J. Cotton Res. Dev. **28** (2) 316-318 (July, 2014)

Toxicity studies of insecticides against leafhopper, *Amrasca biguttula biguttula* (Ishida) on *Bt* cotton under laboratory conditions

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ABSTRACT : The per cent mortality of leafhopper nymphs was more in thiamethoxam (50.67 %) followed by imidacloprid (46.67 %) and clothianidin (37.33 %). These three chemicals were *on par* with each other but differed significantly with other insecticides. Further, these superior molecules were bioassayed using Potter's tower to find out LC50 values. Accordingly, the insecticides *viz.,* thiamethoxam, imidacloprid and clothianidin had 0.001, 0.007 and 0.041 LC50 values.

Keywords : *Amrasca biguttula biguttula,* bioassay, *Bt* cotton, toxicity

Among the sucking pests attacking cotton in early stages of crop growth, leafhoppers constitute as one of the important sap feeders. Both nymphs and adults suck the sap from under surface of the leaf. The desaping by the leafhoppers cause specking symptoms. At present, most of the commonly used insecticides are not able to suppress its population below economic threshold due to indiscriminate use (Santhini and Uthamasami, 1997).

Recently, neonicotinoids, a group of insecticides of chloronicotinyl class, such as imidacloprid and thiamethoxam have been found very effective for the control of homopteran insects attacking cotton (Kumar and Santharam, 1999 and Mohan and Katiyar, 2000).The use of these insecticides against sucking pests in cotton is expected to increase in the days to come, because these are new and translocate systematically and acropetally with long residual activity.Effective management of insect pests in most of the agricultural ecosystems is dependent on variety of inputs including ready to supply safe and highly effective chemical pesticides. For effective management, the search for new molecules in terms of bioefficacy trials is a continuous and inevitable process. Hence, the experiment under laboratory conditions with insecticides like thiamethoxam, imidacloprid and few more new molecules in comparison with conventional insecticides against leafhopper, on *Bt* cotton was tested. Further, bioassay studies on *A. biguttula biguttula* for the superior molecules was conducted to prescribe its susceptibility status to these insecticides.

Toxicity of 9 insecticides *viz.,* T_1=thiamethoxam (25 % WDG) @ 0.2 g/l, T_2= acetamiprid (20 % SP) @ 0.2 g/l, T_3=pyriproxyfen (10 % EC) @ 1.0 ml/l, T_4=acephate (75 % SP) @ 1.0 g/l, T_5=clothianidin (50 % WDG) @ 0.12 g/l, T_6=oxydemeton methyl (25 % EC) @ 1.5 ml/l, T_7=imidacloprid (17.8 % SL) @ 0.3 ml/l, T_8=dimethoate (30 % EC) @ 1.75 ml/l and T_9=lambda cyhalothrin (5 % EC) @ 0.5 ml/l was evaluated against third nymphal instars of *A. biguttula biguttula* on *Bt* cotton under laboratory conditions. The required concentrations of each insecticide were prepared in distilled water. The exposure test of the insect to insecticides was given as per the procedure described by Santhini and Uthamasamy (1997) with slight modifications. In the present investigation, instead of using glass chimney covered with

Table 1. Bioassay of insecticides against leafhopper, *A. biguttula biguttula* on *Bt* cotton

	Per cent mortality of leafhoppers at different intervals (h)			
	24	48	72	96
T_1	50.67 (45.38)* [a]	82.67 (65.52) [a]	100.00 (90.00) [a]	100.00 (90.00) [a]
T_2	24.00 (29.28) [c]	56.00 (48.45) [d]	78.67 (64.41) [d]	93.33 (75.20) [b]
T_3	0.00 (0.00) [f]	6.67 (14.79) [g]	17.33 (24.46) [h]	33.33 (35.20) [e]
T_4	36.00 (36.85) [b]	73.33 (58.92) [b]	90.67 (72.29) [c]	100.00 (90.00) [a]
T_5	37.33 (37.65) [b]	73.33 (58.92) [b]	93.33 (75.20) [bc]	100.00 (90.00) [a]
T_6	13.33 (21.37) [d]	21.33 (27.48) [e]	46.67 (43.07) [e]	76.00 (60.71) [c]
T_7	46.67 (43.07) [a]	80.00 (65.50) [a]	97.33 (82.30) [ab]	100 (90.00) [a]
T_8	2.67 (7.69) [e]	16.00 (23.47) [ef]	32.00 (34.42) [f]	57.33 (49.21) [d]
T_9	24 (29.28) [c]	65.33 (53.93) [c]	81.33 (65.53) [d]	100 (90.00) [a]
Control	0.00 (0.00) [f]	0.00 (0.00) [h]	0.00 (0.00) [i]	0.00 (0.00) [e]
CV (%)	12.16	8.31	5.89	3.63
S.Em ±	1.56	2.13	2.02	1.52
P=0.05	4.57	6.24	6.04	4.45

