the result of the analysis. This introduces a bias as this analysis excludes the cell type specific differences. It can also mask particular cell types that may have biologically relevant functions. Generally, the heterogeneity nature of multicellular organisms’ tissue has been an obstacle for studying cell type specific profiling.

Gene expression analysis using total RNA of bulk tissue cannot assign specific messages to the particular cell types (Schmid et al. 2012). Therefore, cell type specific RNA expression profiling is crucial for a better understanding of the role of each distinct cell types. Besides, biologically important functions of cell types will not be masked. Hence, methods to dissect the specific cell types from the heterogeneous tissue are necessary.

Manual microdissection of tissue has been used for many years. This technique has several limitations
Pre-germinated seed treatment with soaking, heating, chilling and its integration for rice seed invigoration

SHAMBHOO PRASAD ● BIRENDRA PRASAD ● RAJ KUMAR SINGH
Received: February 06, 2016, Revised: November 14, 2016, Accepted: November 20, 2016

ABSTRACT A study of pre-germinated seed treatments with soaking, heating, chilling and its integration was conducted on two rice cultivar (viz. Prasad and Pant Sugandha Dhan-15) to explore the possibility of improvement in seed germination and seedling vigour under laboratory condition. The experiment comprised of six treatments and seeds were subjected with soaking, heating (40 °C), chilling (-20 °C), heating followed by chilling and chilling followed by heating after soaking for 24 h along with untreated control. Seed germination and subsequent seedling growth was greatly influenced by soaking, heating and chilling as indicated by statistically higher value of seed germination at first as well as final count and seedling vigour i.e. root, shoot and seedling length, fresh and dry weight of seedling, vigour index, relative growth index (RGI), germination index (GI) and mean daily germination (MDG). Soaking successfully integrated with heating followed by chilling and chilling followed by heating over untreated control for both the rice cultivars while, chilling solely had somewhat lower influence on rice seed invigoration.

KEYWORDS Soaking, heating, chilling, seed invigoration, rice

INTRODUCTION
Food shortage is one of the most serious global problems in this century and hence meets the expanding food demands of the rapid growing world population crop grain production will need to increase. Considering its highest cultivation area and amount of production amongst crops and being main source of calories for people, rice (Oryza sativa L.) is the most important staple food for about half of the human race. It ranks third after wheat and maize in terms worldwide production. Rice is a versatile as well as primary food of the Asians and over 85% of the rice production in this continent, that’s way it can be grown at the elevation of the more than 3000 m in the Himalayas and at sea level in the deltas of great rivers of Asia. Poor seedling establishment is one of the major yield limiting constraints both transplanted and direct seeded rice especially under stressful conditions (Du and Toun 2002). Use of high quality seed ensures better seedlings, which emerge rapidly, tolerate adverse abiotic conditions and resist diseases and pests.

Rapid and uniform crop stand is a prerequisite for better quality produce. If seed germinate erratically over long time, seedling growth will not be uniform and plants will mature over a wider period. Seed invigoration treatments are therefore developed to improve seed performance during germination and emergence (Prasad and Prasad 2011). The purpose of these treatments is to shorten the time between planting and emergence (Farooq et al. 2006). Farmers have been adopted traditional seed soaking before sowing the rice in nursery since decades but these results in poor germination and uneven nursery stand (Ahmad 1998, Prasad et al 2012). Heat treatment reduced germination time, synchronized germination, improved germination rate and increased the seedling stand in two cultivar of rice was also reported (Lee and Kim 2002). Emergence
Genetic diversity assessment of taro germplasm in Tarai region of Uttarakhand

Khushboo Kathayat ● ML Kushwaha ● Monisha Rawat ● Pooja Pandey
Received: July 27, 2016; Revised: November 14, 2016, Accepted: November 20, 2016

ABSTRACT

Taro (Colocasia esculenta (L.) is one of the important underground vegetable crops grown vegetatively in various parts of India as well as in Africa. But there are few standard cultivars available for commercial cultivation and local germplasms across various parts of the world have a lot of genetic variation. Therefore, forty five genotypes of taro were evaluated in Augmented Block Design with three checks accommodated in six blocks during March to October 2014 at the Vegetable Research Centre, GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand to assess the genetic diversity using principal component analysis and cluster analysis. Approximately 78.216% of variation was recorded due to first seven principal components on various genotypes. The genotypes were further subjected to Hierarchical cluster analysis that resulted into seven non-overlapping clusters. The maximum number of genotypes was included in cluster III. Cluster V was recorded to have highest mean for maximum traits under study. Therefore PA-41, PA-4 and PA-23 are used for developing high yielding taro varieties.

KEYWORDS

Taro, Colocasia, diversity, principal components, cluster, genotypes

INTRODUCTION

Taro (Colocasia esculenta (L.) Schott var. antiquorum) known as eddoe type or Arvi belongs to the monocotyledonous family Araceae. It is believed that the origin of domesticated taro is from ‘wild type’ C. esculenta var. aquatilis, which is from North East India or South East Asia (Matthews 1991). Cultivated ones are mostly diploid (2n=2x=28), although some triploids are found (2n=3x=42). It is a vegetatively propagated crop and cultivation is through the corms and cormels. It is grown widely in Uttar Pradesh, Bihar, Punjab, West Bengal, Assam, Uttarakhand, Orissa, Andhra Pradesh and Tamil Nadu. They are a good source of thiamine, riboflavin, iron, phosphorus, zinc and a very good source of vitamin B6, vitamin C, niacin, potassium, copper, and manganese. Despite its importance as a popular edible tuber crop, very little attention has been devoted to the genetic improvement of taro in Uttarakhand. At genotypic level and to assess relative contribution of different components to the total divergence both at intra and inter-cluster levels, genetic diversity is a useful tool for measuring the degree of divergence in a biological population (Jatasara and Paroda 1978). For estimation of diversity within the germplasm, several workers have postulated principal component analysis and clustering of genotypes (Smith et al. 1995). These techniques identify plant traits that help in characterization of the distinctness among selected genotypes. They are often extended to the classification of a population into groups of distinct orders based on similarities in one or more characters and thus guide in the choice of parents for hybridization (Nair et al. 1998).

Principal component analysis or simply PCA is a statistical procedure concerned with elucidating the covariance structure of a set of variables. In particular it allows us to identify the principal directions in which
Genetic variability in bacterial wilt resistant F\textsubscript{3} progenies of tomato

SANJAY CHADHA • ISHITA WALIA
Received: August 10, 2016, Revised: October 12, 2016, Accepted: October 15, 2016

ABSTRACT Fifteen bacterial wilt resistant F\textsubscript{3} progenies of tomato along with one bacterial wilt resistant standard check (Palam Pride) were studied for the extent of genetic variability with respect to fruit yield and contributing traits in mid hill conditions of Himachal Pradesh. To ascertain severity of the disease, two susceptible checks, Roma and Marglobe were planted at every alternate 11\textsuperscript{th} row in the experiment. Analysis of variance indicated sufficient amount of variability among the progenies for all the traits except plant survival. High estimates of PCV and GCV were exhibited by total fruits per plant and marketable fruits per plant. High heritability along with high genetic advance was observed for total fruits per plant, marketable fruits per plant and marketable yield per plant. High to moderate heritability coupled with high to moderate genetic advance indicated preponderance of additive gene action which implied that these traits could be improved by pure line selection. Whereas, recombination breeding will prove effective in improving the traits viz., days to first harvest, pericarp thickness, duration of fruit harvest and total soluble solids.

