

Maize Matters

Technological Inventory for Maize Cultivation in Zone-I



ICAR-Agricultural Technology Application Research Institute
Zone-I, PAU Campus Ludhiana-141004, Punjab



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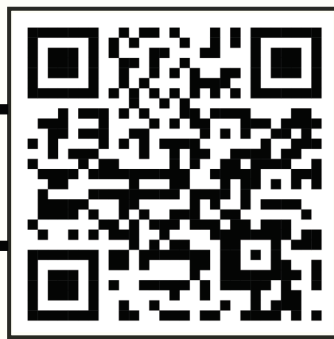
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PREFACE

Maize, the third most important cereal crop in the world after wheat and rice, holds a pivotal place in global food and feed systems. Its versatility spans across uses in poultry and animal feed, bioethanol production, human consumption, starch extraction, and numerous industrial applications. In recognition of its growing economic and strategic significance, NITI Aayog, Government of India, has recently identified maize as a critical feedstock for bioethanol production under the Ethanol Blending Program (EBP). This policy shift is aimed at reducing fossil fuel dependency and carbon emissions, with targets of achieving E20 (20% ethanol blend) by 2026 and E30 (30% blend) by 2030.

As a result, the demand for maize is expected to rise significantly in the coming years, surpassing that of traditional cereals like wheat and rice. By 2025, projections indicate that maize will emerge as the most consumed cereal crop globally, driven by its multifaceted utility and alignment with national energy and food security priorities.

In this context, the present publication, "Maize Matters: Technological Inventory for Maize Cultivation in Zone-I", has been meticulously compiled to document and disseminate the technological advancements and best practices in maize cultivation across the agro-ecological regions of Zone I. It is intended to serve as a comprehensive resource for extension professionals, researchers, policy planners, and stakeholders involved in maize value chains.

We express our sincere gratitude to Dr. M.L. Jat, Secretary (DARE) and Director General (ICAR), for his visionary leadership and strategic direction that inspired this initiative. We are deeply thankful to Dr. Rajbir Singh, Deputy Director General (Extension), and Dr. Ranjay Kumar Singh, Assistant Director General (Extension), for their sustained encouragement, constructive feedback, and unwavering support.

We also acknowledge with appreciation the Program Coordinators of KVKs, the farming community, and all field functionaries whose active participation and field-level insights were crucial in compiling this inventory. Our special thanks go to the Vice-Chancellors and Directors of Extension Education from the State Agricultural Universities and Institutes in Zone I for their continued collaboration and institutional backing.

Finally, we extend our heartfelt congratulations to the entire team at ICAR-ATARI, Ludhiana, whose dedication and commitment were instrumental in realizing this publication.

We hope this technical bulletin contributes meaningfully to ongoing and future maize development initiatives in the region and beyond.

- Authors

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TECHNOLOGICAL INVENTORY

PUNJAB

Varietal information

1. **Long-duration varieties/hybrids:** Dekalb (DKC) 9144, Bioseed 9788, Punjab Maize Hybrid (PMH) 14, PMH 13, Advanta (ADV) 9293, JC 12, PMH 11 and PMH 1 are recommended for their high yields ranging from 18.2 to 24.8 quintals per acre. These hybrids exhibit moderate resistance to key pests and diseases like fall armyworm, stem borer, maydis leaf blight, and charcoal rot.
2. **Medium-duration variety:** JC 4 is highly recommended for irrigated and kandi areas of Punjab due to its adaptability, delivering a yield of 13.0 quintals per acre and excelling in chapati quality traits, making it highly suitable for organic farming.
3. **Short-duration hybrid:** PMH 2, is grown for its shorter maturity duration of 83 days after sowing, yielding 18.0 quintals per acre. It is tolerant to bacterial stalk rot, offering a quick and reliable harvest.
4. **Private hybrids:** ADV 764, CP 858 and P 3302 are recommended for cultivation due to their moderate resistance to maydis leaf blight, charcoal rot, and maize stem borer.



Agronomic Practices

Time of sowing

Maize sowing in Punjab is recommended from the last week of May to the end of June, with earlier sowing in water-logging-prone areas to establish crops before the rains, ensuring higher yields and timely vacating of fields for toria or potato.

Seed rate

Seed rates vary with 7.0 kg per acre for Pearl Popcorn and 10.0 kg per acre for other varieties.

Method of sowing

The recommended maize sowing methods include using a maize planter or seed cum-fertilizer drill, a four-row pneumatic planter, trench sowing, bed/ridge sowing, and zero tillage sowing.

Fertilizer management

Practicing green manuring in maize fields is recommended by sowing crops like dhaincha, sunhemp, or cowpea during the second fortnight of April, using 12/20/20 kg of seed per acre. In cases, where summer moong is cultivated, the straw should be buried before maize sowing. Applying a full dose of nitrogen (50 kg N per acre) along with green manuring is beneficial for high maize yields and improved soil health, especially in a maize-wheat rotation system. If green manuring is not practiced, it is recommended to apply farmyard manure (FYM) or compost and in fields with continuous FYM application of over 6 tonnes per acre annually, the basal doses of phosphorus, potassium, zinc, and nitrogen may be omitted.

Varieties wise fertilizer recommendation

- a) PMH 1, 11, 13 & 14, ADV 9293, JC 12, and Punjab Sweet Corn 1, the recommended fertilizer application is 110 kg Urea, 55 kg DAP or 150 kg SSP, and 20 kg MOP per acre.
- b) PMH 2, JC 4, Punjab Baby Corn 1, and Pearl Popcorn, the recommendation is 75 kg Urea, 27 kg DAP or 75 kg SSP, and 15 kg MOP per acre.

Timing of fertilizer application

One-third of the nitrogen, along with the full amount of phosphorus and potassium, should be applied at sowing, while the remaining one-third of nitrogen should be top-dressed at the knee-high stage and the final one-third at the pre-tasselling stage.

