Indian Journal of Agricultural Sciences **91** (6): 876–9, June 2021/Article

Assessing production potential and quality parameters of ELS cotton (*Gossypium barbadense*) genotypes

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Received: 19 November 2020; Accepted: 08 January 2021

ABSTRACT

There is a huge demand for ELS cotton (*Gossypium barbadense* L.) in India for its premium fibre properities, however, the area and production of ELS is very less.There is a considerable scope for extending the area of ELS under rainfed condition to increase the production. But the fibre quality got severely affected due to moisture stress in rainfed condition as the crop has long phase of growing period. Hence the experiment is conducted to ascertain the relationship between phenological periods with quality parameters to identify sensitive phenological periods for better crop management and also to assess the production potential of ELS genotypes compared with hirsutum hybrids. Amongst genotypes, seed cotton yield (kg/ha) was significantly higher with RCH659 BG II (H × H) (2839 kg/ha) The quality parameters results revealed that suvin non Bt showed the significantly highest fibre length (39.3 mm of 2.5% span length) and fibre strength (32.0 g/tex). Fibre quality was superior in early formed bottom bolls compared to middle and top bolls. Quality traits were highly correlated with duration of the crop as duration gets shorter, quality becomes deteriorated. The duration of the first squaring, 50% flowering, and 50% boll bursting were positively and significantly correlated with fibre length and strength . The duration of 50% squaring to first flowering was significantly positively correlated with uniformity ratio.The economic analysis showed that inter specific hybrid MRC 7918 BG II registered the highest net return (₹ 116916/ha) which is better than intra-hirsutum hybrid RCH659 BG II (H× H)(₹ 99332/ha).

Keywords: ELS cotton, Fibre quality, Phenological parameters, Rainfed

Cotton is grown on 12.5 m.ha with the production of 360 lakh bales of lint during 2019–20. Despite good harvest, there is a mismatch in demand and supply of different staple groups of cotton, particularly in Extra Long Staple (ELS) cotton. *Gossypium barbadense* L. is known for its finest fibre properties being cultivated in less than 2% in the world. The country is still importing ELS cotton annually from Egypt, Sudan, USA, and other countries. The demand for ELS cotton in India is about 9 lakh bales against the availability of about 4 lakh bales only. The requirement of this cotton is expected to be about 20 lakh bales by 2030. Currently, 2 lakh ha of ELS cotton is being grown in India. The demand for the textile products made out of ELS cotton (32 mm and above) is growing exponentially and the potential for value addition of the products made out of these cotton varieties is very high. Realizing the importance of strengthening the position of the textile industry on this front, It is very essential to make the fine and superfine count cotton yarns available. To sustain in the global competition, it is essential to make the cotton available to the mills on par with our competitors (Sankaranarayanan *et al.* 2020). Therefore, it has become essential for India to give priority for increasing the ELS cotton production to retain the market share and also to improve the income of the farming community. The major constraint in adopting barbadense variety is its long duration (180-210 days); thus less suitable for rainfed situations because of long gestation periods. However, the ELS is grown as a rainfed crop in major areas. The moisture stress in crop growth periods affects the yield and quality parameters. Moderate to severe drought during the growing season which reduces yield and fiber quality attributes (Smith *et al.* 2011 and Wiggins *et al.* 2014). Hence, the experiment was conducted to assess the production potential of ELS genotypes in comparison to hirsutum hybrid and find out the relationship between phenological periods with quality parameters to identify sensitive phenological periods for better crop management.

MATERIALS AND METHODS

A field trial was conducted under the irrigated condition at main farm of ICAR-Central Institute for Cotton Research, Regional Station, Coimbatore, Tamil Nadu, India during the fall season (August to March) of 2018–19. The soil

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Table 1 Growth parameters, seed cotton yield (kg/ha) and duration of phenological phases of genotypes

Treatment	Plant height (cm)	No. of Nodes	No. of squares	No. of flowers	No. of busted bolls	No. of monopodia	No. of sympodia	LAI	Boll weight (g)	Seed cotton yield (kg/ha)	First Squaring	50% squaring	First flowering	50% flowering	First boll bursting
G1. Suvin non Bt	131.7	25.6	15.5	0.9	26.3	2.5	20.7	2.2	2.72	1142	43	48	63	65.7	96.7
G3. RCH 625 BG II	159.6	28.2	23.9	1.3	33.8	2.3	23.5	3.6	3.83	2013	39.3	45.7	58.3	61.0	91.0
G2. HB 2110 BG II	167.7	31.4	22.5	1.4	28.7	3.5	20.8	2.7	3.74	1958	42	45.3	59.7	62.3	87.0
G3. MRC 7918 BG II	164.4	29.4	19.9	0.6	42.9	2.7	25.1	2.7	3.43	2684	39.3	42.7	58.3	61.3	87.3
G4. CCB 29 non Bt	117.2	22.7	7.5	0.7	25.6	2.8	18.1	1	2.82	1282	44.3	47.3	60.7	66.3	85.7
G5. RCH 659 BG II (control)	129.8	26.9	20.1	1	34.9	2.9	21.5	2.4	5.06	2839	42	45	58.7	61.3	99.0
SEd	7.9	1.5	3.8	0.3	1.9	0.4	1.3	0.5	0.6	226	1.8	1.7	1.7	2.2	5.1
CD(5%)	17.6	3.3	8.5	0.6	4.2	0.9	2.8	1	0.3	503	3.3	1.8	2.1	1.6	3.1