KEYWORDS Tomato, variability, heritability, genetic advance

INTRODUCTION
Tomato (Solanum lycopersicum L.), 2n=24, is one of the most popular and widely grown vegetables in the world. It is a versatile vegetable for culinary purpose. Ripe tomato fruit is consumed fresh as salad and utilized in the preparation of a wide range of processed products such as powder, puree, ketchup, sauce, soup, canned fruit. Unripe green fruits are used for preparation of pickles and chutney. Tomatoes are important source of lycopene (antioxidant), vitamin A, vitamin C and minerals (Singh et al. 2014). Tomato is extensively grown during summer-rainy season in hills. The summer-rainy season crop grown in lower and mid-hill pockets of the north-western hills fetches high prices being off-season crop of the plains. Bacterial wilt is one of the most important constraints in humid tropical and sub-tropical areas causing huge losses. Hence, identification and development of new improved disease resistant cultivars is very important to further boost up the production and productivity of the crop in wilt prone areas of Himachal Pradesh. In order to select superior genotypes, the knowledge regarding the extent of genetic variability with respect to fruit yield and component traits is highly desirable. Therefore, the present study was undertaken on 15 bacterial wilt resistant F\textsubscript{3} progenies of tomato along with one standard check to measure the extent of genetic variability.

MATERIALS AND METHODS
The experiment was laid out in highly bacterial wilt sick prone plots maintained at Vegetable Research Farm of CSK HPKV, Palampur, Himachal Pradesh, during summer-rainy season, 2015 in randomized block design (RBD) with three replications. The experimental material was comprised of 15 bacterial...
Genetic analysis of morpho-meteric traits in cowpea varieties

SHAMBHOO PRASAD ● JS VERMA
Received: December 2, 2016; Revised: December 22, 2016, Accepted: December 23, 2016

ABSTRACT Genetic components of variance were estimated for eighteen morpho-meteric traits of 28 released cowpea varieties, grown for three consecutive seasons at Pantnagar. Pooled analysis of variance showed significant difference among all the studied characters. Expected mean for next generation were higher than grand mean and selection intensity ranged from 6.83 to 100.61%. Maximum values for selection intensity was computed for plant height (100.61%), seed yield per plot (77.71%) and pod length (71.12%). Traits viz., plant height (41.01%), seed yield per plot (39.44%) and pod length (27.82%) had higher genotypic coefficient of variation while phenotypic coefficient of variation ranged from 7.01 to 44.13%. Higher magnitude of heritability coupled with moderate to high genetic advance was recorded for plant height (80.36%), pod length (93.77%, 55.49%), number of seed per pod (90.92%, 23.93%) and 100-seed weight (88.48%, 35.83%) indicating considerable variability present among experimental materials. Therefore, based on genetic parameters and breeding objectives, the suitable variety may be isolated and utilized as donor parent in the crossing nursery for development of an ideal variety with higher yield potential and better suitability under changing environmental conditions.

KEYWORDS Genetic component, GCV, PCV, heritability, genetic advance, cowpea

INTRODUCTION Pulses are integral component of Indian agriculture, not only being a cheap source of protein in vegetarian diet, but also because of their ability to fix atmospheric nitrogen in the soil. Ensuring nutritional security for increasing population and sustainable crop production are the major challenges in India. Among pulse crops, cowpea is important multi-use crop, used as vegetable, grain, forage, mulch, green manure and quick growing cover crop under a wide range of climatic conditions. Cowpea production is facing a number of biotic and abiotic constraints resulting into low grain and fodder yield per unit area. Even after number of varieties have been developed and released for better yield, these have been slow in getting to the farmers. Development of cultivars with early maturity, acceptable grain quality, resistance to diseases and pests is necessary to overcome the ever growing food shortage (Ehlers and Hall 1997). Therefore, there is need to generate more information on variability present among the existing varieties that used to broadening the gene pool of the crop for selection and development of more improved varieties not just in yield but with better nutritional values.

Information regarding genetic variability is a prerequisite for initiating any crop improvement programme and for adoption of appropriate selection techniques (Dhanwani et al. 2013) and extent of variability may be helpful to improve the yield by selecting the yield component characters because yield is a complex trait, whose manifestation depends on the component traits such as heritability (h²), genetic advance, genotypic and phenotypic coefficient of variability. Generally selection made on the basis of estimated heritability (h²) alone is likely to be misleading because estimates of heritability of traits are environment specific (Shimelis and Shiringani 2010) thus it becomes necessary to determine the other...
Effect of seed bio-priming on seed quality parameters of lentil under mid Himalayas

PANKAJ KUMAR • DEEPA KHULBE • BIREN德拉 PRASAD • SRINIVAS P • RAJENDRA PRASAD

Received: July 27, 2016; Revised: December 22, 2016, Accepted: December 25, 2016

ABSTRACT To formulate proper seed priming strategy, the response of four lentil varieties to seed bio-priming with Pant Bioagent-3 (Pseudomonas fluorescens + Trichoderma harzianum), Azotobacter sp. and Bavistin, in terms of field performance and seed quality was assessed. Seed bio-priming with Azotobacter formulation and Pant bioagent-3 significantly increased the field emergence (77.66 % and 71.66 % respectively), seed yield per plot. Germination and viability were improved through seed priming to 80 % and 88.66 % in DPL-62 with Azotobacter bio-priming. Vigour index improved to 18.8, 17.0 and 14.9 with bio-priming as compared to 10.13 in non-primed control in variety DPL-62. Significant improvement in the seed health was also observed in case of bio-primed seed. Seed discoloration reduced to the level of 12.33 %, in Kali Masoor with Pant Bioagent-3 bio-priming, while least seed infection (11.66 %) was in fungicide (Bavistin) seed treatment for DPL-62. Seed bio-priming improved seed health, in addition to enhancing the seed quality.

KEYWORDS Bio-priming, lentil, Azotobacter, Pant Bioagent-3, seed quality, hill agriculture

INTRODUCTION Lentil (Lens culinaris L. Medik), one of the oldest food legumes known to the mankind, is rich in carbohydrates, fibres and proteins. The crop is cultivated in several countries including India especially in semi-arid regions of the world (Masood et al. 1993). India ranks second in lentil production after Canada. In India, Uttar Pradesh accounts for the maximum area and contributes around 45 % of the country’s production. Due to the climatic suitability of the hill region, lentil is an important Rabi season crop for hill agriculture of the country where it is generally cultivated as mixed crop with wheat. The extensive tap root system makes it moderately drought resistant to thrive on a well-drained soil under rainfed conditions of the hills. Hence, it can be grown successfully on un-irrigated land besides adding nutrients to the soil being a leguminous crop. There is enormous scope of promoting lentil cultivation in mid-hills of Uttarakhand. Area under lentil cultivation in Uttarakhand was 12,000 ha with average productivity of 883 kg/ha in the year 2011-12 (Anonymous 2016). However, being a crop of rainfed condition and due to poor productivity, lentil still remains largely neglected in hill regions. Being the only pulse crop in vast area in mid-hills during Rabi season, there is a need to promote and improve its cultivation in the region. Low yields are suspected to be the result of poor seed quality, poor germination, establishment and growth, especially during moisture stress during initial growth period. Usage of untreated seeds makes them vulnerable to seed and soil borne fungi particularly those causing root rot and wilt (Khare 1996). To overcome these problems, seed bio-priming can be a promising solution to fortify and protect the seed during initial growth phase. Uttarakhand being an organic state discourages use of chemical fungicides.
Evaluation of lilium cultivars for suitability under low hill conditions of Himachal Pradesh

RESHMA NEGI ● KUMUD JARIAL ● RS JARIAL ● SUNIL KUMAR ● SR DHIMAN
Received: July 2, 2016; Revised: November 12, 2016, Accepted: November 20, 2016

ABSTRACT Studies were conducted with four cultivars of lilium namely, Pollyana, Alliana, Toscana and Grand Paradiso to assess their performance with respect to growth and flowering to find out suitable cultivar for low hills of Himachal Pradesh under natural growing conditions. The findings revealed that among different cultivars, tallest plants with maximum leaf number were obtained in cvs. Pollyana and Alliana. The largest flower of cv. Pollyana exhibited maximum flower diameter (18.36 cm) significantly followed by Alliana (16.00 cm). However, minimum flower diameter was observed in cultivar Toscana (12.33 cm). Statistically more number of flowers per plant was observed in cultivar Pollyana (10.60) and minimum in cultivar Grand Paradiso (4.63). The duration of flowering was recorded significantly higher in cultivar Pollyana (15.00) followed by Alliana. In all, cv. Pollyana was found to perform best under subtropical conditions of the area followed by cv. Alliana and is suitable for cultivation under low hills of state.

