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## Ending the pink bollworm's winter refuge

*off-season vigilance holds promise for next season's cotton*

The pink bollworm (*Pectinophora gossypiella*) has emerged as one of the most persistent threats to cotton cultivation in Punjab. Being a pest that survives only on cotton, it overwinters inside immature or half-opened bolls that remain attached to sticks left in the field after harvest. These residues become the primary source of carryover populations for the next season. During the cold months, the larvae lie dormant within the bolls, waiting for warmer days to complete their development and re-emerge as moths, ready to infest the new crop. This makes the winter period a crucial opportunity to break its life cycle.

To prevent carryover, farmers should terminate the crop early to avoid late-season bolls that harbour larvae. After the final picking, cotton plants should be mechanically shredded, and animals like sheep and goats may be allowed to graze on the residues. Cotton sticks must not be stacked in fields or under shade; instead, they should be beaten on the ground to dislodge larvae and stored vertically, away from fields, to ensure destruction or use by mid-March. Covering stored sticks with a fine net can further prevent adult moths from escaping.

Ginning mills also play a vital role in curbing the pest's spread. All seed-cotton should be ginned by March, and waste destroyed immediately. Uncrushed seed must be fumigated or acid-delinted before sale, as even apparently healthy *kapas* may conceal larvae. Preventing the movement of infested seed-cotton and installing pheromone traps near ginneries are equally important. With collective vigilance today, Punjab's cotton fields can wake to a pest-free season ahead, when cotton blooms again in the next kharif

**Amandeep Kaur and Vijay Kumar**  
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Pink bollworm larva in a cotton flower



Pink bollworm larva in a cotton boll



Cotton sticks stacked in field

# Taming the tiny terrors in horticultural crops

## ecofriendly options for mite management

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*Mites are among the most significant arthropods in agriculture—some notorious ones inflict severe economic losses, while others serve as valuable allies in biological control. Plant-feeding mites are minute, typically measuring only 200–600 microns, yet capable of causing devastating damage when their populations surge. Most phytophagous mites belong to the suborder Prostigmata. Families such as Tetranychidae (spider mites), Tenuipalpidae (false spider mites), Eriophyidae (gall and bud mites), and Tuckerellidae are entirely plant-feeding, while certain species of Tarsonemidae (broad mites) also attack crops. Using their needle-like mouthparts (chelicerae), these mites pierce plant tissues and suck out sap, resulting in bronzed, curled leaves, weakened plants, and substantial yield losses if left unmanaged.*

### Why mite outbreaks are increasing?

In recent years, mite problems have become more severe due to multiple interacting factors:

*Indiscriminate use of broad-spectrum pesticides that eliminate beneficial predators and disrupt natural balance.*

*Adoption of high-yielding varieties and intensive cultivation practices that make plants physiologically more suitable for mite multiplication.*

*Excessive use of fertilizers, especially nitrogen, which enhances plant succulence & favours rapid mite build-up.*

Together, these practices have created ideal conditions for frequent and damaging mite outbreaks across horticultural systems.

### Mite pest monitoring and surveillance

Effective management of mite pests begins with a thorough understanding of their biodiversity, abundance, ecology, economic importance in each crop ecosystem and their precise identification. Regular monitoring and early detection are the foundation of Integrated Mite Management (IMM), as visible damage often appears only after significant feeding has occurred. Farmers should periodically inspect the undersides of leaves using a hand lens to detect early infestations. Based on the observed intensity of mite populations, appropriate bio-rational or chemical control measures can then be applied judiciously.

### Eco-friendly management strategies

#### Cultural control

Cultural practices play a key preventive role in keeping mite populations below damaging levels:

*Keep fields weed-free and ensure timely irrigations during April–June to prevent drought-like stress that favours mites.*

*Remove castor and wild cannabis plants near fields, as they serve as alternate hosts.*

*Discourage the use of pyrethroids on mite-susceptible crops.*

*Apply prophylactic acaricide sprays in known endemic areas.*

*Avoid ratoon crops or offseason brinjal and sugarcane plants that allow mites to survive between main seasons.*

#### Use of botanicals

Botanical extracts are ecofriendly, economical, and safe alternatives for mite management.

**Capsicum (under protected cultivation):** Spray dried neem fruit powder extract @ 5 kg per acre in 100 litres of water.

**Okra:** Spray PAU homemade Dharek extract @ 1600 ml in 100 litres of water per acre.

**Cucumber:** Spray PAU homemade neem extract @ 1400 ml/acre in 100 litres of water or dried neem fruit powder extract @ 5 kg/acre.

Repeat the botanical spray after 7 days of the first application if the mite infestation persists.

#### Preparation of dried neem fruit powder extract:

Collect fresh neem fruits, dry them in the shade, and grind them to a coarse powder. Mix 5 kg of this powder in 100 litres of water and let it stand for 12 hours. Filter through muslin cloth and spray as such.

#### Preparation of PAU homemade neem/dharek extract:

Take 4 kg of green branches, leaves and fruits of the





neem or dharek tree and boil in 10 litres of water for 30 minutes. Filter through muslin cloth and spray at the recommended dose.

#### Use of oils

Vegetable oils can effectively suppress mite and other soft-bodied pest populations.

Spray 10 litres of soybean oil or cottonseed oil + 1.25 kg detergent powder (as surfactant) in 500 litres of water per acre to manage psylla, aphids, thrips & mites on citrus.

#### Important precautions

Ensure there is no water stress in the orchard at the time of spraying.

