Package of Practices for Cotton Cultivation in North Karnataka

Cotton Research Station, UAS – Dharwad (Karnataka)

Cotton is an important commercial crop. It is grown in an area of 5.47 lakh ha, out of which 90 per cent of the area is occupied by Bt-cotton. The total cotton production is 18.44 lakh tones with productivity of 13.49 qt. kapas per hectare (2017-18). Cotton cultivation is found to be remunerative in diversified agricultural zones of Karnataka due to continues research on varietal improvement, crop production and protection technologies under irrigated and rainfed conditions,

Varieties: Details indicated in Table 1.

Agricultural Inputs required.

1. **Seed Rate**

Methods of sowing	Seed rate (kg/ac)	
	Varieties	Hybrids
Drill sown	3.0-4.0	--
Hand dibbling	2.0-2.4	1.0– 1.2

Note: Use delinted seeds for uniform and higher germination. Adopt the following method for delinting of cotton seeds.

- Soak 1 kg of cotton seeds in 100 ml commercial grade Sulphuric acid (H_2SO_4) for 2-3 minutes. Wash the acid treated seeds with 2 % Calcium Chloride ($CaCl_2$), then with clean Water; dry the seeds under shade and use for sowing after recommended seed treatment. This will increase the germination percentage.

- Use recommended and authentic varieties/Hybrids for sowing (Refer Table 1).

- Cotton crop to be sown during 1st week of June by utilizing saline water (5 ds/m) and subsequently irrigating the crop with canal water for higher yields without any bad effects on soil in Tungabhadra command area.

- When cotton is to be grown in saline soils, soak the seeds with IAA @ 20 mg or Calcium nitrate @ 30 g dissolved in one liter of water for 8 hrs and dry in shade for 12 hrs which will increase the yield.

Table 1. List of cotton varieties and hybrids (Non Bt) recommended for cultivation in Karnataka

Variety/ Hybrid	Zone/Ecology	Time of sowing	Duration (days)/Special features	Seed cotton yield (q/acre)	
				Irrigated	Rainfed
a. Inter specific hybrids (Extra long/ Long staple cotton)					
DCH - 32	2,3,8&9 Irrigated and assured Rainfed	May to 15th July	190/Long staple	6.0 – 8.0	4.8 – 6.0
RAHB - 87	2&8 Irrigated and assured Rainfed	May to15th July	190/Long staple	6.0 – 8.0	4.8 – 6.0
DHB - 915	2,3,8, 9& 10 Irrigated and assured Rainfed	May to 15th July	190/Long staple	6.0 – 9.2	4.8 – 6.0
DHB -1071	3,8, 9 & 10 Irrigated and assured Rainfed	May to 15th July	190/Long staple	7.2 – 8.0	6.0 -7.0
b. Intra *hirsutum* hybrids					
DHH -11	2,3&8 Irrigated / Assured Rainfed	May to 15th July	160/Big boll size & good opening, higher GOT	8.0 - 10.0	6.0 - 7.2
RAHH - 95	Karnataka Irrigated /Assured Rainfed	April to June	160-170	6.8 – 7.2	6.0 - 6.4
RAHH - 98	South Zone Rainfed	April to June	160-170	---	7.0 - 8.4
c. *G. hirsutum* varieties					
RAH -100	2&3 Irrigated	May to July	160	7.2 – 8.0	---
Sahana	2,3&8 Irrigated/Assured Rainfed	May to July	160 /Tolerant to bollworms	7.2 – 8.0	6.0 - 7.2
d. Desi cotton (*Herbaceum*) varieties					
DDHc -11	2,3& 8/Rainfed	June - July	180/Good quality lint	---	4.0 - 4.8
RAHS -14	2& 3/Rainfed	June - July	180/Suitable for saline soils & Protected irrigation	---	4.0 - 4.8
DLSa -17 *(Arboreum)*	2,3& 8/Rainfed	May - July	160/Long staple, Good opening and more lint	---	4.8 - 6.0

Seed treatment

Treat the seeds before sowing with micronutrients like Zinc Sulphate, Ferrous sulphate, Manganese sulphate and Magnesium sulphate @ 0.4 g per kg of seeds through seed polymer (@ 8 ml/kg seed).

