Horticulture in Punjab has been established to boost the rural economy which not only has much higher potential to generate higher profit/unit area but also provides more productive employment opportunities along with the much required nutritional security for the people. Out of the total 3.79 lakh ha area under horticulture crops, around 0.90 lakh ha is under fruits and 2.89 lakh ha under vegetables. Floriculture is considered as a big boost in the state during the past few years and area under floriculture in Punjab is 2120 hectares out of which 1668 ha is under fresh flowers and 448 ha is under seed production of seasonal flowers. PAU is working on improved varieties and production technologies to enhance production of horticultural crops, increase water and fertilizer use efficiency through micro-irrigation and strengthen nutritional security. PAU is imparting trainings related with skill development to create employment generation opportunities for rural youth in horticulture and post harvest management, especially in the agro-processing sector. The vegetable nutrition garden has occupied an important place in every home either in the backyard, near the house or on-farm. PAU has recommended the technology for round the year mushroom production with paddy straw mushroom & milky mushrooms in summer and oyster & shiitake mushrooms in winter. Horticulture crops can be replacement of traditional crops to save resources and increase farmers' profits, provided suitable infrastructure and marketing opportunities are available.
Responding to challenges of Punjab agriculture through reorientation of research

BY NAVTEJ SINGH BAINS
Director of Research

The research areas strengthened cover (i) diversification crops including fruits and vegetables, (ii) natural resource conservation, (iii) integrated pest and nutrient management, (iv) nutrition, processing and value addition, (v) farm machines to facilitate natural resource management and reduce cost of cultivation, and (vi) biotechnology tools for improvement of vegetables, fruits, pulses and maize.

Punjab’s rice-wheat cropping system has remained intimately coupled with national food security needs for more than half a century. The association has been marked by an unbroken spell of food grain production at productivity levels that vie with the best in the world. Though unsustainability issues got flagged in 1980’s, yet the role and policy context of Punjab agriculture remained unchanged till recently. The intensification of rice-wheat cropping system has continued till present time. We have been waiting to jump from this peak (symbolizing the present productivity system) to the next which is at the same level of livelihood support if not higher but rooted in a more sustainable landscape. If this is to be done without encountering transition costs, strategic support to the state’s agriculture (which is undoubtedly well deserved) is mandatory. The challenges on the road to sustainable agriculture in Punjab and possible solutions are matters of deliberation in multiple fora. Punjab Agricultural University’s role often comes into question in this context: Has some ground been prepared for the perceived and the unforeseen challenges? Significant re-orientation of research work at PAU, over the last one decade, has taken place in response to existing and emergent challenges and is shared here briefly.

The research areas strengthened cover (i) diversification crops including fruits and vegetables, (ii) natural resource conservation, (iii) integrated pest and nutrient management, (iv) nutrition, processing and value addition, (v) farm machines to facilitate natural resource management and reduce cost of cultivation, and (vi) biotechnology tools for improvement of vegetables, fruits, pulses and maize. This strengthening was facilitated through redeployment of scientists in the above key areas. This is reflected in the increase in number of scientists at the main campus over the 2010 levels in case of fruit crops (21 to 27); vegetables (20 to 23); fodder, maize and cotton (8 to 18); and biotechnology of diversification crops (8 to 15). During the same period, faculty positions at Fruit Research Stations of the University (at Abohar, Gangian, Bahadurgarh and Jallowal) increased from 8 to 15. At Regional Station located at Ballowal Saunkhri (devoted to rainfed and Kandi area agriculture), the number rose from 10 to 15. The faculty at Regional Research Station, Bathinda, with focus on cotton, oilseeds and salinity research was enhanced from 13 to 24, while at Regional Research Station, Kapurthala it went up from 2 to 11 for research on sugarcane. This was achieved through restructuring, keeping overall faculty strength of the University almost constant, in line with available resources.

As an important measure, research programmes on alternative crops were shifted to relevant agro-ecological niches (rather than use these locations as testing sites only, while conducting major research work at main campus). As part of this move, strong research teams were set up at the Regional Research Stations of the University. The shifting of research programmes on cotton, citrus and sugarcane to Bathinda, Abohar and Kapurthala, respectively, delivered positive results. Sugarcane subproject at Faridkot was recently (2020) shifted to Gurdaspur to house it in a denser sugarcane cultivation zone. In keeping with the philosophy of diversified, region specific research, new farms were set up to target relevant geographical niches besides enhancing the range of evaluation sites in view of stability of performance demanded by the changing climate scenario. These stations were set up at Khanaura (Hoshiarpur) for potato and pea; Dayal Bharang (Amritsar) for pear and pea; Ratta Khera (Muktsar) for research on saline, waterlogged soils; Jeewan Singh Wala (Bathinda) for ber, jamun and guava; and Ruldu Singh Wala (Bathinda) for agroforestry.

Over the last decade, interdisciplinary units representing convergence of multiple activity/knowledge streams for serving new needs have been set up. These include School of Organic Farming, Water Management and Technology Centre. Agricultural Marketing Innovations Research and Intelligence Centre (AMIRIC), Food Industry Business Incubation Centres at Ludhiana and Bathinda, and Skill Development Centre.

New initiatives are continuously required in organizations to keep irrelevance and obsolescence at bay. Many of these were made possible through faculty redeployment (mentioned above) and taking up of new research mandates. Salient initiatives over the last 10 years include the following: (i) Hybridization as a regular research strategy in fruit crops (citrus, guava and mango), (ii) Creation of Fruit and Basmati Breeding Sections, (iii) Rice research on early duration varieties (PR 121, PR 126, etc. developed),
Acquisition of large germplasm sets of diversification crops (cotton, sesame and minor millets), (v) Introduction of moringa, olive, dragon-fruit, etc. for exploring potential as new crop, (vi) Mutation breeding initiated in pulse crops to generate variability not available in germplasm evaluated, (vii) Facilitating mechanization through crop breeding: e.g. cotton ideotype for mechanical harvesting, mono-picking varieties of pea, (viii) Initiating breeding programme in potato with crossing work at PAU Research Station in Lahaul-Spiti (Keylong), (ix) Developing machines to address emergent situations, e.g., high clearance sprayer for cotton, Lucky Seed Drill, portable maize dryer and mobile pea threshers-cum- depodder, (x) Development of maize composites and production of seed of maize hybrids in Peninsular India by arrangement with Maharashtra State Seed Corporation. (xi) Development of a large set of technologies based on biopesticides and biofertilizers, (xii) Focus on marketing intelligence research through data based projections (AMIRIC) and pilot marketing projects (recently conducted for mash in Gurdaspur district, and spring moong in Moga district), (xiii) Orienting research to crop niches through improved varieties (e.g. variety J 87 of groundnut), (xiv) Safe food production practices certification scheme as a more sustainable agricultural system and a more widely applicable alternative to organic food certification.

Dividends from the above discussed restructuring and new initiatives have started manifesting and the confidence gained in the process augurs well for future challenges, however daunting. Among the salient ones is development of short duration Parmal rice varieties (e.g., PR 121 and PR 126) which are 3 to 5 weeks earlier in maturity than full duration varieties and possess good milling quality, besides competitive yield. Acreage share of about 70 per cent among Parmal rice grown in the state, translates into substantial saving of water. A promising basmati rice variety Punjab Basmati 7 has also been released recently (2021).

The Punjab Agricultural University has emerged as a leader in Bt cotton with three Bt varieties released at national level. Access to new and established Bt genes through various collaborations, initiative on transgenic based resistance to whitefly, development of novel plant type for mechanized picking and tapping into wild and related species for whitefly and cotton leaf curl resistance has helped firm up cotton’s position as the frontrunner for crop diversification. Besides these initiatives aimed at future technologies, confidence has been built up in the growers by successful implementation of IPM based whitefly management at an unprecedented scale over the last five years. Recovering from whitefly caused crop failure of 2015 (197 kg lint/ha), record yields of 750 to 827 kg lint/ha and saving of approximately Rs 2,500 to 3,000/ha in pesticide use (compared to pesticide cost incurred by farmers in 2015) were achieved in the state during these five years (2016-2020).

Engagement with emergent situations is illustrated well by multiple approaches and technologies (surface retention, incorporation, ex situ uses for bioenergy, etc.) developed and disseminated by PAU for paddy straw management. The PAU-developed farm machines, such as, Super Straw Management System and Happy Seeder were at the core of Central government support to various North Indian states under its crop residue management programme. The latest paddy straw management innovation is a strip seeder that combines advantages of Happy Seeder and Super Seeder which is under farmer field testing.

The focus on breeding in horticultural crops has paid rich dividends in form of a breakthrough i.e. less seeded variety, PAU Kinnow 1; Daisy and W Murcotts diversification options in citrus; excellent guava varieties - Punjab Safeda, Punjab Kiran and Punjab Apple Guava; unique vegetable varieties like wilt resistant and popular chilli hybrid (CH 27); virus resistant pumpkin (Punjab Nawab); hull less seeded, PAU Magaz Kadu 1; nematode resistant Jhar Karela; carotene rich cherry tomatoes, Punjab Kesar Cherry; and heat tolerant marigold, Punjab Gainda No. 1. This is just an eclectic subset of horticultural varieties whose number released per year now often exceeds those of field crops.

Latest among a series of water saving, macro and micro irrigation technologies developed at PAU is the Tar Wattar Direct Seeded Rice, another example of rapid research response to an emergent situation. The Tar Wattar methodology finalized ahead of the 2020 planting has found favour with the farmers and has distinct water saving features. This agronomic solution also involved development of a unique machine in the form of Lucky Seed Drill which facilitates simultaneous weed management as well. Short and medium duration varieties have fitted in well with DSR requirements. Molecular marker based speed breeding for DSR traits has been ramped up and some fixed materials are already in initial testing. While the relevant genetic resources were being developed, finished variety development has now been initiated. To expect that variety development should have preceded reasonable adoption of DSR on farmers’ fields is not realistic. Further, resources do not permit starting breeding programmes in a vacuum.

Diversification potential of oilseeds and pulses is generally over rated and these were never grown on a large acreage in Punjab historically. These crops are nevertheless under intense research focus and canola (Gobhi Sarson) variety GSC 7 has earned grower acceptance across the state. Similarly, an important research lead in pulses is the substantial yield enhancement in case of early maturing, Arhar variety, AL 882 grown under late, high density planting regime.

With all the above focus on diversification crops, it should go to the credit of the University that it has also maintained its turf in rice and wheat, and used its strength to mould the programmes in the desired direction e.g., short duration, water saving, residue management amenable Parmal rice varieties and wheat varieties suited to resource conservation technologies. Quitting this arena, as sometimes suggested, would have been an undesirable situation, inviting criticism and rendering PAU weak vis-à-vis competing institutes. So, if questions must be asked about diversification of cropping pattern in Punjab, let the discerning observer ask as to why, with an array of diversification technologies, wonderful varieties of vegetables, fruits and alternative field crops accompanied by their production technologies, has diversification eluded Punjab?
Processing: A need for sustainable fruit industry

BY KRISHAN KUMAR AND SUBHASH CHANDER
Dr JC Bakhshi Regional Research Station, Abohar

The adoption of fruit processing can manage post-harvest losses, ensure better price and generate employment opportunities.

To raise awareness about the health and nutritional benefits of fruits and vegetables, the United Nations has rightly declared 2021 as the Year of Fruits and Vegetables. The importance of fruits in boosting immunity has been realized even more during the prevailing COVID-19 pandemic. Unlike food grains, fruits are highly perishable and have a short shelf and storable life. Due to these limitations, the fruit crops have to be marketed in a short period which compels the farmers to sell their produce at marginal prices. In case of bumper production also, glut is created in the market, causing fall in sale price. It is estimated that 6-16 per cent of the produce is lost in the value chain from farm gate to consumer. The processing of fruits into other value added products offers an opportunity to the farmers to regulate prices of their produce, fetch better prices and generate employment. This can also assure extended availability of fruits in the form of a product and minimize post-harvest losses.

Fruits processed products: The fruits can be processed into various value added products like jam, jelly, preserve, candies, juice, squash, nectar, ready to serve (RTS) beverages, carbonated beverages, pickle, etc. The specification for these fruit products is given in Table 1.

Fruit crops and their processable varieties: The processable varieties and processed product of different fruit crops are listed in Table 2 and described below:

Citrus: Citrus comprise mandarins, sweet orange, lime and lemon, and grapefruit. Among mandarins, Kinnow has high juice content, but seeds upon crushing impart delayed bitterness in the juice. The recently released variety PAU Kinnow 1 has low seed content. This may prove to be a good prospect for juice industry. After juice extraction, the fruit peel remains as the by-product. Kinnow peel contains various flavonoids. Nowadays, the peel is being used for extraction of nutraceuticals. The peel can also be used for making wine by alcoholic method of fermentation. Sweet oranges are used for extracting fresh juice. Limes and lemons can generally be used for making pickles.

Mango: Mango is mostly processed in the form of mango pulp in India. The desi/achari mango is used extensively for making of pickles. A lot of other products are also being prepared from mango pulp at domestic and commercial scale.

Guava: Guava can be processed into juice, nectar and leather. The red-fleshed varieties ‘Punjab Pink’ and ‘Punjab Kiran’ are highly suitable for coloured juice. The guava pulp can also be mixed with other nutritionally rich fruits like mango, papaya, aonla, etc. to add flavour and increase nutrient content.

Grapes: Grapes can be processed into juice, raisin, wine and vinegar. The ‘Punjab Macs Purple’ variety of grapes is rich in anthocyanin and eventually a rich source of antioxidants. It can be processed into juice and red wine. This variety has high total soluble solids (17-18%) with acidity of 0.50 per cent. This yields 60-65 per cent juice. For making wine, a small scale technology has been standardized by PAU. Similarly, the production technology of

Table 1: Specification for different fruit products

<table>
<thead>
<tr>
<th>Product</th>
<th>Fruit Juice (%)</th>
<th>TSS (%)</th>
<th>Acidity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural juice</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ready to Serve (RTS)</td>
<td>10</td>
<td>10</td>
<td>0.3</td>
</tr>
<tr>
<td>Nectar</td>
<td>20</td>
<td>15</td>
<td>0.3</td>
</tr>
<tr>
<td>Squash</td>
<td>25</td>
<td>40-50</td>
<td>1.0</td>
</tr>
<tr>
<td>Chutney</td>
<td>40</td>
<td>50</td>
<td>1.0</td>
</tr>
<tr>
<td>Jam</td>
<td>45</td>
<td>68</td>
<td>0.5-0.7</td>
</tr>
<tr>
<td>Jelly</td>
<td>45</td>
<td>65</td>
<td>0.5-0.7</td>
</tr>
<tr>
<td>Preserve</td>
<td>55</td>
<td>68-70</td>
<td>-</td>
</tr>
<tr>
<td>Canned fruit</td>
<td>Dip in 20-55° B sugar syrup</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pickle</td>
<td>Add 10% salt</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Contd on page 7
Diversification in South-Western Punjab through citrus wealth

BY AK SANGWAN, MK BATTH AND PK ARORA
Fruit Research Station, Abohar

Citrus is highly prized and remunerative fruit crop of the region, and its cultivation has proved to be a boon for the farmers due to its higher economic productivity as compared to other fruit crops. It comprises grape fruit, lemons, limes, sweet oranges and mandarins.

The citrus fruit ranks numero uno in production and trade among all fruits produced in the South-Western part of Punjab. The agro-ecological conditions of South-Western Punjab are best suited for the production of citrus. Citrus is highly prized and remunerative fruit crop of the region, and its cultivation has proved to be a boon for the farmers due to its higher economic productivity as compared to other fruit crops. In citrus, Kinnow mandarin is primarily cultivated due to its more adaptability and higher returns. But the markets witnessed a huge glut of Kinnow fruits, resulting in price crash during peak harvesting period and low economic returns to the fruit growers. Therefore, to expand the area under citrus cultivation, monoculture of this single crop should be avoided. Citrus comprises many species of economic importance which can be commercially cultivated in the region; it includes grape fruit, lemons, limes, sweet oranges and mandarins. These varieties will lead to diversification within citrus and widen the harvesting window, which may be helpful in avoiding glut of any single variety and enhancing the profit of the farmers.

In mandarins, Kinnow is the most popular variety; it has replaced most of other citrus varieties under cultivation and area is consistently increasing under this fruit till date. Because its trees are highly productive; it is not uncommon to find 1,000-1,500 fruits per tree in the region. This helps to the fruit growers in getting handsome returns, much higher than those obtained from most of other fruit crops even at low rate. In recent time, PAU also recommended improved variety of Kinnow mandarin for general cultivation in the state i.e. ‘PAU Kinnow 1’. Its fruits are low-seeded as compared to Kinnow mandarin having 0-9 seeds per fruit. All other traits are comparable to Kinnow mandarin. Besides, Daisy mandarin is also a good option as it is an early variety and matures within first to third week of November. The average fruit weight is high (210 g) with reddish orange skin colour and glossy appearance. W. Mucrott, a mid-season variety which matures from January 1-20 having average fruit weight of 201 g, is also available for cultivation in the state.

