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Evaluation of commercially available Bt cotton genotypes for their agronomic performance and economic returns*

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Abstract : A field experiment was carried out at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, during *Khari*f 2006-07 to assess the agronomic performance of Bt cotton genotypes and their economic returns. The field trial was laid out in randomized complete block design with total of ten cotton genotypes, including eight Bt cotton hybrids *viz,* MRC-6918 Bt, MRC-6322 Bt, MRC-7351 Bt, RCH-2 Bt, JK-Durga Bt, JK-CH 99 Bt, NCS-207 Bt, and NCS-145 Bt and two non-Bt cotton hybrids, *viz*. DHH-11 and DCH-32. Among the tested genotypes (8 Bt and 2 non-Bt genotypes), JK-CH 99 Bt recorded significantly higher yield (3323 kg/ha) which was on par with JK- Durga Bt (3302 kg/ha), MRC-6322 Bt (3230 kg/ha) and NCS-207 Bt (2927 kg/ha). Bt cotton genotypes given higher monitory returns in the form of BC ratio where it was in the range 2.32 - 4.04 rupee per rupee invested for Bt genotypes.

Key words: Bt cotton, economics, leaf area index, seed cotton oil

Introduction

Cotton is one of the most important commercial crops cultivated in 70 countries of the world with a total coverage of 30.61 million ha. Over one quarter of the world cotton area is in India. Bt cotton replacing more and more conventional cotton area and it is estimated that Bt cotton would cover an area of 13.4 million hectares. The most recent study revealed that yield gain of 31%, a significant reduction in the number of pesticide sprays by 39%, and an 88% increase in profit or an increase of $250 per hectare for the 2004 cotton growing season. Transgenic cotton provided a handy tool to reduce the pest menace. The performance of Bt-cotton varied, from region to region with changing agroclimatic conditions, pest pressure and cropping systems thus, it is necessary to test the validity of Bt technology in prevailing field conditions. Bt cotton is becoming popular among the farming community because of its ability to ward-off bollworm menace. This technology is highly beneficial to the growers and to the environment by reducing chemical insecticide treatments for target pests, increasing crop yields and preserving populations of beneficial arthropods. The introduction of transgenic cotton hybrids and their scope for extensive coverage in India in the coming years, there is a need for evaluating yield and yield components of transgenic cotton varieties. Several Bt cotton genotypes have entered the market with GEAC approval but the yield potential of these genotypes were claimed different by different companies. Thus there is need to ascertain the on - farm yield potentials of these Bt cotton genotypes.

Material and methods

The field experiment was conducted at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka during *kharif* 2006. The soil of experimental site was medium deep black soil. Chilli crop was taken up during *kharif*-2005, while in *rabi* the land was fallow. The experiment consisted of eight commercially available Bt cotton genotypes (hybrids) and two non-Bt cotton hybrids as treatments viz., MRC-6918 Bt, MRC-6322 Bt, MRC-7351 Bt, RCH-2 Bt, JK-Durga Bt, JKCH-99 Bt, NCS-207 Bt, NCS-145 Bt, DHH-11 and DCH-32 and two conventional non-Bt hybrids like. The field experiment was laid out in a Randomized Complete Block Design, with three replications. The land was ploughed once before commencement of experiment with mould board plough and later harrowed twice to bring the soil to fine tilth. The different cotton genotypes were dibbled at 90 cm apart with intra row spacing of 60 cm on 30th June 2006. Two seeds per hill were dibbled to a depth of 4 cm on flat bed. Gap filling was done 10 days after sowing. The 50 per cent of recommended dose of nitrogen and full dose of Phosphorus and Potassium were applied (100:50:50 N: P: Kg ha^{-1}) at the time of sowing and the remaining 50 per cent of N was applied at 30DAS. Biometric observations were recorded on five tagged plants selected randomly in each plot. The data collected from the experiment at different growth stages were subjected to statistical analysis as described by Gomez and Gomez (1984). The level of significance used in 'F' and't' test was P=0.05. Critical difference (CD) values were calculated wherever the 'F' test was found significant.

Results and Discussion

In the present investigation among different genotypes studied, JK-CH 99 Bt produced significantly higher yield (3323.0 kg/ha) which was on par with JK-Durga Bt (3302.4 kg/ha), MRC-6322 Bt (3230 kg/ha) and NCS-207 Bt (2927 kg/ha). The lowest yield was observed in a non-Bt popular hybrid DCH-32 (2122.0 kg/ha). Higher yield/ha is supported by higher per plant yield which ranged between 179.03 g/plant (JK-CH 99 Bt) to 114.81 g/plant (DCH-32). Among Bt genotypes, JK-CH 99 Bt produced 53 per cent higher seed cotton yield and also 53 per cent higher per plant yield when compared with the lowest yielding Bt

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Table1. Seed cotton yields and cotton seed oil content (%) of different cotton genotypes.