KEYWORDS Bulbs, cut flower, lilium, Pollyana, sub tropical zone

INTRODUCTION Lilium is one of the most important flowering geophytes of the world. The genus Lilium comprises of many species and these are divided into seven sections. Northern hemisphere mainly Asia, North America and Europe, especially China, Nepal, Korea and Japan are the gene centres of this genus around the world. Lilium is a perennial ornamental crop belonging to Liliaceae and has great ornamental, medicinal and edible value. It is being cultivated for centuries as an ornamental plant due to its importance in production and commercialization of cut flower in the international market. Due to its size, beauty and longevity, Lilium is one of the most superior cut flowers in the world. Due to their large and attractive flowers having capacity to rehydrate after a long transportation, popularity of lilium is gaining momentum in our country. Lilium is incredibly attractive wonderful ornamental plant with varied uses and grown in border or planted in lines along formal paths, beds, and pots and are excellent cut flowers of magnificent appearance and outstanding range of colour, fragrance and adaptability to several environmental conditions (Bahr and Compton 2004). Lilium deserves to be called the “Aristocrat” of the plant world. Lilies can be used for informal planting in grassland or among orchard trees, along crocuses, bluebells and tulip to create flower meadow. The pointed leaves are stark green in colour and provide exciting contrast to the bright, flamboyant blooms. Lilium is native to Northern Hemisphere including 100 species (McRae 1998). Earlier, its cultivation was restricted to temperate zone but now with the efforts of researchers, it is being grown successfully in plains too. There is marked difference in desired plant heights at the time of flowering, total number of marketable flowers, spike length and several other qualitative and quantitative parameters in various cultivars of Lilium. There is a great demand of this flower but people of
Effect of sucrose and aluminium sulphate on postharvest life of lilium cv. Monarch

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ABSTRACT In this study, effect of sucrose and aluminium sulphate on prolonging vase life and postharvest quality of lilium was investigated. Lilium flowers cv. Monarch after harvest were kept in vase solutions containing sucrose (2 %) or aluminium sulphate (100 ppm or 200 ppm) alone or in combination. While, control flowers were kept in distilled water. Results indicated that combination treatment of aluminium sulphate (200 ppm) and sucrose (2 %) was highly effective in extending vase life of lilium up to 12.8 days compared to control (9.5 days). Uptake of water by these flowers was also recorded maximum (37.67 ml) than other treatments. Flowers kept in vase solution containing aluminium sulphate (200 ppm) had the maximum fresh weight of 42.65 g while, maximum withering weight (21.81 g) was recorded in flowers treated with sucrose (2 %) + aluminium sulphate (100 ppm). The combination treatment of sucrose 2 % and aluminium sulphate 200 ppm also delayed the opening of first and second flowers by 2.33 and 3 days, respectively than control. The flower longevity and diameter of opened flowers were also recorded highest by this treatment. Conclusively, combination treatment of sucrose (2 %) and aluminium sulphate (200 ppm) was found highly effective in preserving quality and extending vase life of lilium during postharvest storage.

KEYWORDS Lilium, postharvest, vase life, sucrose, aluminium sulphate

INTRODUCTION Lilium is one of the important ornamental bulbous plant commercially grown for cut flower production in the world (Singh 2014). However, owing to highly perishable in nature, the cut inflorescence of lilium has a limited postharvest life of 10 days. The vase life of lilium is highly dependent on the carbohydrate level of the inflorescence at the time of harvest. Following harvest, there exist a competition for stored food reserve between the buds and open flowers. It has been reported that removal of floral buds from lilium inflorescence increased the vase life of open flowers that are remain attached (van der Meulen-Muisers et al. 1995). This suggests that carbohydrates are one of the major limiting factor determining the vase life of lilium. In addition to this, it is well documented that postharvest life of cut flowers is limited owing to accumulation of microorganisms in vase solutions and flower stems (de Witte and van Doorn 1988, van Doorn et al. 1989). During postharvest storage of cut flowers, microorganisms enter through stem and block the xylem vessel primarily due to production of extracellular polysaccharides and also debris from dead microorganisms, thereby reduces the water uptake by flowers (van Doorn 1997, 2012). Reduced water supply along with continuous transpiration by the flowers results reduced turgor pressure in rapid senescence of cut flowers. Therefore, inclusion of carbohydrate as well as antimicrobial compound in vase solution is recommended to reduce the bacterial proliferation and extend vase life of cut flowers.

Aluminium sulphate (Al₂(SO₄)₃), an antimicrobial compound has been recommended in commercial preservative solutions for maintaining vase life of several cut flowers (Liao et al. 2001, Ichimura et al. 2006). Aluminium sulphate acidifies vase solution, diminishes bacterial proliferation and enhances water uptake. Diminished water movement from the vase solution to different parts of the flower stem cause
ABSTRACT The present investigation was carried out at the experimental farm of the Department of Floriculture and Landscape Architecture of Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan. The investigations were carried out on 4 spray commercial cultivars i.e. ‘Surf’, ‘Nanako’, ‘Ajay’ and ‘White Bouquet’ of chrysanthemum. These cultivars were planted on 9 planting dates at an interval of 15 days starting from April 9 to August 7. Significant difference was obtained among spray the cultivars for all vegetative and floral parameters. Though, successful flowering in spray type cultivars of chrysanthemum included in the studies was obtained in all the planting dates, however, later plantings resulted in cut stems of shorter length. Among spray types, ‘Surf’ should be planted before July 8, ‘Nanako’ and ‘White Bouquet’ before June 8 and ‘Ajay’ before July for producing marketable cut stems. With the help of planting dates flowering of these cultivars under Solan - Nauni conditions can be regulated from September 10 to November 1 i.e. for 52 days.

KEYWORDS Flower regulation, Chrysanthemum, Planting dates, Growth, Flowering

INTRODUCTION Chrysanthemum (Dendranthema grandiflora Tzvelev), popularly known as ‘Guldaudi’ in India and ‘Glory of the East’ or ‘Mum’ in USA, is one among the top cut flowers and pot plants of the world. In addition, its flowers are also used for making garlands, venis, gazras and religious offerings. It is native to northern hemisphere, chiefly Europe and Asia and belongs to the family Asteraceae (Anderson 1987). The varied Indian agro climatic conditions are highly suitable for its commercial cultivation and as a result it is being grown almost in every state.

In Himachal Pradesh, it is cultivated on an area of 315.31 ha out of 913.79 ha total area under floriculture in the state (Anonymous 2013). Light, temperature and relative humidity are the most important limiting factors for plant growth and development. Adverse effect of these climatic factors may lead to low yields or complete failure of the crop. Hence, the effect of date of planting on growth and development in chrysanthemum is very important for commercial cultivation. Because of varied agro climatic conditions, its time of planting in hills is different than the plains. Under mid hill conditions of Himachal Pradesh it is generally planted in the first fortnight of June and due to nature of flowering under short day conditions, flowers of one or the other cultivar(s) are often seen in the market from October to December months, however, flower availability of particular commercial cultivar(s) is restricted only to 10-15 days. Preliminary studies have shown that different cultivars of chrysanthemum behave differently for their growth and flowering parameters due to variation in the planting time, even though it is a short day plant. Hence, keeping these facts in view, the possibility of supplying...
Effect of collection season, type and length of explant on callus induction and its survival in peach

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ABSTRACT It takes 5-6 weeks to complete callus formation over callus surface in peach. During the course of investigations effect of explants collection season, type and length of explants for callusing in peach were standardized. Among various combinations best response in terms of maximum callus induction (97.78 %) was noted in spring x internodal segments x 0.5 cm length of explants closely followed by (95.55 %) in spring x leaf disc x 0.5 cm length of explants however maximum callus culture survival (100 %) was noted in spring x leaf disc as well as in internodal segments x 0.5 cm length of explants. Observations on callus morphology indicate that the leaf disc explants collected during winter season formed white, watery type callus with poor callus growth while no callus formation was noticed in internodal segments in winter season. However, yellowish green, friable type callus with excellent growth was observed during spring season in leaf disc and green colour callus along with compact callus type were observed with internodal segment. During summer season brown colour callus with friable type were noticed in leaf disc explants with good callus growth and whitish green colour callus with semi-compact type were observed in internodal segment explants along with excellent callus growth.

