International Journal of Agriculture Innovations and Research
Volume 5, Issue 1, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy) :
Received : 21/07/2016 | Accepted on : 29/07/2016 | Published : 02/08/2016

Productivity, Economics and Nitrogen use Efficiency of Bt Cotton as Influenced by Planting Geometry and Nitrogen Fertilization Under South Gujarat Conditions

M. H. Gohil
Department of Agronomy, N. M. College of Agriculture
Navsari Agricultural University, Navsari - 396 450, India

V. P. Usadadiya
Department of Agronomy, N. M. College of Agriculture
Navsari Agricultural University, Navsari - 396 450, India

J. D. Thanki
Department of Agronomy, N. M. College of Agriculture
Navsari Agricultural University, Navsari - 396 450, India

L. K. Arvadia
Department of Agronomy, N. M. College of Agriculture
Navsari Agricultural University, Navsari - 396 450, India

***Abstract* – A Field experiment was conducted at Main Cotton Research Station, Navsari Agricultural University, Surat during kharif 2012-13 with an objective to find out optimum plant geometry and requirement on productivity, economics and NUE of Bt cotton (Var. G. Cot. Hy-8 BG-II). Twelve treatment combinations consisting of three levels of plant geometry (120 x 30, 120 x 45 and 120 x 60 cm) and four levels of nitrogen (160, 200, 240 and 280 kg Nha-1) were tried in factorial randomized block design with four replications. Bt cotton sown at 120 x 60 cm and 280 kg Nha-1 registered remarkably higher values for growth and yield attributes viz., plant height, number of sympodia, number of bolls plant-1, boll weight and seed cotton weight plant-1 of Bt cotton. Significantly the highest seed cotton and stalk yields were recorded under plant geometry at 120 x 45 cm and 280 kg N ha-1 but, it was remained at par with 240 kg N ha-1. The quality of Bt cotton in terms of ginning percentage, oil content and fibre uniformity ratio as well as bundle strength were not influenced significantly due to different plant geometry and levels of nitrogen but, chlorophyll content was found to be significantly increased with increasing levels of nitrogen.**

***Keywords* – Bt Cotton, Pant Geometry, Nitrogen Level, Nitrogen use Efficiency.**

I. INTRODUCTION

Cotton is a king of fibre crops due to its industrial importance, it is known as “White Gold”. It is an important cash crop, major source of foreign exchange and plays an important role in agriculture, industry and economic development of the country. At present genetically modified cotton is widely accepted by Indian farmers. Average productivity of India is 560 kg lint ha-1, which is low as compared to world average of 785 kg lint ha-1 (Anon., 2012). By introducing the Bt gene in hirsutum species for control of bollworms, Bt hybrids have become popular among farmers. Bt hybrids cultivated on commercial scale, the cotton production in country has reached to 31 million bales with increase in productivity. In Bt cotton vegetative growth is restricted due to 100% setting of fruiting bodies on the plant, which require closer spacing for better yield. Thus agronomic requirement like, plant geometry and fertilizer needs vary for Bt cotton. The first public sector Bt cotton hybrid variety developed by this university G. Cot. Hy-8 BG-II is most popular among farmers of Gujarat. In view of this the present study was planned to find out suitable plant geometry and fertilizer needs for Bt cotton (G. Cot. Hy-8 BG-II) under South Gujarat conditions.

II. MATERIALS AND METHODS

A Field experiment was carried out at Main Cotton Research Station, Navsari Agricultural University, Surat during kharif - rabi 2012-13. The experimental soil was clayey in texture, low in organic carbon (0.46 %), medium in available nitrogen (298 kg/ha) and phosphorous (49 kg/ha) and high in available potassium (528 kg/ha) and slightly alkaline in reaction (pH 7.8). The Bt cotton variety G. Cot. Hy-8 BG-II sown with dibbling method as per treatments. Twelve treatment combinations consisting of three levels of plant geometry (S1: 120 x 30 cm, S2: 120 x 45 cm and S3: 120 x 60 cm) and four levels of nitrogen (N1: 160 kg ha-1, N2: 200 kg ha-1, N3: 240 kg ha-1 and N4: 280 kg ha-1) were tried in factorial randomized block design with four replications. All other practices were followed as per the recommendations. Cotton was sown in 1st week of July and 40 kg P2O5 applied as basal from Single Super Phosphate as per recommendation 40 kg P2O5/ha. N was applied in five equal splits at 30, 60, 75, 90 and 105 DAS as per treatments in the form of urea.. In order to minimize weed competition, pre-emergence application of Pendimethalin @ 1.0 kg ha-1 followed by one hand weeding and two interculturing were done. The crop was irrigated at an interval of 20 days after cessation of rainfall. Plant protection measures were taken as and when necessary. The observations related to growth and yields were recorded and subjected to statistical analysis. The fibre quality parameters were evaluated at Cotton Research Laboratory as HIV.

