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Conceptual ideas of carnivorous plants to utilize in the field of agriculture

M ANBARASU
Received: June 6, 2017, Revised: August 20, 2017, Accepted: September 3, 2017

ABSTRACT Usually, when we think of "carnivorous," animals come to our mind. Yet there are some wonderfully fascinating plants that eat animals. It seems a contradiction, but this meat eating habit of some plants is an interesting and normal adaptation of nature. Carnivorous plants have evolved in places where the soil is poor and low in nutrients. Here, animals can provide them missing ingredients needed for survival. The carnivorous plants have fascinating methods of luring, trapping and digesting animals which provide an adequate supply of necessary nutrients. Green plants require sunlight for photosynthesis. Some selected carnivorous plants like venus flytrap, flypaper and pitfall, trap plants to use as catch crops or emergency crops, smother crops, trap crops, replacement inter crops and avenue crops which had naturally habit evolved to eat the insects. This habit can be used in agriculture, mainly for pest control (especially in sucking pest especially when they are more resistant to pesticides), weed management and nutrient management etc. These management strategies are mainly maintained through inorganic ways, as pesticides, weedicides and fertilizers are being discouraged by researchers as well as farmers. Carnivorous plants thus may occupy important place in future agriculture. This paper presents some of such ideas of better use of nature to maintain sustainable ecology / environment.

KEYWORDS Carnivorous plants, pest control, nutrient management, agriculture field

INTRODUCTION

About 650 species of vascular carnivorous (Latin: carnivorous) plants occur throughout the world, out of the total of about 300,000 species of vascular plants (Rice 2006). Carnivorous plants belong to 15-18 genera of 8-9 botanical families and 5 orders (Heubl et al. 2006, Porembski and Barthlott 2006). Due to many remarkable and striking morphological, anatomical, physiological and ecological features, carnivorous plants have always attracted considerable interest of both researchers and gardeners. Nevertheless, the degree and extent of knowledge of the main disciplines studying this particular ecological functional plant group, has always considerably lagged behind the study of non-carnivorous plants. In modern days, eco-physiological research of carnivorous plants has progressed considerably within the last decade and has elucidated most of the particulars of carnivorous plants (Darwin 1875).

Uses of carnivorous plants in agriculture

In agricultural field, research on utilization of carnivorous plant has begun. Many plants have evolved adaptations in order to survive in low nitrogen environments. Insect carnivorous plants, such as pitcher plant and sundews (Nepenthes and Drosera, respectively) are able to obtain substantial amounts of nitrogen from the insects that they capture. Secondly, numerous plants form associations with mycorrhizal fungi that can provide soluble nitrogen from the soil, some of which may be insect-derived nitrogen, obtained from decaying insects or insect frass. Finally, a specialized group of endophytic insect-pathogenic fungi (EIPF) provide host plants with insect-derived nitrogen. These soil-inhabiting fungi form a remarkable symbiosis with certain plant species (Scott et al. 2013). The concept of murderous plants and inclusion of carnivorous plants as a subset, was...
Effect of compatible solutes spray on seed yield and its contributing traits in bread wheat to mitigate heat stress

MK KARNWAL • HS CHAWLA
Received: August 22, 2017, Revised: September 14, 2017, Accepted: September 18, 2017

ABSTRACT Continuous changes in climate and environment and intensive cropping system is putting more pressure to find out new strategies that delivers both a substantial increase in seed yield and resilience to extreme and fluctuating weather events. Thus, present investigation was carried out to examine possible role of foliar spray of compatible solutes on twelve seed yield and its contributing traits under late (25th November) and very late (25th December) sown conditions. Among all compatible solutes examined under study, maximum seed yield per plant were obtained in both cultivated varieties of wheat (i.e. HD 3038 (V1) and UP 2628 (V2)) with the spray of T1-glycine betaine 600 ppm (40.70 g V1T1, 41.94 g V2T1) followed by T2-tocopherol 150 ppm (40.49 g V1T2, 39.33 V1T3) and T3-salicylic acid 400 ppm (38.12 g V2T3, 38.09 g V1T2). Spray with glycine betaine 600 ppm (T1) followed by T2-tocopherol 150 ppm and T3-salicylic acid 400 ppm at vegetative and reproductive stage significantly increased days to heading as well as days to maturity in both environmental conditions. Thus, spray with T1-glycine betaine 600 ppm followed by T2-tocopherol 150 ppm and T3-salicylic acid 400 ppm were found significantly superior to mitigate the heat stress at growth, development and reproductive stages and produced higher seed yield in bread wheat cultivated varieties.

KEY WORDS Wheat, heat stress, compatible solute spray, glycine betain, salicylic acid, seed yield

INTRODUCTION Wheat is one of the most important food crops grown worldwide. Drought and heat stress are the major stress conditions that restrict wheat growth and production in Europe. Wheat is grown in India on an area of about 31.18 million ha with a production of 95.91 million tonnes and productivity of 3.1 t/ha (Anonymous 2017). To deliver food security for the 9 billion population in 2050, a 70 % increase in world food supply will be required. Projected climatic and environmental changes and intensive cropping system emphasize the need of new strategies that delivers both a substantial increase in seed yield and resilience to extreme weather events. Among the abiotic stresses affecting plant growth, reproduction and seed yield, high temperature is one of the most prominent ones because it directly affects the anthesis and seed setting thereby play very significant roles in reducing agricultural production worldwide (Boyer 1982). Constantly changing environment involves the accumulation of certain organic compounds of low molecular mass in the cytoplasm, collectively known as compatible solutes are needed for acclimatization of plant (Bohnert et al. 1995). Compatible solutes are defined as small molecules that are very soluble in water and are also uniformly neutral with respect to the perturbation of cellular functions, even when present at high concentrations (Yancey et al. 1982). The properties of compatible solutes allow the maintenance of turgor pressure during water stress, which is an intrinsic feature of major forms of abiotic stress such as cold and heat stress. In addition, some compatible solutes can serve as efficient protective agents by stabilizing the structures and functions of certain macromolecules (Papageorgiou and Murata 1995).

Thus, it is widely accepted that the accumulation of these compounds in plants contributes in a fundamentally important manner to the acclimatization
Estimates of combining ability for development of F₁ hybrids in cucumber

TUSAR RANJAN SAHOO ● DINESH KUMAR SINGH
Received: August 29, 2017, Revised: September 16, 2017, Accepted: September 18, 2017

ABSTRACT Eleven lines of parthenocarpic and gynoecious cucumbers were crossed with three monoecious testers in line × tester design producing 33 F₁ hybrid seeds. Hybrids were then grown in randomized block design in two environmental conditions (E1, March-June; E2, August-December) under polyhouse. Fifteen economically important characters were observed from five plants selected at random. The best promising general combiner and tester were PCUCP-4 and PCUC-8, respectively with significant general combining ability for yield contributing characters, which could be used for accumulation of favourable genes in breeding programmes. Different environmental conditions inside polyhouse influence the performance of cross combinations. Parthenocarpic along with monoecious genotypes produce more stable cross combinations than gynoecious with monoecious types inside polyhouse. The best cross combinations based on specific combining ability effects for fruit yield per plant were PCUCP-3 × PCUC-8 and PCUCP-3 × PCUC-25 in E1 and E2, respectively. In both the environments, PCUCP-4 × PCUC-8, PCUCP-3 × PCUC-8 and PCUCP-7 × PCUC-25 cross combinations were found to be the most stable for maximum characters and could be used for hybrid cucumber production under polyhouse conditions.

KEYWORDS Cucumber, combining ability, hybrid, parthenocarpic, stability

INTRODUCTION

Cucumber (Cucumis sativus L.) is one of the most important cucurbitaceous vegetables grown worldwide with great economic importance (FAOSTAT 2017). In tropical and subtropical countries, it is grown both as spring and summer crop, for its edible tender fruits, mostly used for salad, pickles, dessert fruit and rayata preparation. Cucumber is widely cultivated commercially due to its reasonable price and high demand in the local market. Cultivation of cucumber in open field conditions is extremely difficult during winter season under north Indian conditions as seed germination and vegetative growth are severely affected due to frost and cold. However, its cultivation under protected structures provides protection from the excessive cold. Further, round the year supply of fresh produce especially during off-season, which fetches very high prices, is possible under protected conditions (Yadav et al. 2014). But, cucumber cultivation under protected conditions in India is limited due to lack of suitable parthenocarpic, gynoecious varieties stable under high temperature conditions of protected structures and non availability of suitable hybrid seeds to grow inside polyhouse. Therefore, breeding for high yielding stable parthenocarpic varieties for protected cultivation is immensely needed (Kumar and Kumar 2017).

