

## Approved Package of Practice for Cotton: Haryana State

Cotton agronomy research is oriented to develop best agro technique for attaining maximum yield potential from cotton varieties and very useful recommendation for cotton production technology have been evolved under prevailing agro-climate of the State.

### Time of sowing:

Cotton is grown in Kharif season in the State. Time of sowing spread over a period of April to first fortnight of June. However, in case of American cotton optimum time of sowing is May for better yields. Delay in sowing results in yield reduction. For all desi cotton varieties/hybrids, best sowing time is mid April to 1<sup>st</sup> week of May, while during May & June burning of seedling is very high. In case of American cotton variety H 1117 and hybrid HHH 223, recommended sowing time is mid April to 10<sup>th</sup> May and for H 1226 & hybrid HHH 287, the sowing time is mid may for normal *hirsutum* genotypes and third week of May to first week of June for compact type.

### Method of Sowing:

- Before sowing seeds should be dipped in water upto 5-6 hours for better germination .
- Sowing in 4-5 cm depth.
- Seeds treated with 5 gm Emisan, 1 gm streptocyclin and 1 gm succinic acid in 10 litres of water.
- In termites affected areas seeds treated with 10 ml chlorpyrifos apart from above mentioned chemicals.
- Seed treated with carbendazim @2 gm /kg in the root rot affected areas.
- Seed treated with Imidacloprid @ 7.5 gm / kg seed to escape the crops from sucking pests upto 40-60 days.

### Plant population and Geometry:

On the basis of large number of trials on different varieties following recommendation for seed rate, spacing and plant population are finalized for our state and are adopted by the farmer's of the state.

Varieties	Seed rate (kg/ha)	Spacing (cm)	Plant population per ha.
American cotton	15-20	100x20 67.5x30	50000 49380
Desi cotton	10-12	67.5x30 67.5x60	49380 24690
Hybrid	3-5	100x40	25000

### Fertilizers:

For obtaining high yield in cotton, 80-100 Kg N per ha for American Cotton and 50 kg N for desi cotton along with 30 kg P<sub>2</sub>O<sub>5</sub>/ha and in case of hybrid cotton, 150 kg N, 60 kg P<sub>2</sub>O<sub>5</sub>, 60 kg K<sub>2</sub>O and 25 kg Zn SO<sub>4</sub>/ha has been recommended. However, the nitrogenous fertilizer application, half quantity at squaring and half at flowering gave highest seed cotton yields. In case of hybrid split the N dose in three parts i.e. sowing, squaring and flowering stage. In sandy soil the research results have revealed that 90 per cent dose of fertilizer through soil application and 10 per cent through foliage spray at the

boll development stage gave the highest seed cotton yields. Inoculation of cotton seed with *C<sub>2</sub>*, *M<sub>4</sub>* and *Azospirillum* culture resulted into saving of 25-27 kg N/ha.

### **Tillage and Weed control:**

Pre-planting deep ploughing every year or alternate year was found to be effective for better root development and optimum vegetative growth resulting in higher seed cotton.

Interculture through mechanical methods is a usual practice for controlling the weeds in cotton crop. However, combination of weeding with interculture gave better results over the years. Pre-emergence application of stomp @ 1.5 litre a.i./ha and post emergence application of diuron 0.5 kg + grammaxone @ 1.5 litre/ha gave better results for effectively controlling the weeds.

### **Integrated Weed Management:**

Use of tractor drawn harrows for interculture and weeding is common in Haryana. *Pendimethalin* @ 1.5 Kg ai/ha + one hoeing at 35 DAS

- Before 1st irrigation 1 or 2 dry hoeing should be done .
- After first irrigation 2-3 hoeing by *kasola*
- Deep hoeing by tractor mounted cultivator till the crop reaches one feet height.
- The spray of basalin @ 800 ml/ acre dissolved in 200 litre water before sowing or Treflan @ 800ml/acre before germination or Stamp @ 1.0-1.5 l/acre dissolved in 200-250 litre water after sowing or Duron @ 200 gm/acres or gramaxon @600 ml/ acre or to be used after germination.

### **Irrigation:**

Cotton requires 800-1000 mm water during crop period. In Haryana, though the cultivation is under irrigation condition, but normal rainfall is very helpful for obtaining optimum yields of cotton. About 4 irrigation supplying 240 mm amount of water are needed and rest of the water is fulfilled through rains during the season. The main requirement of irrigation is in the month of April, May, August and September (to avoid water stress during critical stages i.e. flowering and fruiting). Last irrigation should not be given after the opening of about 1/3<sup>rd</sup> bolls.