2. Fertilizer requirement

A. Organic manures

a. Irrigated

- FYM or Compost @ 4 t/acre or Poultry Manure@0.8 t/acre or FYM @ 1.2t/acre + Crop residues@0.8t/ac+ Vermicompost @ 0.4 t/acre apply 2-3 weeks before sowing.
- Grow sunhemp (as green manure) between two rows of cotton and incorporate ***in situ*** after 30 DAS which helps in increasing the soil fertility, reducing weed population and saving 50 per cent recommended fertilizers.

b. Rainfed

- FYM or Compost@ 2.0 t/ac

B. Bio Fertilizers

Treat the seeds required for one acre with 200 g each *Azospirillum* and *Phosphorous Solubilising Bacteria* (PSB) before sowing which can save 8.0 kg N/acre and 4.0 P_2O_5/acre out of the recommended fertilizers.

C. Inorganic fertilizers

Table 2. Quantity of recommended nutrients

Zones/ Varieties/Hybrids	Recommended quantity of nutriments (kg/acre)		
	Nitrogen (N)	Phosphorus (P_2O_5)	Potash (K_2O)
1. Rainfed (Varieties non Bt)			
a. Northern dry tract (Zone 2 & 3)	12	6	6
b. Transitional tract (Zone 8)	16	10	10
2. Rainfed (hybrides- Non Bt)			
a. Malanad tract (Zone 9)	40	40	40
b.Transitional tract (Zone 8)	32	16	16
c. Intra *hirsutum* Bt hybrids	40	20	20

d. Inter specific Bt hybrids*	50	25	25
***** Basal: 25% each N & K_2O of recommended nutrients with 100% P_2O_5 Top dressing: Remaining 75% N & K_2O in equal splits at 30, 60 & 90 DAS.			
3. Irrigated **a. Hybrids**			
1. Interspecific hybrids	60	30	30
2. Intra *hirsutum* hybrids	48	24	24
3. Intra *hirsutum* Bt hybrids (Malaprabha Command Area)	60	30	30
4. Intra *hirsutum*Bt hybrids (Tungabhadra Command Area)	72	36	36
b. Varieties	32	16	16
4. Summer cotton			
a. Varieties	32	16	16
b. Intra *hirsutum* hybrids	48	24	24

Planting geometry

Planting geometry can be modified and adopted based on soil type and fertility. Following planting geometries have been recommended under different soils and various growing situations.

Table 3. Recommended Spacing

1.Rainfed situation (For varieties)	60 m x 30 cm or 90 cm x 20 cm
2.Irrigated (For varieties and summer cotton)	75 cm x 30 cm (Average soil) or 90 cm x 30 cm (Fertile soil)
Irrigated (*Inter specific* hybrid)	120 cm x 60 cm (Fertile soil) 90cm x 60cm (Red & low fertility soil)
Irrigated (*Intra specific* hybrid)	90 cm x 60 cm
3.Transitional Zone (Zone-8, Assured rainfall areas for Hybrids) a. Interspecific hybrids :90 cm x 60 cm b. Intra *hirsutum* hybrids : 90 cm x 60 cm or 90 cm x 30 cm c. Bt cotton (Intra *hirsutum* hybrids) :90 cm x 60 cm d. Bt cotton (Inter specific hybrids) :120cm x 60 cm	

4. Heavy rainfall tract (Zone 9 – Malanad tract) a. Interspecific hybrids : 90 cm x 60 cm (Average fertility soils) : 120 cm x 60 cm (Fertile soil) b. Intra *hirsutum* hybrids : 90 cm x 60 cm or 90 cm x 30 cm Note: Planting geometry can be suitably modified based on the soil fertility.

