The month of October is very important for farmers of Punjab and adjoining states as they need to manage paddy straw during this time of the year. The management of paddy straw for timely sowing of wheat has become the epicenter of all agricultural activities. Rice is the major Kharif crop of Punjab and is cultivated on an area of about 3.1 million ha in the state which produces around 20 million tonnes of straw. Most of this paddy straw is burned in the fields which not only pollutes the environment and leads to many health issues but also leads to substantial loss of plant nutrients (especially N and S) and organic carbon which has important implications for soil health. PAU, Ludhiana has developed many farm machinery based technologies for in-situ management of paddy straw and is engaged in promotion of these technologies through demonstrations, lectures, field days, radio/TV talks, print/social media, ICTs, etc. For in-situ management of paddy straw, PAU has developed technologies like PAU Super SMS, Happy Seeder, PAU Smart Seeder, Super Seeder, PAU Surface Seeder, Tractor operated Paddy Straw Bale Shredder-cum-Mulcher and Paddy Straw Chopper-cum-Spreader. Farmers can use any one of these techniques based on their convenience for better management of paddy straw. The studies have shown that in-situ paddy straw management improve soil health and that it is also the best way for sustainability of rice-wheat production system. In this context and to tackle the issue of paddy straw management, Punjab Agricultural University (PAU) has come up with new method of paddy straw management and sowing of wheat named as ‘Surface Seeding-cum-Mulching’ which is a low-cost and easy method for in-situ paddy residue management for early and timely sown wheat. So let’s strive for a clean and green Punjab by pledging that no one will burn paddy straw in the field this year.

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Wheat varieties with improved quality and higher yields for varietal diversification

GURVINDER SINGH MAVI, ACHLA SHARMA AND VIRINDER SINGH SOHU
Department of Plant Breeding and Genetics

Wheat is cultivated on an area of more than 35 lakh hectare in the Punjab state. A varietal mosaic comprising as many recommended varieties as possible should be encouraged to safeguard the wheat crop against biotic and biotic stresses. A lot of options regarding wheat varieties are being offered to farmers by Punjab Agricultural University, Ludhiana. In this context, two recently released special purpose varieties (PBW Zinc 2 and PBW RS 1), besides other wheat varieties recommended for cultivation in Punjab, are discussed in this article. Biofortification strategy is considered to be the best option where suitable varieties possessing higher zinc in grain are being developed. As a result of continuous and concerted research efforts, PAU has developed a new wheat variety PBW Zinc 2 that has recently been released by the State Variety Approval Committee for Field Crops for general cultivation in the Punjab state. This variety recorded about 12 per cent higher grain zinc concentration than the previously released biofortified variety PBW 1 Zn and at least 25 per cent higher grain zinc than other popular normal wheat varieties. The PBW Zinc 2 also possesses higher grain iron concentration and grain protein content in comparison to previously recommended wheat varieties. Its ears are medium dense with red glume colour. Farmers are advised to grow the biofortified wheat variety PBW Zinc 2 for their own domestic consumption and sell the surplus produce in the market that will in turn be procured by government agencies and distributed through public distribution system to the zinc deficiency prone economically weaker sections of the society.

The PAU has developed another variety PBW RS 1 that is a premium wheat variety, having enhanced resistant starch levels in the grain. It has also been released by the State Variety Approval Committee for Field Crops for cultivation in the Punjab state. It has nutraceutical value owing to decreased digestibility of starch, which further leads to low glycemic index. This makes the variety a best choice for diabetic patients and weight watchers. It is a medium duration variety with an average plant height of 87 cm and 17.1 quintals yield per acre.

High yielding wheat varieties are being regularly developed and released by the Punjab Agricultural University, Ludhiana in sync with the Department of Agriculture and Farmers' Welfare, Punjab. In this context, wheat variety PBW 826 has recently been released for cultivation in North-Western Plains Zone of India comprising Punjab, Haryana, Delhi and Rajasthan (excluding Kota and Udaipur division); Western Uttar Pradesh (except Jhansi division); Jammu and Kathua district of Jammu & Kashmir; Paonta Valley and Una district of Himachal Pradesh; and Tarai region of Uttarakhand as well as in North-Eastern Plains Zone of India comprising Eastern UP, Bihar, Jharkhand, Orissa, West Bengal, Assam and plains of NE States under irrigated timely sown conditions. The PBW 826 showed moderate resistance to yellow and brown rust diseases under natural and artificial disease epiphytotic conditions. The PBW 826 recorded an average plant height of 100 cm. It matures in 148 days and has good tillering capacity. It has better grain appearance, higher hectolitre weight and lower sedimentation value with amber hard, bold and lustrous grains.

SuSheRi (PBW 766): This variety exhibited tolerance to high temperatures. It has an average plant height of 106 cm and matures in around 155 days. It gives an average yield of 23.1 quintals per acre and is moderately resistant to yellow rust and resistant to brown rust diseases.

PBW 824 has an average grain yield of 23.3 quintals per acre. It is resistant to brown rust and moderately resistant to yellow rust diseases. It has higher 1000 grain weight and hectoliter weights, with an average plant height of 104 cm and a maturity period of 156 days.

PBW 869 is a medium duration variety that exhibits better performance under zero tillage and sowing with Happy Seeder/Super Seeder planting under rice residue retained fields. The PBW 869 has longer coleoptiles that facilitate better emergence through rice residues. It has an average plant height of about 101 cm, matures in 158 days and is resistant to brown rust and moderately resistant to yellow rust. Its average yield is 23.2 quintals per acre, and the recommended
seed rate is 45 kg per acre for sowing with Happy Seeder.

**PBW 803** has been released for the South-Western regions of Punjab, including Bathinda, Faridkot, Ferozepur, Fazilka, Mansa and Sri Muktsar Sahib districts. The PBW 803 has an average plant height of about 100 cm and yields around 22.7 quintals per acre. It matures in approximately 151 days and shows improved performance in areas with severe salinity and sodicity.

**PBW 1 Chapati** is a premium quality bread wheat variety having excellent chapati making properties. Chapati made from this variety is whitish in color and sweet in taste, and remains soft even after hours of cooking with good palatability and texture. Its average plant height is 103 cm and matures in 154 days. This variety is moderately resistant to both yellow and brown rusts. Its average yield is 17.2 quintals per acre.

**PBW 1 Zn** possesses higher grain zinc concentration compared to other varieties, and thus has an advantage in terms of nutritional quality. It is moderately resistant to yellow and brown rust diseases. This is the first biofortified wheat variety identified and released at the national level for cultivation in the North Western Plains Zone of India (NWPZ) including Punjab. It gives an average yield of 22.5 quintals per acre. Its average plant height is 103 cm and matures in about 151 days.

**Unnat PBW 343** is an improved version of the landmark wheat variety PBW 343 that has been improved for resistance to yellow rust and brown rust through MABB (Marker Assisted Backcross Breeding). It gives an average yield of 23.2 quintals per acre. It is resistant to brown rust and fairly resistant to yellow rust diseases. Its average plant height is 100 cm and it matures in about 155 days. Besides high grain yield and rust resistance, it possesses heat tolerance, lodging resistance, convenient plant height and a very good plant type.

**Unnat PBW 550** is a rust resistant version of medium duration variety PBW 550. It possesses resistance to yellow and brown rust diseases. It has been recommended for cultivation in the Punjab state for medium sowing period i.e. second to fourth week of November with a seed rate of 45 kg/acre. It gives an average yield of 23.0 quintals per acre. Its average plant height is 86 cm and it matures in about 145 days.

**PBW 725** has an average grain yield of 22.9 quintals per acre with an average plant height of 105 cm. It possesses high degree of resistance to yellow and brown rust.

**PBW 677** is also a full duration variety that takes about 157 days to mature. It gives an average yield of 22.4 quintals per acre. Its average plant height is 107 cm. The PBW 677 possesses moderate resistance to yellow and brown rusts. Both PBW 725 and PBW 677 varieties are suitable for growing under poplar plantation.

Other varieties namely **DBW 187, DBW 222, HD 3226, HD 3086, HD 2967 and WH 1105** are also recommended for timely sown conditions, albeit with a caveat to avoid their cultivation in areas prone to yellow and brown rusts. The two durum wheat varieties **WHD 943 and PDW 291** are recommended for cultivation in the state. **WHD 943** gives an average yield of 19.8 quintals per acre. Its average plant height is 93 cm and matures in about 154 days. It possesses desirable quality characteristics suitable for pasta making. **PDW 291** has an average yield of 19.4 quintals per acre. It is relatively shorter in height with an average plant height of 83 cm. It matures in about 155 days. Both these varieties are resistant to yellow rust and brown rust, and possess field resistance to loose smut and Karnal bunt diseases.

**PBW 660** is recommended for cultivation under rainfed timely sown conditions and the recommended sowing time of this variety under rainfed conditions is fourth week of October onwards. It is a dwarf variety with an average plant height of 100 cm. Its grains are amber, hard, bold and lustrous with very good chapati quality. It is resistant to yellow rust and brown rust. It matures in about 162 days. Its average grain yield is 17.1 quintals per acre.

**Late sown varieties** are suitable for sowing where wheat follows cotton, sugarcane or potatoes, etc. **PBW 752**, with an average height of 89 cm, matures in approximately 130 days and yields around 19.2 quintals per acre. **PBW 771**, characterized by an average plant height of 80 cm and a maturity period of about 133 days, yields approximately 19.0 quintals per acre. Both these varieties can be sown until the end of December. The **PBW 757** can be sown upto the first fortnight of January; it matures in about 114 days, and exhibits resistance to yellow rust and brown rust. It has an average height of 82 cm and yields approximately 15.8 quintals per acre.

**Some important points to consider:**

- Seed rate should be 40 kg per acre except for Unnat PBW 550 and PBW 869 varieties, the seed rate is 45 kg per acre.
- Grow different recommended varieties for better yield and do not depend on a single variety.
- Avoid cultivation of HD 2967, HD 3086 and DBW 222 in sub mountainous areas.
- Seed of recommended varieties must be purchased from certified agencies only.
- Prefer to grow newly recommended wheat varieties.
- Ensure proper seed treatment before sowing.

*Gurvinder Singh Mavi: 98880-54666*
In irrigated situations, varieties PBW Zinc 2, PBW RS 1, PBW 826, PBW 869, PBW 824, PBW 803, Sunehri (PBW 766), PBW 1 Chapati, Unnat PBW 343, DBW 222, DBW 187, HD 3226, Unnat PBW 550, PBW 1 Zn, PBW 725 and PBW 677 have been advised. Farmers in Punjab’s submontane region must cultivate the Unnat PBW 550, PBW 725, PBW 677, PBW Zinc 2, and PBW RS 1 varieties because they have more resistance to yellow rust.

Wheat is an important rabi crop of Punjab having productivity of 42.16 q/ha in 2021-22 in Punjab. This crop requires low and mild temperature (maximum temperature of 15-22°C and minimum temperature of 4-11°C) with less humidity during the early stages of the crop which results in better tillering. The mild temperature (maximum within 15-22°C and minimum within 21-28°C) during earing and grain filling stage helps in the proper ripening and grain filling of the crop. The temperature during 2021-22 was higher than in previous years, so the productivity was less. The farmers can get better grain yields by adopting the following improved agronomic practices.

Improve varieties

The key for boosting yield is choosing improved good-yielding cultivars that are disease resistant, area and sowing machine specific. Growing unrecommended cultivars, especially those that are recommended for other zones or states, may lead to poor performance and rise in the prevalence of fungal diseases like yellow rust. In irrigated situations, varieties PBW Zinc 2, PBW RS 1, PBW 826, PBW 869, PBW 824, PBW 803, Sunehri (PBW 766), PBW 1 Chapati, Unnat PBW 343, DBW 222, DBW 187, HD 3226, Unnat PBW 550, PBW 1 Zn, PBW 725 and PBW 677 have been advised. Farmers in Punjab’s submontane region must cultivate the Unnat PBW 550, PBW 725, PBW 677, PBW Zinc 2, and PBW RS 1 varieties because they have more resistance to yellow rust. The cultivars WH 1105, HD 3086, HD 2967, DBW 222, and PBW 803 should not be grown by farmers in a submontane area of Punjab because they are prone to yellow rust.

Preparation of the field/Paddy straw management: The field should be prepared in accordance with the kind of soil and the previous crop. In comparison to heavy soils, light soils require fewer plowings to prepare. Successful wheat farming depends on having enough soil moisture at sowing.

Sowing methods: There are so many methods to raise wheat crop. But broadly, these methods can be categorized as sowing wheat crop after tillage and after no tillage.

Sowing methods after tillage

The seed-cum-fertilizer drill: This seed-cum-fertilizer drill is used following the field’s preparation. It ensures that seeds and fertilisers are placed correctly. The seed should be planted 4-6 cm deep with a row-to-row spacing of 15-20 cm, and the soil should be at the right wattar conditions.

Sowing methods without tillage

Zero till drill: If the rice crop is harvested and threshed manually, or shredded paddy straw is removed, the wheat crop can be seeded straight on the field with a zero-till drill without seedbed preparation. If weeds are present, they should be controlled with Gramaxone 24 SL at a rate of 500 g per acre one week before the wheat crop is sown.

Happy Seeder/Super Seeder/Smart Seeder: Wheat can be planted directly in standing paddy stubbles using a Happy Seeder, PAU-Happy Seeder with press wheel attachment, Super Seeder, or Smart Seeder. In these machines, the sowing depth should not exceed 3.0 to 5.0 cm. Because of the availability of loose paddy straws, rodent control measures should be undertaken. Although all wheat varieties can be sown with a Happy Seeder, Super Seeder, or Smart Seeder, the PBW 869 variety is preferred for usage with a Happy Seeder, Super Seeder, or Smart Seeder in in-situ rice residue managed areas.

c) Paddy Straw Chopper-cum-Seeder: A Chopper-cum-Seeder can be used to chop paddy straw. It enables Happy Seeder’s better operation by breaking straw into small bits.

Time of sowing: The yield of wheat is significantly influenced by the timing of sowing. The best time to sow a wheat crop is during the first fortnight of November. The grain yield of wheat decreases by 1.5 q/acre per week as a result of the delayed seeding. The sowing of long-duration varieties should be started from October.
25. As PBW RS 1 and Unnat PBW 550 are slightly shorter duration varieties, sowing should start in the second week of November. If sown early and frost occurs in the first fortnight of January, then it may cause sterile spikelets.

Seed treatment plays an important role not only in enhancing the grain yield but also helps in saving the crop from insects-pests and diseases. Protecting the crop from termite damage and seed-borne diseases is only possible with a seed treatment. For termite control, 160 ml Dursban/Ruban/ Durmet (Chloropyrathophos 20 EC) or 240 ml Regent (Fipronil 5 SC) per acre seed can be used. The loose smut and flag smut diseases are more prevalent in the submontane region of Punjab covering Hoshiarpur, Shaheed Bhagat Singh Nagar, Ropar and SAS Nagar districts. For the control of these diseases, treat the seed with 13 g Raxil Easy and Orius (tebuconazole6 FS) per 40 kg seed by dissolving in 400 ml of water or Vitavax power (carboxin+tetramethyl thiurum disulphide 75 WS) @ 120 g or Vitavax (carboxin 75 WP) @ 80 g or Tebuseed/Seedex/Exzole (tebuconazole 2 DS) @ 40 g per 40 kg seed. Always prefer seed treating drum to treat the seed for proper covering of seed with the fungicide. First, treat the seed with insecticide followed by fungicide and at the last with biofertilizers. Biofertilizers (dissolve 500 g consortium 1 litre of water to apply on 40 kg seed) can be used for better yield. Consortium biofertilizer should be applied after a gap of at least 6 hours of pesticide treatment to wheat seeds. Seed treatment with insecticide and fungicide should not be done earlier than one month as it reduces seed germination.

**Fertilizer application**: Fertilisers must be applied based on soil tests, as excessive fertilisation can lead to soil and water pollution. Organic manures such as farmyard manure (10 tonnes), poultry manure (2.5 tonnes), gobar gas slurry, rice husk or bagasse (4 tonnes per acre), or green manuring crops such as dhaincha or sunhemp are always recommended. These manures not only promote soil health by increasing organic carbon content in the soil, but also reduce farmer’s reliance on chemical fertilisers, thus, lowering production costs.

**Fertilizer management in conventionally sown crop**

In medium fertility soils, 90 kg urea/acre and 55 kg DAP/acre are applied to the wheat crop. Apply DAP at the time of sowing, half the nitrogen dose at the first irrigation, and the remaining half at the second irrigation.

b) **Fertilizer management in Happy Seeder/Super Seeder/Smart Seeder sown crop**

At sowing, apply DAP at a rate of 65 kg/acre. Broadcast 45 kg of urea per acre before the first irrigation and the remaining 45 kg before the second irrigation. Irrigation should immediately follow urea application. To reduce the risk of second irrigation being delayed on heavy soils, use 45 kg of urea before sowing and the remaining 45 kg before first irrigation. Urea fertiliser can be applied following irrigations in Super Seeder planted circumstances. If the wheat crop exhibits yellowing/deficiency symptoms at the late tillering and late jointing stages, a foliar spray of 3% urea (9 kg urea in 300 litres of water per acre) quickly helps to revitalise the crop.