It is revealed from the studies that irrigation applied in furrows rather than flooding resulted in 25% saving of water and also the utilization of nutrients was more efficient.

### **Cropping system:**

Cotton - Wheat, Cotton - Mustard, Cotton - berseem

### **Use of defoliant:**

Some times the delayed opening of bolls resulted in low yield and little time is left for field preparation of taking next rabi crop in rotation. Defoliant hastens the boll opening. Application of Dropp @ 200 g/ha at the time of 60 per cent boll opening stage contributed significantly for increasing the effective number of bolls opening and thus seed cotton yield.

### **Shedding of fruiting bodies in cotton:**

Studies revealed that in cotton 7-35 per cent of floral buds and 2-64 per cent of bolls shedding are due to physiological disorders and remaining shedding is attributed to insect infestation. Plant capacity to induce nitrate reductase and ethylene biosynthesis is diminished with the lowering of metabolic energy available in the abscising plant part. Such parts face internal water stress even under normal conditions and nutrients such as N and P and carbohydrates are drained out and shedding of fruiting bodies is caused.

### **Method of P<sub>2</sub>O<sub>5</sub> application:**

If Phosphorous fertilizer is not applied at the time of sowing due to any reason, then it should be applied after 1<sup>st</sup> irrigation (45-50 DAS) from DAP fertilizer through para method. It should be 10 cm away from the cotton plants on both side.

### **Foliar application of nutrients:**

Application of MgSO<sub>4</sub> +DAP (1+2%) as a foliar spray has increased 15% to 21% higher seed cotton yield over control. Three sprays would be carried out with an interval of 25 days. Spray schedule should be started at 75 days old crop. This recommendation has been accepted at the national level and at state level spray of urea @ 2% is recommended.

### **Pest Management:**

- Avoid growing bhindi, moong and arhar in the cotton crop and as border row in order to reduce the incidence of *Helicoverpa* and spotted bollworms, jassids and whitefly. Bhindi, moong, daincha and castor are also the most preferred hosts of tobacco caterpillar, helping the pest to multiply and shift to cotton.
- Monitor insect pests regularly every week during vegetative phase and twice a week during reproductive phase. Use pheromone traps for monitoring bollworms.
- For whitefly control, use systemic insecticides or neem formulations. Use of yellow sticky traps or yellow sheet with grease helps in mass trapping of whitefly adults.

### **Disease Management:**

- Application of *Trichoderma harzianum*, *Trichoderma viride* and *Gliocladium virens* in soil @0.33% (w/w basis) were effective in reducing root rot of cotton.
- Coating of seeds with bioagents @ 1.0% showed root rot reduction and yield improvement.
- Spray of Plantomycin (30-40g per acre) or Streptomycin (6-8g per acre) and copper oxychloride (600-800 gper acre) in 150-200 litre water is recommended for the management of foliar diseases.
- In order to control boll rot, copper oxychloride or carbendazim @ 2g per litre may be added to any insecticide recommended for bollworm control

## List of released cotton cultivars released from HAU

### American Cotton Varieties. (*G.hirsutum* L.)

**H 777:** This variety was developed through selection of plants (Mass selection) from Bikaneri Narma (unspecified strain popular with farmer) and released for general cultivation in 1978. The release of H 777 brought a revolution for cotton cultivation in the State. Extra ordinary feature of this variety was its early maturing shorter duration habit. Its crop duration is 180 days when planted in the month of May, then crop is terminated by middle of November. Because of its early maturing habits, the farmers in the State adopted cotton-wheat rotation very successfully. This variety remained on the cotton map of the state for more than a decade. It was resistant to jassids and escape spotted as well as pink boll worm considerably by virtue of its being early in maturity and synchronous in production of flowers and fruiting bodies, and completes its life cycle before the onset of frost

Its plant grows upto 120-150 cm, bears 3-6 strong monopods, semi spreading, stem and leaves covered with hairs, flowers and pollens of cream colour and boll shape is oblong with pointed tip. Its average yield is 18 q/ha.

**H 655 c:** Another American cotton variety H 655c also released at the same time in 1978. It was developed through hybridization, following pedigree method of breeding, from a cross of "02982 x PRS-74". Its boll weight was 3.2 g and far superior in fibre length and fibre properties, spinnable at 40's. The duration of the variety was 210 days, more than the other early maturing varieties. Due to this reason the farmers for cultivation under double cropping system did not prefer this variety. Its average yield is 15 q/ha.