Genotype	Seed cotton yield		
	(kg/ha)	(g/plant)	Cotton seed oil %
MRC-6918 Bt	2163.5	116.6	15.30
MRC-6322 Bt	3230.4	174.4	16.20
MRC-7351 Bt	2762.3	149.0	15.30
RCH-2 Bt	2798.5	151.2	14.10
JK-Durga Bt	3302.4	178.7	15.61
JK-CH 99 Bt	3323.0	179.0	14.80
NCS-207 Bt	2962.9	159.7	14.40
NCS-145 Bt	2685.1	144.8	16.60
DHH-11	2335.3	126.2	15.80
DCH-32	2122.4	114.8	14.50
Mean	2768.6	149.4	15.26
SEm±	130.1	7.0	0.11
CD at 5%	386.6	20.9	0.34

genotype MRC-6918 (2163.5 kg/ha) (Table 1).

The yield advantage of Bt genotypes JK-CH 99 Bt to the extent of 56.6 per cent over DCH-32 and 42.7 per cent over DHH-11 noted in the present investigation explicitly supports the superiority of Bt cotton cultivation over non-Bt ruling hybrids. The results obtained are similar to the findings of Halemani *et al.* (2004) who indicated 36-80 per cent yield advantage of Bt genotypes over non-Bt genotypes DCH-32 and DHH-11. Hallikeri *et al.* (2004) also reported 88 -112 per cent yield advantage of Bt genotypes over non-Bt DHH-11 and NHH-44 genotypes. Comparison within Bt genotypes in the present study has shown greater variations (1-53 %) yield advantage among different tested Bt genotypes which is significantly higher than studies of Hallikeri *et al.*, 2004 and Halemani *et al.*, 2004 who reported (14 %) and (2-10%) yield advantage respectively among the tested Bt genotypes.

The main yield contributing factor in the cotton is sympodial branches which were found significantly higher in JK- Durga Bt. As compared to non-Bt DCH-32 and DHH-11 genotypes it produced 43.2 and 42.6 per cent higher number of sympodial branches respectively (Table 2). Hallikeri *et al.* (2004) also noted 10 per cent higher number of sympodial branches in Bt genotypes than non-Bt DHH-11. The significant difference noted in sympodial branches may be due to genetic potential of a genotype to produce fruiting branches. Similar results obtained with respect to monopodial branches where JK-Durga Bt recorded significantly higher number of monopodial branches (3.80). However lowest number of monopodial branches were recorded with MRC-6918 Bt (2.80) (Table 2). LAI an another

Table 2. Monopodial branches, sympodial branches, leaf area index (LAI) and dry matter production of different cotton genotypes

Gentypes	Monopodial/pl	Sympodial/pl	Leaf area at harvest dm^2 /pl	LAI at harvest	Dry matter accumulation (g/pl) at harvest			Total in plant
					In stem	In leaves	In reproductive parts	
MRC-6918 Bt	2.80	18.73	131.36	2.26	89.26	90.20	113.58	292.24
MRC-6322 Bt	3.13	22.27	129.09	2.22	90.30	96.45	116.41	304.66
MRC-7351 Bt	3.07	19.67	129.62	2.24	87.45	90.95	116.41	287.90
RCH-2 Bt	3.00	21.33	118.25	2.04	86.46	79.87	110.62	276.29
JK- Durga Bt	3.80	24.53	136.16	2.36	96.85	96.85	123.07	310.95
JK-CH 99 Bt	3.13	21.80	117.56	2.01	87.16	90.10	123.61	300.21
NCS-207 Bt	3.00	21.20	121.47	2.11	86.09	86.15	114.80	286.38
NCS-145 Bt	3.00	20.33	116.97	2.02	84.70	82.85	97.90	264.78
DHH-11	3.07	17.20	117.36	2.05	76.60	81.49	100.43	257.86
DCH-32	1.73	9.20	121.156	2.10	82.76	85.40	85.40	274.21
Mean	3.11	20.42	123.94	2.14	86.24	88.03	112.36	285.55
SEm±	0.11	0.93	5.38	0.10	1.83	2.16	2.34	4.11
CD at 5%	0.32	2.77	15.97	0.29	5.45	6.41	6.95	12.21

Table 3. Cost involvement and economic advantage in cultivation of different Bt cotton hybrids

