Package of Practices for Cotton Cultivation in North Cotton Growing Zone of India

ICAR-CICR, Regional Station, Sirsa, Haryana

Cropping year: 2023-24

Important points:

- Select and grow only recommended varieties/hybrids of cotton.
- For better germination and early establishment of plants apply heavy pre-sowing irrigation.
- Complete the sowing by 15thMay.
- Refuge in bag as seed mix of Bt and Non-Bt has been recommended for sowing but grow non-Bt cotton as a refuge on the periphery of Bt cotton in the case supplied in a separate pouch.
- Apply first irrigation till 4-6 weeks after sowing depending on soil type and rain fall.
- To enhance the fast and synchronizing opening of bolls, apply last irrigation in end-September.
- To avoid simultaneous build-up and spread of pests and diseases to cotton, don't grow okra, moong, arhar, castor, cucurbits and dhaincha in and around the cotton fields.
- Apply 4 sprays of 2% potassium nitrate (13:0:45) solution starting at flower initiation at weekly intervals.
- Balanced use of nutrition and avoid excessive use of nitrogenous fertilizers.
- Regular monitoring is an effective strategy for managing insect pests and diseases in cotton. Survey cotton fields regularly.
- Avoid using synthetic pyrethroids after September 15 to minimize the resurgence of whitefly.
- Use recommended insecticides only. Avoid tank mixing and use of readymade insecticidal mixtures.

Climatic Requirements:

Cotton is a *Kharif* season crop for North Cotton Growing Zone of India and requires uniformly high temperature varying between 21°C and 32^{o} C. Warm days of cool nights with large diurnal variations during the period of fruiting are conducive to good boll & fibre development. The cotton-picking period must have bright sunny days to ensure a good quality of the produce.

Soil Type:

Cotton can be successfully grown on all type of soils, except sandy, saline or waterlogged types. Proper drainage of excess water during rains is essential.

Rotations

Cotton – Wheat / Barley, Cotton – Sunflower, Cotton – *Senji* / *Barseem* / Oats, Cotton–Sunflower- Paddy-Wheat, Cotton – *Raya,* Cotton – Chickpea (Bengal gram).

Recommended hybrids and varieties:

States	Desi Cotton (*Desi kapas*)		American Cotton (*Narma*)		American Bt-Cotton (*Narma*)	
	Varieties	Hybrids	Varieties	Hybrids	Varieties	Hybrids
Haryana#	CICR-1, CICR-3, HD 123, HD 324, HD 432	CICR-2, AAH 1, KR 64	CSH 3129, CSH 3075 (HDPS), H 1098, H 1117, H 1226, H 1236, H 1300	CSH 198, CSH 238, CSH 243, CSH 1862	CICR Bt. 6	Select Bt-hybrids recommended by ICAR-CICR & SAUs, each year.
Punjab#	LD 1019, LD 949, FDK 124, CICR-1, CICR-3	CICR-2	F 2228, LH 2108, CSH 3129, CSH 3075 (HDPS)	LHH 144, HHH 287, HHH 223, CSH 198, CSH 238, CSH 243, CSH 1862	CICR Bt. 6, PAU Bt 2 and PAU Bt 3	
Rajasthan#	HD 123, RG 8, RG 18,RG 542, CICR-1, CICR-3	RAJ.D.H.9, CICR-2	RS 875, RS 2013, RS 810, RST 9, Bikaneri Narma Ganganagar Ageti, CSH 3129, CSH 3075 (HDPS)	RAJ.H.H.16, CSH 198, CSH 238, CSH 243, CSH 1862	--	

#Source: Package of Practices of respective states

Agronomic Practices:

Sub Soiling Operation and land Preparation:

To break the hard soil pan, cross sub soiling at 1.0 m spacing or operatemould board plough for deep ploughing before preparing the field.This will help in breaking the hard pan, increasing water infiltration and better root development of cotton plants.

Time of Sowing:

Sow the crop from1st April to 15th May. Sowing during this period ensures better yield and escapes the attack of insect pests and diseases. Sowing should be done in the morning and evening hours. Complete sowing of *Desi*(*arboreum*)cotton within April only.