**Irrigation**: The optimal moisture in the soil at the time of planting is beneficial to crop emergence. Pre-sowing irrigation should always be attempted if moisture in the soil is not sufficient. If a crop is to be followed by paddy whose harvesting has been delayed, irrigation can be given in the standing paddy crop which can advance the sowing of wheat crop by 5-10 days. The land should be divided into plots to make better use of irrigation water. The first irrigation should be light and be given three weeks after sowing for crops planted in October, and four weeks after sowing for crops planted later. The subsequent irrigations should also be determined based on the date of sowing and soil type given as follows:

<table>
<thead>
<tr>
<th>Sowing Period</th>
<th>Area/conditions/purpose</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>From the fourth week of October to the fourth week of November</td>
<td>Entire state</td>
<td>PBW 826, PBW 824, Sanchari (PBW 766), DBW 187, HD 3226, Unnat PBW 343, PBW 725, PBW 677, HD 3086 and WH 1105</td>
</tr>
<tr>
<td>From the second week of November to the fourth week of November</td>
<td>Entire state except sub-mountainous districts</td>
<td>HD 2967 and DBW 222</td>
</tr>
<tr>
<td>From the fourth week of October to the first week of November</td>
<td>South-Western districts of Punjab</td>
<td>PBW 803</td>
</tr>
<tr>
<td>From the fourth week of October to the first week of November</td>
<td>Entire state for Happy and Super Seeder</td>
<td>PBW 869</td>
</tr>
<tr>
<td>From the fourth week of October to the first week of November</td>
<td>Entire state/ product specific</td>
<td>PBW RS1 (resistant starch) and Unnat PBW 550</td>
</tr>
<tr>
<td>From the fourth week of October to the first week of November</td>
<td>Entire state/Product specific (Durum)</td>
<td>WHD 943 and PDW 291</td>
</tr>
</tbody>
</table>

**Seed rate**: The optimum plant population is required for successful wheat production. The seed should be cleaned, properly graded, free of other crops/variety seeds, bold, and free from diseases, particularly seed-borne diseases as karnal bunt. The recommended seed rate for all varieties is 40 kg/acre; however, 45 kg seed/acre should be used for PBW 869 and Unnat PBW 550. Under Happy Seeder sowing, 5 kg seed per acre can enhanced for better look of the emerged crop.

**Seed treatment and inoculation**: Seed treatment and inoculation is specific to the area/district.
Among these factors, the high soil moisture is the most important one contributing to the development of the guava wilt across the basal region of the trunk. Numerous factors have been reported for the occurrence, spread and development of the guava wilt across the entire guava producing states of India. Among these factors, the high soil moisture will cause the crop to develop early in the season and reduce the crop yield.

**Enriching zinc content in wheat grain:** The zinc content in wheat grain (for nutritional quality improvement) can be increased by giving one or two sprays of 0.5% zinc sulphate heptahydrate (21%) solution from anthesis to early grain development stages in the evening hours.

**Terminal heat stress management:** Sowing should be done as soon as possible. In the most recent years (2021-22), the wheat variety PBW 766 (Sunehri) was shown to have the highest yield in high temperature circumstances in a total of 15 Punjab districts. Apply 2% KNO₃ (13:0:45) by dissolving 4 kg in 200 litres of water at the boot leaf and anthesis stage, or salicylic acid @ 75 ppm (by dissolving 15 gram salicylic acid in 450 ml ethyl alcohol and mixing it with 200 litres of water per acre) at the boot leaf and early milk stage in the evening hours to mitigate the effect of high temperature and increase wheat yield. These foliar sprays also extend crop duration and maintain leaves greener for a longer period of time. As a result, yield can be increased.

Farmers can increase wheat crop productivity by implementing these enhanced wheat agronomic practices.

- **Hari Ram:** 95010-02967

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**Integrated practices for the management of wilt in guava orchards**

**JS BRAR, HARPREET SINGH AND NARESH ARORA**

**Department of Fruit Science**

Guava is an important fruit crop of Punjab and ranks second after Kinnow mandarin. Presently, guava occupies an area of 12,500 ha in the state. Guava cultivation is rapidly rising in the state and is being cultivated in almost all the districts of Punjab owing to certain advantages over the other fruit crops. Guava has wider adaptability to soil and climatic conditions, precocious bearing, two fruiting in a year and high nutritive value of the fruits. Although guava is comparatively less prone to be attacked by diseases, however, guava wilt is the most destructive one not only in Punjab, but in the entire country, causing substantial mortality of plants and yield losses. So far, no definite solution has been available for its management, since its first report in India in 1935. The plants affected with wilt show symptoms of chlorosis, defoliation, wilting and eventually death of the plants. The roots also show rotting symptoms and bark splitting occurred at the basal region of the trunk. Numerous factors have been reported for the occurrence, spread and development of the guava wilt across the entire guava producing states of India. Among these factors, the high soil moisture or water stagnation due to rainfall in the monsoon months, flood irrigation system in the orchards, faulty cultural practices such as repeated and deep cultivation, intercropping and recurrent disturbance or injury to the root system are major contributing factors for this menace. Among biotic factors, the pathogen infection induced rotting of the root system is the prime contributing factor. Hence, many guava plants under abiotic along with biotic stress conditions succumb to this menace within few months.

As guava wilt is a complex problem in which biotic as well abiotic factors contribute to the development of wilt problem in guava plants, its management involves integrated practices including various cultural and chemical practices. Following management strategies can be adopted to manage guava wilt in orchards:

This malady can be prevented by providing the provisions to drain out excessive rainwater from the orchards. The slight slope can be provided to avoid water stagnation. Avoid heavy irrigation. Drip irrigation system can be of great help. Keep the basins of the trees raised to avoid water stagnation.

In the pre-bearing phase of the guava orchards, the separate irrigation system for the plants and the inter-crops must be ensured. Avoid intercropping in the established orchards.

Avoid repeated and deep cultivation to suppress the weeds in the orchards to evade root injuries. Recurrent disturbance and injuries to the root system results in biosynthesis of stress hormone, ethylene in the leaves which cause yellowing and senescence of leaves.

Spray Cobalt Chloride @ 150 ppm (1.5 g in 10 litres of water) in October-November on the plants exhibiting wilt type symptoms.

Uproot and burn the wilt affected trees along with all the roots.

Drench the soil in the pit with 2 per cent Formalin solution and cover with Sarkanda and old wetted gunny bags before replanting at the site of dried wilt affected plants. Also expose the soil for 14 days and then replant healthy guava plants.

- **JS Brar:** 99158-33793
Farm machinery for rice residue management

ARSHDEEP SINGH, APOORV PRAKASH AND MAHESH NARANG
Department of Farm Machinery and Power Engineering

Rice is the major Kharif crop of Punjab and is cultivated on an area of about 3.1 million ha in the state. Due to narrow window period of about 2-3 weeks for wheat sowing after rice harvesting with combine harvester, the rice residue is burnt to clear the field for sowing of next crops like wheat. With the adoption of high yielding rice in Punjab, it is estimated that around 20 million tonnes of paddy straw is generated in the state each year. Off-field use of paddy straw is limited due to high silica content in rice straw and narrow window period between rice harvesting and sowing of next crops, about 70 % of the total rice straw produced in the state is burned in the fields. PAU, Ludhiana has developed many farm machinery technologies for management of paddy straw either in the field or for off-field utilization of paddy straw. Details of these technologies are shared below:

Paddy straw can be managed in the field either by using straw as surface mulch or by mixing the straw in the soil. Nutrients available in paddy straw like Nitrogen, Phosphorus, Potash, Sulfur and Organic Carbon are retained in the soil in in-situ management technique thus benefitting soil health. Also continuous use of in-situ straw management methods leads to increase in productivity of rice-wheat cropping cycle. Below mentioned machinery can be used for in-situ paddy straw management:

A. Machinery for in-situ rice residue mulching

1. PAU Super SMS

To facilitate the working of in-situ rice residue mulching machines like Smart seeder or Happy seeder in combine harvested paddy field, a straw bruising attachment “PAU Super SMS” was developed by PAU and is fitted behind straw walkers of combine harvester. Super SMS is mounted at the rear of the self-propelled combine harvester. Super SMS consists of stationary housing attached to the rear end discharge of the combine harvester. The straw ejected out of the straw walkers of the combine harvester is fed to the unit and is chopped by flail blades mounted on a rotor shaft. Serrated blades are fitted on inside the housing to reduce chopping size.

Tips for Super SMS mounting
- The rotating flail blades, bushes, plates and nut bolts of the rotor should be of exactly same dimensions i.e. proper fitment should be there, otherwise this may cause vibrations in the Super SMS unit.
- Dynamic balancing reduces the vibration in the rotor of the Super SMS at high speed of rotation.
- Super SMS attachment should be properly supported with the chassis of combine harvester body so as to minimize overhang and vibrations.
- V-belt and pulley section should be so selected that belt slippage is within acceptable limits.

2. Happy Seeder

PAU has developed and recommended a machine named Happy Seeder for sowing of wheat directly into the combine harvested paddy fields, thus preventing rice straw burning. It is a tractor PTO driven machine which can be operated by 45 HP or above tractor and can cover 0.33-0.38 ha/h. Happy Seeder in a single operation cuts the straw in front of furrow openers and throws it over the sown crop which acts as mulch to improve the soil health. Before operation of Happy seeder, the loose stubbles need to be evenly spread.

3. PAU Smart Seeder

PAU Smart Seeder manages the rice residues by shallow incorporation & surface mulching. PAU Smart Seeder places wheat seeds in a well-tilled narrow band of soil and covers the seed rows with soil, using furrow closing rollers. Tillage in seed rows and furrow closing rollers, enhance the soil seed contact and conserves furrow moisture, which results in early and uniform wheat establishment. PAU Smart Seeder consists of a rotor at front to cut and incorporate the rice residues into the soil. The blades of the strip till rotor are arranged to achieve a narrow band (10 cm wide) ahead of the furrow openers. The passive disc furrow openers move in the narrow tilled band and place seed and fertilizer in the soil. The area between the pair of disc furrow openers remains untilled and mulched with paddy residues. The furrow closing rollers mounted behind the disc openers close the furrow and enhance the soil seed contact to achieve better initial germination of wheat. The furrow closing roller also acts as depth control mechanism for sowing wheat. It is a PTO driven machine operated by 45
HP or above tractor and it covers about 7-8 acre per day.

4. PAU Surface Seeder

PAU Surface Seeder comprises of a straw cutter-cum-spreader fitted with seed & fertilizer box attachment. This machine can be easily operated by the 40 HP tractor or above. It is a low-cost machine which does uniform application of wheat seed & basal fertilizer along with cutting & spreading of paddy straw in a single operation. It is followed by irrigation for initiating the germination of wheat.

5. Tractor operated Paddy Straw Bale Shredder-cum-Mulcher

A tractor operated paddy straw bale shredder-cum-mulcher can be used for reducing straw size of a straw bale and spreading it uniformly in the field for mulching in widely spaced crops. Manual spreading of loose straw is highly laborious for mulching. This machine will reduce dependence on labour for mulching; reduce straw size thereby effective controlling weeds. The machine was operated using a 38 hp tractor. Machine was evaluated on garlic crop sown on beds of 1.0 meter top width. Average field capacity of the machine was observed as 0.25 ha/h. Application of straw mulch through shredder in garlic leads to yield benefit of about 9-10 %.

B. Machinery for in-situ rice residue incorporation

1. Super Seeder

A tractor operated Super Seeder is a machine used for direct sowing of wheat in combine harvested paddy field. The machine is a combination of Roto broadcaster (Roto seed drill) and disc type seeding attachment. The machine consisted of a straw managing rotor for incorporation of paddy straw and a seeding unit for sowing wheat directly after combine harvesting. The straw managing rotor consisted of flanges on which 6 blades per flange are fitted. Power to the rotor is provided by tractor PTO through a gear box. Seeding unit consisted of a seed and fertilizer box having flutted roller type seed metering unit and disc type furrow openers for each row. Seed and fertilizer tubes are opened at the rear of discs. The furrow opener discs are powered. Machine is operated by a 55 hp or above tractor.

2. Paddy Straw Chopper-cum-Spreader

PAU has developed and recommended a Paddy straw chopper-cum-spreader for chopping the paddy straw left in the combine harvested paddy field. It chops the straw into pieces and spreads it in the field in a single operation. The machine can be operated by 45 HP or above tractor and can cover about 0.32-0.35 ha/h. Incorporation can be done by different methods depending upon the availability of machinery and irrigation water available with the farmer. The chopped straw can be mixed/ incorporated in the soil as follows:

- If sufficient moisture is available at the time of sowing of wheat after paddy harvesting then mix the chopped paddy straw into the soil with the help of Mouldboard Plough. Thereafter, prepare the field using rotavator.
- If sufficient period is available (2-3 weeks depending upon soil type) before wheat sowing after paddy harvesting, give shallow irrigation and mix the chopped straw with the use of Disc harrow or Rotavator.

C. Machinery for collection of rice residue

1. Straw Baler

Straw baler is a machine which collects the paddy straw and compresses it in the shape of rectangular or round bales. Before operation of baler, standing stubbles are first harvested with the help of stubble shaver. Square baler can form bales of varying length from 40-110 cm. The weight of rectangular bales varies from 15 to 25 kg depending on moisture content of straw and length of bale. The capacity of baler varies from 0.7-0.72 ha/h after raking paddy straw.

Large round balers can make bales of 300 to 500 kg. Bale width is generally 120 cm and bale diameter varies from 90-180 cm. These bales can be used for power generation, compressed biogas, bio-ethanol, making cardboard, packing material, composting, biogas production, mulching etc.

2. Rake

The Rake is used for making windrows of harvested stubbles. Rake consists of rotary spikes which comb the loose stubbles in the field to make a windrow of stubbles. Rotary combing unit is powered by Tractor PTO through gear box. To increase the field capacity of Straw Baler; Rake is operated after Stubble Shaver to collect loose stubbles in the field and make windrows of stubbles. By this number of turns of Baler in the field are reduced and thus field capacity is increased.

* Arshdeep Singh: 97799-41983
Management of paddy residue has remained a big challenge for farmers in the region. Though different options for paddy straw management are available and adopted, but still, farmers resort to open straw burning, probably due to high cost and higher energy requirement associated with some of these technologies. It indicates the need for development of more cost-effective and easily executable paddy straw management technologies to halt residue burning, completely. In this context, Punjab Agricultural University (PAU) has come up with new method of paddy straw management and sowing of wheat named as ‘Surface Seeding-cum-Mulching’.

‘Surface seeding-cum-mulching’ is a low-cost and easy method for in-situ paddy residue management for early and timely sown wheat. It does not require much costly machinery and high HP tractors. It provides complete mulching, and weed infestation is also less. In this method, wheat seed and basal fertilizer are uniformly broadcasted in a combine harvested paddy field. It is followed by one pass of cutter-cum-spreader to cut paddy stubble (at 4 - 5 inch above soil surface) and spread them uniformly which acts as mulch. It is followed by light irrigation to initiate germination of wheat. For sowing one acre, 45 kg wheat seed (treated with recommended pesticides) and 65 kg DAP as basal are used. The of surface seeding can be done in following two ways.

1. **PAU Surface Seeder:** It is a low cost and simple machine in which seed & fertilizer box with fluted roller metering system has been mounted on to a cutter-cum-spreader. It sows wheat seed and apply basal fertilizer in a combine harvested paddy field, and cut & spread paddy straw, simultaneously. It is followed by light irrigation. This machine can be easily operated by the 45HP tractor or above and sow 1.5 acres of wheat in one hour.

2. **Combine Harvester (fitted with seeding attachment):** In this, a seed & fertilizer box has been mounted on to a combine harvester. It sows wheat and apply basal fertilizer at the time of paddy harvest. It is followed by a single operation of cutter-cum-spreader and light irrigation.

Alternatively, if the above cited machines not available, wheat seed and basal fertilizer can be broadcast manually after combine harvesting followed by cutter-cum-spreader and light irrigation.

**Benefits**
- It is environment friendly technique of wheat sowing, without burning paddy residue.
- It is an easy technique for in-situ paddy residue management and sowing of wheat.
- It ensures timely sowing of wheat crop.
- It costs 2-3 times lesser than other methods of straw management. The sowing cost is Rs. 700 to 800 per acre which is even lesser than sowing of wheat after straw burning.
- It does not require costly machinery and high HP tractor for residue management.
- It encourages in-situ residue management which is eco-friendly and builds-up soil health.
- Paddy mulch in wheat reduces water evaporation, will helps in water saving.
- It provides complete mulching which save the crop from terminal heat stress.
- It reduces herbicide use, as weed infestation is lesser in a mulched field.
- It will halt paddy straw burning.