Table 4: Application of recommended fertilizers

Situation	Basal at the time of sowing	Top dressing
Rainfed	100% N, P_2O_5& K_2O	---
Assured rainfed (Transitional belt)	50% N & 100% P_2O_5 & K_2O	50% N 60 days after sowing (DAS)
Irrigated	50% N & 100% P_2O_5 & K_2O	50% N in three equal splits at 50,80 &110 days after sowing (DAS)
Zone - 3	12.5 % N & K_2O and 100% P_2O_5	12.5 % N & K_2O 25 DAS, 50% N & K_2O 50 DAS and 12.5% N & K_2O each at 75 & 100 DAS.
Malanad	33% N, P_2O_5 & K_2O	67% N, P_2O_5& K_2O in equal splits at 60 & 90 DAS

Transplanting of Bt cotton

Transplanting method of Bt cotton seedlings enables right time of planting in the season which ensures required plant population per unit area resulting in higher yields. Raise Bt cotton seedlings in polythene bags (5" x 4" size) filled with mixture of soil and compost (1:1) 15-20 days earlier to the commencement of cotton sowing season (June first week). Transplant 20-30 days old seedlings with a planting geometry of 90 cm x 90 cm (Deep black soils) or 90 x 60 cm (Medium deep black soils) immediately after sufficient rainfall or irrigating the field.

Irrigation

Irrigate the crop in red/sandy soils at an interval of 10-15 days and in black soil at an interval of 20-30 days based on the weather conditions. Irrigate at sowing, twice before flowering and four times after flowering without fail. Irrigate in alternate furrows alternatively in deep black soils. Provide drainage in heavy black soils under low infiltration conditions. Cotton crop do not need more irrigation water. Heavy and frequent irrigation enhances the vegetative growth leading to ineffectiveness of plant protection measures, resulting in higher incidence of pest/diseases.

Under canal command areas where in the canal opening is not assured at scheduled time, ensure early sowing with protective irrigation by open/bore well water. Under constraints of irrigation water, foliar spray of Kaolin (60 g/lit) with 1 g teepol or soap, at 3 days after last irrigation reduces transpiration losses from the crop canopy, thus helps the crop to utilize the available soil moisture efficiently. Irrigate crop at 12-15 days interval wherever water table is below 95 cm and salinity is 6 ds/m for higher yields.

Drip irrigation

Drip irrigation can be a viable option under constraints of irrigation water in zone 3 and 8 for hybrid cotton and *hirsutum* cotton verities cultivation. It can save electricity, labour and 50% of irrigation water as against the surface furrow irrigation. Though initial cost is more the area under crop can be doubled with saved water and the cost can be recouped within 3-4 years of drip system installation. Under drip irrigation paired row planting at 60 cm – 120 cm – 60 cm can save 50% laterals as against the normal planting.

Operate drip system daily or once in three days and replenish 80 per cent cumulative ET of corresponding days by drip for hybrid cotton and 50 per cent for *hirsutum* varieties. Drippers having discharge capacity of 4 lit/sec to be used. Laterals to be placed at 90 cm apart and drippers at 60 cm under normal planting. In case of paired row planting (60 cm - 120cm - 60 cm) the above time of drip operation has to be doubled as the number of laterals and drippers are reduced to 50 per cent as compared to normal planting of 90 cm x 60 cm.

Drip irrigation and fertigation in Bt cotton

Drip irrigation can be suitably adopted for Bt cotton in medium black soils of zone -8. Under drip irrigation sowing has to be done in paired row planting (60-120-60cm) instead of normal furrow planting 990 cm x 60 cm). The spacing between two laterals and two drippers has to be 120 cm & 60 cm respectively, with dripper discharge of 4 lit/sec. Replenish 80% ET of a particular day through drip irrigation. Based on the calculations the recommended irrigation time under drip during different months under zone -8 is given in Table below. Accordingly the drip irrigation to Bt cotton is to be given at 3 days inertval.

Table 5: Recommended drip irrigation time (in minutes) to Bt cotton during different Months under zone – 8

Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
40	50	60	65	70	35	25	25	40	50	55	55

Fertigation

Apply 10% of the recommended N & K_2O and 100% P_2O_5 basally at the time of sowing and apply remaining 90% N & K_2O as fertigation through drip in six equal splits during 30 DAS to 105 DAS at 15 days interval. Urea and muriate of potash (MOP) is to be used for fertigation.

