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Evaluation Of Newer Insecticides And Entomopathogenic Fungus Against Leafhopper, Amrasca Biguttula Biguttula Ishidaon On Okra

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Abstract: *One of the most widely planted vegetable crops in various regions of our nation is okra, Abelmoschus esculentus (L.) Moench. Okra is grown in the summer and Kharif seasons. Infestation of insect pests one of the important limiting factors in the cultivation of okra. Numerous insect pest species decimate the okra crop. About 72 species of insects have been documented on okra. Among the numerous pests attacking in okra crop, leafhopper, Amrasca biguttula biguttula Ishida; are considered as major pests and cause considerable losses in yield. Both the nymphal and adult stages of leafhopper cause damage by sucking the sap from leaf tissue. Therefore, the current study was conducted to assess the effectiveness of novel molecules with a unique mode of action in order to provide an achievable solution for the sustained control of the okra sucking insect pest. In this study, the efficacy of new generation insecticides viz., Diafenthuron 50 WP@ 300gm a.i./ha, Broflanilide 20 SC @ 25 gm a.i./ha, Spinetorum 1.7 SC @ 46.8 gm a.i./ha, Flonicamid 50 WG @ 75 gm a.i./ha evaluated. The maximum reduction of leafhopper populations was recorded in Flonicamid (2.31 leafhoppers per leaf) followed by Diafenthuron (2.66 leafhoppers per leaf), Spinetorum (3.22 leafhoppers per leaf) Broflanilide (3.64 leafhoppers per leaf) after one day of spraying. Same trend had been recorded for the 5, 10, and 15 days after spraying. However botanical and microbial insecticides showed significant reduction of leafhopper over control. Therefore, for effective management of leafhopper in okra, these novel insecticides can be used alternatively depending upon the stage of pest.*
Key Word: *Abelmoschus esculentus, Metarhizium anisopliae, Verticillium lecanii, Beauveria bassiana*

INTRODUCTION

One of the most widely planted vegetable crops in various regions of our nation is okra, *Abelmoschus esculentus* (L.) Moench. Okra is grown in both the summer and Kharif seasons. In India, it is cultivated on 0.509 m ha area with an annual production of 6.095 million tonnes with an average productivity of 12 t/ha. Insect pest infestations are a significant limiting factor in okra cultivation. Numerous insect pest species decimate the okra crop. About 72 species of insects have been reported on okra (Srinivas and Rajendran, 2003). Among the numerous pests attacking in okra crop, leafhopper, *Amrasca biguttula biguttula* Ishida; whitefly, *Bemisia tabaci* Genn.; aphid, *Aphis gossypii* Glover; and shoot and fruit borer, *Earias vitella* Fab. are considered as major pests and cause considerable losses in yield (Aarwe *et al.*, 2020). Krishnaiah (1980) reported leafhopper cause 40-56 per cent yield losses in okra. The yield loss due to leafhopper desapping in okra extents 54 to 66 per cent (Sharma and Sharma, 2001; Dhandapani *et al.*, 2003; Satpathy *et al.*, 2004). The pest is extremely difficult to control owing to its robust reproductive potential, ability to travel quickly from one plant to another, and living environment (Fouly *et al.*, 2011). To control these sucking pests, farmers use traditional insecticides like organophosphate, carbamate, and synthetic pyrethroid. Systemic insecticides have caused resistance in the insect pest and disruption of the agroecosystem by impacting non-target species as a result of frequent application. Therefore, the current study was conducted to assess the effectiveness of novel molecules with a unique mode of action in order to provide an achievable solution for the sustained control of the okra sucking insect pest.

