Laboratory assay in the management of spotted bollworm, *Earias vittella* (Fab.) (Noctuidae : Lepidoptera) on transgenic *Bt* cotton

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ABSTRACT

Insect pests are the major problem in cotton production. Among the pests, bollworm complex is very serious throughout the country and it poses a serious threat to cotton cultivation in many agro- ecological zones. The present study was undertaken to evaluate the efficacy against the spotted bollworm, *Earias vittella* (Fab.) which is predominant in most of the cotton growing areas all over the world. The experiment was conducted with neonates and third instar of the spotted bollworm on squares and bolls of Bt cotton cultivars namely MECH 162 *Bt* ,MECH 184 *Bt*, RCH2 *Bt* along with check varieties MCU7 and SVPR3.The percentage mortality on squares and bolls under laboratory conditions was observed. On square basis, at 65 DAS, RCH2 *Bt* recorded (96 %) a higher percentage mortality followed by MECH 162 *Bt* (93.33 %) and MECH 184 *Bt* (89.33 %) compared to their *NBt* counterparts and check varieties MCU7 and SVPR3. Significantly higher percentage mortality was observed in *Bt* hybrids at 80, 95 and 110 DAS. On boll basis, RCH2 *Bt* recorded a higher percentage mortality, 29.41 and 33.00 percent followed by MECH 162 *Bt* (22.08 and 22.07 %) and MECH 184 *Bt* (18.33 and 11.07 %) at 128 and 143 DAS respectively compared to their *NBt* counterparts and check varieties. The highest per cent mortality was recorded in RCH2 *Bt* followed by MECH 162 *Bt* and MECH 184 *Bt* on square and boll basis. All the *Bt* varieties recorded higher per cent mortality compared to their check varieties. It was concluded that RCH2 *Bt* (93.67% and 29.37%) was more effective against the spotted bollworms, *E. vittella* compared to the other cultivars.

Key words : *Earias vittella*, crop pest, management, *Bt* cotton

INTRODUCTION

Cotton is an important commercial crop in tropics and subtropics. It is attacked by as many as 1326 species of insects throughout the world (Hargreaves, 1948; Manjunath, 2004). Among the pests, bollworm complex is very serious throughout the country and pose a serious threat to cotton cultivation in many agro-ecological zones (Uthamasamy, 1994; Deore *et al.*, 2010) update the reference). To reduce the damage more than 70 per cent of the insecticides is applied for the management of bollworm alone. Application of insecticides to manage the insect pests has resulted in the resurgence, resistance of the target insect pests. Transgenic *Bt* cotton technology is probably one of the most exciting advances in cotton pest management in recent times. Bt transgenic plants incorporating Cry IAC genes are known to be toxic to *Helicoverpa armigera* (Hub.), *Pectinophora gossypiella* (Saunders), *Earias vittella* (Fab.) and *Earias insulana* (Boisd.) (Jeff Whitworth *et al.*, 2010). In India, "Bollgard" Bt gene (Perlak *et al.*, 1990) of Monsanto was introduced into the Indian Cotton hybrids developed by MAHYCO (Maharashtra Hybrid Seed Company Ltd.,) Jalna, India appears to be the first transgenic crop. Govindan *et al.* (2010) reported that among the *Bt* cotton evaluated, RCH2 *Bt* top fully opened leaves showed highest mortality of third instar larvae of *Spodoptera litura larvae* followed by squares, middle leaves and young green bolls observed at 168 hours after treatment followed by RCH 515Bt. Previous work available in this line of interest is very meager. It becomes imperative to test the efficacy by the way of conducting laboratory experiments on the ability of cotton cultivars to control *Earias vittella* population. The present study was undertaken to test the efficacy under laboratory condition against the spotted bollworm, *E. vittella.*

MATERIALS AND METHODS

Bt cotton against the bollworms was evaluated under laboratory conditions and compared with *NBt* cotton along with check varieties like SVPR3, MCU7, The *Bt* cotton

includes the hybrids from MAHYCO, Jalna and Rasi seeds Pvt.Ltd, Tamil Nadu, India.

