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Impact of plant spacing and nitrogenous fertilizer on incidence of sucking pests in Bt cotton

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ABSTRACT

Field experiment was conducted to study the impact of plant spacing and nitrogenous fertilizer on incidence of sucking pests in Bt cotton at College Agronomy farm, B.A. College of Agriculture, Anand Agricultural University, Anand during *Kharif*, 2010-11. The Bt cotton raised at wider spacing 150×60cm recorded lower activity of major sucking pests *viz*., aphid, leafhopper and whitefly. Application of 360 kg N/ha, higher dose, enhanced the activity of sucking pests. The lower incidence of sucking pests was noticed with the application of lower dose @ 180 kg N /ha. Bt cotton grown at the widest spacing (150×60 cm) with the higher fertilizer dose (360 N kg/ha) recorded significantly higher (1996 kg/ha) seed cotton yield. The sucking pest population declined with increased spacing and with decreased fertilizer level and *vis-a-vis*.

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INTRODUCTION

Cotton is an important commercial crop unanimously designated as 'king of fibre crops' and is prone to insect pests attack at various stages of crop growth. World total cotton production was recorded 120.97 million bales from the 34.35 million hectares of total cultivated area and 767 kg/hectare productivity in 2012-13 (Anonymous, 2013). Introduction of synthetic pyrethroids, though brought desirable control of bollworms, resulted in resurgence of sucking pests *viz.*, aphid, *Aphis gossypii* Glover; leafhopper, *Amrasca biguttula biguttula* (Ishida); thrips, *Thrips tabaci* Lindeman and whitefly, *Bemisia tabaci* (Gennadius) (Ajri *et al*., 1986 and Patil *et al*., 1986). On introduction of Bt cotton, the population and infestation due to major bollworms is now under control. However, year after year, the infestation of sucking pests showed increasing trend. Farmers generally rely on the use of synthetic insecticides to combat these pests. Continuous and indiscriminate use of insecticides resulted in development of resistance to insecticides, which reflected on the reliability of efficacy of insecticides. The technology should aim at meeting high nutrient demand of crop by use of recommended doses of fertilizer.

Plant spacing and fertilizers alter the plant architecture, photosynthetic efficiency of leaves, boll size and production pattern (Bhalerao *et al*., 2010 and Samani *et al*., 1999). Plant spacing directly influences the soil moisture extraction, light interception, humidity and wind movement (Heitholt *et al*., 1992) which in turn influence plant height, branches development, fruit location and size, crop maturity and ultimately on yield. Plant spacing significantly affected on health, growth and development of the crop as well as microclimatic condition of the crop ecosystem on multiplication of the pest (Jain and Bhargava, 2007). The efficient use of fertilizers is a key factor in maximizing the yield of a crop in such a way that it has a minimal impact on the environment. Nitrogen is one of the most essential and major nutrients for plant growth and yield in the world. Bt cotton plants require larger amount of nitrogen than any other element and is important for canopy area development and photosynthesis resulting in higher boll number and yield of crop. Nutrient deficiencies, as a consequence of nutrient depletion over the years, have decreased seed cotton yields due to imbalance and inadequate fertilization that not only affect the fibre quality of cotton, but also cause deleterious effect on physico-chemical and biological properties of soil. Nutrient management improves the plant health, which enables the plant to tolerate against the incidence and attack of herbivores. An understanding of basic agronomic practices such as optimal row spacing, fertilizer rates, insect pests, diseases and crop response to these factors are essential for maximizing yields. Application of higher doses of nitrogenous fertilizers increases the quantum of some amino-nitrogen concentrations in the plant system that makes it more conductive for fast development and higher fertility of the insect pests (Jain and Bhagava, 2007). Work on manipulating plant density, use of fertilizer and their impact on yield, is crucial to generate enough information and database for use by emerging farmers that would be interested in commercial production of this crop. Realizing the immense importance of cotton crop, there is a dire need to improve the yield potential of the crop under the local environmental conditions. Keeping all these points in view, a research work was framed out to see the impact of plant spacing and nitrogenous fertilizer on incidence of sucking pests in Bt cotton.

MATERIAL AND METHODS

An experiment was laid out in a Split Plot Design with four levels of spacing (S_1: 120×45 cm, S_2: 120×60 cm, S_3: 150×45 cm and S_4: 150×60 cm) and four levels of fertigation (N_1: 180 kg N/ha, N_2: 240 kg N/ha, N_3: 300 kg N/ha and N_4: 360 kg N/ha) adopting three replications having plot size of 6.0×7.2 m during *Kharif*, 2011 at College Agronomy Farm, B.A. College of Agriculture, Anand Agriultural Univeristy, Anand. The Bt cotton [RCH-2 (BG –II)] was raised after following standard agronomic practices. Experimental area was kept free from insecticidal spray.