MATERIALS AND METHODS

The research work comprising field experiments were conducted during Summer season of 2022 and Kharif of 2023 at the Experimental Farm of Loknete Mohanrao Kadam College of Agriculture, Sonsal-Hingangaon, Kadegaon. It has subtropical climate having an average rainfall of 455 mm. Okra cv. Sahiba was raised by using standard cultivation practices given by MPKV, Rahuri except plant protection measures. The experiment was replicated for three times under Randomized Block Design with nine treatments. The okra seeds were dibbled in the plot size of 3.0 x 2.7 m area with 30cm × 20cm spacing. The treatment viz. T_1 Azadirachtin 0.03 EC@1.5 lit, T_2 *Verticillium lecanii* 1 x 10^8cfu/ml 1.15 WP @ 2.5 kg/ ha, T_3 *Metarhizium anisopliae* 1 x 10^8cfu/ml 1.15 WP@ 2.5 kg/ha, T_4 *Beauveria bassiana* 1 x 10^8cfu/ml 1.15 WP@2.5 kg/ha, T_5 Diafenthuron 50 WP@ 300gm a.i/ha, T_6 Broflanilide 20 SC @ 25 gm a.i/ha, T_7 Spinetorum 1.7 SC @ 46.8 gm a.i/ha, T_8 Flonicamid 50 WG @ 75 gm a.i/ha and T_9 Untreated control were applied from 30 days age of the crop. The spraying was accomplished using a hand operated knapsack sprayer equipped with a hollow cone nozzle. All the three replications were treated at a time. All the three rounds of spray applications of insecticides were undertaken at an interval of 15 days. The data of leafhopper pests were recorded from randomly selected five plants in each plot. From each plant three leaves i.e. top, middle and bottom were considered for recording observations a day before and 1, 5, 10 and 15 days after the treatment application.

Statistical Analysis

The experimental data were analysed as per the method of statistical analysis of Randomized Block Design as proposed by Panse and Sukhatme (1985).

RESULT AND DISCCUSION

The data on the post treatment mean leafhopper count per leaf for Summer 2022 are presented in the Table 1 and fig. 1. The mean leafhopper population recorded from 1-15DAS indicated Flonicamid (2.31 leafhoppers per leaf) followed by Diafenthuron (2.66 leafhoppers per leaf), Spinetorum (3.22 leafhoppers per leaf) Broflanilide (3.64 leafhoppers per leaf) after one day of spraying. Same trend had been recorded for the 5, 10, and 15 days after spraying. Azadirachtin (4.39 leafhoppers per leaf), *V. lecanii* (6.56 leafhoppers per leaf), *M. anisopliae* (7.10 leafhoppers per leaf) and *B. bassiana* (7.83 leafhoppers per leaf). Maximum protection over control of leafhoppers was reported in T6 Broflanilide (79.47%) followed by Diafenthuron (76.26%), Spinetorum (74.36%) and Flonicamid (72.10%). Among biopesticide, V. lecanii provides 53.14 % which was highest followed by *B. bassiana* (43.32%) and M. *anisopliae* (42.40 %).

The data on the post treatment mean leafhopper count per leaf for Summer 2022 are presented in the table 2. The overall mean of three sprays revealed that, among the botanical, biopesticides and insecticides least leafhoppers population was recorded in flonicamid (2.31 leafhoppers per leaf) and diafenthiuron (2.66 leafhoppers per leaf) followed by spinetoram (3.22 leafhoppers per leaf), broflanilide (3.64 leafhoppers per leaf), azadirachtin 5 per cent (4.39 leafhoppers per leaf), *V. lecanii* (6.56 leafhoppers per leaf), *M. anisopliae* (7.10 leafhoppers per leaf), and *B. bassiana* .with 7.83 leafhoppers per leaf (Table 2 and Fig. 2).

