



## Optimization of fertilizer requirement for *Bt* and non *Bt* cotton hybrids under two plant geometry levels

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**ABSTRACT** : Field experiments were carried out at Tamil Nadu Agricultural University, Cotton Research Station, Srivilliputtur during August to January 2013-14 and 2014-15 to optimize fertilizer requirement of *Bt* and non *Bt* hybrids of cotton with two levels of spacing under irrigated conditions. The experiments were conducted in split split plot design with three replications. The treatments consisted of four cotton hybrids (three *Bt* Malliga, RCH 2 and Super star and one non *Bt* TSHH 0629) in main plots and two levels of plant geometry (90 x 60 cm and 112.5 x 60 cm) in sub plots and three doses of fertilizers (100% RDF - 120:60:60 kg NPK / ha, 125% RDF- 150:75 :75 Kg NPK /ha and 150% RDF -180:90:90 Kg NPK/ ha) were accommodated in sub sub plots. The results revealed that taller plants, higher number of sympodia, bolls per plant and boll weight were associated with Super star *Bt* and Malliga *Bt* hybrids. Super star *Bt* also registered significantly the highest seed cotton yield than other three hybrids during 2013-2014 and comparable yield with Malliga and TSHH 0629 during 2014-2015. Adoption of normal recommended spacing of 90 x 60 cm recorded significantly higher seed cotton yield than wider spacing of 112.5 x 60 cm. The effect of both 125 and 150 per cent RDF on number of bolls / plant and seed cotton yield was *on par* and significantly superior than 100 per cent RDF during both the years of study. Higher total income, net income and benefit cost ratio were also observed with Super star *Bt* and Malliga *Bt* under 90 x 60 cm spacing and 125 per cent RDF.

**Key words** : Cotton hybrids, economics, fertilizers, seed cotton yield, spacing

Cotton also known as “White Gold” is an important fibre cum cash crop in India and Tamil Nadu as well. In Tamil Nadu, it is cultivated in an area of 1.42 lakh ha during 2015-2016 with production of 2.80 lakh bales and productivity of 599 kg/ ha which is below the world average yield of 788 kg/ ha (Anonymous, 2017). Recently promising *Bt* and non *Bt* cotton hybrids of different growing habit cultivated in the state need to be exploited under improved agronomic practices. Response of cotton to applied nutrients is governed by environment and cultural factors. Among various production factors, spacing and fertilization play a very significant role for

efficient utilization of available sources. Cotton plant being heavy feeder needs proper fertilizer application. Balanced fertilization is one of the major key factors for sustaining and enhancing the cotton yields. Determination of optimum plant spacing with fertilizer dose for *Bt* and non *Bt* cotton for realizing optimum yield is necessary for maximum utilization of various resources like light, soil moisture and CO<sub>2</sub> to augment crop yield. Effect of nutrients may differ with spacing because of their profound impact on canopy structure, phenological behavior and fruiting pattern. Efficient cotton production packages from the modern agronomy of cotton with

optimum spacing and fertilizer application explore the avenues for realizing the potential yields. With these back ground, the present studies were, therefore, undertaken to optimize the spacing and fertilizer requirement of promising *Bt* and Non *Bt* cotton hybrids.

### MATERIALS AND METHODS

Field experiments were carried out at Cotton Research Station, Srivilliputtur during August to January 2013-2014 and 2014 -2015 to optimize fertilizer requirement of *Bt* and non *Bt* hybrids of cotton with two levels of spacing under irrigated conditions. The experiments were conducted in split- split plot design with three replications. The treatments consisted of four cotton hybrids (three *Bt* Malliga , RCH 2 and Super star and one non *Bt* TSHH 0629) in main plots and two levels of plant geometry (90 x 60 cm and 112.5 x 60 cm) in sub plots and three doses of fertilizers (100% RDF - 120:60:60 kg NPK/ha, 125% RDF- 150:75 :75 kg NPK /ha and 150% RDF -180:90:90 kg NPK/ ha) were accomodated in sub sub plots. The soil of the experiment field was sandy clay loam with a pH of 8.3. The available nutrient N, P and K status of the soil was low, medium and high respectively. The fertilizers were applied as per treatment schedule. One third dose of nitrogen and potash and full dose of phosphorus were applied as basal application at the time of sowing. Top dressing of remaining dose of nitrogen and potash were given as each one third dose at 40 and 60 days after sowing. The sources of nutrients were urea (46% N), Single Super phosphate (46% P<sub>2</sub>O<sub>5</sub>) and Muriate of potash (60 % K<sub>2</sub>O). All other recommended agronomic

practices were followed uniformly. Crop received the rainfall of 419.2 mm in 21rainy days during 2013 - 2014 and 471.9 mm in 28 rainy days during 2014- 2015. The biometric observation on plant height, yield attributes and seed cotton yield were recorded and economics were also worked out.

