

Growth and yield of *Bt* cotton (*Gossypium hirsutum* L.) as affected by nitrogen, phosphorus and potassium under irrigation condition

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ABSTRACT

An experiment was conducted at Cotton Research Station, Junagadh Agricultural University, Junagadh during *kharif* season of two consecutive years 2006-07 and 2007-08 to study the "Effect of nitrogen, phosphorus and potassium on growth and yield of *Bt* cotton under irrigated conditions" on medium black clay soil. The experiment comprising three levels of nitrogen viz., 160, 200 and 240 kg N/ha, two levels of phosphorus viz., 0 and 50 kg P₂O₅/ha and four levels of potassium viz., 0, 60, 90 and 120 kg K₂O/ha. The results revealed that application of 240 kg N/ha produced significantly higher seed cotton (4027 kg/ha), lint (1432 kg/ha) and stalk yields (5589 kg/ha) than lower levels of nitrogen. Increase in nitrogen level from 160 to 240 kg N/ha appreciably improved the growth and yield attributing characters viz., plant height, plant spread, number of monopodial and sympodial branches /plant, number of bolls/plant, boll weight and number of seeds/ boll. Application of 50 kg P₂O₅/ha recorded higher values of growth and yield attributing characters and yields over control. Seed cotton, lint and stalk yields, growth and yield attributing also increased significantly with 120 kg K₂O/ ha over control.

Key words : *Bt* cotton, growth, yield, yield attributes, nitrogen, phosphorus, potassium

Bt cotton (*Gossypium hirsutum* L.), the "white gold" is one of the most important commercial and industrial crop and play a key role in economical and social affairs of the world. Cotton plants have the deeper root system (45-100 cm) which is efficient in availing the native soil nutrients. The introduction of *Bt* cotton may change the status of area, production and productivity of cotton. India is the largest producer of seed cotton and oil in the world, ranks 1st in area and 2nd position in production with 11.00 million hectare and 32.50 million bales, respectively. However, the average productivity in India is 503 kg lint/ ha and is far behind of the world average of 785 kg lint/ha (Anonymous, 2011). Research evidence revealed that the productivity of cotton is medium, this might be due to a poor crop management practices and its cultivation on poor and marginal lands. The chemical fertilizer provides the major and primary plant nutrients.

Sufficient quantity of nitrogen, phosphorus and potassium play vital role in the nutrition of plants. Therefore, application of optimum dose of nitrogen, phosphorus and potassium fertilizers become important from growth as well as production point of view. Very meagre work has been done on effect of nitrogen, phosphorus and potassium on growth and yield of irrigated *Bt* cotton particularly in Saurashtra region of Gujarat and hence present experiment was conducted at Cotton Research Station, Junagadh Agricultural University, Junagadh.

MATERIALS AND METHODS

A field experiment was conducted at Cotton Research Station, Junagadh Agricultural University, Junagadh, during *kharif* season of two consecutive years 2006-07 and 2007-08 to study the growth and yield of *Bt* cotton as affected by nitrogen, phosphorus and potassium under irrigated condition. Twenty four treatment combinations comprised of three levels of nitrogen viz., N₁-160, N₂-200 and N₃-240 kg N/ha, two

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levels of phosphorus viz., P_0-0 and P_1-50 kg P_2O_5 /ha and four levels of potassium viz., K_0-0 , K_1-60 , K_2-90 and K_3-120 kg K_2O /ha were tried in randomised block design with factorial concept and replicated three times. The experimental soil was slightly alkaline with pH 7.99, clayey in texture, calcareous in nature, medium in available N (295 kg/ha), low in available P (24.36 kg/ha) and medium in available K (362 kg/ha) with EC (0.44 dS/m), organic carbon (0.33 %), CEC (0.01 cmol (p+) /kg). Hybrid *Bt* cotton VICH-5 was sown on 8th July 2006 and 20th June 2007 by dibbling method keeping inter and intra to spacing of 120cm and 45cm, respectively. All other agronomic practices were adopted as per recommendation made for the crop. The whole quantity of phosphorus in the form of single super phosphate was applied as per treatment as basal. Nitrogen in the form of urea and potassium in the form of muriate of potash were applied in four equal splits at basal and then after at 30, 45 and 60 days after sowing.

Randomly five plants from each net plot were selected for recording growth and yield attributing characters. Seed cotton, lint and stalk yields of each net plot were recorded in kg/net plot and converted on hectare basis.