Similarly, Singh *et al.* (2020) reported that with the use flupyradifurone 200 SL @ 2.5 ml/l, the pre-treatment pest load of 21.22 jassid/5 leaves per plant was reduced to 4.55 and 3.60 jassid/5 leaves per plant after 10 days of first spray and second spray respectively was the best treatment. Also, Garg *et al.* (2018) reported that flupyradifurone 200SL @175g.a.i. ha^{-1} was found most effective (1.08/plant) for controlling jassid population in comparison to different doses of same formulation and phosphomidon 40%SL @ 300g.a.i. ha^{-1} at 3rd day after spray. Similar performances of these insecticides have also been recorded at 7 and 10 days after spray. The significantly minimum (2.87 jassid/plant) population have observed in plot treated with flupyradifurone 200SL @175 g a.i. ha^{-1} followed by flupyradifurone 200SL @150 and 125 g a.i. ha^{-1} at 15th day after spray. Jadhav *et al.* (2017) concluded that fenpropathrin 30EC at 200 ml a.i./ha was found most effective while during second spray the highest population reduction of leafhopper was seen in imidacloprid 70WG at 35g a.i./ha treatment. The average marketable fruit yield among different treatments ranged from 41.43 to 72.42 q/ha. The maximum yield was obtained with imidacloprid 70WG at 35 g a.i./ha, followed by diafenthiuron 50WP at 600 g a.i./ha and thiamethoxam 25WG at 100 g a.i./ha. Rana *et al.* (2017) reported that all the treatments resulted in lower jassid population as compared to untreated control. The application of thiamethoxam @ 0.3 g/l was found to be the best for suppression of jassid which recorded 1.51 jassid/plant which was statistically at par with spiromesifen @ 0.8 ml/l which recorded 1.62 jassid/plant followed by dimethoate @ 2ml/l (1.66 jassid/plant) and thiacloprid @ 0.5 ml/l (1.67 jassid/plant). The highest seed yield was recorded from the plots treated with thiamethoxam (1.18 t/ha). Anu (2014) reported that diafenthiuron 50 WP @ 200, 250, 300 and 600 g a.i./ha was the most effective against jassid which recorded 1.85, 1.58, 1.53 and 1.50 jassid/ leaf. It was significantly superior over the untreated control plot which recorded 3.80 jassid/leaf. In the experiment it was also observed that emamectin benzoate 5% SG @ 6.75 g a.i./ha was least effective against jassid which recorded 3.13 jassid/leaf. Neelima *et al.* (2011) reported that fipronil 5 per cent SC @ 50 g a.i./ha was effective in bringing down the population of leaf hoppers up to 72.3 per cent over control at 14 days after spraying. About 20 per cent reduction of leafhopper population over control was observed with green-chilli garlic extract and neem oil. Per cent reduction in leafhopper population was less with bio- control agents viz., *L. lecanii* @ 2500 g/ha (11), *M. anisopliae* @ 2500 g/ha (12.3), *B. bassiana* @ 2500 g/ha @ 2500 g ha (14.9).

The study demonstrated that chemical insecticides, particularly flonicamid, diafenthiuron, spinetoram, and broflanilide, were the most effective in reducing the incidence of whiteflies compared to biopesticides and biological control agents.

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Table 1: Efficacy of different botanical, biopesticides and insecticides for the management of leafhoppers, *A. biguttula biguttula* on okra after all three sprays during summer 2022

Tr. No.	Treatments	Dose (l or kg or g a.i./ ha)	Mean no. of leafhoppers /leaf				
			1 DAS	5 DAS	10 DAS	15 DAS	Mean
T_1	Azadirachtin	1.5 l	4.70 (2.28)*	4.20 (2.17)	3.88 (2.09)	4.54 (2.25)	4.33 (2.20)
T_2	*Verticillium lecanii*	2.5 kg	5.93 (2.54)	5.09 (2.36)	4.26 (2.18)	5.47 (2.44)	5.19 (2.38)
T_3	*Metarhizium anisopliae*	2.5 kg	6.40 (2.63)	5.48 (2.45)	4.76 (2.29)	6.07 (2.56)	5.68 (2.48)
T_4	*Beauveria bassiana*	2.5 kg	6.85 (2.71)	6.30 (2.61)	5.89 (2.53)	7.17 (2.77)	6.55 (2.65)
T_5	Diafenthiuron	300 g	1.96 (1.57)	2.30 (1.67)	2.62 (1.77)	3.16 (1.91)	2.51 (1.73)
T_6	Broflanilide	25 g	2.78 (1.81)	3.06 (1.89)	3.60 (2.03)	4.04 (2.13)	3.37 (1.96)
T_7	Spinetoram	46.8 g	2.27 (1.66)	2.85 (1.83)	3.16 (1.91)	3.66 (2.04)	2.99 (1.86)
T_8	Flonicamid	75 g	1.19 (1.30)	1.68 (1.48)	2.00 (1.58)	2.74 (1.80)	1.90 (1.54)
T_9	Untreated control	-	10.15 (3.26)	9.78 (3.21)	9.31 (3.13)	9.36 (3.14)	9.65 (3.19)
	S.E.m ±	-	**0.03**	**0.02**	**0.01**	**0.02**	**0.01**
	C.D. at 5%	-	**0.09**	**0.06**	**0.04**	**0.06**	**0.04**

*figures in the parenthesis are $\sqrt{x+0.5}$ transformed values; DBS- Day Before Spraying; DAS- Days After Spraying

Table 2: Efficacy of different botanical, biopesticides and insecticides for the management of leafhoppers, *A. biguttula biguttula* on okra after all three sprays during kharif 2023

