Indian Journal of Entomology Online published Ref. No. e23328 DoI. No.: 10.55446/IJE.2024.1328

EFFICACY OF INSECTICIDES AGAINST MAJOR SUCKING INSECT PESTS OF OKRA AND THEIR EFFECT ON NATURAL ENEMIES

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ABSTRACT

Field experiment was conducted at the central research field, during kharif (March to July 2022). The experiment was laidout in RCBD (randomized complete block design). Ten treatments were evaluated against jassid *Amrasca biguttula* (Ishida) and whitefly *Bemisia tabaci* (Gennadius). At vegetative stage, lowest number of *A. biguttula* (0.25/ leaf) and *B. tabaci* (0.12/ leaf) was observed with emamectin benzoate + abamectin @ 0.50 g/ l and chlorantraniliprole + thiamethoxam @ 0.50 ml/ l. respectively, *A. biguttula* (1.16/ leaf) and *B. tabaci* (0.33/ leaf) was recorded as lowest with emamectin benzoate + abamectin @ 0.75 g/ l at fruiting stage. The lowest fruit infestation (9.56%) was observed with chlorantraniliprole + thiamethoxam @ 0.75 ml/ l. Maximum number of ladybird beetle, *Coccinella septempunctata* (L) (2.59/ plant); spider, *Hippasa agelenoides* (Simon) (1.20/ plant) and green lacewing, *Chrysoperla carnea* (Stephens) (2.50/ plant) were observed when no insecticide was used. Both chlorantraniliprole + thiamethoxam @ 0.75 ml/ l and emamectin benzoate + abamectin @ 0.75 g/ l led to the least number of *C. septempunctata* (0.33/ plant). Flubendiamide @ 0.50 g/ l led to insignificant number of *H. agelenoides* (0.33/ plant). The highest fruit yield (19.56 t/ ha) was achieved from emamectin benzoate + abamectin @ 0.50 g/ l.

Key words: okra, sucking pests, *Amrasca biguttula*, *Bemisia tabaci*, insecticides, chlorantraniliprole, emamectin benzoate, abamectin, coccinellid, lace wing, spider, yield

Okra (*Abelmoschus esculentus* L. Monech), commonly known as “bhendi”, is cultivated throughout Bangladesh (BBS, 2022). Growers of okra commonly claim productivity losses due to insect infestations.The okra shoot and fruit borer *Earias vittella* (F.) caused 45–57% damage (Srinivasan, 1983). Sucking pests, such as the jassid *Amrasca biguttula biguttula* (Ishida) and whitefly *Bemisia tabaci* (Gennadius) are becoming more common due to changing climate conditions and due to indiscriminate use of pesticides (Jain et al., 2021). Adults and nymphs both suck cell sap from the underside of leaves (Singh et al., 2008). According to Singh et al. (2008), yellow vein mosaic virus is also spread by *B. tabaci*. In ideal circumstances, insect pests can cause crop yield losses of 35-40% or even 60-70% (Salim, 1999). To control *B. tabaci* and *A. biguttula*, a variety of systemic and contact insecticides as well as biopesticides are currently advised (Suryawanshi et al., 2000; Satpathy et al., 2004). Most farmers are now realizing that these pesticides did not yield the intended control of sucking pests. Farmers use many pesticides indiscriminately to control sucking pests, which has resulted in resistance development in addition to the death of the pest's natural enemies and residual toxicity (Rohit et al., 2020). Finding safe compounds with improved insecticidal qualities, reduced mammalian toxicity, and safety to natural enemies etc. is crucial to solving these issues. Therefore, this study to validate and the effectiveness of various doses of more recent insecticides against sucking pests of okra.