### RESULTS AND DISCUSSION

**Plant height :** The height of cotton hybrids at harvest was not significantly influenced by fertilizer levels, however significant variation on plant height was effected by hybrids and geometry (Table.1). Among the hybrids, TSHH 0629 produced taller plants but on par with Super Star which was also on par with that of Malliga and all these three hybrids were significantly taller than RCH 2 during both the years of study. Cotton sown under normal spacing of 90 x 60 cm recorded significantly higher plant height than wider spacing of 112.5 x 60 cm during 2013-2014 and both the spacing produced statistically similar plant height during 2014-2015. The variation in plant height by different *Bt* and non *Bt* cotton hybrids was observed by Sekhon *et al.* (2013) and Bharathi *et al.* (2016). Similarly positive response of plant height with higher dose of fertilizers was reported by Rawal (2015).

**Yield attributes :** The different *Bt* and non *Bt* hybrids exhibited significant influence on all the yield attributes during both the years of study (Table 1). Among them, Super star *Bt* and TSHH 0629 non *Bt* recorded higher number of sympodia/plant and number of bolls / plant and both were comparable during both the years

**Table 1.** Effect of hybrids, spacing and fertilizer levels on growth and yield attributes of cotton

Treatments	Plant height		Sympodia		Bolls		Boll	
	at harvest (cm)		(No/plant)		(No/plant)		weight (g)	
	2013- 2014	2014- 2015	2013- 2014	2014- 2015	2013- 2014	2014- 2015	2013- 2014	2014- 2015
<b>Bt hybrids</b>								
Malliga <i>Bt</i>	86.8	120.8	19.48	21.73	24.5	43.14	4.43	5.03
RCH 2 <i>Bt</i>	68.1	108.7	20.33	20.48	24.1	41.06	3.28	3.74
Super star <i>Bt</i>	90.1	122.6	22.88	23.82	29.6	44.27	4.77	5.11
TSHH 0629 non <i>Bt</i>	96.5	123.9	21.91	22.56	29.2	46.55	3.30	3.86
SEd	3.62	4.93	0.83	0.87	0.39	1.31	0.29	0.26
CD (P=0.05)	7.74	10.56	1.77	1.86	0.84	2.80	0.62	0.56
<b>Geometry</b>								
Normal spacing(90x60cm)	89.2	117.4	20.61	22.43	28.2	42.53	3.92	4.59
(25%) Higher spacing(112.5x60cm)	82.0	116.8	20.80	22.85	29.9	43.17	3.95	4.68
SEd	2.93	-	-	-	-	-	-	-
CD (P=0.05)	6.55	NS	NS	NS	NS	NS	NS	NS
<b>Fertilizer levels</b>								
RDF (100%) (120:60:60 kg NPK/ha)	80.0	114.5	19.72	22.01	26.7	41.2	3.91	4.52
RDF (125%) (150:75 :75 kg NPK/ha)	81.9	117.7	20.59	22.62	29.6	43.7	3.93	4.67
RDF (150%) (180:90:90 kg NPK/ ha)	82.5	118.1	20.87	22.96	30.2	44.8	3.94	4.71
SEd	-	-	-	-	1.32	0.86	-	-
CD (P=0.05)	NS	NS	NS	NS	2.84	1.76	NS	NS
<b>Interaction</b>								
	NS	NS	NS	NS	NS	NS	NS	NS

of experimentation. Regarding boll weight, the *Bt* hybrids Super Star and Malliga registered similar boll weight and significantly superior than other two hybrids. Differential response of *Bt* hybrids on yield attributes of cotton was observed by Sekhon *et al.*, (2013). The two levels of spacing did not influence the yield attributes significantly during both the years of study.