Tr. No.	Treatments	Dose (l or kg or g a.i./ ha)	Mean no. of leafhoppers /leaf				
			1 DAS	5 DAS	10 DAS	15 DAS	Mean
T_1	Azadirachtin	1.5 l	5.18 (2.38)*	3.79 (2.07)	3.40 (1.97)	5.18 (2.38)	4.39 (2.20)
T_2	*Verticillium lecanii*	2.5 kg	8.57 (3.01)	5.58 (2.47)	5.08 (2.36)	6.99 (2.74)	6.56 (2.64)
T_3	*Metarhizium anisopliae*	2.5 kg	8.82 (3.05)	6.47 (2.64)	5.73 (2.50)	7.37 (2.81)	7.10 (2.75)
T_4	*Beauveria bassiana*	2.5 kg	9.60 (3.18)	7.25 (2.78)	6.34 (2.61)	8.13 (2.94)	7.83 (2.88)

T_5	Diafenthiuron	300 g	1.59 (1.44)	2.24 (1.65)	2.97 (1.86)	3.85 (2.08)	2.66 (1.76)
T_6	Broflanilide	25 g	2.63 (1.77)	3.28 (1.94)	3.79 (2.07)	4.85 (2.31)	3.64 (2.02)
T_7	Spinetoram	46.8 g	2.14 (1.62)	3.00 (1.87)	3.28 (1.94)	4.47 (2.23)	3.22 (1.92)
T_8	Flonicamid	75 g	1.34 (1.36)	2.08 (1.61)	2.51 (1.73)	3.32 (1.95)	2.31 (1.66)
T_9	Untreated control	-	14.74 (3.90)	15.29 (3.97)	15.33 (3.98)	15.40 (3.99)	15.19 (3.96)
	S.E.m ±	-	**0.02**	**0.02**	**0.02**	**0.01**	**0.01**
	C.D. at 5%	-	**0.05**	**0.07**	**0.07**	**0.07**	**0.04**

*figures in the parenthesis are $\sqrt{x+0.5}$ transformed values; DBS- Day Before Spraying; DAS- Days After Spraying