Genetic improvement of yield and its contributing characters require selection of appropriate breeding procedures, which are largely dependent upon the study of general combining ability (GCA) of parents and specific combining ability (SCA) of hybrids. Combining ability also indicates the nature and magnitude of gene action involved in the expression of quantitative traits (Kumar and Kumar 2017). The knowledge of nature and magnitude of gene action controlling the inheritance of yield and its contributing traits, along with, proportional contribution of parental
Genetic variability, correlation and path analysis of foxtail millet in Mon district of Nagaland

MS SACHAN
Received: March 17, 2017, Revised: September 15, 2017, Accepted: September 18, 2017

ABSTRACT Genetic variability, correlation and path analysis for seven quantitative traits in fifteen genotypes of foxtail millet were studied at Nagaland under rainfed conditions, with an objective to determine the association of yield with yields contributing characters. High PCV and GCV were observed for productive tillers per plant (28.55 and 19.66) and grain yield per plant (24.13 and 21.75). High heritability coupled with moderate genetic advance at %means was observed for grain yield per plant (91.32 % and 23.93), panicle length (85.65 % and 13.41), and productive tillers per plant (75.42 % and 28.33) indicating that additive gene effects were operating for these characters and selection for superior genotypes was possible. Panicle length had highly significant and positive correlation at genotypic and environment level with grain yield per plant \( r_g = 0.743 \) and \( r_e = 0.786 \). Productive tillers per plant also showed highly significant and positive correlation at the genotypic level and phenotypic level with grain yield per plant \( r_g = 0.748 \) and \( r_p = 0.744 \). These two characters were found to be positively correlated to grain yield per plant. Path analysis revealed that only panicle length showed high direct effect and highly significant positive correlation with grain yield per plant \( 1.424 \) and \( r_p = 0.764 \), indicating the importance of selection based on this character to increase grain yield per plant.

KEYWORDS Foxtail millet, variability, heritability, genetic advance, correlation, path analysis

INTRODUCTION Foxtail millet (Setaria italica Beauv.) is self pollinated crop from the family Gramineae, also known as Italian millet, German millet and Hay millet. It is one of the world oldest cultivated crops and its reference is mentioned in the Chinese records as early as 2700 BC. Its inflorescence is spike with short side branches bearing spikelets and bristles. Most of the world foxtail millet production is concentrated in China, the Near East, and to some extent in southern and central Asia (Gupta et al. 2006). India, with approximately 9 % of world production, is the second most important producer of foxtail millet. In India, it is extensively cultivated in lower Deccan plains and highlands of Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, Uttarakhand and Himachal Pradesh. It is also a popular crop among the tribals of north eastern hill region of India. But the crop has not received adequate attention of the research workers involved in crop improvement.

To have a good choice of characters for selection of desirable genotypes under planned breeding programme for higher yield, the knowledge of nature and magnitude of variation existing in available breeding materials, the association of component characters with yield and their exact contribution through direct and indirect effects are of crucial importance (Sachan and Singh 2003, Mukherjee et al. 2016). Yield is a complex quantitative character and is the resultant of various component characters working together. Therefore, for understanding the effect of the components on yield, it is essential to know the association of different characters among themselves and with that of yield.

The current work aims to determine the association of yield with yield contributing characters and their direct and indirect effects on seed yield of foxtail millet (Setaria italica) at the north eastern
Studies on genetic variability in different genotypes of taro

ANKUSH KUMAR • ML KUSHWAHA • ANKIT PANCHBHAIYA • PRIYANKA VERMA
Received: May 18, 2017, Revised: July 5, 2017, Accepted: July 12, 2017

ABSTRACT Nature has bestowed us with a lot of variability in wild populations of all crops. These variations have been utilized in most crop improvement programmes and for making selection of suitable line for a particular agro-climactic condition. This study, involving 18 genotypes of taro, was carried out in 2015 at Vegetable Research Centre, Pantnagar, to evaluate most promising and high yielding genotypes suitable to this area for cultivation. The extent of genetic variability, heritability and genetic advance in respect to sixteen different characters regarding growth, yield and quality were studied under Tarai region of Uttarakhand. Wide variations were observed for all the characters indicating diverse genetic nature of the base population. The genotype PA 44 was promising as it produced significantly more yield than check variety NDC 1. There were high phenotypic and genotypic coefficients of variation recorded for number of cormels per plant, weight of cormels per plant, weight of corms per plant, etc. Highest genetic advance was noticed in weight of cormels per plant, number of cormels per plant and weight of corms per plant and moderate heritability was noticed in days to sprouting, length of corms, etc. which could be improved by simple selection.

KEYWORDS Genetic variability, PCV, GCV, heritability, taro

INTRODUCTION Taro (Colocasia esculenta (L) Schott var. antiquorum) known as eddoe type or arvi belongs to the monocotyledonous family Araceae, sub-family Aroideae, whose member is known as aroid (Van Wyk 2005). It is an ancient crop, originated in the Indo-Malayan region probably in Eastern India and Bangladesh and is being grown throughout the humid tropics (Yen and Wheeler 1968). It is believed that the origin of domesticated taro is from ‘wild type’ C. esculenta var. aquatilis, either in North East India or South East Asia (Matthews 1991). Taro is one of the few edible species in the genus Colocasia. The corms are consumed as cooked vegetables or are made into puddings, breads or poi. The large nutrient rich leaves are commonly eaten stewed. Petioles are fed to pigs after boiling with broken rice or rice bran. The economic produce (corms and cormels) is rich in starch. It is also a rich source of amino acids. The calcium oxalate content varies from 0.1 to 0.4 % on fresh weight basis (Hussain et al. 1984). Besides, this crop has high medicinal value and is included in many Ayurvedic preparations. As a source of proteins and minerals, arvi is much superior to other tropical tuber crops and potato (Thankappan 1985). Taro contains another group of important chemicals, that is, antioxidants, which are scavengers of free radicals including the superoxide radical, hydroxyl radical, hydrogen peroxide, peroxyl radicals and singlet oxygen that are released in human body due to oxidative stress. Antioxidants have been shown to be associated with reducing rates of mortality due to heart disease incidence of cancer, particularly of mouth, pharynx, esophagus, lung, stomach, colon and other degenerative diseases (Howe et al. 1990, Slatter et al. 2000).

Improvement of crop depend upon the nature and magnitude of variability and the extent to which the desirable characters are heritable, therefore the evaluation and utilization of genetic variability in
ABSTRACT High aesthetic and economic importance of dahlia stimulates breeders for the development of new cultivars. To determine the lethal dose (LD$_{50}$) of gamma rays in different cultivars of dahlia, an experiment was conducted at MFC, GB Pant University of Agriculture and Technology, Pantnagar. Rooted cuttings of three dahlia cultivars viz., Jyotsana, Agni and Glory of India were exposed to acute ($^{60}$Co) gamma ray irradiation at 0.0 (Control), 1.0, 1.5, 2.0, 2.5 and 3.0 kR to determine the lethal dose level. Probit analysis for extrapolated LD$_{50}$ in different cultivars of dahlia for mortality was 2.07, 1.91, and 1.87 kR for Jyotsana, Agni and Glory of India, respectively indicating the higher sensitivity for cultivar Glory of India. There was direct correlation between dose of gamma irradiation and mortality of cuttings. Maximum mortality (47.00%) was observed at 3.0 kR while, minimum (10.00%) was observed at 1.0 kR dose of gamma rays treatment. Different cultivars also exhibited significant differences for mortality percentage by gamma rays irradiation. The LD$_{50}$ values for maximum survival percentage of cuttings can be fixed at 2.07, 1.91 and 1.87 kR of gamma rays irradiation for cvs. Jyotsana, Agni and Glory of India, respectively.