**Precautions**
- The best time for surface seeding is between 25 October to 15 November.
- Avoid surface seeding in highly alkaline soils having poor soil drainage.
- Keep plot size small.
- Plan last irrigation to rice (depending on soil type) at time so that the field is dry at the time of paddy harvest so that there is no problem of sinking of combine harvester.
- Use combine harvester fitted with SMS or uniformly spread the loose straw in the field before surface seeding.
- Use 45 kg wheat seed and 65 kg DAP per acre.
- Always use wheat seed treated with recommend insecticides and fungicides.
- Operate PAU Surface Seeder or cutter-cum-spreader at 4 - 5 inches above soil surface and run tractor at optimum speed for uniform distribution of seed and fertilizer.
- It must be ensured that all wheat seeds are properly covered with paddy mulch.
- Apply light irrigations after sowing to initiate the germination of wheat.

*Jasvir Singh Gill: 79861-88110*
Cultivation of Organic Wheat

CS AULAKH AND AS SIDHU
School of Organic Farming

The prioritization of health over all the other issues by the people is continuously expanding the organic food market. In resonance with this growing demand for organic food, the area under organic farming of cultivated crops in India has also increased to 53.9 lakh ha. In Punjab, organic farming is at its nascent stage and is generally practiced in few selected crops and wheat is one of the most commonly grown crop due to its market demand and price premium. Organic farming is is not just abandoning the agrochemicals but is a system of farm design and management to create an ecosystem at the farm which enables the production of crops without using these agrochemicals. It does not limit itself to production of crops only but encompasses processing, storage and transportation, as per the organic standards, so as to maintain the integrity of produce till it reaches the consumer. Organic standards refrain the use of synthetic chemical fertilizers, herbicides, insecticides, fungicides and plant growth regulators and depend on crop rotations, green manuring, organic manures, biofertilizers, composts and biological pest management. The focus of nutrition management remains on ‘Feed the soil, not the plant’ to improve soil health rather than providing nutrition to the crop plants.

Organic wheat in Punjab is grown for commercial purposes by few organic growers but is grown for home consumption by majority of the farmers. Some important points for growing organic wheat are as under:

Field selection: The first and foremost thing to be kept in mind is that in organic farming it the field that is organic and not the only crop. So any crop grown on organic field with organic standards will be called organic and a crop grown on conventional field with organic practices cannot be called organic. As we are not to apply chemical fertilizers to the crops, so the most fertile field at the farm should be used for organic farming and its location should be such that in case of need for expansion in area in future it should be possible to increase the same. It should preferably have natural buffers around it such as road, canal or channels or artificial buffer should be created to prevent any contamination from the adjacent conventional fields. Organic farming should also not be started on leased land as it would require minimum three years to get organic certification.

Cropping system: For higher wheat yields, prefer kharif moong - wheat - summer moong cropping system.

Varieties: Generally, the organic growers enquire about the desi varieties of wheat as they are of the view that improved varieties are not allowed under organic farming. Any improved variety recommended by the university can be grown but preference should be given to special quality varieties like PBW 1 Chapati for good chapatti making and PBW RS1 for diabetic consumers.

Seed rate and sowing time: Use 40 kg cleaned and graded seed per acre except for Unnat PBW 550, and PBW 869 varieties which require 45 kg seed. If there is a problem of termite and bird damage then use slightly higher seed rate. The sowing time for organic wheat is same as that of conventional wheat.

Sowing method: Wheat may be sown with any of the recommended conventional methods. However, for better weed management, prefer sowing on raised beds with bed planter (2 rows on 37.5 cm wide bed with 30 cm furrow between two beds).

Seed treatment: Use of fungicides or insecticides should be avoided. To manage loose smut, for the next growing season, organic farmers are advised to soak the seed in ordinary water from 8 a.m. to 12 noon on any calm and sunny day during May/June. After 4 hours soaking, the moist seed should be spread out in the sun in a thin layer on a cemented floor on tarpaulin or cloth sheets. After complete drying store the seeds in a dry place till sowing.

Seed inoculation: Treat the seed for one acre with 500 g consortium biofertilizer or 250 g each of Azotobacter and Streptomyces (Azo-S) biofertilizer by using one litre of water on a pucca floor. Allow it to dry in shade and sow immediately. It apart from increasing the grain yield also improves soil health. It can be purchased from the Punjab Agricultural University, Ludhiana or its KVKs or Farm Advisory Service Centers in different districts.

Organic manures: Apply 8, 12 and 16 ton/acre of well decomposed farmyard manure (FYM) in high, medium and low organic matter soils, respectively or apply 1.7 ton/acre well decomposed dry FYM having 1% nitrogen, 1.1 ton/acre vermicompost having 1.5% nitrogen and 0.7 ton/acre castor cake having 2.5% nitrogen. In maize/soybean – wheat cropping system, incorporate residues of maize or soybean in the field and apply 8 ton/acre dry and well rotten farmyard manure per acre during the first five years and later on reduce it by 25 percent.

In kharif moong - wheat - summer moong cropping system, apply 5 ton/acre well decomposed dry farmyard manure (1% nitrogen). Organic manures should be free from any toxic contamination and incorporated into the soil before sowing of the crop. The quantity of these manures can be increased or decreased depending...
upon their nitrogen content.

Weed management: Use of herbicides should be avoided. The infestation of weeds particularly *Gulli danda* can be minimized by rotating wheat fields with berseem, potato, raya, *gobhi sarson*, winter maize etc; early sowing (last week of October/1st week of November) or preparation of soil mulch after seed bed preparation. In bed planted wheat, give two mechanical weedings at 30 and 45 days after sowing by modifying the bed planter by attachment of one tyne in the middle of two sweep type furrow openers. Alternatively, need based 2 - 3 hand weedings may be given. To reduce weed infestation in the next growing season of wheat, remove inflorescence of left out weeds to avoid seed setting in the field.

Pre-sowing decisions and actions for raising disease free wheat crop

**JASPAL KAUR, RITU BALA AND PARMINDER SINGH**

*Department of Plant Breeding and Genetics*

Every year, the wheat crop in Punjab is affected by one or more diseases starting from sowing till harvesting. Among these diseases, some of the diseases like wheat rusts, smuts and bunts can be effectively managed by taking right decision before sowing like selection of disease resistant varieties and seed treatment. Selecting suitable variety according to area prone to a particular disease can reduce the economic loss. Like in case of stripe/yellow rust if disease appears early in the season in any of the sub-mountainous districts (Rupnagar, SBS Nagar, etc.) on susceptible variety, then it can lead to almost 100 per cent yield loss, if not checked timely by applying recommended fungicides. On an average, six fungicidal sprays have to be applied if disease appears in December to save the crop which reduces our cost benefit ratio along with environmental pollution. We can save the economic loss and environment just by sowing rust-resistant varieties particularly in sub-mountainous districts as the environment in these areas is more congenial for disease development and inoculum is available earlier in the season from nearby hills. So, if the disease will not appear in these areas, then whole of the Punjab will be rust free for a particular season. But we should not cultivate a single variety over a large area, which may lead to resistance breakdown. The rust resistant varieties recommended by Punjab Agricultural University are enlisted in the table given below.

<table>
<thead>
<tr>
<th>Wheat diseases</th>
<th>Recommended varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stripe/yellow rust</td>
<td>PBW Zinc 2, PBW RS1, PBW 725, Unnat PBW 550, PBW 752, WHD 943, PDW 291 and PBW 660</td>
</tr>
<tr>
<td>Leaf/brown rust</td>
<td>PBW Zinc 2, PBW 824, PBW 869, PBW 803, DBW 222, DBW 187, PBW 725, Unnat PBW 343, Unnat PBW 550, PBW 1 Zn, HD 3226, PBW 771, PBW 757, WHD 943, PDW 291 and PBW 660</td>
</tr>
<tr>
<td>Karnal bunt/Flag smut/Loose smut</td>
<td>WHD 943 and PDW 291</td>
</tr>
</tbody>
</table>

**Insect-pest management:** The natural predators like ladybird beetle (*Coccinella septempunctata*) become active on appearance of the aphids. In case, aphid infestation increases, spray 2 litre per acre PAU homemade neem extract at weekly interval in 80-100 litres of water using knap sack sprayer.

**Preparation of neem extract:** Boil 4.0 kg terminal parts of the shoots of neem tree including leaves, green branches and fruits in 10 litres of water for 30 minutes. Then, filter this material through muslin cloth and use the filtrate for spraying as per the recommendation.

**Marketing:** There is no organized market for the organic wheat and farmers should initially grow organic wheat for their home consumption and try to develop their own market in nearby towns and cities and only then should increase the area under its cultivation. To enhance the consumer confidence in organic produce, the farm should be got certified from a certification agency to label the produce as organic. The Government of India has accredited 35 inspection and certification agencies to certify organic farms based on the organic standards. The farmers who want to get their farms certified as organic can contact any one of these agencies. The contact details of these inspection and certification agencies can be had from the APEDA website www.apeda.gov.in. The farmers can also contact Punjab Agri Export Corporation Limited, Chandigarh for organic certification of their farms.

* • CS Aulakh: 98883-50044

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**Table 1: Recommended varieties for wheat diseases**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Fungicides</th>
<th>Dose (per 40kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose smut of wheat</td>
<td>Raxil Easy (Tebuconazole)</td>
<td>13 ml in 400 ml water</td>
</tr>
<tr>
<td>Loose smut/Flag smut of wheat</td>
<td>Orios 6 FS (Tebuconazole)</td>
<td>13 ml in 400 ml water</td>
</tr>
<tr>
<td></td>
<td>Vitavax Power 75 WS</td>
<td>120 g</td>
</tr>
<tr>
<td></td>
<td>Vitavax 75 WP</td>
<td>80 g</td>
</tr>
<tr>
<td></td>
<td>Tebusseed/Seedex/Exzole 2 DS (Tebuconazole)</td>
<td>40 g</td>
</tr>
</tbody>
</table>

So, taking right decision for varietal selection and doing seed treatment in a right way can help us to raise healthy wheat crop in the coming season by spending minimal amount on seed treatment. But in case of rusts, we have to be conscious starting from second week of December, even if we have sown the resistant varieties as sometime new races of the pathogen may evolve and can even attack the resistant varieties. So, we should strictly monitor our crop to minimize the losses.

* • Jaspal Singh: 97791-29665
Punjab Agricultural University, Ludhiana have developed a number of technologies by adoption of which the rice residue can be easily managed without any delay and yield penalty in wheat crop and these techniques also help in increasing the soil fertility status along the physical properties of the soil. This article elaborates the harmful effects of rice residue burning and technologies through which this can be easily managed.

The Harmful Effects of Burning of Rice Residue

As mentioned earlier, the very short sowing window between harvesting of rice crop and sowing of wheat, the farmers are reluctant for in-situ management of rice straw in field due to fear of its slow decomposition whereas the removal or ex-situ management is possible only in the areas where there is demand for rice residue for different purposes. The rice crop is cultivated on around 30 lakh hectares of area which results in production of 20 million tonnes of rice residue. The burning of this huge amount of residue not only contribute towards air pollution but also results in loss of precious nutrients present in the rice residue. Moreover, such type of activities may lead to permanent or semi-permanent anti-environmental changes which reflect in the form of climate change. The losses of nutrients and generation of various greenhouse gases due to burning of this much amount of crop residue are described in the following tables.

**Table 1: Loss of various nutrients if 1 tonne of rice residue is burnt**

<table>
<thead>
<tr>
<th>Element or nutrient</th>
<th>Loss in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>400</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>5.5</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>2.5</td>
</tr>
<tr>
<td>Potassium</td>
<td>25</td>
</tr>
<tr>
<td>Sulphur</td>
<td>1.2</td>
</tr>
</tbody>
</table>

**Table 2: Release of different pollutants/greenhouse gases if 1 tonne of rice residue is burnt**

<table>
<thead>
<tr>
<th>Pollutant or greenhouse gases</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulate matter</td>
<td>3 kg</td>
</tr>
<tr>
<td>CO</td>
<td>60 kg</td>
</tr>
<tr>
<td>CO$_2$</td>
<td>1460 kg</td>
</tr>
<tr>
<td>Ash</td>
<td>199 kg</td>
</tr>
<tr>
<td>SO$_2$</td>
<td>2 kg</td>
</tr>
</tbody>
</table>

Although an efficient management of paddy straw is a tough matter but with dedication and adoption of proper technologies this can also be achieved.

The adoption of the following PAU recommended technologies if adopted can help in efficient management in rice residue:

**Machinery for in-situ rice residue management (Happy Seeder or Super Seeder or PAU Smart Seeder)**

PAU Happy Seeder and Smart Seeder are modified drills for sowing of wheat in combine harvested paddy fields which retain the rice residue on surface making the sowing procedure more time and energy efficient. Do sowing with PAU Happy Seeder with 8-inch row spacing for better weed control and higher yield. In Happy Seeder or Smart Seeder sown wheat fields follow proper rodent control measures and apply recommended dose of urea immediately before first and second irrigations. In case of sowing with Happy seeder, use 5 kg higher seed per acre than that recommended for conventional sowing except for PBW 869. The Super Seeder incorporates of rice residue in soil along with sowing of the wheat crop and this in long-run helps in improvement of soil physical properties and enhancing the soil fertility status. For getting best results from these residue management machines, it is very important to keep following points in mind:

1. To ensure good moisture at wheat sowing, give last irrigation to paddy crop two weeks before harvesting.
2. Sow the crop by keeping depth between 1.5 to 2.0 inches in case of Happy Seeder/Super Seeder.
3. The operator of different machines for straw management (like super SMS, Happy Seeder, Smart Seeder, Super Seeder, Chopper/Mulcher,
Mould-board Plough, etc.) should be fully trained.

4. All techniques to manage paddy straw in field can be used in medium and heavy textured soils but in light textured soils, prefer straw incorporation.

5. Grow recommended short to medium duration rice varieties, which provide more time for straw management, facilitate sowing and minimise pink stem borer infestation in succeeding wheat crop due to less straw load.

6. If pink stem borer/rice ear cutting caterpillar damage is observed in previous paddy crop, avoid sowing wheat in the month of October.

7. Regularly monitor wheat crop sown in straw managed fields in the month of November-December to identify the problems related to insect-pests, diseases or rodents and use recommended practices for their management.

8. Regular monitoring of paddy crop should be done in the months of September-October. If the attack of rice ear cutting caterpillar or pink stem borer is observed, adopt recommended practices for their management to check their carry-over to wheat.

9. Use of mulcher before Smart Seeder/ Super Seeder is not necessary.

Wheat sowing after straw incorporation with other machines

Incorporation of paddy straw into soil can maintain and enhance soil fertility with proper management. However, ineffective management of straw incorporation can result in a decrease in production efficiency and increased greenhouse gas emissions.

1. Incorporation can be done by different methods depending upon the availability of machinery and irrigation water available with the farmer.

2. The left-over straw can be chopped by using paddy straw chopper-cum-spreaders into small pieces and can be spread in the field uniformly. The chopped straw can be mixed/incorporated into the soil by tillage operations without any adverse effect on yield of wheat as follows:

3. After paddy harvesting, if sufficient moisture is available at the time of sowing of wheat, then mix the chopped paddy straw into the soil with the help of Mouldboard Plough. Thereafter, prepare the field using rotavator.

4. If sufficient period of 2-3 weeks is available between harvesting of paddy and sowing of wheat give shallow irrigation and mix the chopped straw with the use of disc harrow or rotavator.

Sowing of wheat in standing rice/basmati rice

In case of medium to heavy textured soils with poor infiltration rate, harvesting of rice/basmati rice gets delayed and these further delays the sowing of succeeding wheat crop. So, in such cases sowing of wheat can be done in standing rice/basmati rice by broadcasting 55-60 kg/acre of wheat seed in standing crop before or immediately after the last irrigation during 10-25 October. Ensure sufficient moisture content in the field before sowing and ensure uniform distribution of wheat seed in the field. Harvesting should be preferred with combine fitted with PAU super SMS to avoid the lumps of loose straw of paddy residue for proper germination and establishment of the wheat crop.

Surface seeding-cum-mulching

It is a low-cost and easy technique for in-situ paddy residue management for timely sown wheat. Here wheat seed and basal fertilizer are uniformly broadcasted in a combine harvested paddy field. This is followed by one pass of cutter-cum-spreaders which cut the whole paddy straw (at 4-5 inch above soil surface) acting as mulch. To initiate the germination of wheat, irrigation is applied after broadcasting of wheat seed. For one acre 45 kg wheat seed and 65 kg DAP as basal are used. Use “PAU Surface Seeder” for sowing of wheat.

Rice field with smaller plot size without excessive soil moisture at the time of rice harvest are two pre-requisites for surface seeding.

