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Inside this Issue

Rising temperatures and wheat productivity in Punjab

understanding the impact of heat stress during grain development

The grain development in wheat is largely influenced by temperature with optimum grain filling occuring when maximum temperature remain between 21-28°C and minimum temperature between 7-13°C. If the temperature increases by 1°C during this stage, the grain maturity period may shorten by about three days, which reduces the grain filling rate. Research findings also indicate that 1°C rise during the grain-filling stage may reduce wheat yield by up to 5 percent. According to scientists, one major reason for yield reduction is the sudden rise in temperature during the final growth stages of the wheat in Punjab.

During the current rabi season (2025–26), above-normal day and night temperatures have been recorded in Punjab during the month of February. Moreover, no western disturbances occurred during February; therefore, no rainfall was received in the region. The first week of March has also witnessed a continued rise in temperature, which is not favourable for the wheat crop. During this period, both day and night temperatures have remained more than 5°C above normal.

> *The grain-filling stage of wheat is highly sensitive to temperature and soil moisture conditions. Therefore, maintaining adequate soil moisture in the field during this period is essential. Farmers are advised to follow weather-based advisories and maintain adequate soil moisture in their fields*

To mitigate heat stress in wheat, PAU recommends application of chemicals such as salicylic acid and potassium nitrate, which are beneficial in reducing the harmful effects of high temperature on crop yield. Detailed information regarding the appropriate use of these chemicals is available in the PAU Package of Practices for Rabi Crops. This publication can be purchased from the Punjab Agricultural University or from PAU FASCs/KVKs across Punjab. It is also available for download from the PAU website (pauwp.pau.edu).

Considering the prevailing weather conditions, PAU Ludhiana regularly issues weather-based agro-advisories for farmers, enabling them to make timely decisions on irrigation and crop management to reduce the adverse effects of rising temperatures.

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Promoting spring groundnut-based cropping systems in Punjab

a viable strategy for crop diversification and water saving

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Spring groundnut is an important oilseed crop that can play a significant role in diversifying the rice–wheat dominated cropping system of Punjab. Known as the "king of oilseeds," groundnut is valued for its high nutritional and economic importance, containing about 26 per cent protein and 44–50 per cent oil. Additionally, its haulms and oil cakes provide high-quality livestock feed, making it a versatile crop for both nutritional security and agricultural diversification. Promoting spring groundnut-based cropping systems can therefore offer farmers a profitable and resource-efficient option for crop diversification while also contributing to improved soil health and reduced pressure on water resources.

Improved varieties

To achieve higher productivity and better crop performance, farmers should grow only the recommended short-duration groundnut varieties for the spring season. Well-adapted to Punjab's agro-climatic conditions, these varieties offer timely maturity, strong yield potential and fit seamlessly into diversified cropping systems (Table 1).

Table 1. Recommended varieties of spring groundnut in Punjab

Variety	Days to maturity	Oil content (%)	Shelling (%)	Average yield (q/acre)
J 87	112	49.0	69	15.3
TG 37A	101	48.6	65	12.3

Fertilizer application

For optimum growth and yield, balanced nutrient management is essential. Apply 10 kg nitrogen (12 kg urea), 12 kg P_2O_5 (26 kg DAP) and 90 kg gypsum per acre. Potassium should be applied only if the soil test indicates a deficiency; in such cases, apply 10 kg K_2O per acre (17 kg muriate of potash). Nitrogen, phosphorus and potassium fertilizers should be drilled at the time of sowing, while gypsum should be applied in two equal splits—the first at sowing and the second at the flower initiation stage.

Seed rate, spacing and seed treatment

Maintaining the correct seed rate and spacing ensures proper plant population and higher yields.

***J 87:** Use 48 kg kernels per acre at a spacing of 30 cm × 22.5 cm.*

***TG 37A:** Use 32 kg kernels per acre at a spacing of 30 cm × 15 cm.*

Before sowing, healthy kernels must be treated to protect against seed and soil-borne diseases as well as early insect damage. Treat the seed with 2 ml Neonix 20 FS (imidacloprid 18.5% + hexaconazole 1.5%), or 1.5 g Seedex 2 DS (tebuconazole), or 5 g Thiram (tetramethyl thiuram disulphide), or 3 g Indofil M-45 (mancozeb) per kilogram of kernels. Seed treatment helps control white grubs, termites, and major seed-borne diseases, ensuring healthy crop establishment.

Spring groundnut-based cropping systems for diversification

The continuous cultivation of the rice–wheat system has resulted in several emerging challenges, including groundwater depletion and contamination, declining soil health, crop residue burning, herbicide-resistant weeds, and the emergence of new insect pests. In recent years, many farmers have shifted from spring groundnut to spring maize, which requires frequent irrigations and has further accelerated the decline in groundwater levels. To address these issues, spring groundnut-based cropping systems offer a promising and sustainable diversification strategy. These systems integrate oilseeds, cereals, pulses and vegetables, thereby improving farm profitability, conserving water, and enhancing soil health.

Spring groundnut–Maize–Potato cropping system

This system recorded substantially higher productivity and economic returns compared to the rice–wheat system. Productivity increased by 106.9 per cent, while net returns increased by 74.5 per cent, along with 40 per cent saving in irrigation water.

Spring groundnut–Maize–Peas cropping system

Adoption of this system resulted in an increase of 79.1 per cent in productivity and 51.6 per cent in net returns over the conventional rice–wheat system, with 36.5 per cent water saving.

Spring groundnut–Moong–Potato cropping system

This highly efficient system improved productivity and net returns by 105.5 per cent and 77.9 per cent, respectively, while saving up to 45 per cent of irrigation water and significantly improving soil health.

Spring groundnut–Moong–Peas cropping system

This system also outperformed the rice–wheat system, recording 78.7 per cent higher productivity and 56.4 per cent higher net returns, along with 41.5 per cent water saving and better soil fertility. Besides higher profitability, these systems also enhance soil fertility and biological activity, including beneficial soil microflora and fauna.

For efficient crop scheduling, spring groundnut should be sown up to the first fortnight of March, followed by maize or moong up to the first fortnight of July, & potato or peas in mid-October. The following cropping systems have been found particularly beneficial (Table 2).

