

HIGH DENSITY PLANTING SYSTEM FOR COTTON

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High Density Planting System For Cotton



ICAR-CICR, Nagpur has standardized 'High density Planting System' (HDPS) for cotton that has potential to realize high yields in rainfed farming systems. Under rainfed conditions for contemporary compact BG II hybrids, HDPS at 90 cm x 15 cm is better suited to shallow black soils and red soils. In medium deep to fertile black soils, closer spacing with 90 cm x 30 cm may be adopted as a medium density intervention.

Criteria of selecting cultivars for HDPS

- Compact, short fruiting branches with higher retention of first position bolls
- Small leaves and short statured plants with column or pyramidal architecture
- Bt cotton cultivars tolerant to sucking pest and diseases
- Big boll size (>4g)
- Early maturing, synchronous boll bursting and amenable to machine picking

Land preparation

Pre-sowing operations

- Deep ploughing with mould board plough once in every three years.
- Add well decomposed farm yard manure (FYM) @ 2-5 tonnes/acre (1-2 tractor trolley) wherever available at least 15 days before sowing and spread and mix it evenly into the soil.
- 2-3 harrowings after pre-monsoon showers.

Sowing time operations

- After the receipt of soaking rains, just before sowing, take up one harrowing and planking for preparation of stale seed bed for effective weed management.

Sowing time

- Manual sowing may be taken up after receipt of 70 mm cumulative rainfall in 3 consecutive days. Generally 10th to 30th June is optimum time for sowing in Central India and Telangana.

Sowing

- Use of pneumatic planter for sowing facilitates precision placement of seed at the right depth (5-6 cm) with single seed (saves seed), ensures uniform seedling emergence, establishment of good plant stand and also makes it possible to apply basal dose of fertilizer along with sowing.
- Sowing window for pneumatic planters is very narrow, dry sowing may be carried out (where sound rain forecast is there for next few days) for covering more acreage with a single planter.
- Wherever pneumatic planters are not available manual planting can be done by using marked rope, Gunter's chain, marked plastic pipes, length sticks etc. to maintain plant to plant distance.
- Sowing to be carried out at spacing mentioned below for optimum plant population using seeds with good germination.



Practice	Spacing (cm)	Plant population/acre	Seed rate/Acre (450 g packets)	Soil
HDPS	90 x 15	29,629	6	Shallow soils, Red soils
Closer spacing	90 x 30	14,814	4	Medium deep to deep soils

Weed Management

- HDPS ensures quick canopy closure and improves the competitiveness of cotton crop against weeds.
- Herbicides are applied as pre-emergence and post-emergence in cotton.

Pre-emergence herbicide: Apply Pendimethalin 38.7 % CS @ 700 ml/acre within 24-48 hours of sowing. Pendimethalin application keeps the field weed free for 30 days.

- Make sure that there is enough soil moisture in the field at the time of herbicide application.



- One or two hoeings followed by hand weeding at 20 and 40 days after sowing (DAS) keeps the field weed free. If hoeing or hand weeding is not possible due to continuous rains, post-emergence herbicide may be used to check the weed growth.

Post-emergence herbicide: Spray Quizalofop ethyl 5% EC @ 2 ml /lit water if the field is infested with grassy weeds, Pyriithiobac sodium 10 % EC @ 1.25 ml/lit water for broad leaved weeds or Quizalofop ethyl 6% EC + Pyriithiobac sodium 4% EC (combination product) @ 2.5 ml /lit of water to control both grassy and broad-leaved weeds.

- Post-emergence herbicides are most effective against younger (less than 10-15 days old) weeds or weed plants of less than 4 inches height.
- A minimum of 200 litres of spray volume should be used for application of herbicides per acre.

Nutrient Management

Get the soil tested before sowing and make adjustments in the recommended dose. For HDPS and closer spacing, 36:18:18 kg/acre (N:P₂O₅:K₂O) is recommended dose. Following fertilizer schedule shall be followed for a good yield.

Fertilizer schedule	% of recommended dose per Acre
Basal or at time of sowing	1/3rd N, full dose of P and 1/2 dose of K
Squaring stage (40-45 days after sowing)	1/3rd N, 1/2 of K and 5 kg ZnSO ₄
Flowering and early boll formation stage (70-75 days after sowing)	1/3rd N + 2 kg Boron

Foliar application of plant nutrients helps in correcting nutrient deficiency if any and provide extra nutrient for healthy boll development. Foliar application to be taken up if soil test report suggests nutrient deficiency, in case of excess rainfall received (responsible for leaching of nutrients) and to meet the higher nutrient demand by plants when boll load is higher.