Significant effect of fertilizer application was found only on number of bolls / plant. Among the nutrient levels, application of 150 per cent recommended dose of fertilizers (RDF) though produced significantly highest bolls / plant, it was *on par* with that of 125 per cent RDF and both were significantly higher than the recommended dose of 100 per cent RDF . Production of higher yield attributes under

higher fertilizer dose may be due to the fact that nitrogen helps in cell division and cell elongation leading to increased number of lateral branches. Similar results of higher yield attributes with higher doses of fertilizers were reported by Kumar *et al.*, (2011) and Rawal (2015) . The present findings of production of comparable number of bolls/plant and boll weight by the application of 125 and 150 per cent RDF was also supported by Santhosh *et al.*, (2016).

**Seed cotton yield :** The results revealed that the cotton hybrids, spacing and fertilizer levels exerted significant effect on seed cotton yield (Table. 2). Among the hybrids, Super Star *Bt* produced significantly the highest yield ( 2139 and 2851 kg / ha during 2013-2014 and 2014-

2015, respectively) which was significantly higher than other three hybrids during 2013-2014 and it performed equally good with both TSHH 0629 and Malliga during 2014-2015. These three hybrids were significantly superior than RCH 2 during 2014-2015. Sekhon *et al.*, (2013) and Bharathi *et al.*, (2016) observed significant difference among the *Bt* cultivars on seed cotton yield.

With regard to spacing, normal spacing significantly improved the seed cotton yield than wider spacing. Adoption of recommended spacing of 90 x 60 cm produced higher seed cotton yield of 2091 and 2712 kg/ha as against 1509 and 2244 kg/ha during 2013-14 and 2014-15 respectively under 112.5 x 60 cm spacing. The similar result of higher seed cotton yield

with closer spacing was also reported by Shukla *et al.*, (2013) and Divya. *et al.*, (2016). The higher seed cotton yield with closer spacing was due to higher yield attributes and also higher plant population accommodated/unit area. Manjunatha *et al.*, (2010) reported that increasing the plant density/unit land area increased the interplant competition within the plot for natural resources and because of higher competition between plants, contribution of yield components/plant with closer spacing was lower when compared to wider spacing but the loss in yield attributes / plant was compensated through higher plant population / ha.

Among the fertilizer doses, application of 150 per cent RDF registered seed cotton of 1854 and 2749 kg/ha during 2013-2014 and 2014-

**Table 2.** Effect of hybrids, spacing and fertilizer levels on yield and economics of cotton

Treatments	Seed cotton yield (kg/ha)		Net Income (Rs/ ha)		B-C Ratio	
	2013-2014	2014-2015	2013-2014	2014-2015	2013-2014	2014-2015
<b>Bt Hybrids</b>						
Malliga <i>Bt</i>	1777	2805	36715	60869	1.85	2.33
RCH 2 <i>Bt</i>	1648	2463	30910	47873	1.72	2.00
Super star <i>Bt</i>	2139	2851	53005	62617	2.23	2.37
TSHH 0629 Non <i>Bt</i>	1637	2754	31665	53341	1.75	2.20
SEd	64.5	86.1	-	-	-	-
CD (P=0.05)	138.0	184.3	-	-	-	-
<b>Geometry</b>						
Normal spacing(90 x 60 cm)	2091	2712	51157	57664	2.19	2.27
(25%) Higher spacing(112.5 x 60 cm)	1509	2244	25390	40286	1.60	1.90
SEd	55.1	73.2	-	-	-	-
CD (P=0.05)	122.7	166.5	-	-	-	-
<b>Fertilizer levels</b>						
RDF (100%) (120:60:60 Kg NPK / ha)	1712	2537	34102	51995	1.79	2.17
RDF (125%) (150:75 :75 Kg NPK /ha)	1813	2708	36272	56118	1.80	2.20
RDF (150%) (180:90:90 Kg NPK/ ha)	1854	2749	36142	54691	1.76	2.10
SEd	35.1	47.4	-	-	-	-
CD (P=0.05)	72.3	96.8	-	-	-	-
<b>Interaction</b>						
	NS	NS	-	-	-	-

2015 respectively which were *on par* with 125 per cent RDF (1813 and 2708 kg/ ha) and both were significantly higher than 100 per cent RDF (1712 and 2537 kg/ ha). Similar results of significant increase in seed cotton yield with the application of higher fertilizer levels over RDF as reported by Ghongane *et al.*, (2009), Venugopalan *et al.*, (2009) and Pandagale *et al.*, (2015) were in conformity with the present investigation. Comparable seed cotton yield with 150 and 125 per cent RDF which was observed by Ambati Ravindeer Raju and Sonia K Thakare (2012) was also in favour of this study. Significantly higher yield under higher fertilizer doses was due to the corresponding increase in bolls /plant and boll weight. The interaction effect was not significant.