Method of recording sucking pests population :

For recording the population of sucking pests, three plants were selected randomly in each plot. The population of sucking pests was recorded on three leaves selected randomly from the top, middle and bottom canopy from the selected plants at weekly interval starting from one week after germination until the removal of the crop.

Method of application of fertilizer :

Nitrogenous fertilizer doses were applied in different plots according to respective treatments. Twenty five per cent nitrogen (in urea form) was applied at the time of sowing, while remaining 75 per cent nitrogen was applied in three splits *viz*., 25 per cent, 25 per cent and 25 per cent at 30, 60 and 90 days after sowing, respectively.

Method of recording seed cotton yield :

The yield of seed cotton was recorded as and when ready to harvest. Yield of seed cotton from each plot was weighed separately. Three pickings were made and data on seed cotton yield were summed up for further statistical analysis.

RESULTS AND DISCUSSION

Spacing and fertilizer levels influenced the sucking pest population, as their interaction was significant. All the spacing and doses of nitrogen under study were significantly differed with each other. It indicated that the incidence of sucking pests varied with the varying spacing and nitrogen levels. The population of sucking pest declined with increased spacing and with decreased fertigation level and *vis-a-vis*.

Incidence of aphid *(A. gossypii)* :

It is clear from the results that maximum population of aphid was recorded (14.40/ leaf) from those plots had lower plant spacing (120×45 cm) (Table 1). The population of aphid decreased as plant to plant distance was increased. The aphid population decreased significantly *i.e.* 5.20/ leaf on Bt cotton raised at 150×60 cm, wider plant spacing. The Bt cotton cultivated at a spacing of 120×60 cm (12.25/ leaf) and 150×45 cm (9.89/ leaf) significantly differed with each other and recorded mediocre population of aphid. The present findings are in agreement with Kalaichelvi (2008) and Shwetha *et al.* (2009) who reported the highest aphid population in cotton grown at the closer spacing. Significantly the highest (15.32/ leaf) population of aphid was recorded on the crop fertilized with the highest dose *i.e.* 360 kg N/ ha whereas, the lowest (5.60/ leaf) on the crop grown with the lowest dose *i.e.* 180 kg N/ ha. Crop fertilized with 300 kg N /ha (12.03/ leaf) and 240 kg N /ha (9.43/leaf) found significantly differed with each other and also recorded mediocre population of aphid. These findings are in close conformity with the results of Federico (1978); Cui *et al.* (2004) and Kalaichelvi (2008) who reported higher population of aphid in crop fertilized with the higher doses of nitrogen. The interaction 150×60 cm + 180 kg N/ ha (S_4N_1) registered significantly the lowest (2.65/ leaf) population of aphid while the highest (23.60/ leaf) aphid population was recorded under spacing 120×45 cm + 360 kg N/ ha (S_1N_4). The performance of different spacing and levels of nitrogenous fertilizer were found inconsistent over periods where they received split doses of fertilizer as the interaction S×N×P was significant (Table 1).

Incidence of leafhopper, *A. biguttula biguttula* :

The data presented in Table 2 revealed that the lowest spacing (120×45 cm) of plants showed significantly highest (5.30 / leaf) leafhopper population. The lowest (1.53/ leaf) leafhopper population was recorded on Bt cotton cultivated at a wider plant spacing (150×45 cm). It is indicative from the results that as the spacing increased, the population of leafhopper decreased and *vis-a-vis*. Narrow spacing provides the higher plant density, which may alter the microclimatic condition of the field in favour of leafhopper. Mohite and Uthamasamy (1997); Muhammad *et al.* (2006); Kalaichelvi (2008) and Shwetha *et al.* (2009) also reported the higher population of leafhopper in cotton grown at the closer spacing. Maximum population of leafhopper was recorded (5.30/ leaf) from those plots where lower (180 kg N/ ha) dose of fertilizer was applied. The leafhopper population decreased significantly *i.e.* 1.66/ leaf with the application of the highest fertilizer dose (360 kg N/ ha). The crop fertilized with 300 kg N/ ha (4.06) and 240 kg N/ ha (2.88) significantly differed with each other and also recorded mediocre population of leafhopper. Similar trends of this pest in cotton were also reported by Mohite and Uthamaswamy (1997); Rustamani *et al.* (1999) and Sohail *et al.* (2004). Thus, the present investigation is in conformity of earlier reports. The interaction spacing 150×60 cm + 180 kg N/ ha (S_4N_1) registered significantly the lowest (0.85/ leaf) population of leafhopper while the highest (8.49/ leaf) population was recorded under 120×45 cm + 360 kg N/ ha (S_1N_4). The performance of different spacing and levels of nitrogenous fertilizer were found consistence over periods *i.e.* on split application of fertilizer as the interaction S×N×P was non-significant (Table 2).

