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# Response of *Bt* cotton (*Gossypium hirsutum* L.) to varied plant geometry and fertilizer levels under rainfed condition

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**ABSTRACT :** A field experiment was conducted during *kharif* 2008-2009 to 2010-2011 at Cotton Research Station, Nanded to access performance of *Bt* cotton (*Gossypium hirsutum*) with different plant geometries and fertilizer levels under rainfed condition. The experiment was laid out in split plot design with 4 plant geometries (90 x 60 cm; 120 x 45 cm; 150 x 30 and 180 x 30 cm) in main plot and 3 fertilizer levels (80:40:40; 100:50:50 and 120:60:60 NPK kg/ha) in sub plot with 3 replications. Plant geometry 120 x 45 cm recorded highest growth, yield attributing characters, seed cotton yield (2395 kg/ha) and net returns (Rs. 43,148/ha) followed by plant geometry of 150 x 30 cm. Significant reduction in yield and monetary returns were observed during all the years with geometry 180 x 30 cm. Fertilizer level of 120:60:60 NPK kg/ha was significantly superior to both the lower levels for seed cotton yield (2410 kg/ha) and net returns (Rs. 42,792/ha). Highest B:C ratio was recorded in plant geometry 120 x 45 cm (2.34) and in fertilizer levels 120:60:60 NPK kg/ha (2.30).

**Key words** : *Bt* cotton, fertilizer level, *Gossypium hirsutum*, net returns, plant geometry, rainfed cotton

Cotton "White Gold" is an important raw material for the Indian textile industry and important cash crop of the country. India ranks first in area and second in production with an average productivity of 496 kg/ha. Maharashtra is major cotton growing state comprising 41.46 lakh ha area, most of which is under rainfed condition and the productivity of cotton (305 kg/ha) is still lower than national productivity. To augment the yield potential of transgenic cotton hybrids, it is necessary to adopt suitable agronomic practices. Among various factors of cotton production, proper plant geometry and fertilizer dose play significant role. Plant type of *Bt* cotton is having such an architecture which is adjusting under closer plant spacing. Optimum plant density for *Bt* cotton was studied for black cotton soils of Marathwada and 18,518 plants / ha were found an optimum plant density for the region (Khargkharate *et al.,* 2008). However, farmers are adopting various plant geometries with wider row spacings as well as closer plant spacings. As *Bt* cotton cultivation has resulted in early setting of bolls, ultimately it requires more nutrients. The present study was therefore conducted to find out appropriate plant geometry keeping around same plant population and fertilizer doses for *Bt* cotton under rainfed condition.

## MATERIALS AND METHODS

The field experiment was conducted at Vasantrao Naik Marathwada Krishi Vidyapeeth, Cotton Research Station, Nanded, during *kharif* 2008-2009 to 2010-2011. Experiment was laid out in split plot design consisting of 4 plant geometries (90 x 60 cm ($G_1$); 120 x 45 cm ($G_2$); 150 x 30 cm ($G_3$) and 180 x 30 cm ($G_4$)) in main plot, 3 fertilizer levels ($F_1$=80:40:40 *i.e.* 100% RDF of non *Bt* cotton; $F_2$=100:50:50 and $F_3$=120:60:60 NPK kg /ha) in sub plot and was replicated thrice. The soil of experimental field was medium deep black, low in available nitrogen (224.40 kg/ha), medium in available phosphorus (12.87 kg/ha) and rich in available potassium (836.60 kg/ha) with medium organic carbon content (0.51%) and was neutral in pH (7.85). 'NCS 145' *Bt* hybrid was

sown on 25th July 2008, 30th June 2009 and 28th June 2010 during the period of experimentation. Half dose of nitrogen, full dose of phosphorus and potassium were applied as basal. Remaining half dose of nitrogen was applied 30-35 DAS by ring method.

## RESULTS AND DISCUSSION

**Plant growth and yield attributes:** Plant growth characters, yield attributing characters and seed cotton yield are presented in Table 1. Plant height remained unaffected due to effect of various plant geometries on pooled mean basis. However, fertilizer levels significantly influenced the plant heights. Less bolls and yield /plant at closer intra row spacing might be due to reduced availability of resources for development of individual plant. These results confirm the findings of Phogat *et al.,* (2010). Significantly highest number of bolls / plant was recorded in 120 x 45 cm plant geometry. Increased in fertilizer levels resulted to increase in bolls / plant. Boll weight of 120:60:60 NPK kg /ha was significantly higher over RDF of non *Bt* cotton (80:40:40 NPK kg /ha) where as there was significant increased bolls / plant with increased in fertilizer levels. This is in confirmation with the earlier work reported by Kalaichelvi (2008) and Bhalerao *et al.,* (2012). They reported increase in yield contributing characters with increased in fertilizer levels over recommended fertilizer level of respective location.

