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Biorational management of okra jassid (*Amrasca devastans*)

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Abstract

An experiment was carried out to appraise the comparative efficacy of some biorationals against okra jassid at the Field Laboratory, Department of Entomology, Bangladesh Agricultural University, Mymensingh during January to June 2016. The experiment was accomplished using three botanical oils (Neem oil@ 2ml/L, Mahogany oil @2ml/L & Karanja oil @2ml/L) and four microbial insecticides (Spinosad @ 1ml/ L, *Beauveria bassiana* @ 1 g/ L, Buprofezin @ 2ml/L, Emamectin benzoate @ 1g/L) along with control. Among various biorationals the mean number of nymph plant^{-1} varied significantly ($p<0.01$, $p<0.05$) after 1st, 2nd and 3rd spray. After 1st and 2nd spray, *Beauveria* showed the best results both at 3 DAT (0.00 & 2.33, respectively) while after 3rd spray Mahogany (0.00) performed best at 3 DAT compared to other treatments including control (4.00). In number of adult plant^{-1} effectiveness was reflected on Neem (0.66) among various biorationals at 3 DAT after 2nd spray. Similarly, at 5 and 7 DAT, the lowest number of adult was observed at Emamectin (1.66, 1.00), respectively. It revealed that Neem and Emamectin had strong efficacy in controlling okra jassid in comparison to their control (7.33, 11.33), respectively. After 3rd spray, the efficacy of different biorationals in managing okra jassid was significant ($p<0.01$). The Buprofezin showed the best performance both at 3 and 5 DAT (0.66 & 1.66, respectively). Similarly, the number of curled leaf plant^{-1} varied significantly ($p<0.05$, $p<0.01$) after both 1st 2nd and 3rd spray than the control. The lowest number of curled leaf plant^{-1} was observed in Neem (0.66) treated plants at 3 DAT after 2nd spray. This data revealed that the Neem had strong effect on okra jassid management. The number of curled leaf plot^{-1} also varied significantly ($p<0.01$) after 2nd and 3rd spray than the control. The highest infestation was always found in control treatment. The results indicated that *Beauveria bassiana* had strong efficacy in controlling okra jassid followed by Neem oil, Buprofezin and Emamectin benzoate in comparison to control. Therefore, it might be concluded that these biorational insecticides could be used as eco-friendly management strategy for okra jassid and can be incorporated in developing IPM programme for jassid.

Key words: Biorational, management, okra jassid, *Amrasca devastans*

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Introduction

Okra (*Abelmoschus esculentus* L.) commonly known as lady's finger is one of the most common summer vegetables grown all over the country and occupies an important place of food basket of Bangladeshi consumers (Anon. 1998). It contains carbohydrate, protein and vitamin C in large quantities (Adeboye and Oputa, 1996). Okra mucilage is suitable for medicinal and industrial application. It is an important vegetable crop providing a good source of income to farmers. One of the major constraints identified for the production of okra is the increasing incidence of insect pests, sometimes resulting in substantial yield losses.

Okra is susceptible to the attack of various insects from seedling to fruiting stage (Vyas and Patel, 1991). This crop is infested by many insect species, such as okra shoot and fruit borer (OSFB), okra jassid, cut worm, white fly, aphids etc. Among these due to favorable environmental conditions Jassid, *Amrasca devastans* is key pest in the tropics and subtropics. It is amongst the most important sucking insects that attack and cause heavy loss to okra crop (Dhandapani *et al*., 2003; Jamshaid *et al*., 2008). Among sucking insect pests, jassid and whitefly are more serious (Atwal, 1994) and transmit certain viral diseases. Moreover they cause a great damage by sucking the plant sap. Insect pests cause 35-40% crop yield losses and ultimately increase the level of damage up to 60-70% in optimal conditions (Salim, 1999).

To mitigate the losses due to this pest and to control okra jassid, our farmers are applying various types and high quantity of chemical insecticides but due to indiscriminate and non judicious use of chemical insecticides is causing insecticide resistance, insecticidal residues, phytotoxicity and death of the beneficial insects. Again, residual effect of insecticides causes the imbalance of the agro-ecosystem (Sarker and Nath, 1989). The fruits, which are harvested at short intervals of insecticide spraying, are likely to retain unavoidably high level of insecticide residues which may be highly hazardous to consumers (Sardana *et al.,* 2006). To prevail over the threat of food contamination, host plant resistance and diverse sources of bio-insecticides are being sought to replace the synthetic insecticides. Host plant resistance is a potential and more bio-rational approach of integrated pest management component which can suppress insect pest populations (Ashfaq *et al.*, 2010). Cultivation of resistant varieties is one of the most effective, economical, and eco-friendly tactics which proves to be the most promising method to enhance okra production (Khan *et al*., 2010). Plant derivatives being environment friendly having good potential (Grainge and Ahmad, 1988; Dhingra *et al.*, 2008) as insect control agent. Additionally, these are safe to human and other non-target organisms. Unfortunately, there is very few information is available on botanical management of this pest but till today no attempt has been taken to manage this pest using resistant variety and biorationals specially extracted products of microbes in our country. Considering the importance of eco-friendly approaches to manage the okra jassid, the present study has been intended to evaluate some available biorationals including botanicals and fermented products of microorganisms against this pest.

