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Effect of closer spacing in Bt cotton hybrids under rainfed conditions in red chalka soils of Adilabad district of Telangana

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ABSTRACT : A field experiment was conducted both in black cotton and red chalka soils during *Kharif* 2008-09 and 2009-10 seasons in Adilabad district of Telangana at three different locations through farmers participatory mode to find out the response of BG-II cotton hybrids under two different spacings in rainfed conditions. These experiments were carried out by the district Agricultural Advisory and Transfer of Technology Center, Adilabad in collaboration with ATMA project functioning at Adilabad. Three cotton hybrids *viz.*, Mallika BG-II, Rasi BG-II and Paras Brahma BG –II which are most popular among the farmers were sown under two different spacings in different soils. The data revealed that, hybrids did not differ significantly in plant height, number of sympodial branches/plant, number of bolls/plant, boll weight and kapas yield in both the years of testing and also in both the soils. But, spacings had significantly influenced number of bolls/plant, boll weight and kapas yield. However, interaction effect was significant only for plant height. Closer spacing of 60 x 60 cm in red chalka soils (2033 and 2253 kg ha^{-1}) gave significantly higher kapas yield than wider spacing of 90 x 90 cm (1500 and 1863 kg ha^{-1}) during both the years of investigation, respectively. Thus, it is concluded that Bt hybrids need to be planted with higher plant density to realize good yields.

KEY **W**ORDS : Closer spacing, Rainfed condition, Bt cotton hybrids

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Cotton is an important fibre crop, which is cultivated in more than 80 countries of the world and play a key role in economic and social affairs of the farming community. In India, nearly 65 per cent of the cotton crop is grown under rainfed conditions on a variety of soils ranging from well drained deep alluvial soils in the north to black clayey soils of varying depth in central region and in black and mixed black and red soils in south zone. Cotton is semi-tolerant to salinity and sensitive to water logging and thus, prefers well- drained soils (Revolution in Indian Cotton, 2009). Cotton cultivation in Adilabad district of A.P has gone up after the introduction of Bt cotton hybrids and is presently grown in an area of about 2.794 lakh hectares (2010-2011) mainly due to the Bt cotton, genetically modified to make insecticidal protein(s) from the soil bacterium *Bacillus thuringiensis* was first commercialized in 2002 against bollworms, Bt cotton spread rapidly, resulting in greatly increased productivity and reduced insecticide use (APCoAB, 2009).

Cotton is one of the most important commercial crop grown in the district for the last 50 years under rainfed conditions. Cotton yields under rainfed ecosystem are low owing to erratic rainfall and hence, the crop suffers from moisture stress during post monsoon season which coincides with flowering and boll development stages. Majority of the farmers in the district do not follow the recommended spacing which is most important agronomic practice under rainfed conditions to get good crop yield. The soils of the district are predominantly black which constitutes about 80 per cent. Cotton is the major commercial crop grown in the district for the last 50 years. Sorghum is the staple food crop followed by paddy. Under rainfed condition soybean, redgram, paddy-irrigated, maize cultivated during *Kharif* season and sorghum, wheat, irrigated paddy, Bengalgram, sesamum, safflower, groundnut etc. cultivated during *Rabi* season. Primitive agriculture with local varieties popularly known as Gourani varieties is still prevailing in remote and tribal villages. For sustainability, farmers are adopting.

Rainfed cotton yields are low owing to erratic and uneven distribution" of rainfall. Rainfed cotton suffers from moisture stress during post monsoon season which coincides with flowering and boll development stages. Majority of the farmers in the district were not following the recommended spacing and not maintaining the optimum plant populations in cotton under rainfed conditions and getting poor crop yields. In order to provide a base line data on the performance of Bt cotton hybrids for various spacing under rainfed condition in red chalka soils,the present study was taken up in Adilabad district in six different locations continuously two years under District Agricultural Advisory and Transfer of Technology Center which is one of the Agro-technology transfer center of Acharya N.G. Ranga Agricultural University at Adilabad district head quarters to provide updated agriculture information to the farming community.

It is in this context that a systematic study was undertaken to assess the performance of three Bt cotton hybrids in both black cotton (BC) and red chalka soils with two different spacings. Six locations appropriate to farming situation were chosen in the district.