RESULTS AND DISCUSSION

Effect of Nitrogen

Pooled data of two years furnished in Table 1 showed that application of nitrogen exerted their significant influence on growth and yield attributes as well as seed cotton, lint and stalk yields. Crop fertilized with 240 kg N/ha recorded significantly taller plant (161.0 cm), maximum plant spread (102.6 cm), more number of monopodial (4.55) and sympodial (25.91) branches/plant, more number of bolls/plant (103.4), higher boll weight (6.77), more number of seeds/boll (28.4), higher seed cotton (4027 kg/ha), lint (1432 kg/ha) and stalk yields (5589 kg/ha) over rest of lower nitrogen levels. Per cent increase in seed cotton, lint and stalk yields with the application of 240 kg N/ha was to the tune of 25.80, 27.97 and 24.86 per cent over 160 kg N/ha. This may be due to better availability of nitrogen at active crop growth stage and role of nitrogen in chlorophyll, protein and protoplast formation. These resulted in improvement in growth and yield attributing characters and ultimately yield which is resulted in higher seed cotton, lint and stalk yields. These results corroborate the findings of Karthikeyan and Jaykumar (2001), Kamble *et al.*, (2005) and Muhammad *et al.*, (2007). They also reported similar effects of nitrogen in increasing the plant height, plant spread, number

Table 1 Growth and yield attributes and seed cotton, lint and stalk yields of *Bt* cotton as influenced by nitrogen, phosphorus and potassium

Treatment	Plant height (cm)	Plant spread (cm)	No. of monopodial branches/plant	No. of sympodial branches/plant	No. of bolls/plant	Boll weight (g)	No. of seed/boll	Seed cotton yield (kg/ha)	Lint yield (kg/ha)	Stalk yield (kg/ha)
Nitrogen (kg/ha)										
N_1-160	137.12	88.76	3.99	22.55	89.37	5.87	25.22	3201	1119	4476
N_2-200	151.26	96.05	4.27	24.40	97.37	6.38	27.32	3565	1258	5120
N_3-240	160.98	102.55	4.55	25.91	103.35	6.77	28.39	4027	1432	5589
C.D. at 5%	5.30	2.94	0.14	0.88	3.68	0.23	0.51	170	64	293
Phosphorus (kg/ha)										
P_0-00	145.95	92.99	4.14	22.78	93.28	6.16	26.77	3469	1217	4865
P_1-50	153.63	98.59	4.40	25.79	100.12	6.51	27.18	3726	1322	5259
C.D. at 5%	4.33	2.40	0.11	0.72	3.00	0.18	NS	139	52	239
Potassium (kg/ha)										
K_0-00	139.98	89.89	3.92	22.56	90.31	5.956	26.58	3272	1141	4540
K_1-60	151.01	96.29	4.27	24.31	97.08	6.381	26.87	3598	1269	5074
K_2-90	152.82	97.66	4.42	24.82	98.61	6.465	27.04	3724	1319	5266
K_3-120	155.34	99.32	4.47	25.46	100.78	6.545	27.41	3797	1349	5368
C.D. at 5%	6.12	3.40	0.16	1.02	4.24	0.261	0.59	196	74	338

of monopodial and sympodial branches/plant, number of bolls/plant, boll weight and number of seeds/boll.

Effect of Phosphorus

Application of 50 kg P_2O_5 /ha significantly improved the growth and yield attributes, seed cotton, lint and stalk yields/ha in pooled results (Table 1). Seed cotton, lint and stalk yields with 50 kg P_2O_5 /ha increased by 7.41, 8.63 and 8.10 %, respectively over control. Improvement in yield with phosphorus application is the result of improved growth and yield attributes, resulting from increase in cell division, better root development and high microbial activity which supplied adequate nutrients to the plants. Increase in seed cotton yield of Bt cotton with application of phosphorus was also reported by Deshpande and Lakhdive (1994) and Malewar *et al.*, (2000).

Effect of Potassium

Potassium application @ 120 kg/ ha significantly increased all the growth and yield attributes as compared to control and remained at par with the fertilizing the crop with 90 kg K_2O /ha. Application of 120 kg K_2O /ha produced significantly higher seed cotton (3797kg/ha), lint (1349kg/ha) and stalk yields (5368kg/ha). The per cent increase in seed cotton, lint and stalk yields was to the tune of 16.04, 18.23 and 18.24, respectively over control (Table 1). The increase in growth and yields parameters and finally seed cotton yield by potassium application is well known for its ability to improve crop quality and its role in helping the crop plants to combat a variety of climatic and biological stress. The findings confirm the results of Brar *et al.*, (1987), Nehra *et al.*, (2004) and Kasse and Ahmed (2005). Table 1. Growth and yield attributes and seed cotton, lint and stalk yields of Bt cotton as influenced by nitrogen, phosphorus and potassium

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