KEYWORDS Callus induction, callus culture survival, callus morphology, peach

INTRODUCTION

Peach (Prunus persica L. Batsch) is one of the most important temperate fruit crops of the world. It belongs to the family Rosaceae and subfamily Prunoideae. Peach is one of the most widely consumed fruits in the world, but its recalcitrance in many biotechnological processes has hindered the advancement of in vitro techniques. For most purposes, in vitro callus establishment is important as an intermediate step in peach biotechnology. Most of the advances made in peach have used embryo-derived explants. The main disadvantage of developing a protocol from seed-derived material is that each genotype is unique and not a clone of the parent (Abbott et al. 2008).

Callus is an actively-dividing non-organized mass of undifferentiated and differentiated cells often developing either from injury (wounding) or in tissue culture in the presence of growth regulators. Explants from both mature and immature organs can be induced to form callus. Callus tissue from different plant species may be different in structure and growth habit: white or coloured, soft (watery) or hard, friable (easy to separate into cells) or compact. The callus growth within a plant species is dependent on various factors such as the original position of the explants within the plant, and the growth condition. Although, the callus remains unorganized, with increasing growth, some kinds of specialized cells may be associated with centres of the morphogenesis, which can give rise to organs such as roots, shoots and embryos (Chawla 2003). Callus is initiating by placing small pieces of explants on a growth medium under sterile condition in vitro. The nature of growth regulator treatment has a
Effect of plant extracts on hatching and mortality of root-knot nematode

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ABSTRACT Root-knot nematode (Meloidogyne spp.) is an important pest of vegetables. Overall, 5% global yield losses are guessed due to root-knot nematode only, which may be much higher in tropics and sub-tropics. Experiments were carried out to study the nematicidal effect of different plant extracts namely neem (Azadirachta indica) seed kernel, neem leaf, neem cake, neem oil, marigold (Tagetes erecta), aak (Calotropis gigantea) and carbofuran on hatching and mortality of M. incognita larvae under laboratory conditions. Extracts of all six plants and one market chemical carbofuran showed toxic effect against M. incognita at varying degree. Mortality and hatching inhibition of M. incognita were directly proportional to the concentration of plant extracts and exposure period to each extract. Among all plant extracts, neem seed kernel showed most inhibitory effect followed by neem cake, aak, neem oil, marigold and neem leaf, respectively.

KEYWORDS Azadirachta indica, Tagetes erecta, Calotropis gigantea, Meloidogyne incognita, mortality, hatching, alcoholic extracts

INTRODUCTION
The root-knot nematodes (Meloidogyne spp) are one of the important plant parasitic nematodes that attack vegetable crops worldwide and reduce the yield and the quality of vegetables. The genera Meloidogyne contains more than seventy described species, out of which four species (M. arenarea, M. hapla, M. incognita and M. javanica) are responsible for 95% of infestation in vegetable crops (Sasser and Carter 1985). They are capable of causing severe damage to a wide range of crops, particularly vegetables, resulting dramatic yield loss mainly in tropical and subtropical agriculture. Among all four species of root-knot nematode, M. incognita is widespread and most destructive species (Wondirad and Kifle 2000). Studies have shown that root knot nematode, can cause yield loss up to 85% only in tomato (Sasser 1979, Tayler and Sasser 1978). Unlike other disease causing organisms, nematodes are more challenging to control because they live in soil and cannot easily be seen by naked eyes (Mai 1977). The losses caused by nematodes can be managed by soil fumigation, use of nematicides and by using resistant or non-host plants. Most of nematicides have tended to be rather toxic or volatile, with poor target specificity and harmful to human or environmental safety. The high cost of application of nematicides to manage the nematode and their possible detrimental effect on human as well as animal health and the environment has promoted the search for alternative such as management methods use of botanical products.

A variety of plant products has been evaluated to manage plant parasitic nematodes (Chitwood 2002). In addition to their suppressive effect on nematode density, organic amendments with antagonistic plants improve soil texture, increase water holding capacity, supply of nutrients to deficient soil and stimulate...
Development and validation of IPM technology for ginger in Garhwal region of Uttarakhand

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Received: December 22, 2015; Revised: January 21, 2016, Accepted: January 25, 2016

ABSTRACT Intensive survey was conducted in different villages of Tehri district of Uttarakhand to identify the major ginger growing areas, where insect pests and diseases are major problem, to validate the IPM module under field conditions. Consequently, two villages i.e. Pali and Gaind were selected where, rhizome rot, leaf spot, white-grub and rhizome maggot were posing serious threat to ginger cultivation were identified. Therefore, an IPM module was formulated for existing pests problems based on the available control measures in literature against these pests which was further disseminated to the farmers through conductance of demonstrations at the farmers’ field in Tehri-Garhwal area. The results indicated that the IPM program provided 48.19, 63.94, 52.09 and 57.82 % control of rhizome rot, leaf spot, white grub and rhizome maggots respectively, over non-IPM practice. Analysis of cost benefit ratio of IPM practice revealed that there was 32.82 % increase in yield with net return of Rs. 92.04 thousand per hectare and a B:C ratio of 2.15 over Non-IPM practice. Over all study revealed that the ginger production under IPM situation proved comparatively more economically viable in terms of losses decreased by suppression of pest.

KEYWORDS IPM, ginger, rhizome rot, leaf spot, rhizome maggot, white-grub

INTRODUCTION Ginger (Zingiber officinale Roscoe) is the most common spice of family Zingiberaceae and it is cultivated throughout tropical and subtropical regions (Kavitha and Thomas 2008). Ginger is widely used in food, beverage, confectionary and also used as medicine (Singh 2011). India is a leading producer of ginger in the world with production of 6.55 lakh tonnes of the ginger on an area of 1.33 lakh ha in 2013-14. Among various states, Uttarakhand occupied 2360 ha with productivity of 9.93 tonnes/ha which is quite low (Anonymous 2014). The reason of low productivity seems to be continuous use of degenerated seed which is prone to various diseases. Although foliar disease like; leaf spot (Phyllosticta zingiberi) and storage rot caused by saprophytic fungi and bacteria have been recorded in ginger (Dake 1995) but rhizome rot is very important in view of severe crop losses of 50-90 % (Stirling et al. 2009) and also affecting quality of rhizomes. Generally, the term rhizome rot is used for all the diseases affecting the rhizome irrespective of the pathogens involved which result in the partial or complete rotting of the rhizomes. It is caused by multitude of pathogens such as Pythium spp., Fusarium spp., Sclerotium rolfsii, Rhizoctonia solani, andRalstonia solanacearum (Singh et al. 2012, Tripathi 2014) either alone or in combination and it is enhanced by the presence of nematodes (Meloidogyne sp., Radopholus similis etc.) in the soil (Debnath et al. 2010, Turaganivalu 2013). The rotten parts sometimes attract dipteran flies which further hasten the rotting process (Shukla and Gupta 2015). Farmers in Uttarakhand store ginger rhizomes in ground pits for future use of sowing and marketing. The rhizomes are severely affected due to storage rhizome rot rendering
Modelling flowering time of rhododendron

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ABSTRACT Plant phenology, primarily affected by temperature and photoperiod, is a useful indicator to study the effects of climate change. Even though, it is a proven fact that climate change has affected the phenology of a wide range of species, but degree of impact varies across the species. It is very important to understand the sequence and timing of developmental stages (phenological events) such as bud development and flowering time in response to change in environmental conditions. Along with the identity of being a national flower of Nepal, the beauty of the rhododendron flower welcomes thousands of foreign tourist every year. Non uniformity in flowering time of rhododendron in recent years across the region is commonly expressed by local people and also reported in recent local news. To understand the flowering time behavior of rhododendron a flowering time model was developed in this study. The good agreement between observed and simulated flowering time during the calibration process showed that the developed model has the potential for predicting flowering time of Rhododendron arboreum in response to temperature and photoperiod. Simulation results (Late flowering in higher elevation and early in lower elevation) showed that there exists a linear relationship between altitude and flower onset time of rhododendron in Nepal. In addition, flowering time prediction in response to future climate data showed that phenology of rhododendron is going to shift early as the year advances.