Table 2. Productivity, net returns and water saving in spring groundnut-based cropping systems

Cropping system	Yield (q/acre)			Rice equivalent yield (q/acre)	Net returns ('000 Rs/acre)	Irrigation water saving (%)
	Spring	*Kharif*	*Rabi*			
Spring groundnut–Maize–Potato	16.6	20.5	140.5	104.9	105.6	40.0
Spring groundnut–Maize–Peas	16.0	19.1	49.5	90.8	91.7	36.5
Spring groundnut–Moong–Potato	16.4	4.6	146.3	104.2	107.6	45.0
Spring groundnut–Moong–Peas	16.4	4.2	56.1	90.6	94.6	41.5
Rice–Wheat	–	28.4	22.1	50.7	60.5	–

Conclusion

Spring groundnut-based cropping systems offer a practical and profitable pathway to reduce dependence on the rice–wheat system while addressing critical concerns such as groundwater depletion and soil degradation. By integrating oilseeds, cereals, pulses and vegetables, these systems not only enhance productivity and farm income but also promote efficient resource use and improve soil health. With appropriate varieties, timely sowing and the recommended package of practices, spring groundnut can once again reclaim its place in Punjab's farming landscape, contributing to a more resilient, diversified and sustainable agricultural future.

Groundnut kernels of variety J 87

Groundnut kernels of variety TG 37A

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Early summer fodder crops for sustainable dairy farming

a practical approach to bridging the summer fodder gap

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Dairy farming is deeply woven into Punjab's agricultural economy, providing rural households with a reliable source of income and nutritional security. At the heart of profitable dairying lies a steady supply of nutritious green fodder, which is essential for maintaining animal health and sustaining milk productivity. Yet, fodder availability in the state often falls short of the actual requirement, particularly during the summer months. Although Punjab produces around 716 lakh tonnes of green fodder annually, its availability per animal is only about 30 kg per day, which is considerably lower than the recommended requirement of 40 kg. This shortfall compels farmers to rely increasingly on costly concentrate feed and dry fodder, thereby raising the cost of milk production. Smarter use of available cropping windows offers a practical and efficient path to improving fodder availability without expanding the cultivated area.

After harvesting wheat and before transplanting paddy, farmers generally have a vacant period of nearly two months. This interval presents a valuable opportunity for cultivating short-duration fodder crops that can supply nutritious green fodder during early summer. Fodder crops such as maize, bajra, sorghum and cowpea grow rapidly and can provide harvestable green fodder within 50–60 days of sowing. With proper crop and varietal selection (Table 1) and the adoption of recommended agronomic practices, farmers can obtain a substantial quantity of nutritious fodder.

Maize

For obtaining early green fodder, maize sowing can be started from the first week of March. About 30 kg seed per acre should be used, maintaining a row spacing of 30 cm to ensure proper plant growth. Incorporation of around 10 tonnes of well-decomposed farmyard manure per acre before field preparation is highly beneficial as it improves soil fertility and enhances fodder yield. Maize can also be grown successfully in combination with cowpea to improve fodder quality. In mixed cropping, about 15 kg maize seed along with 6 kg cowpea seed per acre should be used. For nutrient management, apply 150 kg single superphosphate and 55 kg urea per acre at the time of sowing. An additional 55 kg urea per acre should be top-dressed 3–4 weeks after sowing to support rapid vegetative growth. Effective weed management during the early growth stages is essential. In sole maize crop, atrazine 50 WP @ 800 g per acre may be applied in medium to heavy soils, while a reduced dose of 500 g per acre is suitable for light soils. The spray should be applied within 10 days of sowing using about 200 litres of water. However, atrazine should not be used when maize is grown with cowpea, as it may damage the cowpea plants. The crop becomes ready for harvesting as green fodder within 50–60 days after sowing, providing a good quantity of nutritious fodder during the early summer period.

Sorghum

For obtaining early and high-quality green fodder, sorghum should be sown around mid-March. About 20–25 kg seed per acre should be used, ensuring uniform sowing in rows spaced approximately 22 cm apart. Sowing can be done with a seed-cum-fertilizer drill, by the traditional pora method, or with a zero-till drill under no-tillage conditions. At sowing, apply 44 kg urea and 50 kg single superphosphate per acre. A second dose of 44 kg urea per acre should be applied about one month after sowing to promote vigorous vegetative growth.The crop should be harvested between the boot and milk stages, as harvesting at this stage ensures higher yield and better nutritive value.

Under moisture-stress or drought conditions, the level of prussic acid poison (cyanide or HCN) may increase in sorghum fodder. Therefore, providing one irrigation about a week before harvesting is advisable to improve fodder safety and quality.

Bajra

Bajra (pearl millet) is a fast-growing fodder crop and can be sown from March to August. About 6–8 kg seed per acre is sufficient. Sowing may be done by broadcasting, by pora method in rows spaced 22 cm apart, or with a zero-till drill under a no-tillage system. For obtaining early and nutritious fodder, bajra performs best when grown in combination with cowpea.Before sowing, incorporation of about 10 tonnes of well-decomposed farmyard manure per acre is recommended to improve soil structure and nutrient availability. For fertilizer application, apply 22 kg urea per acre at sowing, followed by another 22 kg urea per acre about three weeks later to promote vigorous growth.

Bajra fodder should be harvested at the ear initiation stage or immediately after the emergence of the flag leaf, which generally occurs 45–55 days after sowing. Harvesting at this stage ensures higher digestibility and better fodder quality. It also helps in avoiding ergot disease, which commonly appears during the flowering stage.

Cowpea

Cowpea is an important leguminous fodder crop, known for its soft, palatable and nutrient-rich green fodder. Besides providing quality feed to livestock, it also improves soil fertility through biological nitrogen fixation. For early summer fodder production, sow about 12 kg seed of cowpea variety CL 367 per acre in rows spaced 30 cm apart, starting from the month of March. At the time of sowing, apply 16.5 kg urea along with 140 kg single superphosphate per acre to support early crop growth and root development.

Being a fast-growing crop, cowpea becomes ready for harvesting within 55–65 days after sowing. Harvesting at the pre-flowering stage ensures higher fodder yield, better nutritional quality and improved palatability for dairy animals.

Table 1. Recommended early summer fodder varieties

Crop	Variety/Hybrid	Green fodder yield (q/acre)	Crude protein (%)	Total digestible nutrients (%)
Maize	J 1008	163	11.4	66.2
	J 1007	168		
	J 1006	165		
Bajra	PCB 166	282	8.8	58.2
	PCB 165	234		
	PCB 164	210		
	FBC 16	230		
Cowpea	CL 367	108	22.5	61.2
Sorghum	SL 46	275	9.0	55.6
	SL 45	271		

Conclusion

Seasonal scarcity of green fodder remains one of the most pressing challenges in Punjab. Yet the solution lies closer than many farmers realize, in smarter crop planning and better use of the wheat–paddy interval. Cultivating early fodder crops such as maize, sorghum, bajra and cowpea during this window offers an effective way to bridge the summer fodder gap while putting otherwise idle land to productive use. The harvested fodder can be fed fresh to livestock or conserved as silage to tide over lean periods.