Seed Rate:

States	Desi Cotton (*Desi kapas*) (perhectare)		American Cotton (*Narma*) (per hectare)		American Bt-Cotton (*Narma*) (per hectare)	
	Varieties	Hybrids	Varieties	Hybrids	Varieties	Hybrids
Haryana	7.5 kg	3.125 kg	8.75-10.0 kg	3.75 kg	10.0 kg Bt seed + (Recommended N-Bt as refuge)	2.375 – 2. 970 kg
Punjab	7.5 kg	--	8.75-10.0 kg	3.75 kg	10.0 kg + 2.5 kg refugia	2.375 – 2. 970 kg
Rajasthan	12.0-15.0 kg	--	8.75-10.0 kg	3.75 kg	--	2.375 – 2. 970 kg

#Source: Package of Practices of respective states

*In case of Bt cotton to avoid the development of resistance in bollworms against Bt cotton, non-Bt cotton plant as a structured refuge has to be cultivated in 20percent area around Bt cotton under bollworm protection conditions or 5% under unprotected conditions. In case "Refuge in bag" 5 percent mixture of Non-Bt seed with Bt seed is available, no separate planting of refugia is required.

Acid Delinting of Seed: Bt hybrids seed available in the market is already acid delinted and treated, in case fuzzy seed of Non-Bt *hirsutum or* arboreum (*Desi Kapas*) to be used then acid delinting of fuzzy seed should be done.

Mix 100 g commercial grade concentrated sulphuric acid with 1 kg cotton seed in earthen/ plastic container by stirring it vigorously for two to three minutes with a thick wooden stick. As soon as the fuzz gets dissolved, add 10 litres of water, stir well and drain out water through the perforated plastic basket. Repeat these washings three times to make the seed free from sulphuric acid residue. Dip the washed seed for about one minute in sodium bicarbonate solution (12.5 g sodium bicarbonate in 2.5 litres of water) to neutralize the acid residue on the cotton seed. Give one more washing with water and remove light, damaged and rotten inviable seeds floating on the surface. Dry the healthy fuzz-free seed in the shade by spreading in a thin layer. Adopt following precautions:

Precautions to be taken during acid Delinting of Seed:

1. Metal or wood container should not be used.
2. The operator should wear the plastic gloves.
3. The water containing acid and alkali residue should be properly disposed off in the waste land.
4. Inadequate washing and delayed washing of the seed after acid treatment and residual acid on the seed if not neutralized may impair the germination of seed.

Seed Treatment and Seed Soaking:

Bt -cotton hybrid seed available in the market is already treated. However, if sowing of Bt -varieties / Non-Bt *hirsutum* or arboreum (*Desi Kapas)* has to be done, treat the seed as under:

- Seed treatment with Carboxin 75%WP @2.5g/kg or Thiram 75%WP @ 2.5-3g/Kg or Thiram 37.5+Carboxin 37.5% DS @ 3.5 g / kg seed or Tetraconazole 11.6% w/w (12.5% w/v) SL @ 2 ml /kg seed or *Trichoderma harzianum* or *T. viride* @10g/ kg and or *Pseudomonas fluorescence* @ 10 g/kg seed before sowing should be done.
- The seed treatmentwith 5 g Gaucho 70 WS (Imidacloprid) or 7 g Cruiser 30FS (Thiamethoxam) per kg seed for preventing cotton leafhopperdamage should be applied beforebiopesticide treatment. In case non-delinted seed is used, rub it with fine earth, cow-dung or ash to remove its fuzz and ensure uniform sowing.

Sowing and Spacing:

To maintain optimum plant stand, spacing mentioned as under has to be followed.

Crop	Haryana			Punjab			Rajasthan		
	R x R (cm)	PxP (cm)	Total Plants per ha	R x R (cm)	P x P (cm)	Total Plants per ha	R x R (cm)	P x P (cm)	Total Plants per ha
Desi Cotton (*Desi kapas*)	67.5	30	49,382	67.5	45	32,921	67.5	30	49,382
Desi Cotton (*Desi kapas*) hybrids	67.5	60	24,691	67.5	60	24,691	67.5	60	24,691
American Cotton (*Narma*) varieties	67.5	60	24,691	67.5	60	24,691	67.5	30	49,382
American Bt & Non Bt Hybrids*Narma*	100	45	22,222	67.5	75	19,753	108	60	15,432
American Cotton HDPS (*Narma*)	67.5	15	98,765	67.5	15	98,765	67.5	15	98,765

#Source: Package of Practices of respective states

Weed Control:

Hoe the crop two or three times. The first hoeing should be done before first irrigation. Use tractor mounted cultivator / tractor operated rotary weeder / triphali or wheel hand hoe / *Kasaula* for weeding. Their use after fruiting should be avoided.

