

Approved Package of practices for Cotton: Maharashtra State

I. Major cropping system in the region (crop rotation / intercropping)

A. Intercropping:

- i. Cotton + Green gram / Black gram (1:1 row proportion)
- ii. Cotton + Sorghum + pigeon Pea + Sorghum (6:1:2:1 row proportion)

II. Crop season: *Kharif* (June to February)

III. Land preparation:

Rainfed: Ploughing once after three years

Irrigated: Ploughing every year

Harrowing: Two harrowing after Ploughing and third harrowing before sowing after receipt of monsoon rains to reduce the weed infestation

IV. Method of sowing:

A. Drilling method: For straight varieties

B. Dibbling method: For hybrids (wider spacing)

V. Soil, Seed rate and spacing:

- Normal as well as paired row cropping pattern of sowing for cotton gave similar yields hence either planting pattern can be adopted. Spacing depending upon the hybrids / variety of cotton to be sown.
- For rainfed intra-*hirsutum* hybrids two plants per hill produced significantly higher *kapas* yield than one plant per hill.
- Sowing of *deshi* and *American* cotton to the direction of North-south or East-West was not found beneficial in increasing the yield of seed cotton under rainfed condition.

Situation	Soil type	Spacing	Density (plant /ha)
A) Irrigated cotton			
1. Hybrid	Heavy soil	150 x 90 cm	7,407
	Medium soil	120 x 90 cm	9,259
		120 x 60 cm	13,888
2. Varsity	Heavy soil	90 x 60 cm	18,518
	Medium soil	120 x 60 cm or	13,888
		120 x 30 cm	27,777
B) Rainfed cotton			
i) American varieties	Heavy soil	60 x 60 cm	27,777
	Medium soil	60 x 30 cm	55,555
	Medium soil	90 x 90 cm	12,345
ii) American hybrids	Heavy soil	90 x 60 cm	18,518
	Medium soil	60 x 60 cm	27,777
iii) <i>Deshi</i> varieties	Heavy soil	60 x 15 cm	1,11,111
	Medium soil	45 x 22.5 cm	98,765

Sr.	Particular	Seed rate (kg/ha ⁻¹)	Spacing (cm)
A	G. hirsutum		
i	PKV RAJAT	10-12	60 X 30
ii	AKH-8828	10-12	60 X 30
iii	AKH-081	15-20	60 X 15
iv	DHY-286	15-20	60 X 30
B	G. arboreum		
i	AKA-5/AKA-7/AKA/8	12-15	60 X 15
ii	AKA-8401	09-10	60 X 30
C	Hybrids		
i	PKV HY-2 AND 3	3.5-4.0	90 X 60
ii	PKV HY-4 AND 5	4.5-5.0	60 X 60
	IRRIGATED	2.0-2.5	120 X 90
D	Arboreum hybrids		
i	PKV DH-1	3.0-3.5	60 X 45
ii	AKDH-5	3.0-3.5	60 X 45

VI. Fertilizer:

- Cotton crop should be manured with FYM or compost at least once in 3 years at the rate of 12 to 15 tons/ha.
- The fertilizer dose of 100:50:50 (NPK) kg/ha for irrigated cotton; 80 :40:40 (NPK) kg/ha for rainfed cotton hybrids and 50:25:25 NPK kg/ha both for *desi* and *hirsutum* varieties are recommended. Nitrogen should be in two splits for rainfed cotton crop i.e. 50% at sowing time and 50% at square formation stage and three split for irrigated cotton i.e, 1/3rd at sowing time, 1/3rd at one month after sowing and remaining 1/3rd at 60 DAS. While whole P and K should be applied as basal dose for both rainfed and irrigated cotton.
- The application of basal dose of fertilizer to dibbled cotton crop should be given at the time of sowing by ring method 5 to 6 cm away from dibbled seed. Delay application of basal dose of fertilizers reduces the yield of seed cotton to the tune of 10 to 40% with in late duration period of 10 to 30 DAS.
- Spraying of DAP at the rate of 2% at the time of flowering and boll development stage gave 10 to 20% higher seed cotton yield as well as avoid the redding of cotton.
- Seed treatment with *azatobactor* was found beneficial for cotton crop for reducing the nitrogen dose to the tune of 20 to 25 %.