Incidence of whitefly *(B. tabaci)* :

Maximum population of whitefly was recorded (3.97/ leaf) from those Bt cotton plots raised at plant spacing of 120×45 cm, narrow spacing (Table 3). The whitefly population decreased significantly *i.e.* 1.16/ leaf with 150×60 cm, wider

Table 1 : Impact of different spacing and nitrogen levels on incidence of aphid, *A. gossipy* in Bt cotton (pooled over periods)

Treatments	Number of aphid per leaf				
1	2	3	4	5	6
Main\ Sub plot	N_1	N_2	N_3	N_4	Mean
S_1	3.23^{d} (9.43)	3.81^{gh} (13.52)	4.20^{ij} (16.64)	4.96^{k} (23.60)	4.05^{d} (14.40)
S_2	2.75^{c} (6.56)	3.52^{ef} (11.39)	4.02^{hi} (15.16)	4.28^{j} (17.32)	3.64^{c} (12.25)
S_3	2.39^{b} (4.71)	3.30^{de} (9.98)	3.58^{fg} (11.82)	3.79^{gh} (13.82)	3.27^{b} (9.89)
S_4	1.91^{a} (2.65)	2.29^{b} (4.24)	2.62^{bc} (5.86)	3.14^{d} (8.86)	2.49^{a} (5.20)
Mean	2.57^{a} (5.60)	3.23^{b} (9.43)	3.61^{c} (12.03)	4.04^{d} (15.32)	-
Spacing (S)	S.E. ±			0.04	
	C.D. (P=0.05)			0.12	
Nitrogen (N)	S.E. ±			0.04	
	C.D. (P=0.05)			0.12	
Period (P)	S.E. ±			0.05	
	C.D. (P=0.05)			0.13	
S x N	S.E. ±			0.08	
	C.D. (P=0.05)			0.23	
C.V. (%)				15.57	
S x P	S.E. ±			0.10	
	C.D. (P=0.05)			0.27	
N x P	S.E. ±			0.10	
	C.D. (P=0.05)			0.27	
S x N x P	S.E. ±			0.19	
	C.D. (P=0.05)			0.53	
C.V. (%)				9.88	

Notes:
Figures in parentheses are retransformed values; those outside are $\sqrt{x}$ +1 value.
Treatment means with letter(s) in common are not significant at 5 % level of significance within a column.
Spacing (S) S_1: 120×45 cm; S_2: 120×60 cm; S_3: 150×45 cm; S_4: 150×60 cm.
Nitrogen (kg./ha): N_1: 180 kg/ha; N_2: 240 kg/ha; N_3: 300 kg/ha; N_4: 360 kg/ha.
Bt cotton variety: RCH 2 BG II.

plant spacing. The Bt cotton cultivated at a spacing of 120×60 cm (3.33/ leaf) and 150×45 cm (2.42/ leaf) significantly differed with each other and recorded mediocre population of whitefly. The results of present investigation are in close conformity with the findings of Mohite and Uthamasamy (1997), Muhammad *et al.* (2006) and Kalaichelvi (2008). Significantly the highest (3.84/ leaf) population of whitefly was recorded on the Bt cotton fertilized with the highest dose *i.e.* 360 kg N/ ha whereas, the lowest (1.34/ leaf) in dose *i.e.* 180 kg N/ ha, lowest dose. Crop fertilized with 300 kg N /ha (3.20/ leaf) and 240 kg N/ha (2.42/ leaf) was found significantly different with each other and also recorded mediocre population of whitefly. The present findings are in conformity with those of Mohite and Uthamaswamy (1997); Rustamani *et al.* (1999); Sohail *et al.* (2004); Jain *et al*. (2005) and Sohail, *et al.* (2007). The interaction 150×60 cm + 180 kg N/ ha (S_4N_1) registered significantly the lowest (0.54/ leaf) population of whitefly while the highest (5.45/ leaf) under 120×45 cm + 360 kg N/ ha (S_1N_4). The performance of different spacing and levels of nitrogenous fertilizer was found consistent over periods where they received split doses of fertilizer as the interaction S×N×P was non-significant (Table 3).