**Seed cotton yield :** Seed cotton yield was found highest with plant geometry 120 x 45 m ($G_2$) during all the years of experimentation and on pooled analysis. Wider row spacing of 180 cm with closer plant spacing of 30 cm ($G_4$) was found to reduce the seed cotton yield. This might be due to increased evaporation losses leading to reduced moisture availability in wider row spacing. Plant geometry 120 x 45 cm recorded 2395 kg /ha seed cotton yield on pooled mean basis and was *at par* with 150 x 30 cm geometry (2348 kg /ha). Plant geometry 180 x 30 cm recorded significantly lowest seed cotton yield (2066 kg /ha). This might be due to higher yield attributes in 120 x 45 cm geometry and reduced values in wider row spacing. Bolls / plant and boll weight were found to decreased in wider row spacing *i.e.* 180 x 30 cm plant geometry which resulted to lower yield /plant and /ha.

Increased in fertilizer level resulted to increase seed cotton yield. Every higher level of fertilizer resulting to significant increased in seed cotton yield over lower level. 120:60:60 NPK kg /ha was found significantly superior to 80:40:40 NPK kg /ha (100% RDF of non *Bt* cotton) and 100:50:50 NPK kg /ha for seed cotton yield. This might be due to more vegetative growth, significantly higher bolls /plant and increased boll weight. Ghongane *et al.,* (2009) and Venugopalan *et al.,* (2009) also reported significant increased in seed cotton yield with the application of higher fertilizer levels over RDF.

**Economics :** The net monetary returns influenced by plant geometries and fertilizer levels were found differed significantly. Plant geometry 120 x 45 cm ($G_2$) recorded highest net monetary returns and B:C ratio (Rs. 43,148/ha and 2.34, respectively) and was *on par* with 90 x 60 cm and 150 x 30 cm plant geometry. Plant geometry ($G_1$), ($G_2$) and ($G_3$) were found significantly superior to ($G_4$) for monetary returns. This was due to lower yield with 180 x 30 cm plant geometry than other treatments (Phogat *et al.*, 2010). NMR were found significantly highest with 120:60:60 NPK kg /ha with highest B:C ratio (2.30). This was due to higher yield with increased fertilizer levels.

The interaction plant geometry with fertilizer level were found non significant for yield attributing characters, seed cotton yield and NMR.

**Fibre properties:** There was very slight difference in mean ginning outturn (Table 2). Highest GOT was recorded in plant geometry 90

**Table 1.** Pooled mean of (2008-2010) plant height, yield attributing characters, seed cotton yield, net monetary returns and mean B : C ratio as influenced by plant geometries and fertilizer levels

