Karnataka J. Agric. Sci.,23 (3) : (423-425) 2010

Yield and yield components, uptake of nutrients, quality parameters and economics of Bt cotton (*Gossypium hirsutum* L.) genotypes as influenced by different plant densities*

M. J. MANJUNATHA, A. S. HALEPYATI, B. G. KOPPALKAR AND B. T. PUJARI

Department of Agronomy
College of Agriculture, Raichur -584 102, India
Email: halepyati49@rediffmail.com

(Received : August, 2009)

Abstract: A field experiment was conducted during *kharif,* 2008 at Agricultural College Farm, Raichur to study the performance of Bt cotton genotypes to different plant densities under rainfed condition. The results revealed that among genotypes, Bunny Bt BG-II recorded significantly higher uptake of nutrients (105.5, 22.08 and 114.25 kg ha^{-1}; N, P and K, respectively) and also exhibited superior quality parameters with higher net returns (Rs. 39,152 ha^{-1}) and BC ratio (2.91). Among the spacings, net returns and uptake of nutrients was significantly higher with 60 x 30 cm followed by 75 x 30 cm. Quality parameters did not differ significantly between different spacings.

Key words : Genotypes, plant spacings, Bt cotton

Introduction

Cotton is the most important commercial and premier cash crop of India. It plays a prominent role in farming and industrial economy of the country. With the introduction of Bt cotton hybrids, there has been a significant change in the cotton cultivation scenario of India. Now, around 40 per cent area under cotton is occupied by Bt cotton hybrids. However, the average production is very low when compared to world's average. This is mainly because 70 per cent of cotton area is under rainfed condition. Lack of knowledge about important agronomical practices could also be another reason. So, there is a need to identify suitable Bt cotton genotype which gives higher net returns with lower cost of cultivation. Hence, with these ideas in view, the present study was undertaken to exploit the yield potentiality of Bt cotton genotype by following important agro-technique such as varied plant population under rainfed condition.

Material and methods

A field experiment was conducted during *kharif,* 2008 under rainfed condition at Agricultural College Farm, Raichur which is situated in the North Eastern Dry Zone (Zone-2) of Karnataka at 16^{o} 12' N latitude and 77^{o} 20' E longitude with an altitude of 389 meters above the mean sea level. The experiment was conducted in medium black soil having 0.49 per cent organic carbon, 215.9 kg ha^{-1}available nitrogen (medium), 27.8 kg ha^{-1} available phosphorous (high), 147.5 kg ha^{-1} available potassium (low) and 8.49 pH. The experiment was laid out in split plot design with three replications. Four genotypes *viz.,*Bunny Bt BG-II, Bunny Bt BG-I, non Bt hybrid and check variety (RAS 299-1) and four plant spacings were fitted in sub plot (60 x 30 cm, 75 x 30 cm, 90 x 20 cm and 90 x 60 cm) . The seeds of different genotypes were dibbled during the last week of July 2008, as per the treatments.

Results and discussion

Bunny Bt BG-II recorded significantly higher seed cotton yield (23.55 q ha^{-1}) over non Bt hybrid (18.35 q ha^{-1}) and check variety (11.92 q ha^{-1}) reflecting an increase of 28 and 97 per cent, respectively but it was on par with Bunny Bt BG-I (21.83 q ha^{-1}). Similar results were reported by Indian Institute of Management (Anon., 2001). This is mainly due to significant increase in the yield attributing characters which were noticed in Bunny Bt BG-II. Significantly higher (16.74) number of good opened bolls, total number of harvested bolls (23.83), boll weight (3.53 g) and seed cotton yield per plant (74.8 g) were registered with Bunny Bt BG-II when compared with non Bt hybrid and check variety but it was on par with Bunny Bt BG-I (15.60, 21.99, 3.36 g and 70.4 g; number of good opened bolls, total number of harvested bolls, boll weight and seed cotton yield per plant, respectively) which contributed for increased yield in that genotype (Table 2). The check variety recorded 97 per cent lower yield than Bunny Bt BG-II hybrid because of poor contribution by the yield components (10.71, 17.12, 2.81g and 47.5 g; number of good opened bolls, total number of harvested bolls, boll weight and seed cotton yield per plant, respectively). Less number of good opened bolls and total number of harvested bolls recorded in check variety are the reasons for significantly lower yield. This might be due to the lower dry matter accumulation and less translocation of photosynthates in this genotype.

Bunny Bt BG-II exhibited better yield components which might be due to higher uptake of nutrients by the crop. Bunny Bt BG-II recorded significantly higher uptake of nitrogen (105.50 kg ha^{-1}), phosphorous (22.08 kg ha^{-1}) and potassium of 114.25 kg ha^{-1} when compared to non Bt hybrid and check variety (RAS 299-1) (Table 1). With the increase in the uptake of nutrients, growth components also increased and has lead to the higher dry matter production per plant and its accumulation into different plant parts particularly to the reproductive parts.