III. RESULTS AND DISCUSSION

Effect on Growth

The growth and yield attributing characters significantly influenced by various plant geometry and fertility levels. The maximum plant height and sympodial branches were recorded higher under 120 x 60 cm plant geometry at harvest. The plant height of Bt cotton was observed significantly higher under the treatment having 280 kg N ha-1 (N4) as compared to remaining levels of nitrogen. Under the same fertility level the maximum numbers of sympodial branches were recorded due to adequate amount of nitrogen application resulting in continuous

vegetative growth. Zarina et al. (2011) also reported similar results.

Effect on Yield

The Bt cotton responded significantly due to different plant geometry. The maximum numbers of bolls plant-1, boll weight and Seed cotton weight plant-1 were recorded under 120 x 60 cm plant geometry as compared to other levels. It was might be due to less competition exerted for light, moisture and nutrients. Sufficient interception of sunlight promotes efficient photosynthesis activities and ultimately greater accumulation of photosynthesis under wider spacing. Narrow spacing with dense plant population resulted in the lower values of yield attributes. The reduction in yield with increase in plant density could be attributed due to more competition within plant to plant spacing. In wider spacing might be attributed to relatively less inter-plant competition because of more space availability to individual plants. These results are similar to the findings of those reported by Hallikeri and Halemani (2002). The perusal of data (Table-1) indicated that significantly the highest seed cotton as well as stalk yields were produced under plant geometry 120 x 45 cm as compared to 120 x 30 cm and 120 x 60 cm. This might be due to higher values of yield attributes and ultimately produce more seed cotton yield. Harvest index did not influenced significantly due to different treatments, however, numerically higher harvest index registered under in plant geometry at 120 x 45 cm. The results are in close conformity with those of Giri (2008).

Favorable effect of nitrogen on yield attributes had resulted into significantly better yields of Bt cotton. Higher level of nitrogen i.e. 280 kg N ha-1 produced higher seed cotton yield as well as stalk yield, but which was remain at par with 240 kg N ha-1. Increased in yield due to increase level of nitrogen might be due to favorable effect of nitrogen on plant growth and development, which was evident from increased dry matter accumulation and yield attributing characters like bolls/plant and boll weight, these effect observed on yields. Different levels of nitrogen exert significant influenced on harvest index of cotton. Kumar et al. (2011) also reported significant and favorable effect of fertility levels on seed cotton yield.

Interaction Effect

Interaction effect of S x N on seed cotton yield of cotton was found to be significant. The treatment of 120 x 45 cm spacing with application of nitrogen @ 280 kg ha-1 (S2N4) recorded significantly higher value as compared to other spacing and lower level of nitrogen, but it remained at par with S2N3 i. e. spacing of 120 x 45 cm spacing with application of nitrogen @ 240 kg ha-1. This optimum requirement for getting economical yield of Bt cotton. This might be due to significant amount of nitrogen available during the crop growth, which increase growth and yield attributes and ultimately enhanced the production of seed cotton yield. Kumar et al. (2011) also observed increasing trend of nitrogen increasing trend in seed cotton yield with decreasing and increasing plant to plant spacing.

Quality Parameters

The quality of Bt cotton in terms of chlorophyll content, ginning per cent, oil content in seed, fibre uniformity ratio and bundle strength were not influenced remarkably due to different plant geometry and levels of nitrogen(Table 3).

Economics

Higher values of net returns and B:C ratio were found with 120 x 45 cm plant geometry might be due to higher seed cotton yield. Increasing trend in net income may be due to increased seed cotton yield with increasing level of nitrogen.

It can be concluded that kharif Bt cotton shall be sown at 120 x 45 cm spacing and applied nitrogen at 240 kg ha-1 (urea applied in 5 equal splits at 30, 60, 75, 90 and 105 DAS) under South Gujarat condition for getting higher seed cotton yield and net monetary returns.

REFERENCES

[1] Anonymous (2012). All India coordinated cotton improvement project, Annual report 2011-12 project coordinator, CICR, Coimbatore, Tamilnadu.

[2] Giri, A.N.; Anudhekar, R.L. Kapse, P.S. and Suryavanshi, S.B. (2008). Response of Bt cotton hybrids to plant densities and fertilizers levels. J. Cotton Res. Dev., 22(1):45-47.