Weed management

For cultural weed control, perform two hoeings at 15 to 30 days after sowing using tools such as a khurpa/kasaula/wheel-hoe/triphali, or tractor-drawn cultivator. Otherwise, uniform application of 30 quintals per acre of paddy straw mulch at sowing can effectively control

annual weeds. Another method involves intercropping cowpea by sowing 8 kg of CL 367 seed per acre between maize rows. The cowpea should be harvested at 35 to 45 days after sowing as fodder, eliminating the need for further weed control.

In chemical weed control, spray of 800 g per acre of Atrataf/Atragold/Masstaf/Traxx 50 WP (atrazine) is recommended for medium to heavy textured soils and 500 g per acre for light soils, within ten days of sowing. Alternatively, atrazine can be applied as a 20 cm wide band over the crop rows at 250 g per acre, followed by hoeing at 15 to 30 days after sowing. For mixed weed flora control, 105 ml per acre of Laudis 420 SC (tembotrione) in 150 litres of water can be sprayed at 20 days after sowing. To control dila or motha, apply 400 ml per acre of 2,4-D amine salt 58 SL as a post-emergence spray at 20-25 days after sowing in 150 litres of water.

Irrigation

Apply 4-6 irrigations based on rainfall to maintain an adequate water supply throughout the growing season. Proper irrigation is especially important during the pre-tasselling, silking, and grain-filling stages to support healthy crop growth and maximize yield. Maize can tolerate heavy rains but is vulnerable to flooding, especially during the early stages. To prevent flooding, create proper drainage at the field's lower end. If damage occurs, apply 6 kg urea per acre (3% solution) in two weekly sprays for moderate damage, or broadcast 12-24 kg of nitrogen (25-50 kg urea) per acre for moderate to severe damage after the flooding subsides.

Plant-Protection

Insect-pests

1. **Maize borer (*Chilo partellus*):** Adopt integrated control measures for maize borer, which is a serious pest from June to September. First, destroy borer larvae hibernating in stubbles, stalks, cobs, and cores by ploughing the fields after harvesting and collecting the stubbles. Use maize stalks, cobs, and cores by the end of February, and chop any remaining stalks for subsequent use. Remove and destroy plants showing severe borer injury during hoeing. Trichocards, with 40,000 eggs of *Corcyra cephalonica* parasitized by *Trichogramma chilonis*, should be released twice: once on a 10-day-old crop and again 7 days later. Spray recommended insecticide, Coragen 18.5 SC (chlorantraniliprole) @ 30 ml in 60 litres of water per acre, 2-3 weeks after sowing if borer injury is noticed.
2. **Fall armyworm (*Spodoptera frugiperda*):** To reduce pest spread, sowing should be done at the recommended time and avoid staggered sowing in adjacent fields. Regularly monitor the field to identify and remove egg masses, which are easily visible due to their

hairy covering. For young crops (up to 20 days old), spray with Coragen 18.5 SC (chlorantraniliprole) at 0.4 ml per litre, Delegate 11.7 SC (spinetoram) at 0.5 ml per litre, or Missile 5 SG (emamectin benzoate) at 0.4 g per litre using 120 litres of water per acre. Direct the nozzle towards the whorl for effective management. In cases of patchy infestations or crops older than 40 days, apply a soil-insecticide or biopesticide mixture (half gram) in the whorls of infested plants. To prepare the mixture, combine 5 ml of Coragen 18.5 SC or Delegate 11.7 SC or 5 g of Missile 5 SG, or 25 g of Delfin WG (*Bacillus thuringiensis* subsp. *kurstaki*) or 25 ml of Dipel 8 L (*Bacillus thuringiensis* subsp. *kurstaki*) with 10 ml of water and mix well with 1 kg of soil.

3. **Hairy caterpillar (*Spilosoma obliqua*):** Use light traps to eliminate moths. Since young larvae tend to feed in groups, they can be controlled by manually removing the infested leaves or uprooting the plants and burying them. For older caterpillars, it is advisable to crush them underfoot or collect and dispose of them by placing them in kerosene water to prevent further damage.

Diseases

1. **Seed rot and seedling blight (Several fungi):** Disease-free seeds should be used to prevent seed rot and seedling blight, which cause poor germination and seedling mortality.
2. **Banded leaf and sheath blight (*Rhizoctonia solani*):** Spray 100 ml of Amistar Top 325 SC (azoxystrobin + difenoconazole) in 200 litres of water per acre at the appearance of the disease and repeat the application at 15-day intervals.
3. **Brown stripe downy mildew (*Sclerophthora rayssiae var zaeae*):** Remove collateral hosts like Takri grass, keeping fields well-drained, and spraying 200 g Indofil M-45 (mancozeb) in 100 litres of water after sowing, with two more sprays at 10-day intervals.
4. **Maydis leaf blight (*Drechslera maydis*):** Destroy infected crop residue, grow improved varieties, and follow a spray schedule as for brown stripe downy mildew.
5. **Bacterial stalk rot (*Dickeya zaeae*):** Destroy diseased plant debris, maintain proper drainage, and prevent excess moisture.
6. **Post-flowering stalk rot (*Fusarium spp.*, *Macrophomina spp.*, *Cephalosporium spp.*):** Grow improved varieties like PMH 1, 11 and 13, and ensure good field management practices.

Harvesting and Threshing

Maize is ready for harvest when the husk cover turns brown and the grains harden, even if the stalks and leaves remain green. In wheat fields, harvest the stalks with the cobs and

stack them. A maize dehusker-cum-thresher or conventional sheller can be used for shelling maize with husks, ideally when moisture content is between 15-20%. For threshing, conventional grain-combines can be used, but maize ears should be dried for 3-4 days after harvesting.

