



Study on the varietal characteristics of cotton crop for mechanical harvesting

P. K. MISHRA*, MANJEET SINGH, G. S. MANES, BHARAT PATEL AND ANOOP DIXIT

Department of Farm Machinery and Power Engineering, Punjab Agricultural University, Ludhiana - 141 004

**E-mail: pramod-coaefpm@pau.edu*

ABSTRACT : The study was carried out to finalize the varieties suitable for mechanical harvesting. The regions selected were district Bathinda, Ludhiana in cotton belt area of Punjab and Nagpur in southeast of India. Three cotton crop varieties sown *viz.*, F2383, RCH773 and Suraj for selected three locations. The different parameters regarding crop *viz.*, variety, height, canopy coverage, stem diameter, agronomic practice etc. were studied. Plant height was found in range between 62.5 to 92 cm with an average plant height of 80.9 cm. The maximum plant canopy across row was 702 mm of variety RCH773 sown at RRS, Bathinda. The minimum plant canopy across row was 34.6 cm of variety Suraj sown at CICR, Nagpur. The average plant canopy across row was 56.8 cm for the varieties under consideration, which is less than row to row spacing *i.e.* 67.5 cm between the plants. The maximum number of sympods was 40 of variety F2383 sown at 67.5x30 cm at PAU, Ludhiana. The minimum number of sympods was 21 of variety Suraj sown at CICR, Nagpur. The maximum yield was 1000 kg/ac of variety Suraj sown at CICR, Nagpur. The minimum yield was 595 kg/ac of variety F2383 sown at 45x30 cm at PAU, Ludhiana. As per picking attribute the RCH773 is suitable for mechanical picking.

Key words : Cotton variety, mechanical picking, monopods, row spacing, sympods

Cotton is an important commercial crop of India, having approximate 12.81 million hectare cultivated area which is largest in the world. India is the largest producer of cotton in the world but yield is much less as compared to the world average yield. The average yield of cotton is only 540 kg/ha as compared to 2151 kg/ha for Australia as against the worlds average of 766 kg/ha (Anonymous, 2014). Several causes may be assigned to the existence of lower average yields which are inadequate inputs, lack of awareness about advanced cultivation practices among farmers, deficiency of irrigation facilities, deficiency of proper timing of field operations and too much dependence on labor to cultivate cotton (Majumdar, 2012). Cotton is cultivated in India in three distinct agro

climatic zones namely, north zone consisting of Punjab, Haryana and Rajasthan; Central zone comprising of Gujarat, M.P and Maharashtra and south zone consisting of Andhra Pradesh, Karnataka and Tamil Nadu. North zone with an area of 24 per cent contributes 30 per cent of production, while the south zone contributes 28.3 per cent, production from 20.5 per cent area and central zone with the maximum area of 55 per cent contributes 40.7 per cent to cotton production.

There are three manual pickings for cotton crop in a season at an interval of 15 days. The first, second and the third picking constitute 35, 50 and 15 per cent, respectively. An adult can pick about 15-20 kg/day of seed cotton, compared to an average picking of 870 to 2180

kg/day by single row spindle type cotton picker. In India, on an average man power required for manually picking of seed cotton is 517 man h/ha. Hand picking is not only tedious work but also ten times costlier than irrigation and about twice that of weeding operation. Picking cost is approximately 10 per cent of the total income from the crop (Prasad *et al.*, 2004). There has been a scarcity of man power availability on cotton farms for picking operations. This also results in delayed picking.

The mechanical harvesting of cotton crop requires different crop characteristics *viz.*, boll and plant characteristics like boll size, boll shape, boll length, trash content, maturity, seed weight, lint per cent, boll stem, carpel flair, plant height, length of longest and lowest limb which depend upon the variety and affect the picking energy, pre-harvest loss and picker efficiency (Kohli *et al.*, 2015). Among the spacing, seed cotton yield, plant height, sympods/plant, boll weight and ginning outturn were found to be non significant, however, monopods and bolls/plant were significantly higher at spacing of 67.5 x 60 cm than spacing of 67.5 x 45 cm (Buttar and Singh, 2007). Wider spacing might have favored higher monopods and bolls/plant but significantly lower plant population might be the reason for mitigating their reflection in yield (Brar *et al.*, 2015). Brush stripped cotton contained 27.8 per cent total trash compared to 4.6 for spindle picked seed cotton. It was further mentioned that some loss of quality is associated with brush stripped as compared to spindle picked even under favorable harvest conditions.