Sweet oranges, another important group, include Early Gold, Mosambi, Jaffa, Blood Red and Valencia Late. Early Gold is recently released variety and its fruits ripen during last week of October to mid of November. It is low seeded variety (2-6 seeds per fruit). Another distinctive variety is Mosambi. It is an early maturing variety and fruits ripen in November. Jaffa is another mid-season variety which matures in December. Blood Red is a prized variety of Punjab, distinguished by the development of red pigmentation in the pulp with deeply coloured cadmium-yellow
Table 2: Fruit crops and their varieties suitable for processing

<table>
<thead>
<tr>
<th>Fruit crops</th>
<th>Varieties</th>
<th>Processed product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandarin</td>
<td>Kinnow and PAU Kinnow 1</td>
<td>Juice</td>
</tr>
<tr>
<td>Sweet orange</td>
<td>Mosambi, Early Gold, Jaffa, Blood Red and Valencia Late</td>
<td>Juice</td>
</tr>
<tr>
<td>Limes and Lemons</td>
<td>PAU Lemon 1 and Kagzi lime</td>
<td>Pickle</td>
</tr>
<tr>
<td>Mango</td>
<td>Desi</td>
<td>Pickle</td>
</tr>
<tr>
<td>Guava</td>
<td>Punjab Kiran and Punjab Pink</td>
<td>Nectar, juice and leather</td>
</tr>
<tr>
<td>Pear</td>
<td>Nijisseiki</td>
<td>RTS, nectar and squash</td>
</tr>
<tr>
<td>Peach</td>
<td>Shan-i-Punjab</td>
<td>Canning</td>
</tr>
<tr>
<td>Plum</td>
<td>Satluj Purple and Kala Amritsari</td>
<td>Non-alcoholic carbonated beverages</td>
</tr>
<tr>
<td>Grapes</td>
<td>Punjab Macs Purple</td>
<td>Juice and wine</td>
</tr>
<tr>
<td></td>
<td>Perlette</td>
<td>Vinegar</td>
</tr>
<tr>
<td>Aonla</td>
<td>Kanchan</td>
<td>Powder, preserve and candy</td>
</tr>
</tbody>
</table>

For grapefruit cultivation, Marsh Seedless and Duncan are white fleshed varieties suitable for the area. Marsh Seedless is known for absence of seeds, if present, these are few (0-6) and usually rudimentary; it ripens in December-January, whereas, Duncan ripens later in January. Star Ruby and Red Blush are red fleshy varieties of grapefruit; these are high in demand. Star Ruby is an early variety which ripens during last week of November and the fruits are seedless (1-2 seeds).

Lime and lemons may be a good choice for small farmers as they can earn handsome amount through cultivation of these crops at small scale. This group includes many varieties viz., Punjab Baramasi Lemon, PAU Baramasi Lemon 1, Eureka, Punjab Galgal, Kagzi and Sweet Lime which are recommended for the region. Currently, commercial planting material of all these varieties is produced at PAU main campus, Ludhiana and various research stations.

Many diversification alternatives to rice-wheat including cultivation of horticultural crops have been suggested for Punjab agriculture. But despite all efforts, area under horticultural crops is not escalating at faster rate as predicted by the policy planners. It is essential that agricultural land must be treated like a business unit, which ultimately increases output in terms of biomass and evenly distributes annual income throughout the year. Commercial orchard involves high initial investment and monetary gain is possible only after particular time due to long juvenile period. Citrus is highly beneficial and income generating crop as it has a lot of uses like nutritionally and physico-chemically rich edible products, medicinal properties, ecological and environmental benefits for controlling greenhouse effect. There is a lot of scope of high income generation for Punjab farmers through citrus production.

grape vinegar from grape variety ‘Perlette’ has been standardized by PAU that blends the flavour of grape with vinegar.

**Pear:** The soft pear variety ‘Nijisseiki’ is highly suitable for making squash, nectar and ready to serve beverages.

**Peach:** Fully ripened peach can be canned with sugar syrup. Among the recommended peach varieties, Shan-i-Punjab, which is sweet, free stone and remains firm at full maturity, is suitable for canning.

**Plum:** In plum, both the recommended varieties ‘Satluj Purple’ and ‘Kala Amritsari’ can be successfully converted into non-alcoholic naturally carbonated beverages.

Apart from the above fruits, fruit crops like date palm (cv. Hillawi) and fig can be processed as dried products. Similarly, processing of litchi into juice, bael into juice, and pulp and ber into candies can increase their value and price in the market. So, the adoption of fruit processing can manage post-harvest losses, ensure better price and generate employment opportunities. The demand of raw fruits for processing can also prompt area expansion under fruit crops. The training in processing can be acquired from Punjab Agricultural University’s Food Industry Business Incubation Centre located at Ludhiana and Bathinda. The short courses/trainings are also organized by Krishi Vigyan Kendras (KVKs) located in each district.

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Minor fruit crop cultivation: A way to diversity and better nutritional security

BY HARMINDER SINGH AND JS BRAR
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The diversity within fruit cultivation may harness better delicacy and nutritional options, and ensure availability of fresh produce for longer period.

Fruit plants can be grown quite successfully in Punjab due to suitable climate, availability of rich soils and good quality irrigation water. At present, fruit crops occupy 90,446 hectares of area with an estimate production of 1.96 million MT. Citrus, guava, mango, pear, peach, litchi and ber occur more than 95 per cent area of fruit crop in the state. Apart from this, other fruits can also be successfully grown in the state. The diversity within fruit cultivation may harness better delicacy and nutritional options, and ensure availability of fresh produce for longer period. Despite the availability of suitable cultivars and production technologies, the fruit crops like amla, plum, jamun, papaya, phalsa, loquat, sapota, fig, bael and pomegranate fail to get momentum due to one or the other reasons and thereupon still categorized as minor fruit crops of Punjab.

AMLA: It is highly nutritive and popularly known as ‘Amrit phal’. The fruits are rich in vitamin C, pectin and minerals. The processing potential of amla is unmatched as it is the main ingredient in ‘chawanprash’ and one of the three ingredients in ‘triphla’. The fruits are processed into delicious products like preserves, jam, candy, dried chips, jelly, pickles, juice, sweets, murabba and powder for year-round production. It can be grown in varied soil and climatic conditions. It is a potential crop for degraded lands and marginal soils having soil pH of 6.0 to 9.5. It also bears minimal biotic and abiotic stresses.

PLUM: Plum is a temperate fruit crop but its low chilling varieties can be grown quite successfully in Punjab. It can be planted in solid block as well as filler tree in orchards which start bearing late i.e. pear, mango, sapota, litchi, etc. The availability of fresh fruit from the beginning of May fetches good returns as there is no other competition from other fresh fruits except peach. Its fruits can be used either for fresh consumption or processed into squash and jam.

SAPOTA: Sapota is also an important fruit that can be grown, especially, in central and submontane parts of Punjab. Although its juvenile period is quite long, yet it has a very long productive life. Its pulp is sweet and melting, and it is a good source of digestible sugar and has appreciable amounts of dietary fibers, carbohydrates, protein and minerals like potassium, calcium, phosphorus and iron.

JAMUN: Jamun is an indigenous fruit having good commercial value. The fruits are good source of anthocyanins, iron, pectin, phenols and proteins. The pulp and seeds of jamun are well known to cure the diabetes from centuries. The plants are very hardy, and highly suitable for avenue and boundary plantation. It can act as a very good wind break for other fruit orchards. Jamun can be grown on wide variety of soils and does well even on marginal, saline, waterlogged and alkaline soils. It requires very less care, thus, making it highly profitable fruit crop.

PAPAYA: Papaya is quite suitable for planting as backyard plantation and its plants pose an aesthetic value in kitchen gardens. It is the richest source of vitamin A after mango. It is also an excellent option for planting as filler plants in orchards which start bearing late. Due to its sensitivity to frost, stagnation of water, high and low temperature and to leaf curl virus, it is advise to plant under protected conditions. Papaya is very quick growing and starts bearing within 8-10 months of transplanting.

PHALSA: Phalsa is a rich source of vitamin A, iron and minerals. It can be consumed as fresh fruit as well as used for preparing juice and syrup. It is a very hardy and bushy plant, and is highly suitable for intercropping and boundary plantation. It is free from all types of biotic and abiotic stresses and bears fruit heavily.

LOQUAT: Loquat is another fruit crop with scanty plantation, especially, under submontane zone of Punjab. Its fruit usually ripens during March-April when there is hardly any fresh fruit available in the market. It is a low calorie fruit but very rich in potassium, iron and dietary fibers. It grows very well on fertile and light sandy soils.

FIG: It is commonly known as ‘Anjeer’ in North India. Its fruits have a prized position over the centuries owing to their medicinal and dietary properties. The figs are consumed fresh, dried, preserved, candied, canned or used for jam making. It is a fruit with low calorific value and high dietary fiber, potassium, iron and calcium. It has a wider adaptability to different soil and climatic conditions. Its plants are deciduous, thus, tolerating frost and low temperature without injury.

DATE PALM: The cultivation of date palm can also be explored in the areas where little options are available for fruit cultivation. It can tolerate waterlogging, salinity and pH
upto 10.0. It can also be planted as boundary or roadside plantations as in addition to fruit production, the trees give an immense aesthetic value. Fruits have high nutritive and calorific food value and are rich in minerals, vitamins, dietary fibers, proteins, antioxidants and pharmacological properties. It also has an immense processing potential as different types of products like dry dates, juice, wine, chutney, jam, pickles and bakery items can be prepared from fruits.

**BAEL:** It is considered as medicinal fruit plant. Its plants are very hardy, and can thrive well in saline and alkaline soils. It thrives well even under water scarce conditions because the plant sheds its leaves during summer months. The fruits of *bael* are rich source of riboflavin, vitamin A and carbohydrates.

The reference of *bael* fruits in large number of ayurvedic medicines since ancient times signifies its nutritional and pharmacological properties. Fruit pulp acts as a very good laxative, and is beneficial for heart and brain. *Bael ‘Sharbet’* is a cool and refreshing drink during summers, and is quite popular in Patiala as well as surrounding areas.

**POMEGRANATE:** The climatic conditions of Punjab are not highly suitable for cultivation of pomegranate on large scale; hence consult horticulture experts before planting for commercial cultivation. It is commercially grown for table purpose and processing. The bark of the stem, root and rind of the fruit is used for slimming, control of dysentery, diarrhea and killing of tapeworms. Fruit juice is valuable medicine for leprosy patients. Cool winters and hot dry summers produce the best quality fruits. It thrives in hot dry regions with irrigation facilities. Pomegranate plants can tolerate even alkaline and wet soils. The cold winters make the trees deciduous which are otherwise evergreen.

The farmers are urged to plant few acreage or plants of minor fruit crops to bring diversity in fruit cultivation in the state. This will also provide nutritional security to the people. The plants are available at fruit nurseries of PAU located at Ludhiana; University Seed Farm, Ladhowal; Regional Stations, Abohar, Bathinda, Gurdaspur and Ballowal Saunkri; Fruit Research Stations Bahadurgarh (Patiala), Gangian (Dasuya) and Jallowal (Jalandhar). The University has also developed the model of ‘Fruit Nutrition Garden’ in which farmers can plant 55 fruit plants of 21 types in 625 sq m (1.25 kanal) area. This plan is for ensuring the nutritional security of family and availability of fruits round the year. This is an appropriate time for planting of evergreen fruit plants, so the fruit plants discussed above should be planted for commercial as well as backyard plantations. For more details, horticulture experts may be consulted and information is also available at the University website (www.pau.edu) and in University publications.

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Planting of new orchards and initial management of fruit plants

BY SARVPRIYA SINGH, AJITPAL SINGH DHALIWAL AND PALWINDER SINGH

Krishi Vigyan Kendra, Bathinda

An orchard is a long-time venture and mistakes committed at the initial stages of orchard establishment are very difficult to correct at later phases as they cause an unbearable loss to the growers. Orchardist can prevent many risks by adopting appropriate orchard establishment practices. The main aim of this article is to minimize the losses to the new growers, who want to establish a new orchard.

Soil: Soil for an orchard should be well drained, loamy, fertile and free from hard pan up to depth of 2 m. Water table should be below 3 m and not fluctuating. Waterlogged, marshy and salt affected soils should be avoided for fruit growing. Before the plantation of an orchard, it is necessary to check the nutritional status and other conditions of the sub-soil and water so that fruit trees can be selected accordingly.

Layout and planting system: Layout is helpful for the systematic distribution of fruit plants, easy supervision of an orchard, maximum accommodation of number of plants/ha, and sufficient available space for proper tree growth and development. A complete sketch of the orchard should be drawn on a paper before the execution of final layout in the field.

Planting systems

Square system: In this system, the distance from plant to plant within a row and row to row is the same. The plants are planted at right angle to each other and every unit of four plants forms a square. The intercultural operations in the orchard are carried out in both the directions.

Rectangular system: Rectangular system is useful for intensive or high density plantations. The trees are planted along parallel rows running at right angle; the

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Table 1: Spacing in fruit plants under square system

<table>
<thead>
<tr>
<th>Fruit plant</th>
<th>Spacing (m)</th>
<th>Number of plants/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mango/Sapota</td>
<td>9.0 x 9.0</td>
<td>49</td>
</tr>
<tr>
<td>Litchi/Sand Pear/Ber/Amla</td>
<td>7.5 x 7.5</td>
<td>72</td>
</tr>
<tr>
<td>Peach/Loquat</td>
<td>6.5 x 6.5</td>
<td>90</td>
</tr>
<tr>
<td>Citrus/Soft Pear/Guava/Plum/Fig/Kinnow</td>
<td>6.0 x 6.0</td>
<td>110</td>
</tr>
<tr>
<td>Pomegranate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kandhari</td>
<td>4.0 x 4.0</td>
<td>240</td>
</tr>
<tr>
<td>Ganesh</td>
<td>3.0 x 3.0</td>
<td>440</td>
</tr>
<tr>
<td>Grapes (Bower system)</td>
<td>3.0 x 3.0</td>
<td>440</td>
</tr>
<tr>
<td>Banana</td>
<td>1.8 x 1.8</td>
<td>1,230</td>
</tr>
<tr>
<td>Papaya/Phalsa</td>
<td>1.5 x 1.5</td>
<td>1,760</td>
</tr>
</tbody>
</table>

Table 2: Spacing in fruit plants under rectangular system

<table>
<thead>
<tr>
<th>Fruit plant</th>
<th>Spacing (m)</th>
<th>Number of plants/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grapes (Y-Trellis system)</td>
<td>4.0 x 1.5</td>
<td>660</td>
</tr>
<tr>
<td>Peach/Plum</td>
<td>6.0 x 1.5</td>
<td>440</td>
</tr>
<tr>
<td>Kinnow</td>
<td>6.0 x 3.0</td>
<td>220</td>
</tr>
<tr>
<td>Guava</td>
<td>6.0 x 5.0</td>
<td>132</td>
</tr>
<tr>
<td>Patharnakh</td>
<td>8.0 x 4.0</td>
<td>120</td>
</tr>
</tbody>
</table>

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Contd on page 16
Planting of quality evergreen fruit plants for more profits

BY ANIRUDH THAKUR AND MANDEEP SINGH GILL
Department of Fruit Science

The Punjab Agricultural University has increased the nursery production of fruit crops from 1.19 lakh plants during 2012-13 to around 7.0 lakh plants during 2020-21. The farmers should start planting of evergreen fruit crops after the onset of monsoon season during July-August.

The planting season for planting evergreen fruit crops is approaching and there is a huge demand for fruit crops in Punjab state. The Punjab Agricultural University has increased the nursery production of fruit crops from 1.19 lakh plants during 2012-13 to around 7.0 lakh plants during 2020-21. In view of the huge demand for planting material, many growers buy plants from private nurseries. The sustainable increase in fruit production can be achieved by genuine, healthy and high quality planting material of recommended varieties. The persistent threat of spread of bud transmittable diseases and root rot with nursery plants makes nursery production especially in citrus, a highly specialized and technical job. There are only 85 registered nurseries in Punjab. Out of this, 50 nurseries are in private sector, 26 are Punjab Government nurseries and PAU has nine nurseries.

Planting season: The farmers should start planting of evergreen fruit crops after the onset of monsoon season during July-August. However, the most ideal planting time for evergreen fruit crops is September-October when there is decrease in temperature.

Mother and rootstock block: The farmers should look weather the fruit nursery is maintaining mother plant blocks in healthy conditions, free from bud transmittable diseases like greening and ring spot in citrus. Besides, the number of mother plants should be in proportion to the production capacity of the nursery.

Use of recommended rootstock: The rootstocks impact fruit crop production by influencing plant size, fruit yield and fruit quality. Besides, they also provide resistance to abiotic stresses like high soil pH and salts apart from resistance to soil. Hence, it is very important to ascertain the use of recommended rootstock for different fruit plants. In nurseries, separate rootstock blocks should be maintained keeping in view the scale of nursery production. While buying plants from any fruit nursery, farmers should ascertain that the fruit nursery is using recommended rootstocks for propagation of fruit plants. Irrespective of other fruit crops, there are number of commercial rootstocks in citrus. Rough lemon locally called as Jatti Khatti is a suitable rootstock for propagating Kinnow, Daisy, Jaffa, Grapefruit, Lime and Lemon. Carrizo citrange rootstock can also be used for Kinnow, Daisy and W. Murcott in soils with pH less than 8.0. Carrizo citrange rootstock is tolerant to Phytophthora root and collar rot; and imparts better fruit quality. While sweet orange variety Blood Red should be propagated on Cleopatra and Mosambi on Pectinifera rootstock. Sardar or Portugal cultivars are used as rootstock in guava. Wild seedlings are used as rootstock in mango, ber and aonla. Litchi is propagated by layering.