Maize Drying

A portable maize dryer with a 3-ton capacity dries maize grains from 25% to 15% moisture in 8-10 hours. The dryer operates at temperatures of 60-75°C, with grain temperature maintained at 45°C for seed and 60°C for commercial use. It uses 4 litres of diesel per hour initially, reducing to 2 litres per hour due to heat recovery, and can be powered by tractor PTO or electricity. One skilled and one unskilled labourer are required to operate it.

JAMMU REGION

Varietal information

Maize hybrids

1. **Ganga Safed 2 (GS-2)**, a white grain hybrid ideal for sub-tropical areas of Jammu Division with a maturity period of 95-100 days, suited for rotations like Maize-Wheat, Maize-Toria-Wheat, Maize-Potato-Wheat, Maize-Sarson-Moong/Mash, and Maize-Potato-Fodder/Moong/Mash.
2. **Vivek Maize Hybrid-25**, an early maturing yellow grain single-cross hybrid with medium plant height, yields an average of 45 q/ha in mid-hill ecology.
3. **Vivek QPM-9**, an early maturing quality protein hybrid with orange-yellow grains, performs well in isolated conditions, yielding about 45 q/ha under mid-hill ecology.
4. **HQPM-1**, a late-maturing yellow grain hybrid with a yield potential of 50 q/ha, is suitable for irrigated conditions in sub-tropical plains, requiring isolation from other maize fields.
5. **PHM-12**, a medium-maturing yellow grain single-cross hybrid, is recommended for mid-hill ecology under irrigation, with an average yield of 45-50 q/ha and a maturity period of 130-135 days.

Composite maize varieties

1. **Vijay**, is a semiflint yellow-grained variety suitable for altitudes between 600-1350 m, adaptable for crop rotation based on altitude.



2. **C-6 (Shalimar)**, an orange-yellow flint variety, is ideal for hilly areas at 1050-1800 m and can be rotated with early oilseeds, barley, or vegetable peas up to 1500 m.
3. **C-2**, with yellow grains, is also suitable for hilly areas between 1050-1800 m.
4. **Super Composite (Mansar) and Composite (Trikuta)**, both orange flint varieties with a yield potential of 50-60 q/ha, are recommended for mid-elevations in Jammu.
5. **Composite C-8**, with creamy white, bold, semiflint to semident grains, yielding 45-50 q/ha, is also suited for mid-elevations of Jammu.
6. **Composite C-15 (Rehmat)**, an early-maturing variety with yellow dent and semident grains, is recommended for higher elevations up to 2250 m, offering a yield potential of 50-60 q/ha.

Agronomic Practices

Time of sowing

The recommended sowing time for maize vary by variety and region:

- a) In irrigated plains, variety GS-2 should be sown in the first fortnight of June.
- b) For unirrigated plains, varieties such as C-8, C-5 and Mansar, sowing should commence with the onset of the monsoon and should not extend beyond July 10.
- c) In intermediate regions, varieties like GS-2, Mansar, Vijay, C-5, and C-8 should also be sown with the onset of the monsoon but not later than June 30, with GS-2 suitable only up to 600 m altitude.
- d) In temperate areas, varieties such as Mansar, C-2, C-6, Vijay, and C-15 should be sown up to 1500 m from April to May 15, and above 1500 m, sowing should be restricted to April. Vijay is recommended for altitudes up to 1350 m, while C-15 can be sown up to 2250 m, with local tall maize sown in April.

Seed rate

For plain areas, use 8 kg of seed per acre for line-sown crops, while broadcast sowing requires 12 kg of seed per acre. In hilly areas, the recommended seed rate is 14-16 kg per acre.

Method of sowing

Sow hybrid maize in rows 75 cm apart and composite maize in rows 60 cm apart, maintaining a plant-to-plant distance of 20 cm to ensure optimal plant population for higher yields. Sowing should ideally be done using a seed drill or maize ridger, whether tractor-driven, bullock-drawn, manually operated, or behind the plough, at a depth of 3-5 cm. If broadcasting is used, seeds must be distributed uniformly across the field to achieve a consistent plant population.

Fertilizer management

Apply 60 quintals of well-rotted FYM or compost per acre, thoroughly incorporating it into the soil during the first ploughing. For fields with average fertility, specific fertilizer doses are suggested, but if 150 quintals of FYM or compost are applied, the recommended nutrient quantities should be reduced by 25%. It is recommended to apply fertilizers as follows:

- I. In irrigated plain areas, use 58 kg urea, 52 kg DAP, 20 kg MOP, and 10 kg zinc sulphate per acre.
- ii. In unirrigated plain areas, apply 40 kg urea, 36 kg DAP, 13 kg MOP, and 4 kg zinc sulphate per acre.

Zinc sulphate should be applied at least once every three years to maintain soil micronutrient balance.

Timing of fertilizer application

Apply the entire quantity of phosphorus and potassium, along with zinc sulphate and two-thirds of nitrogen at the time of sowing as a basal dose using a pora. The remaining nitrogen should be applied in two equal splits: the first when the plants reach the knee-high stage, approximately one month after sowing, and the second before tassel formation, around two months after sowing. The application of Single Super Phosphate (SSP) @ 140 kg per acre can provide equally effective results as DAP, while also supplying sulphur to the soil.

Weed management

Keep the maize crop weed-free for the first 40 days after sowing. Perform two hoeings: the first at 15 days and the second at 30 days after sowing. Weeds within rows can be effectively managed using tools like traphali, 5-tinned hoes, or a hand blade hoe. Additionally, the crop should be earthened up at the knee-high stage (around one month after sowing) using a bullock-drawn ridger or a spade.

