Package of Practices for Cotton Cultivation in Marathwada Region of Maharashtra

1. **Land preparation:** Rainfed - Ploughing once in three years and 2-3 harrowing

   Irrigated – Ploughing every year and 2-3 harrowing

2. **Seed and sowing**

   a. **Seed rate (kg/ha)**

Region	Cotton species	Seed rate (kg/ha)	
		Rainfed	Irrigated
Marathwada	*Arboreum* variety	10-12	
	Hirsutum variety	5-6	
	Hirsutum hybrid	2.0 – 2.5	1.5 – 1.75
	Hirsutum variety HDPS	12.5	
	Bt cotton hybrid	2.0-2.5	2.0-2.5
	Bt cotton HDPS	2.5-2.75	

   b. **Seed treatment**

i) Insecticides

i. Imidacloprid 48 FS @ 7.5 g per kg seed or Thimethoxom 30 FS @ 7.5 g per kg seed

ii. Thirum or Captan @ 3 g / g seed or Carbosulfan 25 DS @ 60 g per kg seed

ii) Fungicides

Thiram/ Capton fungicide @ 3 g per kg seed

iii) Bioinoculant

Azotobactor and phosphate solubilizing bacterial (PSB) culture @ 25 g /kg seed or 6 ml per kg seed

   c. **Sowing time**

Cotton type	Sowing type
Irrigated (Pre-monsoon)	25th March to 7th June (When temp. falls below 39^{O} C)
Rainfed (Monsoon)	Onset of monsoon to 15th July (after 75-100 mm rainfall)

   d. **Sowing depth:** 5.0 to 7.5 cm

e. Spacing

Cotton type	Spacing (cm)	
	Rainfed	Irrigated
Desi variety	45 x 22.5	
American variety	60 x 30	
American hybrid	90 x 60	90 x 90 (Medium) 120 x 90 (heavy)
American variety HDPS	60 x 10	
Bt variety (American var.)	60 x 30	
Bt hybrid	120 x 45 90x60 (delayed sowing)	180 x 30 150 x 30 120-60 x 60
Bt hybrid HDPS	90 x 30	

f) Sowing method

Cotton type	Sowing method
Desi variety	Drilling
American variety	Drilling / dibbling
American hybrid	Dibbling
American variety HDPS	Drilling on BBF
Bt hybrid	Dibbling on flat bed or BBF
Bt hybrid HDPS	Drilling / dibbling

3. Nutrient management

a. Organic manures

1. Rainfed: 5 t FYM per ha; irrigated: 10 t FYM per ha or
2. Vermicompost – 2.5 t / ha

b. Chemical fertilizer dose

Cotton type	Fertilizer dose (N, P_2O_5 and K_2O kg/ha)	
	Rainfed	Irrigated
Arboreum variety	50:25:25	-
Hirsutum variety	60:30:30	-
Hirsutum hybrid	80:40:40	100:50:50
Hirsutum variety HDPS	75:37.5:37.5	-
Bt hybrid (through soil)	120:60:60	150:75:75
Bt cotton (through drip irrigation)	-	80:40:40
Bt hybrid HDPS	150:75:75	-

c. Time of application

Region	Cotton type	Fertilizer dose (N, P_2O_5 and K_2O kg/ha)					
		Rainfed			Irrigated		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O
Marathwada							
Arboreum variety	At sowing	25	25	25			
	30 DAS	25					
Hirsutum variety	At sowing	30	30	30			
	30 DAS	30					
Hirsutum hybrid	At sowing	40	40	40	20	50	50
	30 DAS	40			40		
	60 DAS				40		
Hirsutum variety HDPS	At sowing	37.5	37.5	37.5			
	30 DAS	37.5					
Bt hybrid (soil)	At sowing	48	60	60	30	75	75
	30 DAS	36			60		
	60 DAS	36			60		
Bt cotton (fertigation)	At sowing				12	8	8
	20 DAS				16	8	8
	40 DAS				16	8	8
	60 DAS				12	8	8
	80 DAS				12	8	8
	100 DAS				12		
Bt cotton HDPS	At sowing	60	75	75			
	30 DAS	45					
	60 DAS	45					

d. Foliar Nutrition

1. Urea 2% at 30-40 DAS
2. DAP 2% at 60-65 DAS
3. $MgSO_4$ 0.2% at square formation and flowering
4. MOP 1.5% or KNO_3 1% at 70 DAS and 85 DAS
5. Boron 0.1% at flowering and boll development
6. Micronutrient grade II 0.5%
7. Potassium shuonite 0.5% at 55 and 70 DAS

e. **Micronutrient** (as per soil test values)