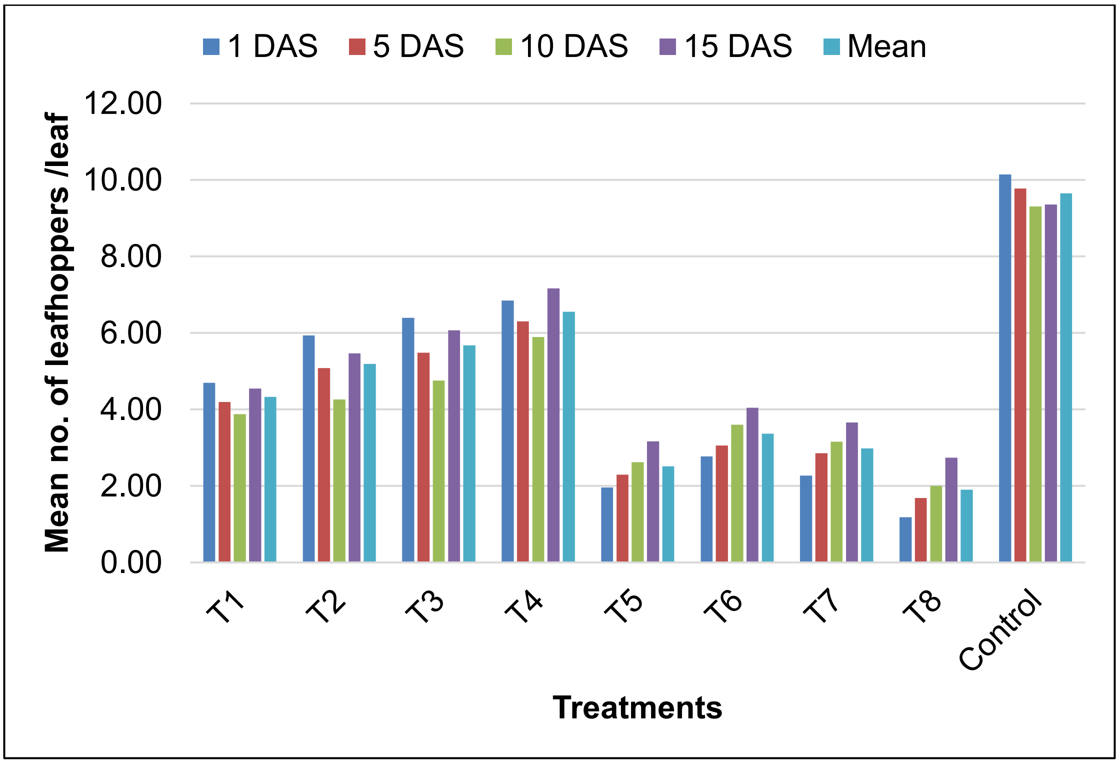

Fig 1: Efficacy of different botanical, biopesticides and insecticides for the management of leafhoppers, *A. biguttula biguttula* on okra after all three sprays during summer 2022

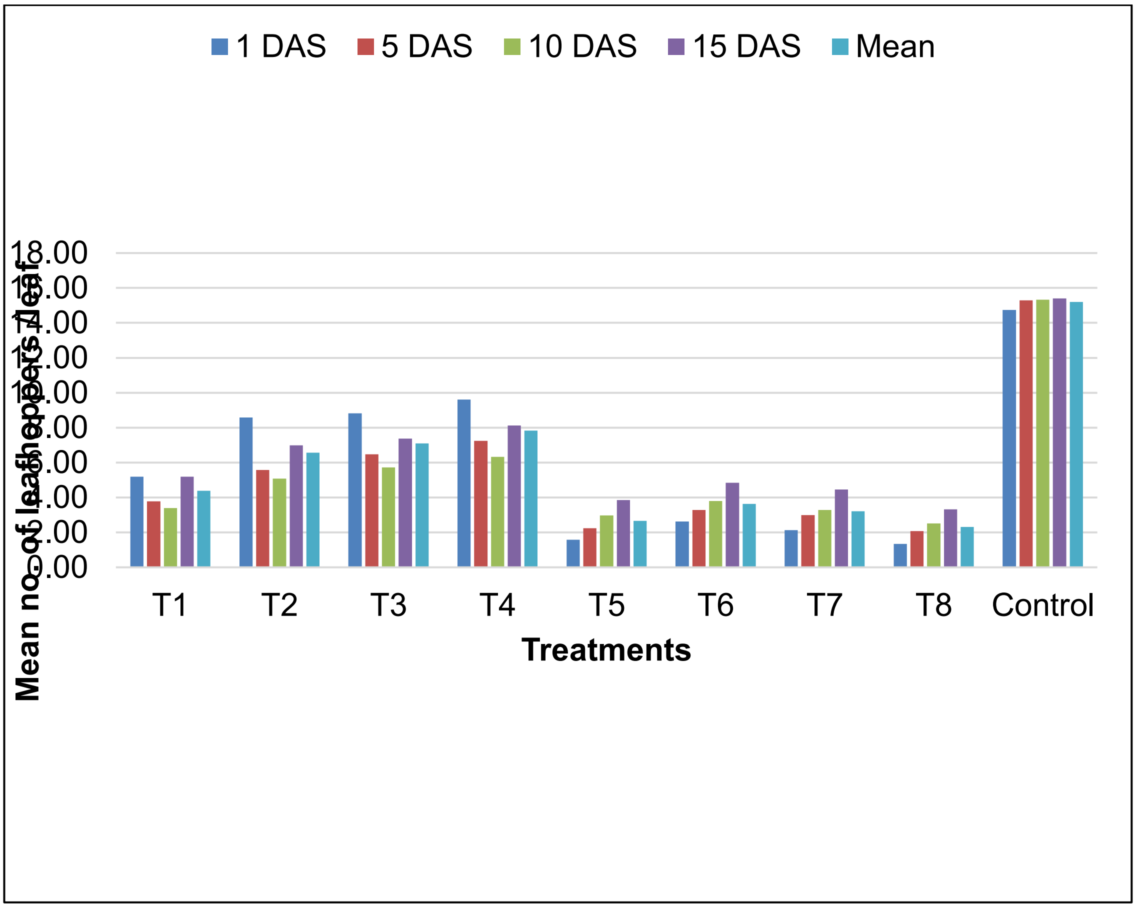

Fig 2: Efficacy of different botanical, biopesticides and insecticides for the management of leafhoppers*, A. biguttula biguttula* on okra after all three sprays during kharif 2023