MATERIALS AND METHODS

Study was carried out in the experimental field of Sher-e-Bangla Agricultural University, Dhaka, during kharif from March to July 2022. Ten treatments with three replications using RCBD were evaluated in three blocks, was further divided into ten plots (275 m^2 of space and 30-unit plots). The size of each plot was 6 m^2 (3× 2 m) with 60 x 40 cm spacing. Seeds of BARI Dherosh-2 were obtained from the Bangladesh Agricultural Development Corporation (BADC)'s seed division in Gabtoli, Dhaka. The plots were seeded on March 24, 2022, with 60 seeds (three seeds/ pit and 20 pits/ plot). The treatments were done in three doses and untreated control viz. T_1= belt 24 WG (flubendiamide) @ 0.25 g/ l, T_2 = belt 24 WG (flubendiamide) @ 0.50 g/ l, T_3 = belt 24 WG (flubendiamide) @ 0.75 g/ l, T_4= voliam flexi 300 SC (chlorantraniliprole + thiamethoxam) @ 0.25 ml/ l, T_5 = voliam flexi 300 SC (chlorantraniliprole

+ thiamethoxam) @ 0.50 ml/ l, T_6 = voliam flexi 300 SC (chlorantraniliprole + thiamethoxam) @ 0.75 ml/ l, T_7 = pine 6 WG (emamectin benzoate + abamectin) @ 0.25 g/ l, T_8 = pine 6 WG (emamectin benzoate + abamectin) @ 0.50 g/ l, T_9 = pine 6 WG (emamectin benzoate + abamectin) @ 0.75 g/ l and T_{10} = untreated control water. Each treatment was applied at 10 days interval and mean number of insects were taken after each spraying both at vegetative and reproductive stages. For data collection, five plants from each plot were chosen randomly. Statistical analysis was done by Statistix 10 computer software and mean was compared by the Tukey HSD test (0.005).

RESULTS AND DISCUSSION

The effectiveness of pesticides viz. flubendiamide, chlorantraniliprole + thiamethoxam and emamectin benzoate + abamectin at different doses against *A. biguttula* and *B. tabaci* and their effect on natural enemy were evaluated. The results showed significant variations among treatments (Table 1). At vegetative stage, lowest number of *B. tabaci* (0.12/ leaf) was recorded from T_5 (chlorantraniliprole + thiamethoxam) @ 0.50 ml/ l. These results are in agreement with those of Saini et al. (2023) on thiamethoxam 25 WG @ 0.5 g/ l and lambda-cyhalothrin 4.6% + chlorantraniliprole 9.3% @1 ml/ l against *B. tabaci*. At flowering and fruiting stages, lowest number of *B. tabaci* (0.83/ leaf) and (0.33/ leaf) was recorded with T_9 (emamectin benzoate + abamectin) @ 0.75 g/ l, respectively. Similar results were obtained by Hasan et al. (2008). Sujayanand et al. (2013) reported that the thiamethoxam and acetamiprid resulted in the effective management of leafhopper. Rohit et al. (2020) found that the less incidence of *B. tabaci* was recorded with thiomethoxam 25% WG @ 200g/ ha followed by chlorantraniliprole 18.5% SC @ 150ml/ ha, flubendiamide 20% WG @ 250g/ ha and emamectin benzoate 5% SG @ 200g/ ha.

At vegetative stage, lowest number of *A. biguttula* (0.25/ leaf) was recorded from T_8 (emamectin benzoate + abamectin) @ 0.50 g/ l. At flowering stage, it reduced to (1.18/ leaf)/ @ 0.75 g/ l. Similar trend was observed at fruiting stage. Reddy et al. (2018) found that a combination of insecticide (chlorantraniliprole 8.8 % + thiamethoxam 17.5 % SC) is effective against sucking pests in cowpea. The present findings are of Rohit et al. (2020) observed that thiamethoxam 25%WG, chlorantraniliprole 18.5%SC, emamectin benzoate 5%SG and flubendiamide 20%WG are effective against *A. biguttula.* Bisht et al. (2017)revealed that thiamethoxam 25%WG @ 25g a.i/ ha was the best. Sangamithra et al. (2018) found that the combination of insecticides with different modes of action and target group is effective. In case of fruit infestation (curled), lowest fruit infestation (9.56%) was obtained from T_6 (chlorantraniliprole + thiamethoxam) @ 0.75 ml/ l treated plots (Table 1).