KEYWORDS Rhododendron, climate change, modelling, phenology

INTRODUCTION

Global climate change (especially warming) is realized as a primary factor responsible for shifting timing of phenological events of plant species throughout the world (Menzel et al. 2006, Root et al. 2003, Ibanez et al. 2010, Lamsal and Amgain 2010). This change in climate is going to be very rapid in future. Global CO₂ level in the atmosphere will be doubled by the year 2100 and global mean temperature will rise by 1.4 to 5°C. Most importantly, it is predicted that impacts of global climate change will be more pronounced in higher altitude (Beniston 2003).

The relationship between environmental factors and the sequence and timing of developmental stages of any plant species is known as phenology (McMaster et al. 2011). Phenology is realized as a very useful indicator and considered one of the possible approaches to study the effects of climate change as it combines the climate factors over a long period of time (Ranjitkar 2013). Almost every plant is adapted to annual season cycles which are determined by seasonal atmospheric changes (Shah et al. 2014). Plant phenology is primarily affected by temperature and photoperiod along with soil moisture, precipitation, nutrient etc. Nowadays, it is a proven fact that climate change has affected the phenology of a wide range of species, but degree of impact varies across the species. It is very important to understand the sequence and timing of developmental stages (phenological events) such as bud development and flowering time in response to change in environmental conditions. This is because it will give insight into how much a species should shift given the changes in its environment (Visser and Both 2005).

In Nepal, altitude and temperature vary along with latitude. Higher elevation and lower temperature are associated with higher latitude and lower elevation and warm temperature with lower latitude. Air temperature in mountain regions decreases with a lapse rate of
Assessment of water quality parameters of Lake Chamo - implications for freshwater fishes, Gamo Gofa Zone, Southern Ethiopia

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ABSTRACT Water quality determinants are important indicators for monitoring changes in physical, chemical and biological properties of aquatic ecosystems, and are excellent sentinels for demonstrating linkages between aquatic and terrestrial ecosystems. In this study triplicates of water samples were collected from onshore and offshore locations in Lake Chamo, and analysed for surface water temperature, dissolved oxygen, pH, biological oxygen demand, suspended solids, salinity, alkalinity, major nutrients and phytoplankton biomass during the study period. The main objective of the study was to evaluate the conservation status of Lake Chamo by comparing results of present study with the recommended standards for warm freshwater fishes. The study showed mixed outcomes where results for most of the variables demonstrated favourable conditions whilst results for suspended solids, turbidity, sechi depth, conductivity and salinity revealed potentially threatening environment for fishes. Increasing vegetation cover and improving buffering capacity of wetlands circumscribing Lake Chamo are recommended as an alternative solution to downscale the effects of outlying variables to sustain production and productivity of fishes in Lake Chamo.

KEYWORDS Water quality, Lake Chamo, fishes, assessment

INTRODUCTION
Ethiopia is naturally gifted with water resources including lakes particularly within the middle and South-Ethiopia Rift Valley systems. Most of them are highly productive and contain diverse populations of indigenous fishes that considerably contribute to local and national economy (Reyntjens 1998, Tudorancea and Taylor 2002). These lakes and their associated wetland ecosystems are important habitats for numerous types of plant and animal communities including hippopotamus, crocodiles and migratory birds. However water quality parameters particularly salinity and turbidity showed increasing trends over the last few decades due to improper human activities within their catchments leading to declining fish production.

Lake Chamo, which is reckoned to be one of the most productive lakes in the South Ethiopian Rift Valley systems, is not an exception to severe impacts of anthropogenic activities within its catchment (Eyasu 2004). Studies showed that Lake Chamo is characterized as alkaline lake with sodium, carbonates and bicarbonate, and chloride ions dominating ionic rations (Kebede and Willen 1996). The lake was also known for its immense phytoplankton, zooplankton and fish composition and diversity compared to other lakes within same rift system such as Lake Abaya. Phytoplankton community is dominated by different species of cyanophyceae, chlorophyceae and bacillariophyceae, while piscifuna communities were mainly represented by economically important species such as Oreochromis niloticus, Lates niloticus, Labeo horie, Barbus bynni, Clarias gariepinus and Bagrus docmak (Tefera 1993). Nonetheless the lake and its resources, particularly fish resources, are increasingly threatened by overfishing and water pollution arising from population pressure and weak law enforcement.
Factors influencing small holders’ participation in dairy cooperatives

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ABSTRACT A study was carried out in Udham Singh Nagar and Almora districts of Uttarakhand to ascertain the milk marketing pattern, factor influencing cooperative membership and proportion of milk output sold. Logit model was employed to identify the significant factors influencing cooperative membership, while multivariate linear regression equation was fitted to identify the factors influencing proportion of output sold by farmers. The findings of the study revealed that in the region having cooperative network, Dairy Cooperative Society (DCS) was the predominant marketing agency. In the region outside the milk route of dairy cooperative network, middlemen were the predominant agency in the plains, while, in hills, milk producer sold to village consumers. Distance to market and non-farm income significantly influenced cooperative membership. Landholding had positive influence on cooperative membership in plains. Price received for milk exerted negative influence on proportion of output sold, implying that households in plains which received lower price for milk sold a greater proportion of milk produced so as to compensate for lower price with higher volume and thus get higher returns.

KEYWORDS Cooperative membership, cooperative network, marketed surplus

INTRODUCTION Livestock sector in India has experienced phenomenal growth during the last few decades. It is long being argued that growth in livestock sector has more potential to reduce poverty than a similar growth in crop sector (Birthal and Taneja 2006). Despite rapid expansion of production and inherent potential in this sector, there is an apprehension whether small holder milk producers can take advantage of the emerging opportunities. One of the necessary conditions for farmers to reap economic benefit from this sector is the provision of assured marketing outlets that are sufficiently remunerative to them. In India, inability of smallholder producers to access markets is one of the major limitations in harnessing opportunities in livestock production.

Dairy cooperatives have played a key role in India in providing small producer households a remunerative and sustainable market. Cooperative systems have long been recognized as a potential catalyst for stimulating entry into the market and promoting growth in production and consumption (Ashalatha et al. 2004). Network of dairy cooperatives has expended considerably since the launch of operation flood programme.

In spite of potential inherent in dairy cooperatives to bring smallholder producers within the organised fold and effectively link them to markets, performance and impact of cooperatives have not been uniform across all regions of the country. Milk procurement through cooperatives still remains low. Despite a considerable horizontal expansion of district cooperative societies (DCS), no significant change has occurred in the average size and scale of the village level dairy cooperatives. Similarly, milk procurement per member has hardly ever exceeded 550kg/year (Birthal and Taneja 2006). To enhance small holder participation in cooperatives, it is imperative to focus
Impact of income and education on the selection of milk and milk products in Nagaon, Assam

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ABSTRACT Selection and consumption patterns of milk and milk products i.e. powdered milk, butter, ghee, paneer and curd are different in different areas. These variations are sometimes assigned to demographic characteristics like age, sex, religion, income etc. Besides these, sometimes personal preferences also play an important role in decision making of the consumers. This study was undertaken in the Khagarijan Development Block of Nagaon district of Assam to analyse the impact of Income and Education on the selection of Milk and milk products. Descriptive research was conducted by preparing a structured questionnaire by selecting 120 households both including rural and urban areas of Nagaon. Random sampling was used to select the 120 households. It was found that there was no impact of education on selection of powder milk, butter, ghee and curd but there is an impact of education in selection of paneer in the study area. While Income has an impact on selection of paneer, ghee and curd but there is no influence on butter and powder milk.