Total harvest loss was not affected by plant size, but increased when spacing between stripping rolls widened. Stick content in harvested cotton increased when branch moisture decreased and plant height increased; however, increased spacing between stripping

rolls lowered stick content (Wanjura *et al.*, 2012). Fine foreign material was not significantly affected by branch moisture content, plant size, or spacing between stripping rolls. Spacing between stripping rolls was the most important variable in explaining total harvest loss. Cumulative rainfall between the first freezing temperature and harvest was the most important parameter for predicting quantity of sticks in harvested cotton. Keeping in view the effects of above mentioned cotton crop factors this study was carried out for collecting information's of the plant characteristic.

Development of performa and data collection : The basic data of the canopy structure, cropping pattern and agronomic practices were collected from the three different locations *viz.*, Punjab Agricultural University, Ludhiana, Regional Research Station, Bathinda and Central Institute of Cotton Research (CICR), Nagpur on a pre devised Performa (Goyal *et al.*, 2009).

Agronomic practices of cotton crop at different locations : The cotton variety F2383 was sown at Research Farm of Department of Farm Machinery and Power Engineering, PAU, Ludhiana. While RCH773 was sown at Regional Research Station, Bathinda. The local cotton variety Suraj was sown at Research Farm of CICR, Nagpur. The crop was sown by adopting a new planting system *i.e.* High Density Planting System (HDPS) at 45x30 and 67.5x30 cm spacing for selected cotton varieties with the help of tractor operated inclined plate planter. The crop was harvested about 188-198 days after sowing. Fig. 1 shows the views of F2383 and RCH773 cotton varieties in the field.

Cotton picking window : The complete picking of cotton full filed in at least three



Fig. 1. Crop view of F2383 and RCH773 cotton varieties

pickings starting from the third week of September to final picking in the first week of December extending over a period of two and half months for northern India whereas for southern India cotton picking window ranged from first week of December to first week of February. It was observed that picking span (start of first picking to last picking) for northern India was comparatively more than the cotton sowing region of southern India and it may be because of the climatic conditions. The complete ripening/ maturing of cotton bolls was achieved earlier in southern India.

Measurement of plant characteristics

: Plant characteristics were measured for twenty five plants from three different locations identified by attaching aluminum foils on the top of plants. Different data collected for plants of different variety are such plant height, plant width and height of first monopod, first sympod, lower most bolls and plant width. All cotton crop was mechanically harvested with finger type stripper. The picking efficiency, ground and stalk loss and trash content were also recorded.

The selected crop characteristics regarding mechanical harvesting were recorded for three varieties of cotton crop from respective locations (Table 1). The harvesting was completed in three pickings. Overall percentage

of cotton picked was 36.5 to 52.6 per cent in first picking, 25.6 to 55.0 per cent in second picking and 8.5 to 21.8 per cent in third picking for all the three varieties.

On an average plant height was found in range between 62.5 to 92 cm with an average plant height of 80.9 cm. The cotton crop having plant height less than 100 cm is generally considered suitable for mechanical picking. The maximum plant canopy across row was 70.2 cm of variety RCH773 sown at RRS, Bathinda. The minimum plant canopy across row was 34.6 cm of variety Suraj sown at CICR, Nagpur. The average plant canopy across row was 56.8 cm for the varieties under consideration, which is less than row to row spacing *i.e.* 67.5 cm between the plants.

The maximum height of lower boll was 28.2 cm of variety F2383 sown at 45x30 mm at PAU, Ludhiana. The minimum height of lower boll was 34.6 cm of variety F2383 sown at RRS, Bathinda. The average height of lower boll was 23.7 cm for the varieties under considerations, this character of plants will be useful in deciding the minimum ground clearance of header. The maximum height of upper boll was 83 cm of variety RCH773 sown at RRS, Bathinda and minimum height of upper boll was 34.6 cm for variety Suraj sown at CICR, Nagpur with an average height of upper boll was 69.66 cm. The