was clay loam in texture, low in available N (154.8 kg/ha), medium in available P (14.3 kg/ha) and high in available K (542 kg/ha) with a pH 8.1 and EC 0.5 dS/m. Soil test on micronutrient showed 0.36, 0.82, 2.1, 2.0, and 0.07 ppm of DTPA-extractable zinc, copper, manganese, iron, and boron (hot water extract) respectively. The treatments comprised of genotypes namely Suvin and CCB 29 (*G. barbadense*, non-Bt), MRC 7918 BG II, Ankur HB 2210 BG II and RCH 625 BG II (interspecific BG II hybrid (H × B)) and RCH 659 BG II (intra hirsutum hybrid, (H × H)) were evaluated in randomized block design with three replications. A basal dose of 45 kg of N, 45 kg of $P_2O_{5,}$ and 45 kg of K_2O per ha was applied to all genotypes and the remaining 45 kg of N per ha was top-dressed at the time of earthling up. Pre-emergence application of pendimethalin @1 kg/ha was also applied on the plots followed by two hand weedings to keep the experimental plot weed-free. Growth attributes, yield parameters, and seed cotton yield were recorded during the investigation. In each plot, a uniform plant stand was maintained and standard agronomic practices were followed for raising and maintenance of plants. The observations were recorded on five randomly selected plants per genotype per replication for the parameters, viz. plant height, number of nodes, number of squares, number of flowers, LAI, sympodia and yield components, the number of bursted bolls per plant and average boll weight (g), seed cotton yield per plant (g) as well as yield kg per ha were also recorded. Leaf area was measured by the disc method as suggested by Vivekanandan *et al*. (1972). Differences by genotypes in growth, yield, and fiber properties were compared using an ANOVA at the five per cent level for significance. Fibre quality parameters, viz. 2.5% span length, micronaire, uniformity ratio and fibre strength were also analysed. The quality parameters were analysed by using High Volume Instruments (HVI, Statex- Fibrotex model). Economics was also calculated based on the prevailing market price of inputs and outputs.

RESULTS AND DISCUSSION

The experimental results on growth parameters revealed that the significantly higher plant height (167.7 cm), number of nodes (31.4/plant), and number of monopodia (3.5/ plant) were recorded with HB 2110 BG II. The genotype, MRC 7918 BG II had registered significantly the highest number of sympodia (25.1/plant), and the number of busted bolls (42.9) . The results on yield attributes, significantly highest boll weight (5.1 g) was recorded with RCH 659 BG II (control) because of fact that the genetic background (intra hirsutum hybrid) of the genotypes (Table 1). The pure barbadense and inter specific hybrids are known for lesser boll weight genetically. Dhamayanathi *et al.* (2010) reported comparatively lesser boll weight in Pima cotton genotypes.

Amongst genotypes, seed cotton yield (kg/ha) was significantly higher with RCH 659 BG II (H × H) (2839 kg/ ha), which had outperformed over MRC 7918 BG II (2684 kg/ha), suvin non Bt (1142 kg/ha), RCH 625 BG II (2013 kg/ha), Ankur HB 2210 BG II (1958 kg/ha) and CCB 29

non Bt (1282 kg/ha) (Table 1). The reduction of seed cotton yield at the rate of 59.8, 29.1, 31.0, 5.5, and 54.8% were calculated as compared to RCH 659 BG II with suvin non Bt, RCH 625 BG II, Ankur 2210 BG II, MRC 7918 BG II and CCB 29 non Bt. Hybrid with the genetic background of hirsutum had high genetic potential than barbadense species. The growth characters of RCH 659 BG II were observed moderate level growth characters because of higher boll weight (5.1 g), thus helped to produce significantly higher seed cotton yield and edge over others. The major yield contributing factors are genotype, environment, and cultural practices. when the environment and cultural practices are similar; then the genetic potential of genotype determines the yield potential (Bradow and Davidonis 2000). These results are in closer conformity with the findings of Sisodia and Khamparia (2007) and Bastia (2000).