Genotypes	Total cost of cultivation (`/ha)	Gross return (`/ha)	Net returns (`/ha)	B:C
MRC-6918 Bt	14780	49099	34319	2.32
MRC-6322 Bt	14780	72560	57780	3.91
MRC-7351 Bt	18530	62054	43524	2.35
RCH-2 Bt	14780	62846	48066	3.25
JK- Durga Bt	14780	74144	59364	4.02
Jk-CH 99 Bt	14780	74546	59766	4.04
NCS-207 Bt	14780	66574	51794	3.50
NCS-145 Bt	14780	59560	44780	3.03
DHH-11 Non Bt	12280	52510	40230	3.28
DCH-32 Non Bt	12280	49064	36784	3.00

important growth parameter also varied significantly and the highest LAI was found in JK- Durga Bt which was 12.4 per cent and 15.1 per cent higher than the DCH-32 and DHH-11, respectively. Among Bt genotypes, variation falls in the range of 4-17 per cent (Table 2). Total dry matter production was also found to be the highest in JK- Durga Bt (310.95 g/plant) which was 13 per cent and 20 per cent higher than DCH-32 and DHH-11, respectively, (Table 2). Among Bt genotypes, variation falls in the range of 2-17 per cent. The results are similar to the results of Hallikeri *et al.* (2004) who reported 13-20 per cent higher dry matter in Bt genotypes than in non-Bt genotypes.

Cotton seed oil content varied significantly among different genotypes. Oil percentage values ranged from 14.10-16.60 per cent. NCS-145 Bt produced significantly higher oil percent (16.60%) which was 5 and 14 per cent higher oil yield than in DHH-11 and DCH-32 respectively. The lowest oil content was noted with RCH- 2 Bt (14.10%) and the highest yielding JK-CH 99 Bt carried 14.80 per cent oil (Table 1). The results are comparable with the study of Gambhir *et al.* 1997 who also used NMR method for oil content estimation and reported seed oil content in the range of 13.4-25.2% for acid delinted cotton seeds.

Economics of Bt cotton cultivation noted in the study indicate that the total cost of cultivation was maximum for Bt when compared to non-Bt (Table 3). JK-CH 99 Bt recorded significantly higher gross returns (74546 ` /ha) and was followed by JK-Durga Bt (74144 ` /ha), MRC-6322 Bt (72560 ` /ha) and NCS-207Bt (66574 ` /ha). Similar trend was also found in net returns where JK-CH 99 Bt has given (59766 ` /ha) followed by JK-Durga Bt (59364 ` /ha), MRC-6322 Bt (57780 ` /ha) and NCS-207Bt (51794 ` /ha). BC was in the range 2.32 – 4.04 rupee per rupee invested. Similar results were reported by Patil *et al.* (2004) who obtained higher economic returns with Bt genotypes. The results of the present investigation clearly indicated the adoptability of all Bt hybrids for Dharwad region under rainfed condition.

References

Gambhir, P. N. and Moharir, A. V., 1997, NMR analysis of seed oil content in ginned and acid-delinted samples of certain diploid and tetraploid cotton cultivars. J. Indian Soc. Cotton Improv.,1997 : 38-40

Gomez, K. A. and Gomez, A. A., 1984, Statistical Procedures for Agricultural Research, Edition 2, John Willey, New York, p. 693.

Halemani, H.L., Hallikeri, S.S., Nandagavi, R.A. and Nooli, S.S., 2004, Performance of Bt cotton hybrids at different levels of fertilizers under protection irrigation. In : *Int. Symp. Strat. Sust .Cotton Prodn.* – A Global Vis. UAS, Dharwad, November 23-25, pp. 153-155.

Hallikeri, S.S., Halemani, H.L., Nandagavi, R.A. and Nooli, S.S., 2004, Response of Mahyco Bt cotton hybrids to levels of fertilizer under protective irrigation. In : *Int. Symp. Strat. Sust. Cotton Prodn. – A Global Vision,* UAS, Dharwad, November 23-25, pp.139-141.

Hegde, M., Nidagundi, J.M., Biradar, D.P., Udikeri, S.S. and Khadi, B.M., 2004, Performance of Bt and non-Bt cotton hybrids against insect pests under irrigated condition. In: I*nt. Symp. Strat. Sust. Cotton. Prodn. – A Global Vision,* UAS, Dharwad, November 23-25, pp.143-145.

Patil, B.V., Bheemanna, M., Hanchinal, S.G. and Kengegowda, N., 2004, Performance and economics of Bt cotton cultivation in irrigated ecosystem. *In : Int. Symp. Strat. Sust. Cotton Prodn. – A Global Vision,* UAS, Dharwad, November 23-25, pp. 139-142.