Incidence of thrips, *T. tabaci* :

The data presented in Table 4 revealed the lowest spacing (120×45 cm) of plants which showed significantly highest (2.84 / leaf) thrips population. The lowest (0.88/ leaf) thrips population was recorded in Bt cotton raised at a wider plant spacing (150×45 cm). It is indicative from the results that as the spacing increased, the population of thrips decreased and *vis-a-vis*. Muhammad *et al.* (2006) and Shwetha *et al.* (2009) also reported the higher population of thrips in cotton grown at the closer spacing. Maximum population of thrips was recorded (2.61/ leaf) from those plots applied lower fertilizer dose (180 kg N/ ha). The thrips population decreased significantly *i.e.* 1.10/ leaf in Bt cotton treated with the highest fertilizer dose (360 kg N/ ha). The crop fertilized with 300 kg N/ ha (2.35) and 240 kg N/ ha (1.86) significantly differed with

Table 2 : Impact of different spacing and nitrogen levels on incidence of leafhopper, *A. biguttula biguttula* in Bt cotton (pooled over periods)

Treatments	Number of leafhopper per leaf				
1	2	3	4	5	6
Main\ Sub plot	N_1	N_2	N_3	N_4	Mean
S_1	1.88e (2.53)	2.39g (4.71)	2.68i (6.18)	3.08j (8.49)	2.51d (5.30)
S_2	1.69d (1.86)	2.10f (3.41)	2.52h (5.35)	2.77i (6.67)	2.27c (4.15)
S_3	1.57bc (1.46)	1.92e (2.69)	2.14fg (3.58)	2.35g (4.52)	1.99b (2.96)
S_4	1.36a (0.85)	1.50b (1.25)	1.66cd (1.76)	1.84e (2.39)	1.59a (1.53)
Mean	1.63a (1.66)	1.97b (2.88)	2.25c (4.06)	2.51d (5.30)	-
Spacing (S)	S.E. ±		0.02		
	C.D. (P = 0.05)		0.05		
Nitrogen (N)	S.E. ±		0.02		
	C.D. (P = 0.05)		0.05		
Period (P)	S.E. ±		0.03		
	C.D. (P = 0.05)		0.09		
S × N	S.E. ±		0.03		
	C.D. (P = 0.05)		0.10		
C.V. (%)			11.31		
S × P	S.E. ±		0.07		
	C.D. (P = 0.05)		0.19		
N × P	S.E. ±		0.07		
	C.D. (P = 0.05)		0.19		
S × N × P	S.E. ±		0.14		
	C.D. (P = 0.05)		NS		
C.V. (%)			10.31		

Notes :
Figures in parentheses are retransformed values; those outside are $\sqrt{x+1}$ value; NS = Non-significant
Treatment means with letter(s) in common are not significant at 5 % level of significance within a column.
Spacing (S) S_1: 120×45 cm; S_2: 120×60 cm; S_3: 150×45 cm; S_4: 150×60 cm
Nitrogen (kg/ha): N_1: 180 kg/ha; N_2: 240 kg/ha; N_3: 300 kg/ha; N_4: 360 kg/ha.
Bt cotton variety: RCH 2 BG II.

Table 3 : Effect of different spacing and nitrogen levels on incidence of whitefly, *B. tabaci* in Bt cotton (pooled over periods)

Treatments	Number of whitefly per leaf				
1	2	3	4	5	6
Main\ Sub plot	N_1	N_2	N_3	N_4	Mean
S_1	1.80^{f} (2.24)	2.20^{i} (3.84)	2.39^{k} (4.71)	2.54^{l} (5.45)	2.23^{d} (3.97)
S_2	1.61^{d} (1.59)	1.97^{g} (2.88)	2.30^{j} (4.29)	2.45^{k} (5.00)	2.08^{c} (3.33)
S_3	1.45^{bc} (1.10)	1.83^{f} (2.35)	2.01^{g} (3.04)	2.12^{h} (3.49)	1.85^{b} (2.42)
S_4	1.24^{a} (0.54)	1.40^{b} (0.96)	1.52^{c} (1.31)	1.71^{d} (1.92)	1.47^{a} (1.16)
Mean	1.53^{a} (1.34)	1.85^{b} (2.42)	2.05^{c} (3.20)	2.2^{d} (3.84)	-
Spacing (S)	S.E. ±		0.01		
	C.D. (P = 0.05)		0.03		
Nitrogen (N)	S.E. ±		0.01		
	C.D. (P = 0.05)		0.03		
Period (P)	S.E. ±		0.02		
	C.D. (P = 0.05)		0.07		
S x N	S.E. ±		0.02		
	C.D. (P = 0.05)		0.07		
C.V. (%)			8.17		
S x P	S.E. ±		0.05		
	C.D. (P = 0.05)		0.13		
N x P	S.E. ±		0.05		
	C.D. (P = 0.05)		0.13		
S x N x P	S.E. ±		0.09		
	C.D. (P = 0.05)		NS		
C.V. (%)			8.57		