Sr.	Particulars	RDF NPK (kg/ha ⁻¹)	Time of application	Method of application
A				
i	Hybrids Irrigated	100:50:50	1/3 rd N and full P ₂ O ₅ and K ₂ O as basal, 1/3 rd N after 30 DAE and 1/3 rd N after 60 DAE	Ring method / Spot application
ii	Rainfed	50:25:25	1/2 N and full P ₂ O ₅ and K ₂ O as basal, 1/2 N after 30 DAE	Ring method / Spot application
B	Improved varieties	50:25:0	1/2 N and full P ₂ O ₅ as	Broadcasting

	of <i>Hirsutum</i>		basal, 1/2 N after 30 DAE	followed by hoeing
C	Improved varieties of <i>arboreum</i>	30:15:0	1/2 N and full P ₂ O ₅ as basal, 1/2 N after 30 DAE	Broadcasting followed by hoeing
D	Arboreum hybrids	50:25:25	1/2 N and full P ₂ O ₅ and K ₂ O as basal, 1/2 N after 30 DAE	Spot application / Broadcasting

Application of chemical fertilizers should be as per soil test report.

VII. Integrated Nutrient Management:

- A. Application of FYM / compost 5 t per hectare every year + 50 % RDF
- B. For *Hirsutum* varieties / hybrids apply 50 % RDF as basal and 4.5 t /ha lucreana lopping 30 and 40 days after sowing. This INM not only save fertilizer but improve soil fertility.
- C. Application of 50 % RDF (25 + 12.5 kg ha⁻¹ N and P₂O₅) before sowing or glyricidia green foliage lopping at 30 DAE @ 5 t/ha is recommended to get higher seed cotton yield and net monetary returns with the added benefit of improving physico-chemical soil properties under rainfed condition.
- D. Application of FYM @ 5 t/ha along with low fertilizer dose of 25 + 12.5 kg/ha N and P₂O₅ is recommended for cotton variety AKH-081 grown under shallow soil (less than 25 cm) to get maximum monetary benefit in rainfed condition.
- E. For cotton crop 4.5 ppm available iron content in soil and 281 ppm in youngest mature leaf at square initiation stage be considered as critical level for application of iron.
- F. Use of bio-fertilizers:
 - a. Azotobactor @ 25 gm/kg seed
 - b. PSB @ 20 gm/kg seed

VIII. Water management:

- i. Source of irrigation: Well
- ii. Method of irrigation:
 - a. Spot application for pre-monsoon cotton by crow bar method
 - b. Drip irrigation for irrigated cotton
 - c. Furrow irrigation to irrigated cotton
 - d. Protective irrigation by alternate furrow at critical growth stages
- iii. Irrigation scheduling:
 - a. Peak flowering: If there is necessity
 - b. Boll development: If there is necessity
 - c. Stop irrigation after boll bursting
- iv. Intercultural operations:
 - a. Three to four hoeing at an 15 to 20 days interval by bullock drawn implements for removing weeds, aeration and to check evaporation
 - b. At last hoeing open the furrow between two rows of cotton by tying the ropes to hoe for conservation of rains

Water management for rainfed cotton :

- Sowing of cotton crop on contour ridges resulted in to good crop growth and optimum plant population both in high rainfall and low rainfall situation under rainfed condition.
- Dry sowing of cotton on flat bed or top of the ridges or by crow bar method gave higher seed cotton yield than normal sowing of cotton.
- Normal sowing of cotton on flat beds followed by earthingup at the time of each hoeing and opening of ridges and furrows at last hoeing across the slope produced maximum seed cotton yield. Hence, this practice is recommended for rainfed cotton for rain water conservation in cotton crop.

Water management for irrigated cotton:

- For irrigated cotton, irrigation at 10 to 12 days interval till the on set of monsoon is advocated. If there is a dry spell of 3 weeks or more in monsoon, gave protective irrigation to cotton crop. Use of irrigation water to cotton crop at 75-150 CPE ratio was found equally effective. Application of irrigation water at 125 IW/CPE ratio recorded higher seed cotton yield of hybrids than no irrigation and irrigation at 250 IW/CPE ratio.
- H-4 under irrigation at 125 mm CPE ratio recorded significantly higher seed cotton yield over 100mm CPE ratio and irrigations given at critical stages of growth were found more effective for producing more yield.