Table 2. Nymphal susceptibility of *A. biguttula biguttula* to thiamethoxam, imidacloprid and clothianidin in a bioassay

Treatments	24 HAT					48 HAT					72 HAT				
	χ^2at p=0.05	Regression equation	LC50	Fiducial LL	Fiducial UL	χ^2at p=0.05	Regression equation	LC50	Fiducial LL	Fiducial UL	χ^2at p=0.05	Regression equation	LC50	Fiducial LL	Fiducial UL
Thiamethoxam 25 WDG	6.530	0.82+7.50X	0.001	0.001	0.002	3.976	0.83+7.64X	0.001	0.0001	0.001	3.153	0.86+7.83X	0.001	0.0001	0.001
Imidacloprid17.8 SL	2.201	1.23+7.64X	0.007	0.005	0.011	3.712	1.15+7.59X	0.006	0.004	0.009	3.485	1.17+7.68X	0.005	0.004	0.008
Clothianidin50 WDG	0.093	1.14+6.58X	0.041	0.016	0.579	1.100	0.92+6.29X	0.039	0.015	0.317	0.393	0.97+6.61X	0.022	0.010	0.091

N = 25

R = 3

HAT – Hours after treatment LL– Lower limit UL– Upper limit

musline cloth, small plastic containers of size 20 × 8 cm covered with musline cloth were used to cover the treated plants for confining the leafhopper nymphs. *Bt* cotton plants (RCH 2) were raised in small cups individually. The recommended conc of different insecticides were prepared in distilled water for one l volume.15 to 20 day old plants was treated with the above mentioned chemicals by Potter's tower. After treatment, the plants were shade dried, individual cup was kept in a plastic container and immediately after drying, 25 third instar nymphs were released to each plant by using a camel hair brush and covered by musline cloth. One set of untreated control treatment sprayed with distilled water was maintained simultaneously. Each treatment was replicated three times.

The mortality data were recorded after 24, 48, 72 and 96 h after spray by counting the living individuals, The nymphs were considered alive when they responded even after slight prodding with a camel hair brush on its back. The insecticides which shown highest mortality per cents were again subjected to carry out bioassay tests. Varied dilutions of these insecticides were prepared by following serial dilution method. Five conc of each testing insecticides with 3 replications alongwith untreated were maintained simultaneously. The dilutions were sprayed using Potter's tower and the mortality data was obtained. The data thus generated were subjected to probit analysis to work out the LC_{50} values.

The data presented in Table 1 revealed that the per cent mortality of leafhopper was found maximum (50.67%) in thiamethoxam which showed non significant difference with imidacloprid (46.67%). Clothianidin found to be next best treatment which recorded 37.33 per cent mortality at 24 h after spray. There was a cumulative effect of toxicity noticed at 48 h of spray with highest per cent mortality noticed in thiamethoxam spray treatment (82.67 %) which has proved non significant with imidacloprid. Clothianidin stood second to above chemicals followed by lambda cyhalothrin. The standard check treatments *viz.,* oxydemeton methyl and dimethoate recorded low per cent mortality of 21.33 and 16.00 per cent, respectively.

Per cent mortality of leafhoppers recorded at 72 and 96 h after application has followed same trend as that of 48 h of application. However, the thiamethoxam could achieve cent per cent mortality of leafhoppers at 72 h only whereas the imidacloprid and clothianidin took 96 h to achieve the same. The standard check treatments *viz.,* oxydemeton methyl and dimethoate, acetamiprid, pyriproxyfen could not achieve cent per cent mortality even after 96 h of application. Observations pertaining to best treatments for nymphal mortality at 24, 48, 72 and 96 h after treatment were subjected to probit analysis. The relative effect of various conc of insecticide was found out by LC_{50} values and the same are presented in Tables 2. Thiamethoxam was the most toxic insecticide to the third instar nymphs of leafhopper, with LC_{50} value of 0.001 per cent. The next best insecticide was imidacloprid with LC_{50} value of 0.007 per cent and clothianidin 0.041 per cent. On the other hand, pyriproxyfen proved to be least toxic with zero per cent mortality followed by dimethoate with 2.67 per cent mortality. Ravikumar *et al.,* (2003) recorded LC_{50} values (%) for two neonicotinoids, thiamethoxam and imidacloprid and few commonly used insecticides *viz.,* oxydemeton methyl, dimethoate, fenvalerate, monocrotophos and malathion as 0.000314, 0.000813, 0.00597, 0.006273, 0.008110, 0.025100 and 0.02690 per cent, respectively.

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Received for publication : July 17, 2012
Accepted for publication : November 10, 2012