Pre-emergence herbicide application: For control of weeds particularly itsit, madhana / makra, apply 2.5 litre per hectare Stomp 30 EC (Pendimethalin) as pre-emergence within 24 hours of sowing. Use 500 litre of water per hectare for its spray application. The herbicide can also be sprayed with a tractor-mounted sprayer fitted with flat fan nozzle either in the morning or evening hours. Ensure a fine seedbed free from plant residues and clods, adequate moisture in the field at the time of spray of herbicide.

Post emergence herbicide application: In situations where weeds emerge after first irrigation or with the rain shower, Stomp 30 EC can also be applied as post-emergence after first irrigation in 500 litre of water per hectare. If some weeds emerge before the application of the herbicide, a light hoeing / interculture may be done.

Alternatively, spray 1,250 ml per hectare Hitweed Maxx 10 MEC (Pyrithiobac sodium 6% + Quizalofop ethyl 4%) by dissolving in 375 litres of water after first irrigation, in moist soil, to control annual grass and broadleaf weeds. Alternatively, at 6-8 weeks after sowing when the crop is about 40-45 cm in height, spray 1,250 ml per hectare Gramoxone 24 SL (Paraquat) or 2,250 ml per hectare Sweep Power 13.5 SL (Glufosinate ammonium) in 250 litres of water as a directed spray to control weeds in between the crop rows. The directed spray can be done by using a protective hood. Paraquat and glufosinate are non-selective herbicides and can cause injury to the crop if these fall on the crop leaves.

Fertilizer Application:

Apply fertilizer on the soil test basis. The fertilizer recommendations for medium fertility soils are as under:

Sr. No.	States	Crop		Desi Cotton (*Desi kapas*)		American Cotton (*Narma*)	
				Varieties	Hybrids	Varieties	Bt/Non Bt Hybrids
1.	Haryana	Nutrient (kg / ha)	Nitrogen	50		87	175
			Phosphorus P_2O_5	-	Same as American cotton hybrids	30	60
			Potash	-		-	60
		Fertilizer (kg / ha)	Urea	112		187	375
			*DAP	-		67	135
			*SSP	-		187	375
			MOP	-		-	100
2.	Punjab	Nutrient (kg / ha)	Nitrogen	75		75	105
			Phosphorus P_2O_5	30		30	30
			Potash	-		-	-
		Fertilizer (kg / ha)	Urea	162		200	225
			DAP	67		67	67
			SSP	187		187	187
3.	Rajasthan	Nutrient (kg / ha)	Nitrogen	90		100	150
			Phosphorus P_2O_5	20		40	40
			Potash	-		20	-
		Fertilizer (kg / ha)	Urea	195		217	325
			DAP	45		87	87
			SSP	125		250	250
			MOP	-		35	-

*Apply either DAP or SSP as Phosphorus source.

#Source: Package of Practices of respective states

- Omit application of phosphorus to cotton when it follows wheat which had received recommended dose of phosphorus. Where 67.5 kg DAP is used, reduce the urea dose by 25 kg (under Punjab conditions).
- Apply 50 kg muriate of potash and 25 kg zinc sulphate heptahydrate (21%) or 16.25 kg zinc sulphate monohydrate (33%) per hectare to cotton in light soils.
- Drill all phosphorus at sowing. Apply half nitrogen at thinning and remaining half at the appearance of flowers.
- If the soil is low in fertility, the first half dose of nitrogen may be applied at sowing instead of at thinning.
- Apply 1kg boron (10 kg borax) per hectare at sowing inboron-deficient soils.
- To get higher yields, give 4 sprays of 2% potassium nitrate (13:0:45) at weekly intervals starting at flower initiation.
- For high yield and management of leaf reddening in Bt cotton, give 2 sprays of 1% magnesium sulphate (2.5 kg magnesium sulphate in 250 litres of water per hectare) at 15 days interval during full bloom and boll development stages.