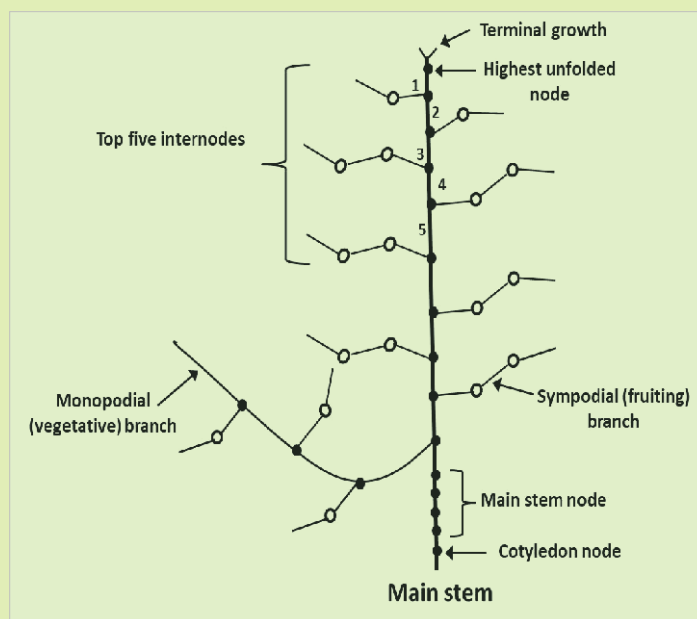
Foliar nutrition schedule	Recommended dose per Acre
90-100 days after sowing	Multi-micronutrient (1 kg in 200 litres of water for an acre)
100-110 days after sowing	19:19:19 or 13:00:45 (3-4 kg in 200 litres of water for an acre)

Canopy Management

To curtail excessive vegetative growth and retain first formed bolls in HDPS, plant growth regulator (PGR) like mepiquat chloride is used 2-3 times starting with the first application at the time of square initiation (40-45 days old crop). The schedule for PGRs in rainfed cotton is presented below-

Canopy Management schedule	Dosage of commercial formulation (Mepiquat Chloride 5% AS)
I Spray (40-45 day crop or Square initiation or crop is 40-45 cm tall)	1.0 ml/litre of water
II Spray (15-20 days after first spray) or 55 to 65 days crop	1.2 ml/litre of water
III spray (need based in case of excessive growth due to rains)	1.2 ml/litre of water

- The need and number of canopy management spray is dependent upon-
 - Soil type
 - Growth pattern of variety/hybrid
 - Prevailing/anticipated weather condition
 - Retention of first position bolls
 - Spacing/plant population
- IInd and IIIrd spray shall be taken when the Average Length of the Top five internodes (ALT5) is more than 4 cm (ALT5 is basically height node ratio (HNR) of the top five nodes).
- Before deciding any spray of PGRs, ensure sufficient moisture in soil with no forecast of dry spell in next 10 days.



- Observation for ALT5 to be taken after 15 days after first or second spray. If ALT5 is less than 4 cm, repeat the observation after every week. When ALT 5 is more than 4, spray PGR.
- Miscounting nodes will cause an error in ALT5, hence care to be taken.
- Undertake PGR spray on a clear rain free day for best results.

Soil water conservation

- Earthing up should be followed after last intercultural operation for soil water conservation. The furrow could be tied at 15 m interval to facilitate moisture retention.
- In low rainfall areas, dead furrow (furrow with desi plough) can help in rain water harvesting. It can be opened after sowing after every 2-3 row interval.



Plant Protection

Insect Pests Management

Window-based approach (Table 1) aids in the judicious use of insecticides as it guides the farmer in the adoption of control measures only after the insect population crosses the ETL (Table 2). Here the ETL is the insect count in a sample of 20 plants per acre.

Table 1. Window-based strategy for management of insects:

Crop growth stage 0-60 days after sowing (DAS)	
Insect	Recommended management tactics
Pink bollworm	At 45 DAS, install pheromone traps @ 2 per acre.
Pink bollworm and sucking pests	At 50 – 60 DAS, spray the crop with Neem oil or neem oil-based formulation (3000 or 1500 ppm) 50 ml + 5% NSKE + 10 gm detergent powder per 10 liters of water.