Apply Atrazine herbicide @ 800 g per acre mixed in 200 litres of water as a pre-emergence spray within 2-3 days after sowing (DAS). For maize intercropped with pulses, the recommended herbicides include Pendimethalin @ 1200 ml per acre as a pre-emergence application and Fluchloralin at 660 ml per acre as a pre-plant incorporation treatment.

Irrigation

Ensure proper drainage arrangements in maize fields during sowing, as maize is a rainy season crop that cannot tolerate waterlogging. For irrigated crops, it is advisable to irrigate the field 5 to 7 days before sowing, ensuring the soil reaches optimum moisture conditions for sowing. The crop should be irrigated as needed, avoiding water stress, especially during flowering and grain formation stages, as moisture stress at these critical periods can

significantly reduce yield. Water should not stand in the field for more than 3 hours to prevent adverse effects on the crop.

Plant-Protection

Insect-pests

1. **Maize cut worm (*Agrotis spp.*):** Regularly rake the field to reduce pest attacks. Light traps should be installed at a density of 1.0 per acre for mass collection and destruction of pests. Pheromone traps are also advised, with 16 traps per acre to attract and eliminate male moths. Prophylactic measures should be undertaken before sowing by mixing chlorpyrifos 1.5% D or lindane 1.3% D @ 10 kg per acre into the soil during the final ploughing. If soil application is not feasible, spraying the crop with chlorpyrifos 30 EC @ 1200 ml in 400 litres of water per acre directly on the soil surface is recommended.
2. **Maize stem borer (*Chilo partellus*):** Uproot and burn the stubbles of the previous crop. Following this, the crop should be sprayed with methyl demeton 25 EC @ 450 ml per acre or alternatively, cypermethrin 10 EC @ 40 ml per acre, deltamethrin 2.8 EC @ 80 ml per acre, or dichlorvos 100 EC @ 25 ml per acre. Granular insecticides like cartap hydrochloride 4 G @ 10 kg per acre or carbofuran 3 G @ 8.0 kg per acre should be applied directly into the whorls using small perforated tins.
3. **Army worms:** Use light devices such as lanterns or electric bulbs, with trays containing a mixture of kerosene and water (1:3) placed underneath the light source to attract and destroy moths. Another method involves digging a 6" x 9" deep trench around the infested field and killing the pests mechanically in the morning hours. The crop can be sprayed with dichlorvos 100 EC @ 200 ml per acre, chlorpyrifos @ 600 ml per acre, or carbaryl 50% WP @ 600 g per acre, mixed in 300 litres of water, for effective armyworm management.
4. **Blister beetle:** Spray the maize crop with Carbaryl 50% WP @ 800 g per acre in 400 litres of water during the tasselling stage, or alternatively, use chlorpyrifos 30 EC @ 0.005%. Raising 1 to 2 rows of trap crops such as bhindi or Arhar around the field is recommended, with mechanical destruction of the beetles to help manage pest infestations.
5. **Aphids:** Use Dimethoate 30 EC @ 0.5 ml per litre of water, or Imidacloprid @ 0.5 ml per litre, or Methyl demeton 25 EC @ 400 ml per acre in 8000 litres of water for effective pest control.
6. **Hairy caterpillars:** Spray Carbaryl 50% WP @ 800 g per acre in 400 litres of water, using foot or rocking spray pumps. Alternatively, Chlorpyrifos 30 EC can be applied @ 600 ml per acre in 300 litres of water.

7. **Maize jassids:** Use Dimethoate 30 EC @ 800 ml per acre or chlorpyrifos 30 EC @ 600 ml per acre in 300 litres of water.
8. **White grub:** Apply Chlorpyrifos 1.5% D or Lindane 1.3% D @ 10 kg per acre, or alternatively, use Carbofuran 3G at 8.0 kg per acre for pest control. The surrounding area should be sprayed with 0.2% Carbaryl 50% WP @ 600 g dissolved in 300 litres of water per acre.

Diseases

1. **Head smut (*Sphacelotheca reiliana*):** Follow proper field sanitation and crop rotation for 2-3 year to minimize the buildup of pests and pathogens. Infected plants should be uprooted and destroyed to prevent further spread. Treating seeds with carbendazim @ 2 g per kg of seed is suggested to protect against seed-borne diseases and ensure healthy crop growth.
2. **Common smut (*Ustilago maydis*):** Smear the seed with captan @ 3 g or carbendazim @ 2g per kg of seed.
3. **Stalk rot (*Erwinia chrysanthemi* pv. *zeal*):** Uproot the affected plants and perform drenching near the collar region using a solution of 2.5 kg mancozeb and 50 g streptocycline dissolved in 1000 litres of water. Alternatively, bleaching powder can be applied @ 10 kg per acre to manage the stalk rot effectively.
4. **Leaf blight (*Excerohilum turcicum* and *Bipolaris maydis*):** Practice clean cultivation to effectively reduce disease incidence in the crop. Spraying the crop with mancozeb @ 0.25% or propiconazole @ 0.1% is advised as soon as the disease symptoms appears.

Harvesting

Hybrid and composite maize plants remain green even at maturity. Harvest the crop when the husk cover over the cobs dries and turns brown, and the grains harden. Shell the grains from dried cobs using traditional methods or a hand corn-sheller, and dry them under the sun to ensure safe storage.

KASHMIR REGION

Varietal information

Pusa Shalimar Maize Hybrid-1 (AH-7154): It is recommended under both rainfed and irrigated conditions for mid-altitude areas of Jammu & Kashmir. It thrives best in well-drained sandy loam to silty loam soils with a pH range of 5.5 to 7.5. Proper seedbed preparation involves deep ploughing to a depth of 20-25 cm, followed by harrowing and planking, ensuring a friable and well-aerated seedbed suitable for optimal growth.

Agronomic Practices

Time of sowing

In hilly areas, sowing is recommended between 20th April and 20th May, while in plain areas, it should be done from 10th April to 25th May.