KEYWORDS Cultivars, gamma rays, LD$_{50}$ value, mortality, radio sensitivity

INTRODUCTION

Dahlia is a prolific and long duration flowering plant with wide ranging forms and colours which make it as an outstanding plant for garden decoration, flower arrangement and as cut flower. The genus *Dahlia* was named in the honour of Dr. Andreas Dahl (1751-1789), an 18th century Swedish botanist and pupil of Linnaeus. Its flowers have a sharp typical fragrance. It is a very popular show flower, specimen plant, used in perennial borders, as bedding plant and for cultivation in pots and tubs. Dahlia occupies a place of pride in any garden anywhere. Dahlia has almost all the colours, viz., white, cream, yellow, orange, pink, crimson, rose, red, maroon, mauve, purple, brown, bicoloured and multicoloured but lacks true blue, green and black colours (Misra and Misra 2017). It is a tuberous rooted, half hardy herbaceous perennial belonging to the family Asteraceae having its origin in Mexico. Migration and hybridization of species from Mexico and South America probably occurred in the early 17th century (De Hertogh and Le Nard 1993). Currently, 36 wild dahlia species are recognized. Cultivated forms, known as *Dahlia variabilis* Desf. also exist. The common variety dahlia was once an important root crop and medicinal plant among the pre-Columbian Indians of Central Mexico, Yucatan and Guatemala. Its roots contain significant amounts of inulin and fructose and small quantities of medicinally active antibiotic compounds like phytin and benzoic acid, concentrated in the skin of the tubers. In the modern world, dahlias cultivated as a crop might prove to be a worthy food supplement in subtropical areas (Whitley 1985). Induced mutations are necessary to enhance the rate of genetic variability. A specific advantage of mutation induction is to develop a range of mutant lines and identify trait specific genes in order to set up molecular gene database and study molecular
Response of different chrysanthemum cultivars under natural and controlled photoperiodic conditions for pot mum production

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ABSTRACT The present investigation was carried out at Solan to find out suitable chrysanthemum cultivars for pot mum production under natural and controlled photoperiodic conditions. The experiment was laid out on 15 cultivars/selections of chrysanthemum in a CRD (factorial) with 3 replications. Off-season flowering was induced by providing artificial short days (16 h dark period with effect from 5.00 pm to 9.00 am) starting from 31 May, 2013, by using covering material i.e. high density polyethylene (white outside and black inside), till 60-70 % buds showing colour. Among different cultivars/selections under studied Pusa Anmol, Vijay, Vijay Kiran and Anmol were found suitable for pot mum production under both conditions. These cultivars produced the most suitable pot mums with earliest flowering, optimum height, increased flower size, enhanced duration of flowering and compact growth under controlled photoperiod. Therefore, Pusa Anmol, Vijay, Vijay Kiran and Anmol can be recommended for pot mum production in low hills conditions of Himachal Pradesh.

KEYWORDS Chrysanthemum, pot mum, photoperiodic control, 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 traded in 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. Varied Indian agro-climatic conditions are highly suitable for its commercial cultivation. 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 2015). 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. But as a result of intensive research by the scientists and practical experience of many growers, its flowers can be produced throughout the year to precise schedules at any time by environmental manipulation, fertilization and using growth regulating chemicals. However, by using artificial and/or natural short/long days, its growth can be manipulated and flowers can be produced throughout the year. This department of University has already developed year round flower production technology by using artificial and/or natural short/long days. Successful flowering of chrysanthemum, throughout the year, by using thick dark coloured tarpaulin, has been obtained under Nauni, Solan conditions of Himachal Pradesh in selected cultivars (Sita and Sehgal 1993). Different
Studies on quality characteristics of seedling mango fruits from different locations of Himachal Pradesh

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Received: June 5, 2017, Revised: June 23, 2017, Accepted: July 5, 2017

ABSTRACT Seedling mango (Mangifera indica L.) is one of the fruit which has got commercial importance for the production of traditional pickle. In Himachal Pradesh (HP) seedling mango is available in the lower hills or plain areas of various districts like Kangra, Hamirpur, Bilaspur, Una, Mandi and Sirmour. Green mature fruits were collected from different locations of HP and analyzed for various quality characteristics which are desirable for pickle making. Among various locations, mangoes from Bhawarna and Amb locations had significantly distinct physical characters i.e. size and weight. However, location Bhoranj had higher values of titratable acidity (4.02 %), chlorophyll content (32.23 mg/100g), starch (8.20 %), reducing sugars (2.57 %), ascorbic acid content (82.47 mg/100 g) and acid edible content indicator (3.31). Total phenols (165.70 mg/100 g) and crude fibre (3.23 %) were found highest in Noorpur and Shree Naina Devi locations, respectively. The highest sensory characteristics scores of overall acceptability were recorded in Bhoranj (7.95) followed by Sulah (7.80), Gopalpur (7.70) and Ghumarwin (7.45) locations and these locations were found to be the best for preparation of pickle.

KEYWORDS Seedling mango, physico-chemical characteristics, acid edible content indicator, crude fibre, pickle

INTRODUCTION Mango (Mangifera indica L.) is one of the most important commercial fruit of tropical and subtropical regions worldwide in terms of production, marketing and consumption. Because of the subtropical and tropical climate mango is an important fruit crop of India. It is found in wild as well as cultivated form in India, China, Mexico, Pakistan, Indonesia, Nigeria, Thailand, South Central America, Philippines, Brazil, Australia and Egypt (Kumar et al. 2007). Mango grows wild or semi-wild nearly throughout India, in tropical and subtropical hilly forests, particularly near ravines.

It is common in subtropical Himalayas, hills of western and Eastern Ghats and the forests of Central India, Bihar, Orissa, Assam and Andaman Islands. (Singh et al. 2009). Wild form of mango also known as seedling mango, which is a large evergreen tree with a heavy dome shaped crown. Fruit is drupe, variable in form and size having thick or thin skin, leathery green, yellowish or red in colour. Its flesh is firm, fibrous, sub acidic and whitish yellow to yellow orange in colour (Anon 1962). The fruit is a rich source of carbohydrates, vitamin-C and A, organic acids, minerals, anti-oxidants, fibres and proteins (Knight 1997). Seedling mango fruit is available in abundance in the lower hills or plain areas of HP. The high acidic nature of fruit can be utilised for pickle making rather than table purpose. As it is not clear that all seedling mangos available in HP are suitable for pickle making and there is greater variation in physico-chemical characteristics of green mature seedling mango, present studies were carried out to compare various quality characteristics for pickle making. So utilization of the green mature seedling mango fruits for pickle preparation can provide higher economic returns to the rural people.
ABSTRACT Five potato varieties (Gudenie, Degemegn, Belete, along with two local varieties named Father and Susalluh) during the autumn season and seven potato varieties (Jalene and Tolcha, in addition to varieties used in autumn) during the winter season were evaluated under rain fed conditions, to evaluate yield potential in Chencha district Gamo-Gofa zone Ethiopia, with experiment laid out in Randomized Complete Block Design (four blocks, three repeats). Statistical results revealed significant differences among the treatments (varieties) in the entire yield traits during the winter season whereas, tuber number per plant and unmarketable yield were statistically significant among the varieties during the autumn cropping season. Highest number of tubers per plant was recorded in Local-1 variety in both the cropping seasons. Unlike autumn season, in the winter cropping season, the highest marketable yield (33.17 t ha⁻¹) was recorded in Local-2 (Susallu) variety, while, lowest marketable yield (12.10 t ha⁻¹) was recorded in Local-1 variety. Highest unmarketable yield was recorded in Local 1 variety. Total yield of tubers ranged from 21.98 t ha⁻¹ (in Local-1) to 13.56 t ha⁻¹ (in Degemegn) in autumn season and 36.64 t ha⁻¹ (in Local-1) to 20.63 t ha⁻¹ (in Tolcha) during the cropping season. The study evidently demonstrated effect of varieties on yield attributes of potato. Growth performance of Irish potato varieties brought from Holeta Research Center was promising, though, yield attribute was found to be superior in Susallu (Local-2) variety.

KEYWORDS Potato, yield attributes, gircha, jalenie, gudenie, tolcha

INTRODUCTION Potato (Solanum tuberosum L.) belonging to the family Solanaceae originated in the highlands of the Andes in South America (Hawkes 1978). Its life cycle is perennial and spreads itself by vegetative propagation. Potato is grown as an annual species for commercial purposes (Graham et al. 2001). Potato is among the most important and promising horticultural crops of the future world. Potatoes are a source of both food and cash income in the densely populated highlands of sub-Saharan Africa and among the major tuber crops produced in Ethiopia (Scott et al. 2000). Several factors do affect the growth, morphological characters and yield attributes of potato, of which, selection of appropriate varieties and production techniques, being the most important ones.