Sorghum variety - SL 45


Bajra variety - PCB 166


Cowpea variety - CL 367


Fodder maize variety - J 1006

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PBD 88: A new high-yielding variety of *desi* cotton

a shattering-tolerant variety for irrigated cotton ecosystems

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Among the cultivated cotton species, desi cotton (Gossypium arboreum L.) holds a special place as an indigenous crop known for its resilience and versatility. Although it produces relatively shorter staple fibre, the lint is well-suited for absorbent cotton, surgical applications, handloom fabrics, denim, and filling materials for quilts and pillows. With the objective of strengthening the productivity and sustainability of desi cotton cultivation, Punjab Agricultural University (PAU) has developed a new high-yielding variety, PBD 88. This variety combines superior yield potential with shattering tolerance and stable performance across environments, making it a promising option for cotton growers in the region.

Varietal performance

PBD 88 has been recommended for cultivation under irrigated conditions in Punjab and recorded an average seed cotton yield of 10.90 quintals per acre, offering a significant improvement over existing varieties.

Plant characteristics

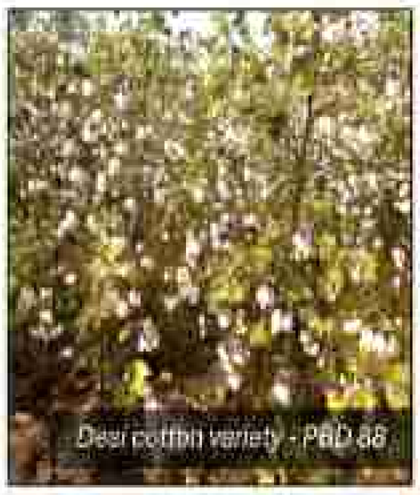
Plants of PBD 88 are vigorous and exhibit green foliage with broad leaves. The flowers bear creamy petals with a distinct petal spot, which is a characteristic feature of the variety. One of its notable advantages is its non-shattering nature, which helps minimize yield losses in the field. The plants attain a height of approximately 160–170 cm and produce medium-sized, open, elliptical bolls with a pitted surface. The variety has an average boll weight of about 2.8 g and a ginning outturn of 38.2 per cent, contributing to higher lint productivity.

Disease and insect-pest reaction

PBD 88 has moderate to high resistance against fungal foliar leaf spot and bacterial blight. The incidence of boll rot was also observed to be lower in PBD 88 compared to that in LD 949 and FDK 124. In terms of insect pests, the variety showed acceptable tolerance levels. The jassid injury grades, as well as populations of whitefly and thrips, were lower or comparable to those recorded in LD 949 and FDK 124. Similarly, boll and locule damage caused by bollworms remained comparable to the checks, indicating stable field performance even under unprotected conditions.

Fibre quality

The variety records an Upper Half Mean Length (UHML) of 20.6 mm, which falls within the acceptable range for desi cotton. It also has a micronaire value of 6.5 µg/inch, indicating medium to coarse fibre fineness. In addition, the variety exhibits a bundle strength of 21.4 g/tex, reflecting satisfactory fibre strength suitable for the end uses typically associated with *desi* cotton.



Desi cotton variety - PBD 88

Other desirable traits

Apart from its yield advantage, PBD 88 possesses several desirable ancillary traits, including higher lint yield, ginning outturn, boll weight and number of bolls per plant, compared with the check varieties, which further enhance its economic value. One of its most significant advantages is its very low boll shattering, recorded at around 2–3 per cent, compared with approximately 16 per cent in LD 949. This substantial reduction in shattering helps minimize field losses at maturity and improves harvest efficiency for farmers. Seed of PBD 88 is available at PAU/RRSs/KVKs.

Conclusion

In an era where farmers seek both productivity and reliability, the introduction of PBD 88 marks an important step towards strengthening *desi* cotton cultivation in Punjab and neighbouring states. With its high yield potential, low boll shattering, favourable disease response and stable performance, the variety offers a dependable option for cotton growers to sustain the traditional strength of *desi* cotton cultivation in the region.

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Liquid bacterial inoculant for higher cotton productivity

an eco-friendly approach for improving nutrient use efficiency

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Cotton, often referred to as the "white gold," is one of the most important fibre crops globally and a major cash crop of India. Besides providing fibre for the textile industry, cottonseed is an important source of edible oil and protein-rich meal. In Punjab, cotton occupies a prominent place in the kharif cropping system, particularly in the south-western districts. However, sustaining high productivity in cotton requires careful nutrient management because the crop has a high demand for nutrients during its growth cycle.

Enhancing nutrient use efficiency in cotton

Cotton is a heavy feeder of nutrients, especially nitrogen. During the active growth phase, vegetative and reproductive structures develop simultaneously, making nutrient management both critical and complex. The crop shows peak nutrient demand during key growth stages such as squaring, flowering, and boll development. A major challenge in cotton cultivation is the low efficiency of chemical fertilizers. Nearly 40–50 per cent of the nitrogen applied through fertilizers is not utilized by plants and is lost through processes such as denitrification, volatilization and leaching, or converted into forms unavailable to crops. Although chemical fertilizers remain essential under present farming systems, their inefficient utilization raises concerns regarding production costs, soil health and environmental sustainability. Therefore, improving fertilizer use efficiency while maintaining ecological balance has become a priority in modern agriculture.

Plant growth-promoting microorganisms (PGPMs)

PGPMs provide an effective and eco-friendly approach to enhancing plant growth through mechanisms such as improved nutrient availability and enhanced root development. Several PGPM formulations are available commercially as microbial inoculants in both carrier-based (solid) and liquid forms. However, conventional carrier-based inoculants often face limitations such as shorter shelf life, increased risk of contamination, and inconsistent field performance.

Liquid bacterial inoculant

Liquid microbial formulations provide a promising alternative to overcome the limitations of carrier-based products. Keeping this in view, PAU has developed a liquid bacterial inoculant capable of enhancing cotton yield under field conditions using Response Surface Methodology (RSM) with a Box–Behnken experimental design via Design-Expert software. The developed formulation exhibits a shelf stability of up to 180 days at room temperature. The application of the liquid bacterial inoculant containing *Bacillus thaonhiensis* along with the recommended dose of fertilizers (RDF) results in around 10.0 per cent increase in seed cotton yield.