Handling and transportation of nursery plants: The evergreen plants are transported with intact earth ball. The citrus, mango, litchi and aonla plants are propagated in black polythene bags. While guava is propagated in soil and uprooted with earth balls. Transportation of plants should be carefully handled to avoid breakage of earth balls. The plants with broken earth balls can dry after planting. While loading the plants in a truck, a layer of cushioning material viz., cereal straw, dried grass or gunny bags should be spread at the base of the truck. Water should be sprinkled on the foliage to keep the plants turgid during long transportation. After reaching the destination, the plants should be kept in shade and watered till planting. The guava and mango saplings are propagated in black polythene bags. Wild seedlings are used as rootstock in mango, ber and aonla. Litchi is propagated by layering.
Seed production: A subsidiary occupation for farmers

BY TARVINDER PAL SINGH AND GAURAV KHOSLA
Director Seeds Office

Farmers may produce quality seed at their own level and this practice will help them to have quality seed for their own use and share it with fellow farmers, enabling them to get higher returns by way of bumper crops.

Seed is the backbone of modern agriculture and quality seed alone is known to account for about 20 per cent increase in the production. It is emphasised that the quality seed is different from an ordinary grain and should possess the following qualities:

- It should be genetically pure and conform to the standards of the required variety.
- It should be healthy, viable and vigorous.
- It should be free from admixtures of other crop seeds and weeds.
- It should be uniform with regard to size, shape and colour.

Different public and private organizations at national and state level as well as Agricultural Universities are engaged in the production of quality seed for meeting the increasing demand of farmers. The Punjab Agricultural University is emphasising the production of breeder and foundation seed for further multiplication by the seed producing agencies. The University is also instrumental in certified and quality seed production as per the available resources. The Punjab State Seed Corporation (PUNSEED) is mainly engaged in the production of certified seed for its distribution in the state. National Seeds Corporation (NSC), Department of Agriculture and many private organizations also produce certified seed to meet the demand of the farmers.

Farmers may produce quality seed at their own level and this practice will help them to have quality seed for their own use and share it with fellow farmers, enabling them to get higher returns by way of bumper crops. Commercial seed production of common field crops along with hybrid seed production can be taken up by the progressive farmers and unemployed youth. Apart from lucrative occupation, the hybrid seed production programme generates employment opportunities for skilled and unskilled labour. The seed production of self-pollinated crops (paddy, wheat, moong, mash, etc.) and often cross pollinated crops (arhar, raya, etc.) can be taken up without any difficulty, however, cross-pollinated crops like maize, bajra and cucurbits need special care with respect to contaminants during seed production.

Selection of field: For seed production, upland areas with good drainage should be preferred for better growth of the crop. Different varieties of crop should be avoided season after season as it may result into varietal mixtures due to occurrence of volunteer plants, especially, in case of rice. In case of pulses, raya, toria, etc., do not select the field where some different varieties of these crops were grown during the last year, because due to prolonged dormancy, these seeds remain dormant during the off-season and germinate with the return of favourable climate, thus, causing admixtures in the new crop.

Source of seed: For seed production, the source seed should always be procured from an authentic source like Punjab Agricultural University, PUNSEED, NSC or IFFDC. For certified seed production, foundation seed should be procured. However, certified seed may be used for quality seed production by farmers.

Seed treatment: Seed treatment with recommended insecticides or fungicides minimizes the possibility of seed infection or early attack of insect-pests. Seed treatment is the most economical method.

Isolation of seed crop: In order to maintain the trueness of variety, it is to be ensured that cross pollination and mechanical mixtures with other varieties/contaminants do not occur. To avoid that, isolation distance for quality seed production in some of the crops is as follows:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Distance in meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat, paddy, groundnut and soybean</td>
<td>3</td>
</tr>
<tr>
<td>Maize and bawjra</td>
<td>200</td>
</tr>
<tr>
<td>Moong, mash, gram and pea</td>
<td>5</td>
</tr>
<tr>
<td>Arhar</td>
<td>100</td>
</tr>
<tr>
<td>Sunflower</td>
<td>200</td>
</tr>
<tr>
<td>Gobhi sarson and raya sarson</td>
<td>50</td>
</tr>
<tr>
<td>Linseed</td>
<td>25</td>
</tr>
</tbody>
</table>

Rogueing and crop inspection: To maintain seed purity and health, it is important that crop is guarded-off from volunteer plants, weeds, off-types, insect-pests and diseases. The objectionable weed plants, volunteer plants, off-types and diseased plants should be rogued out as and when observed. To ensure the field standards, the seed crop
Gladiolus: A promising cut flower

BY KIRANJEET KAUR DHATT AND TANYA THAKUR
Department of Floriculture and Landscaping

The Punjab Agricultural University has recommended the cultivation of gladiolus varieties, such as, Punjab Glad 1, Punjab Glad 2, Punjab Glad 3, Punjab Pink Elegance, Punjab Glance and Punjab Lemon Delight. The gladiolus varieties ‘Punjab Glance’ and ‘Punjab Lemon Delight’ are the most suitable for early planting.

Gladiolus is one of the important cut flowers which occupy a prime position among commercial flower crops, and have high demand in domestic and international trade. It is highly valued for its elegant spikes which are used as cut flower for making flower arrangements, bouquets and for garden decorations. The consumers prefer spikes with good ornamental value, pure colour, excellent stem strength and good keeping quality. The popularity of this flower in interior and garden decoration is increasing day by day due to wide variation in flower colour of different varieties, variable floret shape, longer spikes and more number of florets per spike with longer vase life.

The Punjab Agricultural University has recommended the cultivation of varieties, such as, Punjab Glad 1, Punjab Glad 2, Punjab Glad 3, Punjab Pink Elegance, Punjab Glance and Punjab Lemon Delight. The corms of 5-6 cm diameter are planted in September-November at spacing of 30 × 20 cm about 6-7 cm deep, accommodating 60,000-70,000 corms per acre. The corms start sprouting within 10-12 days depending on the temperature at the time of planting. Generally many of the varieties for cut flower come in bloom after three months of planting, thus, the flowering of gladiolus occurs during November to mid-May under sub-tropical climatic conditions of Punjab. The spikes are harvested preferably in early morning or late evening with sharp secateurs at tight bud stage for distant market or at opening of first floret for local market. The corms are ready for lifting from the field after 8-10 weeks of spikes harvesting when the leaves start drying.

The University has given technology for early planting during first week of July to third week of August which will produce off-season flowering during October-November and help the farmers to fetch better profits and reduce glut in market during main season. The gladiolus varieties ‘Punjab Glance’ and ‘Punjab Lemon Delight’ are the most suitable for early planting. The cost of one corm ranges between Rs 2-3/- and one corm generally gives one spike. The cost of spike in local market is around Rs 1-5/- depending on the demand in the market. The cultivation of gladiolus may be taken up at small scale by the beginners and the area may be expanded as per the experience in handling material in the market as well as raising of crop in the field.

* Kiranjeet Kaur Dhatt: 94634-13742

PAU INVITES APPLICATIONS FOR CROP PRODUCTION TRAINING COURSE

The Directorate of Extension Education, Punjab Agricultural University, has invited applications from the rural youths of Punjab for the three-month training course on “Integrated Crop Production” scheduled to be held from August 2 to October 29, 2021. Youths, who are matriculate and in the age group of 20 to 40, are eligible for the course which will throw light on agriculture and allied occupations. The interested candidates can submit the application by visiting the University website www.pau.edu and clicking the link or visiting the Skill Development Centre, PAU on working days from Monday to Friday from 9.00 am to 5.00 pm. The last date for the receipt of applications is July 29, 2021 and the interview is scheduled to be held on July 30, 2021 at Skill Development Centre at 10.00 am. In view of COVID-19 pandemic, all safety measures will be followed during interview. The candidates must bring their matriculation certificate as well as proof of age certificate along with them. The selected candidates will have to deposit Rs 1,000/- as security, which will be refunded to only those candidates who complete their course successfully. The course fee is Rs 500/- while the accommodation charges are Rs 300/- per month.
Tips for successful cultivation of *Kharif* onion

BY BUTA SINGH ROMANA, AMANDEEP KAUR AND JS KHOSA
Farm Advisory Service Centre, Sangrur

Agrifound Dark Red variety of onion is well suited for *Kharif* season. Its average yield is 120 quintals per acre.

**Onion** is the most important vegetable crop; it is used in each and every vegetable for cooking purpose as well as table purpose. Known for its pungency, Indian onions are available during the whole year in the market. The cultivation of onion is being done for home consumption in the kitchen garden as well as on commercial scale. The Punjab Agricultural University has recommended its cultivation in *rabi* and *Kharif* seasons to fulfill the requirement throughout the year. The farmers mostly grow onion during the *rabi* season (January-April), but the *Kharif* onion (August-November) has been planted in a very negligible area so far due to some production and storage problems.

Farmers need to be precise regarding the time of planting of this crop because the long duration of rising winter can create bolting problem and high temperature can decrease the bulb size. Agrifound Dark Red variety is well suited for *Kharif* season. Its average yield is 120 quintals per acre. The best time for nursery production is mid-June. The seed should be sown in mid-March to produce the bulb-sets. Five kg seed in enough for one acre nursery or bulb-sets production.

**Method of nursery production:** Prepare the raised seed beds of 1 to 1.5 m wide with 20 cm height from the ground level. One acre of nursery can be planted in 20 acres. Apply 125 kg of well-rotten farm yard manure in one *marla* (25 sq m) area and the land should be well-levelled. The nursery should not be repeatedly sown on the same piece of land. The seed should be treated with 3 g of Captan or Thiram per kg of seed before sowing. The seed should be sown in 5 cm apart rows with 1-2 cm deep. Sow the seed uniformly in rows and cover the rows with thin layer of farm yard manure. Sow the seeds in good moisture. Apply first irrigation with sprinkler just after sowing and then apply twice watering daily in morning and evening. The nursery beds should be covered with green shade net or paddy or *sarkanda* straw with 1.5 m height above the bed in North-South direction during the day time and remove this structure after one month when the nursery plant gets hard.

**Production of bulb-sets and quantity:** In *Kharif* season, nursery is sown during mid-June and it will take 6-8 weeks to get ready for plantation. But this period of peak summer and rainfall has the major bottlenecks for the successful nursery production. For the successful and assured cultivation of *Kharif* onion and to secure the failure of summer nursery, it will be profitable to produce the bulb-sets for *Kharif* crop. Sow the 5 kg seed on 1-1.5 m strips in 8 *marlas* (200 sq m) area in mid-March with 5 cm apart rows and irrigate twice a week. Stop the irrigation 15 days before uprooting the bulb-sets at the end of June. Store the bulb-sets with leaves in the aerated baskets at the room temperature. About 2.5-3.0 quintals of bulb-sets having 1.5-2.5 cm size per acre are more suitable to get desired marketable yield.

**Planting time and method:** Plant 6-8 week old healthy nursery or bulb-sets in the first fortnight of August to the first week of September in the well-prepared field. The planting distance should be 15 cm between rows and 7.5 cm from plant to plant for getting good returns. The planting of *Kharif* onion on the raised beds improves the size of the bulb, particularly, in heavy soils where water drainage is a problem. The raised beds should be 60 cm wide with 10 cm height and three rows of bulb-sets with 15 cm apart should be planted in mid-August. The irrigation should be applied in furrows and the water should not overflow the bed.

**Manures and fertilizers:** Apply 20 tonnes of well-rotten farm yard manure, 90 kg of urea, 125 kg of superphosphate and 35 kg of Muriate of Potash per acre. Apply full dose of farm yard manure, phosphorus, potash and half urea at the time of field preparation before nursery planting and broadcast the remaining half urea after four weeks of nursery planting.

**Hoeing and weed control:** The onion plants are grown with closer spacing and have shallow root zone, therefore, weed management should be carried out at proper time because there is serious crop-weed competition from transplanting to 45 days of planting for the growth. Apply 3-4 weedings to control the weeds. First weedding should be done after three weeks of planting and others should be applied at 15 days interval. The weedcides may also be used to control the weeds at proper stage. Apply 380 ml of Goal 23.5 EC (Oxyfluorfen) using 200 litres of water per acre within one week of planting and should be supplemented with one weeding after 60 days, if needed.

**Harvesting, storage and marketing:** The harvesting may be done at the end of November or the first week of December and should not be late, otherwise the bolting may occur and bulb quality will deteriorate. The green bulbs may also be marketed if there is any green onion market.

*Buta Singh Romana: 94172-81311*
Management of different fruit plants during rainy season

BY TRINA ADHIKARY
Department of Fruit Science

Rainy season prevails from July to September in Punjab region. Proper management practices should be followed in new as well as old orchards to avoid losses due to rainy season.

Rainfall is one of the most important climatic factors which determine the success or failure of the fruit crop. It is important to understand the pattern of rainy season, and potential effect on plant growth and fruiting. Soil aeration and proper amount of moisture content in soil are required for root health and optimum plant growth. Roots need to ‘breathe’ and too much water can suffocate them as well as invite various fungal diseases, such as, root rot. Rainy season prevails from July to September in Punjab region. This is considered to be the best time for new plantation of evergreen fruits. Therefore, proper site selection for orchard plantation is of utmost importance as fruit crops are perennial in nature and initial investment is also very high. Once plantation has been done, it is almost impossible to alter the site of the fruit plants. Any wrong decision at the time of planting can result in huge economic loss to the fruit growers. Similarly, the excess water in older plantations also poses a serious threat to various types of biotic and abiotic stresses. Therefore, proper management practices should be followed in new as well as old orchards to avoid losses due to rainy season.

- The best way to avoid the effects of heavy rain on fruit trees is to know the soil profile of the planting site. A well-drained site is suitable against flooding during rainy season. Fruit trees should not be planted next to a river, pond, creek or other water bodies that may cause flooding. A slight slope is preferred for drainage while leveling the site. Standing in the orchard after heavy rains should be drained away to improve the aeration, decrease the moisture in root zone and improve the plant growth.

- Some plants are highly sensitive to waterlogging, such as, water stagnation for one day can kill well established papaya plants. Mango, papaya and amla trees cannot withstand waterlogging during early years of their growth. Citrus plants are also sensitive to water stagnation. Rains may also cause tilting of newly planted fruit pants, which need proper support. Remove the damaged/broken limbs/branches of the plants and spray Bordeaux mixture 2:2:250.

- Among the various physiological and water related disorders in citrus, fruit drop is the most serious disorder coinciding with the rains in Punjab. The foliar applications of 5 g 2, 4-D (Sodium salt of horticulture grade) in 500 litres of water in August and September are quite effective against fruit drop. Avoid application of 2, 4-D (Sodium salt of horticulture grade) in orchards where the broad leaf crops are cultivated as intercrops or are grown in the adjoining fields. The hormone 2, 4-D may be substituted with Gibberelic acid under such conditions.

- Another serious disease in citrus orchards related to excessive moisture is Phytophthora (Gummosis). The affected trees show symptoms of foot rot with profuse gumming, trunk girdling, pale green foliage, stunted growth flushes and twig die-back. Drenching of basin area of trees and main limbs with Sodium hypochlorite 5% @ 50 ml per tree in 10 litres of water can solve the problem.

- Besides micronutrient deficiencies, stem and fruit rot as well as scab also spreads at a faster rate during rainy season. These diseases can be effectively controlled by spraying recommended dose of fungicides before and even after the onset of monsoon season. Citrus scab can be checked by the spray of Bordeaux mixture (2:2:250) starting from the end of June to August at 20 days interval.

- Cracking in pomegranate, baramasi

Figure: (A) Bagging techniques in guava and (B) Fruit cracking in citrus due to uneven moisture supply
lemon and other fruit crops is associated with rains. Drain out excess amount of stagnated water from periphery of such crops. Always apply light and frequent irrigations. Mulching of tree basins with paddy straw or other crop wastes also reduces this problem. Sprinkler irrigation frequent intervals can be effective to reduce fruit splitting. Fruit bagging can also check the fruit cracking problem.

- For the management of fruit fly in rainy season guava crop, regular removal of infested, rotten and fallen fruits from the orchard and burying them at 2-3 feet depth is necessary to keep the orchard clean. Shallow ploughing with cultivator or rotavator is advisable immediately after harvesting to explore and kill the pupating larvae/pupae that exist at 4-6 cm top soil. Keep the orchard and surrounding areas free from weeds. Fruit bagging can also check the fruit fly problem. Fruit fly traps @ 16 traps per acre should also be installed for management.

- Anthracnose disease in grapes is also directly associated with rains. Usually after harvesting of fruits, vineyards remain neglected from July-January, during which anthracnose disease may spread and cause heavy loss to the next crop. Anthracnose can be controlled by spraying Bordeaux mixture (2:2:250) from August onwards. Likewise, application of Score 25 EC @ 500 g in 500 litres of water in middle of July, August and September is also very effective.

- It is advised not to cultivate orchards during monsoon. Integrated weed management practices including manual removal of large weeds, such as, congress grass, bhang etc.; mowing of weeds and mulching can be adopted. Therefore, to avoid the economic loss as well as to maintain the health of the orchards, it is imperative to manage the orchards properly during rainy season.