KEYWORDS Milk products, random selection, quality, consumer trends

INTRODUCTION

The Production of milk began 6000 years ago. India rank first in the world in terms of milk production and consumption. According to Department of Animal Husbandry, Govt. of India report, milk production of India has gone up from 55.7 million tonnes in 1991-92 to 146.3 million tonnes in 2014-15 (DOAAH 2015). The per capita availability of milk has increased from 225 g /day in 2003-04 to 322 g/day in 2014-2015. In India, monthly per capita consumption of liquid milk in rural area is 3.866 L / month and in urban area it is 5.107 L/ month (NSS 2005).

In Assam, production of milk has increased from 750 million L in 2001-02 to 845 million L in 2012-13 and thereby registering a compound growth rate of 0.47 %. The per capita availability of milk is 74 g/day in 2013-14 (AES 2015). The annual growth of milk production in Assam is much lower to the national average. In Assam monthly per capita consumption of liquid milk in rural area is 1.310 L and in urban area 1.998 L (NSS 2005).

There are sufficient milk producers and well developed milk and milk products in Nagaon market. The people of Nagaon urban area buy the milk and milk products from nearer market and also from the local milkman. On the other hand, most of the people of rural areas of the districts produce milk and prepare some milk products at their home. So, the selection and consumption of milk and selected milk products such as powdered milk, butter, ghee, paneer and curd are different in different areas of the Nagaon district. Sometimes various demographic characteristics like age, sex, religion, income etc. affect the selection and consumption of milk and selected milk products. Consumers of varying age, sex, religion, income level, etc. like to consume different type of milk products, based on their taste and their interests and sometimes
Development of osmo-air dried litchi arils from fruits affected with pericarp browning using response surface methodology

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Received: October 12, 2016, Revised: November 20, 2016, Accepted: November 28, 2016

ABSTRACT Response surface methodology (RSM) was used to optimize the blanching time and sugar concentration of osmo-solution for the preparation of value added osmo-air dried arils from the litchi fruits affected with pericarp browning. Three-level factorial design consisting of two variables (blanching time and sugar strength of osmo solution) with 17 runs was prepared. This design was used to develop models for the yield, acidity and sensory scores of the osmo-air dried litchi arils. Responses were mostly affected by the specific combinations of independent variables. The behavior of the response surface was also investigated for the response function by performing a regression analysis. Moreover, graphical optimization was carried out to determine the optimum conditions for the dried arils in terms of quality attributes. The RSM optimized values concerning blanching time and strength of osmo solution were 25 second and 75% TSS, respectively. The developed osmo-air dried product had 21% yield and sensory scores on the nine point hedonic rating scale for different sensory parameters such as appearance, odor, taste and overall acceptability were 8.16, 9, 9, and 8.6, respectively.

KEYWORDS RSM, osmotic dehydration, litchi, blanching, drying, value addition

INTRODUCTION
Litchi (Litchi chinensis Sonn.), a subtropical, non-climacteric and drupe or stone fruit is well known for its pleasant flavor and juicy pulp (aril) with attractive red color pericarp. It is also an excellent source of vitamins and minerals. Under ambient conditions, it loses upto 7-11% weight within one day after harvest due to water losses. The attractive bright red color turns to unpleasant brown color within 24-48 hours which drastically reduces marketability of fruit. Thus these are considered as the major causes of post harvest losses of litchi. Although browning of skin may not affect the fruit, it greatly reduces the commercial value in western and domestic markets, nevertheless, the quality of arils remains almost unaffected and thus such arils can be used for the value addition.

In the last few years, osmotic dehydration process has been considered an important tool for conservation of fruits and development of new fruit products. The osmotic dehydration process has been used as a pretreatment to the traditional processes of drying and freezing (Lombard et al. 2008) and also to produce minimally processed products (Torres et al. 2008, Castello et al. 2009). This technique is also interesting because it provides partial water removal from a food product with low energy consumption and mild heat treatment. Solute concentration of osmo solution and blanching time are the two important variables in this process. A good combination of process variables results in greater yield and high sensory score. Thus, it is very important to determine optimal conditions to develop an osmotically dehydrated product of high quality.

RSM is a useful statistical tool applied in process optimization. Experimental conditions that optimize a process response as a specific characteristic of quality of the final product can be obtained by this method. Desirability function is thus a technique that can be
Screening of methods for extraction of wild pomegranate arils

NS THAKUR ● ANSHU SHARMA
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ABSTRACT An experiment was conducted to find out the best method for the extraction of arils from wild pomegranate fruits at Department of Food Science and Technology, Dr. YS Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh, India. Before, manual extraction of wild pomegranate arils, partial drying of fruits (<10% moisture) in three different drying modes like mechanical cabinet, solar tunnel and open sun for varying time-temperature combinations was done. Exposure of fruits to time-temperature combination of 40 °C for 6 hours (h) in mechanical cabinet drier was found best followed by solar tunnel drier (36-44 °C for 12 h) and open sun (28-30°C for 36 h). Best drying treatments were selected on the basis of quality attributes like ease in separation of arils, no defects, good appearance and sensory scores of extracted arils on 9 point hedonic scale. Manual extraction of arils from mechanical cabinet dried wild pomegranate fruits also took minimum time in comparison of solar tunnel and open sun dried by a single worker, whereas, maximum time was taken for fresh fruits (control).

KEYWORDS Pomegranate, arils, extraction, drying, cabinet dryer, time-temperature relationship

INTRODUCTION Pomegranate is found in its wild form in mid hills of Western Himalayan regions of Jammu and Kashmir, Himachal Pradesh and Uttarakhand states of India, up to an elevation of 1800 m above mean sea level (Saxena et al. 1987, Thakur et al. 2011, Chandra et al. 2014). Wild pomegranate is known for potential antioxidant activities inside human body due to its bioactive and functional components such as vitamin C, organic acids, anthocyanins and phenols (Thakur et al. 2010, 2011, Sharma and Thakur 2016). The arils of wild fruits being extremely acidic in taste are usually not liked by consumers for fresh consumption, thus, conventionally dried to yield a product known as anardana in India (Mahajan et al. 1992, Sharma and Thakur 2016). The variety of this fruit which is locally called as daru in Himachal Pradesh generally found growing under forests of mid hill regions of the state. These fruits are collected by the local farmers for preparation of anardana. Anardana is not only used for enhancing the taste of various food products like chutneys, curries and other culinary preparations but also plays an important role as an medicinal ingredient in many ayurvedic formulations to cure diseases such as stomach infections, vomiting, neurological and kidney disorders (Jalikop et al. 2002). The removal of arils from daru prior to anardana preparation is very difficult and time consuming process, since the arils of this fruit are tightly adhered to each other and peel of the fruit. Manual extraction of arils from rind of wild pomegranate fruits not only causes staining of hands and uniform of the workers but it is also a quite laborious and tiring process. Looking upon the nutritive, medicinal and economical value of wild pomegranate fruits, some attempts have been made to explore the local knowledge associated with removal of wild pomegranate arils in previous years, but no proper scientific techniques have been followed to make
Expression of rhododendron aqueous extract and its use in preparation of RTS beverage

SN SOLANKE ● CS CHOPRA ● SK SHARMA

Received: October 25, 2016, Revised: December 17, 2016, Accepted: December 20, 2016

ABSTRACT Preparation of extract from flowers or herbs for production of any processed product is utmost important to obtain product of good quality. Rhodo drinks are popular in some hilly regions of India but there is a lot of variation in the protocol followed for preparation of petal extract. As a result, consistent product quality is not obtained. The present investigation was undertaken to standardize the technique of obtaining rhododendron (buransh) aqueous extract so that it could be successfully employed in the preparation of ready-to-serve beverage (RTS). Independent factors of the experiment included petal to water ratio (1:0.75 to 1:2.0), boiling time (0-15 min.) along with the crushing technique of obtaining rhododendron (buransh) aqueous extract and its use in preparation of RTS beverage prepared from extract obtained by crushing petals of the flowers are elected n. Buransh squash, a popular beverage is prepared and sold in Kumaon hills.