The abundance of natural enemies viz. ladybird beetle *Coccinella septempunctata* (L), black ant *Lasius niger* (L), spider *Hippasa agelenoides* (Simon), syrphid fly *Syritta pipiens* (L) and green lacewing *Chrysoperla carnea* (Stephens) were recorded. The lower dose of each insecticide viz. T_1 (flubendiamide) @ 0.50 g/ l,T_4 (chlorantraniliprole + thiamethoxam) @ 0.25 gm/ l and T_7 (emamectin benzoate + abamectin) @ 0.25 ml/ l revealed good number of *C. septempunctata* (1.95 no./ plant), (1.00 no./ plant) and (0.83 no./ plant), respectively as against untreated control (2.59 no./ plant) (Table 2). The untreated plot T_{10} also revealed maximum number of *L. niger* (1.72 no./ plant) compared to 0.33 no./ plant with higher dose of chlorantraniliprole + thiamethoxam. Similar findings were recorded by Khan et al. (2022) with *C. septempunctata* and *C. carnea* Bhatt and Karnatak (2018) also observed more predator from the untreated control plot in kharif season.

T_2 (flubendiamide) @ 0.50 g/ l *H. agelenoides* (0.33 no./ plant) and *S. pipiens* (0.33 no./ plant) while, T_6 (chlorantraniliprole + thiamethoxam) @ 0.75 ml/ l experienced least number of *C. carnea* (0.34 no./ plant) Rahman et al. (2019) found that emamectin benzoate + abamectin at various doses (@ 0.25 g/ l and 0.50 g/ l) were less toxic to natural enemies especially to *C. septempunctata* and *H. agelenoides* compared to flubendiamide when evaluated against brinjal shoot and fruit borer, *Leucinodes orbonalis* (Guenee) in brinjal Amalin et al. (2009) found that higher numbers of arthropods were present in non-sprayed fields compared to fields sprayed with insecticides and herbicides. Kumar et al. (2012) also stated that in foliar application, all the systemic neonicotinoids such as imidacloprid, clothianidin, admire, thiamethoxam and acetamiprid were found highly toxic to natural enemies. It is recommended that lower or optimal doses of these insecticides be used in the field for commercial cultivation of vegetables like okra to preserve natural enemies for biological control.

Maximum yield (19.56 t/ ha) was recorded in T_8 (emamectin benzoate + abamectin) @ 0.50 g/ l followed by T_5 (chlorantraniliprole + thiamethoxam) @ 0.50

Table 1. Efficacy of insecticides against *B. tabaci* and *A. biguttula* in okra

Treatment	No of *B. tabaci*			No of *A. biguttula*			% fruit infestation
	At vegetative stage	At flowering stage	At fruiting stage	At vegetative stage	At flowering stage	At fruiting stage	
T_1(flubendiamide @ 0.25 g/ l)	0.31 de	1.46 b	0.88 bc	0.65 c	1.39bc	1.47 bcd	12.36 bc
T_2(flubendiamide @ 0.50 g/ l)	0.53 bc	1.35 bc	0.76 cd	0.74bc	1.47 bc	1.34 bcd	9.90 c
T_3(flubendiamide @ 0.75 g/ l)	0.26 def	1.31 bc	1.02 b	0.26ef	1.48 bc	1.37 bcd	10.67 c
T_4(chlorantraniliprole + thiamethoxam) @ 0.25 ml/ l	0.62 b	1.16cde	0.90 bc	0.37 def	1.75 abc	1.70abc	15.42 b
T_5(chlorantraniliprole + thiamethoxam) @ 0.50 ml/ l	0.12 f	1.28bcd	0.79 bcd	0.92 b	1.92 ab	1.82 ab	10.74 c
T_6(chlorantraniliprole + thiamethoxam) @ 0.75 ml/ l	0.47 bc	1.15 cde	0.75cde	0.55 cd	1.89 ab	1.99 a	9.56 c
T_7(emamectin benzoate + abamectin) @ 0.25 g/ l	0.17 ef	1.11 de	0.63 de	0.44 de	1.27 c	1.23 cd	15.91 b
T_8(emamectin benzoate + abamectin) @ 0.50 g/ l	0.40 cd	1.05 e	0.52 ef	0.25 f	1.95 ab	1.86 ab	9.74 c
T_9(emamectin benzoate + abamectin) @ 0.75 g/ l	0.57 b	0.83 f	0.33 f	0.44 d	1.18 c	1.16 d	10.89 c
T_{10}(untreated control)	1.35 a	1.75 a	1.29 a	1.13 a	2.18 a	2.08 a	24.57 a
CD (p=0.05)	0.16	0.20	0.23	0.19	0.61	0.52	4.05
CV	11.07	5.55	10.33	10.99	12.54	11.04	10.66