Research Procedure

Location and site characteristic of study area:

Adilabad is Northern most district of Andhra Pradesh situated between 77º 46' and 80º 01' of the Eastern Longitude and 18º 40' and 19º 56' of Northern Latitudes. The altitude is around 2000 meters above mean sea level. It is bounded on north, east and west by Maharashtra state and on south by Nizamabad and Karimnagar districts of Andhra Pradesh. The most important river that flows in the district is the Godavari, which forms the southern boundary of the district. The other rivers include the Penganga, the Wardha and the Pranahita. The Kaddam and the Peddavagu are tributaries of the Godavari.

The experiment was conducted on farmer's fields as farmers participatory approach during *Kharif* 2008-09 and 2009-10 seasons at six locations. An average rainfall of 1093.6 mm in 2008 and 1137.0 mm during 2009 season was received in 55 and 57 rainy days, respectively. The experiment was laid out in split plot design with Bt hybrids as main plots and spacing as sub plots with 7 replications. The main plots were same both in BC soils and red chalka soils. However, spacings varied in subplots. In red chalka soils, treatmental spacing adopted was 60 x 60 cm which is the recommended spacing and was tested against a spacing of 90 x 90 cm, adopted by farmers. Three popular hybrids *viz.*, Mallika BG-II, Rasi BG-II and Paras Brahma BG –II were included and the crop was sown in second fort night of June during both the years of study. Standard crop management practices were adopted to raise a good crop. Observations were recorded on yield attributes and the crop was harvested periodically in three pickings and the yield was recorded.

Research Analysis and Reasoning

There was no significant difference observed among the varieties tested for plant height at harvest, number of sympodial branches per plant, number of bolls per plant and kapas yield (kg ha^{-1}). With regard to boll weight pooled mean over two years indicated that Mallika BG II gave significantly higher plant height (113.7 cm) compared to Raasi BG II (109.7 cm) but it was at par with Brahma BG II (113.5 cm). No significant difference was observed among the varieties tested for number of sympodial branches per plant (Table 1). The number of bolls per plant and boll weight was significantly higher in Mallika BG II (34.0 and 4.61, respectively) and it was at par with Brahma BG II (32.7 and 4.57, respectively). Similarly there was no significant difference among the varieties for seed cotton yield except in 2009-10 where Mallika BG II exhibited significantly highest seed cotton yield of

Table 1: Effect of spacing on number of bolls per plant, boll weight and seed yield of cotton in Red chalka soils *Kharif* 2008-09 and 2009-10

Treatments	Plant height at harvest (cm)			No. of sympodial branches / plant			No. of bolls / plant			Boll weight (g)			Kapas yield (kg/ha)		
	2008-09	2009-10	Mean	2008-09	2009-10	Mean	2008-09	2009-10	Mean	2008-09	2009-10	Mean	2008-09	2009-10	Mean
Main plot - Bt. Hybrid															
Mallika BG II	107.5	120.0	113.7	19.5	20.5	20.0	31.5	36.5	34.0	4.40	4.81	4.61	1755	2140	1948
Raasi BG II	104.5	115.0	109.7	19.5	19.0	19.2	29.5	35.0	32.2	4.41	4.55	4.48	1725	1965	1845
Brahma BG II	110.0	117.0	113.5	18.5	18.5	18.5	31.0	34.5	32.7	4.45	4.70	4.57	1820	2070	1945
Mean	107.3	117.3	112.3	19.2	19.3	19.2	30.7	35.3	33.0	4.42	4.69	4.55	1767	2058	1913
S.E.m±	0.5	2.8	1.5	1.22	0.9	0.63	0.77	0.67	0.54	0.05	0.06	0.03	54.0	53.0	48.0
S.E.d±	0.7	4.0	2.1	1.72	1.27	0.9	1.09	0.95	0.77	0.07	0.09	0.05	76.0	75.0	68.0
C.D. (P=0.05)	1.5	NS	4.5	NS	NS	NS	NS	2.06	1.67	NS	0.18	0.11	NS	163.3	NS
CV (%)	11.2	16.4	13.8	16.8	12.2	14.5	16.6	15.0	15.8	13.3	13.4	13.3	18.1	16.8	17.4
Sub plots - spacing															
1. 60 x 60 cm	110.0	119.7	114.8	18.3	19.0	18.7	29.0	34.0	31.5	4.23	4.61	4.42	2033	2253	2143
2. 90 x 90 cm	104.7	115	109.8	20.0	19.6	19.8	32.3	36.6	34.5	4.61	4.77	4.69	1500	1863	1682
Mean	107.4	117.4	112.3	19.2	19.3	19.2	30.7	35.3	33.0	4.4	4.7	4.6	1767	2058	1913
S.E.m±	1.5	2.8	1.34	1.11	0.93	0.65	0.49	0.78	0.35	0.04	0.05	0.04	40.7	58.9	35.8
S.E.d±	2.2	4	1.89	1.57	1.32	0.91	0.69	1.1	0.49	0.06	0.07	0.06	57.5	83.3	50.6
C.D. (P=0.05)	4.7	NS	3.99	NS	NS	NS	1.46	2.32	1.04	0.13	0.15	1.30	121.0	175.1	106.4
CV (%)	14.8	17.9	16.3	18.8	15.6	17.2	15.2	17.2	16.2	13.1	13.5	13.3	17.5	19.3	18.4
Interactions															
S.E.m±	1.2	2.3	1.1	0.9	0.7	0.5	0.4	0.6	0.3	0.03	0.04	0.03	32.6	47.2	28.7
S.E.d±	1.8	3.2	1.5	1.3	1.1	0.7	0.6	0.9	0.4	0.04	0.06	0.05	46.1	66.8	40.6
C.D. (P=0.05)	3.8	6.8	3.2	NS	NS	NS	NS	NS	NS	0.10	NS	NS	NS	NS	NS
CV (%)	14.8	17.9	16.3	18.8	15.7	17.2	15.2	17.2	16.2	13.1	13.5	13.3	17.5	19.3	18.4