INTRODUCTION

Rhododendron arboreum is locally known as buransh in Garhwal, brons in Almora, bras in Kumaon, bhorans and ghanas in Nepal, billi in Nilgiris, ardwal in Punjab and alingi in Tamil. Deep red or pale pink flowers of buransh have sweetish sour taste (Purohit 1960). This flower has pharmacological and anticancer properties (Dhar et al. 1968). The red blooms of buransh flowers are supposed to be good for the heart patients. Traditionally, the petals of the flowers are used in the preparation of chutney by the hill people. At home scale, small quantities of juice extracted from flower is used for preparing jelly and squash and syrup (Vyas et al. 1989, Bhatt et al. 2007). Rhododendron lapponicum leaves and flowering tops can be infused and drunk as tea. White flowers of Rhododendrons can also be used for the preparation of jelly (MacNicol 1967).

The average weight of inflorescence of red colored fresh buransh inflorescence obtained from Bhimtal town of Nainital district (Uttarakhand) was 24.01 g with 15 flowers in an inflorescence (Solanki et al. 2013). Length and width of petals were 5.13 ± 0.45 and 5.88 ± 0.64 cm, respectively. The inflorescence contained 67.63 ± 3.37 % edible portion. Buransh petals contained 89.28 ± 0.56, 8.5 ± 1.60, 2.69 ± 0.12, 0.80 ± 0.03 and 0.68 ± 0.04 % moisture, TSS, acid, ash and pectin, respectively. The respective content of reducing, non-reducing and total sugars was 5.16 ± 0.09, 5.46 ± 0.79 and 10.91 ± 0.86 %. Petals contained 250.5 ± 3.5 mg/100g ascorbic acid and 214.35 ± 3.56 mg/100g anthocyanins. They also concluded that the buransh inflorescence is not only attractive because of its deep red colour but also nutritious and possesses ideal processing qualities. Buransh squash, a popular beverage is prepared and sold in Kumaon hills. However, there is no standard procedure for extracting buransh extract/ juice that is the first and the most important unit operation employed for preparation of

KEYWORDS Rhododendron arboreum, edible flower, RTS beverage, aqueous extraction, juice extraction

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Upscaling of seabuckthorn cultivation in dry temperate zone of Himachal Pradesh

LK SHARMA
Received: July 27, 2016, Revised: November 14, 2016, Accepted: November 20, 2016

ABSTRACT Investigations were carried out in Lahaul and Spiti district of Himachal Pradesh to bring up systematic plantation of seabuckthorn on marginal land. The experiment was laid out in a randomized block design with five treatments and four replications consisting of two sites per replication. Over all, eight potential sites were identified for collection of cuttings from different species (Hippophae rhamnoides and H salicifolia). Mass propagation of species was done through hardwood cuttings taken from heavy bearing plants. In all about 122 ha new area was brought under seabuckthorn cultivation. Every year, the survival percentage of the plantations were calculated. Correlation studies indicated that fruiting and yield of seabuckthorn was be better at lower altitudes than at very high altitudes. The juice recovery from the fruits was also higher from plantations at lower altitudes. In established plantations increasing trends for survival rate were observed which ranged from 45-70 %.

KEYWORDS Seabuckthorn, mass multiplication, survival rate, systematic plantation

Seabuckthorn is a nitrogen fixing, deciduous, thorny plant, which grows widely in Asia and Europe. The plant has recently attracted global attention due to its rich nutritional and medicinal values. It has been reported that the chemical constituents of Indian Hippophae species have high potential than the Chinese and Russian Hippophae (Arimboor et al. 2006). Seabuckthorn berries are quite rich in vitamins and other bioactive substances. Asian populations have been found richer in vitamin C (600-2700 mg/100g). Because of the presence of high content of vitamin C and amino acids, its juice is utilized for the production of several health drinks, jams etc., particularly for weak children, pregnant ladies, aged persons and sports person in China (Rongsen 1992). In India, some exotic forms of seabuckthorn were evaluated at Kukumseri, Lahaul, Himachal Pradesh and some were found highly promising (Singh et al. 2015). However, at ground level in India, comprehensive studies on selection of high yielding land-races from natural populations/habitats, evaluation of promising forms, mass multiplication and conservation of superior genotypes of seabuckthorn, are few (Singh 2006, Singh et al. 2010).

Domestication of wild natural populations is a challenging work. In view of increasing demand of seabuckthorn in Indian market and potential of seabuckthorn in environmental conservation, the present study was carried out with an objective to find out correlation between various physical and chemical characteristics of the plantations and increase the area under systematic plantation in Lahaul and Spiti district.

The study was carried out at Krishi Vigyan Kendra, Kukumseri in the Lahaul and Spiti district of Himachal Pradesh State in India during the year 2008-2014. The district covers approximately 13,835 km² area with an altitudinal range of 2400 to > 6600 m
Leaf nutrient status of a few selections and cultivars of walnut

CHANDRA PANDEY & CS TOMAR
Received: February 03, 2016, Revised: May 05, 2016, Accepted: June 10, 2016

ABSTRACT
An experiment was conducted to study the leaf nutrient status in some cultivars of walnut planted in experimental orchard at Solan Himachal Pradesh to facilitate scheduling of fertilizer application. Considerable variation for foliar macronutrients and micronutrients level was found among walnut selections and varieties. Cultivar “Paynee” was found to have maximum leaf nitrogen (2.79%), phosphorus (0.28%), leaf iron content (123.7 ppm) and minimum copper (4.08 ppm) content. Leaf manganese content was maximum (53.48 ppm) in cultivar “Hartley” while “Local selection 2” recorded the minimum leaf manganese content (51.86 ppm). “Ronde de Montignac” was reported to have maximum leaf copper content (4.26 ppm).

KEYWORDS Foliar, macronutrients, micronutrients, paynee, walnut

Although walnut is a crop with a great export potential, yet its potential remains underutilized in India due to lack of proper nutrient management. Plants require essential mineral nutrients to complete their life cycle and the quantities required for optimum growth and production vary with species, soil type, soil nutrient levels and leaf nutrient levels. The optimum dose of fertilizers and manures to be applied should be set after proper analysis of leaf nutrient status as well as soil. Excess or deficiency of nutrients can cause an imbalance, which can result in abnormal growth and low nut production. The leaf is very sensitive to changes in the plant’s nutrient supply. Till now not much research has been taken up for knowing the nutrient status of walnut cultivars. An effort was made to study the leaf nutrient status in some cultivars and selections of walnut in experimental orchard of Department of Fruit Science, Dr YS Parmar university of Horticulture and Forestry, Nauni, Solan Himachal Pradesh.

Uniform healthy and disease free bearing walnut cultivars and selections, grafted or budded on seedling rootstocks and having same age group (4-5 years) were selected for these investigations. The experimental trees were subjected to uniform cultural practices during the study.

About 50-100 leaves were collected from each walnut tree, from the middle portion of the shoots during the period from 15th July to 15th August. Samples were first washed with tap water followed by 0.1N HCl, distilled water and finally with double distilled water. Samples were then dried by spreading on clean blotting papers the final drying was accomplished in an oven at 68 °C (Chapman 1964). The samples were ground in electrical grinder for further analysis.

Digestion of leaf samples for nitrogen estimation was carried out in concentrated sulphuric acid by
Effect of different spacing and fertilizer levels on growth and yield of different varieties of desi cotton

HARPREET SINGH ● SS MANHAS
Received: August 20, 2016; Revised: November 23, 2016, Accepted: November 25, 2016

ABSTRACT A field experiment was carried out at Bathinda during kharif, 2013 to evaluate two varieties of cotton planted at 3 different spacing and given 3 different level of fertilizer doses. The maximum plant height, monopodial and sympodial branches/plant of desi cotton were recorded with LD-949, alongwith maximum bolls/plant, boll weight and seed cotton yield. The planting of desi-cotton crop at 67.5×60 cm resulted in significantly more number of sympodial branches/plant as compared to 67.5×30 cm and 67.5×45 cm. The maximum bolls/plant of desi cotton were recorded with spacing of 67.5×60 cm which was significantly more than 67.5×30 cm and at par with 67.5×45 cm. Planting desi cotton crop at 67.5×60 cm resulted in more boll weight and seed cotton yield which was at par to 67.5×30 cm and 67.5×45 cm. All growth parameters increased with increase in nitrogen level from 75 to 125 % of recommended dose of fertilizer (RDF). LD-949 is a superior variety than FDK 124 when planted at 67.5 x 60 cm spacing and with 25% higher fertilizer doses than the RDF levels of NP and K fertilizers.