Method of application

Dilute 100 mL of the liquid bacterial inoculant in 125–150 mL of water. Soak the recommended quantity of cotton seed required for one acre in this diluted solution for about two hours. After soaking, shade dry the treated seeds for about 30 minutes before sowing to ensure effective microbial inoculation and improved crop productivity.

Precautions while using liquid bacterial inoculants

Liquid bacterial inoculants contain live microorganisms and should be stored in a cool and dry place, away from direct sunlight and excessive heat.

Always use the inoculant before the expiry date mentioned on the container.

Do not mix the liquid inoculant with other chemicals.

Avoid mixing the inoculant with hot water, as high temperature may destroy the beneficial bacteria present in the formulation.

Conclusion

The use of liquid bacterial inoculants offers a practical step towards more efficient and sustainable cotton production. By improving nutrient utilization and supporting plant growth naturally, such microbial technologies can complement conventional fertilizer practices. Adoption of these innovations can help farmers achieve better productivity while contributing to environmentally responsible agriculture.

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Scientific planting of evergreen fruit trees

practical guidelines for orchard establishment

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A fruit orchard's long-term productivity and profitability largely depend on how carefully and scientifically it is established at the time of planting. Spring offers the most favourable conditions for planting evergreen fruit crops such as citrus, mango, litchi, guava, loquat and papaya. During this period, moderate temperatures and adequate soil moisture promote active root growth, enabling young plants to establish well before the onset of extreme summer heat. Scientific planning, appropriate planting systems, proper pit preparation and careful handling of nursery plants are all essential for establishing a productive orchard. By adopting these recommended practices from the very beginning, farmers can improve plant survival and ensure better orchard performance in the years ahead.

The planting system adopted in an orchard determines plant distribution, ease of management and efficient use of land. Some commonly used systems include:

Square system

This is the most widely practiced and simplest system of orchard planting. In this method, the distance between plants and rows remains the same, forming perfect squares. Plants are placed at the four corners of each square, allowing intercultural operations in both directions. Fruit crops such as citrus, ber and papaya are commonly planted using this system.

Rectangular system

In this system, the spacing between rows is greater than the spacing between plants within the row. This arrangement allows a greater number of trees compared with the square system while still permitting intercultural operations in both directions. It is suitable for high-density planting of crops such as citrus and guava.

Hexagonal system

In this method, six plants are positioned at the corners of an equilateral triangle forming a hexagon, with a seventh plant placed in the centre. This system is generally adopted for large fruit trees such as mango. It accommodates about 15 per cent more plants than the square system. The central plant acts as a *filler* and may consist of early-bearing crops such as plum, peach or papaya. These filler plants are removed once the main orchard trees begin bearing.

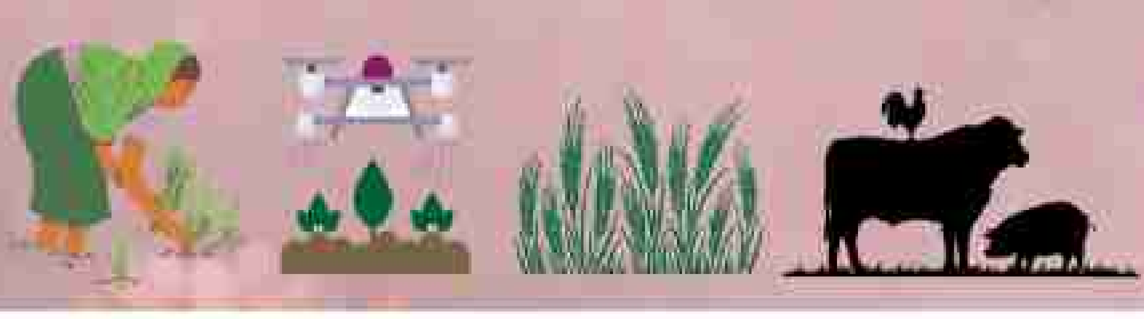
Orchard layout

Proper layout of the orchard ensures uniform plant growth and facilitates smooth cultural operations such as irrigation, interculture and harvesting. The site should be marked accurately at the recommended spacing for each fruit crop. Since the initial layout strongly influences the future performance of the orchard, expert guidance should be sought whenever possible. Generally, the farmers adopt a square system in most orchards (Table 1).

Table 1. Recommended planting distances and approximate number of plants in the square system

Fruit crop	Distance (ft)	Distance (m)	Plants per acre
Mango / Sapota	30	9.0	49
Citrus / Guava	20	6.0	110
Pomegranate (Kandhari)	13	4.0	240
Pomegranate (Ganesh, Bhagwa)	10	3.0	440
Loquat	22	6.5	90
Ber / Litchi	25	7.5	72
Papaya	5	1.5	1760

However, farmers should always purchase 10–20 per cent more plants than the recommended number to replace any plants that may die during establishment. In orchards of crops like mango and litchi, which are planted at wider spacing and take longer to bear fruit, filler crops such as peach, plum, papaya, or phalsa can be planted temporarily. This system helps utilize vacant space efficiently and may accommodate up to 80 per cent additional plants until the main orchard comes into bearing.



Digging and filling of pits

Before planting, the selected field should preferably be laser-levelled. The layout must include proper pathways, irrigation channels and designated planting spots. For each plant, a pit measuring about one metre in depth and one metre in width should be dug either manually or with the help of a mechanical pit digger. The pits should be filled with a mixture of topsoil and well-decomposed farmyard manure in equal proportions. While filling, maintain the soil level about 2–3 inches above ground level so that after irrigation, the soil settles evenly with the surrounding field. Watering should be done before planting the sapling. To protect young plants from termites, mix 10–15 ml chlorpyriphos 20 EC with about 2 kg of soil and add it to each pit.

Selection, handling and transportation of nursery plants

Farmers should always procure healthy, disease-free plants from reliable and certified nurseries. The plants must be of known pedigree, medium in height, and grafted or budded on recommended rootstocks. During lifting, each plant should retain a well-formed earthen root ball to protect the root system. Careful handling during transportation is essential to prevent breakage of the soil ball. Before loading the plants, the vehicle floor should be covered with cushioning materials such as paddy straw, dried grass or sand. Plants should be placed gently and water may be lightly sprinkled on the foliage during transportation to prevent drying.

