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Management of White Fly (*Bemisia tabaci* Genn.) by Different Bio-Pesticides on Red Okra Crop

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted in *Kharif* season 2023 at an organic research farm, Kargua Ji, Department of Entomology, Bundelkhand University Jhansi. The present investigation was worked out with nine treatments including control (untreated) in three replications, a total of 27 plots were

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designed under randomized block design against the white fly infestation on the okra crop. Three applications of treatments were carried out and observations were taken at 3 days, 7 days and 14 days after spraying of the treatments. All the treatments were found significantly effective over control to manage the population of the white fly, where Neem oil was found to be the most effective treatment that recorded a minimum population of 6.94 whiteflies per leaf as per NKSE recorded 9.94 white fly/plant and Karanj oil (10.91), where all Neembased product was found effective against white fly moreover among all microbial pesticides *Beaveria bassiana* found effective. Among all treatments maximum yield was obtained from Neem oil treated plots recorded at 161.36 Qt/hac as per with NSKE (155.87 Qt/hac) but the highest C:B ratio was recorded under NSKE(1:1.82) followed by Neem oil (1:1.77).

Keywords: White fly (Bemisia tabaci); okra; neem oil; NSKE (Neem seed kernel extract).

1. INTRODUCTION

Okra (*Abelmoschus esculentus*) belongs to the family Malvaceae and is a popular vegetable in the Indian subcontinent and also grows worldwide, Indian ranked first in okra production, it is a tropical to subtropical crop requires a warm and humid climate and is sensitive to frost. It is usually consumed as a vegetable its tender green fruit is used for culinary purposes [1]. It is a good source of minerals and nutrients; its seeds are rich in unsaturated fatty acid and rich in fibre which is good for digestion and cures the ulcer of digestive system. Its mature fruit and stems contain crude fibre, which is used in the paper industry [2].

The production and quality of okra fruits are affected by an array of sucking and fruit-boring pests from sowing until harvest. The key sucking pests of okra are whiteflies, aphids, jassids, thrips and mites [3,4]. Among the sucking pests, whitefly, *Bemisia tabaci* Gennadius causes economic damage to okra by feeding on phloem sap, and also transmits the yellow vein mosaic disease. As compared to healthy plants, diseased plants showed a reduction of 24.9% in plant height, 15.5% decrease in root length, and 32.1% in number of fruits per plant, whereas stem girth was reduced by 16.3% [5,6-8]. The injudicious use of synthetic chemicals to manage these pests has resulted in resistance, resurgence, secondary pest outbreaks, and toxicity to beneficial organisms [9,10,11] where the botanicals and bio-pesticides play an important role in overcoming these problems and providing sustainable management of these insects.

2. METHODS AND MATERIALS

To find out the management strategy for infestation caused by white fly okra crop the study was carried out in *Kharif* season 2023 at Organic Research Farm, kargua ji, Bundelkhand University Jhansi (U.P.). Where the nine treatments *viz. Beaveria bassiana*, *Bacillus thurungiensis* var. *kurstaki*, *Verticillium laccani*, *Metarhizium anisople*, Neem oil, Karanj oil, NSKE, Garlic bulb extract and control were used in three replications under randomized block design. The red okra verity kashi lalima was shown in the spacing of 60 x 45 (Row x plant) in all 27 plots of the experimental side. When the population of the targeted insect was reached at ETL, application of the treatments was carried out on the crop. The treatments were applied three times on the crop in the total cropping period.

3. OBSERVATION

The data on insects was collected when the incidence of white flies started; the data collection was carried out after every application of the treatment at 3DAS, 7DAS and 14 days after spraying. The number of whiteflies per was observed and mean data was found to compare before and after spraying of treatments.