KEYWORDS Growth, desi cotton, fertilizer levels, spacing, yield

Cotton is one of the most important fibre crops of India and plays a dominant role in Indian farming and industrial economy. The desi cotton (Gossypium arboreum L.) are known to have survive vagaries of nature for millions of year and thus tolerant and resistant to diseases, pests and adverse environmental conditions. On introduction of Bi-cotton, the population and infestation due to major bollworms is now under control. However, year after year, the infestation of sucking pests viz., aphid, Aphis gossypii Glover; leafhopper, Amrasca biguttula biguttula (Ishida), thrips, Thrips tabaci Lindeman and whitefly, Bemisia tabaci (Gennadius) showed increasing trend. Bt toxins can effectively control specific lepidopterous species, but lack resistance against sucking insect pests (Sharma and Pampapthy 2006). In Punjab desi cotton is also grown on considerable area in the south-west districts for its quality values, domestic consumption, industrial requirements and comparatively less prone to insect pests and diseases (Brar et al. 2015). Low productivity of desi cotton is a major bottle neck in its expansion in area. Plant spacing and fertilizers alter the plant architecture, photosynthetic efficiency of leaves, boll size and production pattern in cotton (Bhalerao et al. 2010, Samani et al. 1999). Plant spacing directly influences the soil moisture extraction, light interception, humidity and wind movement which in turn influence plant height, branches development, fruit location and size, crop maturity and ultimately on yield of cotton (Heitholt et al. 1992). Plant spacing significantly affected on microclimatic condition of the crop ecosystem which affect the multiplication of the pest (Jain and Bhargava 2007). Nitrogen is generally considered to be a limiting factor for the growth, yield and radiation use efficiency of various cotton cultivars (Nicholos et al. 2004). Its deficiency reduces vegetative and reproductive growth and reducing yield due to leaf
Gynodioecious behaviour in some walnut genotypes - a new report

OC SHARMA ● DB SINGH ● S ZAHOOR ● BA PADDRER ● SA HAJI
Received: December 02, 2016; Revised: December 23, 2016, Accepted: December 24, 2016

ABSTRACT Investigations were carried out from 2012 to 2016 in walnut germplasm block of Central Institute of Temperate Horticulture, Srinagar, Jammu and Kashmir to study the effect of training and pruning systems on various traits in walnut (Juglans regia L.). Grafted plants of walnut were planted during 2000-01. Walnut is a monoecious plant, but during investigation of floral traits, two genotypes were observed, that did not bear male catkins continuously from 2012 to 2015 and behaved as gynodioecious, but, produced negligible rudimentary catkins in 2016. There is no report in literature regarding this kind of behaviour in walnut. These plants can be important from breeding point of view, which is otherwise a very tedious job in walnut.

KEYWORDS Gynodioecious, Juglans regia, monoecious, dichogamy

INTRODUCTION
Walnut (Juglans regia L.) is an important nut crop of temperate region. In India, it is mostly grown in Jammu and Kashmir, Uttarakand, Himachal Pradesh and some states in Northern Eastern region. The Jammu and Kashmir is the leader in production of walnut and it was found growing upto 3000m above mean sea level in Ladakh region of Jammu and Kashmir (Sharma et al. 2010).

RESULTS AND DISCUSSION
Data recorded on floral traits in different genotypes indicated different degrees of dichogamy based on male and female flowering. All the plants were monoecious and bore male and female flowers. In the experimental unit, two plants were observed which did not bear male catkins during 2012, 2013, 2014 and 2015 but bore negligible rudimentary and very small catkins during 2016. Female flowering took place in all
Shoot deformation in alstroemeria - a new disorder

OC SHARMA ● DB SINGH ● R KUMAR ● S ZAHOOR ● BA PADDER ● SA HAJI

ABSTRACT A trial was conducted from 2012 to 2015 with nine cultivars of alstroemeria (Alstroemeria hybrida) to know the suitability of different cultivars for round the year production under polyhouse conditions, in temperate climate. Among the nine cultivars, “Rosita” yielded flowers continuously from March to December. Hence, it was advocated for commercial cultivation under polyhouse conditions under temperate climate. While investigating various cultivars for plant foliage and floral traits, few plants in two cultivars i.e. Rosita and No. 14 were found with deformed shoots having more number of leaves, flowers and were different from normal shoots. This new disorder can be called as shoot deformation. This is a new report as far as disorders of Alstroemeria are concerned.

KEYWORDS Disorder, Alstroemeria, rossetting, cymes

INTRODUCTION

Alstroemeria (Alstroemeria hybrida) is also known as the Peruvian Lily or Inca Lily and thought to be originated in South America especially the countries like Chilli, Peru and Brazil but was named after a Swedish baron called Clas Astromer by famous botanist Linnaeus.

About 60 species of alstroemeria grow wild in South America and inhabitats range from snowline Andes and high mountain plateaus down the high land forests to coastal deserts. In the middle of sixties, alstroemeria was first time grown in Europe. It has established a strong growth in Holland after 1977 in terms of acreage. It belongs to family Alstroemeriaceae (Liliaceae) and is one of the most important cut flower in the world. It is a perennial and rhizomatous plant and also develops tuberous storage outgrowth and fleshy roots. The aerial roots can be vegetative or reproductive. Alstroemeria in vibrant colours is excellent in borders and also last well as cut flower in floral arrangements. They are available in a number of colours. In India, alstroemeria is a recent exotic introduction and negligible work has been carried out to get quality cut flowers. So, the experimentation is going on in some parts of the country and different technologies were standardized for commercial cultivation of this flower crop (Singh 2006, Anonymous 2007).

MATERIALS AND METHODS

Nine cultivars of alstroemeria (Alstroemeria hybrida) were evaluated for plant, foliage and floral traits during 2012-15 at ICAR-CITH, Srinagar. Trails on different aspects were conducted under polyhouse conditions. The design of experiment was RBD. The data were recorded on plant height, shoot thickness, leaf length, leaf width, number of cymes per shoot and flower yield per plants.

RESULTS AND DISCUSSION

Cultivar Rosita was found suitable for cultivation under polyhouse condition for continuous supply of flowers from March to December or April to December in different years. Many workers have worked on various aspects of production and vase life of this crop
GUIDELINES FOR AUTHORS

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  ● Key words: About 5-6 keywords to be indicated.
  ● Introduction: This must highlight importance of the problem and its relevance to hill agriculture including previous work done and gaps thereof.
  ● Materials and Methods: Describe the materials used in the experiments, year of experimentation, site etc. Describe the methods employed for collection and analysis of data in short.
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1. Lack of proper statistical tools used for analysis of data.
2. Improper layout of experiments or improper use of experimental materials and procedures.
3. Poor explanation and discussion of the results.
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5. Authors not submitting the revised version of their manuscripts for the permitted time frames.
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<table>
<thead>
<tr>
<th>Type of membership</th>
<th>Fee for SAARC countries</th>
<th>Fee for rest of the nations</th>
</tr>
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<tbody>
<tr>
<td>Annual member</td>
<td>Rs 800/- per year</td>
<td>US $ 30 per year</td>
</tr>
<tr>
<td>Life member</td>
<td>Rs 5,000/- (one time)</td>
<td>US $ 200 (one time)</td>
</tr>
<tr>
<td>Subscriber (organization) member</td>
<td>Rs 2,000/- per year</td>
<td>US $ 100 per year</td>
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