Avoid sprays during flowering.

During hot months (May–June), spray only in late evening hours to prevent phytotoxicity.

Avoid excessive doses, as high concentrations of oil can damage plant tissues.

#### Chemical control

Chemical acaricides should be used as the last resort only when necessary, and as part of an integrated approach.

**Capsicum (protected conditions):** Foliar spray of *Omite 57 EC* (Propargite) @ 200 ml/acre or *Oberon 22.9 SC* (Spiromesifen) @ 100 ml/acre.

Waiting period: 7 days after spray.

**Okra:** Foliar spray of *Oberon 22.9 SC* (Spiromesifen) @

150 ml/acre.

Waiting period: 1 day after spray.

**Brinjal:** Foliar spray of *Omite 57 EC* (Propargite) @ 300 ml/acre.

Waiting period: 1 day after spray.

#### Farmer tips

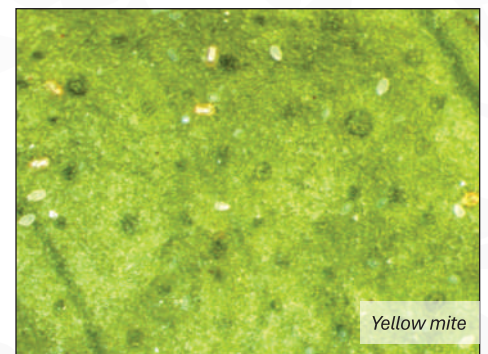
*Prefer selective acaricides over broad-spectrum pesticides to conserve beneficial mite predators and pollinators.*

*Adopt need-based sprays and act at early infestation levels to achieve better control and prevent population explosions.*

*Combine cultural, botanical, and minimal chemical interventions for sustainable, ecofriendly mite management.*

#### Conclusion

Mite management in horticultural crops demands vigilance, precision, and a shift towards ecofriendly practices. By combining regular monitoring, sound cultural measures, and judicious use of botanicals and oils, farmers can keep mite populations under check without disturbing the natural ecosystem. Chemical acaricides, when used need-based and responsibly, can complement these approaches in times of severe outbreaks. Therefore, adopting integrated and ecofriendly strategies is the sole key to sustainable management of these tiny pests.



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# Winning the battle against gulli danda

## integrated approach for better yields

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*Gulli danda (Phalaris minor) is one of the most troublesome weeds infesting wheat fields across Punjab. Emerging in successive flushes during the crop season, it competes fiercely with wheat for moisture, sunlight, and nutrients—causing sharp yield declines and heavy economic losses. Weeds emerging alongside the crop inflict the greatest damage, while late-emerging flushes cause relatively less harm. Years of excessive and often indiscriminate herbicide use have enabled Phalaris minor to develop resistance, making sole dependence on chemicals both risky and ineffective. This growing challenge calls for a smarter, more sustainable solution—an integrated weed management strategy that blends cultural, mechanical, and chemical measures. Such a harmonious approach strengthens the crop, suppresses the weed, and preserves the long-term health and productivity of both soil and wheat.*

### Cultural and mechanical methods

#### Optimum sowing time

*Gulli danda* germinates best at temperatures between 15–20°C. In fields with a known history of infestation, sowing wheat early — from the last week of October to the first week of November — helps the crop escape the first flush of *gulli danda*, as temperatures during this period are not conducive for its germination.

#### Zero-till sown wheat

Sowing wheat under zero or minimum tillage conditions greatly reduces *gulli danda* infestation because soil disturbance is minimal and buried weed seeds are not brought to the surface. In fields where weeds have already emerged in paddy stubbles, apply 500 mL Gramoxone 24 SL (paraquat) in 200 litres of water before sowing to eliminate existing vegetation.

#### Paddy straw mulch

Wheat can be sown directly in rice residue using the Happy Seeder, Smart Seeder or Surface seeding-cum-mulching techniques. The uniform mulch layer suppresses weed germination by limiting light and moderating soil temperature, thus reducing *gulli danda* emergence significantly.

#### Soil/dust mulch at sowing

Since *gulli danda* seeds germinate best from the surface soil layer, allowing the topsoil to dry before seedbed preparation helps suppress its germination. This practice effectively reduces the first flush of weeds, allowing the wheat crop to establish ahead of potential competition.

#### Raised bed sowing

Wheat sown on raised beds experiences lower weed pressure compared to conventional flat sowing. The upper surface of the raised bed dries faster, creating an unfavourable environment for *gulli danda* germination.

### Chemical control

#### Pre-emergence herbicides

Pre-emergence herbicides prevent weed seed germination and provide early-season weed-free conditions (Table 1). Spray immediately after sowing, preferably within two days, in a well-prepared, moist field free from clods. Using a Lucky Seed Drill developed by PAU, enables simultaneous sowing and herbicide spraying, ensuring uniform and timely application.

**Table 1. Pre-emergence herbicides for control of gulli danda and other weeds**

| Herbicide mode of action group | Name of herbicide                             | Dose/acre | Water volume (L/acre) | Weeds controlled             |
|--------------------------------|-----------------------------------------------|-----------|-----------------------|------------------------------|
| I                              | Stomp/Bunker/Dost/Penda 30 EC (pendimethalin) | 1.5 L     | 200                   | Gulli danda                  |
| II                             | Awkira/Momiji 85 WG (pyroxasulfone)           | 60 g      | 200                   | Gulli danda                  |
| III                            | Platform 385 SE (pendimethalin + metribuzin)  | 1.0 L     | 200                   | Gulli danda, broadleaf weeds |
| III                            | Daksh Plus 48 EC (pendimethalin + metribuzin) | 900 mL    | 200                   | Gulli danda, broadleaf weeds |

**Precautions:** 1. If sown with Happy Seeder, mix with basal urea and broadcast before sowing. 2. Do not use Platform 385 SE or Daksh Plus 48 EC in fields sown with raya, sarson, or gobhi sarson.

