Comparative field efficacy of entomopathogenic fungi and certain new insecticide molecules against leafhoppers, *Amrasca devastans* (Distant) on *Bt* cotton

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ABSTRACT

A field experiment was conducted to evaluate the efficacy of certain new molecules as well as entomopathogens as foliar sprays against leafhoppers in Bt cotton at Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh for two consecutive years. The new molecule, flonicamid 50% WG at two doses i.e. at 75 g a.i./ha and 100 g a.i./ha followed by diafenthiuron 50% WP 300 g a.i./ha and buprofezin 25% SC @ 250 g a.i./ha were found promising against leaf hoppers together with high seed cotton yield. New molecules were found significantly superior over to NSKE 5 % and entomopathogens in suppressing the leafhoppers.

Keywords: Entomopathogenic fungi, New Insecticides, flonicamid, Leafhoppers, Bt cotton

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INTRODUCTION

The king of fibres, Cotton (*Gossipium hirsutum* L.), is the most important commercial crop in Indian sub-continent which ranks first in production with 351 L. bales from an area of 105 lakh hectares with a productivity of 568 kg/ha and (All India Coordinated Cotton Improvement Programme - AICCIP, Annual Report 2016-17).Though India ranks first in the world with regard to acreage, the productivity is low as compared to other cotton growing countries because of various external factors. Among the various biotic factors responsible for the low yield, the losses caused by insect pests are of major importance. Various pests cause upto 87 per cent losses to seed cotton yield (Taley *et al*., 1988). After introduction of Bollgard technology (Bt) in 2002, the productivity of cotton is increased, losses due to insect pests are decreased and insecticide use is also reduced. Transgenic Bt cotton can effectively control specific lepidopteron species, but there is a lack of resistance against sucking insect pest (Sharma and Pampathy, 2006). Hence, after the introduction of Bt cotton, there was a change in the insect pest dynamics in cotton ecosystem. The major biotic constraint in the attainment of desired productivity levels in Bt cotton production is the sucking pests. Almost all the present day growing BG II hybrids succumb to yield losses due to the sucking pests such as leafhoppers, thrips, whiteflies, aphids and mealy bug which are active throughout the growing season. Among the sucking pests, leaf hoppers, *Amrasca devastans* (Distant) has become major production constraint, appearing in dangerous proportions throughout the crop growth period in Andhra Pradesh. Earlier, it was observed as early season pest, but in *Bt* era, occurrence of leafhoppers has been observed throughout the season reducing crop productivity. Both nymphs and adults suck the sap from the lower leaf surfaces. In addition, they disrupt transportation in conducting vessels and apparently introduce a toxin that impairs photosynthesis in proportion to the amount of feeding. When several insects suck the sap

from the same leaf, yellow spots appear on the leaves, followed by crinkling, curling, bronzing, and drying, in other words, "hopper burn". In case of a severe condition, all leaves in the plants become crinkled or twisted, photosynthesis get reduced and finally yield reduction occurs (Sharma and Chander, 1998). The leafhoppers can cause upto 21.2 per cent yield loss (Bhosle *et al.*, 2009) and to the extent of 309 kg/ha (Murugesan and Kavitha, 2010).To protect the crop from the leafhoppers and other sucking pests, farmers are using several insecticides belonging to different groups as foliar sprays indiscriminately. At present, most of the commonly used insecticides are not up to the mark in suppressing the leafhopper population below economic threshold. Hence, there is an increased inclination among farmers towards utilization of newer molecules for the management of leafhoppers on Bt cotton. But, in the present scenario, more emphasis is on nonchemical approaches which are environment friendly due to several reasons such as pest resurgence, resistance and pesticide residues. Hence, an experiment was conducted to find out the efficacy of certain new molecules and entomopathogens against leafhoppers in *Bt* cotton.

METRIALS AND METHODS

The field experiment was carried out at the Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh for two consecutive seasons, i.e Kharif 2014-15 and 2015-16 under rainfed conditions. The RCH 2 BG II was selected as test hybrid which is susceptible for leafhoppers and it was sown during the first fortnight of July at a spacing of 105 cm X 60 cm with a plot size of 48 sq.m area for each treatment. The experiment was laid out in a randomized block design (RBD) with eight treatments including untreated control, which were replicated thrice. Three new molecules with different modes of action belonging to different groups such as flonicamid 50% WG (Pyridine carboxamide group - Inhibitor of feeding), diafenthiuron 50 WP (Carbo diamide group - inhibitor of mitochondrial ATP synthesis) and buperofezin 25 SC (IGR – Inhibitor of Insect growth) and two common entomopathogenic fungi such as *Verticillium lecanii* and *Metarhizium anisopliae* (Supplied by Project Investigator, Entomology, AICRP on Cotton, CICR, Nagpur) and a botanical, Neem Seed Kernel Extract (NSKE 5 %) were selected for the present study. All the Acharya N.G. Ranga Agricultural University (ANGRAU) recommended package of practices were followed to raise the crop and two schedule sprays were imposed after noticing the leafhoppers. All the selected test chemicals were taken as per the recommended dosages and sprayed with hand compression sprayer at the rate of 500 L spray fluid per hectare. The number of leafhoppers, both nymphs and adults was recorded from three leaves i.e. from top, middle and bottom canopies of the plant from five randomly selected plants per plot. Pre-treatment population was taken just before the application of treatments and post treatment count was taken 7 days after spray. The pooled mean count of leafhoppers for two sprays for two seasons per 3 leaves is presented hereunder. The picking wise yield of seed cotton was recorded and net plot yield was converted into q ha-1 for analysis. The data thus obtained was subjected to analysis after using appropriate transformations.