Culture of insect

To get healthy, homogenous and disease free culture of the insect, initially *E. vittella* larvae were collected from the normal cotton plants and reared on bhendi fruits. The bhendi fruits were cut into small bits of about 5-6cm and kept in plastic containers (size 20cm height and 17cm diameter). The larvae were allowed to feed on bhendi fruits continuously without any disturbance and allowed for pupation. The pupae were collected and kept in earthern pots for adult emergence. The sexing is difficult because the pupae are covered by dirty white cocoon. The pots were covered with sterile black muslin cloth which served as an oviposition substrate. After emergence, the moths were allowed to feed on 10 per cent honey solution provided in a small penicillin vial with absorbent cotton dipped in it. Oviposition commenced from the second day after mating and the egg cloths were replaced every alternate day as well as any dead moths if any were removed. The egg cloths thus collected were kept in plastic containers and incubated inside an air-conditioned room at 27 ± 1^0C temperature. The neonate larvae after emerging (3 - 4 days) were taken out of the plastic container and transferred to the cut bhendi fruits and thus the culture of insects was maintained

Bioassay

The methodology mentioned by Murugan *et al*. (2003) was followed for the experiment on squares and bolls to evaluate the efficacy against the spotted bollworm *E. vittella*.In this method, instead of polybags, vials and plastic cups were used. The treatment consists of MECH 162 *Bt*, MECH 184 *Bt*, MECH 162 *NBt*, MECH 184 *NBt*, RCH 2 *Bt*, RCH 2 *NBt*, MCU 7, and SVPR 3. Cotton plants were raised in mud pots of size 30cm (d) x 45cm (h). The samples were marked after thorough examination .Five squares were sampled from each potted plants in each replication at 65, 80, 95, and 110 days after sowing (DAS). Each square was placed in individual glass vials of 20 ml capacity. To each vial 5 neonate larvae were released and were covered by muslin cloth, tightly secured by rubber band. The mortality was observed at 24, 48, 72 and 96 hrs after treatment. Similarly bolls from the potted plants were sampled and were placed in a plastic cup (5x3 cm) individually. Since the third instar is highly susceptible, a larva of *E. vittella* was introduced in each cup and these cups were covered by muslin cloth. The experiment was conducted at 128 and 143 DAS. The mortality rate was observed at 24, 48, 72 and 96 hrs after the treatment. The entire set up was kept undisturbed at laboratory condition of 25 ± 2ºC temperature and 75 ± 5% relative humidity. The experiment was conducted in a completely randomized design with three replications. The data obtained from laboratory observations were analyzed in a Completely Randomized Block Design by 'F' test for significance as described by Panse and Sukhatme (1958).The per cent data recorded for the mortality were converted into corresponding angular transformation (arcsin), if the values ranged from 0 to 100 for statistical analysis (Snedecor and Cochran,1967). Critical difference values were calculated at 5 per cent probability level and the treatment mean values of the experiment were compared using Duncans Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The percentage mortality on squares and bolls under laboratory conditions are presented in Table1. On square basis, at 65 DAS, the percentage mortality of neonates was higher in RCH2 *Bt* (96 %) followed by MECH162 *Bt* compared to their *NBt* counterparts RCH2 *NBt* (40%) and MECH162 *NBt*. All the *Bt* hybrids was found to be superior compared to the check varieties MCU7 and SVPR3. At 80 DAS, the percentage mortality was higher in RCH2*Bt* (98.67%) and similar trend of percentage mortality was observed in RCH2 *Bt* at 95DAS and 110 DAS. Significantly high percentage mortality was observed in all the *Bt* hybrids at 80, 95 and 110 DAS compared to the *NBt* counterparts and the check varieties MCU7 and SVPR3.