Use of growth retardant:

In heavy soils, cotton attains excessive vegetative growth during rainy season. To check excessive vegetative growth in heavy soils, give 2 sprays of Chamatkar (mepiquat chloride 5% w/w) 750 ml per hectareusing 200-250 litres of water at 60 and 75 days after sowing(source: Package of Practices of respective states).

Irrigation and Drainage:

Cotton requires 4-6 irrigations depending upon the seasonal rainfall. The first irrigation should be given 4 to 6 weeks after sowing and the subsequent ones at an interval of two or three weeks. However, on light soils or in crops sown on ridges, the first irrigation may be advanced, if necessary. Cotton during its early growth is very sensitive to water stagnation. Therefore, drain out the stagnant water if such a situation arises. To hasten the boll opening, give the last irrigation by the end of September.

PRECAUTIONS:

1.Cotton is highly sensitive to the 2, 4-D herbicide. Some farmers spray the ester form of 2, 4-D for controlling weeds in maize grown near the cotton fields. Owing to the volatile nature of 2, 4-D ester, its vapours cause serious injury to the cotton crop. Hence avoid the application of this herbicide in maize, if cotton is grown in the adjoining fields.

2. After using 2, 4-D on any crop (e.g. wheat, barley etc.), Wash all spraying equipment as well as tubs, buckets, etc. with 0.5 per cent washing soda solution (500 g of washing soda in 100 litres of water), flush all equipments thoroughly with fresh water.

3.To avoid the use of contaminated insecticides on cotton.

Pests &Diseases Management Strategies in North Cotton Growing Zone of India

Sucking Insect Pests	
Pests	Damage symptoms
Thrips Whitefly, leafhopper and mealybug	Appeared in cotton crop after sowing but their maximum damage is during July-September. The decision regarding spray of insecticides should be taken based on Economic Threshold Level (ETL).
Bollworms	
Spotted bollworms, *Earias insulana,* E.*vittella*	Shedding squares, buds, flowers and bolls during July to October
American Bollworm, *Helicoverpa armigera*	Severe shedding of fruiting bodies during September-October
Pink Bollworm, *Pectiniphora gossypiella*	Damage in the form of rosette flowers, boll damage
Tobacco caterpillar *Spospteralitura*	After hatching, first and second instar larvae feed gregariously and skeletonise the foliage, later on, grown-up larvae disperse and feed singly. Besides leaves, they also damage the buds, flowers and green bolls

Table : ETL for different insect-pest in cotton crop

Name of the Pest	ETL
Jassids/Leafhoppers	Two nymphs per leaf or appearance of second grade injury (yellowing in the margins of the leaves)
Thrips	10 adults per leaf
Aphids	Honeydew symptoms on 50% plants (observe 20-25 Plants per acre)
Whiteflies	6-8 adults per leaf
Mealy bugs	5% affected plants
Mites	10 per cm^{-1}
American bollworm (*H. armigera*)	1 egg per plant/ 1 larva per 2 plants
Spotted bollworm (*E. vitella*)	10 % infested fruiting body (Square, flowers and bolls).
Pink bollworm (*P. gossypiella*)	Eight moths per trap per day for three consecutive days or 10 % infested flowers or bolls.
Tobacco caterpillar (*S. litura*)	One egg mass/ 20 plants**or**>5 full grown larva on 10 plants **or** 1 skeletonized leaf / ten plants