NS= Non-significant

Table 2 : Rainfall of the district during the year 2008-09 and 2009-10

Months	2008-09		2009-10	
	Total rainfall received (mm)	No. of rainy days	Total rainfall received (mm)	No. of rainy days
June	126.3	6	101.2	8
July	220	14	166.5	18
August	378.8	16	185.3	15
September	141.87	4	122.5	5
October	12.2	1	39.6	5
November	14	1	26.4	3
December	0.0	0	-	0
January	0.0	0	16.1	1
February	0.0	0	7.5	1
March	2.0	0	0.8	0
April	0.0	0	0.0	0
May	0.5	0	1.0	0
Total	894.5	42	683.0	56

2140 kg ha^{-1} but it was at par with Brahma BG II (2070 kg ha^{-1}).

Effect of spacing:

Closer spacing of 60x60 cm resulted in significantly higher plant height of 114.8 cm compared to wider spacing of 90 x 90 cm (109.8 cm) (Table 2). Similar results were observed by Rajendran *et al*. (2010). The effect of spacing on number of sympodial branches per plant was non significant during individual years and also mean over two years. As regards number of bolls per plant, boll weight and seed cotton yield the effect of spacing where hybrids in closer spacing had lesser number bolls per plant, lesser boll weight and more kapas yield compared to wider spacing. Similar results were obtained by Bhalerao *et al*. (2010) under rainfed condition.

Interaction effect:

Interaction among the hybrids tested and spacing was non-significant for all the parameters in both the soils except for plant height at harvest in both the soils. Overall, the cotton yields recorded during 2008-09 was comparatively low as compared to 2009-10. Though the quantity of rainfall was high during 2008-09 (894.5 mm with 42 rainy days) might be due to high intensity and uneven distribution. Whereas during 2009-10, though rainfall was comparatively low (683.0 mm with 56 rainy days), its uniform distribution for longer period with low intensity enhanced the yield levels due to high soil moisture conservation in rainfed conditions (Table 2).

Conclusion:

Cotton grown under closer spacing with high dense plantings tended to close canopy earlier and more completely, suppress weed growth and mature earlier than wider spacing. The main advantage of closer spacing in cotton includes lower planting costs, soil moisture conservation in rainfed conditions. Cotton can be grown under wider plant to plant spacing of 90 x 90 and 120 x 90 cm will facilitate cultural and plant protection operations besides reducing the costly seed requirements. This finding suggests that maintenance of closer spacing in rainfed particularly under tropical Indian conditions is more beneficial to the farming community than wider spacing.

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