#### Post-emergence herbicides

Apply post-emergence herbicides after the first irrigation, when *gulli danda* plants are at the 2–4 leaf stage (Table 2). This timing ensures maximum susceptibility of the weed and effective control.

#### Guidelines for effective herbicide use

**Select herbicides wisely:** Choose the product based on the existing weed flora and the herbicide-use history of the field. Rotate herbicides belonging to different





**Table 2. Post-emergence (30–35 days after sowing) herbicides for control of gulli danda and other weeds**

| Herbicide mode of action group | Name of herbicide                                   | Dose/acre | Water volume (L/acre) | Weeds controlled                                 |
|--------------------------------|-----------------------------------------------------|-----------|-----------------------|--------------------------------------------------|
| IV                             | Topik/Point/Rakshak Plus 15 WP (clodinafop)         | 160 g     | 150                   | Gulli danda, jangli javi                         |
| IV                             | Axial 5 EC (pinoxaden)                              | 400 mL    | 150                   | Gulli danda, jangli javi                         |
| V                              | Leader/Marksulfo 75 WG (sulfosulfuron)              | 13 g      | 150                   | Gulli danda, jangli javi                         |
| V                              | Total/Markpower 75 WG (sulfosulfuron + metsulfuron) | 16 g      | 150                   | Gulli danda, jangli javi, broadleaf weeds        |
| V                              | Atlantis 3.6 WDG (mesosulfuron + iodosulfuron)      | 160 g     | 150                   | Gulli danda, broadleaf weeds                     |
| VI                             | Shagun 21-11 (clodinafop + metribuzin)              | 200 g     | 150                   | Gulli danda, jangli javi, bhuin, broadleaf weeds |
| VI                             | ACM-9/EMEKE (clodinafop + metribuzin)               | 240 g     | 150                   | Gulli danda, jangli javi, bhuin, broadleaf weeds |

**Precautions:** 1. Use only on wheat sown with raya/sarson/gobhi sarson. 2. Avoid Leader/ Markpower before maize/jowar. 3. Avoid Shagun 21-11 and ACM-9/EMEKE on light soils and wheat varieties PBW RS 1, Unnat PBW 550.

*mode of action groups* (refer to Tables 1 & 2) to delay the development of resistance.

**Use recommended dose only:** Under-dosing results in poor weed control, while overdosing may harm the wheat crop.

**Avoid tank mixtures:** Mixing herbicides without scientific basis can lead to crop injury or reduced efficacy.

**Ensure optimum field moisture:** Herbicides perform best in a *wattar* field with adequate moisture. Avoid applying pre-emergence herbicides when the surface

soil is dry or waterlogged.

**Use proper spraying equipment:** Employ hand, battery, or power-operated sprayers fitted with *flood-jet (tak-wali)* or *flat-fan (cut-wali)* nozzles for uniform coverage. Avoid *gun-type* or *cone* nozzles.

**Opt for light irrigation:** Light irrigation enhances herbicide performance, while heavy irrigation may cause phytotoxicity.

### Preventing replenishment of weed seed banks in the soil

Despite best efforts, some *gulli danda* plants may escape control or germinate later in the season. Even if these do not affect yield significantly, they can add thousands of seeds to the soil, aggravating future infestations. Hence, remove or clip seed heads of surviving plants before maturity to prevent seed deposition in the soil.

### Conclusion

The menace of *gulli danda* in wheat is real but manageable. Sustainable control lies not in reliance on herbicides alone, but through an integrated management approach that combines cultural, mechanical, and chemical practices in harmony. By optimizing sowing time, adopting residue-based sowing techniques, rotating herbicides judiciously, and preventing the replenishment of weed seed banks in the soil, farmers can successfully suppress *gulli danda* infestations while preserving soil health and sustaining wheat productivity.



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# The science & strategy behind profitable poplar farming

## the green gold of Punjab

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*Few trees in Punjab's farmlands promise returns as steady and swift as poplar (*Populus deltoides*). Well-known for its rapid growth and short rotation cycle, poplar stands among the most profitable agroforestry species in the state. Beyond its ecological advantages and role in crop diversification, it provides farmers with a dependable and renewable source of income. With proper scientific management, a well-maintained poplar plantation can yield an impressive net profit of ₹90,000–₹1,25,000 per acre annually. Beyond economic gains, poplar plantations also contribute to environmental well-being by capturing atmospheric carbon and storing it in their biomass and soil, an important step toward carbon sequestration and climate change mitigation. When integrated with compatible intercrops, this profitability can rise even further. To help farmers harness this potential, here are tried-and-tested management practices designed and recommended for the Rabi season.*

### Intercropping for year-round income

Intercropping is a key element of poplar-based farming systems, ensuring regular cash flow even as the trees mature. Choosing crops that thrive under partial shade and use soil nutrients efficiently is essential. Adopt the recommended intercropping practices, varieties, and management tips for the *Rabi* season (Table 1).

