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Reaction of Bollgard II Genotypes Against Non-target Insects of Cotton Eco-system

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ABSTRACT

Field experiment was conducted at the Regional Agricultural Research Station, Lam to find the reaction of cotton bollgard genotypes *viz.,* Brahma BG (*Cry*1Ac), Brahma BG-II (*Cry* 1Ac + *Cry* 2Ab), Atal BG-II, Tulasi BG, Tulasi BG-II, along with Tulasi non-*Bt* and local variety L-788 against non-target insect pests. The lowest incidence of leafhoppers was recorded on Brahma BG (3.78 leafhoppers three leaves^{-1}), and the highest incidence was recorded in non-*Bt* genotype L-788 (5.09 leafhoppers three leaves^{-1}) with significant differences among the genotypes. The incidence of thrips and whiteflies were low during the season. Lower population of spiders and coccinellids were observed during the season.

Key words : Bollgard II genotypes, Cotton, Non-target insect pests

Cotton (*Gossypium hirsutum* L.) is an important cash crop grown in India. The loss in cotton yield is mainly attributed to bollworm complex followed by sucking insect pests. Transgenic cotton incorporating *Cry*1Ac gene derived from *Bacillus thuringiensis* (*Bt*) is one of the most exciting advances made in cotton pest management in recent times. Bollgard II - double gene cotton technology has two *Bt* proteins, *Cry* 1 Ac and *Cry* 2 Ab. Bollgard II provides season long control of key lepidopteran pests including *S. litura.* Combining the *Cry* 2 Ab protein with the *Cry* 1Ac is also expected to delay the development of lepidopteran resistance to *Cry* 1 Ac protein. Bollgard-II was released commercially in India in 2005.

Bollgard II was found to have superior levels of insecticidal activity compared to Bollgard and in particular to augment the late season insect control (Akin *et al*., 2001; Jackson *et al*., 2002). The dual gene technology is being considered as an improvised pest management method not just for its enhanced efficacy, but also as an efficient resistance management strategy.

Bt-Cotton is not toxic to any of the sucking pests of cotton, since the donor Coker 312 is known to be highly susceptible to sucking pests such as leafhoppers and thrips, the hybrids showed slightly enhanced susceptibility to these pests, especially if the recurrent parent did not posses inherent resistance. The *Bt* cotton containing Cry 1Ac is only moderately toxic to leaf eating caterpillar *S. litura*. It is known that the use of synthetic pyrethroids has significant negative impacts on the populations of *S. litura* and several other miscellaneous bugs such as the mirid bugs, *Creontiodes biseretence* (Distant). Reduced use of pyrethroids and several conventional insecticides on *Bt*-cotton is expected to result in the increase of several non-target species.

MATERIAL AND METHODS

Experiment was laid out at Regional Agricultural Research Station, Lam during the *kharif* season 2008-09 with *Bt* cotton hybrids *viz*., Brahma BG (Cry1Ac), Brahma BG-II (Cry 1Ac + Cry 2Ab), Atal BG-II, Tulasi BG, Tulasi BG-II, Tulasi non-*Bt* and local variety L-788. The experiment was laid in Random Block Design (RBD) with three replications. The crop was maintained by following the recommended agronomic practices from time to time and the field was kept under unsprayed condition. The population of non-target pests *viz*., leafhoppers, aphids, whiteflies and thrips were recorded from three leaves one each from top, middle and bottom canopies of the five randomly selected plants per treatment in each replication. The natural enemies population comprising spiders and coccinellids was also recorded on whole plant basis per replication and expressed as mean numbers per ten plants.

RESULTS AND DISCUSSIONS

Non Target pests

The incidence of non target pests (sucking pests) was recorded from 36th standard week (3-9 Sept.) to 42nd standard week (15-21 Oct.).