Intercultivation and weed management

Keep the plots weed free up to 60 days as the crop growth is slow during this period and this is the critical crop growth stage for crop weed competition. Three – four intercultivations at an interval of 15 days after 30 DAS helps in controlling weeds and acts as dust mulch in conserving the available soil moisture. In rainfed situations weeds can be managed effectively by 2-3 intercultivations followed by hand weeding. Apply Diuron 80 WP @ 500 g/acre or Pendimethalin 30 EC @ 2 lit/acre or Pendimethalin 38.7 SC @700 ml/acre in 300 lit of water as pre emergent application immediately after sowing (with sufficient soil moisture). Apply tank mix of Quizolofop ethyl 5 EC and Pyrithiobac sodium 10 EC each @ 300 ml/acre as post emergent application on weeds after 20-30 days after sowing which will control monocot and dicot weeds.

Remunerative Intercropping cropping systems

In rainfed situations cotton based intercropping systems proved remunerative than sole crop of cotton.

Under rainfed conditions adopt the following intercropping systems.

Cotton + onion (1: 5)	Cotton + chilli (1: 1)	Cotton + groundnut (1: 3),
Cotton + green gram (1: 1)	Cotton + soybean (1: 1)	Cotton + Beans (1: 1)
Cotton + coriander (1:2)	Cotton + Peas (1:1)	

Under irrigated conditions adopt the following inter cropping systems.

Cotton + Soybean (1: 3) Cotton + Chilli(1: 1) Cotton + Onion (1: 5).

In black soils of Tungabhadra Project adopt the following inter cropping systems.

Cotton + onion (1: 2) Cotton + chilli (1:1)

Under low rainfall areas adopt Cotton (desi) + Coriander (1:2) and in heavy rainfall areas (Malanad) (Zone-9) adopt Cotton + Paddy (1:6) intercropping systems.

Supply of nutrients through foliar sprays

- Undertake foliar sprays of urea @ 2% or Potassium nitrate @ 1.0% at 80 days after sowing and repeat the same after 20 days.
- Apply two foliar sprays of mixture of EDTA form of Zinc sulphate, ferrous sulphate, Manganese sulphate each @ 0.5% and Magnesium sulphate @ 1.0% during flowering stage at 10 days interval.
- Spray Alpha Napthalene Acetic Acid (NAA) 4.5 SL @ 0.25 ml/lit of water at flower initiation and peak flowering stage to reduce square, flower and boll dropping. Use 320-400 lit of spray mixture.
- Spray growth inhibitor Cycocel @ 0.6 ml/lit of water at 75 and 95 days after sowing to reduce the excess canopy and plant growth in *interspecific* hybrid cotton genotypes.
- Spray Nitrobenzene 20 EC @ 1.0 ml/lit of water to Bt cotton at 55, 75 and 95 days after sowing.

Management of leaf reddening

- In Zone-2 apply Magnesium sulphate @ 10 kg/acre and 25% more fertilizer (Over and above RDF) at sowing basally under irrigated conditions to Bt cotton. Then spray Magnesium sulphate and all 19 water soluble fertilizer each @ 1.0% at flowering (65-75 DAS), boll formation stage (80-95 DAS) and boll development stage (100-110 DAS).
- In zone-3 spray Magnesium sulphate @ 2.0% with Urea @ 2.0% at 70 and 90 days after sowing.

Insect pests and their management

During early growth stages of cotton, incidence of sucking pests and leaf eating insects will be more and more incidence of bollworms during later stages of crop growth. Shoot weevil

affect the crop at all stages. Recently mirid bugs, midge and pink boll worm incidence is also seen. The details of these insects and their management is as under

Table 6: Economic Threshold Level (ETL) of different insects in cotton*

Insect pests	Economic Threshold Level (ETL)
Leafhopper	2 nymphs/ leaf
Aphid	10 aphids/ leaf
Thrips	10 thrips/ leaf
Whitefly	5 whiteflies/leaf
Heliothis	1 caterpillar or 1 egg/plant
Spotted boll worm	5% square or boll damage
Pink boll worm	10% boll damage
Mirid bug	5 bugs or nymphs in squares of one plant

* Recommended insecticides are to be sprayed only when the incidence of a particular insect has crossed the ETL level as indicated above.