Integrated Pest & Diseases Management Strategies		
Pre-Sowing	General	▪ Monitoring and management of sucking pests and disease should be done from February onwards on all alternate hosts —vegetable, ornamentals and weeds ▪
		▪ In case fuzzy seed is to be used for cultivation, do acid delinting and dry seed thoroughly in the sun in a thin layer for 3-4 consecutive days in April. Even the apparently healthy seed-cotton (kapas) may be harbouring larvae of pink bollworm. ▪ Do not grow okra, moong, cucurbits and arhar in the cotton crop and as border rows in order to reduce the incidence of insect pests ▪ Destroy all trash collected during the ginning process. ▪ Remove all seed from the ginneries by the end of March. Fumigate the seed left uncrushed in the mills before end of April with Celphos / Phostoxin / Delicia @ one 3-g tablet per cubic metre space, giving an exposure of 48 hours or use two tablets with an exposure of 24 hours. ▪ Soil application of *Trichoderma harzxianum or T. Viride*and or *Pseudomonas fluorescence* @ 2.5 kg / ha by mixing in 250 kg of vermicompost / well-decomposed FYM. ▪ Keep fields, bunds and the vicinity free of weeds before and after the sowing of cotton. Destroy volunteer / ratoon cotton plants as well as the weed hosts growing near the irrigation channel / canal and fellow lands during the off-season.
Sowing	Sucking pests	▪ Grow recommended high yielding cotton genotype approved by the SAU/ICAR/ Department of Agriculture having tolerance to insect pests. ▪ Ensure timely sowing (up to 15thMay for the American cotton hybrid/varieties and upto 30th April for arboreum/Desi cotton varieties) of the crop as timely sown crop tolerates whitefly and CLCuD. ▪ Apply recommended dose of fertilizers as per the package of practices of respective SAU and after soil health inspection. Avoid excessive urea application during early vegetative phase of the crop. ▪ Grow two dense rows of sorghum or pearl-millet or maize as border around cotton fields. Create ecological diversity by growing Desi cotton and other non host crops between the cotton fields**.**

	Boll worms	▪ Even the apparently healthy seed-cotton (kapas) may be harbouring larvae of pink bollworm. Hence, kapas retained by the farmers should be ginned by the end of March and seed fed to cattle. If this seed is to be retained for sowing, it should be acid-delinted/fumigated or thoroughly dried in the sun in a thin layer for 3-4 consecutive days in April.
	Diseases	▪ Seed treatment with Carboxin 75%WP @2.5g/kg or Thiram 75%WP @ 2.5-3g/Kg or Thiram 37.5+Carboxin 37.5% DS @ 3.5 g / kg seed or Fluxapyroxad 333 g/l @ 1.5ml/kg or Tetraconazole 11.6% w/w (12.5% w/v) SL @ 2 ml /kg seed or *Trichoderma harzianum* or *T. viride* @10g/ kg and or *Pseudomonas fluorescence* @ 10 g/kg seedand or Azotobacter and PSB (phosphate solubilizing bacteria) @ 25 g each / kg seed should be used for nutrients fixationbefore sowing. ▪ *Fusarium* wilt tolerant varieties of Desi cotton should be grown. ▪ In the case of fields with a history of sudden wilt and other soil-borne disease problems, adopt crop rotation, deep ploughing, incorporation of crop residue, green manuring, well-decomposed FYM/compost and seed and soil treatment as mentioned above.
0-70 DAS	Sucking pests	▪ Monitor the fields regularly for sucking pest infestation by observing 3 leaves from upper, middle and lower strata of 20plants /acre. ▪ Install low cost yellow sticky traps as per recommendations (40-50 / acre) of during July to August for whitefly monitoring & management. ▪ Do not generally use any insecticide during early period (0-70DAS)to conserve natural enemies. ▪ Use botanical and initially apply NSKE 5% + Neem oil 5 ml /litre or neem oil-based formulation 5 ml /litre (300 or 1500 ppm) + 1.0gm laundry detergent emulsion (Initial 2 sprays) for sucking pests if approaching ETL(whitefly-18-24 adults/3leaves, thrips-30 to 40 nymphs & adults/3 leaves and jassids, 6 nymphs/3leave).
	Boll worms	▪ Monitoring of bollworms through pheromone traps by installing two traps per acre specific to each bollworm. Apply recommended interventions whenever population of insects' pests crossed ETL. ▪ For Pink Bollworm (PBW) and other bollworms apply neem-based or NSKE as suggested for sucking pest. ▪ For spotted bollworm in Desi cotton apply cypermethrin10 EC @ **500 ml,** cypermethrin25 EC @**200 ml,** deltamethrin 2.8 EC@ **400 ml,** fenvalerate 20 EC@ **250 ml and** fenpropathrin10 EC @ **750 ml per ha**at 10 percent flower initiation.
	Diseases	▪ Root Rot--Spot application of Carbendazim @ 2.0 g / L of water or *Trichoderma harzianum* or *T. viride* @ 6 g / L in the affected patches. ▪ **IPM for CLCuD**:- Vector management by 1-2 foliar spray of Nimbecidine 300 ppm @ 1 L /acre + 0.1% washing powder followed by diafenthiauron (200 gm / acre) / buprofezin (320 ml / acre) for adults and spiromesifen (200 ml/acre)/ pyriproxifen (400-500 ml/acre) for nymphs or 3-5 foliar spray of Salicylic acid (200 ppm) or butter milk 5% or Cow urine +Calcium nitrate (6.6%+0.5%) or mustard oil (3.0%) starting from 30 days after sowing
71-90 DAS	Sucking pests	▪ **Good intensity rainfall helps in the reduction of whitefly & thrips infestation.** ▪ Apply recommended insecticides for sucking pests at ETL as mentioned above .