4. RESULTS AND DISCUSSION

First spray – Observation taken before after and after the first spray revealed that the population of the whitefly was ranged from 15-19 white fly per plant and after the application of the treatments Neem oil was found best effective showed 12.24 insects per leaf where before application it was 17.89 white fly per leaf followed by the NSKE and *Beaveria bassiana* that found 14.24 and 14.24 mean white fly population per plant. Moreover, *Metarhizium anisople* also showed good effectiveness for population reduction but *Bacillus thurungiensis* was found not effective against the population reduction of white flies and all treatments were effective over control. The untreated plot showed a 20.01 mean population of white flies where it was 18.09 before the application of treatments.

Table 1. Effect of treatment on the population of white flies after the first spray

T.no	Treatments	Doses	Mean population of white fly				Mean
			Before	3DAS	7DAS	14DAS	
T_1	*Beaveriabassiana*	5per cent	15.40	13.95	14.21	14.57	14.24
T_2	*Bacillus thurungiensis* var kurstaki	0.5per cent	18.07	17.67	17.88	17.88	17.81
T_3	*Verticiliumlaccani*	2.50ml / liter	17.45	15.82	16.38	16.74	16.31
T_4	*Metarhizium anisople*	2.50 ml / liter	16.06	14.78	15.03	15.36	15.06
T_5	Neem oil	10per cent	17.89	11.78	12.32	12.61	12.24
T_6	Karanj oil	1.5kg	17.05	15.09	15.48	15.72	15.43
T_7	NSKE	5per cent	16.80	14.06	14.22	14.44	14.24
T_8	Garlic bulb extract	5ml/ liter	19.00	16.63	17.06	17.55	17.08
T_9	Water spray control	----------	18.09	18.95	19.96	21.11	20.01
C.D.			N/A	1.844	1.791	1.830	0.496
SE(m)			0.920	0.610	0.592	0.605	0.164

Table 2. Effect of treatment on the population of white fly after the second spray

T.no	Treatments	Doses	Mean population of white fly				Mean
			Before	3DAS	7DAS	14DAS	
T_1	*Beaveriabassiana*	5per cent	16.70	12.68	13.14	13.70	13.17
T_2	*Bacillus thurungiensis* var kurstaki	0.5per cent	17.23	17.00	17.23	17.46	17.23
T_3	*Verticiliumlaccani*	2.50ml / liter	16.40	15.48	15.72	16.15	15.78
T_4	*Metarhizium anisople*	2.50 ml / liter	15.95	14.25	14.74	15.04	14.68
T_5	Neem oil	10per cent	17.32	9.99	10.39	10.66	10.35
T_6	Karanj oil	1.5kg	15.25	13.77	14.36	14.67	14.27
T_7	NSKE	5per cent	16.40	12.51	13.10	13.54	13.05
T_8	Garlic bulb extract	5ml/ liter	16.89	14.69	15.54	15.91	15.38
T_9	Water spray control	----------	15.81	23.41	24.81	27.84	25.35
C.D.			N/A	2.127	2.126	2.017	1.107
SE(m)			0.729	0.704	0.703	0.944	0.366

Table 3. Effect of treatment on the population of white fly after the third spray

T.no	Treatments	Doses	Mean population of white fly				Mean
			Before	3DAS	7DAS	14DAS	
T_1	*Beaveriabassiana*	5per cent	13.82	11.85	12.50	12.72	12.35
T_2	*Bacillus thurungiensis* var kurstaki	0.5per cent	17.98	16.58	16.80	16.89	16.76
T_3	*Verticiliumlaccani*	2.50ml / liter	16.45	13.86	13.99	14.30	14.05
T_4	*Metarhizium anisople*	2.50 ml / liter	15.48	12.94	13.34	13.55	13.27
T_5	Neem oil	10per cent	11.05	6.65	6.95	7.23	6.94
T_6	Karanj oil	1.5 kg	14.87	9.94	10.78	12.02	10.91
T_7	NSKE	5per cent	13.84	9.40	9.78	10.63	9.94
T_8	Garlic bulb extract	5ml/ liter	16.14	12.78	13.53	13.76	13.36
T_9	Water spray control	----------	29.87	30.97	31.41	32.35	31.58
C.D.			1.601	1.510	1.513	1.377	0.522
SE(m)			0.529	0.499	0.500	0.455	0.173