[3] Hallikeri, S.S. and Halemani, H.L. (2002).Effect of spacing and fertilization on hirsutum cotton variety Sahana under irrigation conditions. J. Cotton Res. Dev. 16(2):184-185.

[4] Kumar, M.; Pannu, R.K.; Nehra, D.S. and Dhaka, A.K. (2011). Effect of spacing and fertilizer on growth, yield and quality of different cotton genotypes. J. Cotton Res. Dev. 25(2): 236-239.

[5] Zarina, B.; Khan, N.U.; Mussarat, M.; Khan, M.J.; Ahmad, R.; Khan, I.U. and Shaheen, S. (2011). Response of Gossypium hirsutum genotypes to various nitrogen levels. Pak. J. Bot.,43(5): 2403-2409.

International Journal of Agriculture Innovations and Research
Volume 5, Issue 1, ISSN (Online) 2319-1473

Table 1. Growth, yield attributes, yields, economics and NUE in *Bt* cotton as influenced by plant geometry nitrogen levels

Treatment	Plant height (cm)	Sym podial /plant	Bolls /plant	Boll weight (g)	Yield		Harvest index (%)	N-use efficiency (kg/kg)	Net return (Rs. ha^{-1})
					Seed cotton (kg ha^{-1})	Stalk (kg ha^{-1})			
Plant geometry (S)									
S_1: 120 x 30 cm	88.9	20.6	30.3	3.53	110.5	110.5	34.15	-	58744
S_2: 120 x 45 cm	96.5	21.1	33.7	3.69	118.2	118.2	34.21	-	75178
S_3: 120 x 60 cm	102.5	22.0	36.2	3.77	120.6	120.6	34.18	-	65734
S. Em. ±	2.36	0.43	0.73	0.03	126.6	126.6	0.02	-	-
C. D. (P = 0.05)	6.80	1.24	2.11	0.08	2.7	2.7	NS		-
Nitrogen levels (N kg ha^{-1})									
N_1 : 160	92.3	19.3	32.2	3.61	1924	3729	34.04	32.07	60253
N_2 : 200	94.5	20.5	32.6	3.62	2022	3901	34.14	10.12	64151
N_3 : 240	97.1	22.0	33.6	3.67	2096	4030	34.21	8.73	66926
N_4 : 280	99.8	22.6	35.3	3.74	2207	4223	34.32	7.88	71399
S. Em. ±	2.73	0.50	0.85	0.03	64.0	108.4	0.06		-
LSD (P = 0.05)	7.85	1.43	2.44	0.09	184.2	311.8	0.18		-

Table 2. Interaction effect of due to different plant geometry and levels of nitrogen on seed cotton yield of Bt cotton

Treatment	Nitrogen levels (N kg ha^{-1})				
Plant geometry (S)	N_1 (160)	N_2 (200)	N_3 (240)	N_4 (300)	Mrean
S_1 (120 x 30 cm)	1664	1641	2156	2033	1874
S_2 (120 x 45 cm)	2008	2182	2182	2345	2154
S_3 (120 x 60 cm)	1799	2243	1949	2244	2059
Mean	1824	2022	2096	2207	-
S. Em. ±	110				
LSD (P = 0.05)	319				

Table 3. Quality parameters of Bt cotton as influenced by different treatments

Treatment	Chlorophyll content in leaves (mg cm^{-2})			Ginning Per cent (%)	Oil content in seed (%)	Fibre uniformity ratio	Bundle strength g/t (tenacity)
	60DAS	90DAS	105DAS				
Plant geometry (S)							
S_1: 120 x 30 cm	32.9	35.1	37.6	31.4	16.6	50.2	22.7
S_2: 120 x 45 cm	33.6	35.2	37.9	32.3	17.6	51.1	23.5
S_3: 120 x 60 cm	33.8	35.5	38.3	31.8	17.1	50.6	23.1
S. Em. ±	0.26	0.29	0.38	0.24	0.25	0.32	0.19
LSD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS
Nitrogen levels (N kg ha^{-1})							
N_1 : 160	32.3	34.5	36.5	31.6	16.8	50.4	22.9
N_2 : 200	33.4	34.9	37.8	31.8	17.0	50.6	23.0
N_3 : 240	33.8	35.5	38.5	31.8	17.1	50.6	23.1
N_4 : 280	34.2	36.1	38.8	32.1	17.5	50.9	23.3
S. Em. ±	0.30	0.34	0.44	0.27	0.29	0.37	0.22
LSD (P = 0.05)	0.85	0.98	1.26	NS	NS	NS	NS

*NS – Non-significant