Table 1. Incidence of sucking pests observed on different cotton cultivars during *kharif,* 2008-09

Treatments	Sucking pests (No/ three leaves/ plant)			
	Aphids	Leafhoppers	Thrips	Whiteflies
T1. Brahma BG	4.92 (2.42)*	3.78 (2.18)	8.58 (3.08)	0.35 (1.16)
T2. Brahma BG II	3.95 (2.22)	4.17 (2.27)	8.69 (3.11)	0.58 (1.25)
T3. Atal BG II	4.56 (2.35)	3.98 (2.23)	9.15 (3.18)	0.41 (1.18)
T4.Tulasi BG	5.22 (2.49)	4.04 (2.24)	8.46 (3.07)	0.5 (1.22)
T5. Tulasi BG II	5.42 (2.53)	4.14 (2.26)	8.24 (3.03)	0.5 (1.22)
T6. Tulasi non-*Bt*	4.72 (2.39)	4.39 (2.32)	7.92 (2.98)	0.42 (1.19)
T7. L-788 non-*Bt*	3.91 (2.21)	5.09 (2.46)	6.27 (2.68)	0.67 (1.29)
F-Test	NS	Sig	NS	Sig
S.Em±	0.11	0.07	0.14	0.03
CD (P=0.01)	NS	0.15	NS	0.06
CV%	5.9	3.8	5.7	3.1

*Figures in the parenthesis are square root transformed values.
Significant at 5% level of probability.

Table 2. Incidence of natural enemies on different cotton cultivars during *kharif*, 2008-09.

	Natural enemies 10 plants^{-1}	
Treatments	Spiders	Coccinellids
T1. Brahma BG	1.51 (1.56)*	0.69 (1.29)
T2. Brahma BG II	1.78 (1.66)	0.21 (1.10)
T3. Atal BG II	1.62 (1.60)	0.80 (1.33)
T4. Tulasi BG	1.19 (1.47)	0.23 (1.10)
T5. Tulasi BG II	1.52 (1.58)	0.32 (1.14)
T6. Tulasi non-*Bt*	0.76 (1.32)	0.23 (1.10)
T7. L-788 non-*Bt*	1.65 (1.62)	1.49 (1.55)
F-Test	NS	Sig
S.Ed±	0.142	0.110
CD(P=0.01)	NS	0.241
CV%	11.3	10.9

*Figures in the parenthesis are square root transformed values.
Significant at 5% level of probability

1. Aphid, *Aphis gossypii* Glover:

The aphid incidence was low with a mean aphid population of 3.91 three leaves^{-1} to 5.42 three leaves^{-1} and the population did not differ significantly among the treatments. Minimum incidence in non-*Bt* cotton L-788 and maximum incidence in Tulasi BG II (Table 1) was recorded. The weekly data on aphid incidence revealed that it never crossed ETL (30 three leaves^{-1}) during the season. In all the treatments the peak incidence was recorded during 38th standard week (17-23 Sept.) thereafter the population declined abruptly and continued till 42nd standard week (Table1.)

The present findings corroborate with Bambawale *et al*. (2004) who reported non significant difference between *Bt* and non-*Bt* versions in relation to incidence of aphids. AICCIP (2007-08, 2008-09) also indicated that there was no significant difference in the incidence of sucking pest population between *Bt* and non-*Bt* genotypes. Prasad Rao *et al.* (2007) also reported non significant difference in the incidence of sucking pest population between *Bt* and non-*Bt* genotypes.

2. Leafhopper, *Amrasca devastans* Distant:

The leafhopper incidence was severe with a mean leafhoppers population ranging from 3.78 three leaves^{-1} to 5.09 three leaves^{-1} and was significantly differs among the treatments. Lowest leafhopper incidence of 3.78 per three leaves was recorded in Bramha BG and it is at par in all other treatments except in L-788 which recorded highest incidence of 5.09 hoppers per three leaves. Weekly data revealed that leafhopper was active in all the treatments from 37th standard week (10 - 16 Sept.) to 40th standard week (1 - 7 Oct.) thereafter the population level decreased. No significant differences among leafhopper populations were observed among different Bollgard and Bollgard II genotypes indicating Tulasi BG, Tulasi BG II and Tulasi non-*Bt* reacted similarly to the jassid incidence. These differences mainly due to intrinsic tolerance of original hybrids against leafhoppers and susceptibility of L-788 to leafhoppers.

