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Bioefficacy of novel insecticides and their combinations against *Amrasca biguttula biguttula* in cotton

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Abstract: Field experiment conducted at Regional Agricultural Research Station, Nandyal during *kharif*, 2017-2018 to evaluate the efficacy of individual and combination of novel insecticides *i.e.*, spinetoram, sulfoxaflor, pyriproxyfen, fenpropathrin along with standard check and untreated control against leafhoppers. The results revealed that the insecticides spinetoram (10%) + sulfoxaflor (30% WG) @ 350 ml/ha, sulfoxaflor @ 437.5 ml/ha and sulfoxaflor @ 375 ml/ha recorded 56.39, 54.55 and 53.57 per cent reduction in leafhopper population, respectively after two sprays whereas spinetoram (10%) + sulfoxaflor (30% WG) @ 350 ml/ha, spinetoram (10%) + sulfoxaflor (30% WG) @ 300 ml/ha and sulfoxaflor @ 375ml/ha have recorded highest yield of 2144, 1919 and 1851 kg/ha, respectively.

Key words: Bollworms, chemicals, cotton, spinetoram, sucking pests, sulfoxaflor

Cotton (*Gossypium hirsutum* L.), popularly known as "White Gold" is an important fibre and cash crop of India having global significance. Cotton production in India during 2018-2019 was 36.1 million bales of 170 kg each from an area of 12.24 million ha with a productivity of 501 kg lint/ha. Cotton being a long duration and succulent crop, it is infested by a number of insect pests throughout its growth period. In India, about 162 insect pest species attack cotton crop from sowing to harvesting and causes yield loss up to 50-60 per cent (Agarwal *et al.*, 1984). The insect pests of cotton can be primarily divided into two groups as sucking pests and bollworms. Aphid (*Aphis gossypii* Glover), jassids (*Amrasca biguttula biguttula* Ishida), thrips (*Thrips tabaci* Lind.) and whitefly (*Bemisia tabaci* Genn.) are the major sucking pests of cotton. These sucking pests are noticed at all the stages of crop growth and responsible for direct and indirect yield losses. A reduction of 22.85 per cent in seed cotton yield due to sucking pests has been reported by Satpute *et al.*, (1990). Regular and indiscriminate use of insecticides and the misuse of synthetic pesticides on the crop have led to development of insecticide resistance in target pests, pest resurgence and secondary pest outbreaks, loss of bio-diversity, environmental pollution and residual toxicity and occurrence of human health hazards. However, in present day context chemical control has its own popularity over the other methods of pest control due to its immediate action and remarkable pest control. Crop protection with need based use of safer insecticides is considered as an effective and dependable component of IPM and one of the most important aspects of agro-ecosystem management with regards to the ecological and socio-economic values.

In this context, some newer group of insecticides alone or in combination at recommended dose are used for bringing about effective pest management of cotton. Keeping this in view, the present study was carried out to find the most effective new molecules of insecticides against sucking pests in cotton.

The experiment was conducted during *kharif*, 2017-2018 on black vertisols under All India Coordinated Research Project on Cotton at the Regional Agricultural Research Station, Nandyal. The experiment was laid out in

randomized block design with eleven treatments in three replications. Eleven treatments at their formulation doses *viz.,* spinetoram (10%) + sulfoxaflor (30% WG) @ 300 ml/ha (formulation), spinetoram (10%) + sulfoxaflor (30% WG) @ 350 ml/ha, spinetoram (10% SC) @ 250 ml/ha, sulfoxaflor (30% SC) @ 375 ml/ha, spinetoram (10% SC) @ 291.6 ml/ha, sulfoxaflor (30 % SC) @437.5 ml/ha, pyriproxyfen (5% EC) + fenpropathrin (15% EC) @ 37.5 + 112.5 @ 750 ml/ha, pyriproxyfen (5% EC) @ 750 ml/ha, fenpropathrin 15 per cent ec @ 750 ml/ha, water spray and control (No spray) were evaluated against insect pests of cotton. The sowing was done by hand dibbling with untreated seeds of cotton variety Suraj by placing two seeds/hill with a spacing of 60 x 30 cm on 2nd fortnight of July, 2017. Chemical fertilizers were applied @ 90:60:60 N: P_2O_5: K_2O kg /ha. Gap filling was done within 5-10 days after emergence of the crop and thinning was carried out at 15 days after emergence of the crop keeping one healthy seedling/mount. Intercultural and weeding operations were carried out as needed. Two sprays of insecticides were done, first spray at economic threshold level (ETL) of pests and subsequent spray at 10 days interval. During the period of experimentation jassid appeared as the major sucking pest and the remaining sucking pests were recorded below ETLs. The observations on incidence of leafhoppers was recorded by visual count from three leaves (each from top, middle and bottom) of five plants in each plot at a day before spraying (pre-count) and at 7 days after spraying (post- count) after attaining the ETLs. The plot yield in each treatment was recorded and expressed in kg/ha. The data recorded was suitably transformed and analyzed using the statistical procedures as per Gomez and Gomez (1984)