**Economics :** The economic analysis clearly showed that Super Star *Bt* registered higher total income, net income and Benefit Cost Ratio (B - C ratio) followed by Malliga *Bt* and TSHH 0629 non *Bt*. Regarding geometry, normal spacing recorded higher net returns and B C ratio than wider spacing during both the years of study. Among the fertilizer levels, 125 per cent RDF resulted in higher economic returns than other doses of fertilizers during both the years of experimentation. Association of higher economic returns with higher plant population with closer spacing was noticed by Asewar *et al.*, (2013) and Divya. *et al.*, (2016). Similar findings of higher economic benefits with higher dose of fertilizer was observed by Bharathi *et al.*,(2016)

Thus it is concluded from the study that normal recommended spacing of 90 x60 cm with 125 per cent recommended dose of fertilizers were optimum for both *Bt* and non *Bt* hybrids

cotton under irrigated conditions for higher yield and economic benefits.

## REFERENCES

- Ambati Ravindeer Raju and Sonia K. Thakare 2012.** Effect of nutrient management on FUE, red leaf, fibre properties of *Bt* hybrid cotton (*Gossypium hirsutum*). *Indian J. Adron.* **57** : 390-96.
- Anonymous, 2017.** "Annual Report", ICAR- AICCIP. Central Institute of Cotton Research, Coimbatore
- Asewar, B.V., Pawar, S.U., Bhosle, G.P., and Gokhale, D. N. 2013.** Effect of spacing and fertilizer levels on seed cotton yield and economics of *Bt* cotton. *J. Cotton Res Dev.* **27** : 89 -94.
- Bharathi S., Ratna Kumari, S., Vamsi Krishna A. N and Chenga Reddy, V. 2016.** Effect of nitrogen levels, split application of nitrogen on yield and fibre quality of *Bt* cotton in vertisols *J. Cotton Res. Dev.* **30** : 201-04
- Divya, S., Saravanan, P., Kathiravan, J. and Venkatesan, P. 2016.** Effect of plant spacing on yield and economics of extra long staple (ELS) *Bt* cotton hybrid *J. Cotton Res. Dev.* **30** : 214-17
- Kumar, Mandeep. 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** : 236-39.
- Manjunatha, M. J., Halepyati, A.S., Koppalkar, B. G. and Pujari, B.T. 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. *K.J.Agr. Sci.* **23**: 423-25.

**Pandagale, A. D., Khargkharate, V. K., Kadam, G. L. and Rathod, S. S. 2015.** Response of *Bt* cotton (*Gossypium hirsutum* L.) to varied plant geometry and fertilizer levels under rainfed condition *J. Cotton Res. Dev.* **29** : 260-63

**Santhosh, U.N., Satyanarayan Rao, Biradar, S.A., Desai, B.K., Halepyati, A.S. and Koppalkar, B.G. 2016.** Response of soil and foliar nutrition on *Bt* cotton (*Gossypium hirsutum* L.) quality, yield parameters and economics under irrigation *J. Cotton Res. Dev.* **30** : 205-09

**Sekhon, K.S., Buttar, G.S., Anureet Kaur and Sidhu, B. S. 2013.** Response of *Bt* cotton cultivars on growth and yield irrigated with sodic water.. *J. Cotton Res Dev.* **27** : 76-79.

**Shukla, U. N., Khakare, M.S., Bhale, V. M. and Singh, S. 2013.** Plant population, nutrient uptake and yield of cotton (*Gossypium hirsutum*) hybrids as affected by spacing and fertility levels under rainfed condition. *IndianJ. Agri.Res.* **47** : 83-88.

**Rawal, Sandeep, Mehta, A.K., Thakral, S.K. and Kumar, Mahesh 2015.** Effect of nitrogen and phosphorus levels on growth, yield attributes and yield of *Bt* cotton *J. Cotton Res. Dev.* **29** : 76-78

**Venugopalan, M.V., Sankarnarayanan, K., Blaise, D., Nalayini, P., Praharaj, C. S. and Gangaih, B. 2009.** *Bt* Cotton in India and its agronomic requirements – A review. *Indian J. Agron.* **54** : 343-60.

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