**Quincunx system**

**Quincunx or diagonal system:** In Quincunx or diagonal system, the field is laid out in similar way as that of square system. Then rope is stretched through the diagonal points of the squares and additional wooden pegs are fixed at the points where diagonals cross each other for planting fillers. Filler fruit plants like papaya, Kinnow, phalsa, guava, peach, plum, etc. are planted in between the permanent trees.

**Digging and filling of pits:** One metre deep and one metre wide round pits should be dug for each plant. Refill the pits with a mixture of top soil and farmyard manure in equal parts.

**Selection of nursery plants:** Healthy fruit plants free from diseases and insect-pests, and of known pedigree should be obtained from the reliable nursery and preferably near to the orchard site. The plants should be of medium height budded or grafted on the recommended rootstock.

**Windbreaks and hedges:** A good windbreak should be provided on the windward side of orchard well before the orchard is established. Eucalyptus, arjuna, jamun, seedling mango, mulberry, etc. are good windbreak plants. In the spaces between windbreak trees, a hedge of Bougainvillea, Jatti khati, galgal, karonda, etc. may also be planted. Hedges of citrus species should not be planted around citrus orchard.

**Suitable planting time**

**Evergreen fruit plants:** There are two planting times for evergreen fruit plants viz., February-March and September-October. Planting of citrus, mango and litchi should preferably be done during September-October.

**Deciduous fruit plants:** These are planted in dormant stage preferably during December-mid January before the start of new growth e.g. peach and plum. However, grapes and pear can be transplanted upto mid-February before emergence of new sprouts.

**Irrigation methods:** Proper irrigation system must be planned to obtain uniform water distribution. The main water channel should be made at right angle along the higher level of field. The length of sub-water channels will depend on the type and gradient of soil. Don’t make long water channels because they reduce irrigation efficiency.

**Planting and care of young plants:** Bore holes of suitable size in the centre of the filled pits with the help of planting board. The tree should be planted in these marked holes in such a way that bud union remains about 9 inches above the ground level. The soil around the plants should be pressed firmly with feet followed by light irrigation. After irrigation, if plant is tilted, it should be stalked at wattar condition. After planting, provide support to the plants.

**Training and pruning:** Fruit trees may be pruned at any time, but it is better to avoid those periods when trees are in active growth. The best time for pruning the bearing trees is after the harvest of the fruits during late winter or early spring. Removal of dead and dried wood is necessary to check the further spread of diseases.

The plantation of orchard requires technical skills for better growth and development of fruit trees, especially, related to site selection, layout and management of orchard till harvesting. This technical support is provided by different extension functionaries like Krishi Vigyan Kendras, Regional Research Stations and State Department of Horticulture from time to time. In a nutshell, we hope that the farmers can play a pivotal role in diversification by following the above guidelines and become a guiding light for the other farmers.
Canola rapeseed-mustard oil: The best edible oil

BY VIRENDER SARDANA, KIRAN BAINS AND SANJULA SHARMA

Department of Plant Breeding and Genetics

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onsumption of a certain minimum amount (30 g per person per day) of edible oil or fat is recommended to meet the energy requirements of body. Soybean, rapeseed-mustard, groundnut, sunflower, sesame/til, safflower and niger are the primary sources of edible oils. Oil extracted from rice bran, corn or maize, cottonseed, coconut, palm and olive is also used for edible purposes, either directly or after blending with traditional edible oils. In addition to the amount of intake, the quality of fat or oil is also important because the consumption of too much or wrong type of fat/oil adversely affects human health. Quality of any fat/oil is influenced by its fatty acid composition and relative proportion of saturated fatty acids (SFAs), mono-unsaturated fatty acids (MUFAs) and poly unsaturated fatty acids (PUFAs). Ideal cooking oil is the one that contains healthy fats and nutrients, does not break down on heating and has longer shelf life.

Among different kinds of edible oils, rapeseed-mustard oil is the most commonly used for cooking in India. History of its use dates back to about 3,500 years. It is considered better for cooking than other commonly available vegetable oils due to its higher smoke point (240-255°C), lower percentage of saturated fatty acids (7-8%), moderate and balanced proportion of poly unsaturated fatty acids (PUFAs) mainly linoleic acid (18-22%) and linolenic acid (8-12%), better proportion of phytosterols and antioxidants. However, oil of traditional varieties of rapeseed-mustard has higher proportion (40-50%) of erucic acid and low proportion (12-16%) of oleic acid. Regular consumption of oil with more than 20 per cent erucic acid in the diet causes thickening of arteries which may lead to heart ailments (myocardial fibrosis, lipidosis, etc.).

Rapeseed-mustard varieties/hybrids with very low amounts (<2%) of erucic acid in oil have been developed in several countries. These have been termed as ‘canola varieties/hybrids’ and oil from these as ‘canola rapeseed-mustard oil’. In addition to all the quality attributes of conventional rapeseed-mustard oil, reduction in erucic acid in canola oil has manifested in corresponding increase in nutritionally desirable oleic acid (MUFA) from about 15-16 per cent to about 62-67 per cent. Oleic acid acts as cholesterol scavenger and is involved in generation of good cholesterol (high density lipoprotein - HDL) that is highly resistant to oxidative modification. Such oils also have longer shelf life. Oil rich in oleic acid is best suited for cooking/frying because of its greater thermo-stability at higher temperature. Such oil is less harmful if reused and has longer shelf life. A comparison of canola and non-canola oil for cooking revealed that oil absorption was less for canola than non-canola oil, which means lesser quantity of canola oil is required for cooking. In advanced countries, rapeseed-mustard conforming to canola norms can only be used as edible oil. The US Food and Drug Administration (FDA), European Food Safety Authority and Health Canada have banned consumption of rapeseed-mustard oil with more than 2 per cent erucic acid. Similar restrictions on consumption of high erucic acid rapeseed-mustard oil have been imposed in Japan, Australia and New Zealand.

Olive oil is projected as the best edible/ cooking oil and sold at very high price mainly because of its high oleic acid content (70-75%). However the facts that olive oil has much lower smoke point (190-210°C), proportion of essential fatty acids (8-10% linoleic acid, and 1-3% linolenic acid) and higher proportion of saturated fatty acids (15%) than canola oil are often ignored. Smoke point is the temperature at which oil molecules start to degrade and oil produces visible smoke. The PUFAs are known to reduce blood cholesterol, especially, the harmful LDL and increase HDLs in blood lipids. The HDLs are involved in transporting excess blood cholesterol back to liver for degradation and excretion. Higher consumption of SFAs is known to increase bad cholesterol (low density lipoprotein - LDL) in blood lipid profile which may cause thickening of blood vessels (atherosclerosis) and coronary heart disease. Overall, canola oil has much better fatty acid composition and is much cheaper than olive oil. Therefore, canola oil should be better choice for cooking than olive oil. The Punjab Agricultural University has developed varieties (GSC 7, GSC 6 and RLC 3) and hybrids (PGSH 1707 and RCH 1) of canola rapeseed-mustard.

Increasing awareness about health benefits of canola rapeseed-mustard oil has escalated its demand in India and about one dozen brands of canola oil imported mainly from Canada (major canola producer in the world) are now available in the Indian markets. There is no difference in the quality of imported canola oil and that produced from varieties/hybrids developed by Punjab Agricultural University. On the other hand, Canada and other major canola producing countries in the world use transgenic/genetically modified (GM) cultivars/hybrids, the cultivation of which is not approved in India. Therefore, consumer should shun the use of such oil and prefer indigenously produced canola oil.

• Virender Sardana: 94637-47125
Technology Marketing and Intellectual Property Rights Cell: An insight

BY USHA NARA AND AMARJEET KAUR
Technology Marketing and IPR Cell

The Punjab Agricultural University has played a key role in increasing food grain production in Punjab. The University undertakes basic, applied and adaptive research aimed at improving socio-economic conditions of the farming community through cost-effective technologies. It has developed effective mechanism to transfer knowledge and technologies to farmers and stakeholders through extension services. This has resulted in promoting appropriate technologies for supporting agro-based industries and generating self-employment opportunities for the youth.

Technology Marketing and IPR cell has been set up under the Directorate of Research since 1998 to facilitate the activities, such as, patent filing and commercialization of technologies. Intellectual Property Rights (IPR) cell was further strengthened in 2012 to carry out commercialization of already approved and standardized technologies, processes and products along with IPR management activities of the University. The cell functions through two core committees;

1. Technology Marketing and IPR Committee (TMIPRC) dealing with:
   • Commercialization of various products/technologies developed by University scientists.
   • Signing of MoUs/MoAs between PAU and institutions/organizations/industry / company/cooperatives/self-help groups/individuals.

2. Intellectual Property Assessment Committee (IPAC) determines the patentability of the proposals received from various scientists of the University.

Achievements of the cell

PATENTS: The cell facilitates the scientists for filing the patent from their own research as well as the research of students after obtaining approval from Committee formulated by the Vice Chancellor of the University. Till date, 45 patent applications have been filed by the University scientists in different fields. So far, University has been granted 13 patents as per the list given below in the Table 1.

Commercialization of technologies

Till date, 64 technologies have been commercialized through the cell to 258 stakeholders. Process of commercialization is through fixation of price by approval of Committee designed for each technology and the final approval is obtained from the Vice Chancellor. The Committee decides the

<table>
<thead>
<tr>
<th>Table 1: List of the patents granted to the University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
</tr>
<tr>
<td>An improved field tensiometer for irrigation water management of crops</td>
</tr>
<tr>
<td>A hybrid combine harvester</td>
</tr>
<tr>
<td>A fermentation process for preparation of concentrated sugarcane vinegar</td>
</tr>
<tr>
<td>An improved solar dryer using packed bed natural circulation</td>
</tr>
<tr>
<td>An improved solar cooker</td>
</tr>
<tr>
<td>A process for dyeing textiles using plant sources polygonum Bistorata and Cypruss rotundus</td>
</tr>
<tr>
<td>*Beneficication of phosphate rock for the segregation of phosphorus containing heavy metal free minerals</td>
</tr>
<tr>
<td>Technology development for production of non-alcoholic naturally carbonated beverage from fruit juice</td>
</tr>
<tr>
<td>*Nanofabrication of phosphorous on kaolin mineral receptacles</td>
</tr>
<tr>
<td>An improved greenhouse type solar dryer</td>
</tr>
<tr>
<td>Pressurized all-glass evacuated tube solar water heater</td>
</tr>
<tr>
<td>*Zinc in clay-mineral receptacles in nanoforms for their use as advanced materials including novel fertilizer</td>
</tr>
<tr>
<td>Electric soil disinfector</td>
</tr>
</tbody>
</table>

* Filed through ICAR
### Table 2: List of crops and vegetable hybrids/varieties ready for commercialization

<table>
<thead>
<tr>
<th>Parents of hybrids</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maize:</strong> PMH 1, PMH 2, PMH 10 and PMH 11</td>
<td>Fodder: Pb Ryegrass 1</td>
</tr>
<tr>
<td>Sunflower: PSH 996 and PSH 1962</td>
<td>Mustard: Canola Quality Gobhi Sarson (GSC 7)</td>
</tr>
<tr>
<td><strong>Brinjal:</strong> PBH 3, PBH 4, PBH 5, PBHR 41 and PBHR 42</td>
<td>Cotton: PAU Bt 1</td>
</tr>
<tr>
<td><strong>Chilli:</strong> CH 27 and CH 52</td>
<td>Brinjal: Punjab Raunak and Punjab Bharpoor</td>
</tr>
<tr>
<td><strong>Muskmelon:</strong> MH 27 and MH 51</td>
<td>Pumpkin: Punjab Samrat, PAU Magaz Kaddoo 1 and Punjab Nawab</td>
</tr>
<tr>
<td><strong>Pumpkin:</strong> PPH 1 and PPH 2</td>
<td>Cucumber: Punjab Kheera 1</td>
</tr>
<tr>
<td><strong>Tomato:</strong> PTH 2</td>
<td>Tomato: Punjab Varkha Bahar 4, Punjab Gaurav, Punjab Sartaj, Punjab Swarna, Punjab Red Cherry, Punjab Sona Cherry and Punjab Kesar Cherry</td>
</tr>
<tr>
<td><strong>Fodder:</strong> Pb Ryegrass 1</td>
<td>Chilli: Punjab Tej and Punjab Sindhuri</td>
</tr>
<tr>
<td><strong>Mustard:</strong> Canola Quality Gobhi Sarson (GSC 7)</td>
<td>Onion: Punjab Naroya, PRO 6, PRO 7, PWO 2 and PYO 1</td>
</tr>
<tr>
<td><strong>Cotton:</strong> PAU Bt 1</td>
<td>Bottle Gourd: Punjab Barkat and Punjab Bahar</td>
</tr>
<tr>
<td><strong>Brinjal:</strong> Punjab Raunak and Punjab Bharpoor</td>
<td>Carrot: Punjab Black Beauty and Punjab Carrot Red</td>
</tr>
<tr>
<td><strong>Pumpkin:</strong> Punjab Samrat, PAU Magaz Kaddoo 1 and Punjab Nawab</td>
<td>Okra: Punjab Suhawani</td>
</tr>
<tr>
<td><strong>Cucumber:</strong> Punjab Kheera 1</td>
<td>Pea: MatarAgeta 7 and Punjab 89</td>
</tr>
<tr>
<td><strong>Tomato:</strong> Punjab Varkha Bahar 4, Punjab Gaurav, Punjab Sartaj, Punjab Swarna, Punjab Red Cherry, Punjab Sona Cherry and Punjab Kesar Cherry</td>
<td>Radish: Punjab Mooli No. 2</td>
</tr>
<tr>
<td><strong>Chilli:</strong> Punjab Tej and Punjab Sindhuri</td>
<td>Garlic: PG 18</td>
</tr>
<tr>
<td><strong>Onion:</strong> Punjab Naroya, PRO 6, PRO 7, PWO 2 and PYO 1</td>
<td>Bell Pepper: PSM 1</td>
</tr>
<tr>
<td><strong>Bottle Gourd:</strong> Punjab Barkat and Punjab Bahar</td>
<td>Squash Melon: Punjab Tinda 1</td>
</tr>
<tr>
<td><strong>Carrot:</strong> Punjab Black Beauty and Punjab Carrot Red</td>
<td>Sponge Gourd: Punjab Nikhar</td>
</tr>
<tr>
<td><strong>Okra:</strong> Punjab Suhawani</td>
<td>Bitter Gourd: Punjab Jhaa Karela</td>
</tr>
<tr>
<td><strong>Pea:</strong> MatarAgeta 7 and Punjab 89</td>
<td><strong>Table 3: Department wise lists of various technologies already adopted and ready for adoption</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of the Department and Technology</th>
<th>Department of Apparel and Textile Science</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parents of hybrids</strong></td>
<td><strong>Aromatherapic Textile Products</strong></td>
</tr>
<tr>
<td><strong>Department of Food and Nutrition</strong></td>
<td><strong>Mosquito Repellent Cotton Fabric Technology</strong></td>
</tr>
<tr>
<td><strong>Department of Farm Machinery and Power Engineering</strong></td>
<td><strong>Beetroot Powder as a Natural Colorant Technology</strong></td>
</tr>
<tr>
<td><strong>Department of Food Science and Technology</strong></td>
<td><strong>Pumpkin Seed Flour Technology</strong></td>
</tr>
<tr>
<td><strong>Department of Soil and Water Engineering</strong></td>
<td><strong>Bottling of Sugarcane Juice Technology</strong></td>
</tr>
<tr>
<td><strong>Department of Soil Science</strong></td>
<td><strong>Gluten Free Atta</strong></td>
</tr>
<tr>
<td><strong>Department of Microbiology</strong></td>
<td><strong>Kadhu Di Chutney Technology</strong></td>
</tr>
<tr>
<td><strong>Department of Processing and Food Engineering</strong></td>
<td><strong>Multigrain Atta for Diabetics</strong></td>
</tr>
<tr>
<td><strong>Department of Soil and Water Engineering</strong></td>
<td><strong>Multigrain Instant Porridge</strong></td>
</tr>
<tr>
<td><strong>Department of Soil Science</strong></td>
<td><strong>PAU Punjabi Mixed Tadka Technology</strong></td>
</tr>
<tr>
<td><strong>Department of Microbiology</strong></td>
<td><strong>Premix for Ready to Fry Potato Snacks</strong></td>
</tr>
<tr>
<td><strong>Department of Processing and Food Engineering</strong></td>
<td><strong>Mushroom Processing and Its Use in Value Addition</strong></td>
</tr>
<tr>
<td><strong>Department of Soil and Water Engineering</strong></td>
<td><strong>Maize Flour for Rollable Chapatti</strong></td>
</tr>
<tr>
<td><strong>Department of Soil Science</strong></td>
<td><strong>Frozen Potato and Frozen Vegetables Technology</strong></td>
</tr>
<tr>
<td><strong>Department of Microbiology</strong></td>
<td><strong>Making and Packaging of Saag Technology</strong></td>
</tr>
<tr>
<td><strong>Department of Processing and Food Engineering</strong></td>
<td><strong>Apple Cider (Vinegar)</strong></td>
</tr>
<tr>
<td><strong>Department of Soil and Water Engineering</strong></td>
<td><strong>Bacteriological Water Testing Kit Technology</strong></td>
</tr>
<tr>
<td><strong>Department of Soil Science</strong></td>
<td><strong>Consortium of Biofertilizers</strong></td>
</tr>
<tr>
<td><strong>Department of Microbiology</strong></td>
<td><strong>Fermented Beverage from Fruit and Vegetable Juices</strong></td>
</tr>
<tr>
<td><strong>Department of Processing and Food Engineering</strong></td>
<td><strong>Plant Growth Promoting Rhizobacteria (PGPR)</strong></td>
</tr>
<tr>
<td><strong>Department of Soil and Water Engineering</strong></td>
<td><strong>Brewed Fruit Vinegar Technology</strong></td>
</tr>
</tbody>
</table>

**Progeny:** PAU Lacto-Fermented Functional Beverages and Pickles Technology for Turmeric and Indian Gooseberry

**Department of Plant Pathology:**
- Trichoderma

**Department of Processing and Food Engineering:**
- Honey Heating-cum-Filtration Machine
- Vegetable Washing Machine

**Department of Renewable Energy Engineering:**
- Forced Circulation Solar Dryer
- Advanced Domestic Solar Dryer Technology
- Evacuated Tube Collector Solar Dryer Technology
- Agro-industrial Solar Dryer Technology
- Paddy Straw Based Biogas Plant made up of Mild Steel Sheet (above the ground)
- Modified PAU Fixed Dome Type Janta Model Biogas Plant having capacity from 25 m3/day to 500 m3/day
- PAU Fixed Dome Type Family Size Biogas Plant having capacity from 1 m3/day to 25 m3/day

**Department of Soil and Water Engineering:**
- rooftop Vegetable Nutrition Garden Model using Soilless Media Technology

**Department of Soil Science**
- PAU Leaf Colour Chart

**Rollable chapatti**

**Shelf stable bottled sugarcane**
Nutrient rich fruits of jamun, pickle and desi mangoes

BY MANDEEP SINGH GILL AND NAVPREM SINGH
Department of Fruit Science

A large number of mango and jamun seedlings are growing on scattered/isolated areas in various agro-climatic zones of Punjab. The plants originated from seeds are generally classified as seedlings and these types are showing wide variability in terms of fruit size, weight, TSS/blend, colour, pup/stone ratio, medicinal, nutritional and medicinal properties. These are at present mostly growing along strip of roads, riverbanks, undulated terrain in mountainous tracts, etc. and exhibit a wide range of variability in desirable horticultural traits. Different strains of jamun with desirable characters like small seed, more pulp/stone ratio, good TSS/acid blend and large fruit size are also being evaluated at PAU, Ludhiana and Regional Fruit Research Station, Bahadurgarh.