First spray:

A day before spraying (Pre-count), no significant difference was observed with respect to leafhopper population among the individual chemicals, their combinations and control. The population of leafhoppers ranged from 8 to 11.67 leafhoppers/ 3 leaves (Table 1). However, at one week after spray (post count), the leafhopper population ranged from 2.60 to 10.40 leafhoppers / 3 leaves with the lowest leafhopper population in sulfoxaflor @ 437.5 ml/ha treatment which was *on par* with spinetoram @ 250 ml/ha, sulfoxaflor @ 375 ml/ha, spinetoram + sulfoxaflor @ 350 ml/ha and spinetoram + sulfoxaflor @ 300 ml/ha which recorded 4.47, 4.80, 5.13 and 5.40 leafhoppers/ 3 leaves, respectively. The leafhopper population of 9.60/ 3 leaves was recorded in fenpropathrin + pyriproxyfen @ 750 ml/ha among the insecticide treatments whereas it was highest in both untreated and water spray treatments which recorded 8.60 and 10.40 leafhoppers/ 3 leaves, respectively (Table 1).

Second spray:

Among the 11 treatments including checks, no significant difference was observed with respect to leafhopper population during pre-treatment count during second spray and the leafhopper population ranged from 8.27 to 10.67 leafhoppers/ 3 leaves. One week after spray (post count), the lowest leafhopper population (3.73 leafhoppers/3leaves) was recorded in spinetoram + sulfoxaflor @ 350 ml/ha which was *on par* with spinetoram + sulfoxaflor @ 300 ml/ha, sulfoxaflor @ 375 ml/ha, spinetoram @ 291.6 ml/ha, and sulfoxaflor @ 437.5 ml/ha which recorded 3.80, 3.87, 5.27 and 5.40 leafhoppers/ 3 leaves, respectively. The treatments spinetoram @ 250 ml/ha, fenpropathrin @ 750 ml/ha, fenpropathrin + pyriproxyfen @ 750 ml/ha and pyriproxyfen @ 750 ml/ha followed the best treatment and were found *on par* with each other by recording 6.53, 6.60, 6.87 and 6.87 leafhoppers/3 leaves, respectively (Table 1).

The highest leafhopper population of 7.13 and 8.93 leafhoppers/ 3 leaves was recorded in both unsprayed plot and water sprayed plot.

The highest reduction of leafhopper population over control (56.39%) was recorded in

Table 1. Efficacy of different insecticidal treatments against cotton leafhoppers

S.No.	Treatment	Dose	First spray		Second spray	
		(ml/ha)	Pre- treatment	Post-treatment	Pre- treatment	Post-treatment
T_1	Spinetoram +sulfoxaflor	300	9.47	5.40	8.80	3.80
			(3.14)*	(2.41)	(3.03)	(2.06)
T_2	Spinetoram +sulfoxaflor	350	10.33	5.13	10.00	3.73
			(3.28)	(2.36)	(3.22)	(2.04)
T_3	Spinetoram	250	8.93	4.47	8.27	6.53
			(3.04)	(2.20)	(2.94)	(2.64)
T_4	Sulfoxaflor	375	9.33	4.80	9.33	3.87
			(3.13)	(2.29)	(3.13)	(2.08)
T_5	Spinetoram	291.6	9.13	5.80	8.47	5.27
			(3.10)	(2.48)	(2.98)	(2.39)
T_6	Sulfoxaflor	437.5	8.47	2.60	9.13	5.40
			(2.98)	(1.75)	(3.08)	(2.41)
T_7	Fenpropathrin +pyriproxyfen	750	9.07	9.60	9.40	6.87
			(3.08)	(3.16)	(3.14)	(2.70)
T_8	Pyriproxyfen	750	8.00	9.13	8.67	6.87
			(2.91)	(3.10)	(3.01)	(2.70)
T_9	Fenpropathrin	750	11.67	7.60	10.67	6.60
			(3.48)	(2.83)	(3.33)	(2.63)
T_{10}	Unsprayed	-	9.07	8.60	10.07	7.13
			(3.08)	(3.00)	(3.24)	(2.75)
T_{11}	Water spray	-	8.60	10.40	8.93	8.93
			(3.01)	(3.30)	(3.06)	(3.06)
	SEd (±)		0.29	0.27	0.32	0.25
	CD (p = 0.05)		NS	0.57	NS	0.52
	CV (%)		11.61	12.78	12.46	12.2