Additionally, farmers can consider fodder crops like berseem and oats, annuals such as turmeric (PH-1, PH-2) and sugarcane, or flowers like sweet william and marigold to diversify income streams.

### Optimal irrigation management

Water management plays a decisive role in both poplar and intercrop performance. Follow this irrigation schedule for best results:

**October to February:** Irrigate poplar every 15 days.

**March to April:** Increase irrigation frequency to every 7–10 days during critical growth periods.

Many farmers, however, skip irrigation during March–April, when wheat — the usual intercrop — is ripening or being harvested. This 20–25-day irrigation gap often causes moisture stress, leading to drying or poor growth of poplar trees.

### Farmer tips

Avoid irrigation gaps during wheat ripening and harvest. Instead, plan a system that allows watering poplar without disturbing intercrops.

*When establishing a new plantation, prepare irrigation channels 8 meters (26 feet) apart in a north–south direction before sowing wheat. Plant poplar entire transplants (ETPs) within the channels at 2.5 meters (8 feet) spacing during January–February, while wheat is sown between the channels. This layout accommodates*

**Table 1. Recommended crops for intercropping under poplar**

| Crop             | Varieties                                            | Key recommendations                                                                                                               |
|------------------|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Wheat            | PBW-725, PBW-677                                     | Preferably sow in early November before leaf-fall; increase seed rate and nitrogen dose by 25% over the sole wheat recommendation |
| Mustard          | Raya Sarson (PBR-357, PHR-126), Gobhi Sarson (GSC-7) | Apply 25% extra nitrogen than the standard recommendation for optimal yields                                                      |
| Potato           | Kufri Pukhraj                                        | Complete planting before mid-November for high tuber yield                                                                        |
| Onion            | PRO-7                                                | Transplant seedlings in mid-December under poplar shade                                                                           |
| Other Vegetables | Peas (Punjab 89), Spinach, Radish, Cabbage           | These crops remain fresh for a longer period under partial shade conditions                                                       |

*about 200 trees per acre, ensuring ample space and an independent irrigation mechanism for both crops.*

*In existing plantations, convert tree rows into irrigation channels by building earthen bunds on both sides for smooth water flow and effective utilization.*

### Pruning for superior timber quality

Timely pruning enhances the quality and market value of poplar timber by encouraging straight, knot-free boles. Pruning should be carried out scientifically during the dormant phase (December–January), once the trees have shed most of their leaves (Table 2).

**Table 2. Recommended pruning schedule in poplar**

| Tree Age         | Pruning practice                                                                           |
|------------------|--------------------------------------------------------------------------------------------|
| 1st Year         | Gently rub buds with a gunny bag on lower one-third of the tree to remove unwanted shoots. |
| 2nd - 3rd Year   | Prune the lower one-third portion of the tree.                                             |
| 4th - 5th Year   | Prune the lower half of the tree.                                                          |
| 5th Year onwards | Prune the lower two-thirds portion to produce clear, knot-free timber.                     |





**Farmer tip:** Always make clean cuts close to the trunk and immediately apply Bordeaux paste (2 kg copper sulphate + 3 kg lime in 25 litres of water) on cut surfaces to prevent fungal infection and promote healing.

### Conclusion

A scientific approach including recommended intercrops, smart irrigation, and disciplined pruning transforms poplar agroforestry into a pillar of sustainable and profitable farming in Punjab. By

integrating short-duration crops during the *Rabi* season, farmers can ensure steady income streams while enriching crop diversity and strengthening livelihood resilience. With these scientific practices and effective management strategies, poplar has the potential to turn farmlands into thriving, climate-smart enterprises, enabling Punjab's farmers to cultivate prosperity in harmony with nature.



*Intercropping of sugarcane in poplar*



*Mature potato crop in poplar plantation*



*Intercropping of gobhi sarson in poplar*



*Intercropping of wheat in poplar*

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# Growing wheat the organic way

improved practices for sustainable harvests

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*The rising tide of health awareness across India has opened new horizons for organic farming, and Punjab is embracing this change with enthusiasm. As families increasingly seek safe, pesticide-free, and nutrient-rich food, organic wheat is reviving and redefining Punjab's proud legacy of wheat cultivation. It blends tradition with innovation—offering premium prices, steady demand, and a farming system that safeguards both the land and the livelihood of farmers. Organic farming is far more than the absence of chemicals. It is a holistic approach that nurtures soil health, maintains ecological balance, and ensures lasting productivity for generations. Encouraged by the growing market and the promise of sustainability, many farmers across Punjab are turning toward organic wheat cultivation by following the package of practices recommended by PAU.*

## Field selection

A good start begins with a good field. Select fertile, well-managed land with healthy soil for organic farming. Ideally, the field should be protected by natural barriers such as roads, canals, or water channels to prevent contamination from adjoining conventional farms. In their absence, establish artificial buffer zones. Avoid starting organic farming on leased land, as certification requires a minimum transition period of three years. Choosing a field with potential for future expansion ensures long-term sustainability and easier management.

## Cropping system

Crop rotation lies at the heart of organic farming. To enhance soil fertility and yield, adopt a pulses-based rotation such as *kharif moong–wheat–summer moong*. Pulses enrich the soil with nitrogen through biological fixation and improve soil structure, ensuring better growth and productivity of the succeeding wheat crop.