Materials and Methods

Present experiment was carried out at the Field Laboratory, Department of Entomology, Bangladesh Agricultural University, Mymensingh - 2202. Plants were developed following the procedure described in the first part of report. The experiment was conducted using the biorationals including three botanical oils (Neem oil@ 2ml/L, Mahoany oil @2ml/L, Karanja oil @2ml/L with 1 ml/L of Trix) and four microbial insecticides (Spinosad: Tracer 24Sc @ 1ml/ L, *Beauveria bassiana* @ 1 g/ L, Buprofezin: Award 40WSC @ 2ml/L, Emamectin benzoate: Emamectin benzoate 5SG@1g/L) along with control. Each treatment was replicated thrice. The experiment was designed in RCBD. Unit plot size of the plot was 4ft X 5ft. Seeds of Okra were sown in the field and the plants were developed for conducting experiment. All the treatments were applied in the field just after starting of pest infestation and continued until final harvesting maintaining 10 days interval. Data were collected on the No. of adult, nymph, egg/plant, No. of curled leaf/plant and No. of curled plant/plot. Data were collected for each parameter at 3, 5 and 7 days of each spraying. Recorded data from different experiments was analyzed using statistical program viz. MSTAT-C. All the data were analyzed statistically following the computer package MSTAT-C program. The mean differences among the treatments were adjudged as per test with Duncan's Multiple Range Test (DMRT) and Least Significant Difference (LSD) when necessary.

Results and Discussion

Mean number of nymph plant^{-1}: The mean numbers of nymph plant^{-1} under various biorationals were counted at different time intervals. Variation in mean numbers of nymph plant^{-1} among various biorationals varied significantly ($p<0.01$) after 1st spray (Table 1). The lowest mean number of nymph plant^{-1} was observed in *Beauveria* at 3 DAT (0.00) followed by Buprofezin (1.33) and Karanja oil (3.00ef). The highest mean number of nymph plant^{-1} (14.66a) was observed in control plants. This revealed that the *Beauveria* had strong controlling effect on okra jassid. At 5 DAT and 7 DAT, the lowest number of nymph plant^{-1} (2.33 & 1.33, respectively) was also observed in *Beauveria* bassiana treated plants. But the highest mean number of nymph plant-1(15.66, 17.00, respectively) was the highest both at 5 and 7 DAT in case of control plants (Table 1). The moderate mean number of nymph plant^{-1} was observed in Emamectin (4.33) and Neem (7.33), at 3 DAT; in Emamectin (4.00), Karanja (6.66) and Buprofezin (7.00) at 5 DAT; in Emamectin (6.00), Karanja (7.66) and Spinosad (8.66) at 7 DAT, which were also significantly different ($p<0.01$) from control treatment. This indicated the moderate efficacy of these biorationals on okra jassid (Table 1).

Table 1. Efficacy of different biorational insecticides on the incidence of okra jassid and curled leaf/plant^{-1} & plot^{-1} at 1st spray.

Treatment	1st spray											
	Mean no. of nymph plant^{-1}			Mean no. of adult plant^{-1}			Mean no. of curled leaf plant^{-1}			Mean no. of curled leaf plot^{-1}		
	3 DAT	5 DAT	7 DAT	3 DAT	5 DAT	7 DAT	3 DAT	5 DAT	7 DAT	3 DAT	5 DAT	7 DAT
Neem	7.33cd	12.00b	14.00ab	2.66d	8.33	11.00b	1.66bc	1.66b	1.00	5.00	4.66	4.33
Mahogany	11.00b	11.66b	13.66ab	6.00ab	8.66	9.66c	1.66bc	1.66b	0.66	5.33	5.00	5.66
Karanja	3.00ef	6.66c	7.66c	2.33d	7.00	7.66d	2.00ab	1.66b	0.66	6.66	7.00	4.33
Spinosad	10.00bc	12.66b	8.66a	5.33abc	8.66	8.66cd	2.00abc	1.66b	0.66	6.33	6.00	6.33
Buprofezin	1.33ef	7.00c	12.66b	2.33d	8.33	11.66b	2.00abc	1.66b	1.00	5.66	7.33	7.00
Beauveria	4.33de	4.00d	6.00d	4.00bcd	8.33	8.66cd	1.66bc	2.00a	1.00	6.66	6.33	6.66
Emamectin	0.00f	2.33d	1.33e	3.00cd	3.66	4.00e	1.33c	2.00a	0.66	5.66	4.66	5.66
Control	14.66a	15.66a	17.00a	7.00a	9.33	13.33a	2.33a	2.00a	2.00	8.33	7.66	7.00
Level of sig.	0.01	0.01	0.01	0.01	NS	0.01	0.05	0.05	NS	NS	NS	NS
CV (%)	20.10	11.24	13.07	23.67	62.26	16.17	33.94	33.92	45.82	32.52	30.44	36.11