Crop growth stage 60-90 days after sowing (DAS)

Sucking pests

Jassids	Spray Flonicamid 50 WG @ 4g OR Dinotefuran 20 SG @ 3g OR Imidacloprid 17.8 SL @ 3 ml per 10 liters of water.
Thrips	Spray Thiamethoxam 25 WG @ 2 gm OR Spinetoram 11.7 SC @ 8.4 ml per 10 liters of water.
Whiteflies	Install yellow sticky traps (8 traps /acre from July to August for monitoring and 40 traps/acre for management). Against whitefly adult population: Diafenthiuron 50% WP @ 12g Or Afidopyropen @ 20ml Or Dinotefuran 20 SG @ 3g Or Flonicamid 50 WG @4g or Clothianidin 50%WDG 1ml per 10 liters of water. Against the Whitefly nymphs: Pyriproxyfen 10 EC@ 20ml Or Buprofezin 25 SC @ 20ml or Spiromesifen 22.9 SC @ 12ml per 10 liters of water.
Whitefly and thrips (either or both)	After 70 days old crop, spray Diafenthiuron 50WP @12g Or Spinetoram 11.7 SC 8.4ml Or Profenophos 50EC @20 ml per 10 liters of water.
Whitefly and leafhopper (either or both)	Apply Flonicamid 50 WG @4g Or Dinotefuran 20 SG @ 3g per 10 liters of water.

Bollworms

American bollworm	Spray Chlorantraniliprole 18.5 SC @ 3 ml OR Flubendiamide 39.35 SC @ 2.5 ml OR Indoxacarb 14.5 SC @ 10 ml per 10 liters of water.
Pink bollworm	Pluck and destroy the rosette flowers. Spray Profenofos 50 EC @ 30 ml OR Emamectin benzoate 5 SG @ 5 gm OR Indoxacarb 14.5 SC @ 10 ml OR Chlorpyrifos 20 EC @ 25 ml per 10 liters of water.

Crop growth stage 90-120 days after sowing (DAS)

Sucking pests

Jassids	Spray Thiamethoxam 25 WG @ 2 gm per 10 liters of water.
Thrips	Spray Thiamethoxam 25 WG @ 2 gm OR Spinetoram 11.7 SC @ 8.4 ml per 10 liters of water.
Whiteflies	Spray Dinotefuran 20 SG @ 3 gm OR Spiromesifen 22.9 EC @ 12 ml OR Pyriproxyfen 10 EC @ 20 ml OR Diafenthiuron 50 WP @ 12 gm per 10 liters of water.

Bollworms

American bollworm	Spray Flubendiamide 39.35 SC @ 3 ml OR Indoxacarb 14.5 SC @ 10 ml OR Spinosad 45 SC 4 ml per 10 liters of water.
Pink bollworm	Release egg parasitoid Trichogramma mabactrae @ 60000 (50 cards) per acre OR spray Profenofos 50 EC @ 30 ml OR Emamectin benzoate 5 SG @ 5 gm OR Indoxacarb 14.5 SC @ 10 ml OR Chlorpyrifos 20 EC @ 25 ml per 10 liters of water.

Crop growth stage > 120 days after sowing (DAS)

Pink bollworm	Spray Cypermethrin 10 EC @ 10-15 ml OR Cypermethrin 25 EC @ 4-6 ml OR Lambda cyhalothrin 5 EC @ 10 ml OR Deltamethrin 2.8 EC @ 10 ml OR Fenpropathrin 10 EC @ 15-20 ml OR Fenvalerate 20EC @ 10 ml OR Alphacypermethrin 10 EC @ 6 ml per 10 liters of water.
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Table 2. ETL of major insects

Insect	Economic threshold level (ETL)
Sucking insects	
Jassids or leaf hoppers	25% of plants show infestation grade of II/III/IV OR 2 nymphs per leaf
Aphids	10% of plants show symptoms of cupping/ crumpling of a few leaves on the upper portion of the plant
Thrips	25% of the plants show silvery patches on the underside of leaves above mid canopy OR 10 thrips per leaf
Whiteflies	6 whiteflies per leaf
Bollworms	
American bollworms	20% of plants having one or more 'flared up' squares OR 5-10% infested square or bolls
Pink bollworm	More than 8 moths/trap per night for 3 consecutive nights and or more than 10% infested flowers or bolls (at least two bolls having live pink or white larvae)

Disease Management

Seed/soil borne diseases and seedling diseases (Root rot, wilt)