* Part of the M.Sc.(Agri.) thesis submitted by the first author to the University of Agricultural Sciences, Dharwad - 580 005, India.

Quality parameters differed significantly due to genotypes. Both Bunny Bt BG-II and Bunny Bt BG-I recorded significantly higher (37.39 % and 35.22 %) ginning out turn over other genotypes (Table 1). These results are in line with the findings of Sharma (2002). Bunny Bt BG-II recorded significantly superior mean fibre length (31.73 mm), uniformity ratio (48.67 %) and bundle strength (24.08 g tex^{-1}) over check variety (RAS 299-1), which might be due to significantly higher number of good opened bolls in Bunny Bt BG-II. Maturity ratio and micronaire value did not differ significantly among the genotypes. These results are in conformity with the earlier findings of Hallikeri *et al.* (2004). With respect to economics, significantly higher gross returns (Rs. 59,583 ha^{-1}), net returns (Rs. 39,152 ha^{-1}) and BC ratio (2.91) were obtained by Bunny Bt BG-II when compared to other genotypes but it was on par with Bunny Bt BG-I. This is because of higher seed cotton yield and harvest index obtained (0.243) with Bunny Bt BG-II when compared with other genotypes (Table 2). Similar results were reported by Shankaranarayanan et al. (2004).

Significantly higher seed cotton yield (21.11 q ha^{-1}) was registered with 60 x 30 cm and it was 35 per cent higher over 90 x 60 cm and 11 per cent over 75 x 30 cm but it was on par with 90 x 20 cm (20.10 q ha^{-1}). Similar results were observed by Narayana *et al.* (2008). It was mainly due to higher plant population accommodated per unit area with narrow spacings.

Table 1. Uptake of nutrients and quality parameters in cotton genotypes at different plant densities

Treatments	Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium (kg ha^{-1})	Ginning percentage	Mean fibrelength (mm)	Uniformity ratio (%)	Micronaire value	Bundle strength (g tex^{-1})
Genotypes								
G_1 - Bunny Bt BG-II (NCS 145)	105.50	22.08	114.25	37.39	31.73	48.67	3.86	24.08
G_2 - Bunny Bt BG-I (NCS 145)	101.50	20.50	111.08	35.22	31.00	47.58	4.08	23.96
G_3 - Hybrid (Non-Bt) (NCS 145)	93.25	17.17	103.67	34.86	30.47	46.50	3.83	23.51
G_4 - Check variety (RAS 299-1)	87.17	15.67	99.25	33.05	27.30	45.17	3.81	21.66
Mean	96.85	18.85	107.06	35.13	30.12	46.98	3.89	23.30
S. Em.±	1.87	0.53	2.34	0.72	0.59	0.68	0.06	0.34
C.D. at 5%	6.47	1.83	8.10	2.51	2.05	2.37	NS	1.19
Plant densities								
P_1 - 55,555 plants ha^{-1} (60 X 30 cm)	105.50	23.42	118.75	34.27	29.82	47.17	3.88	23.18
P_2 - 44,444 plants ha^{-1} (75 X 30 cm)	95.58	17.75	103.83	35.43	30.65	46.75	3.96	23.11
P_3 - 55,555 plants ha^{-1} (90 X 20 cm)	103.83	21.42	115.33	34.77	29.84	47.08	3.83	23.38
P_4 - 18,518 plants ha^{-1} (90 X 60 cm)	82.50	12.83	90.33	36.06	30.19	46.92	3.91	23.55
Mean	96.85	18.85	107.06	35.13	30.12	46.98	3.89	23.30
S. Em.±	1.70	1.12	3.32	0.74	0.32	0.50	0.04	0.29
C.D. at 5%	4.96	3.26	9.70	NS	NS	NS	NS	NS

Table 2. Seed cotton yield, yield components and economics of cotton genotypes at different plant densities.