*Figures in parentheses are (“(x+0.5) transformed values

Table 2. Efficacy of different insecticidal treatments against cotton leafhoppers and yield of cotton

S.No.	Chemical	Dose	**Mean**		Per cent reduction	yield
		(ml/ha)	**Pre treatment**	**Post Treatment**	over control	(kg/ha)
T_1	Spinetoram +sulfoxaflor	300	**9.13**	**4.60**	49.64	1919
T_2	Spinetoram +sulfoxaflor	350	**10.17**	**4.43**	56.39	2144
T_3	Spinetoram	250	**8.60**	**5.50**	36.05	1729
T_4	Sulfoxaflor	375	**9.33**	**4.33**	53.57	1851
T_5	Spinetoram	291.6	**8.80**	**5.53**	37.12	1728
T_6	Sulfoxaflor	437.5	**8.80**	**4.00**	54.55	1842
T_7	Fenpropathrin +pyriproxyfen	750	**9.23**	**8.23**	10.83	1813
T_8	pyriproxyfen	750	**8.33**	**8.00**	4.00	1825
T_9	fenpropathrin	750	**11.17**	**7.10**	36.42	1705
T_{10}	unsprayed		**9.57**	**7.87**	17.77	1641
T_{11}	water spray		**8.77**	**9.67**	-10.27	1516
	F- test					S
	SEd					149
	CD (p=0.05)					311
	CV (%)					10.18

spinetoram + sulfoxaflor @ 350 ml/ha followed by sulfoxaflor @ 437.5 ml/ha (54.55%), and sulfoxaflor @ 375 ml/ha (53.57%) treatments. The treatments spinetoram + sulfoxaflor @ 300 ml/ha, spinetoram @ 291.6 ml/ha and fenpropathrin @ 750 ml/ha could able to reduce the leafhopper population by 49.64, 37.12 and 36.42 per cent, respectively (Table 2).

Yield

The highest seed cotton yield of 2144 kg/ha was recorded in spinetoram + sulfoxaflor @ 350 ml/ha which was *on par* with with spinetoram + sulfoxaflor @ 300 ml/ha, sulfoxaflor @ 375 ml/ha and sulfoxaflor @ 437.5 ml/ha which recorded 1919, 1851 and 1842 kg/ha yield, respectively (Table 2).

From the results obtained it is evident that spinetoram + sulfoxaflor @ 350 ml/ha, spinetoram + sulfoxaflor @ 300 ml/ha, sulfoxaflor @ 300 ml/ha and spinetoram @ 350 ml/ha, were effective in reducing the leafhopper population compared to other insecticides and the present results are in agreement with the findings of Ambarish *et al.*, (2017), Hanchinal *et al.*, (2018), and Mandi *et al.*, (2020) who have reported the efficacy of spinetoram + sulfoxaflor @ 350 and 300 ml/ha in reducing the sucking pests population with special reference to leafhoppers in cotton. The individual chemical efficacy of spinetoram and sulfoxaflor as obtained in the present investigation against leafhoppers were in accordance with the reports of Sivaramakrishna and Ramareddy (2020) However, the efficacy of sulfoximes was also reported in cotton against leafhoppers and against plant hoppers by Bedforde *et al.*, (1994) and Bhanu *et al.*, (2015) which also supports the results of the present investigation.

CONCLUSION

Spinetoram (10% w/w) + Sulfoxaflor (30% w/w WG) @ 140 g a.i./ha *i.e.*, 350 ml/ha (formulation) was most effective chemical for the management of sucking pests compared to the other chemicals tested.

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