J. Cotton Res. Dev. **32** (2) 245-249 (July, 2018) **ISSN No. 0972-8619**

Response of *Bt* cotton to various planting geometry and integrated nutrient management under rainfed condition

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ABSTRACT : A field experiment was conducted for two years during (2011-2012 to 2012-2013) at Department of Agronomy , Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani to study the performance of *Bt* cotton (*Gossyipium hirsutum*) with different plant geometries and integrated nutrient management under rainfed condition. The planting geometry 120 x 45 cm recorded highest growth , yield attributing characters, seed cotton yield (1680 kg/ha) and net returns (46136 Rs/ha) followed by, 60-120 x 60 cm paired row planting , significant reduction in yield and net monetary returns were observed during both the years with paired row planting at 45-90 x 75 cm paired row planting.

Integrated nutrient management treatments application of 100 per cent RDF 120:60:60 NPK kg/ha + 25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron @ 0.1 per cent (F_1) was significantly superior treatments for seed cotton yield (1743 kg/ha) and net returns (Rs 52128 /ha)as compared to rest of the INM treatments. The highest B:C ratio was recorded in plant geometry of 120 x 45 cm (2.40) and in integrated nutrient management treatments recorded with (F_1) 100 % RDF 120:60;60 NPK kg/ha + 25 kg $ZnSo_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron @ 0.1 per cent (2.61)

Key words : *Bt* cotton, *Gossypium hirsutum*, integrated nutrient management, plant geometry, net returns, rainfed cotton

White gold is an important raw material for the Indian textile industry and important cash crop of the country and known as king of fibres .the world cotton production during 2014-2015 was 101.10 million metric tones and consumption was 24.65 million metric tones . India ranks first in area 126.55 lakh ha and second in production 400 lakh bales with an average productivity of 537 kg lint/ ha . Maharashtra is major cotton growing state comprising 41.92 lakh ha area, second in production with 85.00 lakh bales most of which under rainfed condition and the productivity of cotton 345 kg lint/ha is still lower than national productivity to augument 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 integrated nutrient management play significant rolein 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 soil of marathwada and 18518 plants /ha were found an optimum plant density for this marathwada region (Khargkharate *et al.,* 2008).

However farmers are adopting various plant geometries with wider row spacing as well as closer plant spacing. 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 integrated nutrient management treatments for *Bt* cotton under rainfed condition.

MATERIALS AND METHODS

The fields experiment was conducted at department of agronomy Vasantrao Naikmarathwada Krishividyaopeeth, Parbhani, situated in subtropical climate in central part of India in the Maharashtra state at 19 ^{0} 16 north latitude and 76^{0} 47 east longitude and 409 meters above sea levels in Marathwada division. The experiment was laid out in split splot design with three replications during *kharif* 2011-2012 to 2012-2013 . consisting of 4 plant geometries (120 x 45 cm) (P_1); 45-90 x 75 cm (P_2) , 60-120 x60 cm (P_3); 75 -150 x 45 cm (P_4) in main plot, and 5 integrated nutrient management treatments (F_1=100 % RDF 120:60:60 NPK kg/ ha + 25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron (0.1%) ; F_2 = (50%) RDF + (50%) FYM+25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron (0.1%) ; F_3= (50%) RDF + (50%) vermicompost +25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron (0.1%); F_4=(50%) RDF + (50%) sunnhemp incorporation +25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron (0.1%) ; F_5= split application of N_6Urea 15 days interval with basal soil application of P and K 25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron (0.1%).

RESULTS AND DISCUSSION

Effect of planting geometry :

Yield attributes : Yield attributing characters and seed cotton yield presented in Table 1 the and the results are revealed that number of picked bolls/plant and seed cotton yield/plant (g) recorded significantly highest with 120X45 cm(normal planting) than rest of the other planting geometries. However it was found *on par* with 60-120 x 60 cm (paired planting) during second year and during both years of experimentation in seed cotton yield/ plant our findings are conformity with Bhalerao and Gaikwad(2010**)**. Among integrated nutrient management treatments the application of 100 per cent RDF 120:60:60 NPK kg/ha + 25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron @ 0.1 per cent recorded significantly highest picked bolls/plant and seed cotton yield/plant (g) than rest of the INM treatments. However it was found *at par* with 50 per cent inorganic + 50 per cent FYM+25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron @ 0.1 per cent substantial increase in various growth attributes plant height, sympodial branches/plant, functional leaves, leaf area/plant and dry matter its subsequent translocation towards sink and finally it improve the yield attributing characters. Similar observation reported by Aruna and Reddy (2009).

Seed cotton yield :seedcotton yield was found highest with plant geometry of 120 x 45 cm (P_1) during both the years of experimentation and in pooled analysis. Wider row spacing 75-150 cm with closer plant spacing of 45 cm (P_4)

Table 1. Pooled mean of 2011-12 to 2012-13 , yield attributing characters, seed cotton yield, net monetary returns and benefit cost ratio as influenced by planting geometries and integrated nutrient management.