		▪ In case of an outbreak in the form of **whitefly** counts observed many times above the ETL, appearance of sticky leaves or sooty mold or presence of whitefly on the upper surface of leaves, spray cotton crop immediately targeting the adults first and subsequently the nymphs**(3-5 days after spray applied for adults)**as using below mentioned insecticides. **Insecticides effective against whitefly adult population** diafenthiuron 50% WP (500 g/ha)**or** afidopyropen50G/L@ 1000 ml/ha **or** dinotefuran 20 SG (150g/ha) **or** flonicamid 50 WG (200 g/ha). **Insecticides effective against the nymphs** pyriproxyfen 10 EC (1250 ml) /ha **or** buprofezin 25 SC (1000 ml/ha) **or** spiromesifen22.9 SC(500 ml /ha) in 500 liters of water/ha. ▪ **Sprays effective against mixed infestation of sucking pests** ▪ If mixed infestations of **whitefly and thrips** either or both are observed above ETL after 70 days old crop, spray diafenthiuron 50 WP (500g/ha) **or** spinetoram 11.7 SC (425 ml/ha) **or** profenophos 50EC (1250 ml/ha)in 500 litre water/ha to manage both the sucking pests ▪ If the mixed infestation of **whitefly and leafhopper** either or both are observed above ETL, apply flonicamid 50 WG (200 g/ha) **or** dinotefuran 20 SG (150g/ha) in 500 liters water/ha. ▪ **In case Sooty mould develop**-- Three Prophylactic/therapeutic sprays of propiconazole 25EC @1ml/L **or** copper oxychloride (COC) 50 WP @ 2.5 g/L at 15 days interval may be applied.
	Boll worms	▪ In case of PBW, ETL either through trap catches (8 moths/trap for 3 consecutive nights) or observed fruiting body damage (flower or green boll) is >10%, spray cotton crop with chlorpyrifos 20 % EC (1250 ml) **or** profenophos 50EC (1250-2000 ml) **or** indoxacarb 14.5SC (500ml) **or** emamectin benzoate 5SG (250 g), thiodicarb 75 WP (625 g) per hectare.
	Diseases	▪ Root Rot/wilt: Spot application of carbendazim @ 2.0 g/Lof water or *Trichoderma harzianum* or *Trichoderma viride* @ 6 g/Lin the affected patches. ▪ IDM for CLCuD: 3-5 foliar spray of Salicylic acid (200 ppm) or buttermilk 5% or Cow urine +Calcium nitrate (6.6%+0.5%) or mustard oil (3.0%)starting from 30 DAS. ▪ Sooty mould --Prophylactic sprays of Flonicamid @ 0.4g/L or propiconazole @1ml/L or COC @ 2.5 g/L.
91-120 DAS	Sucking pests	▪ Apply diafenthiuron 50% WP (500 gm/ha) **or** afidopyropen 50G/L (1000 ml/ha) **or** dinotefuran 20 SG (150g/ha) **or** flonicamid 50 WG (200 g/ha) for whitefly adult's control. ▪ If higher population of eggs and nymphs of whitefly observed under the leaves as indicated by sticky leaves, then application of buprofezin (1000 ml); spiromesifen (500 ml) or pyriproxifen (1000-1250 ml) per hectare is advisable.
	Boll worms	▪ For PBW- chlorpyrifos 20 % EC (1250 ml) **Or** quinalphos 20AF (500-900 ml) **or** thiodicarb 75 WP (625 g) or profenophos 50 EC (1250 ml); indoxacarb 14.5 SC (500ml); emmamectin benzoate 5 SG (250 g) per hectare is advisable. ▪ In case of arboreum or American cotton, incidence of Spotted bollworm or American bollworm is observed apply spinosad 45SC @150-188 ml/ha or flubendiamide 480