## Varieties

Many farmers mistakenly believe that organic wheat must be of traditional *desi* types. In fact, any improved wheat variety recommended by PAU—such as *PBW 872*, *PBW 826*, *PBW 766*, and *Unnat PBW 550*—can be successfully cultivated under organic conditions.

For special end uses and niche markets, growers may prefer trait-specific varieties like:

*PBW Biscuit 1* – ideal for cookies and biscuits

*PBW 1 Chapati* – for soft, flavourful chapatis

*PBW RS 1* – suitable for diabetic consumers

## Seed rate and sowing time

Use 40 kg of clean, graded seed per acre. For *Unnat*

*PBW 550* and *PBW 869*, increase the rate slightly to 45 kg/acre. In areas prone to termite or bird damage, a marginally higher seed rate ensures adequate plant population. The sowing window for organic wheat is the same as that for conventional wheat.

## Sowing method

Any recommended method can be followed. However, bed planting gives better results under organic conditions as it improves drainage and aids in weed management. Sow two rows on a 37.5 cm wide bed with 30 cm furrows in between to conserve moisture and facilitate intercultural operations.

## Seed inoculation

Biofertilizer treatment is essential for a healthy start. Treat seed for one acre with 500 g consortium biofertilizer or 250 g each of *Azotobacter* and *Streptomyces* (Azo-S) using one litre of water on a *pucca* floor. Dry the seed in shade before sowing. This encourages early root development and improves nutrient availability.

## Organic manuring

Healthy soil is the cornerstone of organic wheat success. Apply well-decomposed farmyard manure (FYM) at the following rates:

8 tons/acre in high organic matter soils

12 tons/acre in medium fertility soils

16 tons/acre in low fertility soils

## Alternatively, may use:

1.7 tons/acre of dry decomposed FYM (1% N), or

1.1 tons/acre of vermicompost (1.5% N), or

0.7 tons/acre of castor cake (2.5% N)

For *desi* varieties, apply half these rates. Incorporate





residues of previous crops like maize or soybean. During the first five years of organic farming, apply 8 tons/acre FYM, then gradually reduce by 25%. In the *kharif moong–wheat–summer moong* system, 5 tons/acre of well-rotted FYM at sowing is sufficient. Always ensure that organic manures are free from chemical or heavy metal contamination, and adjust quantities based on nitrogen content.

### Weed management

Weeds are a major challenge in organic systems, but effective management ensures good control without chemicals. Adopt recommended practices such as:

*Dry soil surface mulch or stale seedbed preparation*

*Manual weeding before the first irrigation*

*Removing weeds before seed setting*

To reduce *Gulli danda* infestation, rotate wheat with berseem, raya, potato, gobhi sarson, or winter maize, and prefer early sowing (late October to early November).

In bed-planted wheat, carry out two mechanical weedings at 30 and 45 days using a modified bed planter with an additional tyne. Alternatively, 2–3 hand hoeings may be done. Timely removal of weeds help to reduce future infestations.

### Disease management

Under organic conditions, yellow rust can be managed effectively through natural formulations. Apply four sprays of 20% fermented buttermilk solution (40 litres

of fermented buttermilk in 200 litres of water per acre). Begin the first spray one month after sowing, followed by three sprays at 10-day intervals. Use moderately resistant varieties such as *PBW 826* and *PBW 766* for better protection.

### Marketing and certification

Currently, there is no fully organized market for organic wheat in Punjab. Farmers are encouraged to begin on a small scale for household consumption, develop direct marketing links in nearby towns and cities, and expand gradually. Obtaining organic certification from a recognized agency builds consumer confidence and fetches premium prices. Details of certification agencies are available on the APEDA website ([www.apeda.gov.in](http://www.apeda.gov.in)). Farmers may also seek assistance from the Punjab Agri Export Corporation Limited (PAGREXCO), Chandigarh.

### Conclusion

Organic wheat cultivation is not only an environmentally responsible choice but also a step toward healthy living. By adopting the recommended agronomic practices—balanced manuring, crop rotation, timely sowing, and biological pest management, farmers can produce high-quality wheat that earns a premium in the market. With growing consumer awareness and institutional support, organic wheat farming holds a promising future for Punjab's farmers and the health of its soils alike.



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# Rodent threat in residue-retained wheat

## integrated strategies for collective action

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*The push for sustainable intensification of the rice–wheat system in northwestern India has driven widespread adoption of rice-residue conservation. To curb residue burning and improve efficiency, farmers now use technologies like the Zero Till Seed Drill, Super Seeder, Happy Seeder, Smart Seeder, and surface mulching technologies that retain or incorporate rice straw during wheat sowing, reducing tillage and eliminating burning. Residue retention improves soil moisture, temperature regulation, organic carbon, microbial activity, and weed suppression, making it a key pillar of climate-smart agriculture. However, these benefits come with a new challenge—rodents. Mulched fields and undisturbed soils create ideal shelters, allowing rodents to breed and survive year-round. Thus, a clear understanding of rodent ecology and the timely use of scientifically guided management practices are vital to protect wheat productivity in residue-retained systems.*

### Integrated rodent management practices

Effective rodent control requires a combination of preventive, mechanical, biological, and chemical measures applied in a coordinated manner at different crop stages. The key recommended practices in wheat are outlined below:

#### Cultural control

Rodents often build burrows along wide and elevated bunds. To discourage this, reshape bunds to make them narrow and low, minimizing suitable burrowing sites. Regular removal of weeds and grasses from bunds and fields, either manually or through judicious herbicide use, helps reduce food and cover. Waste areas such as roadsides, canal banks, railway tracks, forest strips, and uncultivated fields often act as reservoir habitats for rodents. Therefore, control measures must extend to these adjoining areas for effective management.