Planting and care of young plants

Planting should be carried out at the centre of the filled pit with the help of a planting board to maintain proper alignment. The bud union of grafted plants must remain about nine inches above the ground level to prevent disease problems and ensure proper growth. After planting, the soil around the plant should be pressed firmly and watered immediately. Staking of young plants is necessary to keep them upright and protect them from wind damage. Dead, diseased or unwanted shoots should be removed after planting. For protection against termites, apply half litre of chlorpyriphos 20 EC per acre followed by light irrigation. Regular removal of sprouts and offshoots from the rootstock is also important. Farmers should continuously monitor the orchard for insect pests and diseases and follow recommended fertilizer doses and spray schedules for healthy plant growth.

Conclusion

Establishing an orchard is a long-term investment that demands careful planning and scientific management from the very beginning. By adopting recommended planting systems, preparing pits properly and using quality nursery plants, farmers can ensure better establishment and vigorous growth of evergreen fruit crops. Attention to detail during the initial stages ultimately results in healthy orchards, consistent yields and enhanced farm profitability. A well-planted orchard repays the farmer's early effort with years of abundant harvests and lasting returns.

A view of guava orchard

Farmers attending a training programme on orchard management

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Integrated pest management in chickpea

strategies to manage key insect pests

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Chickpea is an important pulse crop in Punjab, serving as a major source of dietary protein and contributing to improved soil health through biological nitrogen fixation. However, the crop is often threatened by insect pests at various growth stages, which can significantly reduce yields. Therefore, timely identification of these pests and the adoption of an integrated pest management (IPM) approach are essential for protecting the crop and maximizing productivity.

Major insect pests of chickpea

Insect pests may cause significant economic damage to chickpea under Punjab conditions; among them, termites and gram caterpillar are the most important pests that frequently threaten crop establishment and pod development.

Termites

Termites are a serious pest of chickpea, particularly in light-textured soils. Their damage is most noticeable at the seedling stage and near crop maturity. Termites attack the root system and feed within the root zone, weakening the plants. As a result, affected plants gradually dry up and can be easily pulled out from the soil due to severe root injury. Early detection is essential to prevent extensive plant loss in the field. Termite damaged can be minimized through proper field sanitation by removing crop residues, any stubbles or other decaying organic matter that may harbour termites. Deep summer ploughing is also beneficial as it exposes termites to high temperatures and natural predators. Farmers should apply only well-decomposed farmyard manure, since undecomposed organic matter may encourage termite activity. In addition, careful field selection is important, and fields with a previous history of severe termite infestation should preferably be avoided or managed with appropriate preventive measures.

Gram caterpillar (*Helicoverpa armigera*)

The gram caterpillar is the most destructive insect pest of chickpea. The larvae feed voraciously on leaves, flower buds, flowers and developing pods. In severe infestations, they even bore into the pods and consume the developing grains, causing considerable yield losses. Monitoring for this pest should begin at the pod initiation stage. Farmers are advised to gently shake the plants at 10 randomly selected spots per acre (approximately 100 plants in total) and count the larvae dislodged. If 16 or more larvae are observed from ten spots, the Economic Threshold Level (ETL) is considered reached, and control measures should be initiated immediately.

Integrated pest management strategies

Effective pest management in chickpea requires a combination of preventive and curative practices. Cultural interventions help suppress pest buildup, while biological and chemical methods provide timely control when pest populations exceed the economic threshold limit.

Cultural control

Intercropping chickpea with linseed helps in reducing the population of gram caterpillar. Farmers should sow two rows of linseed (30 cm apart) after every 20 rows of chickpea to suppress pest infestation.

Biological control

When the pest population exceeds the ETL, appropriate control measures should be adopted. Biopesticides are preferred for young larvae of gram caterpillar. Use *Bacillus thuringiensis* var. *kurstaki* 0.5 WP (DOR Bt-1) @ 800 g per acre or HaNPV (Helicop 2% AS) @ 200 ml per acre in 80–100 litres of water per acre. If required, the spray can be repeated after 10–14 days.

Chemical control

Spray Coragen 18.5 SC (chlorantraniliprole) @ 50 ml per acre or Proclaim 5 SG (emamectin benzoate) @ 80 g per acre or Rimon 10 EC (novaluron) @ 160 ml per acre using 80–100 litres of water per acre. A second spray may be given after two weeks if necessary.

Bio-Intensive IPM (BIPM) module for gram caterpillar

A comprehensive bio-intensive IPM module can further strengthen pest management efforts:

Grow PAU-recommended tolerant chickpea varieties.

Intercrop two rows of linseed (30 cm apart) after every 20 rows of chickpea.

Install pheromone traps @ 2 traps per acre to monitor moth activity.

Spray homemade neem extract @ 1750 ml per acre in 80–100 litres of water at the flowering stage.

When the pest population reaches the ETL (16 or more larvae from 10 random spots covering about 100 plants), spray either:

800 g Bacillus thuringiensis var. kurstaki 0.5 WP (DOR Bt-1), or

200 ml Helicop 2% AS (HaNPV) in 80–100 litres of water per acre. Repeat the spray after 10 days if required.

Safety precautions

While using pesticides, farmers should follow recommended safety guidelines to protect themselves and ensure safe crop produce.

Maintain a waiting period of three days after spraying Coragen 18.5 SC before consuming green leaves or grains.

Always wear protective clothing such as gloves, masks and full-sleeved garments while handling and spraying pesticides.

Carefully follow label instructions and recommended doses for the safe and judicious use of pesticides.

Conclusion

Effective pest management in chickpea begins with vigilant field monitoring and the timely adoption of integrated control measures. Cultural practices, biological agents and need-based chemical interventions together form a robust defence against damaging insect pests. By following these recommended IPM strategies, farmers can safeguard their chickpea crop, reduce unnecessary pesticide use and achieve economical and environmentally sustainable production under Punjab conditions.

Pod borer larva feeding on a chickpea pod

A view of pod borer larvae and damaged pods

A field view of damage caused by pod borer larvae

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Establishing a fruit nutrition garden

a practical approach to household nutrition

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Fruits are nature's most complete protective foods, delivering essential vitamins, minerals, antioxidants and nutrients vital for maintaining good health. Regular consumption of fruits strengthens immunity, supports balanced nutrition and contributes meaningfully to overall well-being. Growing different varieties of fruits at home is one of the simplest and most rewarding ways to ensure a regular supply of fresh and naturally ripened fruits for the family throughout the year. Recognizing this, Punjab Agricultural University (PAU), Ludhiana has developed a Fruit Nutrition Garden Model that enables families to grow a diverse range of fruits within the limited space of a household garden.