		SC @ 100 ml/ha or indoxacarb14.5 SC @500ml/ha or chlorantraniliprole18.5SC 150 ml/ ha (only for ABW)
	Diseases	▪ Root rot, wilt-- Spot application of Carbendazim @ 2.0 g/Lor *Trichoderma harzianum* or *Trichoderma viride* @6 g/Lin the affected patches. ▪ Alternaria & Cercospora leaf spot :-Kresoxim-methyl 44.3%SC@ 1ml/L or Azoxystrobin 18.2% + difenoconazole 11.4% SC@ 1ml/L or Propineb 70%WP @2.5-3 g/L ▪ Sudden wilt/parawilt --Avoid water stagnation in the crop.Apply foliar spray of Cobalt chloride @10 ppm or sodium benzoate@ 50ppm and/ordrenching of Copper oxychloride 25g+200g Urea / 10 L immediately after the appearance of the wilting symptoms on the affected plants. ▪ Boll rot --Copper oxychloride 50 %WP @2.5g or Propiconazole 1ml/L of water ▪ For CLCuD, 3-5 foliar spray of Salicylic acid (200 ppm) or butter milk 5% or Cow urine +Calcium nitrate (6.6%+0.5%) or mustard oil (3.0%) starting from 30 DAS. ▪ Sooty mold-- Prophylactic sprays of Flonicamid @ 0.4g/L or propiconazole @1ml/L or COC @ 2.5 g/L ▪ Leaf reddening --Foliar spray of 1% MgSO4, 2%, Urea 0.5%, Zinc Sulphate and 0.2 % Boron, twice at 15 days intervals on 90 days old crop followed by a spray of 2% DAP.
121-150 DAS	Sucking pests	▪ To manage the second flush of whitefly (later part of season after 15thSeptember restricted use of ethion 50 EC (2000 ml/ha) is also advisable.
	Boll worms	▪ For pink bollworm control, spraying the crop with ethion 50 EC (2000 ml/ha)**or**fenvalrate 20 EC (250ml/ha) or lambda-cyhalothrin 5% EC (300-500ml/ha) orcypermethrin 10 EC (500-625 ml/ha) **or** cypermethrin 25 EC (200-250 ml/ha) **or** deltamethrin 2.8 EC (400-500 ml/ha) **or** alphamethrin 10 EC (250-310 ml/ha) **or** fenpropathrin 10 EC (750 ml/ha). ▪ Terminate the crop as early as economically feasible. For this purpose give last irrigation by end of September. It would reduce bollworms damage and their carryover to the next cropping season. ▪ Allow sheep and goat grazing in field after picking to reduce the carryover of bollworms. ▪ Stack cotton sticks away from the field vertically. If possible shredding of cotton stalks in soil is advisable. ***Use 150-200 litres of water /acre or 375-500 litre/ ha for dilution of the insecticides.**
	Diseases	▪ Alternaria & Cercospora leaf spot :-Kresoxim-methyl 44.3%SC@ 1ml/L or Azoxystrobin 18.2% + difenoconazole 11.4% SC@ 1ml/L or Propineb 70%WP @2.5-3 g/L ▪ Boll rot --Copper oxychloride 50 %WP @2.5g or Propiconazole 1ml/L of water ▪ For CLCuD, 3-5 foliar spray of Salicylic acid (200 ppm) or buttermilk 5% or Cow urine +Calcium nitrate (6.6%+0.5%) or mustard oil (3.0%) starting from 30 DAS. ▪ Sooty mold-- Prophylactic sprays of Flonicamid @ 0.4g/L or propiconazole @1ml/L or COC @ 2.5 g/L