**HS 45:** It was released for early sowings (before middle of May) in the State. It was developed through hybridization involving 'H 777x M8", having 2-5 monopods, spreading, leaves medium in size, hairs on stem and leaves, flower and pollen of cream colour. Crop maturity period is 185-190 days and average kapas yield is 16 q/ha. This variety is not under seed chain presently.

**HS-6:** High yielding medium maturing Narma variety HS 6 was released in 1992. It was bred through pedigree method attempting three way cross "(Bikaneri Narma x K3199) x Bikaneri Narma" after extensive testing in research and farmers trials over several locations and years. It was recommended both for early and normal planting (upto 15 May). Its plant height is 150-160 cm. It has 2-5 strong monopods, light green medium size leaves and round boll shape. Being synchronous in flowering and boll opening, less number of pickings are needed. Boll opening is fluffy and clean cotton is picked up with low trash content. Last picking is completed by the end of November vacating the fields for timely sowings of wheat. Its average yield is 20 qt./ha. It has field resistance against insect-pests and diseases (Except cotton leaf curl virus).

**H 974:** Another American Narma variety, suitable for normal and late planting from second fortnight of May to 10<sup>th</sup> of June was released in 1992. Plant is bushy with 2-3 monopods, green and medium broad and flat leaf raised in the center is a distinguishing character of this variety with cream corolla and pollen. It is fairly resistant to bollworms (Pink and Spotted), jassids and tolerant to partial intermittent drought conditions. Its average yield is 1861 kg/ha. This is now not in seed chain.

**H 1098:** This is the first sympodial variety released for cultivation in 1995 for Haryana State. It was bred through 'Pedigree" method involving three way-cross-'(LH 354 xSBI 71) x H 777" as parents. It is high yielding and early maturing having 165 days crop duration suitable for late sowing i.e. 10<sup>th</sup> May to 10 June, Plant is sympodial with 0-1 monopodia (can be

more due to early detopping of growing shoot tip) green and broad flat leaf raised in the center, cream anther and flower. Its average yield is 1943 kg/ha.

**H 1117:** It is the first cotton leaf curl viral disease tolerant variety released for cultivation in the Haryana State. This variety was developed through pedigree method from cross (H777x Ac 134) x (H 777 x GS 21). Its plants are having 4-6 strong monopods, small size cup shape hairy green leaves, cream flower and anther with pointed round bolls. This variety matures in 185 days and suitable for early and normal sowing i.e. 15 April to 15<sup>th</sup> May. Its average yield is 1918 kg/ha and potential yield is 3704 kg/ha.

**H 1226:** It is the first cotton leaf curl virus disease resistant variety recommended for release for cultivation in the Haryana State. This variety was developed through Mass-pedigree method through the cross RS 2013 x H777. Its plants are having 2-3 strong monopodia, small size cup shape hairy light green leaves, yellow flower and dull creamish anther with pointed round bolls. Its petals are dark yellow at the base and light yellow at the periphery/tips. This variety matures in 170-175 days and suitable for normal sowing i.e. around 15<sup>th</sup> May. Its average yield is 2151 kg/ha and potential yield is 4292 kg/ha.

### **American Cotton Hybrid:**

**HHH 81 (Dhan Luxmi):** This is the first intra-*hirsutum* cotton hybrid released in Haryana in 1995. Its plants attain 150 cm. height, having 4-6 strong monopods, leaves green with hairy surface, corolla cream, yellow pollen and big boll with pointed apex. It is fairly resistant to spotted as well as Pink boll worm and other insect-pests and diseases, resistant to lodging and non-shedding, and picking is over before the onset of frost. Its average yield is 2251 kg/ha. It takes 185 days in maturity therefore sowing should be completed before 15 May. It spins at 40's.

**HHH 223:** This is first cotton leaf curl virus disease resistant cotton hybrid released in 2001 for cultivation in Haryana State. Plants are tall and erect growing, leaves green, hairy, medium in size, flower colour yellowish with anthers creamy. It can be sown from 15<sup>th</sup> April to 20<sup>th</sup> May as this hybrid matures in 180 days. The average yield of this hybrid is 2124 kg/ha and potential yield is 3933 kg/ha and ginning out turn is 35.2 per cent.

