Package of Practices for Cotton cultivation in Gujarat

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Introduction:

Cotton, the king of apparel fibre, has played a key role in the development of human civilization. Even today, it occupies an outstanding position in the textile industry despite pressure of manmade fibres and blended fabrics. Gujarat is one of the leading cotton producing state in the country. Gujarat contributes substantially to the national cotton area (24%) and productions (37%).

Cotton Scenario in Gujarat:

Gujarat ranks first in cotton production occupying nearly 24% cropped area of Gujarat, cotton contributes nearly 1/3 to the State Gross Agricultural Product. In the last 10 years, > 500 Bt Cotton hybrids notified for commercial cultivation in central zone. The numbers of Bt Cotton hybrids has been substantially restricted by the state registration committee constituted by Govt. of Gujarat. Bt cotton area has grown by >85% in last ten years unseating food crops. Majority of cotton produced in Gujarat having medium long staple (25.0 to 28.0 mm) with average micronaire values (4.0 – 4.5 mv). The lint productivity shooted up from 139 kg in 1960 to 610 kg/ha in 2022-23 (Table-1). Gujarat is a preferred destination for foreign buyers for purchase of cotton. Each kg increase in lint/ha adds nearly Rs.425 Million of wealth of the State. After the world's first hybrid "Hybrid-4" in 1971, Gujarat again has the pride of releasing first *Bt* Cotton hybrids (BG-II) from Public Sector in the country by releasing of four *Bt* Cotton hybrids *viz*; G.Cot. Hy. 6 (BG II), G.Cot. Hy. 8 (BG II), G.Cot. Hy. 10 (BG II) and G.Cot. Hy. 12 (BG II). About 80 % area of Cotton covers with Bt Cotton hybrids in Gujarat state.

Preparation of soil:

- Select the field where crop rotation had been followed. Avoid mono cropping.
- Every two year deep ploughing to expose hibernating insect-pest and reducing carryover of the pest and soil borne diseases.
- Open ridge and furrow after leveling the field with slope that facilitate proper drainage incase of excess rainfall.

Sowing time:

- Timely sowing is recommended in Gujarat state i.e. onset of monsoon during 15th June to 15th July.
- Avoid advance sowing in irrigated conditions where Pink Boll Worms is problematic.

Selection of variety/hybrids:

- Prefer early maturing Bt cotton hybrids Public sector or private sector *Bt* Cotton hybrids having 150-180 days maturity.
- Prefer tolerant / resistant *Bt* Cotton hybrids considering the key sucking pests of the region (hybrids with hairiness).

- Where irrigation facilities are available, Public sector G. Cot Hy-6 (BG-II), G. Cot Hy-8 (BG-II), G. Cot Hy-10 (BG-II), G. Cot Hy-12 (BG-II) and GTHH 49 (BG II) can be selected.
- Sow refuge as prescribed on the seed packet for resistance management.
- Plan to sow interspersing of sorghum or bajra @ 10:1 row to enhance the natural enemy population.
- Where cotton is sown at wider distance, grow intercrop (Cowpea, cluster bean or green gram) in the area if there is no problem of pig, swine and wild cow, etc..

Seed rate and spacing:

- Spacing of 120 x 45 cm with seed rate of 450 g/acre at the depth of 4-6 cm according to availability of moisture in the soil.

Seed Treatment

- Treat the seed with thiamethoxam 2.8 g or imidacloprid 70 FS 7 g/kg seed for the control of sucking pests
- Treat the seed with *Azotobacter* @ 30 g/kg seed for fixation of Atmospheric Nitrogen in the soil.

Nutrient Management:

- Incorporate 10 tonnes FYM or Compost per hectare and apply KMB and PSB @ 5 Lit/ha.
- Add Azotobacter culture @ 5 litre/ha enriched with 100 kg FYM per hectare.
- Apply 240 kg N in five equal splits at 30, 60, 75, 90 and 105 DAS and 40 Kg P_2O_5/ha as basal doze to cotton hybrids under irrigated condition.
- Apply 60 kg sulphur per hectare through recommended dose of P_2O_5 in the form of SSP (250 kg) along with 250 kg phosphogypsum/ha as basal dose for *Bt.* cotton hybrids.
- Spray 3% KNO_3 at squaring, flowering and boll development stages to reduce Leaf reddening, shredding of squares and bolls. It also increases the boll size.

Integrated Nutrient Management:

- For integrated nutrient management under South Gujarat Agro-climatic zone-II, it is advised to apply recommended dose of fertilizer based on soil test value + FYM 10 t/ha + one spray of 2% urea at flowering stage and one spray of 1% urea + 1% MgSO4 during boll development stage to control leaf reddening.