On boll basis, RCH2 *Bt* recorded a higher percentage mortality of third instar larvae namely 29.41 and 33.00 percent followed by MECH 162 *Bt* and MECH 184 *Bt* compared to their *NBt* counterparts RCH2 *NBt*, MECH 162, MECH 184*NBt* and check varieties MCU7 and SVPR3 at 128 and 143 DAS respectively The highest per cent mortality was recorded in RCH2 *Bt* followed by MECH 162 *Bt* and MECH 184 *Bt* on square and boll basis. All the *Bt* varieties recorded higher per cent mortality compared to their check varieties. The results of the laboratory experiments confirm that RCH2 *Bt* was more effective against the spotted bollworms, *E. vittella*

The results of the laboratory experiments confirm that RCH2 *Bt* was more effective against the bollworms. Murugan *et al*. (2003) reported that the superiority of *Bt* hybrids causes mortality of various instars of *Heliothis armigera* under laboratory conditions and further confirmed by Shelkar and Regupathy (2004) by using field bioassay methods. Considering the laboratory experiment against the bollworms, RCH2 *Bt* was found to be effective than other *Bt* hybrids. It was also concluded that the

Table 1. Evaluation of *Bt* cotton against *Earias vittella* neonates and third instar larvae in squares and bolls under laboratory conditions

Treatments	Percent mortality of neonates after indicated days after sowing (DAS) in squares				Percent mortality of III instar larvae after indicated days after sowing (DAS) in bolls	
	65 DAS	80 DAS	95 DAS	110 DAS	128 DAS	143 DAS
MECH 162 *Bt*	93.33 (78.29)^{a}	96.00 (83.24)^{a}	70.67 (57.88)^{b}	44.00 (41.48)^{b}	22.08 (25.51)^{a}	22.07 (25.51)^{a}
MECH 184 *Bt*	89.33 (75.50)^{a}	94.67 (79.40)^{a}	62.67 (52.68)^{bc}	41.33 (39.78)^{b}	18.33 (25.10)^{a}	11.07 (15.83)^{a}
MECH 162 *NBt*	58.67 (50.08)^{b}	74.67 (60.01)^{b}	56.00 (48.48)^{bcd}	41.33 (39.78)^{b}	14.67 (18.14)^{b}	3.67 (6.46)^{c}
MECH 184 *NBt*	46.67 (43.09)^{b}	71.99 (58.15)^{b}	44.00 (41.48)^{cd}	38.66 (38.28)^{b}	11.07 (15.83)^{b}	3.67 (6.46)^{c}
RCH2 *Bt*	96.00 (78.47)^{a}	98.67 (86.15)^{a}	88.00 (73.29)^{a}	92.00 (77.28)^{a}	29.41 (30.04)^{a}	33.00 (34.86)^{a}
RCH2 *NBt*	40.00 (39.16)^{b}	66.67 (54.79)^{b}	60.00 (50.82)^{bcd}	34.67 (36.02)^{b}	7.34 (12.91)^{c}	7.34 (12.91)^{bc}
MCU 7	33.34 (35.00)^{b}	52.00 (46.21)^{b}	42.67 (40.65)^{cd}	36.00 (36.80)^{b}	7.33 (12.91)^{c}	0.00 (0.06)^{c}
SVPR3	34.67 (35.22)^{b}	57.33 (49.27)^{b}	34.67 (36.02)^{d}	24.00 (28.47)^{c}	7.33 (12.91)^{c}	0.00 (0.06)^{c}
CD Value	16.59**	13.20**	14.69*	14.45*	20.38**	17.23**

NS - Not significant In a column means followed by a common letter are not significantly different by DMRT (P = 0.05)
* - Significant at P = 0.05; Values in parentheses are arcsin transformed values
** - Significant at P = 0.01; DAS- Days after sowing

RCH2 *Bt* hybrids are superior and effective against the spotted bollworm.

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