Jamun being tall in nature is grown preferably as windbreaks in fields. It is under-utilized minor fruit crop of Punjab. Mainly two types of jamun are known viz., ‘Ra-jamun’, bearing big sized sweet fruits and ‘Kaatha or Desi’ bearing small fruits with acidic pulp. Jamun fruit has considerable nutritive value. It is a good source of minerals, iron, sugars, protein and carbohydrates. Fully ripe fruit is eaten as fresh and processed into syrup, jam, jelly and squash. Fruit and seeds are considered as an effective medicine for diabetic patients. The fruit is a rich source of phenols, anthocyanins, pectin and protein. Ripe fruit is also dried with salt and preserved as a digestive powder or churan. Small jamun fruits, which constitute a large proportion of the genetic diversity, are not suitable for table purpose and can be exploited in the beverage industry as they contain appreciable amounts of acid, tannins and anthocyanins. The foliage serves as a fodder for cattle; twigs form good datoon.

In India, mango pickle is prepared from seedlings/varieties showing distinct properties like sour sweet taste with high acid blend and pulp stone ratio, almost round shape, thick peel and more course fibre content. Fruits with attractive red blush on peel are preferred for sucking type of mangoes mostly due to juicy type and soft flesh with coarse fibres. Farmers maintaining seedlings with these distinct characteristics are selling fruit at premium price. In Doaba and Kandi regions of Punjab, old mango plantations predominantly from seedlings are established naturally or propagated through selected stones from meritorious indigenous mango plants on the basis of fruit quality characteristics by locals. Among these strains, Punjab Agricultural University has recommended eight strains (GN, to GN7 and Gangian Sindhuri) for general cultivation in the Punjab state.

• Mandeep Singh Gill: 88722-00119
Nutrition garden: Vegetables in home gardens

BY AMARJIT SINGH SANDHU, SAT PAL SHARMA AND PRITPAL SINGH
Department of Vegetable Science

A well planned kitchen garden provides multiple environmental, economic, social and aesthetic benefits, besides a regular supply of fresh, pesticide residue free and nutritious vegetables.

Though Punjab is a food crop surplus state contributing a significant proportion to the central pool, yet ensuring a nutritional security to the masses is still a great challenge. The state annual vegetable production of 58 lakh tonnes appears to be sufficient for proving each and every individual a daily recommended allowance of 285 g of vegetables for a wholesome diet. However, almost half of the total production is contributed by the starchy crop, potato. Thus, considering the state vegetable production dynamics, post-harvest losses and the proportion of per capita income to be spent on vegetables, it is not possible to provide adequate proportion of green leafy, beans, root and tuber vegetables. There is an urgent need to resort to the counter strategies to meet the growing demand of vegetables and thus to avert nutritional insecurity. Consequently, there is an increased attention towards kitchen gardens as a strategy to grow vegetables themselves for their own use with minimum or no use of pesticides.

Kitchen gardens or Tubewell gardens are an integral part of domestic food systems and the agricultural landscape of Punjab. In general, farmers grow vegetables in the available or marginal pieces of land rather than on a specifically allotted area. A well planned kitchen garden provides multiple environmental, economic, social and aesthetic benefits, besides a regular supply of fresh, pesticide residue free and nutritious vegetables. Hence, encouraging vegetable gardening at home can play a significant role in improving nutritional security to rural and urban households in Punjab.

Benefits of kitchen gardening
• Gives year round supply of fresh and pesticide residue free nutritive vegetables.
• Helps to save expenditure on purchase of vegetables.
• Provides opportunity for horticultural therapy through exercise and aesthetic value.
• Strengthens social connection through sharing of vegetables and concerted efforts of family for growing of vegetables.
• Provides environmental and ecological advantage through effective utilization of kitchen waste water and kitchen waste materials.

Selection of location: Since the family members perform most of the garden operations in their spare time, the location should preferably be in regular approach. A kitchen garden should be established near the tubewell or water source in an open area receiving at least 5-6 hours of sunlight, and safeguarded against domestic and stray animals. The farm land used for gardening should not be infested with perennial weeds, such as motha, khabbal gha, baru and dhoob grass. Size and shape of vegetable garden depends on availability of land, number of persons in family and spare time available for its care.

Availability of seeds and nursery: The seeds of improved varieties of vegetables should be procured from a trust worthy source and it will also be available from mid-August as vegetable seed kits at seed shops of Punjab Agricultural University, Ludhiana; Krishi Vigyan Kendras and Farmers’ Advisory Service Centers at district levels. Growers can produce the seed of cucurbits, root vegetables, peas, chilli, tomato, brinjal, okra, cowpea, onion, garlic, Chinese sarson, leafy vegetables, arum, turmeric and sweet potato on their own for the next season. Vegetables, such as, onion, cauliflower, cabbage, broccoli, knol-khol, tomato, brinjal, chilli, and Shimla mirch are transplanted through nursery seedlings. Different vegetables have their specific times of sowing and seed rates (Table 1). Therefore, the timely arrangement of seeds is essential for sowing at appropriate time.

Insect-pest and disease management: Mechanical and biological techniques should be preferred for managing insect-pests in kitchen garden. The garden should be carefully inspected for the larvae and eggs of the insect-pests every day and these should be destroyed mechanically. Collect leaves, twigs and fruits infested with insects/ diseases and destroy or bury deep in the soil. Only use the recommended insecticides and fungicides at the prescribed rate and time following proper spray procedures. Pick all ready to harvest vegetables before spraying any pesticide and follow the prescribed waiting period for next picking.
Table 1: Recommended variety, time of nursery sowing, time of transplanting and method of sowing of winter season vegetables

<table>
<thead>
<tr>
<th>Vegetable crop</th>
<th>Variety</th>
<th>Time of nursery sowing</th>
<th>Time of transplanting</th>
<th>Method of sowing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onion</td>
<td>PRO 6, Punjab White, Punjab Naroya PRO 7, POH 1 and PYO 1</td>
<td>Mid-October to Mid-November</td>
<td>First week of January to Mid-January</td>
<td>15 × 7.5 cm in rows</td>
</tr>
<tr>
<td>Garlic</td>
<td>PG 17 and PG 18</td>
<td>--</td>
<td>End of September to Mid-October</td>
<td>15 × 7.5 cm through dibbling</td>
</tr>
<tr>
<td>Peas</td>
<td>Early sowing: AP 3, Ageta 6, Ageta 7 and Arkel Main season: Punjab 89 and Mithi Phali</td>
<td>--</td>
<td>Mid-October to Mid-November</td>
<td>30 × 7.5 cm in rows</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>Pusa Snowball 1 and Pusa Snowball K 1</td>
<td>Main season: August Late season: October</td>
<td>Main season: September Late season: November</td>
<td>Main season: 45 × 45 cm Late season: 45 × 30 cm in rows</td>
</tr>
<tr>
<td>Cabbage</td>
<td></td>
<td>Main season: September Late season: October</td>
<td>Main season: October Late season: November</td>
<td>Main season: 45 × 45 cm Late season: 60 × 45 cm in rows</td>
</tr>
<tr>
<td>Broccoli</td>
<td>Palam Samridhi</td>
<td>Mid-August to Mid-October</td>
<td>Mid-September Mid-October</td>
<td>Late season: 45 × 45 cm in rows</td>
</tr>
<tr>
<td>Chinese sarson</td>
<td>Saag Sarson and Chinese Sarson 1</td>
<td>Mid-September</td>
<td>Mid-October</td>
<td>30 × 45 cm in rows</td>
</tr>
<tr>
<td>Carrot</td>
<td>PC 161, Punjab Carrot, PC 34 and Punjab Black Beauty</td>
<td>--</td>
<td>August-September</td>
<td>45 × 7.5 cm on ridges</td>
</tr>
<tr>
<td>Radish</td>
<td>Pusa Chetaki, Punjab Pasand, Punjab Safed Mooli 2, Japanese White and Pusa Himani</td>
<td>--</td>
<td>July-August, September – October, November-December and January-February</td>
<td>45 × 7.5 cm on ridges</td>
</tr>
<tr>
<td>Turnip</td>
<td>L-1</td>
<td></td>
<td>August-September</td>
<td>45 × 7.5 cm on ridges</td>
</tr>
<tr>
<td>Palak</td>
<td>Punjab Green</td>
<td>--</td>
<td>August-October</td>
<td>20 cm spaced rows</td>
</tr>
<tr>
<td>Coriander</td>
<td>Punjab Sugandh</td>
<td>--</td>
<td>September - November</td>
<td>30 cm spaced rows</td>
</tr>
<tr>
<td>Salad (Lettuce)</td>
<td>Punjab Lettuce 1</td>
<td>Mid-September to Mid-November</td>
<td>Mid-October to Mid-December</td>
<td>45 × 30 cm in rows</td>
</tr>
<tr>
<td>Potato</td>
<td>Early sowing: K. Pukhrjaj and K. Surya Main season: K. Jyot and K. Pushkar Late season: K. Sindhuri and K. Badshah</td>
<td>--</td>
<td>Autumn season: End of September to Mid-October</td>
<td>60 × 20 cm on ridges</td>
</tr>
<tr>
<td>Kasuri methi</td>
<td>Kasuri Supreme</td>
<td>--</td>
<td>October</td>
<td>20 cm in rows</td>
</tr>
</tbody>
</table>
Protecting honey bee colonies from pesticide poisoning

BY PARDEEP KUMAR CHHUNEJA, JASPAL SINGH AND AMIT CHAUDHARY
Department of Entomology

Honey bees not only benefit beekeepers by providing honey, bees wax, propolis, royal jelly, pollen and bee venom but are also very important to the crop growers as pollinators of their fruits, vegetables and field crops. The crop pollination is an important crop input as are irrigation, fertilizers, and pesticide application; sometimes all the latter physical inputs will not be able to produce the desired crop yield if there is lack of pollination for want of pollinators. Honey bees are known to be the most important pollinators due to obvious reasons and regarded as beneficial to farmers. According to an estimate, the bees benefit mankind 10-20 times monetarily through pollination services than the value of the honey.

Effects of pesticide poisoning of bees: The control of insect pests, diseases and weeds in most cases is done solely by the application of some pesticide. Honey bees are susceptible to many pesticides, especially, insecticides. The former suffers direct loss due to death of his bees and also decrease in honey production and other bee products, while the grower suffers because of decreased crop pollination and hence also the yield. The bee floral crops which receive pesticide application during their blooming period e.g. raya/ sarson, sunflower, seed crop of berseem, cotton and sesame are risk prone to the bees, though these constitute generally the major bee flora of the Punjab. The increase in migration of honey bee colonies on these crops is also bringing plentiful reports of bee mortality.

Sources of bee poisoning: The pesticide may directly hit the bees while they are visiting the blooms or may be killed by the residual toxicity of the pesticides when the blooms are visited for forage even later by the bees. It may also be caused by the drift of toxic chemicals either directly towards the apiary site or onto non-target areas like to some water reservoirs, etc. and bees drinking or contacting water are contaminated. The resultant cumulative effect of the contaminated pollen may lead to death of nurse bees and other house worker bees, and depletion of brood due to feeding on contaminated food.

Effect of pesticidal factors: Chlorinated hydrocarbons have both acute and residual toxicity. Malathion and dimethoate, belonging to organophosphorus group, have acute toxicity. Cypermethrin and fenvalerate (synthetic pyrethroid group) have direct toxicity against the honey bees. The insecticides are marketed in different formulations and their harmful effects occur in the following decreasing order: dust > EC > wettable powder > granules. The other factors associated with honey bee poisoning are: type/fineness of spray, stage of the crop (crop in bloom), weather conditions, etc. Some mineral oils used as a carrier in the formulation of insecticides are harmful to bees. Systemic insecticides are rather safe to bees, especially, in granular form. Though systemic organo-phosphorus insecticides applied as sprays are known to exert direct toxicity effects, yet they have not been reported to exhibit any delayed effect or their secretion in nectar except for dimethoate on onion. Synthetic pyrethroids though have very high inherent toxicity to honey bees, yet are regarded comparatively safer to honey bees owing to low behavioural toxicity since due to their repellent effect, the bees escape their direct hit and avoid visiting the fields sprayed by this group of insecticides for some time.

Differential symptoms in pesticide poisoning and other cases of bee mortality: Most of the times, the beekeepers confuse the poisoning or suspect the mortality due to some disease. In general, if there is sudden and simultaneous very heavy bee mortality (i.e. a large number of dead bees are seen on ground in front of the colonies) in a number of honey bee colonies, it is generally a sign of pesticide poisoning. In case of any adult bee disease, there is gradual progression in the mortality of bees unlike the sudden and heavy bee mortality due to pesticidal poisoning. The trembling movements of appendages, in general, are commonly found in the crawling bees affected due to insecticidal poisoning. During crawling, the poisoned bees may be sometimes falling sideways. In case of pesticidal poisoning, some dead bees lying in front of the colonies can be seen carrying pollen pellets in their corbiculae (pollen baskets). Further, the symptoms may be correlated with the crop, its growth stage at the time and reports of pesticidal application.

Management practices against pesticidal hazards
Guidelines for beekeepers

- The beekeepers should maintain the apiary at a place where use of pesticides or at least drift from pesticides is the minimum. The beekeeper should be fully aware of the type of pesticides used in the locality, which in turn depends on the cropping pattern and the pest complex.

- In case the spray programme is to continue for longer period, it is preferable to move the hives away to the safe location free from even the drift.
• Apiarist should have close liaison with the surrounding growers so that the beneficial activity of bees is not jeopardised by the irrational use of pesticides by the latter. Feeding of colonies with sugar syrup and pollen at the time of pesticide application reduces bee foraging, which results in their less exposure to pesticides.

• The use of pollen trap in front of the colonies helps in restricting the income of pesticidal contaminated pollen into the hive and thus protects the young/nurse bees and brood from poisoning.

**Guidelines for crop growers**

• Pest should be tried to hit at the vegetative phase of the crop and avoid spraying at the blooming of the crop until it is very necessary, particularly, if the blooms are visited by the bees and the crop happens to be a major bee flora.

• The pesticides should be used only when necessary. For this purpose, integrated pest management approaches available for most of the crops including economic threshold levels (ETL) should be strictly followed.

• If there is a choice for insecticides, the least hazardous chemicals should be chosen.

• Granules or spray formulations should be preferred to dusts. Pesticide formulation containing attractants should be discouraged as far as possible during the crop in bloom.

• The spray operation in the late evening is always preferable as it not only gives better deposit and distribution (because of invert currents) but also is safer to bees as by this time, the bees’ foraging activity has subsided.

• The blending of branded repellents with the insecticides, if compatible, has been reported effective in protecting the bees by repelling them away from the fields being sprayed.

• It is in the mutual interest that the farmer should intimate the spray programme in advance to the beekeeper so that the latter may take necessary steps to protect his bees.