In Ethiopia, there are limited numbers of released potato varieties for the farmer. Most of the released potato varieties demonstrated inconsistency with respect to yield attributes across locations and seasons. As can be noted from various agro-climatology documents, Ethiopia is endowed with diverse agro-ecological and soil conditions. In the country, Holeta Research Center, takes the leading role in breeding and releasing potato varieties followed by Haramaya. Most of the varieties bred and released by Holeta Research Center are confined and perform prominently under agro-ecological conditions similar to the research center. In Gamo Gofa Zone 15,000 ha of land is covered by potato production which is 9 % of the total potato production in the country. Some of the varieties of potato released by Holeta Research Center have been introduced to Chencha area, few years back. However, the productivity and quality is quite substandard compared to the national recommendation. Therefore the objective of this research was to evaluate and identify the superior potato varieties for yield attributes. Potato cultivation in Ethiopia would need intensification of the improved variety and year round...
Response of fruit thinning on yield and quality of peach cv. Red June

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ABSTRACT The present experiment was laid out to study the response of fruit thinning on yield and quality of peach cv. Red June. Treatments consisted of foliar sprays of NAA (25, 50 and 75 ppm), ethrel (100, 200 and 300 ppm), thidiazuron (10, 20 and 30 ppm) at two weeks after petal fall and hand thinning of fruits to the intensity of 10, 20 and 30 % at pea stage and unthinned control. Foliar spray of ethrel @ 300 ppm significantly increased the fruit thinning (29.05 %), whereas, tree sprayed with NAA @ 75 ppm resulted in least fruit drop (5.87 %). Different thinning treatments resulted in decreased yield as compared to control in which highest fruit yield was recorded (15.21 kg/tree). The maximum fruit weight, fruit length, fruit breadth, fruit volume, pulp to stone ratio, total soluble solids, ascorbic acid, total sugar and reducing sugar with minimum fruit firmness and titratable acidity were recorded in fruits harvested from the trees sprayed with ethrel @ 300 ppm followed by ethrel @ 200 ppm. Therefore, it can be concluded that ethrel @ 300 ppm was found as most effective chemical thinner when applied two weeks after petal fall in peach cv. Red June as it produces superior quality fruits.

KEYWORDS Peach, fruit thinning, NAA, ethrel, thidiazuron

INTRODUCTION Peach (Prunus persica (L.) Batsch) is one of the important stone fruits with wide range of climatic adaptations. It is a temperate zone plant and its commercial production area is confined between the latitude of 30 and 40° N and S. In India, however, its cultivation is confined to mid hill zone of Himalaya extending from Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Punjab, Haryana and parts of Uttar Pradesh, Tamil Nadu to North-Eastern Hill region. Due to early access to the commercial markets, peach cultivation has become a highly economic preposition. The area under this crop has increased at a fast rate since it is being planted as sole crop as well as a filler tree in orchards of mango, litchi, pear, etc. The agro-climatic conditions of the mid-hill region of Uttarakhand are very congenial for peach production, yet the productivity of quality fruit is substantially low. The major factors responsible for the low productivity and poor quality are poor management and non-adoption of improved orchard management practices.

It is well established that heavy bearing of peach trees adversely affects the size and quality of fruits resulting in poor returns to the growers. Heavy crop load can result in fruits with small size and poor quality, breakage of limbs, exhaustion of tree reserves and reduced cold hardiness. Reducing the fruit load through proper pruning and thinning, especially near the ends of branches, lessens the chances of limb breakage. To make fruit thinning easier, prune trees adequately to keep them small and lower to the ground. Fruit thinning is essential practice to optimize fruit size, maximize crop value, improve fruit shape, colour quality and promote return bloom to maintain tree growth and structure (Byers et al. 2003). The practice of fruit thinning often leads to improvement in size and quality of the fruits. Thinning of the peach fruits advanced the fruit maturity by 4 to 7 days and increases the fruit size by 20 to 35 % as compared to
Studies on fruit growth pattern, fruit drop and maturity of ber genotypes under tarai conditions

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ABSTRACT The present investigation was conducted at Pantnagar with an objective to investigate the fruit growth pattern, fruit drop and maturity of ber genotypes. The experiment comprised of twenty four treatments of ber genotypes arranged in Randomized Block Design with two replications. The results showed that fruit length and fruit diameter were higher in cv. Noki and Sanaur 3, while, minimum was recorded with Illaichi and Chhuhara, during November to December, respectively. Maximum fruit length and diameter were recorded with Sanaur 6 and Umran while minimum was recorded with Nazuk during January to February, respectively. Maximum fruit drop was observed with ZG 2, followed by Illaichi, Kala Gola and Sanaur 6 and minimum with Sanaur 3. Cultivars of ber can be classified into three groups viz. early, medium and late group, based on maturity. Cultivar Rohtaki Gola in early maturity group, ZG 3 in mid maturity group and Umran in late group were found to be promising cultivars for cultivation in tarai areas.

INTRODUCTION
Ber (Zizyphus mauritiana Lamk.), an indigenous fruit of India, belongs to family Rhamnaceae. It is an ideal fruit for cultivation in the arid and semi-arid zones. In India, ber is cultivated on 44,000 ha area yielding 425 thousand metric tonnes of fruit with national productivity of 10 mt/ha (NHB 2015). Ber is highly paying crop and rich in food value particularly in ascorbic acid and protein. Ber fruits are richer than apples in protein, phosphorus, calcium, carotene and vitamin C. The fruits are eaten fresh as well as dried and processed into the products like candy, jelly, jam, murabba, squash, juice, powder, slices, tutti-frutti and wine. A large number of ber cultivars are found scattered all over the country. Some varieties are preferred for their early or late ripening quality of their fruit pulps. Certain cultivars are better when consumed as raw and still others are prized for candying and drying. The choice of suitable cultivars is of paramount importance for their successful cultivation. Therefore, the present studies were undertaken with the objective to study fruit growth pattern, fruit drop and maturity of twenty four genotypes of ber.

MATERIALS AND METHODS
The experiment was carried out at Horticultural Research Centre, Patharchatta of GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. For the present study, twenty six years old and uniform trees of ber genotypes planted at 6 × 6 m spacing in square system were selected for this experiment. The trees were pruned at equal height and uniform intensity in the second week of May every year. Twenty four genotypes of ber were taken for experiment i.e. Banarasi Pewandi, Chhuhara, Chinese, Dandan, Illaichi, Kaithli, Kala Gola, Narikeli, Nazuk, Noki, Rohtaki Gola, Sanaur 1, Sanaur 2, Sanaur 3, Sanaur 4, Sanaur 5, Sanaur 6, Selected Safeda, Seo,
Studies on the influence of different types of mulches on quality of pomegranate cv. Bhagwa

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Received: June 22, 2017, Revised: September 20, 2017, Accepted: September 20, 2017

ABSTRACT Pomegranate is an important fruit having anti-oxidant, anti-viral and anti-tumor properties and is said to be good source of vitamins especially vitamin A, C and E, as well as folic acid. For crop cultivation mulches play an important role in conserving soil moisture especially in water deficient areas. Present investigation was carried out to evaluate the effect of organic and inorganic mulching materials on quality of pomegranate cv. Bhagwa. Different mulching materials used were T1-Black polythene mulch (100 microns), T2-Silver polythene mulch (100 microns), T3-White polythene mulch (100 microns), T4-Paddy straw mulch (6” thickness), T5-Sugarcane trash mulch (6” thickness), T6-Maize stover mulch (6” thickness) and T7-Control (without mulch). Results indicate that treatment T1, i.e., plants under black polythene was found to be most effective to improve the quality (TSS-15.89 ºBrix, pH-3.57, total sugars-14.40 % and shelf life 27.85 days) of pomegranate cv. Bhagwa. Physiological loss in weight was also least in this treatment, indicating that it resulted in fruits with maximum shelf life. Therefore, black polythene mulch can be recommended for obtaining better quality and shelf stable fruits of pomegranate cv. Bhagwa.