Notes: Figures in parentheses are retransformed values; those outside are √X+1 value; Treatment means with letter(s) in common are not significant at 5 % level of significance within a column; Spacing (S) S_1: 120×45 cm; S_2: 120×60 cm; S_3: 150×45 cm; S_4: 150×60 cm; Nitrogen (kg/ha): N_1: 180 kg/ha; N_2: 240 kg/ha; N_3: 300 kg/ha; N_4: 360 kg/ha; Bt cotton variety: RCH 2 BG II; NS = Non-significant

Table 4 : Impact of different spacing and nitrogen levels on incidence of thrips, *T. tabaci* in Bt cotton (pooled over periods)

Treatments	Number of thips per leaf				
1	2	3	4	5	6
Main\ Sub plot	N_1	N_2	N_3	N_4	Mean
S_1	1.67^{d} (1.79)	1.95^{h} (2.80)	2.06^{ij} (3.16)	2.18^{k} (3.75)	1.96^{d} (2.84)
S_2	1.53^{c} (1.34)	1.80^{ef} (2.24)	2.04^{i} (3.16)	2.10^{j} (3.41)	1.86^{c} (2.46)
S_3	1.37^{b} (0.88)	1.74^{de} (2.03)	1.83^{fg} (1.41)	1.90^{gh} (2.61)	1.71^{b} (1.92)
S_4	1.22^{a} (0.49)	1.29^{a} (0.66)	1.41^{b} (0.99)	1.57^{c} (1.46)	1.37^{a} (0.88)
Mean	1.45^{a} (1.10)	1.69^{b} (1.86)	1.83^{c} (2.35)	1.94^{d} (2.61)	-
Spacing (S)	S.E. ±		0.01		
	C.D. (P = 0.05)		0.04		
Nitrogen (N)	S.E. ±		0.01		
	C.D. (P = 0.05)		0.04		
Period (P)	S.E. ±		0.02		
	C.D. (P = 0.05)		0.06		
S x N	S.E. ±		0.02		
	C.D. (P = 0.05)		0.07		
C.V. (%)			9.32		
S x P	S.E. ±		0.04		
	C.D. (P = 0.05)		0.12		
N x P	S.E. ±		0.04		
	C.D. (P = 0.05)		0.12		
S x N x P	S.E. ±		0.08		
	C.D. (P = 0.05)		NS		
C.V. (%)			8.33		

Notes : Figures in parentheses are retransformed values; those outside are √x+1 value ; Treatment means with letter(s) in common are not significant at 5 % level of significance within a colum; Spacing (S) S_1: 120×45 cm; S_2: 120×60 cm; S_3: 150×45 cm; S_4: 150×60 cm; Nitrogen (kg/ha): N_1: 180 kg/ha; N_2: 240 kg/ha; N_3: 300 kg/ha; N_4: 360 kg/ha; Bt cotton variety: RCH 2 BG II.; NS = Non - significant each other and also recorded mediocre population of thrips. Rustamani *et al.* (1999); Sohail *et al.* (2004) and Sohail *et al.* (2007) also reported similar trends of this pest in cotton. The interaction plant spacing 150×60 cm + 180 kg N/ ha (S_4N_1) registered significantly the lowest (0.49/ leaf) population of thrips while the highest (3.75/ leaf) population was recorded under spacing 120×45 cm + 360 kg N/ ha (S_1N_4). The performance of different spacing and levels of nitrogenous fertilizer was found consistence over periods *i.e.* on split application of fertilizer as the interaction S×N×P was non-significant (Table 4).