• **Pardeep Kumar Chhuneja: 98888-85556**

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**Planting of quality evergreen contd from page 11**

**Rootstocks for propagating evergreen fruit crops**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Type of rootstock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinnow, Daisy, Jaffa, Grapefruit, Lime and Lemon</td>
<td>Rough lemon</td>
</tr>
<tr>
<td>Kinnow, Daisy and W. Murcott</td>
<td>Carrizo citrange only for areas with soil pH &lt; 8.0</td>
</tr>
<tr>
<td>Mosambi</td>
<td>Pectinifera</td>
</tr>
<tr>
<td>Blood Red</td>
<td>Cleoptera</td>
</tr>
<tr>
<td>Guava</td>
<td>Sardar or Portugal</td>
</tr>
<tr>
<td>Mango</td>
<td>Desi mango</td>
</tr>
<tr>
<td>Aonla</td>
<td>Desi aonla</td>
</tr>
<tr>
<td>Ber</td>
<td>Desi ber and Katha ber</td>
</tr>
</tbody>
</table>

**Standards of nursery plant of fruit crops (citrus, guava, mango, ber and amla) at the time of sale to farmers**

<table>
<thead>
<tr>
<th>Method of propagation</th>
<th>Budding/ grafting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant age</td>
<td>Not less than one year old</td>
</tr>
<tr>
<td>Plant height</td>
<td>&gt; 60 cm</td>
</tr>
<tr>
<td>Stem diameter</td>
<td>&gt; 0.8 cm</td>
</tr>
<tr>
<td>Grafting/budding height</td>
<td>Not below 9 inches</td>
</tr>
<tr>
<td>Disease and pest incidence</td>
<td>Free from insect-pests and diseases</td>
</tr>
</tbody>
</table>

are uprooted from the field with earth balls and packed in rice straw. These need early planting after reaching the destination as irrigation of these plants is not possible in view of chances of breakage of earth ball. The plants in polybags can be kept for long time till they are planted. Hence, prior planning is required before taking the delivery of plants from fruit nursery.

**Planting and care of saplings:** After the delivery of plants, holes of suitable size should be bored in the centre of the filled pits with the help of planting board. The saplings should be planted in the holes in such a way that the bud union remains around 9 inches above the ground level. The soil around the plants needs to be pressed with feet. After light irrigation, if plant is tilted, it should be stalked when the soil returns to optimum moisture level (**wattar**). The plants need protection against white ant attack; apply chloropyriphos @ 0.5 litre per acre followed by light irrigation. Remove the root suckers and sprouts on the young plants regularly. Train the leader of the fruit plants from the first year of planting by staking.

**Important points to be followed by the fruit growers**

• Fruit crops are of perennial nature, hence always buy the fruit plant from recognized nurseries.

• Consult an expert from PAU and State Horticulture Department regarding recommended crop varieties and rootstocks for your region.

• The fruit plants sold by the approved nurseries are only of recommended varieties which perform better and they are produced by standard vegetative propagation methods.

• Most of the fruit plants are available in approved fruit nurseries at nominal rates, hence do not buy fruit plants at exorbitant rates from hawkers and floriculture nurseries.

The fruit growers can get long life of healthy orchards with the use of genuine quality planting material of recommended varieties on recommended rootstocks.

• **Anirudh Thakur: 94633-70765**
Impact of heat stress on poultry production and its mitigation strategies

BY RAMANDEEP KAUR DHALIWAL AND YASHWANT SINGH
Guru Angad Dev Veterinary and Animal Sciences University

Heat stress reduces growth, reproductive performance and egg production in poultry birds. The optimum temperature for performance/thermoneutral zone is between 19-22°C for laying hens and 18-22°C for growing broilers. The signs of heat stress in poultry include panting with open mouth; spreading their wings and squatting near to the ground; droopy acting; lethargic; closed eyes; lying down; increased water intake; decreased appetite; reduced egg production, egg size, egg shell quality and body weight; and increased cannibalism. Birds subjected to hot climatic conditions, spend less time in feeding; more in drinking, panting, resting as well as more time with their elevated wings and move towards cooler places. Prolonged heat stress exposure in laying hens may also reduce eggshell thickness, egg weight and increase egg breakage. High environmental temperature and humidity cause reduction in feed intake, lower body weight and lower feed conversion efficiency that may adversely affect the potency of broiler production and their meat quality. Moreover, exposure of heat stress during transportation of birds from production farms to processing center compromises the meat quality. The protein content was lower and fat deposition higher in birds subjected to heat stress.

Mitigation strategies to ameliorate heat stress in poultry

There are different approaches pertaining to relieving the adverse impacts of heat stress on poultry production. These approaches can be broadly categorized under housing management, nutritional and breeding strategies.

Breeding management: It involves genetic selection of breeds with increased capacity of coping with heat stress conditions and developing new strains of higher thermo-tolerance by designing suitable breeding programme.

Housing management: The management strategies include appropriate shelter design; providing shade; using sprinklers; implementing cooling devices, fans and ventilation systems.

- Provide adequate ventilation for number of birds housed.
- The orientation of building, insulation and roof overhang should be in scientific manner to reduce the heat effect.
- Insulate sheds sufficiently to avoid solar heat gain in the shed through indirect solar radiation.
- Reduce stocking densities as these provide more floor space per bird and allow more heat to escape from their body and litter.
- Increasing air movement over the birds can increase heat removal from birds. Therefore, position fans to optimize air circulation.
- Width of the open sided poultry shed should not be more than 30 ft to facilitate cross ventilation.
- Use of sprinkler and fogger with fan reduces the temperature inside the house on hot climatic condition. However, during rainy season, avoid the use of sprinkler and foggers as they increase the level of humidity which also has detrimental effect on birds.
- Remove the humid air from the poultry house, particularly, during rainy season and enter equal amount of fresh air from outside. Ventilation system should be maximized as the air movement assists removal of ammonia, moisture and carbon dioxide from the poultry house and enters fresh oxygen from outside.
- Use evaporative cooling pads or atomizing nozzle.
- Provide shade for pastured poultry or decrease sun exposure in the barn by planting shady trees around the poultry shed.

Nutritional management: The nutritional interventions comprise ration balancing and providing essential micronutrients to boost up the productive and reproductive performance in poultry birds.

- As feed consumption decreases, increasing nutrient density may assist in maintaining proper nutrient intake by the bird.
- Feed the birds during cooler part of the day to increase feed consumption.
• Continuous supply of fresh, clean, cool and soft water is recommended. Watering space should be doubled.
• To increase the feed consumption, offer the feed in the form of wet mash or crumbles as it reduces energy expenditure for eating.
• Increase the mineral level during hot climate as their excretion increases during this time. Addition of calcium and phosphorus in summer months may reduce the effect of heat stress.
• Employ the use of certain feed additives, such as, betaine, enzymes, antioxidants, mycotoxin binders, phytogenics, and probiotics to alleviate effects of heat stress.
• Natural sources of Vitamin C e.g. lemon, orange, tomatoes, etc. can be included in the diet of poultry birds to alleviate the heat stress during hot and humid conditions.
• Providing more energy in the form of high quality fat reduces heat produced by the bird and improves the performance as the fats have higher water content and stimulate feed consumption.

In conclusion, it is necessary to adopt different intervention methods involving various approaches, together with breeding management (i.e. genetic selection of thermo-tolerant breeds), environmental management (such as housing design, ventilation, sprinkling, shading, etc.) and nutritional manipulation (i.e., diet formulation, addition of nutrients and diet supplements) to optimize and sustain poultry production within the ever-changing climate situation.

Harvesting and threshing: Harvesting of the seed crop should be done when it reaches full maturity and dry stage. Seed with high moisture content or when harvested/threshed under humid conditions becomes more prone to internal and external injuries in the form of cracks or scratches due to mechanical processes, thus, favouring invasion by storage fungi. Therefore, seed crop should be harvested on a clear sunny day. Seed crop should be harvested separately and combine harvesters or threshers should be cleaned properly before harvesting to avoid admixtures with other varieties.

Storage: Clean and dry storage site is a fundamental requirement for safe seed storage. If bags are to be used, prefer new gunny bags for seed storage. Store houses must be rat and bird proof but at the same time should be airy for ambient storage of seeds. Safer moisture limits of stored seed, low relative humidity and low temperature favour good storage life of seed. If needed, conditioned seed storage may be adopted.

In store houses, seed of different varieties should be kept separately and clearly marked for crop, kind and production year to avert any mistake while taking out seed for sale or packing. To avoid any infestation with storage insect-pests, the seed lots may be fumigated with Celphos (Aluminium phosphide) or Phostoxin (Hydrogen phosphide). Seeds should have low moisture content for fumigation to avoid loss of viability. Duration of fumigation is also very important to maintain germination of seeds. Usually 3-7 days exposure period is considered safer for fumigation with Celphos when moisture and temperature limits are kept under control. Maximum moisture level of different seeds at the time of storage is as under:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Maximum moisture (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddy</td>
<td>13</td>
</tr>
<tr>
<td>Wheat, barley, maize, bajra and soybean</td>
<td>12</td>
</tr>
<tr>
<td>Arhar, cotton, berseem, guinea grass, mash, moong, gram, lentil and groundnut</td>
<td>10</td>
</tr>
<tr>
<td>Linseed, sunflower and guara</td>
<td>9</td>
</tr>
<tr>
<td>Rapeseed and mustard</td>
<td>8</td>
</tr>
</tbody>
</table>

Seed testing: Before sowing in the next season, the germination capacity of the seed should be got tested from the seed testing laboratories to assess the quality and planting value of seed. Minimum seed germination standards for some of the crops are as given below:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Minimum germination (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize hybrids, synthetics and composites</td>
<td>90</td>
</tr>
<tr>
<td>Wheat, barley, gram, rapeseed and mustard</td>
<td>85</td>
</tr>
<tr>
<td>Paddy, berseem and linseed</td>
<td>80</td>
</tr>
<tr>
<td>Lentil, moong, mash and bajra</td>
<td>75</td>
</tr>
<tr>
<td>Sunflower, groundnut, soybean and guara</td>
<td>70</td>
</tr>
<tr>
<td>Cotton</td>
<td>65</td>
</tr>
<tr>
<td>Guinea Grass</td>
<td>20</td>
</tr>
</tbody>
</table>

After gaining expertise and confidence in seed production, farmers can expand their production as certified seed after attaining seed production licence from the Director of Agriculture or can become contract seed growers for various private and public seed producing agencies.

• Tarvinder Pal Singh: 98724-28072
Diseases and physiological disorder in cotton

BY RUPESH KUMAR ARORA, ASHOK KUMAR AND PARAMJIT SINGH

Regional Research Station, Bathinda

Cotton crop suffers from fungal, bacterial and viral diseases as well as physiological disorder. Therefore, farmers are advised to adopt PAU recommendations for the efficient management of diseases and physiological disorder in cotton.

Cotton is an important fibre crop grown in Punjab during Kharif season. Many factors are responsible for low productivity and production of cotton but the significance of plant diseases that damage the crop from sowing to maturity is the most important. These diseases also affect all the quality parameters of cotton lint adversely. Cotton crop suffers from fungal, bacterial and viral diseases as well as physiological disorder.

**Cotton Leaf Curl:** Cotton Leaf Curl (CLCuD) is a viral disease transmitted by whitefly. The disease generally appears in June. The initiation of disease is characterized by thickening of small vein on the lower side of young upper leaves with netted appearance. Later upward/downward curling appears; small leaflets also develop on the underside of leaves on the main as well as lateral veins. If plants affected at early stages lead to short intermodal length and cause stunting, the number of flower and fruiting body reduces in diseased plant. Protect the crop against whitefly vector by using recommended insecticides. Follow clean cultivation and destroy all the weed hosts (*kanghi buti* and *peeli buti*) which act as collateral host for virus.

**Parawilt:** It is a physiological disorder that may occur in any variety or hybrid and plants show sudden dropping of leaves which appear after droughts when the crop is heavily irrigated or there is heavy rain and bright sunshine appears. Plant gets wilted, typically at flowering and boll formation stage of the crop, but the root system remains intact. Spray cobalt chloride @ 10 mg per litre of water (10 ppm) just after the appearance of symptoms of Parawilt. This spray will not be effective if permanent wilting occurs.

**Leaf spots:** Foliar leaf spots are caused by different fungi and characterized by producing varying size spots on the leaves. Higher severity causes strong defoliation in cotton crop. The disease perpetuates through diseased debris. This disease is characterized by circular and semicircular brown colour spots with broad violet margins. High relative humidity favours irregular rain development of disease. To manage fungal leaf spot in July-August during rainy season, the crop should be sprayed with Amistar top 325 SC @ 200 ml in 200 litres of water. If required, repeat the spray at an interval of 15-20 days.

**Leaf reddening:** In Bt cotton hybrid, reddening of the leaves is seen at later stages at the time of flowering and boll formation stages, which hamper the photosynthesis activity and lead to the yield loss in cotton crop. It mainly occurs due to the deficiency of magnesium, as it is an important constituent of the chlorophyll and responsible for maintaining healthy green leaves. Two sprays of 1% Magnesium Sulphate (1 kg in 100 litres of water) should be done at 15 days interval during full bloom and boll development stages to manage leaf reddening.

**Droppings:** The droppings in cotton crop are usually noticed when the crop is under stress either abiotic or biotic viz., nutrient deficient soil, high temperature or drought, improper application of foliar nutrient spray or irrigation at the time of flowering or boll formation, pest and attack, etc. If the cultural practices are not followed properly, the droppings can enhance and lead to economical loss. Proper management i.e. cultural, nutritional and plant protection measures adopted during raising of cotton crop from sowing till picking plays an important role against
Mushrooms are considered as nature’s highly nutritious vegetarian food item in the world. Punjab Agricultural University has developed cultivation technology for five mushroom varieties, namely, white button mushroom, dhingri, shiitake, milky and paddy straw mushroom. With respect to fruits and vegetables, mushrooms are considered as a good source of proteins, fibres, vitamin B3, vitamin B5, vitamin C, vitamin D, selenium, copper and riboflavin which make it a better diet.

The fruiting body, mycelium and broth of mushrooms possess numerous medicinally important bioactive components in the form of polysaccharides, alkaloids, terpenoids, flavonoids, proteins, phenolics, enzymes and lectins. The presence of bioactive medicinally important components in mushrooms provides not only proteins but also treats number of deadly diseases, such as, cancer, renal failure and stroke damage. Thus, there is a need to exploit this wonderful source of nutrients and promote it for diversification towards subsidiary occupation of mushroom cultivation in Punjab.

**Nutritional value of mushrooms**

**BY SHIVANI SHARMA AND SHAMMI KAPOOR**

*Department of Microbiology*

Mushrooms are a rich source of B-complex group of vitamins that is thiamine, riboflavin, niacin, vitamin B-6 (pyridoxine), pantothenic acid and vitamin D.

- Minerals, such as, potassium, copper, ergothionine and selenium are found in abundant amount in mushrooms.
- Mushrooms are a good source of calcium and copper that help to maintain a healthy bone density and structure which in turn prevent osteoporosis and arthritis.
- Mushrooms are an excellent source of dietary iron and copper which help in forming blood cells.
- Selenium present in the mushroom improves the skin elasticity and prevents ageing. The mushroom polysaccharide maintains hydrated and healthy skin.
- The bioactive compounds, such as, polysaccharides and terpenoids present in the mushroom activate the immune cells and proteins which in turn attack tumor cells.
- The daily consumption of button mushrooms could act as prebiotic by improving microbial community in the gut, which could then improve the regulation of glucose in the liver. Mushrooms can make a great snack for diabetic people as they contain low-calorie nutrient dense carbohydrates that don’t raise blood sugar levels.
- Mushrooms contain potassium which relaxes and calms the nerves, and maintains a healthy level of blood flow.

Protective measures to manage cotton diseases

- Follow the crop rotation for 3-4 years as the inoculums of root rot survive in the field.
- In wilt infested desi cotton fields, follow crop rotation with American cotton or non-host crop for 5-6 years.
- Instead of ploughing the diseased cotton sticks in the field, remove the cotton sticks from the field and use these as a fuel. These protective measures will also help in reducing the input cost.

**Tirak:** Bad boll opening, also called Tirak, is a physiological disorder which is more pronounced in the dry belt adjoining Rajasthan and Haryana. The factors i.e. persistent dry weather, high temperature, light sandy soils, improper irrigation, low humidity, nutrient deficiency, too early sowing works singly or in combinations during the flowering/fruiting stages favour the incidence of Tirak and may increase the intensity of this malady. Tirak is usually noticed in the later stages of the growth phase at the time of boll opening, if it coincides with the dry spell. It is characterized by the yellowing and reddening of leaves, followed by bad/poor opening of bolls. Proper management of the cotton crop i.e. timely irrigation and adequate nutrient/fertilizer applications are the precautionary measures for the management of Tirak.

**Protective measures to manage cotton diseases**

- Follow the crop rotation for 3-4 years as the inoculums of root rot survive in the field.
- In wilt infested desi cotton fields, follow crop rotation with American cotton or non-host crop for 5-6 years.
- Instead of ploughing the diseased cotton sticks in the field, remove the cotton sticks from the field and use these as a fuel. These protective measures will also help in reducing the input cost.