Seed rate

The recommended seed rate is 8 kg per acre.

Method of sowing

Sow maize seeds in lines, maintaining a spacing of 60 cm between rows and 20 cm between plants. The seeds should be placed at a depth of 3-5 cm for optimal growth and yield.

Fertilizer management

Apply 78 kg Urea, 40 kg DAP and 20 kg MOP per acre for rainfed areas, and 104 kg Urea, 52 kg DAP and 30 kg MOP per acre for irrigated areas. Additionally, incorporating 4-6 tons of farmyard manure (FYM) per acre is advised to improve soil fertility.



Weed management

Apply Atrazine @ 800 g per acre as a pre-emergence herbicide, diluted in 300 litres of water, to effectively control weeds. Alternatively, manual weeding at 15 DAS or mechanical weeding after 30-40 days can be carried out. In all cases, follow up with earthing-up at the knee-high stage (35-40 DAS) to enhance weed control and support crop growth.

Timing of fertilizer application

Apply half of the nitrogen, the full dose of phosphorus and potassium as basal, and the remaining nitrogen in two splits: one at the knee-high stage and the other before tasselling, ensuring good soil moisture.

Irrigation

In rainfed hilly and plain areas, it is recommended to provide irrigation only during the most critical growth stages if necessary. These stages include the knee-high stage, silking stage, and grain-filling stage.

Plant-Protection

Insect/pest

Stem borer: Grow Pusa Shalimar Maize Hybrid-1, as it is moderately resistant to stem borer.

Disease

Turcicum Leaf Blight (TLB): For effective management, spray Mancozeb @ 0.25% to control TLB or Dimethoate @ 2.0 ml per litre of water or apply Carbofuran 3G granules (3-5 granules per whorl) as a whorl application at 15 days after germination. Cultivate Pusa Shalimar Maize Hybrid-1, which shows moderate resistance to TLB.

Harvesting

Maize in hilly areas typically matures within 125-130 days, while in plain areas, it is ready for harvest in 110-115 days.

UTTARAKHAND

Varietal information

Varieties based on maturity

1. Early-maturing varieties (75-80 days)

Composite Maize: Kanchan, Gaurav, Surya, Vivek Composite Maize 11, 31, 35 and 37.

Hybrid Maize: Pant Hybrid Maize 1, 4 and 5, PEEMH 5, Vivek Hybrid Maize 21, 23, 25, 33, 39, 43, 47, 53, DMH 107, PMH 2, HM 13, Pusa HM 4 and 8.

2. Mid-maturing varieties (80-90 days)

Composite Maize: Tarun, Naveen, Kiran, Navjot, Bajoura Makka 1, Pratap Makka 1, Pusa composite 3 and 4.

Hybrid Maize: JKMH 1701, Boya 9544, HM 4, 10 and Pant Hybrid Maize 6.

3. Late maturing varieties (90-100 days)

Composite Maize: Devaki, Prabhat, Kisan and Vijay.

Hybrid Maize: HQPM 1 and 4, HM 11, Buland and P 3522.

Recommended Varieties for Specific Regions

1. Tarai, Bhawar and Plains Regions

Hybrids: HM 4, 10, HQPM 4, 5, Pant Sankar Makka 1, Vivek Makka 51, Sartaj Prakash, Pant Hybrid Maize 4, Buland, Bio 9544, P 3522, Pant Hybrid Makka 5 and 6.



Composite: Tarun, Naveen, Kanchan, Shweta, D 765, Surya, Gaurav, Amar, Bajoura Makka 1, Vivek Sankul 11 and Pant Hybrid Makka 3.

2. **Hilly Regions**

Hybrids: Vivek Sankar 5, 9, 21, 23, 25, 33, 39, 47, 55, DMH 109, HM 13 and Vivek QPM 9.

Composites: Vivek Sankul Makka 11, VL Makka 37, Vivek Sankul 31, 35, Pragati, Kanchan, Naveen Shweta.

Special Purpose Maize Varieties

1. **For Fodder:** African Tall and J 006.
2. **Sweet Corn:** Sugar 75, Win Orange Sweet Corn and HSC 1.
3. **Popcorn:** VL Amber and Pant Popcorn 1.
4. **High-Protein Maize:** HQPM 1, 4, 5, 7 and Vivek QPM 9.
5. **Baby Corn:** HM 4 and VL Baby Corn 1.

Agronomic Practices

Time of sowing

Area-wise sowing schedule for various regions is given below:

1. **Terai, Bhabar and Plain areas:** Second week of June.
2. **Lower Hill areas:** From early June to mid-June.
3. **Mid-Hill areas:** From late May to mid-June.
4. **High Hill areas:** From late April to mid-May.

Seed rate

Recommended seed rates for different maize types:

1. **For Composite Maize:** 7.2- 8.0 kg per acre.
2. **For Hybrid Maize:** 8.0- 8.8 kg per acre.
3. **For Popcorn:** 4.8- 5.6 kg per acre.
4. **For Baby Corn:** 16.0- 18.0 kg per acre.
5. **For Sweet Corn:** 3.2 kg per acre.

Method of sowing

Sow seeds in rows with specific spacing based on the purpose of cultivation. For grain maize, maintain a row-to-row distance of 60 cm and a plant-to-plant distance of 25 cm. For baby corn and fodder, the recommended spacing is 50 cm between rows and 15 cm between plants.

Seeds should be sown at a depth of approximately 5.0 cm. If using home-grown seeds, treat them with Thiram 40 FS @ 24 ml per kg seed or Thiram 75 WS @ 25-30 grams per litre of water.