Use of Growth Regulators

- Spray 45 ppm Ethylene (1.125 ml/10 lit of 39% commercial product) at square initiation stage (35-40 DAS)

Weed management:

- Keep the field weed free up to 60 days
- Apply Pendimethalin @ 1 kg a.i./ha as pre-emergence followed by two hand weeding at 30 & 60 days after sowing(DAS) or Fluchloralin @ 1.00 kg a.i./ha pre-emergence followed by Quizalofop-ethyl @ 0.05 kg a.i./ha at 30 & 60 DAS.

Irrigation:

Where irrigation facility is available, irrigation should be given 3-4 weeks after last effective rainfall. In black soils, irrigation should be given at an interval of 20-25 days where as, in sandy

loam soils (GORADU), it should be applied at 15 days interval. Irrigation water can be saved up to 30 % with irrigating the crop with alternate furrow method without decreasing in the yield as compared to 100% irrigated area.

In rainfed cultivation, when shortage of rainfall occurs, crop should be irrigated with one or two life saving irrigations.

Use of drip irrigation system:

Adoption of drip irrigation technology saves upto 41% irrigation water and brings about 0.74 ha additional area under irrigation. Drip should be laid out at a distance of 1.2 mt with a dripper (4 lph) spacing of 0.45 mt and operated for 60 to 70 minutes on alternate day (0.4 PEF).

The farmers of South Gujarat Agro-climatic Zone II growing Bt cotton under irrigated conditions are advised to adopt drip irrigation in paired row planting (60 x 45 x 180 cm) and schedule irrigation at 0.8 PEF. Further, they are advised to apply 180 kg N/ha (75% RDN) in 6 equal splits at 15 days interval starting from 15 DAS through drip system to obtain higher seed cotton yield and net profit besides with saving of irrigation water by 20% an nitrogen by 25%. The system shuld be followed as under.

System details should be adopted as under:

1	*Main line*	*:*	75 mm
2	*Sub main line*	*:*	63 mm
3	*Lateral (inline)*	*:*	16 mm
4	*Lateral spacing*	*:*	240 cm
5	*Dripper*	*:*	4 lph
6	*Dripper spacing*	*:*	45 cm
7	*Operating pressure*	*:*	1.2 kg/cm^2
8	*Operating frequency:*	*:*	Alternate day
9	*Operating time:*	*:*	70-85 minutes

Detopping and nipping:

For reducing vegetative growth of cotton plants, detopping of 5to 6 cm top shoud be made at 95 days after sowing and nipping of sympodial branched should be done at 105 days after sowing.

Intercropping:

For obtaining higher net monitory returns and reducing risk various intercrops like Groundnut, Soybean, Urid (Black gram) and Mung (Green gram) can be grown in cotton.

Cropping sequence:

For obtaining higher net monitory returns, it is recommended to grow summer green gram with recommended package of practices as preceding crop of *Bt* cotton hybrid. They should apply 2% banana pseudostem enriched sap (20 ml/ liter) as foliar spray at flowering stage with recommended dose of fertilizers (240 kg N + 40 kg P2O5 per ha) to achieve higher seed cotton equivalent yield and net realization. *Bt* cotton hybrid should be fertilized with 40 kg P_2O_5 as basal

and 240 kg N applied in 5 equal splits at 30, 60, 75, 90 and 105 days after sowing as top dressing under South Gujarat condition.

Plant Protection:

(A) Plant protection measures for insect-pests:

- Installation of pheromone trap @ 5/ha for monitoring bollworms and use need based mass trapping @ 40/ha especially for PBW in hot spot area and daily notice of moth trapping in the trap and change of lure as prescribed on the pack
- Install yellow sticky trap @ 20/ha for monitoring white fly and swapping the cotton plants across row with oil smeared polythene sheet for mass trapping of white fly.
- ETL based application for key pests considering use of plant products (neem oil or Azadirachtin 1500 ppm in the early crop window)
- Collection and destruction of egg masses of Spodoptera, aphid colonies or rosette flowers along with the white or pink larvae of pink bollworm as well as fallen squares and bolls, if any.
- Three releases *Trichogrammatoidae bactrae* @ 1.5 lakh/ha at 15 days interval - initiating at squaring stage depending on availability in the region (SAUs are mass producing and supplying on request).
- Alternate spraying of insecticides of different groups for respective target pests on ETL population Table 1 and 2.
- Timely picking and transporting to market instead of storing at home for longer time. The infested seed cotton should be separated before transporting.
- Timely crop termination not later than January 15 or 180-210 days
- Crop residue management by using rotavator or shredder and/or composting cotton stalk.