Paddy straw removed

Although the surface retention or in-situ incorporation of paddy/basmati residue has a bundle of benefits but if the residue is too much then some or requisite machinery is not available it can be used for some other purposes after removal from the fields:

- **Baling of rice residue**: The left-over straw can be cut by using stubble shaver and collected after 2 to 3 days (sun drying) by using straw baler. Straw baler collects the straw and compresses it in the form of bales.
- **Paddy/Basmati straw silage for cattle feed**: Urea-treated straw (paddy/basmati straw is ensilaged with 2-3 % urea) can increase intake and digestibility of this paddy straw-based feed
- **Paddy straw can also be used for mushroom production.**
- **Mechanized composting**: Compost is produced by mixing of paddy straw, animal manure and enzymes using the turner to optimize the composting

- Thatching for crops
- Paper pulp and cardboard
- For making mats, baskets and other household things
- Electricity generation
- Poultry litter
- Livestock bedding
- Mulching
- Packing of fruits and vegetables
- Straw geyser

Jayesh Singh: 98767-37802
Integrated weed management in wheat

MS BHULLAR, MANPREET SINGH AND PERVINDER KAUR
Department of Agronomy

W eed plants compete with crop plants for resources and reduce crop yield and quality. Proper management of weeds enhances crop yields and economic returns. Wheat crop is infested mainly with grass weeds (gulli danda, jangli javi and bueen) and broadleaf weeds (jangli palak, bathu, kandyali palak, button booti, bhambola and hirankhuri). These weed plants emerge at different times during the crop cycle. The weed plants which emerged earlier had more negative effects on crop yield than weeds plants which emerged at later stages. Management practices which create favorable environment for crop and unfavorable environment for weeds provide effective management of weeds. These practices include cultural, mechanical methods, and herbicides. Currently, herbicides have replaced cultural and mechanical methods as herbicides are relatively cost-effective and provide selective control of weeds. However, the concerns about environmental fate of herbicides and their residues in food commodities demand judicious use of herbicides. In this context, the proper identification of weeds and knowledge of previous history of the weed flora in the field is important for choosing the best herbicide. The knowledge regarding proper application technology of herbicides is also important for realizing the best herbicide efficacy. The herbicides recommended for control of different weeds in wheat are given in Tables 1-3. The continuous use of one method results in weed plants adapting to that method and under these situations, one or more weed species become dominant over time. In any case, the weed management must start with non-chemical methods, such as cultural and mechanical, which may be integrated with need-based application of herbicide. This article discusses different cultural and mechanical practices which need to be incorporated in the weed management program, along with herbicides, for effective management of gullidanda and other weeds in wheat fields.

Cultural and Mechanical methods

Ideal sowing time: Adjustment in sowing time, depending on history of weed flora in the field, helps in effective management of weeds. In fields having history of gullidanda infestation, early sowing of wheat during 25 October to first week of November would escape the first flush of gullidanda which causes the highest yield reduction. However, in case of jangli javi, avoid early sowing as the temperature during this period is more suitable for germination of jangli javi.

Sowing method

a. Soil/dust mulch at sowing: Most of weed seeds, especially of gullidanda, germinate best from the surface soil layer. As weed seeds need moisture for germination, so if we allow surface soil dry up before seed bed preparation, it will reduce weed incidence significantly, especially the first flush of weeds.

b. Sowing with Happy Seeder: Wheat sown with Happy Seeder under zero till conditions, in presence of paddy straw mulch, had lower weeds. Paddy straw on soil surface acts as mulch which prevents germination of weeds especially grass weeds.

c. Surface Seeding-cum-Mulching: It is a low-cost and easy technique for sowing wheat from 25 October to 15 November. In this method, wheat seed and basal fertilizer are uniformly broadcasted in a combine harvested dry paddy field. It is followed by one pass of cutter-cum-spreader to cut the whole paddy straw (at 4-5 inch above soil surface) which acts as mulch and prevents weed germination. It is followed by irrigation to initiate germination of wheat. For sowing one acre, 45 kg wheat seed (treated with recommended pesticides) and 65 kg DAP as basal are used. Surface sowing can be done with ‘PAU Surface Seeder’ machine which sows wheat seed and applies basal fertilizer in a combine harvested paddy field, and cuts and spreads paddy straw, simultaneously.

Crop rotation: Crop rotation is one of the best ways for solving weed problem. The rotation of wheat crop with berseem, sugarcane, potato, or mustard significantly reduces seed production of weeds commonly occurring in wheat fields. In case of berseem, multiple cutting does not allow seed production by weeds. In sugarcane, the weed seed production is restricted by herbicides and repeated inter-culture. In potato, the herbicides and digging operations are done. In mustard, the smothering effect and early harvest restrict the weed seed production. In this way, wherever feasible, and especially in fields having history of heavy infestation of gullidanda and other weeds, the rotation of wheat with these crops helps in effective management of weeds.

Herbicides

1. Pre-emergence: Pre-emergence herbicides prevent germination of gullidanda and few broadleaf weeds (details in Table 1). Spray any of pre-emergence herbicide immediately after sowing, but in all cases within two days of sowing. Use 200 litres of water...
The herbicides provide best weed control when sprayed uniformly in a well-prepared moist field free from clods, as herbicides need moisture for activation. Prefer use of Lucky Seed Drill which sows wheat and sprays herbicide simultaneously. If wheat is to be sown with Happy Seeder, any of pre-emergence herbicide can be applied by mixing with basal dose of urea and broadcast just before sowing.

2. Post-emergence: The weeds can be controlled with application of any of post-emergence herbicides, depending on weed flora present in the field (details in Table 2 and 3), after first irrigation. Post-emergence herbicides provide best control when weed plants are in 2 to 3 leaf stages. Large weed plants develop capacity to degrade herbicide which results in poor weed control.

C. Tips for getting best efficacy from herbicides: The adoption of important tips, given below, helps in achieving best weed control with herbicides:

Selection of herbicide: The herbicide selection must always be based on the presence of weed flora and herbicide use history of the field. Do not choose herbicide/s which has not given good results in previous year/s. Adopt rotational use of herbicides having different mode of action (see Tables). When herbicide rotation is properly followed, herbicide continues to provide effective control of weeds which otherwise becomes ineffective/control is reduced, if same herbicide is used continuously year after year.

Herbicide dose: Always use recommended dose of the herbicide. Use of lower dose gives poor weed control and higher dose causes toxicity to crop plants.

Herbicide mixture: Do not use mix of two or more herbicides at the time of spray as these often cause toxicity to wheat plants, poor weed control or both.

Soil moisture: Herbicides provide best weed control when applied in a wattar field having optimum soil moisture. The application in a dry field results in poor weed control. Presence of excess soil moisture causes toxicity to crop plants (For example in case of Atlantis/Total/Markpower/Shagun/ACM-9/EMEK).

Type of sprayer: Use hand operated, battery operated, or power operated sprayer fitted with single or multiple nozzles. Do not use ‘gun sprayer’ as uneven spray application results in poor control of weeds, toxicity to wheat plants or both.

Type of nozzles: Use flood jet (tak wali) or flat fan (cut wali) nozzles for pre-emergence application and ‘cut-wali’ nozzle for post-emergence application. Do not use cone type (gole) nozzles as

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### Table 1: Pre-emergence herbicides for control of gullidanda and other weeds

<table>
<thead>
<tr>
<th>Herbicide mode of action group</th>
<th>Name of herbicide</th>
<th>Dose/acre</th>
<th>Water volume (Litre/acre)</th>
<th>Weeds controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Stomp/Bunker/Dost 30 EC (pendimethalin)</td>
<td>1.5 litres</td>
<td>200</td>
<td>Gullidanda,</td>
</tr>
<tr>
<td>II</td>
<td>Awkira/Momiji 85 WG (pyroxasulfone)</td>
<td>60 g</td>
<td>Gullidanda</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Platform 385 SE (pendimethalin + metribuzin)</td>
<td>1.0 litre</td>
<td>Gullidanda, broad leaf weeds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dakshplus 48 EC (pendimethalin + metribuzin)</td>
<td>900 ml</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 2: Post-emergence (at 30-35 days after sowing) herbicides for control of gullidanda and other weeds

<table>
<thead>
<tr>
<th>Herbicide mode of action group</th>
<th>Name of herbicide</th>
<th>Dose/acre</th>
<th>Water volume (Litre/acre)</th>
<th>Weeds controlled</th>
<th>Precautions regarding use of herbicides</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>Puma power 10 EC (fenoxaprop-p-ethyl)</td>
<td>400 ml</td>
<td>150</td>
<td>Gullidanda, jangli javi</td>
<td>If raya, sarson or gobhi sarson is sown in wheat, use only fenoxaprop or clodinafop herbicides at recommended doses. Do not use Leader/ Total/ Markpower where maize/jowar is to be sown after wheat. Do not use Shagun 21-11 and ACM-9 on light textured soil and on wheat varieties PBW RS 1 and Unnat PBW 550. Avoid using Atlantis on wheat variety Unnat PBW 343.</td>
</tr>
<tr>
<td></td>
<td>Topik 15 WP (clodinafop)</td>
<td>160 g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Axial 5 EC (pinoxaden)</td>
<td>400 ml</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Leader 75 WG (sulfo sulfuron)</td>
<td>13 g</td>
<td></td>
<td>Gullidanda, jangli javi, broadleaf weeds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total/Markpower 75 WG (sulfo sulfuron + metsulfuron)</td>
<td>16 g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Atlantis 3.6 WDG (mesosulfuron + iodosulfuron)</td>
<td>160 g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Shagun 21-11 (clodinafop + metribuzin)</td>
<td>200 g</td>
<td></td>
<td>Gullidanda, jangli javi, bueen, broadleaf weeds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ACM-9/EMEK (clodinafop + metribuzin)</td>
<td>240 g</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
spray distribution is not uniform which results in poor weed control.

**Irrigations:** Application of light irrigations helps in achieving best weed control. Heavy irrigations often result in herbicide toxicity to crop plants.

**D. Weed seed harvest:** Some weed plants may escape even after adoption of different methods of weed control or germinate at later crop stages. Those weed plants may or may not reduce crop yield but seeds produced from these plants will certainly increase weed problem in next season. Hence, do not allow these weed plants to set seed. To ensure this, uproot these weed plants or cut their heads with sickle or any other means.

To summarize, the weeds problem in wheat is manageable. The solution lies in the adoption of integrated use of chemical and non-chemical methods, listed above.

**Table 3: Post-emergence herbicides for control of broadleaf weeds**

<table>
<thead>
<tr>
<th>Herbicide mode of action groups</th>
<th>Name of herbicide</th>
<th>Dose/acre</th>
<th>Water volume (Litre/acre)</th>
<th>Weeds controlled</th>
<th>Time of spray (days after sowing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VII</td>
<td>2,4-D sodium 80 WP/ 2,4-D ethyl ester 38 EC</td>
<td>250 g/ml</td>
<td>150</td>
<td>Jangli palak, bathu, maina and jangli halon</td>
<td>35-55 for timely, 45-55 for late sown crop</td>
</tr>
<tr>
<td>VIII</td>
<td>Algrip/Markgrip 20 WP (metsulfuron methyl)</td>
<td>10 g</td>
<td>150</td>
<td>Kandiali palak, jangli palak, bathu, maina and jangli halon</td>
<td>25-30</td>
</tr>
<tr>
<td>IX</td>
<td>Affinity 40 DF (carfentrazone ethyl)</td>
<td>20 g</td>
<td>200</td>
<td>Bhambola, button boati, kandiali palak, jangli palak, bathu, maina and jangli halon</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>Lanfida 50 DF (metsulfuron methyl + carfentrazone ethyl)</td>
<td>20 g</td>
<td>200</td>
<td>All broadleaf weeds</td>
<td></td>
</tr>
</tbody>
</table>

**Pea cultivation under organic farming**

**MANISHA THAKUR AND AS SIDHU**

*School of Organic Farming*

Vegetables are highly nutritious, easily digestible, and require a short period of time for their growth and production. They are generally consumed fresh and more frequently, as a result consumer concern towards pesticides free vegetables is increasing day by day. Under conventional production system, a large quantity of agrochemicals (herbicides, pesticides and fungicides) is being used by vegetable growers at frequent intervals to manage weeds, insect-pests and diseases. All agrochemicals and chemical fertilizers which are used for conventional farming are also the source of ground water pollution, environmental deterioration and contamination of food, as they enter the food chain. Hence, there is an urgent need to grow vegetables devoid of contaminants. Growing vegetables organically is one of production methods that are supportive of the environment and prohibit the use of synthetic inputs. Because of these benefits, conventional growers are turning to organic farming. Pea (*Pisum sativum* L.) is a valuable legume crop in organic farming. It provides nitrogen to the soil for the succeeding non-leguminous crops via symbiosis with N fixing bacteria, and produce grain that is rich in protein. Since there is an increasing interest in organic farming of vegetable crops, the aim is to provide organic cultivation practices for farmers to grow the crop successfully under organic farming conditions.

**PEA**

**Variety:** Any recommended variety can be sown but prefer Punjab-89, its well filled and good quality pods.

**Sowing time:** Mid October to mid November

**Seed rate:** 30 kg seed per acre should be used.

**Seed Inoculation:** Inoculate the recommended seed with one packet (500g) bacterial culture (*Rhizobium leguminosarum*) per acre to ensure nodule formation and quick growth. Moisten the seed with half litre of water and mix it thoroughly to give a fine covering of the culture to every seed. Let it dry in shade and sow immediately.

**Organic manure:** Being a legume crop, nutrient requirement of pea is low. Apply 2.0 tonnes farm yard manure/acre (1.0% N) on dry weight basis at the time of sowing.

**Weed management:** Use of paddy straw mulch effectively control weeds. Apply 40 quintal per acre paddy straw mulch immediately after sowing. Escaped weeds, if any, can be removed by hand weeding.

**Irrigation:** Seed sowing should be done in proper soil moisture conditions. First irrigation should be given after 15 days of sowing. Further irrigations should be given at flowering and then at fruit set. The total number of irrigations required are 3-4 depending upon the soil type and weather conditions.

**Insect-pest management:** Neem based biopesticides may be used to control insect-pests. Treat the seed with 15 g Tale based formulation of *Pseudomonas fluorescens* per kg seed before sowing to control wilt, root rot and collar rot (*Fusarium oxysporum* and *Rhizoctonia solani*) diseases.

*Manisha Thakur: 8580474170*
Judicious use of fertilizers for rabi crops

AAS GILL AND VK SINGH
Department of Soil Science

Fertilizers play a major role in crop productivity of present agriculture. The underuse of fertilizer may decline crop productivity. However, excessive and indiscriminate use of fertilizers not only adds to the cost of cultivation but sometimes adversely affects the crop yields too. Balanced and need based application of fertilizers is therefore of utmost importance for higher net returns, better soil health and safe environment.

Soil test-based applications of fertilizers are recommended to obtain higher yield and fertilizer use efficiency. However, in absence of soil testing, the fertilizer recommendations for medium fertility soils in major rabi crops are as under:

### Wheat

Inoculate the seed for one acre with 500 g consortium or 250 g each of Azotobacter and Streptomyces (Azo-S) biofertilizer and one litre of water. Allow it to dry in shade and sow immediately.

Drill whole of Phosphorus (55 kg di-ammonium phosphate or 155 kg single super phosphate per acre) and potassium (20 kg muriate of potash per acre, if required as per soil test) at sowing and broadcast 45 kg urea per acre with first and second irrigation. If second irrigation is delayed due to rains, the fertilizer N dose shall be broadcasted at 55 days after sowing. No urea is required at sowing if di-ammonium phosphate is used as source of phosphorus. If phosphorus is to be applied through single super phosphate, apply 20 kg urea per acre at sowing. The dose of potassium may be doubled (40 kg muriate of potash per acre) for the districts of Gurdaspur, Hoshiarpur, Ropar and Shahid Bhagat Singh Nagar.

**Manganese deficiency**

Wheat crop show manganese deficiency symptoms when grown on soils having less than 3.5 kg available manganese per acre. The manganese deficiency can be corrected by spraying 0.5% solution of manganese sulphate (1 kg manganese sulphate in 200 litres of water per acre). Generally three to four sprays are required. Initiate the spray 2-4 days before first irrigation and subsequently give 2-3 more sprays at weekly interval on sunny day. Durum wheat varieties are relatively more prone to manganese deficiency. It is therefore, recommended not to cultivate these varieties on manganese deficient soils.

**Barley**

Apply 55 kg urea and 27 kg DAP per acre at sowing to barley. If soil is deficient in potassium, apply 10 kg muriate of potash per acre at sowing.

**Toria, Raya, Gobhi Sarson and African Sarson**

Apply 55 kg urea and 50 kg single superphosphate per acre at sowing to **toria**. However, to **raya, gobhi sarson** and **African sarson**, apply 45 kg urea and 75 kg single superphosphate at sowing and 45 kg urea per acre with first irrigation. If soil is deficient in potassium, apply 10 kg muriate of potash per acre at sowing.

Always prefer Single Super Phosphate over DAP as a source of phosphorus in light textured soils to meet the sulphur requirement of crops. In case, Single Super Phosphate is not available, apply 50 kg gypsum per acre to oil seeds crops. However, in case of **gobhi sarson**, apply 80 kg gypsum or 13 kg Bentonite-Sulphur per acre in sulphur deficient soils. Apply 26 kg DAP per acre to supply phosphorus in these soils.