IX. Weed management:

- a. Keep the field weed free up to 60 days after sowing (9 weeks) by adopting three to four hoeing followed by 2 to 3 manual weedings.
- b. If labourers are problem in that area use any one herbicides from following table for control of weeds

Sr.	Common name	Trade name	Dose kg a.i. /ha	Time of application
1	Fluchlorin	Basalin 45 EC	0.75 to 1.0	Pre sowing
2	Trifluralin	Treflon 48 EC	1.0	Pre sowing
3	Pendamethalin	Stomp 30 EC	1.0 to 1.5	Pre emergence
4	Diuron	Class 80 % WP	0.5 to 1.0	Pre emergence
5	Oxadizone	Ronstar 25 EC	0.5 to 0.75	Pre emergence
6	Alachlore	Lasso 50 EC	1.0 to 1.5	Pre emergence

- i. Out of these, use any one herbicide to control the weeds
- ii. Hoeing and weeding should be undertaken 30 to 45 days after sowing

X. Cotton based cropping systems :

- Normal as well as paired row sowing of cotton gives similar yields, hence either planting pattern can be adopted. Spacing depending upon the hybrid/ variety of cotton. Intercropping of urd (T₉) in general (solid or paired row planting) should be adopted for getting maximum monetary returns.
- In sequence cropping system, the sequence of cotton followed by summer groundnut and cotton followed by summer sunflower were found more remunerative than other sequences.
- Cropping system of cotton intercropped with pigeon pea (6:2) gave significantly higher gross monetary returns. The next best cropping systems was cotton intercropped with soybean.

XI. Plant Protection Technology:

General behavior insect pest of cotton

In Maharashtra state cotton crop is heavily damaged by almost 21 insect pests. Out of these at seedling stage sucking pests viz. jassids (*Amrasca biguttulla biguttulla*), Aphids (*Aphis gossypii*), Thrips (*Thrips tabaci*) cause serious damage to cotton crop. From 1985-86 onwards-white fly (*Bemica tabaci*) has also become an important sucking pest. After square formation, bollworms viz. Spotted bollworm (*Earias insulana* and *Earias fabea*), American bollworm (*Helicoverpa armigera*) and Pink bollworm (*Pectinophora gossypiella*) found to cause heavy losses in cotton crop. Occasionally red cotton bug (*Dysdercus cingulatus*) and dusky cotton bug (*Oxycarenus hyalinipennis*) found infesting cotton bolls. Incidence of leaf defoliator's viz. Tobacco leaf eating caterpillar (*Spodoptera litura*), Cotton leaf roller (*Sylepta derogata*) etc occur very rarely. Since last 10 years incidence of leaf miner (*Bacculatrix thuribiella*) is also noticed.

A) Chemical Insecticides and their doses recommended :

a) Sucking pests : (Aphids, jassids and thrips)

- Soil application of phorate 10 G @ 10 kg/ha or Imidacloprid 70 ws seed treatment @ 10gm/kg seed or Thiomethoxam 70ws seed treatment @ 4.28 gm/kg seed
- Spraying of methyl demeton 25 EC @ 8m /10lit. of water or
- Spraying of dimethoate 30 EC @ 10ml/ 10 lit of water or
- Spraying of acetamiprid 20 sp @ 15 g.a. % /ha

b) For White fly

- Methyl demeton 25EC @ 40 ml /10 lit of water or
- Dimethoate 30 EC @ 33 ml/10lit of water or
- Trizophos 25 EC @ 10 ML /10 lit of water or
- Monocrotophos 36 WSC @ 28 ML/10 lit of water or
- Fenprothrin 50 EC @ 10ml/10 lit. of water

c) For Bollworms

- Endosulfan 35 /Ec @ 17 ml /10 lit of water or
- Quinalphos 25 EC @ 20 ml /10 lit of water or
- Carbaryl 50 wp @ 40 gms/10 lit of water or
- Monocrotophos 36 WSC @ 17 ml/10 lit of water or
- Phosalone 35 /ec @ 14 ml/10 lit of water or
- Spinosad 45 /sc @ 0.01 % particularly for American and spotted bollworm
- Beta-cyfluttrin 2.5 EC @ 0.0025 % particularly for pink bollworm

d) Synthetic pyrethroids recommended for bollworms :