Fertilizer management

Apply fertilizers based on soil testing for optimal maize growth. If soil testing is unavailable, for early-maturing varieties, apply 87 kg urea, 150 kg SSP and 26 kg MOP per acre. For medium and late-maturing varieties, apply 105-130 kg urea, 150 kg SSP, and 26 kg MOP per acre. Phosphorus and potash, along with one-fourth of nitrogen, should be incorporated into the furrows at sowing, while the remaining nitrogen should be top-dressed in three equal splits at the 3-4 leaf stage, knee-height stage and tasselling stage, ensuring placement near roots for better uptake. In zinc-deficient soils, use 10.0 kg zinc sulphate heptahydrate (21% zinc) or 8.0 kg zinc sulphate monohydrate (33% zinc) per acre before sowing, or spray 0.5% zinc sulphate spray (with 2.0% urea) on standing crops if deficiency symptoms appear. For baby corn, higher urea dose of 156 kg per acre is required, with one-third applied at sowing and the rest in two equal doses at 20-25 days and 40-45 days after sowing.

Weed management

Perform at least two hoeings, the first at 20 days after sowing and second at 35 days after sowing. Earthing up at 25-30 days after sowing is also beneficial as it helps reduce lodging and suppress weeds. For chemical control, spray Atrazine 50 WP @ 8 kg per acre immediately after or within 2-3 days of sowing, but avoid its use if maize is intercropped with a leguminous crop. Alternatively, use Tembotrione @ 115 ml per acre or Topramizone @ 30 ml per acre, applied at 20-25 days after sowing. Ensure adequate water availability of 200 litres per acre for herbicide application.

Irrigation

Ensure adequate moisture during the early stages of growth, knee-high and flowering stage for optimal maize development. During the Kharif season, irrigation is typically unnecessary due to sufficient rainfall, but in the absence of rain, irrigation should be provided as required. Proper drainage after rainfall is crucial to prevent yellowing and stunted growth of plants. Additionally, ensuring sufficient water during cob formation is critical to avoid smaller and fewer grains.

Plant-Protection

Insect/pests:

1. **Stem borer:** Incorporate 13.2 kg of Carbofuran 3G per acre into the soil during sowing. If the pest affects standing crops, apply the same quantity near the plant base along the crop rows after irrigation. Alternatively, an effective control measure involves spraying 265 ml of Dimethoate 30% EC mixed in 200-250 litres of water per acre over the affected areas.

2. **Shoot fly:** For effective control, insecticides recommended for stem borer, such as Dimethoate, should be applied at the specified dosage per acre. Additionally, treat seeds with Imidacloprid 48% FS @ 1.0 ml per kg before sowing. In cases of severe infestation, it is suggested to spray Monocrotophos (250 ml per acre) or Oxydemeton Methyl 25% EC (400 ml per acre) in 200-250 litres of water per acre for optimal control.
3. **Fall armyworm:** Initiate control measures at the early stages of pest infestation. For effective management of this pest, spray 0.5 ml per litre of 11.7% SC Spinetoram, 0.4 ml per litre of 18.5 SC Chlorantraniliprole, or a mixture of 12.0% Thiamethoxam + 9.5% Lambda-cyhalothrin @ 0.2 ml per litre of water.

Diseases:

1. **Ring spot and sheath blight:** As soon as the symptoms of the disease appear, remove and discard the lower leaves. For disease control, spray 200-250 litres of water with 1.0 kg Mancozeb, 0.8 kg Propiconazole/Validamycin or 0.4 kg Carbendazim per acre as soon as symptoms appear. If necessary, apply a second spray 10 days later.
2. **Tulasita or brown striped soft rot:** Yellow stripes appear on the leaves and on the underside of the leaves, white, cotton-like fungal growth is visible. Infected plants produce fewer ears or may not produce any at all.
3. **Blight:** Spray Mancozeb/Zineb 75 WP @ 0.6-0.8 kg per acre by dissolving it in 280-320 litres of water. The first spray should be applied when symptoms of the disease appear. A second spray should be done 10-15 days after the first application.
4. **Stem rot:** This disease is more commonly found in areas with heavy rainfall, where water stagnates. It causes watery spots on the pores of the stem, which eventually rot and emit a foul odour. The leaves turn yellow, dry up, and the plants fall over due to rotting at the stem. Apply 25 kg of bleaching powder per hectare along with irrigation water. Ensure proper drainage of water in the field.

Harvesting and Yield

When the husks covering over cobs start turning yellow, the crop is ready for harvesting. Early-maturing varieties yield an average of 40-45 quintals per hectare, while medium and late-maturing varieties yield 50-60 quintals per hectare.

HIMACHAL PRADESH

Varietal information

Recommended varieties

1. **Girija composite:** It is suitable for areas where waterlogged or deep soils are prevalent. It is a hybrid maize variety that grows well in regions with heavy rainfall and where proper drainage is essential. The plants are medium in height with thick stems and broad, dark green leaves. The maize cobs are placed in the middle of the plant, reducing the chance of them falling due to wind. The kernels are orange in colour and hard and matures in approximately 110 days, with an average yield of 40 quintals per hectare.
2. **Bajoura Makka:** It is an early maturing variety, suitable for regions with intermediate and high elevations. The kernels are shiny, orange and hard. The ears grow between the plant, making harvesting easier and the plants do not fall over. This variety is resistant to maize blight, matures in 85-94 days and yields approximately 35-38 quintals per hectare.
3. **HQPM-1:** This hybrid variety contains twice the amount of essential amino acids (lysine and tryptophan) than normal corn. The corn cobs of this variety are long and round and the grain weight is 280-290 grams per 1000 grains. It is an early maturing variety, suitable for intermediate and high altitude areas. The plants are of medium height, the leaves are medium broad and dark green in colour. Its grains are light orange in colour and cobs are ready to harvest in 110-112 days and yields 68-70 quintals per hectare.