#### Mechanical control

Flood irrigation can help by drowning and flushing out rodents from their burrows. Emerging animals can then be destroyed manually. Trapping is another effective method for small or localized infestations. In crop fields, use 40 traps per hectare, placing them along runways, active burrows, and damaged spots. Captured rodents should be humanely destroyed by submerging the traps in water and then burying the carcasses safely.

#### Biological control

Encouraging and protecting natural predators—such as owls, kites, hawks, eagles, snakes, mongooses, cats, and monitor lizards—greatly aids in long-term rodent suppression. Preserving these natural allies forms an

eco-friendly component of rodent management.

#### Chemical control

Poison baiting remains the most widely practiced and effective method of rodent control. The choice of bait material and timing of application are crucial for success.

#### Preparation of rodenticide baits

**2% Zinc phosphide bait:** Mix 1 kg broken wheat grains with 20 ml edible oil, 20 g powdered sugar, and 25 g zinc phosphide. Prepare fresh bait as needed.

**Mode of action:** On ingestion, it releases phosphine gas in the stomach, killing rats within 2–3 hours. However, sub-lethally poisoned rats develop bait shyness; therefore, do not repeat zinc phosphide baiting within two months.

**0.005% Bromadiolone bait:** Mix 1 kg broken wheat grains with 20 ml edible oil, 20 g powdered sugar, and 20 g bromadiolone powder thoroughly.

**Mode of action:** This anticoagulant prevents blood clotting by depleting vitamin K, leading to death after 2–3 days. Since the toxic effect is delayed, rodents consume sufficient bait for a complete kill and do not develop aversion. Importantly, vitamin K acts as an antidote in case of accidental human or livestock ingestion.

#### Bait application methods

**Burrow baiting:** Conduct baiting twice at an interval of 10–15 days after wheat sowing (November – December), preferably one week before or after irrigation. In the evening, close all burrows; next morning, identify reopened burrows and insert about





10 g of poison bait wrapped in paper about 6 inches deep, then seal with loose soil. For *Bandicota bengalensis* burrows, gently remove fresh soil to locate tunnels and place bait deep inside.

**Crop baiting:** Rodent damage often increases during the reproductive stage of wheat (February–March). To control this, apply 1 kg bait per hectare before the *milky grain stage* by placing 10 g bait at 100 points per hectare along bunds and active rodent runways. After 2–3 days, collect and safely dispose of uneaten bait and dead rodents to avoid secondary poisoning of non-target animals.

#### Community-based approach

No single method ensures complete control. Rodent populations can rebound quickly after partial elimination. Hence, an integrated rodent management strategy—combining cultural, mechanical, biological, and chemical measures at different crop stages—offers the most effective and sustainable results. Moreover,

control efforts in isolated fields are often neutralized by migration from nearby untreated areas. Therefore, village-level anti-rat campaigns, involving collective participation of farmers to treat both cultivated and uncultivated lands simultaneously, are strongly recommended for lasting success.

#### Conclusion

Rodent infestation poses a growing challenge in residue-retained wheat systems, threatening the sustainability of the rice–wheat cropping pattern. Through timely, integrated, and community-based rodent management, farmers can safeguard wheat establishment, ensure better yields, and sustain the ecological and economic benefits of conservation agriculture. Empowered with awareness and collective action, our villages can move towards a rodent-resilient and residue-responsible future.



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# Preparing honey bee colonies for winter

## guidelines for effective hive management

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*Winter in Punjab, stretching from December to mid-February, brings short days, cold winds, and heavy fog that often pushes night temperatures below 5°C. During this time, honey bees get very few chances to forage and spend most of their time clustered inside their hives, depending on stored honey to survive the cold. Without careful management, colonies face the twin threats of starvation and cold stress, which can weaken them or even lead to their collapse. Effective winter care is therefore essential, not only to keep colonies strong but also to ensure healthy brood rearing and a vigorous start when spring arrives.*

### **Colonies' inspection**

Before winter sets in, carefully inspect each colony to assess its condition. Strong colonies with young, prolific queens and adequate worker strength stand the best chance of thriving through the season. Conduct quick inspections at noon on calm, sunny days, avoiding early mornings and late evenings when low temperatures can chill the brood. During inspection, beekeepers should evaluate the queen's performance, colony strength and the reserves of honey and pollen. Colonies with poor bee strength should be provided sealed brood combs (without adult bees) from stronger colonies. Alternatively, the weak colonies can be united using the newspaper method. If food stores seem low, it is better to support the colony early by adding one or two sealed honey combs from hives that have excess stores.

### **Move colonies to warm and sunny spots**

Colonies placed in shaded or damp areas suffer more during the winter. Shifting them to a warm, sunny spot helps bees to maintain hive temperature and remain active for longer hours. Follow the beekeepers' golden rule of "three feet or three kilometres." If the sunny site lies closer within the same apiary, shift colonies gradually, about three feet each day, until they reach the desired location. If a suitable site is far away, move the hives at least three kilometres to prevent bees from returning to the old site. Always shift colonies in the evening, after the foragers have returned. Turn the hive entrances towards the southeast direction so that the bees receive gentle morning sunlight to warm up quickly.