- Adopt suitable crop rotation practices
- Avoid indiscriminate use of nitrogenous and phosphatic fertilizers
- Treat the seeds with Carboxin 37.5% + Thiram 37.5% DS @3.5 g per kg of seeds to prevent seed borne fungal and bacterial diseases OR Trichoderma powder (biofungicide) at the rate of 5 g per kg of seeds
- Soil drenching with 2 kg of Trichoderma harzianum OR T.viride WP formulation mixed in 200 litres of water for application in total one acre for the management of soil borne diseases and nematode infestation problem



Leaf spot disease

Spray of Pyraclostrobin 20% WG @10 g OR Carbendazim 50% WP @4 g OR Metiram 55%+Pyraclostrobin 5% WG 20 g OR Kresoxim-Methyl 44.3% SC @10 ml OR Propiconazole 25% EC @10 ml OR Propineb 70 WP @25-30 g OR Azoxyystrobin 18.2% W/W + Difenoconazole 11.4% W/W SC@10 ml OR Fluxapyroxad 167 g/L+Pyraclostrobin 333 g/L SC @6 g per 10 litres of water is recommended.



Bacterial leaf blight

- Prophylactic spray of copper oxychloride 50 WP/WG @25-30 g per 10 litres of water.



- Seed treatment with *Pseudomonas fluorescens* 0.5% WP @10 g per kg seed for the management of bacterial leaf blight

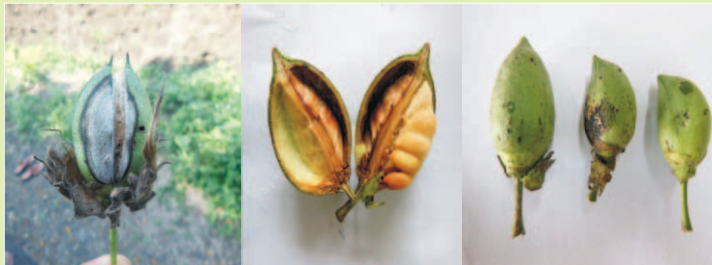
Grey mildew

Foliar spray of Azoxystrobin 18.2% w/w+ Difenoconazole 11.4% w/w SC @ 10 ml OR Kresoxim-methyl 44.3% SC@ 10 ml per 10 litres of water.



Boll rot disease complex (Bacterial and fungal)

Prophylactic spray of copper oxychloride 50 WP/WG @25-30 g and after seven days, foliar spray of propiconazole 25 EC @10 ml OR Propineb 70 WP @25 g OR carbendazim 50 WP @ 4 g OR Azoxystrobin 18.2% w/w+Difenoconazole 11.4% w/w SC @10 ml OR Fluxapyroxad 167 g/L + Pyraclostrobin 333 g/L SC @ 6 g mixed in 10 litres of water is suggested during flowering and early boll developmental stages to manage boll rot disease complex (bacterial and fungal) in cotton, particularly in case of prevailing cloudy weather, high humidity, winds, rain splash and drizzle rains occurs.



Harvest

Crop is ready for first picking after 130-135 DAS and 2nd picking by 150-160 DAS. First picked cotton in general is of better quality. Picking wise storage in cloth bags is recommended. While picking and storage care should be taken to avoid contaminants such as hair, white polythene, other extraneous materials, etc.



Cotton stalk shredding

Standing stalk of cotton to be shredded with tractor operated mobile cotton shredder followed by spray of *Trichoderma harzianum*/T. viride WP @ 5 g/litre of water and mix the shredded biomass onto the soil. *Trichoderma* formulation helps in speedy decomposition and bioconversion of cotton residues. Shredding the cotton stalks add about 2.0 ton/acre biomass to the soils (about 20 kg N, 2.0 kg P₂O₅ and 12 kg K₂O added to soil) and improve the organic carbon content of soil in long run. Shredding of left over cotton bolls on stalk destroys resting stages of PBW and reduces off-season survival and carry over.



Advantages of HDPS

- HDPS gives 20-30% higher yield on an average than conventional cotton under rainfed conditions. In shallow soils, yield advantage is generally much higher in a good season with well distributed rainfall.
- After harvesting of HDPS cotton by 150 days, second crop can be taken up in the rabi season (chickpea, wheat, linseed, mustard, maize etc.) with the help of limited irrigation facility.
- HDPS cotton not only ensures good crop yield but also makes cotton crop ready for mechanical picking.
- Early maturity and timely harvest of crop before the onset/ severity of pink bollworm in November/December prevents yield loss and reduces cost of cultivation.

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