**Gram and Lentil**

Mix thoroughly one packet each of Mesorhizobium (LGR-33) and Rhizobacterium (RB-1) biofertilizers with one acre seed of gram and moisten it with minimum amount of water. Dry in shade and sow the seed within one hour after inoculation. Apply 13 kg urea and 50 kg single superphosphate per acre at sowing to **Desi** grams. However, to **Kabuli** grams, apply 13 kg urea and 100 kg single superphosphate per acre at sowing.

Moisten the seed of lentil for one acre with minimum amount of water and mix thoroughly one packet each of Rhizobium (LLR-12) and Rhizobacterium (RB-2). Dry in shade and sow the seed within one hour after inoculation. Apply 11 kg urea and 50 kg single superphosphate per acre at sowing to lentil.

**Berseem and Oats:**

Inoculate one acre seed of **berseem** with one packet of **rhizobium** culture before sowing. Apply 6 tons of farmyard manure per acre and 125 kg single superphosphate at sowing. However, if, farmyard manure is not applied, apply 22 kg urea and 185 kg single superphosphate per acre at sowing.

**Manganese deficiency:**

The manganese deficiency symptoms in berseem appeared when the crop reaches to the cutting stage, it is recommended to spray the crop with 0.5% manganese sulphate solution to new sprouts after two weeks of cutting.

* Arsh Alam Singh Gill: 84770-00001
Timely management of pests & diseases must for potential yield in mustard

PRABHJODH SINGH SANDHU AND SARWAN KUMAR
Department of Plant Breeding and Genetics

Cooking without oils can’t be imagined in India. These are not important for taste buds only, its a nutritional requirement also, particularly for the vital organs being the source of energy. Rapeseed-mustard is an important oilseed crop of the rabi season in Punjab where oil is used in kitchen as well as for our livestock also. We compromise our health with the purity level of oil purchased from the market available at competitive pricing. The mindset that purchasing oil from the market is cheaper as compared to own produced is because of non-realization of potential yield of the oilseed crops. India imported 13.11 lakh tonnes of edible oils worth 157 thousand crores which is 56% of its total annual consumption in 2022 and about 60-65% of this is palm oil, harmful for our health and used for blending the edible oils. To make India self-sufficient in edible oils, the minimum support prices are raised under National Food Security Mission so that the farmers turn to grow oilseeds crops. Among rapeseed-mustard group, Raya is mainly cultivated in south-western districts of Punjab while Gobhi sarson can be successfully cultivated in all areas except dry regions of the state. A number of insect-pests and diseases are known to attack this crop from sowing till harvest. Among diseases, Alternaria blight alone can cause damage up to 30-40 percent while mustard aphid can lead to complete crop failure if timely management is not done. Similarly Sclerotinia rot can cause huge losses if not managed timely and effectively. Timely observation and action of utmost importance for their effective management to get potential yields. In this article, the detailed information about diseases and pests is discussed.

**Diseases:** In rapeseed-mustard, appearance of diseases generally start during second fortnight of December when temperature is down, less sunshine hours and humidity is more. The lower leaves remain wet for longer periods which facilitates the germination of spores of different diseases and their further spread.

1. **Alternaria blight (Black spots):** This disease appears on all crops of rapeseed-mustard group generally during the month of December and flare up in January-February after rainy showers. Disease appears as small brown to blackish spots appear on the lower leaves which remain unnoticed. These spots enlarge and develop prominent concentric black rings like a target board. These rings are actually spores of the fungus which lead to secondary spread of the disease to whole foliage resulting a blighted appearance and defoliation. Similar dark brown to black lesions are developed on pods also. Infected pods produce small, discolored and shriveled seeds. This fungal pathogen survives in crop debris or weed hosts. Timely sowing of the crop and judicious use of fertilizers (especially urea) are very important to protect the crop from this disease.

2. **White rust:** This disease appears only on raya and not on gobhi sarson. It also takes care of Alternaria blight and does not cause yield losses up to 35 per cent. It appears as elongated water soaked lesions on leaves and the stem which are covered with white cottony mycelial growth of the fungus. Such plants show wilting and pre-mature ripening, shedding of stem and drying. Grey-black coloured sclerotia of the fungus develop on the affected surface or in the pith. On maturity of the crop, the affected plants look whitish and erect growing from a distance. Such plants should be cut at ground level and buried deep so that the sclerotia do not fall on ground. Pathogen survives as sclerotia in debris.

3. **Stem rot:** The disease appears in end of January or first fortnight of February. It can cause yield losses up to 35 per cent. It appears as elongated water soaked lesions on leaves and the stem which are covered with white cottony mycelial growth of the fungus. Such plants show wilting and pre-mature ripening, shedding of stem and drying. Grey-black coloured sclerotia of the fungus develop on the affected surface or in the pith. On maturity of the crop, the affected plants look whitish and erect growing from a distance. Such plants should be cut at ground level and buried deep so that the sclerotia do not fall on ground. Pathogen survives as sclerotia in debris.
or in soil and can survive for up to 10 years. These sclerotia spread during harvesting, threshing and cultivation operations. They may also mix in seed and are transferred to newer areas. For effective management of this disease, use clean seed and destroy the crop residue after harvest. Avoid excessive application of irrigation as well as nitrogenous fertilizers. Practice crop rotation with non-host crops like wheat, barley and maize. Recommended plant to plant and row to row spacing should be maintained and disease severity is more on densely sown crop. Do not irrigate the field from 25 December to 15 January as sclerotia of the pathogen germinate during this period. This practice decreases the inoculum in the soil and ultimately decreases chances of infection.

4. **Downy mildew:** The disease appears on the leaves as light green or pale lesions which enlarge in size and become grayish. Grey coloured downy growth of the fungus can be seen on the under surface of these lesions during morning hours. These spots dry up, shrivel and result in defoliation. Disease is more severe on foliage and inflorescence. There is deformation of the apical stem portion and no pod formation takes place. Loses can be much more if white rust attack is also there. Gobhi sarson is more prone to downy mildew as compared to raya.

**Insect-Pests**

1. **Mustard aphid/Tela/Chepa:** The mustard aphid (plant lice/tela/chepa) is the most serious pest of rapeseed and mustard crops in the state. On rapeseed-mustard, it remains very active from January to mid-March. It is a small green louse like insect which suck the plant sap in large quantities. Nymphs and adults can be seen covering the top portion of the twig in large numbers. As a result the plants remain stunted, pods shrivel up and seeds do not develop properly. The crop heavily infested by this insect gives a withered look and ultimately fails to give any yield.

2. **Painted bug:** The painted bug is a beautifully coloured small insect, 6-7 mm long and 3-4 mm wide, shining black body painted with pink and yellow spots. The young ones (nymphs) have many pale brown and red markings on the body. Both nymphs and adults suck the sap from plants and devitalize them. Its attack is more severe on germinating crop of mustard during the month of October though damage also occurs at maturity time. The damage can be seen in patches in the field. The attacked seedlings wilt and die. It is more severe in hot and dry parts of the state.

3. **Mustard Sawfly:** This pest damages at early stage of the crop when plants are young. Damage is caused by charcoal black larvae which feed on the leaves. These larvae are different from normal caterpillar in that they have three pairs of thoracic legs and eight pairs of abdominal legs. They have very loose grip on the plant and readily fall down upon slight disturbance. Since larvae attack at the early stage of the crop, hence, damage can be severe.

4. **Hairy caterpillar and cabbage caterpillar:** Hairy caterpillar is commonly known as ‘**Bhaboo Kutta**’ or ‘**Kutra**’. It is more serious on **toria** during September-October. The hairy caterpillar has pale yellow body with long hairs on it. However, the anterior and posterior ends of body are black. On the other hand cabbage caterpillar is light green with black spots on the body. Moreover there are no long hairs on body. The adult females of both the pests lay eggs in masses mostly on the underside of leaves. The young larvae after coming out from the eggs feed on leaves gregariously for first few days. However, the grown up larvae disperse in the field and migrate from one field to other.

**Pest Management Strategy**

**Pest Management at Seedling Stage:** Irrigation of field after four weeks of sowing results in reduction in painted bug population. For the control of sawfly, spray the crop with Ekalux 25 EC (quinalphos) @ 250 ml/acre in 80 litres of water.

**Management of Mustard Aphid:** When aphid population reaches 50-60 aphids/top 10 central twig, spray the crop with 40 g Actara 25 WG (thiamethoxam) or 400 ml Rogor 30 EC (dimethoate) in 100 litres of water per acre. Repeat the spray after 15 days if required.

**Management of Bihar Hairy Caterpillar and cabbage caterpillar:** Since these pests lay eggs in mass, these egg masses and young larvae in the gregarious phase can be collected and put in kerosenized water or insecticidal solution. Alternatively, they can be buried deep in the soil.

- Prabhjot Singh Sandhu: 98555-19676
Important aromatic and spice crops: Production practices

RAJENDER KUMAR, PARAMJIT KAUR AND VAJINDER PAL KALRA
School of Organic Farming

Celery: popularly known as Karauli in Punjab, is an important medicinal and spice crop. Its essential oil is used in spices, perfumes and pharmaceuticals. In Punjab, it is cultivated on an area of about 4000 ha mainly in Amritsar, Tarn Taran, Gurdaspur and some parts of Patiala districts. Punjab Celery 1 has an average seed yield of 4.5 q/acre. Its seeds have a total oil content of 20.1% and an essential oil content of 1.9%. The crop should preferably be raised by transplanting of seedlings. The ideal time to sow the nursery is between mid-September and mid-October. It requires 400 g of seed to raise nursery for transplanting in one-acre area. The optimum time of transplanting is from mid-November to end December. Plant the seedlings at plant to plant distance of 25 cm and a row to row distance of 45 cm. The crop is ready for harvesting when seeds in most of the umbels turn light brown in colour.

Fennel: Fennel is commonly known as saunf. Ajmer Fennel 2 has an average seed yield of 5.0 quintals per acre. Its seeds contain 1.6 to 1.8% of essential oil and takes 170-175 days for maturity. The time of sowing is last week of October to first week of November. Sow the seed 3-4 cm deep by kera method in rows 45 cm apart using 4 kg seed per acre. Apply 20 kg nitrogen (45 kg urea) in 2-3 splits depending upon the texture of the soil. Harvest when the umbel changes its colour from green to light yellow as delay in harvesting causes shattering of seeds.

Mentha: Mentha can also play an important role as a diversification crop to prevailing rice-wheat cropping system. The area under mentha cultivation is increasing steadily with present spreading of 15000 hectares in Punjab. Japanese mint (Mentha arvensis L.), peppermint (Mentha piperita), spearmint (Mentha spicata), and bergamot mint (Mentha citrata) are the four most common mentha species, although only Japanese mint and Peppermint are grown in Punjab. The important varieties of menthol mint i.e., CIM Kranti and Kosi are recommended for commercial cultivation in Punjab. Mentha is propagated through suckers. About 2 quintals of freshly dug 5-8 cm long suckers are enough for one acre. The best planting time is the mid-January to the end of January, however, Kosi and CIM Kranti should be planted from end of January to mid of February. The suckers are laid end to end, 4-5 cm deep in furrows, 45 cm apart and are then covered with soil by planking lightly. Apply 24 quintal of paddy straw mulch per acre and apply a light irrigation after planting as this practice improves emergence.

RAGI BOUNTY BALLS

Ingredients (g): Ragi flour: 80g, Coconut powder: 180g, Coco powder: 10g, Condensed milk: 150g, Milk/dark chocolate: 250g

Method: Roast ragi flour on medium flame (till aroma) and cool it. In the separate bowl, add coco powder, milk maid and coconut powder and mix properly. Add this mixture into ragi flour and mix properly. Make a soft dough and roll the balls, set in refrigerator for 15-20 minutes. On the other hand, melt chocolate in the double boiler and coat these balls with the melted chocolate and refrigerate for again 15-20 minutes.

• Neerja Singla: 95014-88441
In an era defined by rapidly changing food systems, increasing concerns about food security, and a growing awareness of environmental sustainability, the concept of kitchen garden has emerged as a beacon of self-reliance and mindful consumption. The cultivation of oilseeds and pulses in a kitchen garden has gained significant attention due to their multifaceted benefits that range from addressing nutritional deficiencies to contributing to global sustainability goals. Oilseeds are replete with proteins, dietary fiber, vitamins (including B vitamins), and minerals (such as iron, potassium, and magnesium). Oilseeds are also reservoirs of heart-healthy unsaturated fats, including omega-3 fatty acids. On the other hand, pulses, often referred to as the ‘poor man’s meat’ are considered sustainable alternative to animal protein sources, aligning with contemporary dietary trends that prioritize health and environmental stewardship. Pulses are a valuable source of complex carbohydrates and dietary fiber, making them instrumental in regulating blood sugar levels and supporting digestive health.

Growing oilseeds and pulses in a kitchen garden is a smart and sustainable way to meet your home consumption needs and can significantly reduce your grocery expenses. Pulses have the added benefit of fixing nitrogen in the soil. Keeping in view the nutritional health and significance of agricultural diversification, Punjab Agricultural University, Ludhiana has developed a mini-kit for *rabi* season containing seeds of lentil, *desi* gram, canola *gobhi sarson* and linseed to meet the household needs of pulses and oilseeds that can prove very beneficial for farmers. This mini seed kit contains 250 g seed of lentil, 500 g desi gram, 250 g canola *gobhi sarson* and 200 g linseed to meet the household needs of a family.

According to World Health Organization (WHO), for a balanced diet, per person consumption of pulses and vegetable oil should be 80 g and 20 g, respectively. The consumption of pulses by an average person is only 30-35 g per person per day. Pulses are a good source of protein and an excellent source of amino acids. The importance of cultivating canola *gobhi sarson* lies in the fact that it contains less than 2% erucic acid which is considered good for human health. In our society, linseed is used to make ‘panjiri’ and ‘pinnis’ in winter. Linseed oil is rich in omega-3 fatty acids. A daily intake of 10 g of linseed oil is a healthy amount to meet the daily requirements of omega-3 for men (1.6 g/day) and for women (1.1 g/day).

This seed kit can be cultivated in an area of about 1 *kanal 15 marla* and is sufficient to meet our domestic needs and also helps in agricultural diversification. Important agronomic practices for successful cultivation of these crops are given in the table below. This kit can be obtained from PAU Campus (Ludhiana), various *Krishi Vigyan Kendras* and Farm Advisory Service Centers (FASCs).

*Navneet Kaur: 94656-10571*

**Table: Agronomic practices for cultivation of pulses and oilseed crops**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Variety</th>
<th>Quantity of seed in kit</th>
<th>Area required</th>
<th>Time of sowing</th>
<th>Spacing (cm)</th>
<th>Fertilizer requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lentil</td>
<td>LL-1373</td>
<td>250 g</td>
<td>2 marlas</td>
<td>Second fortnight of October for sub-mountainous regions and from end of October to first week of November in other areas.</td>
<td>22.5</td>
<td>165 g urea and 625 g SSP at the time of sowing.</td>
</tr>
<tr>
<td><em>Desi</em> gram</td>
<td>PBG-8</td>
<td>500 g</td>
<td>5 marlas</td>
<td>10-25 October (rainfed conditions), 25 October to 10 November (under irrigated conditions).</td>
<td>30</td>
<td>400 g urea and 1.5 kg SSP at the time of sowing.</td>
</tr>
<tr>
<td><em>Gobhi</em> sarson</td>
<td>GSC-7</td>
<td>250 g</td>
<td>1 <em>kanal</em>, 6 marlas</td>
<td>10-30 October</td>
<td>45*10</td>
<td>15 kg urea in two equal split doses (at sowing and at first irrigation), 12 kg SSP at sowing.</td>
</tr>
<tr>
<td>Linseed</td>
<td>LC-2063</td>
<td>200 g</td>
<td>2 marlas</td>
<td>First fortnight of October</td>
<td>23*7-10</td>
<td>685 g urea, 1.25 kg SSP at the time of sowing.</td>
</tr>
</tbody>
</table>
Selection of healthy seed tubers from cold stores is the key to disease-free potato crop

SANDEEP JAIN, RITU RANI AND SATPAL SHARMA
Department of Plant Pathology

Having disease-free seed tubers is the foundation for achieving abundant and high-quality potato production as tubers serve as an important source of disease inoculum. Keeping potatoes free of tuber-borne diseases requires continuous pre- and post-harvest care. Tubers spend much of their life cycle either underground in fields or in cold stores. Careful examination and sorting of seed lots from cold stores before sowing is one of the most important steps in managing potato tuber-borne diseases. In Punjab, late blight, black scurf, scab, leaf roll, and mosaic are among the major pathological problems that are transmitted from infected seed tubers.