### **Protecting hives from cold winds**

In Punjab, cold winds usually blow from west to east. Placing hives near walls, thick hedges or bushes offers

natural protection against these chilly winds. Seal any cracks or gaps in the hive boxes with mud. Narrow the entrance of weak colonies with mud or cardboard strips so bees can easily maintain internal warmth. Keep hives dry to prevent dampness, as moisture inside the hive can be as harmful as cold. Establishing permanent windbreaks, such as live hedges or bamboo screens on the windward side of the apiary, also helps reduce heat loss.

### **Uniting weak or queenless colonies**

Weak or queenless colonies seldom survive harsh winter conditions. Such colonies should be united with strong, queen-right ones using the newspaper method. Place a perforated newspaper sheet over the frames of the stronger colony, remove the bottom board of the weaker one, and set it on top of the perforated newspaper. Over the next few days, the scents of both colonies blend as the bees gradually chew away the paper and unite peacefully. Remove any remaining paper after three days. This simple and effective method helps to create stronger colonies that can better withstand cold stress.

### **Providing inner and outer packing**

During winter, bees maintain warmth by forming a cluster, but additional insulation reduces energy loss and conserves food. Colonies with around ten frames generally do not need inner packing, but those with six or seven frames benefit from it. Push all combs to one side of the hive, place a dummy board after the last comb, and fill the empty space with dry paddy or wheat straw or with wooden frass wrapped in newspaper. In very weak colonies, move all combs to the centre and insulate from both sides. For outer packing, place a two-inch layer of paddy straw between the hive bottom and stand, trimming any straw that touches the ground to





avoid moisture and pests. Wrap the hive loosely with a plastic or tarpaulin sheet, keeping the entrance open for ventilation. Before insulation, ensure each colony has at least 4–5 kg of food. Since night temperatures often drop 10–15°C lower than daytime readings, proper timely insulation is the key to keeping colonies safe during the coldest hours.

### Feeding bees during winter

During winter, bees usually visit rapeseed and mustard blooms for nectar and pollen. However, continuous fog or rain may confine them for several days, making stored food essential for survival. If food reserves within colonies are low, provide supplemental feeding. The best option is to transfer one or two sealed honey combs from colonies with surplus honey. Alternatively, feed sugar syrup in a 2:1 sugar-to-water ratio by filling it into empty combs or placing it in a division-board feeder between the combs. Avoid open feeding, as it can trigger robbing and create unnecessary disturbance

in the apiary.

### Store empty combs safely

After honey extraction in November, several combs may remain empty. These unused combs make it difficult for bees to maintain warmth. Remove such combs before providing winter packing. Stack and fumigate them properly to prevent attack by wax moths or other pests, and store them in a dry, cool place for reuse in spring.

### Conclusion

Winter might seem like a resting period for honey bees, but it is actually a crucial time that influences their success in the upcoming spring. Beekeepers can reduce winter losses by conducting timely inspections, ensuring proper insulation, uniting weak colonies, and providing adequate feeding. Through these simple and scientific management practices, beekeepers can safeguard their colonies through frosty winters and build up quickly with buzzing vitality once spring arrives.



A strong bee colony with supers



Worker bees feeding on stored honey



A training on winter management of bee colonies at KVK Moga



Demonstrating newspaper method for uniting bee colonies



Inner winter packing in the bee hive



Inner winter packing on two sides of combs



Filling of sugar syrup in empty combs



Workers bees on a comb in a strong bee colony



A young prolific queen bee surrounded by workers bees

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# PL 891: Punjab's pride in functional grains

## redefining barley as a health grain

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*Barley is one of the oldest cultivated cereals, valued globally for its multiple uses—as animal feed, malt for brewing, and an increasingly popular ingredient for human nutrition. While about 70 % of global barley is used for feed and 20–25 % for malting, the growing awareness about dietary fibre and functional foods has renewed interest in barley's nutritional potential. Among cereals, barley stands out for its rich composition of  $\beta$ -glucans, starch, amylose, and proteins, which play an important role in maintaining overall well-being. These naturally occurring components support better digestion, balanced metabolism, and a wholesome diet, making barley an excellent choice for those seeking nutritious and fibre-rich food options.*

The Punjab Agricultural University (PAU) has developed the state's first hulless food barley variety, PL 891, marking a milestone in functional grain breeding. Barley is broadly categorized into hulled and hulless types, depending on the presence or absence of an adhering hull. Hulless barley offers a distinct advantage—it requires negligible processing, thereby preserving the nutrient-rich endosperm and germ that are often lost during dehulling. This makes it highly suitable for direct human consumption as whole grain, flour, flakes, or *sattu* (energy drink).

### PL 891 - Salient features

**Type:** Two-rowed hulless food barley

**Maturity:** 114 days

**Plant height:** ~102 cm (medium tall)

**$\beta$ -glucan content:** 4 %

**Protein content:** 12 %

**Average yield:** 16.8 quintals per acre

**Disease resistance:** Resistant to major pathotypes of yellow rust, brown rust, and leaf blight

### Nutritional strengths

With its 4%  $\beta$ -glucan and high protein content, PL 891 offers steady energy release, supports digestive wellness, and keeps one fuller for longer.

### Agronomic practices

**Preparatory tillage:** Carry out 2–3 ploughings followed by planking to prepare a fine seedbed.

**Time of sowing:** Preferably sow by mid-November. Delayed sowing up to the end of December will gradually affect the yield.