Table 4. Economics of cultivation and yields

T. no.	Treatments	Yield Qt/h	Cost of yield (Rs)	Common cost (Rs)	Treatment cost (Rs)	Total cost (Rs)	Net Income (Rs)	C:B ratio
T_1	*Bauvariabassiana*	137.68	247824	88800	5175	93975	153849	1:1.64
T_2	*Bacillus thuringiensis* var. kurstaki	123.54	222372	88800	4950	93750	128622	1:1.37
T_3	*Verticillium lacccani*	139.67	251406	88800	5175	93975	157431	1:1.68
T_4	*Metarrhiziumanisoplae*	135.64	244152	88800	4050	92850	151302	1:1.63
T_5	Neem oil	161.36	290448	88800	16200	105000	185448	1:1.77
T_6	Karnaj oil	149.47	269046	88800	21240	110040	159006	1:1.44
T_7	NSKE	155.87	280566	88800	10800	99600	180966	1:1.82
T_8	Garlic extract	140.36	252648	88800	3375	92175	160473	1:1.74
T_9	Water control	101.11	181998	88800		88800	93198	1:1.05

Labour – 300/day/labour (in rupees)
Seed rate – 350/50gram seeds (in rupees)

Second spray-After the second spray the observation showed that Neem oil was found best effective treatment which showed a 10.35 mean population of whitefly per leaf while before the second application, it was 17.32 white flies per leaf, Neem oil followed by NSKE and *Beaveria bassiana* which showed 13.05 and 13.17 mean population of white fly while it was 16.40and 16.70 before application respectively, more over *Metarhizium anisople* has also effective that also reduced population and showed14.68 mean population of whitefly while it was 15.95 before a second application of treatment and remain all treatments also found effective against white fly over control. The untreated plot showed a 15.81 mean population of white fly while observation taken after application of the treatments found a 25.35 increased population of whitefly per leaf of okra.

Third spray- The final observation of the white fly population taken before application data showed 11.05 to 29.87 mean population of white fly per was reported and after the third application of treatments found Neem oil was best effective in reducing the population of white that showed 6.94 mean population while it was 11.05 white fly per leaf at before application of treatments followed by NSKE and Karanj oil that showed 9.94 and 10.91 mean population of white fly while it was 13.84 and 14.87 mean population of white fly per leaf respectively before spray of treatments where entomo-pathogen *Beaveria bassiana* and *Metarhizium anisople* also found effective to control infestation that showed 12.35 and 13.27 mean white fly per leaf, remain all treatments found effective over control to manage the white fly population in okra crop while the untreated plot showed 31.58 increased population of white fly per leaf.

Fruit yield and cost-benefit ratio- The observation of the yield and economics of treatments found maximum fruit yield of 161.36 Q/hac was obtained from the Neem oil treated plot followed by 155.87 Q/hac and 149.47 Q/hac yield under NKSE and Karanj oil respectively and while minimum fruit yield under-treated plot was obtained from 123.54 Q/hac under the *Bacillus thuringiensis* treated plot where the highest economic return calculated based on C:B ratio was obtained from NSKE showed 1:1.82 followed by Neem oil that showed 1:1.77 C:B ratio.

5. CONCLUSION

The above field experiment concluded that Neem oil was found best effective in controlling the white fly population followed by NSKE where Neem oil gives maximum yield and is highly effective in the management of the white fly NSKE was also similarly effective as Neem oil but gives higher C:B ratio, among all treatments *Bacillus thuringiensis* was found least effective to management of white fly and entomopathogenic fungi *Beaveria bassiana* also effective to control population of the treatments.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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