Table 1. Plant characteristics of different varieties

Characteristics Field location	Average values of observed data					Average values
	PAU, Ludhiana		RRS, Bathinda		CICR, Nagpur	
Cotton variety	F2383	F2383	F2383	RCH773	Suraj	
Plant spacing (cm)	45x30	67.5x30	67.5x30	67.5x30	60x10	-
Plant height (cm)	75.6	91.8	83.0	92.0	62.5	80.98
Plant canopy across row (cm)	56.6	68.4	54.2	70.2	34.6	56.80
Height of lower boll (cm)	28.2	27.6	19.2	23.4	20.2	23.72
Height of upper boll (cm)	68.6	68.0	77.0	83.0	51.7	69.66
Monopods/plant	2.0	3.0	2.0	2.0	2.0	2.0
Sympods/plant	32.0	40.0	31.0	30.0	21.0	30.0
Crop yield (kg/ac)	595.0	690.0	715.0	1395.0	1000.0	879.00

monopods was found in the range of 2 to 3. The maximum sympods was 40 of variety F2383 sown at 67.5x30 cm at PAU, Ludhiana. The minimum sympods was 21 of variety Suraj sown at CICR, Nagpur. The maximum yield was 1000 kg/ac of variety Suraj sown at CICR, Nagpur. The minimum yield was 595 of variety F2383 sown at 45x30 cm at PAU, Ludhiana.

The maximum picking efficiency was 82.8 per cent of variety RCH773 sown at 67.5x30 cm at RRS, Bathinda. The minimum picking efficiency was 76.8 per cent of variety F2383 sown at 67.5x30 cm at RRS, Bathinda. The maximum ground and stalk loss was 23.6 per cent of variety F2383 sown at 67.5x30 cm at RRS, Bathinda. The minimum ground and stalk loss was 17.2 per cent of variety RCH773 sown at 67.5x30 cm at Bathinda. The maximum trash content was 26.8 per cent of variety F2383 sown at 67.5x30 cm at RRS, Bathinda. The minimum ground and stalk loss was 21.2 per cent of variety RCH773 sown at 67.5x30 cm at Bathinda. Results depict that, variety RCH773 sown at 67.5x30 cm at Bathinda is suitable for mechanical harvesting as compare to other varieties (Table 2).

Table 2. Mechanical picking attribute of different varieties

S. Attribute No.	F2383	F2383	F2383	RCH773	Suraj
1 Plant spacing (cm)	45x30	67.5x30	67.5x30	67.5x30	60x10
2 Picking efficiency (%)	78.8	79.8	76.8	82.8	81.3
3 Ground and stalk loss (%)	21.2	20.2	23.6	17.2	18.7
4 Trash content (%)	21.8	24	26.8	21.2	22.5

CONCLUSIONS

Maximum height of crop varied from 62.5 cm to 92 cm for all the three varieties of cotton. Number of sympods and monopods varied from 21 to 40 and 2-3, respectively. The RCH773 has maximum cotton yield of 1395.0 kg/ac. As per picking attribute the RCH773 is suitable for mechanical picking.

REFERENCES

- Anonymous, 2014.** Production, yield and area of cotton. *www.indiastat.com*. A site registered with main library, Punjab Agricultural University, Ludhiana.
- Brar, A. S., Sarlach, R. S. and Rathore, P. 2015.** Response of *desi* cotton (*Gossypium arboreum* L.) hybrids to spacing and fertilizer levels under irrigated conditions. *J. Cotton Res. Dev.* **29** : 79-80.
- Buttar, G. S. and Singh, S. 2007.** Effect of date of sowing and plant spacing on the growth and yield of *desi* cotton (*Gossypium arboreum* L.). *J. Cotton Res. Dev.* **21**: 49-50.
- Goyal, R., Singh, A., Dixit, A. and Manes, G. S. 2009.** Study on the varietal characteristics of promising cotton varieties with reference to their suitability for using modern cotton picker, *J Res, SKUAST-J* **8** :18-24.
- Kohli, S. S., Sharma, K., Singh, M., Sharma, A., and Mishra, P. 2015.** Attribute based coding, review and gap analysis of cotton harvesting processes and machines. *Int Comm Agri Bio Engg, CIGR J.* **17** : 120-27.
- Majumdar, G. 2012.** Mechanization of cotton production in India, *CICR Tech. Bull* 1-56.
- Prasad, J., Kapur, T., Majumdar, G., Sandhar, N. S., Patil, P. G., Shukla, S. K., Jaiswal, B. N. and Patil, A. B. 2004.** Technology and equipment for harvesting, cleaning and ginning of cotton. *Tech. Bull*, **113** : 1-93. CIAE, Bhopal.
- Wanjura, J. D., Faulkner, W. B., Hold, G. A., Pelletier, M. G. 2012.** Influence of harvesting and gin cleaning practices on southern high plains cotton quality. *Appl. Eng. Agric.* **28** : 631-41

Received for publication : December 5, 2016

Accepted for publication : May 6, 2017