1. $MgSO_4$ @ 20 kg/ha soil application

2. $FeSO_4$ @ 20 kg/ha soil application
3. $ZnSO_4$ @ 25 kg/ha soil application
4. Trichoderma viridae @ 2.5 L per ha drenching at 30 DAS for Zn solubilization

e) Manuring in organic cotton production

1. FYM - 10 t / ha
2. Seed treatment of Azotobacter and PSB @ 10 g / kg seed + application of neem cake @ 250 kg/ha + *in-situ* green manuring of sunhemp @ 50 kg seed / ha
3. Seed treatment of Azotobacter and PSB @ 10 g / kg seed + intercropping of green gram (1:1)

4. Irrigation management

1. At 50% evapotranspiration
2. Opening of dead furrows at 2.7 m intercropping system and 5.4 m in sole cotton

Important growth stage: Germination, Square formation, Flower initiation, boll formation and boll maturity stages are very important. Moisture stress at these stages affects the yield.

Water requirement of Bt Cotton: Sowing of Bt hybrid cotton at 90 ×90 cm in ridges and furrow and irrigated by alternate furrow irrigation method at 75 mm CPE (9 to 10 days interval) is recommended for obtaining higher seed cotton yield, higher monetary returns, maximum water use efficiency, water saving and to avoid parawilt.

Irrigation interval: According to situations (soil moisture and stage of crop)

Moisture conservation: Spraying of Kaoline 6%, dust and straw mulching
Opening of furrows in last week of September before withdrawal of monsoon in Marathwada and 40-60 DAS in Vidarbha.

5. Gap filling and thinning

Gap filling: 3-5 days after germination of seed.

Thinning: 10-15 days after sowing keeping two healthy seedlings per hill in non - Bt cotton & one healthy seedling per hill in Bt cotton.

6. Weed management / interculture

Earthing up/ hoeing/ weeding etc.: Keep weed free field up to 60 days after sowing by two weeding and three-four hoeing / interculture and 2-3 weeding

Chemical weed control:

1. Spraying of Pendimethalin 30 EC pre-emergence herbicide @ 2.5 litre/ha or Diuron 80 WP @ 0.5 kg/ha or Oxyflurofen 23.5 EC @ 0.1 kg/ha in 1000 liters of water.
2. Spraying of Pyrithiobac sodium @ 62.5 g *a.i.* / ha and Quizolofop ethyl @ 50 g *a.i.* / ha as post emergence herbicide @ 1.5 liters/ha in 500 liters of water at 10 to 35 DAS.

7. Cropping systems

Intercropping:	Green gram (1:2 or 1:1) Black gram (1:1) / Groundnut (1:1) / Pigeon pea (6:1 or 10: or 2:2) / Soybean (1:1)
	Cotton + sorghum + pigeon pea + sorghum (6:1:2:1)
Mixed cropping:	Cotton + cowpea + Maize
Crop rotation:	Cotton – Sorghum – Ground nut
	Cotton – Soybean – Chick pea
	Cotton – Wheat – Soybean - Chick pea

8. Growth management

Square fall: Sowing of cotton on well drained soil, Integrated nutrient management, foliar feeding of nitrogen, spraying of 20 ppm NAA.

Growth retardation:

i. Nipping at 75 to 90 DAS

ii. Spraying of Cycocel @ 200 ml/ha

iii. Spraying of Mapiquat chloride 25 g a.i. / ha during square formation to flowering twice each at 15 days interval

9. Plant protection - Insects

Major Insect pest and diseases:

Major pests of Bt cotton: Aphids, Jassids, thrips, whitefly, mealy bugs, mites and pink boll worm

Management:

Biological:

- Conservation of Lady bird beetles, *Chrysoperla carnea,* Syrphid fly, *Aenasius bambawalei* and Release of *Trichogrammatoidea bactri* parasitoid @ 1,50,000 eggs/ha.
- Spraying of 5% NSE or Neem oil @ 50 ml or *Verticillium lecanii* @ 40 g per 10 lit of water.
- Installation of pheromone traps @ 5/ha for monitoring of pink bollworm.
- Use of yellow sticky traps (6 x 8 inch) @ 10/ha for monitoring of whitefly. Spraying of Emamectin benzoate (*Streptomyces avermeitilis)* @ 4.4 g or Spinosad 45 SC (*Saccharipolyspora spinosa)* 4 ml per 10 liters of water for the control of pink bollworm.