Treatments	Seed cotton yield/plant (g)		Picked bolls/ plant		Boll weight (g)		Seed cotton yield (kg/ha)			NMR			Benefit cost ratio		
Plant geometry (cm)	2011-2012	2012-2013	2011-2012	2012-2013	2011-2012	2012-2013	2011-2012	2012-2013	**Pooled**	2011-2012	2012-2013	**Pooled**	2011-2012	2012-2013	**Pooled**
P_1-120 x 45	98.46	93.15	29.48	27.26	3.65	3.56	1732	1628	**1680**	48373	43900	**46136**	2.47	2.32	**2.40**
P_2-45-90 x 75	90.71	80.87	23.50	23.20	3.50	3.50	1508	1466	**1487**	39608	32901	**36255**	2.22	1.98	**2.10**
P_3-60-120 x 60	95.58	89.82	27.34	25.33	3.59	3.54	1663	1556	**1609**	48931	39468	**44199**	2.53	2.18	**2.36**
P_4-75-150 x 45	93.63	84.63	25.28	24.53	3.53	3.52	1621	1486	**1554**	45772	35206	**40489**	2.41	2.05	**2.23**
SE +	1.49	1.37	0.67	0.78	0.02	0.05	39.02	30.11	**29.71**	1417	1492	**1312**	-	-	**-**
CD (p=0.05)	4.46	4.10	1.99	2.31	0.07	NS	115.95	89.46	**88.27**	4207	4433	**3899**	-	-	**-**
Integrated nutrient management															
F_1(100%RDF)	101.40	100.05	30.04	29.28	3.70	3.60	1772	1713	**1743**	55761	48494	**52128**	2.73	2.49	**2.61**
F_2(50%RDF+50%FYM)	98.12	96.18	28.22	26.96	3.61	3.59	1693	1628	**1661**	49024	41571	**45297**	2.45	2.20	**2.33**
F_3(50%RDF+50%V.C)	91.56	79.35	25.40	23.61	3.52	3.50	1579	1471	**1525**	44479	35150	**39815**	2.37	2.06	**2.21**
F_4(50%RDF+GM)	87.08	71.54	22.57	20.11	3.42	3.39	1465	1325	**1395**	36514	26369	**31442**	2.13	1.80	**1.97**
F_5(Split application of N_6)	94.01	87.12	26.08	25.51	3.60	3.57	1646	1532	**1589**	42577	37758	**40168**	-	-	**-**
SE +	1.76	1.90	1.17	0.90	0.02	0.007	43.96	60.93	**61.57**	2912	2330	**2551**	-	-	**-**
CD (p=0.05)	5.20	5.58	3.49	2.68	0.06	NS	130.62	181.92	**182.9**	8651	6925	**7580**	-	-	**-**
Interaction effect															
SE+	2.25	2.19	2.27	1.80	0.004	0.019	76.15	105.62	**106.63**	5043	4036	**4419**			
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	**NS**	14983	NS	**NS**			
Grand mean	**94.06**	**86.97**	**26.43**	**25.12**	**3.57**	**3.53**	**1627**	**1531**	**1583**	**45671**	**37869**	**41770**	**2.41**	**2.13**	**2.27**

was found to reduce the seed cotton yield than normal planting. This might be due to increased evaporation losses leading to reduced moisture availability in wider row spacing as well as lowest picked bolls/plant,boll weight and seed cotton yield/plant. Plant geometry 120 x 45 cm recorded (1680 kg /ha) seed cotton yield on pooled mean basis and was at par with 60-120 x 60 cm paired row planting during both the years andpooled mean also (1609 kg /ha), similar findings were observed by several workers Bhaleraoet *al* (2008) Rao and Shetty (2008). Among INM treatments the applications of (F_1) 100 per cent RDF 120:60:60 NPK kg/ha + 25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron @ 0.1 per cent, (F_2) 50 per cent inorganic + 50 per cent FYM + 25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron @ 0.1 per cent and (F_5) split application of N_6 @ 15 days interval with basal soil application of p and k 25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron @ 0.1 per cent they were equally producing seed cotton yield kg/ha during both the year of experimentation and pooled analysis data also it might be due to application of micronutrient and foliar spray of boron and its higher nutrient uptake resulting in various growth attributes *viz.,* plant height, sympodial branches/plant, functional leaves, leaf area, dry matter accumulation and its subsequent translocation towards sinks. The cumulative effect of higher nutrient application finally might have reflected in yield attribute *i.e.* bolls/plant, seed cotton yield/plant boll weight and finally increased seed cotton yield (kg/ha) Similar findings were observed with Srinivasulu and Hema (2007) and Narayana *et al.,* (2011).