Table 7 Major insect pests and their management

1.Major sucking insect pests		
Leafhopper	**Thrips**	**Aphids**
The leafhopper appears 15-20 days after sowing. Both adult and nymphs of the pest move side way on the lower surface of leaves and suck the sap resulting in yellowing of the leaves from the margin and later turn red; leaves dry under severe infestation.	Small sized adult and nymphs of thrips lacerate and suck the sap from lower surface of the leaves which turn whitish first. In case of severity, leaves turn brownish and brittle leading to tearing.	Damage of this pest is starts at early stage of crop. Both nymphs and adults suck the sap from the low surface of leaves and discharge honey dew on which sooty mould develops and leaves turn black. The infestation of aphid is sever during could climate (November & December).
Management practices **Seed Treatment:** Before sowing treat seeds with 10 g Imidacloprid 70 WS or 5 g Thiamethoxam 70 WS for the control of early sucking pest up to 35-40 days.		

Insecticide spray: If necessary based on economic threshold levels (ETL) of sucking insect pests, spray the crop with 5% neem seed kernel extract (NSKE) or systemic insecticides like Dinotefuron 20 SG @ 0.3 g or Fipronil 80 WP @ 0.1 g or Clothianidin 50 WG @ 0.075 g or Acetamiprid 20 SP @ 0.2 g or Thiamethoxam 25 WG @ 0.2 g or Oxydemeton methyl 25 EC @ 1.5 ml or Dimethoate 30 EC @ 2 ml per liter of water. About 160-200 liters of spray solution is required per acre.		
2. Other sap sucking insects and their management		
Pests	**Damaging symptoms**	**Management strategies**
Serpentine leaf miner	The damage symptom is noticed when the crop is at 2- 3 leaves stage. Insect mines the leaves in serpentine manner Leading to whitening of leaves. The insect damage is noticed up to 40 - 50 days old crop.	Spray the crop with any one of the above mentioned systemic insecticides if damage is severe.
Whitefly	It appears when the crop is 50 days old. Both adults and nymphs suck the sap from the lower surface of leaves resulting in yellowing of leaves. Insects discharge honey dew on leaves on which black sooty mould develops hindering photosynthesis. Because of this, squares and small bolls drop down.	Install 20 yellow sticky traps per acre just above the crop. Spray the crop with 5 % neem seed kernel extract or neem based insecticides or Trizophos 40 EC @ 1.5 ml/ liter of water based on economic threshold level.
Red spider mite	The mite pest appears generally in the later stage of the crop. Mites are red in colour and suck the sap from the lower surface of the leaves resulting in reduction of yield and quality.	Spray the crop with Dicofol 18.5 EC @ 2.5 ml/ liter of water.
Midge (Flower bud maggot)	Incidence starts during flower bud initiation. Adult midge lay the eggs in the buds. Affected buds and flower starts rotting from inside, finally buds & flowers dry and drop off.	Spray Malathion 18.5 EC @ 2.0 ml/lit of water during flower bud initiation stage.
3.Cotton bugs and their management		
Mirid bug	Both adults and nymphs suck the sap from flower buds and small bolls leads to dropping. Black spots are seen on	Spray the crop with Profenophos 50 EC @ 2.0 ml or Acephate 75 SP @ 1.0 g or Fipronil 5 SC

	the infested bolls. Sometimes, infested bolls show parrot beak appearance. The affected bolls may not open properly. The infestation of the pest is noticed from 55 to 120 days.	@ 1 ml/ liter of water.
Red cotton bug and dusky cotton bug	They appear in the later stage of the crop and suck the sap from the bolls resulting in bad boll opening, staining of lint and reduction of the seed quality.	Spray the crop with any one of the above contact insecticides.
Mealy bug	Both adult and nymphs suck the sap from leaves, bolls, stalks and stems and discharge honey dew on which black sooty mould develops affecting the photosynthesis which in turn affect the plant growth.	Spray the crop with Buprofezin 25 SC @ 1 ml/ liter of water.
4. Shoot weeviland its management		
Shoot weevil	The adult weevil lays eggs on stem. The grubs bore in to the stem feeding on the inner content and reaching pupal and adult stages inside. The affected stem portion become hallow and break down due to blow of wind or any mechanical disturbance.	Sow one row of okra for every 20 rows of cotton. Collect adult weevils found on okra during morning time and destroy them. Spray Profenophos 50 EC @ 2.0 ml/lit with DDVP 76 EC @ 0.5 ml/lit of water after observing the weevil activities or the incidence.