Fibre quality parameters are by and large heritage (Venugopalan *et al.* 2009). Quality parameters analysis found that significant variation is noticed amongst genotypes. Fibre length, and fibre strength have shown variable results, where the variability has been explained by genotypes genetic background (Meredith *et al.* 2012). The quality parameters results revealed that suvin non Bt showed the significantly highest fibre length (39.3 mm of 2.5% span length) and fibre strength (32.0 g/tex) among others (Table 2). Which was followed by other ELS genotypes. The significantly least 2.5% span length (31.3 mm) and, fibre strength (22.0 g/tex) were recorded with intra hirsutum hybrid (RCH 659 BG II). The genotypes recorded significantly highest seed cotton yield. However, the significant reduction respectively of 20.4 and 31.3% of 2.5% span length (mm) and fibre strength (g/tex) were calculated with RCH 659 BG II. Koebernick *et al.* (2012) reported that fibre length and strength had significant ($P<0.001$) negative association with yield. The results further revealed that a significant reduction in fibre quality traits was observed as compared with bottom harvested bolls than the middle and top ones. The reduction of 7.1, 4.5, 12.7 and 19.4 percent of 2.5% span length(mm), uniformity ratio, fibre strength (g/tex) and micronaire respectively were observed as compared to bottom bursted bolls to top one. Fibre strength was slightly greater in bolls from the first 4 to 6 week of flowering, compared with fibres from bolls produced by flowers opening during the last 2 weeks of the flowering period (Jones and Wells 1997).

The phenological phase of genotypes includes squaring, flowering, boll bursting at first and 50% appeared, and the dry matter recorded at squaring, flowering, and boll bursting at 50% appeared were correlated with quality parameters. The duration of the first squaring ($r = 0.58$ for 2.5% span length and $r = 0.56$ for strength (g/tex)), 50% squaring ($r = 0.75$ for 2.5% span length and $r = 0.76$ for strength (g/tex)) and 50% boll bursting ($r = 0.52$ for 2.5% span length and $r = 0.56$ for strength (g/tex)) were positively and significantly correlated with fibre length and strength.The duration of 50% squaring to first flowering was significantly positively correlated with uniformity ratio ($r=0.47$). Dry matter recorded at different phenological phases had a non-

Table 2 Quality parameters, nutrient uptake, available nutrient status and economics of genotypes

Treatment	2.5% span length (mm)	Uniformity ratio	Strength(g/tex)	MIC(µ/inch)	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)	Total cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)
G1. Suvin non Bt	39.3	42.7	32.0	3.2	48.4	10.1	56.9	143.2	18.0	510.7	107517	141608	34091
G3. RCH 625 BG II	36.5	43.0	29.4	3.0	79.0	13.8	82.1	134.0	17.6	480.2	87736	161040	73304
G2. HB 2110 BG II	37.1	43.0	29.4	3.1	59.2	11.3	63.9	138.9	17.6	504.7	86911	156640	69729
G3. MRC 7918 BG II	37.4	42.3	30.0	3.1	83.1	16.4	82.8	131.7	15.8	501	97801	214720	116919
G4. CCB 29 non Bt	38.0	43.7	30.7	3.3	63.8	11.4	65.3	141.9	18.2	517.3	109537	158720	49183
G5. RCH659BGII (control)	31.3	45.7	22.0	3.9	77.4	13.8	80.1	136.5	17.2	475	85203	184535	99332
SEd	0.7	0.7	0.8	0.2	4.3	1.2	4.1	4.4	1.0	12.4	9885	23812	28020
CD (5%)	1.5	1.6	1.8	0.4	9.6	2.7	9.1	9.8	2.2	27.6	11101	29412	30694

significant correlation with quality parameters. Linearity was not established with micronaire. None of the duration of selected phenological phases was significantly negatively correlated with quality parameters, which indicate that the duration of different phenological phases could not be reduced without penalizing quality parameters.

The economic analysis showed that inter specific hybrid MRC 7918 BG II registered the highest net return (₹ 116916/ha) and better than intra-hirsutum hybrid RCH 659 BG II (H×H) (₹ 99332/ha) (Table 2). The market price of barbadense and interspecific hybrid is always higher than hirsutum hybrids because of associated with higher quality; which helped in addition to higher seed cotton yield to realize higher income with MRC 7918 BG II. The nutrient uptake found that the significantly highest nitrogen (83.1 kg/ha), phosphorus (16.4 kg/ha) and potassium (82.8 kg/ha) with MRC 7918 BG II. Owing to higher N and P uptake, higher dry matter production was registered with this genotype and uptake is a positive function of dry matter yield. The boosted dry matter production enabled the increased nutrient uptake by the plants (Makhdum *et al*. 2007 and Sankaranarayanan *et al*. 2018). The suvin registered significantly least nitrogen (48.4 kg/ha), phosphorus (10.1 kg/ha) and potassium (56.9 kg/ha) uptake. The available nutrient status estimation revealed the highest nitrogen availability (143.2 kg/ha) with Suvin. The other barbadense straight variety (CCB 29 non Bt) found with significantly highest available phosphorus (18.2 kg/ha) and potassium (517.3 kg/ha). The result might be due to the production of less seed cotton yield, less demand for nutrients that restored the soil at relatively high soil available nutrients. The negative balance of K is reported with the high yield of cotton and external application through fertilizer is far lesser than what is removed (Blaise *et al*. 2005).