KEYWORDS Pomegranate, bhagwa, mulches, quality, shelf-life

INTRODUCTION

Pomegranate (Punica granatum L.) belongs to family Punicaceae and is regarded as ‘fruit of paradise’, an ancient favourite fruit of tropical and subtropical regions of the world. The fruit is symbolic of ‘plenty’ and also referred as seed apple. The versatile adaptability, hardy nature, low maintenance cost, steady and high yield, fine table, therapeutic values and better keeping quality are the main features responsible for its spread on a wide scale (Khodade et al. 1990). But, in the present days, the soil moisture becomes a very limiting factor in dry areas due to uneven rainfall and pomegranate is exposed to prolonged moisture stress in non rainy periods (Nov-May) due to high rate of evapo-transpiration that leads to the production of poor quality fruits, which becomes a limiting factor for export quality pomegranate production and weeds compromise crop productivity through competition for resources including water, nutrients and light (Wisler and Norris 2005). Pomegranate, basically is a crop of dry regions, where water is a scarce resource, therefore needs to be brought under mulching, for realising higher yields of better quality. This will also lead to improvement in water use efficiency with optimum utilization of available water for maximising production. Therefore, such studies will be useful in accentuating production of quality fruits of pomegranate, with minimal use of water, thereby, increasing the water use efficiency of pomegranate plants.

MATERIALS AND METHODS

The field experiment was conducted at Department of Fruit science, University of Horticultural Sciences, Udyanagiri, Bagalkot. The experiment consisted of seven treatments viz. T1-Black polythene mulch (100 microns), T2-Silver polythene mulch (100 microns),
Growth and yield of rice as influenced by different planting techniques

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Received: June 26, 2017, Revised: September 4, 2017, Accepted: September 5, 2017

ABSTRACT A field experiment was conducted at the farm of Uttar Dinajpur Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Chopra, Uttar Dinapur, West Bengal, India to study the effect of different planting techniques on growth and yield of rice (cv. Koushalya). The results obtained for two years on tillering pattern depicted that maximum tiller number (715.7 m⁻²) was obtained in system of rice intensification (SRI) method at 70 days after sowing (DAS). Rice crop grown with SRI technique matures at least 4-7 days earlier than other planting methods. SRI technique produced maximum plant height (152.9 cm), moderate number of chaffy grains per panicle (25.9), maximum number of in-effective tillers (43.2 m⁻²), whereas, double planting technique produced least plant height (133.1 cm) as well as least number of in-effective tillers (16.0 m⁻²). SRI technique also out yielded all other treatments with respect to yield components, grain yield (5.6 t ha⁻¹) and straw yield (7.6 t ha⁻¹). However, double transplanting method recorded highest harvest Index (HI), while, it was least with SRI method. Considering all the factors, SRI method proved to be the best method as compared to other transplanting methods under study.

KEYWORDS Rice, system of rice intensification, double transplanting method

INTRODUCTION Rice is a staple food and has a tremendous influence on agrarian economy of India. It is cultivated in India over a total geographical area of 44.14 million ha with annual production of 106.65 million tonnes with productivity of 2.42 t ha⁻¹. In West Bengal, rice is grown over 5.51 million ha, producing 15.37 million tonnes, with productivity of 2.79 t ha⁻¹. Rice production is dependent on many factor such as climatic condition, availability of soil moisture, soil fertility and other biotic and abiotic factors, which either directly or indirectly affect its growth and development. Moreover, quality and higher yield production in rice, planting techniques play a vital role.

In West Bengal the crop is cultivated in all the three seasons viz. aus, aman and boro, where, farmers mostly believe in traditional planting, giving continuous flooding during vegetative stage with draining of the water during grain ripening stage. This method of continuous flooding is practiced in all the rice growing areas because it is believed rice is an aquatic plant or at least a hydrophilic one. It is also believed that, the planting methods have a huge impact on the growth and yield besides cost of cultivation and labour requirement in rice production systems. The choice of planting technique may depend on the availability of man power and technology, especially, in developed countries where labour is very limited. Therefore, using suitable method of planting, it is possible to increase production, productivity and profitability of rice crop (Birhane 2003).

The most common methods are transplanting the rice seedlings grown on dry nursery bed or wet nursery bed, double transplanting method and system of rice intensification (SRI) method. All planting methods have some merits and demerits. Depending upon the monsoon rain and cropping systems, the farmers choose their transplanting methods. SRI method
Effect of foliar application of seaweed saps on chemical soil quality, growth and yield of black gram

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Received: March 16, 2017, Revised: June 6, 2017, Accepted: July 24, 2017

ABSTRACT A field experiment was conducted to evaluate impact of seaweed (Kappaphycus sp. and Gracilaria sp.) saps on chemical soil health, growth and yield of Vigna mungo. Foliar application of saps was carried out 35 days after sowing and at flowering with four concentrations (2.5, 5, 10 and 15 %) of K-sap and G-sap separately, 7.5 % of K-sap + 50 % RDF and control. At harvest, highest build up of organic carbon was recorded due to 15 % K-sap foliar application while highest available N was observed due to 10 and 15 % K-sap. Foliar application of 7.5 % K-sap + 50 % RDF and 5 % G-sap supported the highest available P and K in soil at harvest, respectively. At flowering, highest nodule number of 43 plant\(^1\) was recorded due to 5 % G-sap. Foliar application of seaweed saps at various concentrations, except 2.5 %, enhanced the grain yield by 27.43 % over control. The foliar application of 7.5 % K-sap + 50 % of RDF also produced the 25.73 % higher grain yield over control which was at par with those of other treatments, saving 50 % of chemical fertilizers vis-à-vis environmental pollution.

KEYWORDS Black gram, seaweed, Kappaphycus sp., Gracilaria sp., nodulation, soil quality, grain yield

INTRODUCTION In recent years, a growing interest has been observed with natural bio-stimulating substances, as long-term imbalanced use of chemical fertilizers with no or meagre amount of organics have shown adverse impact on overall soil productivity due to deterioration of physico-chemical parameters, microflora and microecology of soil (Swarup 1998). Seaweeds are new generation of natural organic fertilizers and bioactive material, water-soluble derived from marine macro algae. Recently use of natural seaweed products as substitutes to the conventional synthetic fertilizers is gaining importance. In agriculture, the application of seaweeds has gained importance as soil conditioners, fertilizers and green manure, due to the presence of high amount of potassium salts, micronutrients and growth substances. Various genera of seaweeds have been found potential to be used as biofertilizer in the form of extracts. Liquid seaweed fertilizer is a unique combination of N, P, K, trace elements, alginites and simple sugars that are in dissolved form. These are easily absorbed through roots and leaves, besides releasing trace elements bound to the soil (Chapman and Chapman 1980, Thivey 1982). The seaweed extracts are rich in micro and macro nutrients, which could enhance the soil chemical quality and accelerates the metabolic functions of plants vis-à-vis increased yield. It is a natural source of Plant Growth Regulators (PGR) like auxins, cytokinins and gibberellins, and also multi-minerals and carbohydrates that basically enrich the soil and help plants to endure environmental stress. Seaweed manure besides increasing the soil fertility increases the moisture holding capacity and supplies adequate trace elements thereby improving the soil structure. The extracted chemicals from seaweeds are biodegradable, non-toxic, non-polluting and non-hazardous to humans, animals and birds (Dhargalkar

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Soil potassium release as indices of potassium supplying power of coastal soils of West Bengal

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ABSTRACT An exhaustive pot experiment was conducted to assess the potassium supplying power of four coastal soils of West Bengal by comparing the different test values of soil K indices estimated by different chemical extraction procedures with plant indices viz., total dry matter yield and plant K uptake. The soils having wide variations of physical and chemical properties and forms of K were subjected to intensive cropping with two cycles of a crop rotation consisting of three successive crops viz., paddy - greengram - sunflower in two consecutive years. Results showed that plant dry matter yield and cumulative K uptake had highly significant positive correlations with available K (NH₄OAc-K), non-exchangeable K (HNO₃-K), step K, constant rate K (CR-K), cumulative release K, planar K (Kₒ), and equilibrium activity ratio of K (ARₑOK) and significant negative correlations with non-specific sites K and Gibb’s free energy change. Based on the magnitude of the correlation coefficient values between soil K indices and plant indices, various soil K parameters were arranged in the sequence of Kₒ > CR-K > cumulative K release > ARₑOK > NH₄OAc-K > step K > HNO₃-K. These suggest that any of the soil K parameters might serve as a good index of long-term K supplying power of the coastal soils.