4. **PMZ-4:** This medium-duration variety is suitable for both irrigated and unirrigated areas. Its plants are of medium height and the cobs are long and thick, positioned in the middle of the plant. The grains are thick, semi-flint, and golden yellow in colour, with approximately 400 seeds per cob. This variety is suitable for both green cobs and grains. It has moderate resistance to stalk rot disease and is quite resistant to leaf diseases. Its average yield is 78 quintals per hectare and matures in 96-105 days.
5. **Bajoura popcorn:** This is a special type of maize suitable for popcorn, which is ideal for the lower and mid-hilly regions of Himachal Pradesh. The grains are small, and upon popping, they expand up to twenty times their original size. The kernels are narrow, soft, and shiny, with a bright orange-yellow colour. The plants are medium in height with long, slender cobs, averaging 120 grams per thousand grains. It is resistant to leaf blight diseases, mature in 95-100 days and yields 25-28 quintals per hectare.
6. **Bajoura sweet corn:** It is popular for fresh consumption as well as for use in processed products. The plants of this variety have medium-height, sturdy stems, and dark green leaves. The tassels are large and open, with red silk. The kernels are less shrivelled and have a golden-yellow colour, containing 20-22% sugar. The maximum sugar content is found 18-21 days after pollination, making it ideal for harvesting green cobs. The grains of this variety are thinner compared to regular maize, which makes them softer. It matures in 100-105 days and yields 28-30 quintals per hectare.
7. **Palam Hybrid Maize-2:** It is a medium-duration, high-yielding single-cross hybrid variety, suitable for the lower and mid-hill regions of Himachal Pradesh. It has wide, dark green, and drooping leaves. The plants are of medium height, with cobs positioned in the middle. The grains are yellow and semi-flint in texture. This variety is resistant to Turcicum and Maydis leaf blight diseases. The average yield is 68-70 quintals per hectare.

Agronomic Practices

Time of sowing

Suitable sowing times for different areas in the state are as follows:

1. **High-altitude areas:** Sowing should be done from 15th May to the first week of June.
2. **Mid-altitude areas:** Sowing should be done from 20th May to 15th June.
3. **Low-altitude areas:** Sowing should be done from 15th June to 30th June.

If maize sowing cannot be done under adverse conditions, pulses like black gram or horse gram can be sown until the first week of August. If sowing is delayed, leguminous crops should be intercropped.

Seed rate

The recommended seed rate is 8 kg per acre.

Method of sowing

Farmers often sow maize crops using the broadcasting method, which is not ideal because it does not maintain uniform spacing between plants. This leads to inadequate access to sunlight, carbon dioxide, nutrients, and moisture. Additionally, the seeds either remain too close to the surface or go too deep, affecting germination. Therefore, to achieve higher yields, maize should be sown in rows spaced 60 cm apart, with 20 cm between seeds, ensuring 75,000 plants per hectare. Seeds should be sown 3-5 cm deep to ensure proper germination. For sloping land prone to soil erosion, rows should be aligned opposite to the slope for sowing.

Fertilizer management

Apply 4-6 tons of well-decomposed manure per acre to improve soil texture and enhance water-holding capacity. In acidic soils ($\text{pH} < 6$), applying a mixture of rock phosphate and superphosphate in a 50:50 ratio provides the crop with the same amount of phosphorus as using superphosphate alone. Lime should be applied in acidic soils based on soil testing.

One-third of the nitrogen and the full amounts of phosphorus and potash should be applied at the time of sowing. The remaining dose should be applied in two splits, when the crop reaches the knee-high stage and just before tasselling. In lower hilly regions, nitrogen should be applied in four parts: one-fourth at sowing, one-fourth when the crop reaches the knee-high stage, one-fourth just before the tassels emerge and remaining one-fourth during tasselling. Fertilizer recommendations for composite, hybrid and local maize varieties are given below:

For composite or hybrid varieties

- i. **In case of sufficient rainfall:** Apply 104 kg Urea, 150 kg SSP and 26 kg MOP per acre.
- ii. **In case of deficit rainfall:** Apply 78 kg Urea, 112 kg SSP and 20 kg MOP per acre.

For local varieties

- i. **In case of sufficient rainfall:** Apply 70 kg Urea, 100 kg SSP and 20 kg MOP per acre.
- ii. **In case of deficit rainfall:** Apply 52 kg Urea, 74 kg SSP and 13 kg MOP per acre.

In areas prone to crop lodging due to strong winds, delaying nitrogen application slightly can help slow plant growth and reduce lodging risks. In regions such as Una and Indora, where zinc deficiency is prevalent, apply 10 kg zinc sulphate per acre at the time of sowing. In high rainfall areas, using cow dung manure in the maize-wheat crop rotation is more beneficial when manure is applied to the maize crop and phosphorus fertilizers are applied to the wheat crop.

Weed management

In the maize crop, controlling weeds within 20-30 days after sowing is crucial to ensure the fertilizers provided to the crop are utilized effectively. Manual weed removal not only requires significant labour but also becomes challenging during prolonged periods of continuous rainfall. Hence, the chemical method of weed control is both cost-effective and efficient in keeping weeds under control from the very beginning. Apply Fluchloralin 45 EC @ 0.4 kg a.i. per acre before sowing by preparing a solution in 280-300 litres of water. If maize is intercropped with black gram or pigeon pea, perform weeding and hoeing five weeks after sowing. The control measures for two prominent weeds are outlined below:

- i. **Blue Flower:** This weed appears in maize crops during the flowering stage, affecting both male and female flowers. In the 2-3 leaf stage during the male and female flowering phase, spray 0.4 kg 2,4-D sodium salt per acre. Alternatively, spray 0.4 kg per acre glyphosate mixed with 280-300 litres of water directly on the weed plants before flowering. The perennial variety of blue flower weed can also be controlled using the same quantity of glyphosate as mentioned above.
- ii. **Motha (Nutgrass):** Use glyphosate @ 300 ml or ammonium sulphate @ 1.50 kg per acre in 300 litres of water. Apply this mixture after wheat harvest or seven days before maize sowing. For effective control 30-40 days after maize sowing, spray 300 ml glyphosate per acre directly on the nutgrass plants, ensuring the chemical does not come into contact with maize plants.