Late blight is highly destructive seed-borne disease that can seriously impact potato yield particularly if the disease attack before tuberization of the crop. Fortunately, the incidence of late blight has been observed to be in low proportions during 2022-23. For successful control of this disease, apart from using fungicides, efforts should be made to reduce the initial inoculum of the disease, which survives in the tubers. This disease primarily perpetuates through diseased potato tubers that get stored in cold stores along with healthy produce. If such diseased tubers are sown, late blight starts from the small seedlings emerging from the soil and heavy disease incidence may be observed under favourable weather conditions. The late blight affected tubers can be diagnosed by the presence of brown coloured depressed patches on the skin of the tubers. Such blight-affected tubers are generally referred as ‘Pathar Dag Wale Alloo’ in the district of Hoshiarpur. Before sowing, farmers should ensure that potato tubers being used as seed tubers are free from late blight infection. It is advised to sort out and destroy the late blight-affected tubers showing shallow or sunken reddish-brown patches on the surface that may extend several centimetres into the tubers. Apart from late blight, black scurf and potato scab are also major diseases carried through infected tubers. The diagnostic feature of black scurf infected tubers is the presence of superficial black rough incrustation on the skin of the tubers. Black scurf infected seed can reduce plant stands and cause serious losses, especially in mild weather. Affected tubers have sclerotia which are black, irregular lumps attach superficially to the tuber skin. These black sclerotia germinate, producing a fungal growth that infects plants causing stem cankers and wilting in field. Although the black scurf fungus is present on tubers as well as in soils and it can be transmitted from both sources, however, it is generally accepted that seed is the more important source of inoculum. The fungus is transmitted from the mother tuber to the stolons and progeny tubers. Stem canker is more prevalent if the weather is cool and wet, as these conditions slow plant emergence and favour the growth of the fungus. In contrast to scurf, potato scab infected tubers can be recognized by the presence of circular shallow to deep dark brown scars or pits on the tubers. It does not affect the yield much, but it reduces quality and appearance. Farmers should sort out affected tubers showing deep, circular lesions of the size of 0.5-1.0 cm in diameter. Over the last few years, the surveys conducted by the Department of Plant Pathology have revealed that incidence of these diseases is increasing in the farmer’s fields year after year. The basic reason is use of infected seed tubers for sowing. The farmers do not sort out such infected tubers from the seed lots. Invariably black scurf infected tubers are also mistaken as soil adhering to the tubers. Both these diseases are soil-borne as well seed borne. Use of scurf/scab infected tubers would also lead to the heavy load of inoculum in the soil, which ultimately would lead to high disease incidence in the field. Potato growers are advised to sort out infected tubers before sowing and if the produce is heavily infected with these diseases, then the same should not be kept as seed in cold stores rather it should be used for table purpose.

Never sow potato tubers without seed treatment. Before planting, always treat the potato seed tubers with Systiva (Fluxapyroxad 333g/l FS) either by uniform spraying over tubers @ 80 ml in 8 l of water or tuber dipping @ 80ml/ 100l of water. Emesto Prime (Penflufen 22.43 FS) @ 8.3 ml or Monceren (Pencycuron) @ 2.5 ml per litre of water for 10 minutes after taking out of the cold storage. The seed potatoes obtained from the cold stores cannot be planted immediately. Keep the treated tubers in a cool place/shade exposed in diffused sunlight for...
8-10 days, which initiates sprouting and helps the sprouts to become strong.

For producing quality virus-free potato seed, ‘Seed Plot Technique’ should be used in Punjab. This technique aims at raising a healthy seed crop of potato in Punjab during the period of low aphid incidence, which is responsible for transmitting the viral diseases like leaf-roll, PVX, PVY and PVA. For the seed crop, healthy seed potato, free from viral infection should be obtained and planted in autumn during the first week of October at a spacing of 50 x 15 cm to ensure the development of large size seed tubers. For mechanized planting sow the seed crop at a spacing 65 x 15 cm or 75 x15 cm depending upon the available machinery. An acre of the seed crop will produce enough seed for planting of 8 to 10 acres of the crop. Normal plant protection measures should be adopted to control aphids and other insect pests. Rogue out otherwise unhealthy plants noticed during the growing season to ensure the production of quality seed. Towards mid-December, irrigation may be restricted and later withheld completely so that the haulms wilt and fall down. As soon as there are 20 aphids per 100 leaves, cut the haulms. Allow the tubers to mature in soil for about 15 days. The harvested crop may be graded and transferred to cold storage for planting in the following autumn season.

* Sandeep Jain: 98723-22880

### A story of courage and determination crop residue management: Gurbir Kaur

**MANPREET JAIDKA, RAMANDEEP KAUR AND AMANDEEP SINGH BRAR**

**Krishi Vigyan Kendra, Budh Singh Wala, Moga**

Working hard with self-belief and determination towards any task certainly creates wonders. Bibi Gurbir Kaur d/o Sh. Sukhpal Singh has created an example to make this fact true. Gurbir Kaur, belonging to village Jhandwala, District Moga, is 41 years old in a family of five sisters and one brother. She started joining hands with her father in agricultural work during her college education. After the passing away of her parents, Gurbir Kaur has not only taken care of agriculture but also managed the family affairs responsibly. After getting her ancestral land mortgage-free and buying more land, her total land holding is 25 acre. For crop production, she also takes 10-12 acre of land on lease basis. Gurbir Kaur is associated with Krishi Vigyan Kendra, Budh Singh Wala, Moga from last 5 years. A clear example of this is the use of super SMS from 2019-20 onwards for the harvesting of paddy crop with motivation from KVK, Moga in the context of crop residue management. After harvesting paddy crop with a combine harvester, she is successfully cultivating wheat crop by sowing without burning the paddy residue. For this purpose, KVK, Moga provided happy seeder machine and all technical know-how to Gurbir Kaur to sow wheat crop without setting stubble on fire. Following are the details of grain yield of wheat crop of her farm without burning of paddy residue:

<table>
<thead>
<tr>
<th>Year</th>
<th>Technique used</th>
<th>Grain yield (q/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018-19</td>
<td>Conventional</td>
<td>20.89</td>
</tr>
<tr>
<td>2019-20</td>
<td>Happy seeder</td>
<td>21.13</td>
</tr>
<tr>
<td>2020-21</td>
<td>Happy seeder</td>
<td>21.27</td>
</tr>
<tr>
<td>2021-22</td>
<td>Happy seeder/ Smart seeder</td>
<td>18.6*</td>
</tr>
<tr>
<td>2022-23</td>
<td>Smart seeder</td>
<td>20.17</td>
</tr>
</tbody>
</table>

*received higher grain yield than district average (17.3 q/acre) due to heat stress at grain filling stage

Gurbir Kaur had decided that she will sow the wheat crop with her own modified smart seeder during the year 2022-23. Therefore, by gaining experience in crop residue management and seeing the success of residue management techniques, Gurbir Kaur modified her rotavator to a smart seeder by incurring a cost of Rs.60,000/-. This method helped her in cost cutting as she had no need to purchase a new machine for residue management. With the encouragement of the team KVK, Moga, she cultivated wheat crop on an area of 35 acre by sowing with smart seeder. For example, in the field next to her farm, from the year 2021-22, cultivation of potato on an area of about 50 acres has started without burning the stubble. During the year 2021-22 by}

* Sandeep Jain: 98776-73363
Palak, lettuce, coriander and kasuri methi are major green leafy vegetables. They are generally used as salad, cooked vegetable and for garnishing of various food products. According to World Health Organization, we require 116 g of green leafy vegetables for fulfillment of balance nutrition to our body. Every home regardless of in urban, peri-urban and rural area should cultivate green leafy vegetables in nutrition garden or in pots. These are short duration crops and ready for harvesting in 4-6 weeks after sowing. These are rich source of vitamin A, C, K and minerals like iron, calcium and phosphorous. Besides, these are also rich source of carbohydrates which is a major part of balanced diet.

**Climate**: Winter season is suitable for cultivation for green leafy vegetables as cool season enhances its growth. It requires temperature of 13-16 °C for growth and taste. If temperature rises, there is adverse effect on germination of seeds.

**Soil**: Well fertile and well drained sandy loam to loamy soils with pH of 6-7 are suitable for cultivation of good quality green leafy vegetables. Acidic soil effects the germination of seed and quality(yellowing/browning of margins of leaves) of leaves.

**Recommended cultivation practices**

**Source of seed**: Always purchase seed of green leafy vegetables from Punjab Agricultural University Ludhiana or authorized dealers of State Seed Certification Authority to get good quality as well as yield from these vegetables.

**Recommended varieties**: Recommended varieties and their distinguished characteristics are given in the table below:

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Variety</th>
<th>Distinguished Characters</th>
<th>Yield quintal per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palak</td>
<td>Punjab Green</td>
<td>It has semi-erect shining dark, green long thick sweet succulent foliage. It takes 30 days to first harvest of fully developed leave.</td>
<td>125</td>
</tr>
<tr>
<td>Lettuce</td>
<td>Punjab Lettuce-1</td>
<td>Leaves are light green, shining, loose and crispy. It takes 45 days to first harvest of fully developed leave.</td>
<td>35</td>
</tr>
<tr>
<td>Coriander</td>
<td>Punjab Sugandh</td>
<td>Leaves are medium, green, tender with excellent aroma. It gives four cuttings and is late in bolting.</td>
<td>100</td>
</tr>
<tr>
<td>Kasuri Methi</td>
<td>Kasuri Supreme</td>
<td>Plants are trailing type with profuse tillers. Leaves are broad, light green and trifoliate.</td>
<td>150</td>
</tr>
</tbody>
</table>

**Sowing practices**

Plough the field two to three times to fine tilth. Treat seed with Captan/Thiram @ 2.5 g per kg of seed. Follow the given table for sowing practices of each crop.

**Manure and fertilizer**: Apply 10 tonnes of farmyard manure along with 35 kg of N and 12 kg of P₂O₅ per acre for palak cultivation. Apply whole of farm yard manure, P₂O₅ and half Nitrogen before sowing and remaining nitrogen should be applied in two split doses after each cutting. For lettuce, apply 15 tons of farmyard manure along with 25 kg of N and 12 kg of P₂O₅ per acre for palak cultivation. Apply whole of farm yard manure, P₂O₅ before sowing and 1/3 nitrogen before sowing. Remaining nitrogen should be applied after six weeks of sowing. Apply 30 kg nitrogen in coriander and 30 kg nitrogen in Kasuri Methi in 3 equal doses, first dose at sowing, second dose at first cutting and third at second cutting.

**Irrigation**: Irrigation should be applied immediately after sowing for proper germination or sow seed in proper moisture condition of soil. These leafy vegetables have shallow root system, so irrigate crop after an interval of 10-15
days to keep proper moisture of soil.

Weed control: Weed infestation is not a major problem in *palak* and lettuce because they grow faster during initial growing period. While two weeding are needed in coriander and *methi* first 3-4 weeks after sowing and second at 5-6 weeks after sowing because these crops face problem of weed infestation due to slow growing during initial growing period.

Harvesting, care and marketing: *Palak* will be ready for harvesting in about 3-4 weeks after sowing, so subsequent cutting should be done at an interval of 20-25 days. Harvest fully developed tender leaves every week in lettuce. In case of coriander and *methi*, green leaves are harvested on attaining 20-25 cm height. Make different weight bundles after sorting for selling in market for fetching better profit margin.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Time of sowing</th>
<th>Seed rate per acre</th>
<th>Spacing/techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Palak</em></td>
<td>September to October</td>
<td>4-6 kg</td>
<td>Seed should be sown 3-4 cm deep in rows at 20 cm apart.</td>
</tr>
<tr>
<td><em>Lettuce</em></td>
<td>Nursery Raising -September to mid -November</td>
<td>400 g</td>
<td>Sow seed in 50 m² area for one acre.</td>
</tr>
<tr>
<td></td>
<td>Time of transplanting -Mid November to mid -December</td>
<td></td>
<td>Transplant 4-6 weeks old seedling in field at rows spacing of 45 cm and plant to plant spacing of 30 cm.</td>
</tr>
<tr>
<td><em>Coriander</em></td>
<td>First week of October</td>
<td>8-10 kg</td>
<td>Do not sow coriander capsule as such because it gives poor germination; so first rub the capsule of coriander gently to break them into 2 to 4 parts and then pore seed at 30 cm apart rows.</td>
</tr>
<tr>
<td><em>K a s u r i Methi</em></td>
<td>First week of October</td>
<td>10 kg</td>
<td>Seed should be sown 3-4 cm deep in rows at 20 cm apart.</td>
</tr>
</tbody>
</table>

Guru Kirpa Self Help Group (SHG): Income generation through millets

GURUPDESH KAUR AND RAJNI GOEL

Krishi Vigyan Kendra, Patiala

* Millets, called as “Nutri- Cereals” due to their high nutritional content and dietary fibre, are good source of proteins, micronutrients and phytochemicals, and have many health promoting properties. Overall, millets are highly nutritious and versatile crops that offer a range of health benefits. Millets can be a great addition to a healthy and balanced diet. Government of India brought forward a proposal for International Year of Millets 2023 which was accepted by 75th session of the UN general assembly.

India has already celebrated the year 2018 as National Year of Millets and Krishi Vigyan Kendra, Patiala is organizing trainings for farm women in preparing healthy products from millets since 2018 for their inclusion in regular diet to combat malnutrition. After acquiring trainings from Krishi Vigyan Kendra, Patiala, a group of likeminded and enterprising rural women, having skills of delicious and nutritious cooking, infused themselves together into Guru Kirpa Self Help Group from village Kalyan. They started preparing millets based products like biscuits, chakli, gujia, kheer, tikki, ladoo, matri, shakarpare, kachori etc. KVK, Patiala guided them in product development, packing, labeling, registration and marketing. Initially, Guru Kirpa SHG started providing millets products as refreshment meals in various trainings conducted by KVK, Patiala, National Rural livelihood mission, Patiala and other government departments. The members of SHG got good response from consumers which increased their confidence as well as income. They also participated in Eat Right Millet Mela & Walkathon 2023 organized by district administration, Patiala and prepared delicious lunch comprising of *Kodra roti*, *moong masur dal*, raita along with salad and *micro-greens chutney* followed by *Barnyard rice kheer* and *ragi* ladoo as sweet dish. The lunch was hit during the event and cuisine connoisseurs of Patiala admired and appreciated the culinary skills of the group and women members secured more orders from allied departments. While selling the millet based products Mrs. Gurpreet Kaur and other members convince prospective buyers to try *ragi/bajra pinni* or biscuits as healthy alternatives to junk food. They also get feedback and inputs from consumers to continuously improve their products. Brisk sale of their products in Patiala through melas, exhibitions and linkages with district administration boosted the confidence of group members. Now, the group has also started exhibiting in *Pehal Mandi*, Sangrur. They are now earning Rs. 20000/- to 25000/month. Guru Kirpa SHG, apart from having steady income, is a source of inspiration for women folk of its locale. Women residing in their neighborhood have started coming out of their dwellings to emulate and succeed like Guru Kirpa SHG.

* Balvir Kaur: 94636-12320
* Gurupdesh Kaur: 7696809999
Millets have excellent climatic resilience as they are survivors to adverse climatic conditions. They can be cultivated in low rainfall regions and variable temperatures, making them suitable for cultivation in dynamic agro-ecological zones. Presently millets have been termed as ‘cereals of the future’ due to their nutritive properties, nutraceutical potential and excellent agrarian environmental sustainability. Millets comprise sorghum, pearl millet and other minor crops including finger millet, foxtail millet, proso millet, barnyard millet, kodo millet, and little millet.

**Nutritive potential and health benefits of millets**

Millets are highly nutritious grains as they contain plethora of nutrients comprising dietary fibre, resistant starch, proteins, unsaturated fats, minerals (iron, zinc, phosphorus and magnesium), and vitamins (specially B complex). Majority of these nutrients such as minerals, vitamins and fibre are compartmentalized in the outer regions of the grains, thus they must be consumed whole as milling and pearling often lower the nutrient contents. Millets further are rich sources of bioactive compounds such as polyphenols, flavonoids, carotenoids and sterols which add nutraceutical properties to these grains. They are further naturally gluten free grains and have low glycemic index.

High content of dietary fibre helps in maintaining gastrointestinal health, promotes bowel movement and lowers the risk of heart attacks. Richness of nutrients also provides satiety or fullness, thereby contributing to calorie control and weigh management. Mineral and vitamin content of millets helps in regulation of various physiological, metabolic and neurological processes. Complex carbohydrate and higher resistant starch make them low glycemic foods which are suitable for diabetic patients.

**Processing of millets**

Processing of millets is needed to eliminate the anti-nutritional factors and make them edible for human consumption. They can be processed by various techniques depending on the end product, and desired functionality. Mechanical processes such as milling and pearling improve the nutrient digestibility and ease of processing to value added products. Soaking, germination and fermentation processes are also employed for natural processing of grains to enhance the nutrient composition, antioxidant potential and nutrient digestibility. Thermal processes including baking, popping, extrusion, roasting and cooking transform the raw millet grains into ready to eat food products.

**Value added products:** Millet whole grains, pearled grains, flours, grits and flakes both in native and processed forms are suitable for different value added food products.

**Bakery products:** Millets can be successfully used in the development of cookies, biscuits cakes, muffins etc. Millets can used in place of refined wheat flour with healthy and nutritious millet flour for the development of bakery products.

**Pasta and Noodles:** Products such as pasta, macaroni and noodles are generally prepared from semolina; however, to reduce the wheat content and add variety to the existing products, millets can be incorporated at varying levels without any deterioration to the quality characteristics.

**Roasted millets:** Millet can be roasted in open pan or with salt/sand to prepare a ready to eat product which is commonly consumed as roasted snacks.