Table 1 Sucking pest management

Sr.	Insecticides	Insect Pests	Dose per 10 Lit Water
1	Azadirachtin 1500 ppm	A, J, W	50 ml
2	Imidacloprid 17.8 SL	A, W, J, T	3 ml
3	Acetamiprid 20 SP	A, J, W	2 g
4	Thiamethoxam 25 WG	J, A, T, W	3 g
5	Acephate 75 SP	J	10 g
6	Chlorpyriphos 20 EC	A, W	25 ml
7	Profenophos 50 EC	J, A, T, W	20
8	Monocrotophos 36 SL	A, T, W, J, GW	10 ml
9	Fipronil 5 SC	A, J, T, W	30 ml
10	Diafenthiuron 50 WP	W, A, T, J	10 g
11	Flonicamid 50 WG	A, J, T, W	3 g
12	Spiromesifen 22.9 SC	W, M	10 ml
Note: J=Jassid, W=White fly, A=Aphid, T=Thrips, M=Mite, GW=Grey Weevil,			

Table 2 Bollworms management

Sr.	Insecticides	Insect Pests	Dose per 10 Lit Water
1	Monocrotophos 36 SL	BW	25 ml
2	Chlorpyriphos 20 EC	BW	25 ml
3	Profenophos 50 EC	BW	20 ml
4	Cypermethrin 10 EC	SBW, ABW, PBW	10 ml
5	Deltamethrin 1.8 EC	BW	10 ml
6	Spinosad 45 SC	ABW, PBW	3 ml

7	Emamectin benzoate 5 SG	BW	5 g
8	Indoxacarb 14.5 SC	BW	5 ml
9	Flubendiamide 480 SC	ABW, SBW	3 ml
10	Chlorantraniliprole 18.5 SC	ABW, SBW	3 ml
Note: SBW= Spotted bollworm, ABW= American Bollworm, PBW=Pink Bollworm BW=Bollworm			

(B) Disease management:

1	Seed borne diseases #	Delinting with sulphuric acid @100 ml/kg seed and seed dressing with mercuric fungicide @2-3 g/kg of seed
	#Wash the seeds thoroughly after acid delinting dry it in shade before seed dressing	
2	Bacterial blight $	Streptomycin sulphate @ 0.005% + copper oxychloride 0.2% spray Bacterial blight (Xanthomonas axonopodis Pv. malvacearum) disease of cotton causes 11.95, 11.14 and 9.26% avoidable loss in seed cotton yield of cultivars LRA-5166, G.Cot.Hy-10 and BC-68-2, respectively.
	$ Two to three sprays at 15 days interval after disease initiation	
3	Wilt and Root rot	Follow cultural practices like long term crop rotation, balanced application of NPK, organic manure, mixed cropping of Moth or Urid, irrigation at short intervals, green manuring and destruction of infected debris.
		Farmers of Gujarat growing cotton are advised to follow soil amendment with farm yard manure @ 20 tons/ha or pressmud or poultry manure @ 2 tons/ha for effective and economical management of root rot disease.
		Farmers of Gujarat growing cotton recommended to following seed treatment with commercially available biocontrol agent *Tricoderma viride* @ 5g/kg seed for safer, effective and economical management of root rot disease.
4	Alternaria leaf spot ®	Captafol or Mancozeb @ 0.2% spray
	® Four sprays at 20 days interval after disease initiation	
5	Parawilt	It is a physiological disorder and can be managed by following treatment measures within 24 hours which includes providing aeration to the root zone by drilling in root zone followed by drenching of Urea with fungicides.

High Density Planting System in Cotton:

Farmers of South Gujarat growing Non *Bt* hirsutum cotton desire to adopt high density planting system are recommended.

Variety suitable for HDPS:

For irrigated condition, G. Cot. 34 and for rainfed condition, G Cot. 42 and GN Cot. 44 varieties are recommended for high density planting system in Gujarat State.

Spacing for HDPS:

Farmers may sow the crop with maintaining 60 x 15 cm or 60 x 20 cm spacing for high density planting system.

Fertilizer application:

Cotton grown with high density farmers are advised to apply 225 kg N/ha in five equal splits at 30, 60, 75, 90 and 105 DAS.

Information provided by: Research Scientist (Cotton), Main Cotton Research Station, Navsari Agricultural University, Surat-395007, Gujarat (2023)

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