The present findings are in accordance with Abro *et al*. (2004) who reported that the population of leafhoppers in *Bt* cotton was below ETL and at par with non-*Bt* cotton hybrids. Vennila *et al.* (2004) tested five *Bt* hybrids, out of which only 134 *Bt* was relatively tolerant to leafhoppers and on par with the tolerant conventional hybrid NHH 44.

3. Thrips, *Thrips tabaci* Lind. :

The thrips incidence was low during the season and mean thrips population ranged from 6.27 three leaves^{-1} to 9.15 three leaves^{-1} with no significant differences among the treatments. Minimum incidence was recorded in non-*Bt* cotton, L-788 and maximum in *Bt* cotton genotype, Atal BGII. The weekly data on thrips incidence revealed that the pest never crossed ETL (30 three leaves^{-1}) during the season. In all the treatments peak incidence was recorded during 36th (3-9 Sept.) to 38th standard week (17-23 Sept.) afterwards population declined and remained low till 42nd standard week.

The present findings are in agreement with Lakshmi Sowjanya (2008) and Prasad *et al.* (2008) who reported non significant differences between *Bt* and *NBt* hybrids with respect to thrips population.

4. Whitefly, *Bemisia tabaci* (Gennadius):

The whitefly incidence was very low during the season and the mean whitefly population ranged from 0.35 / three leaves to 0.67 / three leaves and was significantly different among the treatments. Lowest whitefly population of 0.35 per three leaves was recorded in Bramha BG and it is significantly at par with Atal BG II (0.41), Tulasi non-*Bt* (0.42), Tulasi BG (0.5) and Tulasi BG II (0.5). Highest population was recorded in non-*Bt* cotton L-788 (0.67 / three leaves) Weekly data revealed that whitefly was not active in all the treatments during the season

The present findings are in accordance with Bambawale *et al*. (2004) who reported the lowest incidence of whiteflies in *Bt* hybrids compared to non-*Bt* hybrids. However, Cui and Xia (2000) reported that an increase in the population of whiteflies in *Bt* cotton over non-*Bt* genotypes. Long *et al.* (2005) and Jeyakumar *et al.* (2008) also reported that whitefly incidence was more in certain *Bt* hybrids than that of non-*Bt* hybrids.

Incidence of Natural enemies

The incidence of natural enemy populations like spiders and coccinellids were recorded. Incidence was recorded from 36th to 42nd standard week which corresponds to 3 - 9 September to 15 - 21 October.

1. Spiders

The number of spiders recorded was low during the season and ranged from 0.76 to 1.78

per ten plants with no significant difference among the treatments. Lowest population per ten plants was recorded in non-*Bt* Tulasi and highest population of 1.78 was recorded in *Bt* genotype Bramha BG II (Table 2). Weekly data revealed that spider population peaked during 41st standard week (8 - 14 October)

The present findings are in consonance with Basavaraja *et al*.(2008) who reported that there was no effect of *Bt* cotton cultivation on the predatory population of cotton insect pests. Prasad *et al*. (2008) also reported that the incidence was almost similar in both *Bt* and non-*Bt* hybrids, which revealed that the *Bt* cotton hybrid had no adverse effect on the predatory fauna. Lakshmi Sowjanya (2008) also reported that the population of natural enemies was more or less similar in stacked *Bt*, *Bt* and their corresponding non-*Bt* hybrids.

2. Coccinellids:

The number of coccinellids recorded was also low during the season and ranged from 0.21 to 1.49 per ten plants with significant differences among the treatments. Highest number of coccinellid population per ten plants was recorded in non-*Bt* genotype L-788 which is significantly at par with *Bt* cotton Atal BGII. Bramha BG recorded 0.69 coccinellids per ten plants which is significantly at part with all other treatments except L-788 (Table 2). The weekly data revealed fluctuations in coccinellid populations during the season. Peak population of 1.70 per ten plants was recorded in L-788 during 39th standard week (24-30 Sept.) later on population was declined . Though, significant differences were observed among the treatments, no clear cut trend was observed between *Bt* and non-*Bt* hybrids. However, Hargety *et al. (*2005) reported that coccinellid population was consistently high in *Bt* cotton hybrids compared to non-*Bt* cotton hybrids. These differences in observations may be due to variation in pest incidence and prevailing climatic conditions during the period of study.

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