Table 2. Interaction effect of planting geometry and integrated nutrient management on Net monetary return (Rs/ha) during 2011-2012

Planting geometry	Integrated nutrient management				
	F1	F2	F3	F4	F5
P_1	63174	56643	50520	41536	29992
P_2	48050	39184	37923	31683	41203
P_3	58174	51700	45731	37543	51507
P_4	53647	48569	43743	35296	47606
SE			5043		
CD (p=0.05)			14983		
GM			45671		

Economics : The net monetary returns influenced by plant geometries and integrated nutrient management were differed significantly by plant geometries 120 x 45 cm (P_1) recorded highest net monetary return and B:C ratio (46136 Rs/ha) and (2.40) respectively and it was found *on par* with 60-120 x 60 cm during both the years and pooled data . paired row planting of (P_3) and (P_4) were found significantlysuperior to (P_2) for monetary returns. This might be due to lower plant population as compared to other planting geometry ultimately there is lower yield with 45-90 x 75 cm plant geometry than other treatments (Phogat*et al* ., 2010).Among integrated nutrient management treatments NMR were found significantly highest with the application of 100 per cent RDF 120:60:60 NPK kg/ha + 25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron @ 0.1 per cent (52128 Rs/ha) with highest B:C ratio (2.61) than rest of the other INM treatments.However it was found *on par* with RDF 50 per cent inorganic + 50 per cent FYM+25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron @ 0.1 per cent during both the years and pooled data. The integrated nutrient management treatments (F_2), (F_3) and (F_5) found *at par* with each other and significantly superior over (F_4) this was due to higher yield

with the 100 per cent RDF of rainfed *Bt* cotton along with application of micronutrient and two foliar sprays of boron , that directly assimilate and available to plant hence its converted in to higher yield and stalk yield ultimately higher net monetary returns. Similar findings reported by Narayana *et al.,* (2011) and Gokhale *et al.,* (2011).

Interction effect: The interaction effect of planting geometry with integrated nutrient management were found non significant for yield attributing characters, seed cotton yield during both years in pooled also. But the inter action effect with NMR showed significant impact observed from Table 2. that the interaction effect (P_1F_1) planting geometry 120 x 45 cm with the application of 100 per cent RDF (120:60:60 NPK kg/ha) + 25 kg $ZnSO_4$+ 20 kg $FeSO_4$ + two foliar sprays of boron @ 0.1 per cent recorded the significantly highest net monetary returns of 63174 Rs/ha and it was significantly superior over all rest of the treatment combinations. However it was found *at par* with P_1F_2, P_1F_3,P_3F_1,P_3F_2, P_4F_1,P_4F_2 and P_3F_5 .

REFERENCES

Aruna, E. and Reddy, B.S. 2009. Response of *Bt* cotton to plant geometry and nutrient combination. *Indian J. Agric. Res.*, **43 :** 206-10

Bhalerao, P.D., Gawande, P.P., Ghatol P.U. and Patil, B.R. 2008. Performance of *Bt* cotton hybrids for various spacing under rainfed condition. *Agric. Sci. Digest*, **28 :** 54-56.

Bhalerao, P.D. and Gaikwad, G.S. 2010. Productivity and profitability of *Bt* cotton (*G. hirsutum*) under various plant geometry and fertilizer levels. *Indian J. Agron.*, **55:** 60-63.

Gokhale, D.N., Shinde, V.S., Gadade, G.D., Sawargaonkar, G.L. and Zade, K.K. 2011. Sustaining rainfed *Bt* cotton (*G. hirsutum* L.) productivity through moisture conservation and integrated nutrient management techniques. *J. Cotton Res. Dev.*, **25 :** 197-201.

Khargkharate, V.K., Pandagale, A.D., Deosarkar, D.B. and Awasarmal, V.B. 2008. Response of *Bt* cotton hybrid under varied plant densities and fertilizer levels. National seminar on *"Second Green Revolution : Necessity Compulsion".* 19-21 Oct., 2008, A.R.S Adilabad, pp. 153

Phogat, V., Satyavan, Dahiya, D.S., Sharma,S.K. and Kumar, Sanjay 2010. Effect of quality irrigation water and plant densities on productivity and economics of upland cotton *J. Cotton Res. Dev.* **24 :** 48-51.

Naryana, E., Aparna D. and Geogre, M. 2011. Response of *Bt* cotton (*G. hirsutum* L.) for integrated rain water and nutrient management. *J. Cotton Res. Dev.*, **25 :** 68-70.

Rao, S. and Setty, R.A. 2008. Performance of hirsutum cotton under different row spacing and fertilizer levels. *J. Cotton Res. Dev.*, **22 :** 176-77.

Srinivasulu, K. and Hema, K. 2007. Effect of integrated nutrient management in enhancing and sustaining cotton (*G. hirsutum* L.) productivity. *J. Cotton Res. Dev.*, **21 :** 218-21.

Received for publication : December 16, 2016
Accepted for publication : May 19, 2018