**Extruded snacks:** Extruded snacks are the most versatile food products which can be easily prepared using different combination of millet flours and seasonings.

**Indigenous products:** Millets can also be used to develop several indigenous products such as chapatti, pancakes, chilla, panjiri, ladoo, and energy bar. For the preparation of these products, traditional base raw material can be successfully replaced with millet flour which enhances the minerals, bioactive compounds, dietary fibre and protein content of the indigenous products.

The Department of Food Science and Technology, Punjab Agricultural University, Ludhiana provides trainings related to processing and value addition of millets.

* Rajan Sharma: 98884-66395
Use of paddy straw as animal feed by scientific methods

KANWARPAL SINGH DHILLON, BIKNAMJIT SINGH, GURLAL SINGH GILL
Krishi Vigyan Kendra, Amritsar

Straw (wheat/rice) contains constituents such as cellulose, hemi-cellulose, lignin and silica. But it is difficult for the dairy animals to digest lignin and silica from them. Silica is more abundant in the leaves than the stems of rice and it has been observed that the stems of rice is easier for the animals to digest than leaves of rice, because of this, rice straw that used for animal’s feed should cut close to the ground as possible so that the portion of stems of rice straw in the feed is more than that of leaves.

Rice straw can be used with green forage in place of wheat straw or in addition to wheat straw, as the constituents of rice straw and wheat straw are almost the same, wheat straw is higher in lignin and lower in silica than rice straw. Wheat straw or rice straw alone cannot meet the animal’s body requirements, they only fill the stomach (rumen) of the animal, but by processing the straw (wheat/rice) with scientific methods its quality can be increased which is as follows:

- Fermentation of rice straw with urea
- Uromol (urea + molasses) impregnated paddy straw

Fermentation of rice straw with urea:

Method of processing:
- First dissolve 14 kg of urea in 200 liters of water.
- After mixing it well, cover it with a tarpaulin sheet in the corner of the shed for 9 days.
- Meanwhile, the internal temperature of the covered straw reaches 50-55°C. This temperature increases the digestibility of the fiber by breaking the lignocellulosic bonds between the fiber and lignin.
- After 9 days the fermented straw becomes usable as animal feed.
- Wheat straw, stems of maize, millet and sorghum, dry fodder or other crop residues can also be processed in this way.

Uromol (urea + molasses) impregnated paddy straw

Method of processing:
- First mix 1 kg of urea in 3 kg of molasses and heat the solution at 100°C for 30 minutes.
- Then add 30 liters of water to this solution and dilute it.
- Spread 100 kg of rice straw on a tarpaulin sheet and sprinkle this solution evenly over the straw so that all the straw comes in contact with the uromol mixed solution, after which mix it well.
- After processing the straw with urea, farmers can dry it in the sun and use it for animal feed.

Benefits of urea fermented straw:
- Nutrient content is increased in fermented straw compared to unfermented straw (Table 1).
- Fermented straw becomes more tender and palatable. Due to which the ability of the animal to eat straw increases (Table 1).
- The cost of feed is reduced, because protein is available from the fermented straw, due to which the quantity of milk can be increased with less concentrate feeding.
- Addition of ad libitum urea fermented straw + 25 g salt and + 50 g mineral mixture + vitamin A and 2 kg green fodder fulfills the basic nutritional requirements of the infertile animals.
- It proves to be a good source of nutrients during fodder shortage. Farmers can easily adopt this method on their farms.
- Things to remember while urea fermented straw feeding:
  - Do not open the entire tarpaulin sheet after 9 days. Use the fermented straw to one side as required.
  - Open up the fermented straw in air before feed the dairy animals, so that the ammonia gas escapes and does not get into the eyes of the animals.
  - Calves below 6 months of age should not be fed urea treated straw.
  - Feed the dairy animals gradually by mixing fermented straw with unfermented straw.

<table>
<thead>
<tr>
<th>Nutrient component</th>
<th>Unfermented straw</th>
<th>Fermented straw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Protein</td>
<td>2.5-3.5 %</td>
<td>6-8 %</td>
</tr>
<tr>
<td>Digestible Crude Protein</td>
<td>-</td>
<td>3-4 %</td>
</tr>
<tr>
<td>Digestible Crude Fiber</td>
<td>40-45 %</td>
<td>70-75 %</td>
</tr>
<tr>
<td>Total Digestible Nutrient</td>
<td>40-45 %</td>
<td>50-55 %</td>
</tr>
<tr>
<td>Palatability</td>
<td>5-6 %</td>
<td>10-12 %</td>
</tr>
</tbody>
</table>

Kanwarpal Singh Dhillon: 99156-78787
Integrated management of Pink stem borer in paddy-straw managed wheat fields

Department of Plant Breeding and Genetics

BEANT SINGH

Wheat is the largest acreage small grain crop of Punjab. To minimize the air pollution level and sustain soil productivity, a large number of farmers in Punjab and adjoining states are adopting conservation tillage practices for sowing of wheat crop without burning the paddy straw. These practices include sowing of wheat in the standing stubble with Happy Seeder and Smart Seeder or after incorporation of paddy straw in soil with rotavator, super seeder and mould-board plough. Recently, PAU has recommended surface seeding in which wheat is sown by keeping the chopped straw on soil surface. The farmers well versed with these technology are aware of pink stem borer. However, the new farmers shifted to these conservation practices need to be apprised of some of insect-pests problems in paddy straw managed wheat fields.

Pink stem borer is originally a pest of rice, but now it is appearing on wheat crop as well. Generally, it cause damage to paddy/basmati and late sown maize crops in the month September/October which may be carried over to wheat crop. Mostly, it attacks 30-45 days old wheat crop. The larvae of pink stem borer, bores into the stem of young plant and kills the central shoot causing ‘dead heart’. The infested tillers first look pale brown and ultimately dry up. At the ear emergence stage, its attack results in white ear-heads with little or chaffy grains.

**Integrated management of Armyworm and Pink stem borer**

- Regular monitoring of paddy/basmati/late sown maize crop should be done in the months of September-October. If the attack of pink stem borer is observed, adopt recommended practices for their management to check their carry-over to wheat.
- If pink stem borer damage is observed in previous paddy crop, avoid sowing wheat in the month of October.
- Regular surveillance of paddy straw managed wheat fields should be done in the month of November-December.
- Prefer to irrigate the wheat fields during day time to maximize predation of insect-pest by birds.
- Greater vigilance is needed near forests/birs. Light/pheromone traps can be used for the early detection of moths of armyworm.
- Minor attack of pink stem borer is automatically controlled with first irrigation to wheat crop. Thereafter, in the month of January, the growth of this pest gets arrested owing to the prevailing low temperatures. In case of severe infestation, apply of 7 kg of Mortel/Regent 0.3 G (fipronil) or 1 litres of Dursban 20 EC (chlorpyriphos) mixed with 20 kg of moist sand in one acre before first irrigation. Alternatively, foliar spray of Coragen 18.5 SC (chlorantraniliprole) @ 50 ml/ac in 80-100 litre of water per acre with knapsack sprayer may be applied.
**WHEAT**

1. Sowing of timely sown varieties of wheat like, PBW 826, PBW 803, PBW 824, Sunehri PBW 766, PBW 1 Chapati, DBW 222, DBW 187, HD 3226, Unnat PBW 343, Unnat PBW 550, PBW Zn 2, PBW RS 1, PBW 1 Zn, PBW 725, PBW 677, HD 3086, WH 1105, HD 2967, should be completed up to fourth week of November. PBW 869 variety has been recommended for sowing with Happy Seeder/Super Seeder in in-situ rice residue managed fields. After fourth of November prefer PBW 771 & PBW 752.

2. Drill 55 kg DAP or 155 kg single super phosphate (SSP) at the time of sowing to medium fertility soils. No urea is required at sowing if DAP is used as source of phosphorus however, apply 20 kg urea per acre at sowing if phosphorus is applied through SSP. Apply muriate of potash @ 20 kg per acre in soils testing low in available potash. But in districts of Shaheed Bhagat Singh Nagar, Gurdaspur, Hoshiarpur, Mohali and Ropar, apply 40 kg muriate of potash per acre. Apply microbial consortium (biofertilizer) to wheat seed before sowing. It enhances absorption of phosphorus from soil and improves plant growth. Apply 100 kg gypsum per acre at sowing in sandy soils to meet sulphur requirement. If wheat follows groundnut which received recommended dose of gypsum, apply 50 kg gypsum per acre. Drill 65 kg DAP in Happy seeder or Super seeder sown wheat at the time of sowing.

3. For need based nitrogen application in wheat with the help of PAU-Leaf Color Chart (LCC), drill 55 kg DAP/acre at sowing to medium fertility soils. Apply 40 kg urea/acre to timely sown and 25 kg urea/acre to late sown wheat (Sown after 15th of December) with first irrigation.

4. To rainfed wheat, at the time of sowing, apply 35 kg urea, 100 kg single super phosphate and 20 kg muriate of potash per acre in medium to high moisture storage capacity soil (sandy loam and finer soils). In loamy sand soil (low moisture storage capacity), the fertilizer dose should be reduced to half. Apply potassium only to soils testing low in this nutrient.

5. In case zinc sulphate has not been applied to the previous crop of rice or maize, apply 25 kg zinc sulphate (21%) or 16 kg zinc sulphate (33%) per acre at the time of sowing in zinc deficient soils.

6. If manganese deficiency was noticed last year, avoid sowing of durum wheat varieties WHD 943 & PDW 291 from the last week of October to the 1st week of November. Do not grow durum wheat in light soils.

7. Termite is a serious pest of wheat particularly in rainy area. Before sowing, seed must be treated with 40g Cruizer 70 WS (thiamethoxam) or 160 ml Dursban/Ruban/Durmet 20 EC (chlorpyriphos). Dilute the above mentioned insecticide in one litre of water and spray on one acre seed (40 kg) spread on the pucca ground or polythene sheet or tarpaulin in a thin layer. In case of severe infestation, broadcast 7 kg Mortel 0.3 G (fipronil) or 1.2 litre Dursban 20 EC (chlorpyriphos) per acre mixed with 20 kg moist sand before first irrigation.

8. For control of loose smut of wheat, treat the seed of all wheat varieties except durum wheat varieties WHD 943 and PDW 291 with Raxil Easy/Orius 6 FS@ 13 ml or Vitavax Power @ 120g or Vitavax @ 80g or Tebused/Seedex / Exzole 2 DS@ 40g per 40 kg seed. This treatment also controls flag smut. Seed treatment should not be done earlier than one month of sowing as it affects seed germination. Neonex 20 FS (imidacloprid + hexaconazole) @ 80ml/40kg seed can be used for the control of termite and loose smut of wheat.

**PULSES**

1. In lentil, grow varieties LL 1373, and LL 931. Complete sowing of lentil crop by first week of November. For higher yields, inoculate the seed with Rhizobium culture. Apply 11 kg urea and 50 kg single super phosphate per acre at the time of sowing. If the Rhizobium culture has not been used, then apply 100 kg super phosphate per acre at sowing. In gram, grow variety PBG 10 & PBG 7 under irrigated conditions throughout Punjab state or PBG 5 in the sub-mountain districts whereas Desi gram PBG 8, GPF 2 and Kabli gram L 552 under irrigated conditions except submountain districts and PDG 4 for Rainfed (Barani) conditions in the state except sub mountain areas should be sown.
The sowing must be completed by 10th November as further delay in sowing results reduction in yield. Inoculate the seed with rhizobium culture and plant growth promoting rhizobium at sowing. Apply 13 kg urea and 50 kg single super phosphate/acre to rainfed/irrigated desi gram at sowing. For Kabuli gram application of 13 kg urea and 100 kg single super single superphosphate per acre is recommended.

2. To manage gram blight, grow resistant varieties PBG 7 and PBG 5.

3. Treat the seed of pea with Talc based formulation of Pseudomonas fluorescence @ 15 g/kg seed for control of wilt.

RAPESEED AND MUSTARD

1. Complete the sowing of Raya and African sarson upto 15 November. Under late sowing, transplanting of gobhi sarson is more profitable than direct sowing. Use 60 days old seedlings of gobhi sarson (GSL-1) but for canola gobhi sarson use 30 days old seedlings.

2. To early sown raya, apply 45 kg urea per acre with first irrigation. In rainfed conditions, apply 35 kg urea and 50 kg single super phosphate per acre by drilling at the time of sowing.

SUGARCANE

Irrigate the crop at monthly interval. Start crushing/harvesting early maturing varieties like CoPb 95, CoPb 96, Co 15023, CoPb 92, CoJ64, CoJ85 and Co 118.

CELERY

Start transplanting celery crop from 15th November at a spacing of 45 x 25 cm. Use 60-70 days old seedlings. At the time of transplanting, apply 45 kg urea and 100 kg single super phosphate per acre.

FODDER PRODUCTION

1. Take the first cutting of berseem. In case of manganese deficiency on the crop in light textured soils, spray Manganese Sulphate (0.5%) two weeks after the cutting.

2. Conserve the surplus maize fodder as silage at milk dough stage.

3. Take the last cutting of Napier bajra in early November because further delay will cause mortality of stumps.

4. Sow oats, white senji or metha or sarson as intercrop in Napier bajra and sow oats seed mixed with 1 kg seed of raya for more fodder yield.

VEGETABLES

Root crops

1. Start sowing European varieties of Radish (Japanese White), Carrot and Turnip.

2. Apply 15 tonnes of farmyard manure per acre and mix it with the soil by ploughing about 10 days before sowing these crops. Apply 55 kg urea and 75 kg single super phosphate per acre at the time of sowing. Apply 50 kg muriate of potash for carrot only.

3. Irrigate these crops only when it is must, otherwise excessive irrigation will lead to hairy, cracked, deformed, and forked roots.

Cole crops

1. Transplant 4 to 6 weeks old seedlings of cabbage, chinese cabbage and late season cauliflower in lines at spacing of 60 cm x 45 cm, 30 cm x 30 cm and 45 cm x 30 cm, respectively. Repeat watering as and when required according to weather & soil conditions. Fill the gaps to obtain good crop stand after a week and irrigate.

Potato

1. Rogue out virus affected plants from seed plots. Apply second dose of 85 kg urea per acre and increase the dose of urea to 115 kg per acre in case of light soils and do earthing up in 40-45 days old crop.

2. Spray crop with Indofil M-45/Mass M-45/Markzeb/Antracol/Kavach @ 500-700 g or Copper Oxycarbonate 50 WP/Mark copper @ 750-1000 g/acre in 250-350 litres of water in the first week of November before the appearance of disease followed by 5 more sprays at 7 days interval. Under heavy disease situation instead of 3rd and 4th spray of Indofil M-45/Mass M-45/Markzeb/ Antracol/Kavach give two sprays of Revus 250 SC @ 250 ml or Melody Duo or Ridomil Gold or Curzate M-8 or Sectin 60 WG @ 700g or Equation Pro @ 200 ml per acre at 10 days interval.

Tomato

1. In the 1st week, sow 100 g seed of PTH-2, Punjab Ratta, Punjab Gaurav, Punjab Sartaj, Punjab Swarna, Punjab Red Cherry, Punjab Kaser Cherry, Punjab Sona Cherry, Punjab Chhuhara varieties on raised beds. Treat the seed with Captan @ 3 g/kg of seed. Two marlas (50m2) area is sufficient to grow seedlings for an acre. At the time of preparing beds, add well rotten farmyard manure @ 250 kg per marla.

2. In the last week of this month, start transplanting. Prepare beds 0.75m wide and keep plant-plant distance at 30cm. Apply 10 tonnes farmyard manure and 55, 155, and 45 kg urea, single super phosphate and muriate of potash per acre, respectively. Transplant two seedlings at a 30 cm space between the plants. Irrigate immediately, fill gaps in the following week next week and irrigate.

3. For kitchen gardening and for local market, prefer Punjab Ratta. For processing, grow Punjab Ratta/PTH-2. In nematode infested soils, plant only the resistant variety Punjab NR 7.

Onion

Sow 4-5 kg seed either of the varieties PRO-7, PRO-6, Punjab Naroya, Punjab White, PWO-2, PYO 1 or POH-1 hybrid in 8 marlas bed area to raise seedlings for transplanting an acre. For seed production of onion varieties, plant 4-6/acre of medium size, healthy bulbs at a spacing of 60 cm (Row to Row) and 30cm (bulbs to bulbs). Apply light irrigation once after 10 days.

Leafy Vegetables

1. Start harvesting, grading, packing and marketing of spinach, chinese cabbage and methi. After each harvest apply 20 kg urea per acre for quick rejuvenation and healthy foliage development.

2. Irrigate methi and palak once a week.

3. Sow seed or transplant seedlings of lettuce (Punjab Lettuce-1) after applying 55 kg urea and 75 kg of single super phosphate per acre. Keep lines and plants 45 and 30 cm apart, respectively.