KEYWORDS Step K, constant rate K, non-exchangeable K, Q/I relation, coastal soils

INTRODUCTION

Rapid chemical soil testing procedures across the globe have been suggested to assess the plant availability index of soil K for making sound fertilizer recommendation. But none of these could give authentic and reliable indicator in soils due to extreme heterogeneity of soil characteristics, crops and climatic conditions (Subba Rao et al. 2009). It thus failed to provide a good relationship between estimated soil K and plant K uptake. Neutral normal ammonium acetate which extracts both solution and exchangeable K (surface and edge sites) has been used most widely an extractant for evaluating plant available soil K (Pal and Bansal 1999, Bedi et al. 2002, Aramrak et al. 2007, Hosseinpur and Zarenia 2012). However, the usefulness of this method in predicting the soil K available to crops is questionable (Tafaroji et al. 2005, Zarrabi and Jalali 2008). Many researchers alternatively suggested the non-exchangeable K of soil as the predictor of available plant K. Extraction of soil with boiling IN HNO₃ method which extracts solution, exchangeable and non-exchangeable K has been advocated as a good index of long term K supplying ability of soils (Tiwari et al. 1996, Bhatt and Meisheri 2007). In this connection, ‘step K’ and ‘constant rate K’ to measure the K releasing capacity of soil under intensive cropping condition is relevant (Haylock 1956). Step K generally measures the plant-utilizable non-exchangeable K, whereas constant rate K determines the rate of K release from mineral lattice under K stress. The thermodynamic approach most often used to characterize the K supplying capacity of soil is the quantity-intensity (Q/I) relationship of potassium (Beckett 1964 a, b). In simple terms, the Q/I relationship of a soil relates the change in the labile K in the soil to corresponding changes in effective concentration in the equilibrium solution. Numerous
Evaluation of biocontrol agents for management of Stemphylium blight of onion

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ABSTRACT onion is an important commercial crop grown all over the world. It is attacked by many diseases which cause yield losses and result in lowering the quality and export potential of the produce. Stemphylium blight caused by Stemphylium vesicarium (Wallr.) Simmons is one such disease, which has become an economic threat since past few years, especially in Northern and Eastern India. In the present study, field evaluation as well as in vitro tests were conducted for evaluating some biocontrol agents for the management of Stemphylium blight, as well as to record their effects on yield and quality parameters of onion. The results of the in vitro study revealed that Trichoderma harzianum strain PBAT-21 gave highest mycelial inhibition (60 %), followed by Pseudomonas fluorescens strain PBAP-27 (57.45 %). From the results of the field experiments, all the treatments were found to be significantly better over check in reducing the disease severity. T. harzianum was found to be most effective, giving almost 50 % disease control over check after spray at 45 days after transplanting, followed by P. fluorescens. The yield and proportion of A-grade bulbs were also higher in the T. harzianum treatment. Thus, it was concluded that T. harzianum PBAT 21 was most effective among the tested bioagents in managing the Stemphylium blight of onion.

KEYWORDS Stemphylium vesicarium, bioagents, Trichoderma, inhibition, yield

INTRODUCTION Onion is one of the most important commercial crops, grown all over the world, used as a vegetable and is the most widely cultivated species of the genus Allium. India is the second largest producer of onion but still India falls behind in terms of productivity. Among the various reasons, diseases are an important constraint in onion production. The crop is attacked by many diseases which not only causes yield losses but also result in lowering the quality and export potential of the produce. Stemphylium blight, caused by, Stemphylium vesicarium (Wallr.) Simmons, is one such disease, which was not a major economic threat in the past, but in recent years, has become a serious problem throughout the country, especially in Northern and Eastern India including Uttarakhand. Surveys conducted by NHRDF indicated that Stemphylium blight was more severe in the winter/summer than in the rainy season with 1.3-100 % incidence and sometimes may cause 100 % crop losses (Singh et al. 1992, Gupta et al. 1994). Leaf blight can prematurely defoliate the crop and make it more susceptible to secondary infections. Disease intensity varies from 5 to 50 % in bulb crop and 20 to 90 % in seed crop. Despite of the other management strategies like cultural practices, field sanitation, biological control, farmers are more inclined on using chemical management options as it offers quick and ensured effectiveness. But use of chemical fungicides has various drawbacks like development of resistance in the pathogen against a particular chemical or group of chemicals due to the repetitive use of the same chemical, problems of pesticide residue accumulation in the edible plant parts which deteriorates the quality of harvested produce and makes the onion bulbs less desirable or unfit for consumption and export purposes. Therefore, it is urgent to work out effective and safe management options such as biological control that can be included...
Codling moth and its area wide integrated pest management in Kargil, Ladakh

BASHIR AHMED RATHER

Received: April 5, 2017, Revised: September 21, 2017, Accepted: September 24, 2017

ABSTRACT The present study was aimed to understand the impact of area wide pest management capsule against codling moth (CM) in Kargil region. Different management strategies implemented include pheromone traps for monitoring and mass trapping, three consecutive sprays with three different insecticides each and cultural practices like destruction of infested fruits and burlapping of tree trunks. Time of application of different tools of pest management from biofix to overwintering of larvae yielded significant results in reducing the damage in comparison to control. Average captures of codling moth/trap/week were 7.73 and 6.52 during I and II year, respectively. The mean fruit injury during I year was recorded at 19.62 % against control at 70.65 %, while, during II year, it was recorded at 14.38 % against control (67.18 %). Overall impact of the pest management module recorded significant reduction in pest infestation and consequently in CM fruit injury in comparison to control during both the years of study. Results of the two year study revealed that, installation of pheromone traps for monitoring and mass trapping, combined with timely application of three consecutive insecticide sprays and adoption of cultural practices like removal and destruction of infested fruits and burlapping of tree trunks, effectively controlled the larval infestation in the field.

KEY WORDS Codling moth, chemical control, pheromone, apple, area wide IPM, damage

INTRODUCTION Kargil the cold arid region of Jammu and Kashmir is located between 32-36 °N latitude and 76-79 °E longitude, about 205 km from Srinagar with a total geographical areas of about 14 thousand km². The altitude of the area ranges from 9000 ft to about 14000 ft amsl. The region is characterized by extremes of seasonal temperatures ranging from -35 °C in winter to 35 °C in summer. Besides the region experiences high transpiration and evaporation due to low humidity and high velocity winds.

Codling moth, Cydia pomonella L. is the predominant and key pest of apple, widely distributed in all the fruit growing areas of Ladakh. The alternate host is pear and walnut but the larvae may also attack plum, apricot, crab apple, quince, and other fruits. Its distribution is restricted to Ladakh region of Jammu and Kashmir state (Malik et al. 1972). The damage caused by the pest is enormous (48-89 %) and average fruit infestation of apple was recorded at 49.7 and 42.5 % for Kargil and Leh districts respectively (Zaki 1999).

All the cultivars of apple (indigenous and introduced) are reported to be seriously infested by pest with varying degree of susceptibility. It completes 1-3 generations in one season in Ladakh region. Mature codling moth larvae overwinter in silken cocoons under loose bark in cracks and crevices, in the soil or in wooden materials (bins, ladders, poles, buildings, large prunings) or beneath stones beside infested trees. Larvae pupate in the spring and adults usually begin to emerge in early May and continue emerging until late June (mid-July in cooler areas), depending on temperature. The rate of development varies with temperature proceeding more rapidly in areas with warm weather and climates like Hardas, Sanjak and Batalik, as compared to Akhchal, Shilikchey Kirkatchoo, Minge, and Gongma (Hussain et al. 2014). An understanding of the biology and population...
ABSTRACT Yield gaps in adoption of Pusa Basmati 1509 under irrigated farming situations were assessed in district Mandi, Himachal Pradesh during Kharif seasons from 2014-15 to 2016-17. A total of 56 Front Line Demonstrations on Pusa Basmati-1509 were conducted in 26 villages of four paddy growing development blocks of the district. Improved technological package of Pusa Basmati 1509 was compared with that of farmers’ practice and results revealed that with the adoption of improved production technology on Pusa Basmati 1509, the grain yield was invariably higher (4002 to 4325 kg ha\(^{-1}\)) than the farmers’ plot yields (3550 to 3800 kg ha\(^{-1}\)) during all consecutive years. The magnitude of yield increase in FLD’s over farmer’s plot yields was in the range of 12.67 to 13.81 %. The technological gap ranged from 675 to 998 kg ha\(^{-1}\), extension gap from 452 to 525 kg ha\(^{-1}\) and technology index varied between 13.50 to 19.96 % in different years under study. On an average, the net return under demonstrated technology was 18.33 % higher over the farmer’s practice. Bridging the yield gaps by deploying more efficient research, extension services, ensuring timely agricultural input supplies and creating improved /milling facilities is suggested to intensify the Basmati acreage in the region.