A significant reduction in fibre quality traits was observed as compared with bottom harvested bolls than the middle and top ones. Duration of first squaring, 50% flowering, and 50% boll bursting were positively correlated with fibre length and strength. Suvin showed the highest fibre length (39.3 mm of 2.5% span length) and fibre strength (32.0 g/tex) compared with hirstum hybrids. The study inferred that RCH 659 BG II (H × H) (28.4 q/ha) had outperformed than ELS genotypes. Interspecific hybrid MRC 7918 BG II registered the highest net return (₹ 116916/ha).

ACKNOWLEDGEMENTS

The authors are grateful to the ICAR-Central Institute for Cotton Research for supporting this research work.

REFERENCES

Bastia D K. 2000. Response of cotton hybrid Savita to spacing and NPK treatments under rainfed conditions of Orissa. *Indian Jouranl of Agricultural Sciences* **70:** 541–42.

Blaise D, Singh J V, Bonde A N, Tekale K U and Mayee C D. 2005. Effect of farm yard manure and fertilisers on yield, fibre quality and nutrient balance of rainfed cotton (*Gossypium hirsutum* L.). *Bioresearch Technology* **96:** 345–49.

Bradow J and Davidonis G H. 2000.Quantitation of fiber quality and the cotton production-processing interface: a physiologist's perspective. *Journal of Cotton Science* **4:**34–64.

Dhamayanathi K P M, Manickam S and Rathinavel K. 2010. Genetic variability studies in *Gossypium barbadense* L. genotypes for seed cotton yield and its yield components. *Electronic Journal of Plant Breeding* **1**(4): 961–65.

Jones M A and Wells R. 1997. Field yield and quality of cotton grown at two divergent population densities. *Crop Science* **37:**1190–95.

Koebernick J C, Constable G A, Stiller W N and Shiming Liu. 2012. Negative associations still exist between yield and fibre quality in cotton breeding programs in Australia and USA. *Field Crops Research* **128**: 1–7.

Makhdum M I, Pervez H and Ashraf M. 2007. Dry matter accumulation and partitioning in cotton (*Gossypium hirsutum* L.) as influenced by potassium fertilization. *Biology* and *Fertility* of *Soils* **43**: 295–301.

Meredith W R, Boykin D L, Bourland F M, Caldwell W D, Campbell B T, Gannaway J R, Glass K, Phillips-Jones A, May L M, Smith C W and Zhang J. 2012. Genotype × environment interactions over seven years for yield, yield components, fiber quality, and gossypol traits in the regional high quality tests. *Journal of Cotton Science* **16**:160–69.

Sankaranarayanan K, Jagvir Singh and Rajendran K. 2018. Identification of suitable high density planting system genotypes its response to different levels of fertilizers compared with Bt cotton. *Journal of Cotton Resesarch and Development* **32**(1): 84–96.

Sankaranarayanan K. 2020. ELS cotton-status and strategies for enhancing production presented in National Symposium on Cotton Production Technologies in Next Decade: Problems and Perspectives, Odisha University of Agriculture Technology, Bhubaneswar, Odisha, 22–24, January, 2020.

Sisodia R I and Khamparia S K. 2007. American cotton varieties as influenced by plant densities and fertility levels under rainfed conditions. *Journal of Cotton Resesarch and Development* **21**: 35–40.

Smith C W, Hague S, Hequet E F and Jones D. 2011. TAM B139-17 ELS Upland cotton. *Journal of Plant Registeration* **5**:1–5.

Venugopalan M V, Sankaranarayanan K, Blaise D, Praharaj C S and Gangaiah B. 2009. Bt cotton (*Gossypium* sp) in India and its Agronomic requirements- A review. *Indian Journal* of *Agronomy* **54**: 343–60.

Vivekanandan A S, Gunasena H P M and Sivanana Yogam T. 1972. Statistical evaluation of accuracy of three techniques used in estimation of leaf area of crop plants. *Indian Journal of Agricultural Sciences* **42**: 857–60.

Wiggins M S, Leib B G, Mueller T C and Main C L. 2014. Cotton growth, yield, and fiber quality response to irrigation and water deficit in soil of varying depth to a sand layer. *Cotton Science* **18**:145–52.