RESULTS AND DISCUSSION

The population of leafhoppers ranged from 5.40 to 6.75/3 leaves at one day before spraying without significant differences, indicating the uniform population among the experimental plots. Seven days after the spraying, the population of leafhoppers was numerically lowest in the experimental plots treated with flonicamid 50 % WG @ 100 g a.i./ha. But it was found statistically on par with its lower dose i.e. flonicamid 50 % WG @ 75 g a.i./ha, diafenthiuron 50 % WP @ 300 g a.i./ha and buprofezin 25 % SC @ 250 g a.i./ha. While the population of leaf hoppers was 4.47/ 3 leaves in *V. lecanii* treated plots and it was 4.83/ leaves in the plots treated with *M. anisopliae*. All the three inorganic chemical molecules were found significantly superior to NSKE 5 % and entomopathogenic fungi in reducing leafhopper population.

However, all the treatments were found significantly superior to the untreated control in reducing the leafhoppers at seven days after spraying. The percent reduction in leafhopper population over untreated control was above 70 per cent with flonicamid 50 % WG and it was above 60 per cent with diafenthiuron 50 % WP and buprofezin 25 % SC. But it was below 50 per cent with the remaining treatments such as 5 % NSKE, *V. lecanii* @ 10 g/lt and *M. anisopliae* @ 10 g/lt (Table.1).

Table 1. Efficacy of insecticides against leafhoppers and seed cotton yield (Mean of 2014-15 and 2015-16).

S.No	Insecticide	Dosage (ga.i./ha)	Leafhoppers/3 leaves/ plant (Mean of two sprays)*		Per cent reduction over control	Mean Yield (q/ha)
			PTC	7 DAS		
T1	Buprofezin 25% SC	250	5.85 (2.62)	2.62 (1.90)	63.8	22.3
T2	Flonicamid 50% WG	75	5.40 (2.53)	1.83 (1.68)	72.6	22.4
T3	Flonicamid 50%WG	100	5.40 (2.53)	1.58 (1.61)	76.3	23.1
T4	NSKE	5 %	6.60 (2.76)	4.10 (2.26)	49.7	18.1
T5	Diafenthiuron 50%WP	300	6.10 (2.66)	2.57 (1.89)	65.9	20.5
T6	*Verticilium lecanii*	10 g/l	6.70 (2.77)	4.47 (2.34)	46.0	17.6
T7	*Metarhizium anisopliae*	10 g/l	6.75 (2.78)	4.83 (2.41)	42.0	15.5
T8	Control	--	6.05 (2.66)	7.40 (2.90)	-	13.8
	F test		NS	Sig		Sig
	CD		-	0.3		4.8
	CV (9%)		-	8.2		14.4

* Figures in parenthesis are √X+1 transformed values; PTC – Pre treatment count at one day before spraying; DAS – Days after spray

The present findings are in close proximity with Nemade *et al*. (2017) who reported that flonicamid is highly effective against leafhoppers in Bt cotton. Chandi *et al*. (2016) also reported that the percent reduction in leafhopper population was the highest with flonicamid 50 WG which is in concurrence with present findings. The efficacy of diafenthiuron and buprofezin against the sucking pests in cotton and other crops was reported earlier (Sreekanth and Reddy, 2011; Zala *et al*., 2014; Bajya *et al*., 2016; Kumar *et al*., 2015; Nemade *et al*., 2015; Jadhav *et al*., 2017) in cotton. The better efficacy of insecticide molecules with new chemistries over entomopathogenic fungi and other biopesticides was reported earlier (Kalyan *et al*., 2012; Saner *et al*., 2013), thus confirming the present findings. In the present study, the botanical, 5 % NSKE was found better when compared to entomopathogens in reducing the leafhoppers coupled with more seed cotton yield. Earlier, Neemazol, neem oil and NSKE 5% were reported effective over entamopathogenic fungal agents against leafhopper (Naik *et al*., 2012). Highest seed cotton yield was recorded from flonicamid 50 % WG treated plots followed by buprofezin 25 % SC and diafenthiuron 50 % WP which were significantly superior to the other treatments. The seed cotton yield was above 20.0 q/ha from the insecticide treated plots. The remaining treatments such as 5 % NSKE, *V. lecanii* @ 10 g/lt and *M. anisopliae* @ 10 g/lt were found on par with each other with more than 15 q/ha seed cotton yield. However, all the treatments were able to produce significantly superior seed cotton yield when compared to that of untreated control (13.9 q/ha) which recorded the lowest yield (Table. 1). The results are in concurrence with those of Chandi *et al*. (2016) and Nemade *et al*. (2017) who reported high seed cotton yield from flonicamid 50 WG in cotton.

The new molecules such as flonicamid 50 % WG, diafenthiuron 50 % WP and buprofezin 25 % SC can be used for effective control of leafhoppers in Bt cotton as a substitute for conventional insecticides in case of severe incidence. Though the efficacy of EPF and NSKE 5 % is less when compared to chemical insecticide molecules, they were able to exert up to 40-50 per cent reduction over untreated control, hence they can be used in cotton ecosystem to safeguard the environment.

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