KEYWORDS Technology gap, extension gap, technology index, Pusa Basmati -1509

INTRODUCTION

Paddy holds a unique position among all domesticated crop species as it is the staple food for over half the world’s population (Singh et al. 2012). It is grown in more than 100 countries globally in 162 million ha area with production of 741.5 million tonnes (FAO 2014). However, more than 90 % of the world’s rice is grown and consumed in Asia. In India, it is grown over about 44 million ha area with production of 109 million tonne. In order to meet the food and nutritional requirements of the people, the projected demand of rice by 2030 has been estimated at 904 million tonnes for the world and 824 million tonnes for Asian countries. India alone would require producing, about 156 million tonnes of rice by the year 2030 with the annual increment rate of 3 million tonne in the current rice production (Dass et al. 2017).

Basmati rice has a unique position in the rice world due to its price, fragrance, aroma, grain morphology, quality and other desirable traits. Aromatic rice cultivars constitute a small but special group of Indian rice cultivars and are considered best in terms of quality and aroma. In India, basmati rice is cultivated on foot hills of the Himalaya in the North Western parts of Indian sub-continent comprising the states of Haryana, Punjab, Uttaranchal, Western Uttar Pradesh, Jammu and Kashmir, Himachal Pradesh and Delhi. India produces about 70 % of the world’s basmati and nearly two third of the total production is exported to other countries (Verma et al. 2012). According to APEDA, the total area under basmati cultivation was 1.69 million ha with production of 6.15 million tonne during 2016 of which 3.99 million tonne was exported to other countries. Among agricultural commodities, basmati is the main source of export revenue to the Indian economy. Himachal Pradesh is an important hilly state of India has got the geographical indicator for basmati rice cultivation. Mandi district is
Agricultural productivity and resource use efficiency in the hills of North-East India- a case study of Arunachal Pradesh

MAILA LAMA
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ABSTRACT Present study examines growth in productivity and resource use efficiency in production of food crops in Arunachal Pradesh, a hilly state of North-East India. Agriculture is an important sector of the state’s economy. Though the contribution of agriculture in GDP of the state has declined to less than 20 %, it still accounts for around 60 % of employment. The arable land in the state is limited owing to hilly and mountainous topography. So, there is a need to improve productivity to raise income of farmers and promote rural development. The analysis of data showed that productivity of food grains in the state was lower than national average. At the same time, compound annual rate of growth (CARG) in productivity was low. The regression analysis indicated that there is inefficient allocation of resources by the farmers in the hill agriculture. The study suggests for improving extension services to disseminate new technology in the rural areas, introducing HYV seeds, improved planting material, and adoption of new technologies for improving productivity.

KEYWORDS Hill agriculture, productivity, resource use efficiency, Cobb-Douglas production function

INTRODUCTION Agriculture is an important sector of Indian economy. With industrialisation and growth of service sector, the importance of agriculture in the nation’s gross domestic product (GDP) has declined substantially over the years from 56.5 % in 1950-51 to less than 20 % at present. In 2015-16, it accounted for 17.4 % of the GDP (GOI 2016). But agriculture continues to be the mainstay of the Indian economy because of its greater share in employment and livelihood (Sekar and Suresh 2012). In India still a vast majority of people derive their livelihood from agriculture. It provides employment to around half of the total workforce (48.9 % in 2011-12) of the country (GOI 2016). It is also an important source of foreign exchange earnings. In 2015-16, agriculture and allied products accounted for 9.2 % of the country’s export earnings. The agricultural productivity in India has improved significantly in the post green revolution era. However, it is still very less compared to even some neighbouring countries like China. This may be attributed to limited spread of green revolution in few areas and few crops. The spread of green revolution was limited in the eastern parts of the country where agriculture continues to remain backward.

North Eastern Region (NER) of India, which comprises of eight states namely, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, is one of most backward regions of the country. The region accounts for around 8 % of the country’s total geographical area. But almost two-third of the region is hilly and the rest is under plains. Agriculture is the mainstay of majority of the people in North-East India. In the hilly states cultivable land area is limited, being confined to the valleys and hill slopes. There are two distinct farming systems in North-East India. In the hills of North-East India...
An economic analysis of turmeric marketing in Erode district of Tamil Nadu

VIRENDRA SINGH • DHIVYA S
Received: March 3, 2017, Revised: June 12, 2017, Accepted: June 15, 2017

ABSTRACT India is the largest producer, consumer and the exporter of turmeric and contributes 80 % of world’s production. Tamil Nadu ranks first in terms of area and production of turmeric. Erode district is famous for turmeric production and marketing. Understanding of the cost of handling operations and marketing will enable farmers to take appropriate decision. To achieve different objectives, data pertaining to the year 2015-16 from 80 farmers and 15 intermediaries of each type were collected. Unit cost of handling operations was Rs. 665.40 /q, of which 73% was occupied jointly by curing, drying and polishing operations. The marketed surplus of turmeric was 90.56 %. Most of the produce (62 %) was sold in regulated market, with higher concentration of sales during March, April and May. Channel – II was most efficient channel, with lowest marketing cost (Rs. 533.04/q), margins (Rs. 965.96/q) and price spread (15.70 %). The study emphasized a need for evolution of processes/tools, which would help to reduce the cost of handling operations and also reduce dependence of farmers on labour. The model Agricultural Produce Market Committee Act needs to be enforced with honesty to rationalize marketing cost and margins and rule out the possibility of malpractices.

KEYWORDS Turmeric, marketing cost, marketing margins, marketing efficiency, handling operations, utilization pattern, disposal pattern

INTRODUCTION India is known as the “Spice Bowl of the world” as a wide variety of spices is grown in the country since ancient times. Because of varying climate ranging from tropical to temperate, almost all spices are grown splendidly in India. Turmeric (Curcuma longa) is a yellow spice with a warm mellow flavour, derived from rhizome. It is known as “Golden spice of life” and “Indian saffron”. Indian turmeric is considered to be the best in the world because of its high curcumin content, which is responsible for a wide range of health benefits. Turmeric rhizomes are used for condiments, dye and as an aromatic stimulant in several medicines. Apart from the uses as spice, it is also used as traditional medicine in Asian countries such as India, Bangladesh and Pakistan because of its beneficial properties (Chattopadhyay et al. 2004). In Ayurvedic medicine, turmeric is a well-documented treatment for various respiratory conditions (e.g., asthma, bronchial hyperactivity and allergy), as well as for liver disorders, anorexia, rheumatism, diabetic wounds, runny nose, cough, and sinusitis (Araujo and Leon 2001). It is used in pickles as a preservative and also as a colouring agent for butter, cheese and other foodstuffs. In the cosmetics in pharmaceutical industry, it is extensively used in preparations of indigenous medicines. It is mentioned in the ‘Vedas’ that it had been used at the time of marriages, worship and other religious ceremonies of the Hindus. Even now it is considered as a sign of good omen at given prominence at the time of festivals, etc.

India dominates the world production scenario of turmeric by contributing more than 80 % of world’s production. Turmeric is one of the spice crops which earns a sizeable amount of foreign exchange (Rs.112975 crores during 2014-15). The major export destinations for Indian turmeric are Iran, UAE,
Impact of climate resilient practices in Uttarkashi district of Uttarakhand

GAURAV PAPNAI • VK SACHAN • PANKAJ NAUTIYAL • MANISHA • RK TIWARI
Received: August 25, 2017, Revised: September 14, 2017, Accepted: September 18, 2017

ABSTRACT The present study was conducted to identify the technological and socio-economic impact of the climate resilient technologies demonstrated at National Innovation for Climate Resilient Agriculture (NICRA) village at Uttarkashi district of Uttarakhand. Total 100 beneficiary farmers were selected through random sampling. To assess the impact, the ex-post-facto research design, where before and after comparisons on different aspects of NICRA project were done. The difference was tested using t-test and found that it was statistically significant. Findings reveal that the average cultivable land area of NICRA farmers after the project interventions was significantly higher than that of before the implementation of the interventions all through in kharif, rabi and summer seasons. Findings of cropping intensity, employment days, annual savings, expenditure pattern and crop yield were significantly higher in comparison to before implementation of the intervention. Findings of the study exhibited an encouraging impact of the demonstrated technologies in various spheres of farmers life of NICRA village.