Evaluation based on yield :

The activity of sucking pest varied with the varying spacing as well as nitrogenous fertilizer and also reflected on the seed cotton yield. Significantly higher (1588 kg/ha) yield of seed cotton was recorded in Bt cotton raised with the widest (150×60 cm) spacing than rest of the spacings but was at par with the spacing 150×45 cm (1394) followed by spacing 120×60 cm (1362) (Table 5). The Bt cotton variety RCH 2 (BG II) when spaced at 120×60 cm yielded significantly the lowest (1125) seed cotton. Siddiqui *et al.* (2007); Saleem *et al.* (2009) and Bhalerao *et al.* (2010) also reported the same trend earlier. Bt cotton fertilized with the highest does of nitrogen *i.e.* 360 kg/ ha in a split recorded significantly the highest (1542 kg/ha) yield of seed cotton than the rest of the doses. Bt cotton raised with 300, 240 and 180 N kg/ha were at par and yielded more or less equal *i.e.* 1336, 1289 and 1303 kg/ha, respectively (Table 5). Sawan (2008) and Hakoomat and Roheel (2011) also recorded the higher yield of seed cotton fertilized with the higher dose of nitrogen. Crop grown at the widest spacing (150×60 cm) with the highest dose of nitrogen (360 kg/ha) (S_4N_4) recorded significantly the highest (1996 kg/ha) yield of seed cotton. However, it was at par with the spacing 120×60 cm with 360 N kg/ha (S_2N_4) (1734 kg/ha) followed by spaced at 150×60 cm with 300 N kg./ha (S_4N_3) (1558 kg/ha). Further, the Bt cotton RCH II (BG II) raised after following spacing 120×60 cm fertilized either with 240 or 360 N kg/ha *i.e.* S_2N_2 or S_2N_4 recorded lower yield of seed cotton (1030 and 1018 kg/ha, respectively). Wider plant spacing in cotton increased the plant height, number of bolls per plant and boll weight and ultimately reflected on yield (Hussain *et al*., 2000). Nitrogen is an essential nutrient for cotton that affects plant growth, fruiting bodies and thereby the yield (Boquet *et al*., 1994).

The highest incidence of sucking pests was noticed in closer spacing as compared to the wider spacing under present investigation. This might be due to the fact that insect would be able to find refuge and escape from the pesticide treatment and natural enemies in closer plantation. Also, the microclimate inside the canopy of closer spaced plants would be encouraging the insect development. The higher incidence of sucking pests was noticed under higher nutrition levels because excessive nitrogenous fertilizer increased crop susceptibility to pests and this could be due to more succulence of plants caused by excessive fertilizer, which predisposed the plant foliage to be easily attacked by the sucking pests.

In nutshell, plant spacing and fertigation levels has significant impact on the population of sucking pests in Bt cotton. The wider spaced plants applied with the lower fertigation level recorded the lower infestation as compared to the closer spaced plants with the higher fertigation levels.

Table 5 : Impact of different spacing and nitrogen levels on seed cotton yield

Treatments	Seed cotton yield (kg/ha)				
1	2	3	4	5	6
Main\ sub plot	N_1	N_2	N_3	N_4	Mean
S_1	1263^{de}	1283^{cde}	1169^{de}	1734^{ab}	1362^{b}
S_2	1240^{de}	1030^{e}	1215^{de}	1018^{e}	1125^{c}
S_3	1343^{cd}	1413^{cd}	1402^{cd}	1417^{cd}	1394^{ab}
S_4	1369^{cd}	1429^{cd}	1558^{bc}	1996^{a}	1588^{a}
Mean	1303^{b}	1289^{b}	1336^{b}	1542a	-
Spacing (S)	S.E. ±		64.60		
	C.D. (P = 0.05)		224		
C.V. (%)			16.36		
Nitrogen (N)	S.E. ±		49.55		
	C.D. (P = 0.05)		144		
S x N	S.E. ±		99.09		
	C.D. (P = 0.05)		289		
C.V. (%)			12.55		

Note : Treatment means with letter(s) in common are not significant at 5 % level of significance within a column; Spacing (S) S_1: 120×45 cm; S_2: 120×60 cm; S_3: 150×45 cm; S_4: 150×60 cm; Nitrogen (kg/ha): N_1: 180 kg/ha; N_2: 240 kg/ha; N_3: 300 kg/ha; N_4: 360 kg/ha; Bt cotton variety: RCH 2 BG II.

It is required to adopt plant spacing and nutrition levels precisely in Bt cotton so as to limit the sucking pest population at an economically acceptable level.

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