5. Boll worms and their management

Spotted boll worm	***Heliothis or Helicoverpa*boll worm**	**Pink boll worm**
Caterpillars bore in to the shoots of 35-40 days old crop affecting the growth and increasing the side shoots. In the later stage, the pest damages the flowers, squares and bolls leading to flare up of squares and bad boll opening.	The caterpillars bore in to the squares and developing bolls by keeping half of the body inside the bored hole and feed on the inner content. The infestation leads to dropping of squares and bad boll opening.	The pink coloured caterpillars infest flowers and developing bolls. The affected flowers turn rosette appearance. The caterpillars enter in to young bolls and feed on the seeds leading to bad boll opening.

Management strategies for boll worms

- Install two pheromone traps/acreat 50 meters apart in the field after 40 days of sowing to monitor the boll worm incidence. Change the lures once in 15 days.
- Transplant 25 days old marigold seedlings or dibble short duration pigeon pea (ICPL-87) around

the cotton crop and spray ovicidal insecticides on these crops.

- Based on egg load, spray the crop with ovicidal insecticides like Profenophos 50 EC @ 2 ml/lit or Thiodicarb 75 WP @ 1.0 g/ lit of water.
- For young *Helicoverpa* caterpillars, spray the crop with HaNPV 200 LE/ acre along with 5% jaggery and 0.1% boric acid powder during cool weather condition to increase the effectiveness.
- Nip the shoots after 80 – 90 days after sowing to avoid egg laying which in turn reduces the boll worm damage.
- Spray the crop with newer molecules like Indoxacarb 14.5 SC @0.5 ml or Spinosad 48 SC @ 0.2 ml or Emamectin Benzoate 5 SG @ 0.25 g/ liter of water to manage *Heliothis*. Spray the crop with other insecticides like Carbaryl 50 WP @ 3 g or Quinalphos 25 EC @ 2 ml or Chlorpyriphos 20 EC @ 2.5 ml/ liter of water.
- Spray the crop after 100 days once or twice with Pyrethroids like Decamethrin 2.8 EC @ 0.5ml or Cypermethrin 10 EC @ 0.5 ml or Fenvelarate 10 EC @ 0.5 ml or Betacyflothrin 25 EC @ 0.5 ml/ liter of water at 15 to 20 days intervals. Spray solution of 400-500 lit/acre is required.

Special management strategies for pink boll worm (PBW)

For monitoring of PBW, install two pheromone traps/acre and change the lures once in 20 days. For mass trapping of the male moths, install 12 pheromone traps/acreat equidistance, and to kill the trapped moths put cotton pad dipped with DDVP insecticide in to the traps. Change the lures once in every 20 days intervals. Follow this mass trapping continuously till all bollsdevelop and mature completely.

ETL for pink boll worm (PBW)

- Eight adult moths of PBW in the traps everyday continuously for 3 days.
- Six infested flowers out of randomly selected 60 flowers and 2 damaged bolls out of randomly selected 20 bolls or more than 2 larvae in the bolls (10% boll damage).

Plant protection measures based on ETL

- Spray Profenophos 50 EC @ 2.0 ml/lit or Thiodicarb 75 WP @ 1.0 g/lit or Spinetoram 11.7 SC @ 1.0ml or Quinolphos 25 EC @ 2.0 ml/lit of water within 100 days of crop duration.
- In 100 days old crop take up need based sprays with Lambdachyalothrin 5 EC @ 0.5 ml/lit or Decamethrin 2.8 EC @ 0.5 ml/lit or Cypermethrin @ 10 EC @ 0.5 ml/lit of water. Spray solution of about 400-500 lit/acre is to be used.
- Complete the kapas picking as early as possible in the crop. Under any circumstances cotton crop should not be continued after the completion of kapas picking by supplying water and fertilizes (Rationing of cotton crop should be discouraged).
- Destroy the infested cotton seeds after ginning.
- Destroy the PBW infested and tinted kapas found in storage or in the ginning factory

Integrated pest management in Bt cotton

- In rainfed cotton, sow one row of okra after every 20 rows of cotton as a trap crop for shoot weevil. Collect the adult weevils on okra during morning hours by hand and destroy them. Observe the presence of boll worm eggs on okra fruits, if found harvest the fruits to minimize the boll worm pressure on cotton.
- Growing of maize or cowpea all along the borders of the cotton crop to encourage natural enemies which reduces the sucking pests.
- Use insecticide treated Bt cotton seeds to control early sucking pests up to 30 to 40 days. If the

sucking pests cross the ETL, spray the crop with systemic insecticides like Dinotefuron 20 SG @ 0.3 g/lit or Thiamethoxam 25 WG @ 0.2 g/lit or Acetamiprid 20 SP @ 0.2 g/lit of water.Spray solution of 160-200 lit/acre is to be used.