KEYWORDS NICRA, impact assessment, climate, resilient, technologies

INTRODUCTION

Climate is changing gradually, at its own pace, since the evolution of earth but presently, it has gained momentum due to unintended man-made disturbances. These changes are having adverse impact on human health and the overall environment on which we depend. As agricultural production is one of the sectors of society most vulnerable to climate variability and change it is important to explore linkages between agricultural ecosystems, uncertain trajectories of future climate, and land use changes over periods of time (Parry and Carter 1989, Meinke et al. 2006). The hill agriculture system heavily depends on nature and natural resources like water, soil and forest and more vulnerable by the occurrence of extreme weather events such as rainfall, drought, floods, cold waves and relative humidity (Malla 2014). Rainfall changes have been distributed unevenly through the seasonal cycle: increases concentration in late spring to summer, whereas, winter has seen little or no change. Furthermore, the increase has been particularly marked near the western margin of the Pampas, displacing westward the transition to semi-arid regions that represent the boundary of rainfed agriculture (Berbery et al. 2006). High variation in environmental factors such as temperature, rainfall and others affect crop growth negatively and certain crops get positively affected due to change in these environmental factors. Thus, change in climatic variables may have positive and negative impact on agricultural productivity and food security situation in the economy (Greg et al. 2011). Changes in rainfall due to global climate change may affect the surface moisture availability, which becomes important for germination and crop stand establishment in the rainfed areas. Modifications in the surface and groundwater availabilities with the rainfall change, are difficult to be observed when the land use
Influence of common household processing methods on retention of bioactive components of selected plant foods

P ADIYAMAN ● G HEMALATHA
Received: August 5, 2017, Revised: September 4, 2017, Accepted: September 5, 2017

ABSTRACT The influence of household processing methods (open cooking and pressure cooking) on the retention of bioactive components of selected plant foods viz., Oryza sativa (rice), Eleusine coracana (ragi), Cajanus cajan L. (red gram), Vigna radiata (green gram), Vigna mungo (black gram), Moringa oleifera (drumstick), Amaranthus polygonoides (sirukeerai), Alternanthera sessilis (ponnanganni), Solanum lycopersicum (tomato), Solanum melongena (brinjal), Momordica charantia (bitter gourd), Solanum tuberosum (potato), Raphanus sativus (radish), Daucus carota subsp. sativus (carrot) and Allium cepa (small onion) were evaluated. The highest loss of bioactive components was observed in all plant foods after boiling (open cooking) and pressure cooking except carrot and tomato. Cooking carrot and tomato by pressure and open cooking methods had maximum retention for total antioxidant capacity (14.21 and 78.99 %) and flavonoids (56.54 and 95.20 %) contents respectively. The present study revealed pressure cooking method as the most effective cooking method in terms of better retention of antioxidant capacity and phytochemicals, which was more than 70 % of the bioactive components in the selected plant foods. Therefore, application of thermal processing had both positive and negative impact on the bioactive components of the plant foods depending on the cooking methods and type of foods.

KEYWORDS Plant foods, DPPH, FRAP, phenols, flavonoids

INTRODUCTION

Plant foods are important constituents of the human diet and provide significant quantities of nutrients, especially carbohydrates, minerals, vitamins, and fibre. Plant foods are known to have abundant amount of different antioxidant compounds including flavonoids, polyphenols, carotenoids, ascorbic acid, tocopherols and glutathione (Faller and Fialho 2009). Antioxidants are substances that delay or inhibit oxidative damage to a target molecule by scavenging the free radicals or by promoting their decomposition (Jacob 1995). The major phytochemicals (flavonoids, coumarins, tannins and other phenolic compounds) found in plant sources are capable of terminating free radical reactions and prevent our body from oxidative damage (Casanova et al. 2008, Lobo et al. 2010).

A number of epidemiological studies have revealed that a high consumption of plant foods is strongly associated with lowering the incidence of degenerative diseases such as cancer, cardiovascular diseases, premature aging, cataract and macular degeneration (Cheung and Ooi 2003, Zhang and Hamauzu 2004). Surplus consumption of plant foods provide maximum micro-nutrients which is essential for maintaining normal function of the body physiology (Bhupathiraju et al. 2013).

In India, thermal processing are methods commonly employed for cooking viz., boiling in water, pressure cooking, microwave treatment and boiling after overnight soaking. These cooking processes bring about a number of changes in physical characteristics, chemical composition and nutrient content of plant foods (Zhang and Hamauzu 2004). Thermal treatment decreased the total phenolic content in the selected vegetables such as kale, spinach, cabbage, swamp cabbage and shallots and antioxidant capacity in some of them (Ismail et al. 2004). Cooking affects the phytochemical compounds and antioxidant activity of broccoli (Zhang and Hamauzu 2004). Minimum loss of
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- Acknowledgements: (wherever applicable).

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<th>Degree</th>
<th>Name of University/Institute</th>
<th>Year</th>
<th>Major Field of Study</th>
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9. Category of membership (please tick)
   Life member / Annual member / Organization / Subscriber member

10. Payment of membership fee of (Rs) ………………… was made by CASH/ NEFT/ RTGS into ISHA’s
    Account No. 3119 0343 798 (IFSC SBIN 000 1133) vide Transaction Id …………………… dated:
    ……………………….. in favour of Indian Society of Hill Agriculture.

DECLARATION
   I wish to become the LIFE/ ANNUAL/ SUBSCRIBER member of the Indian Society of Hill
   Agriculture and if enrolled agree to abide by the rules and regulations of the society.

Date: ……………………………. Signature: ……………………………..
Place: ……………………………. Name: (……………………………………..)
Membership of the society shall be open to individuals from all nations and shall consist of the following categories of members with qualifying criteria as indicated against each. Membership can be obtained by filling a membership form and sending it to businessmanagerjha@gmail.com with a copy to editorinchiefjha@gmail.com along with membership fee (effective from 1st Jan, 2015) as detailed ahead.

(i) Ordinary Members (annual Membership)
This membership shall be offered to the individuals interested in promotion of Hill Agriculture and its allied branches. This shall also be the minimum fee to be deposited PER AUTHOR for getting a paper published, in case it is accepted for publication. There shall be an annual fee of Rs 800/- for individuals from all SAARC countries including India and US $ 30 per year for individuals from rest of the nations.

(ii) Life Members (continuing Membership)
There shall be a one time life membership fee Rs 5,000/- for individuals from all SAARC countries including India and US $ 200 for individuals from rest of the nations.

(iii) Patrons (continuing Membership)
Any individual or institution making a payment of a substantial sum (as may be prescribed by the Executive Council from time to time).

(iv) Subscribers
Any corporate body / institution / library / association of persons can subscribe Journal of Hill Agriculture by making an annual payment of Rs 2000/- for all SAARC countries including India and US $ 100 for rest of the nations.

The membership fee should be transferred by NEFT/ RTGS or directly deposited into ISHA’s Account as detailed below:

Name of Account Holder: Indian Society of Hill Agriculture
Account No.: 3119 0343 798
Name of Bank: State Bank of India
Name of Branch: Pantnagar (Uttarakhand)
Branch Code: 001133
For NEFT/ RTGS Transfer IFSC Code: SBIN 000 1133

Important Note: For all transactions, please do not forget to send your duly filled
(i) duly signed membership form,
(ii) bank transaction Id
(iii) scanned copy of stamped deposit slip (counter foil).
by e-mail to businessmanagerjha@gmail.com with a copy made to editorinchiefjha@gmail.com

**SUMMARY**

<table>
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<th>Type of membership</th>
<th>Fee for SAARC countries</th>
<th>Fee for rest of the nations</th>
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<tr>
<td>Annual member</td>
<td>Rs 800/- per year</td>
<td>US $ 30 per year</td>
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<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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</table>

Year shall be counted w.e.f. January 1 to December 31 of each year. If somebody deposits fee in October 2017 it shall be counted only for that year i.e. 2017.
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