**Seed rate:** Use 50 kg seed per acre.

**Method of sowing:** In rainfed areas, sow by kera if adequate moisture is available, or by pora if surface moisture is low. Run sohaga after kera sowing only. Sowing can also be done with a seed-cum-fertilizer drill or zero-till drill after rice. Maintain 22.5 cm spacing for

normal sowing and 18–20 cm for late sowing.

**Fertilizer application:** Apply fertilizers on a soil test basis, as always recommended. In the absence of soil test report, apply the following per acre on medium fertility soils:

**Nitrogen (N):** 25 kg ( $\approx$ 55 kg urea)

**Phosphorus ( $P_2O_5$ ):** 12 kg ( $\approx$ 27 kg DAP or 75 kg superphosphate)

**Potassium ( $K_2O$ ):** 6 kg ( $\approx$ 10 kg muriate of potash) only in soils testing low in K.

Drill all fertilizers at sowing. If urea is used, apply it before pre-sowing (rauni) irrigation.

**Weed control:** Carry out one hoeing with an improved wheel hand hoe after the first irrigation.

**Irrigation:** In south-western dry districts, two post-sowing irrigations are required; elsewhere, one irrigation 5–6 weeks after sowing is usually sufficient.

**Harvesting:** Harvest the crop immediately after maturity to prevent lodging and grain shattering.

### Conclusion

Hulless barley with its superior nutritional profile, easy processing, and multiple end uses, holds immense promise for both consumers and the food industry. Continued breeding efforts at PAU aim to enhance  $\beta$ -glucan content and expand the role of barley in everyday diets in form of chapattis, breads, cookies, *dalia* and health drinks. As awareness grows, hulless barley may well become Punjab's next health grain.



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# Field pea variety IPFD 12-2

balanced nutrition, higher yields

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*Field pea (*Pisum sativum* L.) is an important rabi legume crop valued for its versatility as food, feed, and fodder. Rich in protein, complex carbohydrates, vital minerals, and essential amino acids, field pea delivers complete and balanced nutrition for both humans and livestock. Its symbiotic partnership with *Rhizobium* bacteria naturally enriches the soil with nitrogen, enhancing fertility and promoting sustainable farming. Varieties in vibrant colours—yellow, orange, or green—find their way into dals, soups, snacks, flours, and high-quality animal feeds. Abundant in dietary fibre and easily digestible protein, field pea also contains “rumen-friendly” starch that supports better animal health and productivity. With the adoption of recommended cultivation practices, field pea promises robust yields, improved soil health and lasting benefits for every farming household.*

## Improved variety

Punjab Agricultural University recommends IPFD 12-2, a high-yielding and nutritionally superior field pea variety, for cultivation in Punjab. It is a medium-duration variety, maturing in about 124 days. Plants are of the tendril type with a height of about 80 cm, bearing long pods with medium-sized grains. The variety has an average 100-grain weight of 15.6 g and contains 24.5% protein. It offers an average yield of 6.8 quintals per acre and is noted for its excellent cooking quality, nutritional value, and attractive grain appearance.

## Soil and climate

Field pea performs well in well-drained sandy loam to clay loam soils. A pre-sowing irrigation is beneficial for good germination. Being a cool-season crop, the optimum temperature range for its growth is 13–18°C.

## Land preparation

Prepare a fine seedbed by giving two to three ploughings followed by plankings to ensure good tilth for uniform germination.

## Sowing time and seed rate

The ideal sowing period for field pea is from the end of October to mid-November, although sowing may be extended up to the end of November if necessary, which may accrue a minor yield penalty. Use a seed rate of 20–25 kg per acre.

## Method of sowing

Sow the crop in rows 30 cm apart using pora, kera, or a seed-cum-fertilizer drill for uniform seed placement and spacing.

## Seed inoculation

Inoculating seed with *Rhizobium* culture is essential for effective nodulation and improved yield. Moisten the seed required for one acre with a small amount of water, mix thoroughly with one packet of *Rhizobium* culture, and dry the seed in shade before sowing. The inoculated seed should be sown immediately. *Rhizobium* culture is available at the Seed Shop, Gate No. 1, PAU, Ludhiana, and at KVKs/FASCs across Punjab.

## Fertilizer application

Apply 12 kg nitrogen (26 kg urea) and 16 kg  $P_2O_5$  (100 kg single superphosphate) per acre at sowing time to meet the nutrient requirement of the crop.

## Weed management

Keep the field free from weeds by giving two hoeings—the first at three weeks and the second at six weeks after sowing.

## Irrigation

Field pea is generally sown after a pre-sowing (rauni) irrigation. When sown after paddy, irrigation may not be required initially if the soil retains adequate moisture. Usually, two irrigations are sufficient during





the crop season—one at the pre-flowering stage (late December) and the other at the pod formation stage.

### Harvesting

The crop becomes ready for harvest by the third week of March, when the pods are fully mature and dry. Timely harvesting helps avoid grain shattering and ensures good-quality seed.

### Conclusion

Field pea is a nutrient-rich, soil-friendly, and

economically rewarding crop that offers multiple advantages as food, feed, and fodder. The PAU-recommended variety IPFD 12-2 is ideally suited to Punjab conditions and can be successfully sown up to the end of November by following the package of practices developed by Punjab Agricultural University, Ludhiana. By adopting this improved variety, farmers can enrich their soil, enhance profitability, and allow prosperity to take root in every furrow.



Field pea variety IPFD 12-2



Field pea in full bloom



Grains of field pea variety IPFD 12-2



Split grains of field pea variety IPFD 12-2

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