Irrigation

In rainfed conditions, it is essential to spread pine needles or other grasses, etc., at a rate of 4 tons per acre over the land to enhance yield and prevent moisture deficiency during prolonged dry spells. In the month of August, apply 4 tons per acre of materials like maize stalks, leaves of san, basooti, or any other local grasses to the maize crop helps retain soil moisture, which is beneficial for wheat sowing in rainfed areas and provides support during irrigation for maize. If maize is in the tasselling or silking stage and rain is not expected but irrigation is available, water should be applied to the crop. However, standing water should not accumulate in the maize fields, even for a short period. Therefore, proper drainage arrangements must be ensured, which becomes easier when sowing is done in rows.

Plant-Protection

Insect/pests

1. **Stem borer:** The larvae enter the plant and feed on the stems and leaves, creating small holes in the plants. Later, they continue feeding inside the stem. To control, remove weeds and other plants from the field, and clear it of grass and other debris.

Uproot the infested plants with visible symptoms of damage. Before sowing, mix 12 kg per acre 10G Forate (Thimet) into the soil. Later, for plants showing small holes, apply the above granular insecticide to their leaf whorls. During harvesting, cut the plants close to the ground and collect the residues for disposal. Do not use insecticides on maize grown for fodder.

2. **Hairy caterpillar:** These feed on the soft leaves and stems of young plants. The hairy larvae cause damage while staying in clusters. Collect and destroy the larvae feeding in clusters.
3. **White grub, black beetle and root weevil:** These three pests remain hidden in the soil and cause damage to plants after germination. Use good quality decomposed cow dung manure and a higher seed rate.
4. **Striped beetle:** The adult beetle causes significant damage during the flowering stage. Collect and destroy the adult beetle.

Diseases

1. **Bacterial stem rot:** This disease typically occurs when the crop is in the flowering stage. The stem above the soil surface turns dark brown, becomes soft, and mushy. The stem breaks off at the affected area. These plants emit a wine-like odour, which is a prominent symptom of this disease. Ensure that water does not accumulate in the field and provide proper drainage. Grow disease-resistant varieties in the lower and intermediate areas. Do not apply excessive nitrogen fertilizers.
2. **Leaf blight:** Typically, leaf blight affects crops that are 30-40 days old, starting from the drying of lower leaves. This disease affects all parts of the plant and in case of severe infestation, the leaves dry up and plant dies quickly. As soon as the disease appears, spray 0.6 kg Zineb (Indofil Z-78) or Mancozeb (Indofil M-45) in 300 litres of water per acre. For seed crops, popcorn, and sweet corn, apply another spray after 10-day interval.
3. **Brown striped soft rotting:** The disease manifests as narrow greenish-yellow or yellow stripes, 3-7 mm wide, on the leaves, with veins clearly visible. Later, these stripes turn deep red. In the morning, a white, buttery, velvety fungal growth appears on these spots, which are the distinct symptoms of this disease. As soon as the symptoms appear, spray 0.6 kg Mancozeb (Indofil M-45) in 300 litres of water per acre at two-week intervals. Grow disease-resistant varieties.
4. **Top rot:** The symptoms of this disease appear when flowers and cobs emerge in the crop, which later turn into black powder. Treat the seeds with Thiram @ 2.5 grams per kilogram of seed. Infected plants should be removed and burned to prevent further spread of the disease.

5. **Seed rot and seedling blight:** When diseased seeds are sown, especially in wet and cold soil, the seeds may die even before germination, or seedling close to the soil may suffer from blight. Sow only recommended varieties and avoid using broken or damaged seeds. The seeds should be treated with Thiram @ 4.0 grams per kilogram of seed. Sowing should not be done in wet and cold soil conditions to ensure optimal seed germination and growth.
6. **Striped leaf and leaf sheath blight:** The symptoms of this disease appear on all parts of the plant, except for the roots and stems. On plants that are about 40-50 days old, red to brown spots develop on the leaves or parts of the wrapped leaves. From a distance, the affected plants resemble snake skins. Uproot and destroy the diseased plants and sow resistant varieties. Maintain the recommended spacing between rows and plants to prevent diseased leaves from coming into contact with healthy ones. When the crop is 40-50 days old, remove and burn the diseased parts. On appearance of disease, spray 0.25% Mancozeb 75 WP (Indofil M-45), and depending on the severity of the disease, continue spraying at 10-day intervals.
7. **Late blight:** In the stage when male flowers appear, the leaves begin to wilt completely and turn dark green. The lower part of the plant dries up, shrinks, and becomes hollow. This disease is more common in sandy and clayey soils. Apply the recommended amount of potash fertilizer at the time of sowing, especially in areas prone to drought and irrigate at the stage of male flowering.
8. **Brown spot:** The symptoms of this disease appear on the leaves, petioles, and stems. Initially, they appear in clusters on the leaves, which are yellow at first and later turn brown. The disease also affects the stems near the knots and in case of severe infestation, the stem may break. Adopt crop rotation and keep the field free of weeds and residues. Sow disease-resistant varieties.

Harvesting

The high-yielding varieties mature quickly while the plants are still green. Corn should be harvested when the outer husks turn brown and the moisture content is less than 30%. After harvesting the corn, it should be dried, and the kernels should be removed. Once the moisture content of the plants reaches 12-14%, the corn can be taken to the market. The remaining stalks can be used as fodder for animals. Another method is to cut the crop when it is ripe, bundle it into small bundles, stack it to dry, and then extract the kernels as needed.



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