**Ashok Kumar: 85589-10268**
Integrating farmers with the market: Success story of Kharif mash

BY KHUSHDEEP DHARNI AND TARSEM CHAND MITTAL
School of Business Studies

It is imperative to conceptualize the agricultural activities in the frame of agribusiness for achieving long term growth, profitability and sustenance. Agribusiness approach extends beyond on-farm operations and entails a comprehensive view including backward and forward linkages. In the contemporary times, marketing problems have assumed a predominant role in the challenges and issues facing agriculture. The severity of marketing related problems aggravates further, especially, for various crop diversification alternatives, such as, pulses. Non remunerative prices limit the incentive as well as scope for diversification and pose a challenge to the policy makers.

Limited market access and information are identified as the major obstacles for increasing farmers’ income. Farmers possess the requisite skills for production of agricultural commodities but they face hurdle in the domain of downstream supply chain activities, especially, in establishing connectivity with the consumers and markets. Direct linkage to the consumer markets is directly associated with the profitability of the growers. Raw agricultural commodities have typical marketing issues in terms of limited shelf life, potential for sale and remunerative price realization. Value addition in form of product development, processing, packaging and labeling can be effective counters for the above mentioned shortcomings. Value addition activities enhance the marketing potential of the agricultural products and add to the earning potential through better price realization.

The Punjab Agricultural University conducted a pilot project for establishing the direct linkages of Kharif pulse growers without intervention of market intermediaries. The project was primarily aimed at establishing value chain mechanism in context of Kharif mash so as to encourage the cultivation of suitable alternatives of the paddy crop. Kharif crops, other than paddy, encounter the problems related to marketing and remunerative prices for the farmers. Apart from pulse growers, the other participants in this project were School of Business Studies, Department of Food and Processing Engineering, and Krishi Vigyan Kendra, Gurdaspur. For accomplishing the objectives of the project, farmers from Gurdaspur and Hoshiarpur districts were contacted for the procurement of Kharif mash. In all, 918 kg of PAU Mash 114 was procured at Minimum Support Price of Rs 6,000 per quintal.

Major activities undertaken in the project are listed as follows:

• Procurement of mash crop directly from farmers by School of Business Studies.
• Preliminary processing operations at Krishi Vigyan Kendra, Gurdaspur.
• Final processing and packaging by Department of Processing and Food Engineering.
• Labeling and retailing of finished product by School of Business Studies.

After processing, 849 kg of finished product was available. Final product, in form of 1 kg packing, was retailed at Rs 90 per kg. After accounting for various costs, the product had a profit margin of 17.26 per cent.

Successful accomplishment of this pilot project demonstrates that the profitable and direct market linkages for agricultural products are real possibilities. There is a scope for farmers and farmer groups, such as, Farmer Producer Organizations to operate throughout the supply chain. Undertaking end to end operations across the supply chain enhances the profitability and competitiveness of farmers. Therefore, farmers should strive for establishing direct market linkages. Alternatively, public investment in such activities can ensure large scale operations and facilitate the adoption of crop diversification choices.

Financial summary of the project

<table>
<thead>
<tr>
<th>Particular</th>
<th>Amount (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>76,410/-</td>
</tr>
<tr>
<td>Expenditure</td>
<td>63,220/-</td>
</tr>
<tr>
<td>Net Income</td>
<td>13,190/-</td>
</tr>
</tbody>
</table>

The project benefitted the farmers as well as the consumers

<table>
<thead>
<tr>
<th>Benefits for farmers</th>
<th>Benefits for consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Procurement at Minimum Support Price</td>
<td>Premium grade unpolished product</td>
</tr>
<tr>
<td>• Establishment of market linkages</td>
<td>Lower price</td>
</tr>
<tr>
<td>• Viable option for diversification</td>
<td>Assured quality</td>
</tr>
</tbody>
</table>

PAU Mash 114

Financial summary of the project

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• Khushdeep Dharni: 81461-33399

PAU Mash 114
PADDY

- Irrigate the paddy field two days after the ponded water has infiltrated into the soil and stop irrigation two weeks before maturity for easy harvesting and timely sowing of next rabi season crop.
- Rogue out the weeds and off type plants from the paddy.
- Control leaf folder when leaf damage reaches 10 per cent by spraying 20 ml Fame 480 SC (thifluazonym) or 120 g Regent/Mortel/Mifpro G/Mahavir GR 0.3 G (imidacloprid) or 10 kg Padam/Kritap/Sanvex/Caldan/Nidan/Marktap/5565 4 G (cartap hydrochloride) or Dursban 10 G (chlorpyriphos) or 4 kg Vibrate 4 GR (thiocyclam hydrogen oxalate) per acre in standing water. Fame 480 SC/Mortar 75 SG or Coragen 20 SC/Padan/Kritap/Sanvex/Caldan/Nidan/Marktartap/5565 4 G (cartap hydrochloride) or Dursban 10 G (chlorpyriphos) or 4 kg Vibrate 4 GR (thiocyclam hydrogen oxalate) per acre in standing water. Fame 480 SC/Mortar 75 SG or Coragen 20 SC/Padan/Kritap/Sanvex/Caldan/Nidan/Marktartap/5565 4 G (cartap hydrochloride) or Dursban 10 G (chlorpyriphos) or 4 kg Vibrate 4 GR can also control leaf blight effectively.
- To save the crop from sheath blight, keep the bunds of the fields clean by removing grass. On noticing the disease symptoms, spray the crop with Pulsur 24 SC (thifluazonym) @ 150 ml or Epich75 WG (hexaconazole) @ 28.8 g or Nativo 75 WG (thifluazonym + tebuconazole) @ 80 g or Galileo Way 18.76 SC (picoxystrobin + propiconazole) @ 400 ml or Lustre 37.5 SE (fluazinam) + carbendazim) @ 320 ml or Amistar Top 325 SC (azoxystrobin + difenoconazole) or Till/Bumper 25 EC (propiconazole) or Folicur/Orius 2 SC EC (tebuconazole) or Monceron (pyraclostrobin) @ 200 ml in 200 litres of water per acre. Repeat the spray after 15 days interval.
- If high humidity and cloudy weather persists, the crop may be sprayed at boot stage with Galileo Way 18.76 SC (picoxystrobin + propiconazole) @ 400 ml or Kocide 47 DF (Chopper hydroxide) @ 500 g in 200 litres of water per acre to control false smut.

MAIZE

- Maintain adequate water supply, particularly, at tasseling and silking stages. Stress at these stages causes considerable loss in yield.
- After heavy rains if water stagnates in the fields, drain out the excessive water to keep the plants free from bacterial stalk rot. Manage banded leaf and sheath blight of maize by spraying 100ml of Amistar top in 200 litres of water as soon as it appears in the field.
- Fall armyworm (FAW) in grain maize can be checked by spraying with Coragen 18.5 SC (chlorantraniliprole) or delegate 11.7 SC (spinetoram) or 0.4 ml or Missiile 5 SG (emamectin benzoate) @ 0.4 g per litre of water. If spraying is difficult, apply soil-insecticide mixture (about half gram) in the whors of the infested plants. To prepare the soil-insecticide mixture, add 5 ml of Coragen 18.5 SC or Delegate 11.7 SC or Missilie 5 SG in 10 ml of water and mix well in one kg of soil. In case of fodder crop, use Coragen 18.5 SC @ 0.4 ml per litre of water and do not harvest fodder for 21 days after its application to ensure safety to farm animals.

COTTON

- Do not allow the cotton crop to suffer from water stress during flowering and fruiting stages, otherwise a lot of shedding of flowers and bolls will take place, resulting in poor yield. To hasten boll opening, last irrigation may be given at the end of September.
- If the damage/population of sucking insect-pests reaches economic threshold levels, spray the crop with Sefina 50 DC (afidopyropen) @ 400 ml/acre or Osheen 20 SG (dilinazurran) @ 60 g/acre or Polo/Crazee/Ruby/Ludo/Shoku 50 WP (difenphthion) @ 200 g/acre or Lano/Dalata 10 EC (pyridostemifene) @ 500 ml/acre or Oberon/Voltage 22.9 SC (spiromesifen) @ 200 ml/acre or Ulala 50 WG (flonicamid) @ 80 g/acre for the control of whitefly. For the control of jassid, use Keefun 15 EC (tolfenpyra) or Osheen 20 SG @ 60 g per acre or Neon 5 EC (fenpyroximate) @ 300 ml/acre or Ulala 50 WG @ 80g/acre or Actara/Extra super/Dotara/Thomson (thiamethoxam) 25 WG @ 40 g/acre in 125-150 litres of water with manually operated knapsack sprayer. To check the attack of grown up American bollworm larvae, prefer to spray Tracer 48 SC (spinosad) @ 60 ml or Avant 15 SC (indoxacarb) @ 200 ml per acre or Sumpleec 10 EC (pyridalyl) @ 300 ml/acre or Coragen 18.5 SC @ 60 ml/acre or chlorpyriphos 20 EC @ 2 litre/acre. Repeat the spray if it rains within 24 hours of spraying. Mealy bug infested rows/plants should be sprayed with 150 ml Transform 21.8 SC (sulfoxaflor) in 125-150 litres of water.
- To get higher yields, give four sprays of 2% potassium nitrate 13:0:45 (2 kg potassium nitrate in 100 litres of water) at weekly intervals starting from flower initiation.
- Do not use synthetic pyrethroids on cotton for the control of bollworm complex after mid-September.
- To control fungal foliar leaf spots, the crop should be sprayed with Amistar Top @ 200 ml/acre in 200 litres of water at 15-20 days interval.

SUGARCANE

- Prop up the sugarcane crop in the beginning of this month by using trash-twist method. Irrigate the crop at regular intervals for getting better yields.
- Rogue out the canes affected by red rot and wilt. Collect and destroy the shoots infested with Vordaspur borer. Repeat this operation at weekly intervals.
- Start sowing of early maturing sugarcane varieties like CoPb 95, CoPb 96, Co 15023, CoPb 92, Co 118, COJ 85 and COJ 64 from second fortnight of this month. Keep 90 cm distance between rows.
- Grow toria, potato or garlic as intercrops in sugarcane for getting higher returns.

OILSEEDS

Toria: September is the optimum period for sowing of toria. Use short duration varieties TL 17 and TL 15 for better yield and getting the field vacated well in time. Toria may be sown after applying 55 kg of urea and 50 kg of single superphosphate per acre. If single superphosphate is not available, apply gypsum @ 80 kg per acre particularly in sulphur...
deficient soils alongwith nitrogen and phosphatic fertilizers. For getting higher productivity, grow toria + gobhi sarson as intercrops at 22.5 cm row spacing by third week of September or broadcast 1 kg seed of toria and then sow gobhi sarson at 45 cm row to row distance with 1 kg of seed.

Groundnut: Do not allow the crop to suffer water stress at the pod development stage. Any stress at this stage causes drastic reduction in yield of groundnut. Control Tikka disease by spraying with wettable sulphur @ 500-750 g/ace in 200-300 litres of water per acre or Bavistin/Derosal/Agrozim @ 50-60 g/acre in 100 litres of water per acre. Give 3-4 sprays at 15 days interval starting from August.

**FODDER PRODUCTION**

- Sow maize (J 1007 and J 1006) for fodder production upto mid-September to have fodder for the scarcity period.
- Prepare the land for the sowing of berseem during the last week of September. Mix oats and sarson/raja in berseem to get first cutting early. Berseem seed should be free from Kashni seed. Inoculate the berseem seed with Rhizobium culture. Apply 22 kg of urea and 185 kg of superphosphate per acre at the time of sowing berseem. If 6 tonnes of FYM has been applied, then 125 kg of superphosphate per acre will be sufficient. Where rye grass has been mixed in berseem, apply 22 kg of urea per acre after each cutting.
- Preserve the surplus green fodder of maize or bajra as silage or hay to supplement the shortage of green fodder.

**VEGETABLES**

**Potato**
- The climatic conditions are ideal for sowing early varieties i.e. Kufri Surya, Kufri Pukhraj, Kufri Ashoka and Kufri Chandramukhi. Take seed potato from the cold storage in the first fortnight of this month and spread in ventilated place under diffused sunlight in thin layers. Turn the surface of tubers once in a day and allow buds to sprout for a week. Sprouts should attain 0.5 - 1.0 cm length before sowing.
- Use healthy and disease free seed.
- Disinfect the tubers before sowing with 0.25% solution of Monocercen (250ml per 100 litre water) or 0.083% of Ermosto Prime (83 ml per 100 litre water) for 10 minutes to check black scurf of potato.
- Application of FYM @ 20 tonnes per acre or green manuring is beneficial for this crop. Drill 82.5 kg of urea, 155 kg of superphosphate and 40 kg Muriate of Potash per acre at the time of sowing and remaining urea of 82.5kg at the time of earthing-up.
- For weed control, use Gramoxone/Kabuto 24 SL (paraquat) @ 500-750 ml per acre at the stage when most of the weeds have emerged and potato crop showed 5-10 per cent emergence. Use 250 to 300 litres of water in knapsack sprayer fitted with flat fan nozzle and 100 litres of water with power sprayer.
- The newly planted fruit plants are very tender and therefore, operations like irrigation, removal of sprouts stock, training, staking and plant protection measures should be undertaken with extreme care.
- Pre-harvest fruit drop in citrus can be reduced with the spray of 2, 4-D sodium salt of horticulture grade (5 gm) in 500 litres of water during mid-September.
- In citrus, leaf miner can be checked by spraying 200 ml Crocodile/Confidor 17.8 SL (imidacloprid) and citrus psylla can be checked by spraying 200 ml Crocodile/Confidor 17.8 SL or 160 g Actara/Dotara 25. To check withertip or die back, anthracnose or stem-end rot diseases, spray the plants with Bordeaux mixture 2: 2: 250.
- In ber, the incidence of black leaf spots can be managed with the spray of Bordeaux mixture 2:2:250 during this month. To minimize the incidence of ‘lac’ insect in ber, remove the infested shoots.
- Apply 50 kg of FYM along with 2 kg of single superphosphate and 1.5 kg Muriate of Potash to full grown loquat tree in this month.
- Apply supplemental dose of urea @ 500 g to full grown plants of Punjab Beauty pear in this month in addition to recommended dose of fertilizers.
- Apply 500 g of urea, 1,250 g of single superphosphate and 750 g Muriate of Potash to full grown guava trees as second installment in organic fertilizers.

**HORTICULTURAL OPERATIONS**

- It is highly suitable time for planting of evergreen fruit plants, but it should be completed as soon as possible during this month because with the declining temperature, growth of newly planted plants will not take place. Planting of mango, sweet orange, mandarin, lime, lemon,itchi, guava, aonla, loquat, ber and papaya can be done.

**ORNAMENTALS**

**Annuals:** Nursery of winter annuals can be raised during this month on raised beds. Seeds with hard seed coat like sweet pea are sown directly after soaking them in water overnight. Immediately after sowing the seeds, water must be sprinkled on the beds. The seedlings are to be protected from damping off disease in the nursery beds. Take care of watering of the nursery beds.

**Lawn:** The lawns must have gained good growth during the rainy season. Adjust the lawn mower blades in such a way that the lawn is mowed as close to the ground as possible. For getting lush green appearance of the lawn, apply 1.0 kg CAN or 500 g urea per 1,000 sq ft.

**Chrysanthemum:** Take care of drainage in the chrysanthemum pots as poor drainage leads to yellowing of plants. Keep on training the plants. Keep on disbudding the side shoots in case of large flowered chrysanthemum to get appropriate size of the flowers.
Roses: In the second half of this month, the water should be withheld to prepare the rose plants for pruning. The pruning can be done during second fortnight of October. Use sharp secateurs for pruning and apply fungicides on cut ends.

Marigold: Marigold seed sowing is done during this month for winter season crop. Punjab Gainda No.1, planted for seed during July-August, is to be pinched to get more spread of the plants.

Gladiolus and other bulbous crops: Planting of gladiolus corms should be started. Before planting of corms, the corms must be treated with some fungicide solution for half an hour. Well developed bulbs of Narcissus (Nargis), Freesia etc. can be planted now. The soil should be well drained and rich in organic matter. Double Dahlia plants can be raised both from the terminal cuttings as well as from the bulbs during this period.

FARM FORESTRY

Poplar
- Irrigate the poplar plantations at fortnightly interval.
- In poplar nurseries, the caterpillars of leaf defoliator and leaf webber feed on leaves. Control the insects by collecting and destroying the infested leaves.
- Autumn crop of sugarcane can be sown if the poplar age is less than three years, however, maize/bajra/sorghum can be taken as fodder at any age of the poplar.

Safeda
- The planting drive of seedlings or clonal planting stock should be done in pits of 50 × 50 ×50 cm. The pits should be filled with 50 per cent top soil and 50 per cent farm yard manure.