Planning the fruit nutrition garden

The PAU model recommends establishing a fruit nutrition garden in an area of 625 square meters (25 m × 25 m). With proper planning and management, this space can accommodate about 22 different types of fruit plants, ensuring year-round availability of fruits for the family. Since most fruit crops are long-term perennial plants, careful planning is essential for their successful establishment. Proper selection of varieties, layout and direction of planting plays a crucial role in ensuring optimal growth and productivity. For efficient utilization of sunlight and space, the garden should be planned as follows:

Northern side: Tall evergreen fruit trees such as mango, litchi, jamun, loquat, fig and sapota should be planted on the northern side so that they do not cast shade on the other fruit plants.

Inner portion of the garden: Citrus fruits and guava can be planted in the central part of the garden.

South-western side: Deciduous fruit trees like apple, pear, peach, plum and pomegranate should be planted here.

Southern side: Papaya and banana, which are sensitive to frost, should be planted in the last row on the southern side where they receive maximum sunlight and protection.

Eastern side: Different varieties of grapes can be grown along the boundary using a Y-trellis training system.

Western boundary: Karonda and phalsa may be planted as hedge crops.

Northern boundary: Sweet lime can also be planted along the boundary line.

This planned arrangement ensures efficient utilization of sunlight, space and resources while promoting better growth of different fruit crops.

Important points for establishing a fruit nutrition garden

While establishing a fruit nutrition garden, the following important recommendations should be kept in mind:

Follow PAU recommendations regarding selection of varieties, planting time, garden layout, basic maintenance practices, training and pruning, fertilizer application, irrigation, insect-pest management and harvesting.

The ideal planting time for evergreen fruit plants such as citrus, mango, guava and litchi is February–March and July–October.

Deciduous fruit plants should be planted during the winters (dormant period). Peach and plum should be planted by mid-January before the new vegetative flush begins, while pear and grapes should be planted by mid-February.

The layout of the garden should be finalized before digging the pits. Proper provision for paths, irrigation channels and accessibility should be ensured.

For planting, pits of 1 meter depth and 1 meter diameter should be dug for each plant. The pits should be filled with a mixture of top fertile soil and well-decomposed farmyard manure in equal proportions and irrigated before planting.

To control termite or white ant infestation, add 15 ml of

Chlorpyriphos 20 EC mixed in water in each pit, or mix the chemical in 2 kg soil and apply it uniformly in the pit. During planting, ensure that the bud union remains 6–8 inches above the soil surface. It should not be covered with soil or water.

Adoption of organic and eco-friendly practices is highly recommended, including:

Use of paddy straw mulch below the tree canopy to suppress weeds and conserve soil moisture

Application of farmyard manure for plant nutrition

Installation of PAU fruit fly traps for fruit fly management

Use of Bordeaux mixture spray instead of synthetic fungicides for disease management

Newly planted fruit plants should be protected from adverse climatic conditions such as frost in winters and sunburn during summers.

Always purchase planting material from authentic and certified nurseries to ensure healthy and true-to-type plants. The fruit varieties recommended by PAU, Ludhiana are given in table 1.

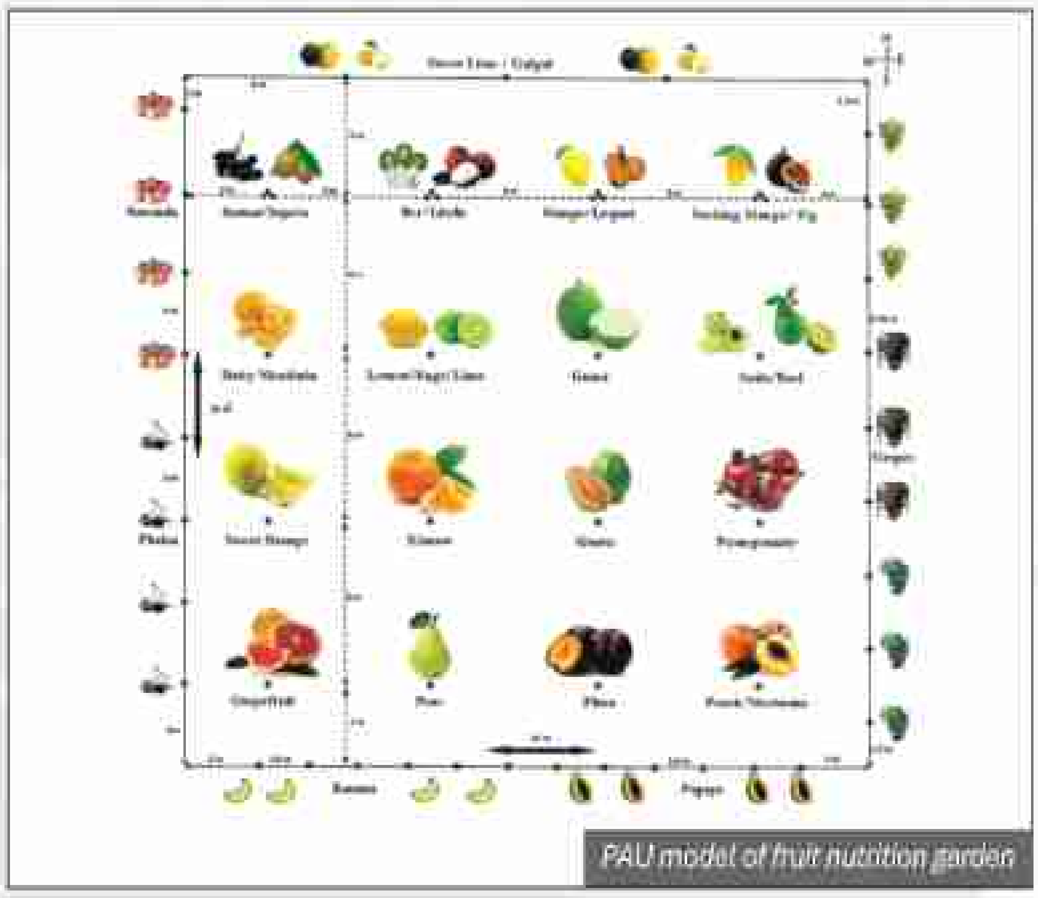
Table 1. Recommended fruit varieties for the fruit nutrition garden