Treatments	Number of good opened bolls $plant^{-1}$	Total number of bolls harvested $plant^{-1}$	Boll weight (g)	Seed cotton yield (g $plant^{-1}$)	Seed cotton yield (q ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs.ha^{-1})	Benefit cost ratio
Genotypes									
G_1 - Bunny Bt BG-II (NCS 145)	16.74	23.83	3.53	74.8	23.55	20,431	59,583	39,152	2.91
G_2 - Bunny Bt BG-I (NCS 145)	15.60	21.99	3.36	70.4	21.83	21,483	53,875	32,392	2.59
G_3 - Hybrid (Non-Bt) (NCS 145)	12.52	18.63	3.18	59.8	18.35	23,649	44,040	22,226	1.93
G_4 - Check variety (RAS 299-1)	10.71	17.12	2.81	47.5	11.92	18,343	27,408	11,449	1.64
Mean	13.90	20.39	3.22	63.1	18.91	20,976	46,226	26,304	2.30
S. Em.±	0.45	0.34	0.08	1.58	0.63		1,491	1,278	0.09
C.D. at 5%	1.54	1.19	0.27	5.46	2.17		5,160	4,421	0.32
Plant densities									
P_1 - 55,555 plants ha^{-1} (60 X 30 cm)	11.91	17.11	3.05	52.4	21.11	21,945	51,635	30,826	2.46
P_2 - 44,444 plants ha^{-1} (75 X 30 cm)	13.73	19.48	3.23	60.3	18.85	20,808	46,022	26,317	2.27
P_3 - 55,555 plants ha^{-1} (90 X 20 cm)	11.82	17.40	3.01	51.3	20.10	21,981	49,117	28,269	2.32
P_4 - 18,518 plants ha^{-1} (90 X 60 cm)	18.12	27.58	3.58	88.6	15.59	19,173	38,133	19,806	2.02
Mean	13.90	20.39	3.22	63.1	18.91	20,976	46,226	26,304	2.30
S.Em.±	0.54	0.57	0.16	1.36	0.48		1,186	1,365	0.10
C.D. at 5%	1.59	1.67	0.48	3.97	1.41		3,461	3,986	0.30

i.e., 55,555 plants ha^{-1} (60 x 30 and 90 x 20 cm) and 44,444 plants ha^{-1} (75 x 30 cm). Significantly higher number of good opened bolls (18.12), total number of harvested bolls (27.58), boll weight (3.58 g) and seed cotton yield per plant (88.6 g) were registered with lower plant population (90 x 60 cm) when compared with 60 x 30 cm spacing (11.91, 17.11, 3.04g and 52.4 g; number of good opened bolls, total number of harvested bolls, boll weight and seed cotton yield per plant, respectively) and 90 x 20 cm spacing (11.82, 17.40, 3.01g and 51.3 g ; number of good opened bolls, total number of harvested bolls, boll weight and seed cotton yield per plant, respectively). Increasing the plant density per unit land area increased the interplant competition within the plot for natural resources and because of higher competition between plants contribution of yield components per plant with 60 x 30 cm and 90 x 20 cm was lower when compared to 90 x 60 cm and 75 x 30 cm spacings but the loss in yield attributes per plant was compensated through higher plant population per hectare and it also lead to the higher nutrients uptake by the plants. Significantly higher nutrient uptake (105.50, 23.42 and 118.75 kg ha^{-1}; N, P and K, respectively) was noticed with 60 x 30 cm when compared to others but it was on par with 90 x 20 cm. It was mainly due to significantly higher plant population accommodated per unit area with the narrow spacings.

The quality parameters were not influenced by the population levels (Table 1). Similar results were observed by Dhillon *et al*. (2006). The spacing of 60 x 30 cm fetched significantly higher net returns (Rs. 30,826 ha^{-1}) when compared with 75 x 30 cm (Rs. 26,317 ha^{-1}) and 90 x 60 cm (Rs. 19,806 ha^{-1}) but it was on par with 90 x 20 cm spacing (Rs. 28,269 ha^{-1}). This is mainly because of higher seed cotton yield per hectare.

Thus, from this study, it could be concluded that Bunny Bt BG-II with 60 x 30 cm followed by 90 x 20 cm performed better with respect to uptake of nutrients, quality parameters and economics.

References

Anonymous, 2001, An analysis of socio-economic impact of Bt biotechnology on Indian cotton farmers. Centre for Mgmt. Agric., Indian Inst. Mgmt., Ahmedabad, India.

Dhillon, G. S., Chhabra, K. L. and Punia, S. S., 2006, Effect of crop geometry and integrated nutrient management on fibre quality and nutrient uptake by cotton crop. J. Cotton Res. Dev., 20 (2) : 221-223.

Hallikeri, S. S., Halemani, H. L., Nandagavi, R. A. and Nooli, S. S., 2004, Response of Mahyco Bt cotton hybrids to levels of fertilizer under protective irrigation. In: *Int. Symp. Strat. Sust. Cotton Prod. - A Global vision 2.Crop Prod.,* November 23-25, Univ. Agric. Sci., Dharwad, pp.48-49.

Narayana, E., Hema, K., Srinivasulu, K., Prasad N.V.V.S.D. and Rao, N.H.P., 2008, Performance of Bt Cotton hybrid (NCS-145 Bt.) to varied spacing and fertilizer levels in vertisol under rainfed conditions. J. Indian Soc. Cotton Improv., 33:36.

Shankaranarayanan, K., Nalayini, P., Prabharaj, C.S. and Dharajothi, 2004, Effect of dates of sowing on the productivity of Bt cotton hybrids. In: *Int. Symp. Strat. Sust. Cotton Prod. - A Global vision 2.Crop Prod.,* November 23-25, Univ. Agric. Sci., Dharwad, pp.103-104.

Sharma, A. B., 2002, Bt Cotton belies promises research. The Financial Express, 23rd April, 2002.