HONEY BEE MANAGEMENT

Provide drawn combs/frames and super chambers as per requirement, in case there is nectar flow or pollen income or both from the available bee flora. Ripe (sealed) honey, in case of the availability of nectar flow, should be extracted. In case of pollen flow, provide a mixture of empty worker brood cell comb in the brood chamber to hasten colony growth, and honey extraction be sorted only to honey supers separated from the brood chamber with queen excluder. All precautions to avoid robbing should be undertaken during and after honey extraction. This would also curb spread of bee diseases and Varroa mite. Dust sulphur powder on the top bars of the bee combs @ 1.0 g per comb against *Tropilaelaps clareae* brood mite’s infestation. Alternatively, fumigation with formic acid @ 5 ml daily for two weeks may be applied. The latter treatment will also take care of Varroa mite but it should be avoided during nectar flow. In the case of heavy infestation by Varroa destructor mite, the destruction of sealed drone brood comb part, Varroa trapping in sealed drone brood and then its destruction, and the use of sticky papers on bottom board coupled with the use of Varroa board can also be integrated. Dusting of icing sugar @ about 2 g in the evening time in between every two bee combs 7-8 times at three days interval is also helpful in reducing the mite infestation. Spray of freshly prepared oxalic acid solution (4.2%) prepared in 60 per cent sugar solution in water, on the adult bees in the late evening thricce at weekly interval, is also helpful in the reduction of the mite population. Proper spacing among the colonies and also among the migrated apiaries, and the extraction of honey from only the super separated from the brood chamber with queen excluder help in preventing spread of Varroa. Keep vigil on brood diseases and on suspicion, immediately consult experts and take appropriate control measures; non-chemical methods should be preferred. The suspected colonies should immediately be isolated from the healthy looking stock. Adopt necessary apiary management operations to avoid wax moth attack inside the colonies. Inspect the stored combs for wax moth attack and apply fumigation with burning sulphur or aluminium phosphide, if necessary. In areas of floral dearth, give sugar feeding (sugar: water = 1:1) to the honey bee colonies according to the needs and take all measures to prevent/check robbing. In the event of pollen flow and drone brood rearing, queen bee rearing can be undertaken depending on the prevailing weather conditions, for stock multiplication or re-queening for which progressive beekeepers can follow mass queen bee rearing technique for which the best performing selected colonies should be used as ‘breeder colonies’. For further information, consult beekeeping experts.

MUSHROOM GROWING

- As per PAU recommendation, start preparing compost using wheat straw or wheat straw: paddy straw (1:1) for the cultivation of button mushroom during second or third week of this month.
- During compost preparation, book your spawn as per requirement for growing button mushroom.
- Discard the spent material (bags) of milky mushroom after 7-8 days. Do not spray animals below six months of age. Animal sheds, especially, corners and crevices should also be sprayed. Strictly follow the manufacturer’s instructions while spraying the insecticides. Keep the animal sheds and surroundings clean to keep the fly population under control.
- For prophylaxis against trypanosomiasis (surra) disease, consult the local veterinarian. Since the disease is transmitted by flies, spray insecticides to keep the flies away.
- De-worm the adult animals regularly at an interval of three months with broad spectrum anthelmintics, keeping in view the prevalence of endoparasites in your area.
- By the end of September, prepare the fields for sowing by proper sanitation and using teat dip by the solution of 75 ml povidone iodine plus 25 ml glycerine.

POULTRY

- Light plays an important role in egg production. Provide 14-16 hours of total light to layers, including the day light. Gradually go on increasing the light when egg production starts.
- Provide extra grit (5 g per bird) in the layer ration to avoid production of thin shelled eggs.
- Stir the litter regularly to avoid dampness. At the same time, sufficient air movement should be made possible inside the poultry shed.
- It is the best season to raise the broilers. Get your broiler chicks from a reputed hatchery.
- Protect the sheds from rodents as they eat feed meant for poultry.

Compiled by: Amarjit Singh
Information supplied by: PK Chhuneja, RK Gupta, KS Suri, Amit Kaul, JS Brar, GPS Dhillon, Ranjit Singh, Ruma Devi, Shivani Sharma and Tejbveer Singh

32

PROGRESSIVE FARMING
**Training Programmes in September**

**KVK, AMRITSAR (98723-54170)**

- **September 02-03**: Nutritional security through integrated nutrition garden
- **September 06**: Integrated pest and disease management in *rabi* crops
- **September 08**: Importance of balanced diet and preparation of low cost recipes
- **September 09**: Establishment of vegetable nutrition garden in urban and peri-urban areas
- **September 13**: Integrated management of paddy straw with different techniques
- **September 15**: Raising of winter season annual flowers
- **September 16-17**: Nutritional recipes from fermentation and sprouting
- **September 20-28**: Beekeeping - A lucrative subsidiary occupation
- **September 21-22**: Milling, grading and packaging of basmati rice
- **September 23**: Seed treatment - A preventive measure for control of seed borne diseases
- **September 27-28**: Processing of honey (heating, filtration, packaging and marketing)

**KVK, BATHINDA (0164-2215619)**

- **September 02**: Protected cultivation and nursery raising technique of vegetable crops
- **September 03**: Self-awareness on social evils
- **September 09-17**: Preparation of value added products out of waste material
- **September 13-17**: Mushroom cultivation and subsidiary occupation
- **September 14**: Diagnosis and management of nutrient deficiency in *rabi* crops
- **September 16**: Role of green manuring in enhancing soil health
- **September 27**: Integrated pest and disease management in *rabi* crops
- **September 29**: Seed production of berseem

**KVK, FARIDKOT (01639-253142)**

- **September 03**: Nutritional security through integrated kitchen gardening
- **September 08**: Integrated pest and disease management in *rabi* crops
- **September 09**: Rice residue management for improving soil health
- **September 13-17**: Mushroom cultivation and processing
- **September 15**: Jaggery making and preparation of value added products from it (including vinegar)
- **September 20**: Improved cultivation techniques of *rabi* crops
- **September 22**: Raising of winter season annual flowers
- **September 23**: Seed production of berseem
- **September 24**: Efficient use of crop residue management machinery
- **September 29**: Efficient use of crop residue management machinery
- **September 30**: Protected cultivation and nursery raising techniques of winter vegetables

**KVK, FATEHGARH SAHIB (01763-221217)**

- **September 02**: Efficient use of crop residue management machinery
- **September 03**: Organic farming in vegetables
- **September 07**: Balanced diet for different age groups
- **September 10**: Planning of nutrition garden and roof top garden in urban and peri-urban areas
- **September 13**: Safe and judicious use of pesticides
- **September 15**: Custom hiring of agricultural machinery
- **September 24**: Improved cultivation practices of *rabi* crops
- **September 28**: Rice residue management technologies for improving soil health
- **September 29**: Improved cultivation of fruit crops
- **September 30**: Integrated pest and disease management in *rabi* crops

**KVK, FEROZEPUR (MALLEWAL) (01632-279517)**

- **September 03**: Integrated nutrient management in *rabi* crops
- **September 09**: Efficient use of crop residue management machinery
- **September 15**: Efficient use of crop residue management machinery
- **September 17**: Integrated pest and disease management in *rabi* crops
- **September 20-28**: Mushroom cultivation as subsidiary occupation
- **September 22**: Seed treatment – A preventive measure for seed borne diseases
- **September 27**: Protected cultivation and nursery raising techniques of vegetable crops
- **September 29**: Improved cultivation practices of *rabi* oilseed and pulse crops

**KVK, GURDASPUR (01874-220743)**

- **September 03**: Improved cultivation practices of *rabi* oilseed and pulse crops
- **September 06-10**: Mushroom production
- **September 07**: Prevention of zoonotic diseases
- **September 09**: Personal hygiene and nutrition for adolescent girls
- **September 15**: Efficient use of crop residue management machinery
- **September 17**: Integrated nutrient management in *rabi* crops
- **September 20-24**: Beekeeping - A lucrative subsidiary occupation
- **September 21**: Efficient use of crop residue management machinery
- **September 28**: Computation of balanced ration for dairy animals

**KVK, HOSHIARPUR (BAHOWAL) (98157-51900)**

- **September 03**: Vegetable crop - Protected cultivation and nursery raising techniques
- **September 06-10**: Value addition to cereals and pulses
- **September 07**: Nutritional security through nutrition garden
- **September 13-17**: Mushroom cultivation and processing
- **September 22**: Establishment of nutrition garden in urban and peri-urban areas
- **September 24**: Integrated nutrient management in *rabi* crops
- **September 28**: Improved crop production and protection practices in *rabi* crops

**KVK, JALANDHAR (NURMAHAL) (01826-292053)**

- **September 01**: Cultivation of fodder crops
- **September 03**: Layout and planting of nutrition garden in urban and peri-urban areas
- **September 06-10**: Mushroom cultivation technology
- **September 09**: Identification of natural enemies in field crops
- **September 10**: Development of driving skills for paddy straw management machinery
- **September 13-17**: Preparation of festive and traditional dishes using jaggery and honey
- **September 15**: Hygiene and personal health in farm women
- **September 16**: Mastitis control and clean milk production
- **September 17**: Operational and driving components of various paddy straw management machines
- **September 20-24**: Poultry farming
- **September 27**: Seed production of different vegetable crops (onion, brinjal and tomato)
- **September 30**: Techniques of soil sampling for field and orchard crops
AUGUST 2021

PROGRESSIVE FARMING

KVK, KAPURTHALA (01822-233056)

September 03: Preventive guidelines for agriculture accidents
September 06-10: Mushroom cultivation as subsidiary occupation
September 08: Integrated farming system
September 09: Balanced diet for different age groups
September 16: Rice residue management technologies for improving soil health
September 17: Raising of winter season annual flowers
September 23: Improved cultivation of fruit crops
September 24: Garment enrichment using different techniques
September 27: Efficient use of crop residue machinery

KVK, LUDHIANA (SAMRALA) (01628-261597)

September 03: Dietary management for lifestyle diseases
September 06: Improved cultivation practices of rabi oilseeds
September 08: Preparation of project report for obtaining agricultural loan
September 09: Seed plot technique for raising disease free potato seed
September 10: Management of repeat breeding in dairy animals
September 13-17: Poultry farming
September 16: Optimum and efficient use of paddy straw management machinery
September 20-24: Seed production techniques in rabi crops
September 21: Nutritional security through integrated nutrition garden
September 23: Food safety and techniques to check food adulteration
September 27: Seed treatment of wheat
September 29: Balanced diet for different age groups
September 30: Crop residue management using Happy Seeder

KVK, MANSA (01652-280843)

September 01-07: Mushroom cultivation as subsidiary occupation
September 03: Efficient use of crop residue management machinery
September 08: Balanced diet for different age groups
September 09: Processing of milk at domestic level
September 13-17: Beekeeping- A lucrative subsidiary occupation
September 14: Feeding and management for poultry birds
September 15: Raising of winter season annual flowers
September 16: Information and communication technology in agriculture
September 20-24: Pig farming
September 22: Self-awareness on social evils
September 23: Improved cultivation of fruit crops
September 27: Management of ruts and karnal bunt of wheat

KVK, MOGA (BUDH SINGH WALA) (98142-190999)

September 01: Production technologies of rabi oilseeds and pulses
September 03: Seasonal flowers production
September 06-10: Hybrid seed production of vegetables
September 13-17: Mushroom cultivation: A subsidiary occupation
September 15: Improved cultivation techniques of rabi crops
September 21-22: Milling, grading and packaging of basmati rice
September 24: Processing of honey (heating, filtration, packaging and marketing)
September 30: Technological intervention in crop residue management

KVK, PATHANKOT (98148-30820)

September 03: Use of plastics in farming practices
September 08: Rural backyard poultry farming as a means of livelihood
September 10: Planning of nutrition garden in urban and peri-urban areas
September 13-17: Mushroom cultivation and processing
September 15: Seasonal flowers’ production
September 22: Integrated nutrient management in rabi crops
September 24: Nutritional recipes for pre-school children
September 29: Improved crop protection practices in rabi crops
September 30: Integrated nutrient management in rabi crops

KVK, PATIALA (RAUNI) (94642-10460)

September 01: Adequate management of paddy stubble by use of crop residue machinery
September 03: Seed production of berseem
September 07: Establishment of nutrition garden in urban and peri-urban areas
September 09: Raising of winter season annual flowers
September 16: Vegetable crops - Protected cultivation and nursery raising techniques
September 20-24: Mushroom cultivation and processing
September 22: Management of paddy straw by different crop residue machinery and its custom hiring
September 27: Nutritious recipes and creative activities for young children and pregnant/ lactating women
September 29: Nutritional gardening
September 30: New cultivation technologies of vegetable crops

KVK, ROPAR (01881-220460)

September 02: Planning and planting of nutrition garden
September 03: Cultivation of rabi crops under poplar and eucalyptus
September 06: Round the year green fodder production
September 08: Protected cultivation and nursery raising techniques of vegetable crops
September 10: Seed plot technique of potatoes
September 13-17: Organic farming and vermi-compost production
September 16: Raising of winter season annual flowers
September 20-24: Preparation of festive sweets and snacks
September 27: Rice residue management technologies for improving soil health

KVK, SANGRUR (KHERI) (01672-245320)

September 02: Feed formulation for different categories of pigs
September 06: Improved cultivation practices of rabi crops
September 09: Efficient marketing of Kharif crops
September 13-17: Repair and maintenance of agricultural machinery
September 20-24: Protected cultivation of vegetable crops
September 21: Protected cultivation and nursery raising techniques in vegetable crops
September 22: Establishment of nutrition garden in urban and peri-urban area

KVK, SHAHEED BHAGAT SINGH NAGAR (LANGROYA) (01823-250652)

September 03: Custom hiring of agricultural machinery
September 08: Integrated pest and disease management in Kharif pulses
September 10: Soilless model for vegetable kitchen garden
September 13-17: Mushroom cultivation as subsidiary occupation
September 20: Seed production of onion
September 22: Improved cultivation practices of rabi cereals/oilseeds/pulse crops
September 24: Happy Seeder technology for crop residue management
September 27: Efficient use of crop residue machinery
September 29: Improved cultivation of fruit crops

KVK, SRI MUKTSAR SAHIB (GONEANA) (98556-20914)

September 03: Nursery raising techniques of vegetable crops in pro-trays
September 06-14: Mushroom cultivation and processing
September 21: Improved crop production and protection practices in rabi crops

SKILL DEVELOPMENT CENTRE (0161-2401960, EXT. 261)

September 06-10: Cultivation of winter mushrooms

Compiled by: Inderjeet Kaur Boparai and SK Thind
PAU DEVELOPS 8 NEW VARIETIES OF HORTICULTURAL CROPS

The Punjab Agricultural University (PAU) has developed eight new varieties of horticultural crops; these include PKH 11 of cucumber; Punjab Sarda of muskmelon; PCP 2 and PCY 2 of carrot; Antirrhinum 1, Antirrhinum 2, Antirrhinum 3 and Antirrhinum 4 of antirrhinum.

Cucumber

PKH 11: This is the first parthenocarpic gynoecious cucumber hybrid of India by any public sector institute which is suitable for cultivation in poly/net house only. Its plants bear 1-2 fruits per node. Fruits are seedless, bitterness free, moderately ribbed, cylindrical in shape, dark green in colour, 16-18 cm long with average fruit weight of 150-160 g and do not require peeling. It takes 45 and 60 days for first fruit picking after sowing in September and January, respectively. Average total yield is 320 q/acre and 370 q/acre in September and January sown crop, respectively.

Muskmelon

Punjab Sarda: It is a canary yellow type cultivar. Its vines are medium long, vigorous and have light green foliage. Its fruits are oval-round, having bright yellow smooth rind, thick white flesh and small seed cavity. It does not attain full-slip stage at ripening. Fruits are attractive, weighing around 780 g. Flesh is thick, creamy white, medium juicy with 13.5 per cent total solids content and characteristic crispy texture. It takes 70 days from transplanting to first picking. Its average fruit yield is 141 q ha-1 yield. It has high firmness, long shelf life and is suitable for distant transportation.

Carrot

PCP 2: (Punjab Jamuni)
It is a tropical variety which gets ready for harvesting in 92 days after sowing. Its foliage is purple green having average plant height of 68 cm. Roots are purple in colour with orange flesh, tapering, 26.5 cm long and 3.45 cm in diameter. Roots have high juice content (500 ml/kg of roots). It is rich in anthocyanin and β-carotene. It has 9.49 per cent dry matter, 7.85 per cent TSS, 0.94 mg/100 g iron and 37.6 mg/100 g of calcium. Average root yield is 222 q/acre.

PCY 2: (Punjab Roshni)
It is a tropical variety and gets ready for harvesting in 96 days after sowing. Its foliage is green having average plant height of 66 cm. Roots are yellow in colour, tapering, 25.6 cm long and 3.43 cm in diameter. It is a rich source of lutein and β-carotene. Roots have high juice content (476 ml/kg of roots), TSS (7.10%), dry matter (10.31 %) and calcium (47.3 mg/100 g). Average root yield is 211 q/acre.

FLOWERS

Punjab Antirrhinum 1: Its plants are tall, leaves dark green and flowers of yellow colour. It takes 91 days to flower, produces 12 racemes and flowering duration is 72 days. This variety is suitable for bedding, pot and cut flower.

Punjab Antirrhinum 2: Its plants are tall, leaves are dark green and flowers of cream colour. It takes 92 days to flower, produces 15 racemes and flowering duration is 77 days. This variety is suitable for bedding, pot and cut flower.

Punjab Antirrhinum 3: Its plants are tall, leaves are dark green and flowers of magenta colour. It takes 87 days to flower, produces 16 racemes and flowering duration is 81 days. This variety is suitable for bedding, pot and cut flower.

Punjab Antirrhinum 4: Its plants are tall. Its leaves are dark green and flowers of pink colour. It takes 89 days to flower, produces 14 racemes and flowering duration is 75 days. This variety is suitable for bedding, pot and cut flower.

These varieties are subject to approval of State Varietal Approval Committee
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