Peanut

1. Complete the sowing of Punjab 89 and Mithi Phali by the mid of November by keeping spacing of 30 cm x 10 cm.
2. Apply 45 kg urea and 155 kg single super phosphate/acre at the time of sowing.
3. Use 30 kg seed per acre. Treat the seed with Talk based formulation of Pseudomonas fluorescens @ 15g/kg seed.
4. Sow peas for seed production during the 2nd fortnight of this month.

**Chilli**
1. For raising chilli nursery sow seeds of CH-52, CH-27, Punjab Tej and Punjab Sinduri at raised nursery beds.
2. For transplanting an acre, 200 g seed is required for raising nursery in one marla area.

**HORTICULTURAL OPERATIONS**
1. To protect the young fruit plants from upcoming winters, prepare the thatches or kullies of sarkanda or farm waste materials on the plants during late November. Care should be taken that the South-West side should be left open to allow sufficient sunlight.
2. Planning and layout forestablishment of newdeciduous plantorchards such as pear, peach, plum, grapes, fig etc. can be done during this month.
3. Withhold the irrigation in this month in deciduous fruit orchards like pear, peach, plum and grapes, so that the trees mayenter dormancy and become sufficiently hard to withstand cool weather.
4. The intercropping of rabi season crops such as wheat, gram, peas and senji to utilize the vacant space in thenon-bearing fruit plants can be done during this month.
5. Apply irrigation toberorchards as the trees are loaded with fruits. Irrigation should be done at 3–4-week interval.
6. Harvesting of early variety of sweet orange like Mosambi and Early Gold will commence towards the end of this month. The ‘Daisy’ mandarin fruitsshould be harvested before 20th November to avoid development of granulation. While harvesting, the stalk should be cut close to the fruit with a seateurs or special type of clipper. 
7. For quality improvement in ber, spray potassium nitrate (15g per liter of water) in the middle of this month.
8. Black spot in ber can be managed with spray of Bordeaux mixture (2:2:250) during this month.
9. To check physiological fruit drop in ber spray Naphthalene Acetic Acid (NAA) @ 15g in 500 liters of water per acre. Dissolve NAA in small quantity of Alcohol and then mix it in water. Wash the spray tank with washing soda before and after spray.
10. Clean and maintain the water channels, paths, surroundings of the orchards as the load of other horticultural operations in most of the orchards is very less in this month.

**ORNAMENTALS**

**Annuals**
1. Transplanting of seedlings of winter annuals like coreopsis, phlox, helichrysum and gaillardia, calendula, petunia etc. can be done in prepared beds and pots during first week.

**Lawn**
To protect the lawn from occasionally low night temperature, frequent but light irrigation should be given. Warm season grasses tend to stop growth, turn little pale and go dormant. Avoid water ponding over lawn.

**Chrysanthemum**
In, early flowering types the dried flowers should be removed immediately after they wither to allow lateral buds to bloom. Continue disbudding of standard chrysanthemums and provide support to potted plants as required. Ensure sufficient moisture in pots, as plants will start blooming during mid to end of this month. Remove dried leaves from base of the shoots and start colouring the pots for exhibit in show next month.

**Rose**
This is the best time for propagation of roses by T-budding. The rooted cuttings of Rose varieties for loose flowers and oil extraction are planted in the field during this month. Ensure proper soil moisture as rose bushes sprout vigorously.

**Bulbous plants**
Plantation of corms of gladiolus and bulbs of narcissus (Nargis), Freezia, Iris can be continued in this month also. Rooted cuttings of decorative Dahlias may be planted in pots or in the beds. Early planted gladiolus sprouts and unfolds its leaves. The plants with sickle shaped leaves must be identified in field, uprooted and destroyed as they are infected with fusarium wilt.

**Marigold**
Seed harvesting for Punjab作Ganda No.1 can be started during this month. Harvest the fully mature and dry flowers for seed purpose. Extract the seeds and keep for drying in well-ventilated and a bit warm place.

**AGROFORESTRY**

**Poplar**
Intercropping in poplar plantations gives higher wood productivity. Wheat varieties PBW 677 and PBW 725 are suitable for cultivation and wheat/potato should be sown during the first fortnight of November. Irrigate the plantations at fortnightly intervals. In case of fields where poplar trees are to be planted in (January - February) sowing of wheat should be done after making channels for planting trees and their subsequent irrigation. Nitrogen/Phosphorus should be applied at 50 per cent higher rate in wheat intercropped in poplar plantations (more than three year age) than in sole wheat.

**Safeda**
Fodder crops (e.g. oats and berseem etc.) should be grown in 10-15 m wide strip running along the boundary plantation of Safeda. Cut the trees in winter and dry the logs in shade to avoid warping and cracking of wood.

**BEE KEEPING**
In the event of drone brood rearing and drone bees’ availability, queen bee rearing can be undertaken on toria/sarson crops for colonies multiplication or for replacement of old queen bees during the start of this month, either through division method or through mass rearing of queen bees from selected better performing colonies. The progressive beekeepers should prefer the latter method for its well known advantages. Colonies should be provided need based space in the form of raised combs or frames with comb foundations and super chambers to cope-up with brood rearing and nectar/honey storage and should be managed for exploiting toria/sarson nectar flow to its maximum. The super should be baited with...
honey combs taken from brood chamber which should be replaced with empty worker brood cell combs about the centre of the brood chamber among the combs. Dust sulphur powder on the top bars of bee combs @ 1.0 g per comb against ectoparasitic brood mite (Tropilaelaps clareae). Alternatively, fumigation with formic acid (85%) @ 5 ml daily for two weeks may be applied which, however, should be avoided during nectar flow. The latter treatment also takes care of Varroa mite. In the case of infestation by Varroa, destruction of sealed drone brood comb part, Varroa trapping on drone brood and then its destruction, dusting of icing sugar on bees @ 15g per 10 combs through bee space in between the combs very late in the evening and use of sticky papers with Varroa bottom board can also be integrated. Late evening application of Oxalic acid (4.2%, w/v), prepared in sugar solution (60% in water, w/v), on the bees @ 5 ml through trickling in bee space between every two combs thrice at weekly interval is also effective against Varroa. Keep vigil of the brood diseases and on suspicion, the suspected colonies should immediately be isolated from the healthy stock; immediately consult experts and undertake the suggested measures. Proper spacing among the colonies and extraction of honey from the supers separated from brood chamber with queen excluder help in preventing spread of Varroa and brood diseases among colonies in the apiary. Ripe (sealed) honey from toria/sarson flow should be extracted. In areas where toria is not grown and colonies are not migrated to sarson areas and Eucalyptus is not in bloom yet, sugar feeding (sugar : water =2:1) can be given to the colonies if food reserves are either scanty or not available in the colonies. While feeding, take all necessary precautions to prevent robbing menace. By the end of November, ensure the placement of colonies under sunshine, near wind breaks for protection from ensuing chilling weather and arrange winter packing.

MUSHROOM GROWING
1. After the completion of white mycelial growth in button mushroom beds, remove the newspaper sheets and cover the bed surface with 1 - 1½” thick layer of disinfected casing soil (farmyard manure and sandy soil ). In case of polythene bags, open the folded layer of polythene and cover it with casing soil as PAU recommendation.
2. On daily basis, sprinkle the water on the cased beds by using a spray pump.
3. After casing, open the doors and windows of the growing rooms for cross ventilation on daily basis for 6-8 hours.
4. Small pin heads start appearing on the cased beds after two weeks of casing, which later on turns into mature fruiting bodies.
5. Dhingri cultivation on wheat straw can also be continued during this month.

DAIRY FARMING
1. Watch the animals in the early and late hours of the day especially at the time of milking for mucous discharge from vagina. If the mucous discharge is clear, get the animals inseminated / mated after 12 to 18 hours in cows and 18 to 24 hours in buffaloes after the onset of oestrus.
2. Animals must conceive within 60-90 days after calving. To achieve this skip first two heats.
3. Watch animals for heat symptoms after 18-21 days of insemination. If no symptoms of heat appear then get the animals checked for pregnancy after 3 months of insemination.
4. Regularly deworm the calves first at 15 days of age, with piperazine liquid (5 ml/10 kg body weight) then at 7 days interval upto one month of age, then at monthly intervals upto six months of age and then at 3 months interval by changing salts.
5. Disbudding should be done within 14-21 days of age.
6. Commercial dairy farmers feed silage throughout the year but small farmers can also plan for silage making to avoid scarcity of green fodder alongwith mineral mixture and concentrate according to production potential of the animal during this period.
7. For appropriate milk yield, do the milking quickly, quietly, cleanly and correctly with full hand or with machine. Apply post heat dip for mastitis control with a combination of Povidone Iodine and glycerin in the ratio of 3:1. Let the animal stand for atleast one hour after milking to avoid mastitis.
8. Check the animal for lactic acidosis by observing dung for looseness. If dung is loose, use 50-70-gram sodium bicarbonate in diet of animals on daily basis it mostly occurs in early lactating animals.
9. Vaccination should be done with goat-pox vaccine @3ml in all healthy dairy animals to prevent the spread of Lumpy skin disease, no vaccine should be administered to effected ones If animals show symptoms of high fever (104-105 F), Nodules or lumps on the body, Swelling on the forelegs isolate it from other herd to protect other animals also avoid anyone to enter at your farm and also restrict your movement to other farms. Milk of infected animals can be consumed after boiling as there is no evidence it can affect humans, if this disease enters at your farm consult your nearest Veterinary hospital.
10. Farmers can also use spray of 5% formalin (500 ml in 10 litre of water) to deactivate lumpy skin disease virus specially during the evening time.

POULTRY
1. Cull out the non productive birds.
2. Prepare curtains needed for coming winter for poultry sheds to avoid sudden downfall of temperature in the shed.
3. Vaccinate the birds against Ranikhet disease and Fowl pox if not already done.
4. Put paddy straw on the roof to protect the birds from cold during winter and use chaffed paddy straw mixed with rice husk as bedding material.
5. Keep poultry sheds clean, dry and warm. Do not store feed for more than 15 days.
6. Prepare brooders for upcoming winter season.

Compiled by:  Amarjit Singh
Training Programmes in November

**November 06-15:** Preparation of value added products from jaggery

**November 07:** Integrated Weed Management in rabi crops

**November 09:** Off season raising of cucumber and sweet pepper under low tunnel

**November 15:** Care and management of newly born calves

**November 17:** Integrated Nutrient Management in rabi crops

**November 20-24:** Protected cultivation of vegetable crops

**November 22:** Diseases of fore-stomach in ruminants

**November 30:** Nursery production of early cucurbits

**November 06:** Improved cultivation practices of rabi cereals/oilseeds/pulse crops

**November 07:** Care and management of newly born calves and pet animals

**November 08:** Agriculture Record Keeping

**November 09:** Management of insect pests and diseases of wheat

**November 10:** Production and value addition of millets

**November 14:** Sensitization regarding reproductive health issues and safe motherhood for farm women

**November 15-30:** Value addition of horticultural crops (winter season)

**November 17:** Formulation of balanced feed for dairy animals

**November 22:** Amelioration of manganese deficiency in wheat and berseem

**November 02:** Care and management of newly born calves and pet animals

**November 03:** Use of jaggery and shakar in preparation of sweets

**November 06:** Amelioration of manganese deficiency in wheat and berseem

**November 08-10:** Seed production of onion-bulb to seed (at different stages)

**November 09-10:** Gur/Shakar making and preparation of value added products from it

**November 10:** Recommended practices for clean milk production

**November 17:** Balanced diet for different age groups

**November 20-24:** Preparation of cleaning agents

**November 02:** Preparation of recipes using millets

**November 03:** Diagnosis of nutrient deficiencies in rabi crops and their remedial measures

**November 06-10:** Preparation of bakery and confectionary products

**November 08:** Care and management of newly born calves

**November 10:** Management of pink stem borer and armyworm in wheat crop

**November 17:** Low tunnel technology for raising early vegetable crops

**November 30:** Integrated Pest and Disease Management in rabi crops

**November 02:** Integrated Weed Management in rabi crops

**November 03:** Integrated Pest and Disease Management of rabi crops

**November 06-15:** Beekeeping- a lucrative subsidiary occupation

**November 09:** Seed production of berseem crop

**November 14:** Marketing and value addition of milk for better profitability

**November 15:** Processing of aloevera at domestic level

**November 20-24:** Preparation of bakery products

**November 23:** Clean milk production and prevention of milk borne diseases

**November 01:** Integrated Weed Management in rabi crops

**November 02:** Prevention of zoonotic diseases

**November 06-10:** Gur/Shakar making and preparation of value added products

**November 07:** Agro-processing complex- a way to become an entrepreneur

**November 08:** Layout, planning and planting of deciduous fruit plants

**November 09:** Efficient irrigation water management in rabi crops

**November 10:** Techniques to check food adulteration

**November 17:** Management of Apis mellifera colonies during winter and spring season

**November 21:** Seed plot technique for raising disease free potato seed

**November 20-24:** Goat Farming

**November 24:** Nutritional deficiencies and fertilizer application to fruit plants

**November 06:** Care and management of newly born calves

**November 07:** Nutritious recipes for young children and pregnant/lactating women

**November 09:** Protected cultivation and nursery raising techniques of vegetable crops

**November 10:** Integrated Nutrient and Weed Management in rabi crops

**November 20-29:** Preparation of eco-friendly cleaning agents

**November 21-30:** Nursery production and protected cultivation of vegetable crops

**November 22:** Diseases of fore-stomach in ruminants

**November 23:** Processing of sugarcane juice into jaggery

**November 24:** Diagnosis of nutrient deficiency in rabi crops and their remedial measures

**November 28:** Preventive/post-accident guidelines in agricultural operations

**November 03:** Tips for jaggery/shakkar making and income enhancement

**November 06:** Low tunnel technology for cucurbits production

**November 07:** Balanced diet for different age groups

**November 17:** Care and management of newly born calves and pet animals

**November 20-24:** Tips for establishment of agro-processing unit and income enhancement from agricultural commodities
November 07: Jaggery and vinegar preparation
November 08: Value addition to pulses by sprouting
November 10: Seed plot technique for raising disease free potato seed
November 17: Amelioration of manganese deficiency in wheat and berseem
November 20-29: Hand embroidery and fabric painting techniques
November 23: Diagnosis and management of nutrient deficiency in rabi crops
November 24: Eco-friendly approaches for insect-pest and disease management of fruits and vegetables
November 20-24: Nursery raising of cucurbits in polythene/plug trays
November 24: Construction, operation and maintenance of paddy straw biogas plant
November 29 –December 5: Entrepreneurship development programme in Goat Farming
November 30: Feeding of mineral mixture and bypass fat in dairy animals

November 02: Introduction of balanced diet for different age groups

November 03: Preparation of sweets at domestic level
November 06-10: Mushroom cultivation and processing
November 08: Training and pruning of agroforestry trees
November 14: Identification of manganese deficiency symptoms and remedial measure in wheat and berseem
November 15: Recommended practices for clean milk production
November 20-24: Embellishment of clothing through different techniques

November 22: Integrated Weed Management in rabi crops
November 23: Integrated Pest Management in rabi crops
November 24: Care and management of newly born calves and pets

November 06-10: Beekeeping- a lucrative subsidiary occupation
November 15: Post-harvest management/handling of fruits and vegetables
November 23: Identification and management of insect-pests and diseases of winter vegetables
November 24: Mushroom cultivation and processing
November 30: Management of honey-bees during winter season

November 01: In situ management of crop residue
November 02: Integrated Nutrient Management in field crops
November 03-09: Preparation of bakery and confectionary products
November 06-10: Mushroom cultivation and processing
November 15: Integrated Weed Management in rabi crops

November 20-24: Beekeeping- a lucrative subsidiary occupation
November 29: New cultivation technologies of vegetable crops

November 03: Care and management of newly born calves and pet animals

November 09: Off season management of pink bollworm in cotton
November 10: Integrated Weed Management in rabi crops
November 14: Agriculture Record Keeping
November 15-24: Beekeeping, honey processing and marketing
November 17: Soap and detergent making
November 20-24: Preservation of winter fruits and vegetables
November 21: Clean milk production
November 23: Management of rust and karnal bunt in wheat
November 24: Self-awareness on social evils
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Dr. B.S. Hunjan
MBBS, MS, M.Ch (Ortho)
Director & Senior Orthopedics Consultant
Formerly at:
- Hull Royal Hospital, U.K., Cade Hill Hospital, Hull, U.K.
- Liverpool Hospital, Sydney, Australia
- Putnam Hospital Centre, New York, USA
- A.O. Fellow University Hospital, Zuerich, Switzerland
- A.O. Fellowship, Kaneko Royal Hospital, Tokyo, Japan
- Stryker Fellow Bumrungrad Clinic, Johannesburg, SA
- B. Brown fellow- General Hospital, Singapore.

Dr. Jaiveer S. Hunjan
MBBS, MS (Ortho)
Certified Robotic Surgeon
Fellowship in Knee & Shoulder Arthroscopy
Consultant Orthopedics Surgeon
Mob.: +91-95699-60630

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HUNJAN HOSPITAL
111-South Model Gram, Kochar Market Road, Ludhiana-141 002
Mob.: 92175-92178, 98140-20234
E-mail: drbshunjjan@gmail.com | Website: www.hunjanhospital.com