Fruit crop	Recommended varieties
Amla	Neelam
Apple	Dorsette Golden, Anna
Bael	Kagzi
Banana	Grand Naine
Ber	Sanaur-2
Dragon Fruit	White Dragon-1, Red Dragon-1
Fig	Brown Turkey
Grapes	Perlette, Flame Seedless, Punjab MACS Purple
Grapefruit	Flame
Guava	Shweta, Punjab, Kiran, Punjab Apple Guava
Jamun	Goma Priyanka, Konkan Bahadoli
Karonda and Phalsa	Local
Lemon/Lime	Baramasi Lemon, Kagzi Lime
Litchi	Dehradun
Loquat	Golden Yellow
Mango	Amarpali
Sucking Mango	Gangian Sindhuri
Papaya	Red Lady 786
Pear	Punjab Beauty
Peach	Shan-i-Punjab
Plum	Satluj Purple, Kala Amritsari (grafted)
Pomegranate	Bhagwa
Sapota	Kalipatti
Sweet Orange	Blood Red, Mosambi

Conclusion

The PAU Fruit Nutrition Garden Model offers a practical, science-based approach for improving household nutrition through planned fruit cultivation. Even within limited space, families can grow a wide range of fruits, ensuring a continuous supply of fresh fruits throughout the year. Such gardens can be established not only in home backyards but also in schools, community spaces and institutional campuses. Beyond improving nutrition, they promote sustainable living by encouraging practices such as composting and organic cultivation, while reducing dependence on market-purchased fruits. By adopting this model, households can transform small spaces into productive green areas that nourish families, strengthen food security and contribute to a healthier and more sustainable future.

A view of a fruit nutrition garden


PAU model of fruit nutrition garden

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Choosing the right cotton variety

the first step towards higher returns

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Cotton is one of the most important cash crops of Punjab and a primary source of natural fibre for the textile industry. Beyond its economic value, cotton offers a viable alternative to the rice–wheat cropping system in the state's dry and semi-arid regions, thereby supporting crop diversification and groundwater conservation. Although comparatively less water-demanding, the crop is highly susceptible to several biotic stresses, including sucking pests, bollworms and Cotton Leaf Curl Virus Disease (CLCuD), as well as abiotic stresses such as drought during the flowering stage. Punjab's cotton belt has repeatedly borne the impact of such vulnerabilities — through whitefly outbreaks in 2015, pink bollworm infestations in 2021, and a severe whitefly and CLCuD outbreak in 2022, which was further aggravated by the widespread cultivation of unapproved and susceptible hybrids. These experiences convey an enduring lesson that choosing the right variety is the first and most decisive step toward ensuring a stable harvest and profitable returns.

Farmers should always select varieties that are well suited to the local agro-climatic conditions. Growing unapproved or un-recommended hybrids often results in poor yield. Another important precaution is to avoid monoculture. Planting the entire farm with a single cotton variety increases the risk of large-scale pest or disease outbreaks. Therefore, farmers are advised to cultivate a combination of recommended varieties or hybrids. To ensure better productivity and resilience, Punjab Agricultural University (PAU) recommends the following cotton varieties and hybrids for the current cropping season.

I. American Cotton

Bt cotton varieties developed by PAU

PAU Bt 3: It is a Bt cotton variety with inbuilt resistance against spotted and American bollworms. It produces an average seed cotton yield of 10.2 quintals per acre. The variety has an average fibre length of 26.2 mm and a ginning outturn of 36.5%. It is tolerant to jassid and Cotton Leaf Curl Disease, making it suitable for cultivation in Punjab.

PAU Bt 2: It possesses inbuilt resistance to spotted and American bollworms. It produces an average seed cotton yield of 10.0 quintals per acre, with a fibre length of 27.6 mm and ginning outturn of 34.4%. The crop matures in 160–165 days and shows tolerance to jassid and Cotton Leaf Curl Disease.

Bt cotton hybrids

Every year, Punjab Agricultural University evaluates Bt cotton hybrids developed or sponsored by private companies for their performance in terms of yield potential, pest resistance and disease tolerance. Based on these evaluations conducted by the Interstate Committee on Cotton in *kharif* 2025, the following hybrids were recommended for cultivation in Punjab during *Kharif* 2026 (Table 1).

Table 1: Bt Cotton Hybrids Recommended for Cultivation in Punjab (*Kharif* 2026)

S. No.	Hybrid Name	SCY (Kg/ha)	CLCuD (PDI %)	S. No.	Hybrid Name	SCY (Kg/ha)	CLCuD (PDI %)
1	MRC 7041	3222	10.31	30	NCS 9002	2702	17.66
2	VICH 310	3101	10.07	31	PCH 876 BGII	2670	12.3
3	ACH 33-2	3091	17.34	32	ACH 777-2 BGII	2670	5.64
4	VICH 309	3053	9.4	33	NCS 4455	2658	19.42
5	MRC 7301	3024	11.38	34	SUPER 965	2648	14.4
6	MRC 7365	2988	8.15	35	ACH 133-2	2640	15.15
7	KCH 172	2949	16.48	36	PRCH 333	2631	19.93
8	SUPER 721	2943	17.38	37	PCH 9602 BG II	2627	11.52
9	GBCH 85	2943	14.68	38	NCS 9024	2608	21.66
10	SUPER 544	2942	9.91	39	SHAKTI 9	2608	2.91
11	VICH 308	2921	8.62	40	SP 7114 BGII	2588	9.16
12	KDCH 441	2914	15.7	41	KDCHH 541 BGII	2566	10.31
13	ANKUR 3244	2902	5.55	42	ACH 177-2	2544	20.47
14	SUPER 971	2864	15.99	43	ANKUR JASSI	2540	9.94
15	RCH 773	2853	15.42	44	ANKUR 3224	2537	16.5
16	KSCH 207	2841	13.24	45	SOLAR 77	2521	19.38
17	RCH 650	2825	13.55	46	RCH 314	2485	6.29
18	PCH 5678 BGII	2823	14.32	47	846-2	2458	20.38
19	PRCH 7799 BGII	2809	7.4	48	SWCH 4735	2448	8.81
20	KCH 999	2784	16.68	49	PCH 9611	2440	23.71
21	ANKUR 3228	2772	16.2	50	PCH 877 BG II	2413	11.07
22	SWCH 4768	2744	6.85	51	RCH 653	2404	4.66
23	KDCH 641	2744	15.49	52	KSCH 211 BGII	2390	7.56
24	MRC 7361	2742	10.08	53	SWCH 4744	2338	6.58
25	ANKUR 5642	2735	15.82	54	NCS 950 BGII	2318	11.63
26	ANKUR 999 BGII	2735	5.0	55	PCH 878 BGII	2279	11.89
27	841-2	2730	15.65	56	SWCH 4755	2263	13.71
28	SWCH 4750	2729	8.61	57	PCH 225 BGII	2250	11.83
29	RCH 776	2729	15.69	58	ABCH 181 BGII	2245	12.63