**HHH 287:** HHH 287 is first genetic male sterility based intra *hirsutum* hybrid released by State Variety Release Committee in 2005 for irrigated conditions of Haryana State. Medium height (150-160 cm) erect growing, leaves green, hairy, medium in size, corolla and anthers cream in colour, close bearing, medium boll wt. (.4 g.). It matures in 160-170 days and farmer can plant wheat crop in time. It is resistant to leaf curl virus disease. Hybrid seed production is easy and cheap (Rs. 125/kg) in comparison to conventional hybrids (Rs. 700/kg). This hybrid possesses ginning percent (34.2), 2.5% span length (27.8 mm), strength (22.4) and spins at 40 count. The yield potential of this hybrid is 3285 kg/ha. and average kapas yield is 2045 kg/ha.

### **Desi Cotton varieties (*G. arboreum* L.)**

**DS-1:** Desi cotton variety DS-1, developed through mutation breeding (gamma Radiation) from variety G 27 and was released in 1983. It replaced the very old desi cotton variety G 27. It is tall growing (150-190 cm) and has tendency to go taller in humid and fertile soil conditions. Its plants body colour is red. Several monopods at the base, leaves medium in size, broad, 3 to 6 lobed, outer margin of petals pink, which gives an impression of pink flower with dark red petal spot at the base or "red eyes" and yellow pollen. It is highly resistant to jassids and bacterial blights. Crop is resistant to lodging and drought, escapes from bollworms due to early maturing habits. Its fibre is coarse and short, not suitable for mill consumption, however it is quite suitable for domestic use, medical dressing and for the non-spinning purpose.

**DS-5:** High yielding early maturing short staple desi cotton variety developed through hybridization (Shamli x S-44-4) was released in 1987. It has green plant body and foliage. 150 cm tall, having several monopods at the base, leaves medium size-narrow 3-5 lobed, flower (corolla) white, dark red 'eye' at the base, yellow pollen with medium size bolls. The variety is resistant to bacterial blight and highly resistant to jassids. Its early maturing and synchronous flowering habit helps in escaping from pink boll worm damage to a greater extent. DS-5 is tolerant to shattering of seed cotton at the time of boll opening, which is an extra-ordinary feature of this variety against most of desi cotton varieties. Due to this character of the variety frequent pickings are not required and this reduces the cost of cotton pickings. Its mean yield is 2238 kg/ha.

**HD 107:** HD 107 was released in 1995. It gave stable performance for seed cotton yield over varying environmental fluctuations. Its plant is semi-determinate, bears 2-3 monopods and 12-15 short sympods. Leaf lobe is narrow with deep cut, small and green leaves, cream corolla colour with yellow pollens and small light red spot on petals inside at the base. Crop duration is 170 days with last pickings in second fortnight of October. It is resistant to Jassids and fairly escape boll worms damages. It has short and coarse fibre suitable for non-spinable purposes. Mean seed cotton yield is 22 quintals per hectares. It possess 38.5% lint and 15.0 mm fibre length.

**HD 123:** This variety is suitable for cotton-wheat/cotton-Raya rotation as its picking is finished about 10 days earlier than old desi cotton varieties. It matures in about 160-165 days. Its average yield is 23 q/ha. It possesses 39.5% lint and 15 mm fibre length. The stem and leaves of HD-123 are of green colour. The leaves are okra type. The flower is white and small. The height of plants is 150 cm with round bolls.

**HD 324:** The state variety release committee has released new desi cotton variety, HD 324 in 2004. The average yield of this variety is 2200 kg/ha against 1719 kg/ha of HD 123 (Local check). The plant of this variety is of red colour. It possesses 3-4 monopods; small leaves with deep lobes, pink coloured flower with spotted red eyes. It is suitable for normal planting and can tolerate drought conditions. It is tolerant to insect pest and diseases. It possesses 42% lint and mean fibre length is 15.0 mm. Crop duration of this variety is 180 days. This can be planted in April and will vacate the field by the end of October

### **Desi cotton hybrid:**

**AAH-1:** The first GMS based hybrid of desi cotton and released at national level for cultivation in north zone during 1999. Its major advantage is that its seed production is cheaper because of its female parent has genetic male sterility (GMS) system. The female parent is DS-5 and the male parent is HD 266. The Hybrid plant is 150 cm in height with dark green coloured leaves having red mid rib and veins and stem. It is sown in April and cotton picking can be done by October. Its average production is 25 q/ha. Its male and female can be obtained from CCS HAU, Hisar.