- Cypermethrin 10 EC @ 7.5ml/10lit of water or
- Cypermethrin 25 EC @ 3.0 ml/10 lit of water or
- Fenvalerate 20 EC @ 6 ml/10 lit of water or
- iv Decamethrin 2.8 EC @ 9ml/10lit of water or
- Fluvalinate 20 EC @ 4.5 ml / 10 lit of water

B) Biological Agents Recommended:

- Release of *Trichogramma chilonis* egg parasitoid @ 1.5 lakh/ha

- Release of chrysoperla carnea eggs @ 10000/ha
- Spray of HaNPV @ 250-500 LE/ha for H. armigera

C) Botanicals Recommended:

- Neem seed extract 5 %
- Spray of azadiractin 300 ppm @ 5 ml/L of water
- Spray of azadiractin 10000 ppm @ 1 ml/lit or azadiractin 1500 ppm @ 2.5 ml/L

D) IPM :

Economic threshold levels for major pests of cotton

Sucking pests :

- Aphids - 10 aphid nymphs/plant or 15-20 % aphid infested plants
- Jassids - 2 to 3 / leaf
- Thrips - 10 thrips/leaf
- Whitefly – 8 to 10 adults or 20 bthrips/leaf
- Aphids, Jassids and thrips together- 10 insects/leaf

A) Bollworms :

- American bollworm : one egg or larva/plant or 5 to 10 % damage in green fruiting bodies (squares, flowers and green bolls)
- Spotted bollworm : 5 to 10 % damage in green fruiting bodies (squares, flowers & green bolls)
- Pink bollworm : 5 to 10 % green boll damage
- Bollworm complex : 5 to 10 % damage in green in green fruiting bodies (squares, flowers and green bolls)

COTTON PATHOLOGY

- All most all *arboreum* cotton varieties were found disease resistant to Para wilt (New wilt) of cotton.
- The fungicide calixin 0.1% (N-tridecyl-1,2, 6 dimethyl morpholin) was found most effective to control the gray mildew of cotton.
- Copper oxy-chloride 0.25% + Agrimycin-100 ppm recommended for control of bacterial blight of cotton.
- Carbendazim 0.1% found most effective to control the boll rot of cotton.
- Seed delinting with sulphuric acid + seed treatment with thairum 2-3 gram/ kg seed Found most effective in reducing the seedling mortality of cotton.
- The crops of Bhendi, Brinjal and Tomato acts as alternate host for the fungus Alternaria so it is suggested that these host plants should not be planted near the cotton crop for minimize the Alternaria leaf spot incidence on the cotton crop
- Identification of races of *Xanthomonas compastris* PV. Malvaceum . In this trial the race No. 10 was identified from NH-452, NHH-44, NHH-302 and PH-93 cotton varieties / hybrids.

PROFORMA FOR VARIETY/ HYBRID RELEASED FOR CROPS

S. No.	University	Name of variety/		Year of release		Duration			Yield (Kg/ha)	Recommended states	Disease reaction	Insect pest reaction	Salient features
		Variety	Hybrid	Center	State	Early	Medium	Late					
1	C.R.S., Nanded M.A.U., Parbhani		NHH-44	CRS, Nanded	M.S. 1983		150-160 days		1200	Maharashtra	Rasistant to Bacterial blight, Alternaria leaf spot	Tolerant to sucking pests	Good rejunvation capacity, wider adaptability
2			PHH-316	CRS, Parbhni	M.S. 1999		150-160		1400	Maharashtra	-"-	-"-	Semi- erect, open plant type ,High GOT(38%)
3		NH-452		CRS, Nanded	M.S. 1995		150-160		1500	Maharashtra	-"-	-"-	Resistant to sucking pests, tolerant to drought
4		NH-545		CRS, Nadned	M.S. 2002		150-160		1600	Maharashtra	-"-	-"-	-"-
5		PA-255		CRS, MB Farm, Parbhani	M.S. 2002		150		1500	Maharashtra	-"-	-"-	Good fibre properties long staple <i>arboreum</i>

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