In addition to above, the following Bt cotton hybrids notified by the Central Ministry of Agriculture and Farmers Welfare for the North Zone under AICRP on Cotton are also recommended for cultivation in Kharif 2026:

Raghuvir, ACH 945-2 BG II, ACH 955-2 BG II, RCH 938-2 BG II, RCH 951 BG II, RCH 846 BG II, RCH 926 BG II, MC 5403 BG II, MC 5408 BG II, MC 5410 BG II, KCH 307 BG II, C 9313 BG II, C 352 BG II, KCH 9323 BG II, KCH 9333 BG II, RCH 960 BG II, RCH 983 BG II, RCH 1136 BG II, RCH 1101 BG II, RCH 1139 BG II, RCH 997 BG II, RCH 1103 BG II, KCH 9355 BG II, ARCH 2020 BG II, ACH 999-2 BG II, ACH 559-2 BG II, ACH 902-2 BG II, C 9314 BG II, C 9403 BG II, SP 7674 BGII, KCH 9377 BG II, DC 5417 BG II and DC 5418 BG II.

Non-Bt cotton varieties

Non-Bt cotton varieties can perform well, particularly in light-textured soils, as they require lower inputs such as water and fertilizers compared to Bt hybrids. Therefore, farmers in water-deficient regions are advised to prefer non-Bt varieties. Another advantage is that these varieties show greater tolerance to whitefly, jassid and para-wilt.

Two non-Bt varieties recommended for Punjab:

F 2228: Produces an average seed cotton yield of 7.4 quintals per acre, with 34.4% ginning outturn and 29.0 mm fibre length.

LH 2108: Produces an average seed cotton yield of 8.4 quintals per acre with 34.8% ginning outturn and 27.9 mm fibre length. The variety matures in 165–175 days and has an average plant height of 145 cm.

II. *Desi* cotton varieties

With increasing demand for surgical cotton, absorbent cotton, upholstery materials and denim fabrics, the importance of short-staple and coarse cotton has increased in recent years.

***Desi* cotton varieties possess several advantages:**

High resistance to Cotton Leaf Curl Virus Disease
Better tolerance to whitefly infestation
Lower water requirement
Reduced input costs

Therefore, cultivation of desi cotton can be economically profitable under resource-limited conditions. Punjab Agricultural University has recommended the following desi cotton varieties:

PBD 88: It is a new high-yielding and shattering-tolerant desi cotton variety with an average seed cotton yield of 10.90 quintals per acre. It has short-staple coarse fibre, 2.5% span length of 20.6 mm and ginning outturn of 38.2%. The variety is resistant to jassid, whitefly, Fusarium wilt and bacterial blight.

LD 1019: It is a shattering-tolerant variety requiring only 2–3 pickings. It produces an average seed cotton yield of 8.6 quintals per acre and is tolerant to jassid, whitefly, Fusarium wilt and bacterial blight.

LD 949: This variety produces an average seed cotton yield of 9.9 quintals per acre with 40.1% ginning outturn. The variety is moderately resistant to Fusarium wilt and bacterial blight and tolerant to whitefly and jassid. Its short and coarse fibres are suitable for surgical cotton.

FDK 124: It is a short-staple coarse fibre variety with 2.5% span length of 21.0 mm and ginning outturn of 36.4%. It produces an average seed cotton yield of 9.28 quintals per acre and is resistant to jassid and whitefly.

Agronomic practices for higher cotton yield

Farmers should follow the following practices to achieve optimum cotton productivity:

Apply heavy pre-sowing irrigation (Rauni) using canal or good-quality water to ensure proper germination and seedling establishment.

Carry out deep ploughing for better root penetration and soil preparation.

Grow only recommended cotton varieties and hybrids.

Complete sowing by 15 May, as delayed sowing significantly reduces yield due to weak plant growth and increased pest incidence.

Provide first irrigation 4–6 weeks after sowing, depending on soil type.

Avoid growing bhindi, moong, arhar, castor and daincha near cotton fields, as they facilitate pest and disease build-up.

Apply four sprays of 2% potassium nitrate (13:0:45) starting from flowering initiation at weekly intervals.

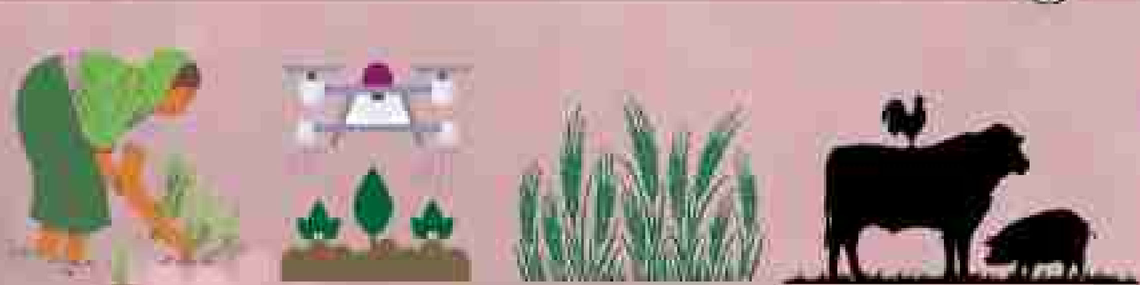
In desi cotton, apply the first spray against bollworms when about 25% plants start forming squares, and subsequent sprays based on pest incidence.

Use only recommended insecticides.

Avoid ready-made insecticide mixtures and tank mixing.

Do not store cotton sticks under shade or in the field; beat the sticks on the ground to dislodge pink bollworm larvae present in unopened bolls.

Ensure proper drainage in fields after heavy rainfall.



Conclusion

Cotton remains central to Punjab's economy, crop diversification and sustainable agriculture, especially in water-scarce regions. Recent seasons have clearly shown that the right variety is the foundation of a successful cotton crop. Recommended varieties, agronomic practices and vigilant pest management can significantly reduce risks and unlock the crop's full yield potential. With informed choices, Punjab's farmers have every reason and every means to restore cotton to its rightful place as a profitable crop of the state's farming system.

A field view of desi cotton variety PBD 88

A close-up view of desi cotton variety PBD 88

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