- Install 2pheromone traps/acre 50 meters apart at 40 days after sowing for monitoring of boll worms. Change the lures once in every 15 to 20 days. Install 8 to 10 branched twigs/ acre which helps the predatory birds.
- Spray HaNPV @ 200 LE/acre along with 5% jaggery and 0.1% boric acid powder during cool weather to increase its efficacy of controlling the early instar *Helicoverpa* caterpillars.
- Spray Acephate 70 SP @1.0g/lit of water when ever mired bug incidence is observed in the crop.
- In 100-120 days old crop spray Thiodicarb 75 WP @ 1.0g/lit of water with 400 lit/acre spray solution which will control *helicoverpa* and PBW effectively.
- Spray Pyrethroids once to cotton crop of 110-130 days to mange PBW effectively.
- Install sticky traps @ 18/acre to manage whiteflies. Spray neem based insecticides @ 5.0% or Triazophos 40 EC @1.5 ml/lit of water depending on the whiteflies intensity.
- Spray water soluble sulphur @3.0 g/lit or Dicofol 18.5 EC @ 2.5 ml/lit of water to manage mite incidence.

Points to be considered in cotton cultivation

- Care to be taken to pick the kapas without admixture of dry cotton leaves and soil particles. Kapas of different species and grades should not be mixed. Kapas of each picking has to be sold separately.
- Follow suitable crop rotation instead of growing cotton after cotton every year.
- Application of recommended fertilizers along with the organic manures will sustain the soil fertility and increase the yields.
- Higher yields are possible with desi cotton varieties when grown under protective irrigation.

Table 8: Diseases of Cotton and their management

Disease	Disease symptom	Management measures
Seedling rots	Drying and drooping of seedlings followed by death of seedlings, presence of small mustard like fruiting bodies can be seen on the root surface	Drench Thiram 75 WP @ 2 g/lit around the root zone
Grey mildew/ Powdery mildew	Presence of whitish mycelial mat of the fungus can be noticed below the leaf surface followed by defoliation with the increased intensity of the disease	Spray Carbendazim 50 WP @ 1g/litof water
Black arm/ Bacterial blight	Appearance of water soaked angular leaf spots followed by vein and stem blight.	Spray Streptomycin sulphate @ 0.5 g/lit and Copper oxychloride 50 WP@ 3g/lit of water

Alternaria Leaf spot	Appearance of concentric ring spots on the foliage followed by defoliation at the later stages	Spray combi product of Metiram 55 WG and Pyrachlorostrabin 5 WG @ 3.5 g/lit of water immediately after incidence of the disease and to be repeated twice at 15 days interval or spray Copper oxychloride 50 WP@ 3g/lit**or** Mancozeb 75 WP @ 2g/lit of water
Rust	Appearance of brown colour ulcers like lesions on undersurface of the leaves and spread to most parts of the leaves. Affected leaves will wither.	1st Spray: Chlorothalonil 75 WP @ 2.0g/lit of water. 2nd spray: After 15 days spray *Pseudomonas florescence* bioagent @ 5.0g/lit of water. 3rd spray: Repeat the spray of Chlorothalonil 75 WP @ 2.0g/lit of water.
Wilt	Gradual drooping and wilting (drying) of plants	Drench Carbendazim 50 WP @ 2 g/lit around the root zone in the soil of affected plants and surrounding plants.
Boll rot	Appearance of ulcer like lesions on the bolls followed by boll rotting. Sometimes development of fungus on the rotted boll with oozing.	SprayCopper oxychloride 50 WP@ 3g/lit and Streptomycin sulphate @ 0.5 g/litwater **or** spray Mancozeb 75 WP @ 2g/lit**or** spray Chlorothalonil 70 WP @2 g/litof water.

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