Chemical:

- Seed treatment with Imidacloprid 70 WS @ 7.5-10 g/kg seeds
- Spraying of diamethoate 30 EC @ 15 ml or Flonicamide 50 WG @ 4 g or acetamiprid 20 SP @ 4 g or Buprofezin 25 SC @ 20 ml acephate 75 SP @10 g or or diafenthuron 50 WP @ 12 g per 10 liters of water for the control of sucking pests.
- Spraying of profenophos 50 EC @ 20 ml or Thiodicarb 75 WP 20 g or Carbaryl 50 WP 40 g or lambda cyhalothrin 5 SC @ 10 ml for the control of pink boll worm.

Integrated Pest Management

1. Deep ploughing during January- February would kill the hibernating larvae. Infested and fallen bolls, leaves and sticks collected after the harvest should burnt.
2. Ratoon cropping should be avoided and seed should be sun or machine heated to 60^0C any time from April –mid May to kill the larvae in the double seed.

3. Seed treatment with thiamethoxam 30 FS @ 10 ml treated seed again treat with 25 g Azotobactor and 25 g PSB /kg seed.
4. Sowing of 20 % non-Bt cotton seed around Bt cotton field as refugia.
5. Grow caster as *Spodoptera* incidence indicator plants (4-8 caster plants/acre) and trap crops like yellow african marigold a trapping mealy bugs, cowpea eco-feast crop to colonize predators and parasitoids grown as a border crop around Bt cotton as per requirement.
6. Spraying of 5% NSKE for the control of sucking pests at 45 and 60 DAS.
7. Spraying of acephate 75 SP @ 10 g or diamethoate 30 EC @ 15 ml or buprofezin 25 SC @ 20 ml or acetamiprid 20 SP @ 4 g or diafenthiuron 50 WP @ 12 g per 10 liters of water for the control of sucking pests at 60-75 DAS.
8. Installation of pheromone traps @ 5/ha for monitoring of pink bollworm, *P.gossypiella* at 80-90 DAS.
9. Use of yellow sticky traps (6 x 8 inch) @ 10/ha for whitefly monitoring at 90 DAS. Avoid excess use nitrogen fertilizer
10. Spraying of *Verticillium lecanii* @ 40 g/ 10 liters of water at 110 DAS.
11. Need base application of Profenophos 50 EC or Triazophos 40 EC @ 20 ml/10 liters of water at 130 DAS for the control of whitefly and pink bollworm.

10. Plant protection- diseases

a) Alternaria leaf blight

Causal organism : *Alternaria macrospora*
Infestation intensity: 0.00 to 40.0 %
Crop growth stage : Through out the growth period
Favorable weather : Temp. 20 to 28 ^{o}C, Hum. >80%, Rainfall: + correlation

Control measure

Preventive measure: clean cultivation, resistant var., wider spacing., spraying of *Psudomonas fluroscence* @ 0.2% at 30, 60 and 90 DAS.
Chemical : Pyraclostrobin 20% WG @ 10 g/ 10 L of water

b) Bacterial blight

Causal organism : *Xanthomonas axonopodis pv. malvaciarum*
Infestation intensity: 0.00 to 30.0 %
Crop growth stage : Through out the growth period
Favorable weather : Temp. 25 to 35 ^{o}C, Hum. >85%, Rain splashes

Control measure

Preventive measure:	Seed treatment with carboxin (2 g/kg seed), seed treatment of carbendazim + Thirum 3 g / kg seed
Chemical :	COC (0.25%) + streptocyline(0.01%)
c) Para wilt Planting of wilt tolerant genotypes (*G. arboreum, G. herbaceum)*. Irrigation if available at grand growth stage. Avoid excessive use of FYM & fertilizers in heavy soils. Provide adequate drainage. To avoid the para wilt incidence under irrigated conditions, the sowing of Bt cotton be undertaken from 2nd fortnight of May to first week of June with 8-15 days irrigation interval.	
d) Grey mildew Two foliar application of wettable Sulphur @ 25 g/10 L water at 10 days interval from the day of first appearance or Carbendazim10 g/10 L water is effective in controlling the disease.	
e) Leaf reddening Adjustment of sowing time to skip over the over the adverse environmental condition during boll development. Application of two sprays of DAP (2%) at 15 days interval during boll development stage in addition to recommended dose of FYM (10 tone) and inorganic fertilizers is recommended for the management of leaf reddening of *Bt* cotton grown under Summer irrigated condition	

11. Harvesting:

Physiological maturity (days) : 120 days onwards

Methods of harvesting: First picking manually at 30 to 35 % of boll bursting & second and third picking at 15-20 days interval.

Information provided by: VNMKV Nanded, (2023)

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