In column. Mean value of three replications containning same letter indicates significantly similar (Tukey p=0.05); CD= critical difference; CV= coefficient of variation

Table 2: Effect of insecticides on natural enemies and yield in okra

Treatment	*C. septempunctata*	*L. niger*	*H. agelenoides*	*S. pipiens*	*C. carnea*	Yield (t/ ha)	% Increase yield over control
T_1(flubendiamide @ 0.25 g/ l)	1.95	1.5	0.64	0.49	0.50	13.91	7.75
T_2(flubendiamide @ 0.50 g/ l)	0.67	0.67	0.33	0.33	1.12	15.90	23.16
T_3(flubendiamide @ 0.75 g/ l)	0.67	1.00	0.84	1.00	0.60	15.56	20.53
T_4(chlorantraniliprole + thiamethoxam) @ 0.25 ml/ l	1.00	0.83	0.33	0.84	0.35	14.75	14.25
T_5(chlorantraniliprole + thiamethoxam) @ 0.50 ml/ l	0.50	0.34	0.36	0.51	0.40	17.49	35.48
T_6(chlorantraniliprole + thiamethoxam) @ 0.75 ml/ l	0.33	0.33	0.34	0.33	0.34	16.01	24.01
T_7(emamectin benzoate + abamectin) @ 0.25 g/ l	0.83	0.33	0.50	0.78	0.65	15.27	18.28
T_8(emamectin benzoate + abamectin) @ 0.50 g/ l	0.50	0.33	0.67	0.67	1.20	19.56	51.50
T_9(emamectin benzoate + abamectin) @ 0.75 g/ l	0.33	1.00	0.65	1.00	0.98	17.20	33.23
T_{10}(untreated control)	2.59	1.72	1.20	1.75	2.5	12.91	-
CD (p=0.05)	0.37	0.30	0.18	0.23	0.31	4.03	-
CV	12.63	12.32	10.46	10.09	12.18	8.68	-

Values means means of three replications; CD= critical difference; CV= coefficient of variation ml/ l (17.49 t/ ha) Rahman et al. (2019) found that biopesticide emamectin benzoate + abamectin gave higher fruit yield against *L. orbonalis* in brinjal. Devi et al. (2015) opined that emamectin benzoate 12g ai/ ha provided the highest fruit yield.

ACKNOWLEDGEMENTS

The authors thank the Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh for providing facilities.

FINANCIAL SUPPORT

This research received no external funding.

AUTHOR CONTRIBUTION STATEMENT

MSIK conducted the experiment and analyzed the data, MEH helped in data analysis, manuscript preparation and revision, TAR contributed in data interpretation, MMR supervised the study and MSH reviewed the manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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(Manuscript Received: June, 2023; Revised: December, 2023;
Accepted: December, 2023; Online Published: January, 2024)
Online First in www.entosocindia.org and indianentomology.org Ref. No. e23328