| Treatment | Plant height (cm) | Bolls / plant | Boll weight (g) | Seed cotton yield (kg /ha) | | | | NMR (Rs /ha) | | | | B:C ratio | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2008-2009 | 2009-2010 | 2010-2011 | **Pooled mean** | 2008-2009 | 2009-2010 | 2010-2011 | **Pooled mean** | 2008-2009 | 2009-2010 | 2010-2011 | **Pooled mean** |
| **Plant geometry (cm)** | | | | | | | | | | | | | | | |
| **$G_1$** 90 x 60 | 110.87 | 37.27 | 3.36 | 2190 | 2342 | 2343 | **2292** | 21320 | 43496 | 55064 | **39960** | 1.53 | 2.67 | 2.56 | **2.25** |
| **$G_2$** 120 x 45 | 113.02 | 41.40 | 3.48 | 2269 | 2464 | 2452 | **2395** | 23366 | 47172 | 58905 | **43148** | 1.58 | 2.80 | 2.64 | **2.34** |
| **$G_3$** 150 x 30 | 113.95 | 34.94 | 3.36 | 2227 | 2454 | 2361 | **2348** | 21768 | 46244 | 55262 | **41091** | 1.53 | 2.72 | 2.55 | **2.27** |
| **$G_4$** 180 x 30 | 114.28 | 33.49 | 3.39 | 2025 | 2139 | 2034 | **2066** | 17033 | 37406 | 44115 | **32851** | 1.42 | 2.44 | 2.37 | **2.08** |
| SE+ | 1.64 | 1.36 | 0.10 | 46.33 | 37.61 | 40.07 | **25.06** | 1205 | 699 | 648 | **1124** | - | - | - | **-** |
| P=0.05 | N.S. | 3.99 | 0.31 | 138.71 | 112.59 | 119.95 | **73.40** | 3606 | 2092 | 1940 | **3291** | - | - | - | **-** |
| **Fertilizer levels (NPK kg /ha)** | | | | | | | | | | | | | | | |
| **$F_1$** 80:40:40 | 111.03 | 34.41 | 3.23 | 1983 | 2190 | 2189 | **2120** | 16212 | 39318 | 50102 | **35210** | 1.41 | 2.49 | 2.46 | **2.12** |
| **$F_2$** 100:50:50 | 113.43 | 36.70 | 3.40 | 2233 | 2336 | 2313 | **2294** | 22310 | 43176 | 53870 | **39785** | 1.55 | 2.60 | 2.53 | **2.23** |
| **$F_3$** 120:60:60 | 114.64 | 39.22 | 3.50 | 2318 | 2523 | 2391 | **2410** | 24094 | 48244 | 56038 | **42792** | 1.58 | 2.76 | 2.56 | **2.30** |
| SE+ | 1.10 | 0.75 | 0.07 | 29.42 | 48.70 | 54.40 | **27.14** | 765 | 985 | 1005 | **841** | - | - | - | **-** |
| P=0.05 | 3.05 | 2.20 | 0.23 | 88.08 | 145.81 | 158.51 | **79.47** | 2290 | 2950 | 3008 | **2465** | - | - | - | **-** |
| **Grand mean** | **113.03** | **36.77** | **3.40** | **2178** | **2350** | **2298** | **2275** | **20872** | **43579** | **53337** | **39263** | **1.52** | **2.66** | **2.53** | **2.23** |
| P=0.05 | 5.84 | 7.61 | 6.03 | 5.68 | 7.18 | 8.20 | **6.92** | 12.70 | 7.83 | 6.53 | **7.41** | - | - | - | **-** |

**Table 2.** Fibre properties as influenced by plant geometries and fertilizer levels

| Treatment | GOT (%) | 2.5 per cent span length (mm) | U.R. (%) | Micronair MV | Tenasity 3.2 mm (g/t) | Elong-ation (%) | Maturity ratio | SFI |
|---|---|---|---|---|---|---|---|---|
| **Plant geometry (cm)** | | | | | | | | |
| $G_1$ 90 x 60 | 35.32 | 30.85 | 47.03 | 3.13 | 22.28 | 5.93 | 0.80 | 8.40 |
| $G_2$ 120 x 45 | 35.22 | 31.68 | 45.25 | 3.48 | 22.33 | 5.95 | 0.81 | 8.33 |
| $G_3$ 150 x 30 | 35.12 | 31.40 | 45.58 | 3.38 | 22.32 | 5.93 | 0.81 | 8.13 |
| $G_4$ 180 x 30 | 34.92 | 30.50 | 44.90 | 3.10 | 22.28 | 5.92 | 0.80 | 8.95 |
| SE+ | 0.31 | 0.46 | 0.78 | 0.14 | 0.12 | 0.03 | 0.01 | 0.32 |
| P=0.05 | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. | N.S. |
| **Fertilizer levels (NPK kg /ha)** | | | | | | | | |
| $F_1$-80:40:40 | 35.06 | 30.98 | 45.35 | 3.15 | 22.45 | 5.95 | 0.80 | 8.65 |
| $F_2$-100:50:50 | 35.14 | 31.4 | 44.43 | 3.23 | 22.48 | 5.93 | 0.81 | 8.85 |
| $F_3$-120:60:60 | 35.23 | 30.93 | 47.28 | 3.42 | 21.98 | 5.93 | 0.81 | 7.85 |
| SE+ | 0.51 | 0.40 | 0.82 | 0.11 | 0.15 | 0.03 | 0.01 | 0.47 |
| P=0.05 | N.S. | N.S. | 2.31 | 0.24 | N.S. | N.S. | N.S. | N.S. |
| **Grand mean** | **35.15** | **31.11** | **45.69** | **3.27** | **22.30** | **5.93** | **0.81** | **8.45** |

x 60 cm (35.52%) followed by 120 x 45 cm (35.22%). GOT was found to increase slightly with increase in fertilizer level. However, other fibre quality parameters were not much affected.

Based on the present study it could be concluded that plant geometry 120 x 45 cm was better than other geometries as it resulted in higher seed cotton yield and monetary returns. Fertilizer level 120:60:60 NPK kg /ha was found optimum and remunerative dose for *Bt* cotton under rainfed condition in Marathwada region.

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