Insecticides for the management of sucking insect pests

Insecticide	Dose/ hectare	Insecticide	Dose/ hectare
Whitefly		**Jassids**	
Dinotefuran 20 SG	150 g	Dinotefuran 20 SG	150 g
Diafenthiuron 50 WP	500 g	Flonicamid Ulala 50 WG	200 g
* Pyriproxyfen 10 EC	1,250 ml	Thiamethoxam 25 WG	100 g
*Spiromesifen 22.9 SC	500 ml	**Thrips**	
Flonicamida 50 WG	200 g	Spinetoram 11.7 SC	425 ml
Buprofezin 25 SC	1,000 ml	Profenophos 50 EC	1,250 ml
Clothianidin 50 WG	50 g	Diafenthiuron 50 WP	500 g
Ethion 50 EC	2,000 ml	**Mealybug**	
Nimbecidine or Achook	2.5 litre	Sulfoxaflor 21.8 SC	375 ml
		**Buprofezin 25 SC	1,250 ml

*Insecticides are more effective against nymphs of whitefly. Wait for 5-7 days to see the effective results.
**This pesticide is safe for natural enemies.(Source: POP SAU/CICR/Label Claim)

Insecticides recommended for the control of bollworms:

Insecticides	Dose/ hectare
Pink and spotted bollworms	
Synthetic Pyrethroids	
Cypermethrin 10 EC	500 ml
Cypermethrin 25 EC	200 ml
Deltamethrin 2.8 EC	400 ml
Fenvalerate20 EC	250 ml
Fenpropathrin10 EC	750 ml
Pink, spotted and younger larvae of American bollworm	
Carbamates	
Thiodicarb75 WP	625 g
Organophosphatic	
Profenophos50 EC	1,250 ml
Chlorpyriphos20 EC	1250 ml
Quinalphos 20AF	1000ml
Ethion50 EC	2,000 ml
Miscellaneous group	
480 SC (Flubendiamide*)	100 ml
Grown up larvae of American bollworm and other bollworms	
Naturalyte	
Spinosad48 SC/ Spinosad 45 SC	150 ml
Oxadiazine	
15 EC (Indoxacarb)	500 ml
Miscellaneous group	
Chlorantraniliprole18.5 SC	150 ml
Emmamectin benzoate 5 SG	250 g
Organophosphates	
Chlorpyriphos20 EC	1250 ml
Tobacco caterpillar	
Insect Growth Regulator	
Novaluron10 EC	375 ml
Miscellaneous group	
Chlorantraniliprole18.5 SC	150 ml

(source: POP SAU/CICR/Label Claim)

Fungicides recommended for the control of diseases

	Chemical*	Disease	Dosage /ha			
			a.i. (g)	Formulation (g/ml)/%	Dilution	Waiting period
	Seed treatment chemicals					
1	Carboxin 75% WP	Angular Leaf spot	1.5 - 1.875 gm/ kg seed	2-2.5 gm/ kg seed		Only one time
2	Thiram 75% WS	Seed born disease	18.8-22.5 gm	25-30 gm	1	7-10
3	Carboxin 37.5%+ Thiram 37.5% WS	Root rot, Bacterial bight	2.5gm/Kg seed	3.5gm/Kg seed	-	~ 3 months
4	Tetraconazole 11.6% w/w (12.5% w/v) SL	Root rot (*Rhizoctonia solani*)	15	120		NA (Seed dresser)
5	Fluxapyroxad 333 g/l FS	Seedling Disease	0.49	1.5 ml/kg seed		
	Foliar spray chemicals					
1	Carbendazim 50% WP	Leaf spot	125	250	750	
2	Kresoxim-methyl 44.3% SC	Leaf spot, grey mildew	250	500	500	25
3	Propiconazole 25% EC	Alternaria leaf spot	125	500	500	23
4	Pyraclostrobin 20% WG	Alternaria leaf spot	100	500	500	14
5	Propineb 70%WP	Alternaria leaf spot	875-1050	1250-1500	500	27
	Mixtures					
6	Fluxapyroxad 167 g/l + Pyraclostrobin 333 g/l SC	Alternaria leaf	150	300	500	27
7	Metiram 55% + Pyraclostrobin 5% WG	Alternaria leaf spot	900-1050	1500-17500	45	45
8	Azoxystrobin 18.2% w/w + Difenoconazole 11.4% w/w SC	Leaf spot and grey mildew	0.03% or 0.3 g/L	0.1% or 1 ml / Litre water	500	12

(Based on Package of Practices and CIB&RC certificate issued up to 30.05.2022)

Information provided by: ICAR-CICR, Regional Station, Sirsa, Haryana (2023)

Information collected and uploaded by Dr. M. Sabesh, CICR