Different letters in a column indicate the significant ($p\leq0.01$, $p\leq0.05$) different among the mean; DAT- Days after treatment.

Variation in mean numbers of nymph plant^{-1} among various biorationals varied significantly ($p<0.01$, $p<0.05$) after both 3rd and 2nd spray (Table 3 & 2). After 2nd spray, the lowest mean number of nymph plant^{-1} was observed in *Beauveria* at 3 DAT (2.33) and 5 DAT (2.33) compared to control at 3 DAT (6.00) and 5 DAT (9.33). This revealed that the *Beauveria* had strong controlling effect on okra jassid. At 7 DAT, the lowest number of nymph plant^{-1} was observed in Buprofezin (0.00) which was statistically similar to Emamectin benzoate (0.33). The moderate mean number of nymph plant^{-1} was observed in Neem (3.66), Mahogany (3.66) and Buprofezin (3.33) at 3 DAT; in Mahogany (3.66), Buprofezin (3.00) and Emamectin (2.66) at 5 DAT; in Spinosad (1.33), *Beauveria* (1.66) and Karanja (1.33) at 7 DAT, which were also significantly different ($p<0.01$, $p<0.05$) from control treatment. This indicated the moderate effect of these biorationals on okra jassid (Table 2).

Moreover, after 3rd spray, the lowest mean number of nymph plant^{-1} at 3 DAT was observed in Mahogany (0.00) followed by Buprofezin (2.33) indicating the strong efficacy on okra jassid compared to other treatments including control (4.00). At 5 DAT the highest mean number of nymph plant^{-1} was observed at Karanja (4.33) and the lowest number was observed at Buprofezin (1.33) among the biorationals (Table 3). But all the treatments showed significantly better performance of the number of nymph plan^{-1} than the control. Variation in number of nymph plant^{-1} at 7 DAT was statistically insignificant (Table 3). Mishra and Mishra (2002) found similar results in an experiment conducted on evaluation of the efficacy of some biopesticides on insect pests and defenders of okra. This result agrees with the findings of Alam *et al.* (2010) who observed that out of three botanicals studied Karanja repelled 93.33%, where as Mahogany and Neem repelled 86.66 and 63.33% and also found the efficacy of botanicals and synthetic insecticides in the following order: Admire 200 SL> Karajan oil >Mahogany oil >Neem oil.

Table 2. Efficacy of different biorational insecticides on the incidence of okra jassid and curled leaf/plant^{-1} & plot^{-1} at 2nd spray.

Treatment	**2nd spray**											
	Mean no. of nymph plant^{-1}			**Mean no. of adult plant^{-1}**			**Mean no. of curled leaf plant^{-1}**			**Mean no. of curled leaf plot^{-1}**		
	3 DAT	5 DAT	7 DAT	3 DAT	5 DAT	7 DAT	3 DAT	5 DAT	7 DAT	3 DAT	5 DAT	7 DAT
Neem	3.66bc	5.33b	3.33bc	0.66b	2.33b	1.66c	0.66b	1.66b	1.33c	2.33c	5.66	3.00b
Mahogany	3.66bc	3.66bc	5.66b	3.66b	4.00ab	2.33c	3.00ab	3.33ab	2.00bc	3.33bc	4.33	4.66ab
Karanja	5.00ab	3.00bc	1.33cd	3.00b	3.33b	6.00b	2.33ab	2.00ab	2.33abc	4.33bc	5.33	4.33ab
Spinosad	4.66ab	3.00bc	1.33cd	3.00b	2.66b	1.00c	2.00ab	1.66b	2.33abc	2.66c	3.00	2.33b
Buprofezin	3.33bc	3.00bc	0.00d	2.00b	2.66b	1.66c	1.00b	2.33ab	2.66ab	3.66bc	5.66	5.66ab
Beauveria	2.33c	2.33c	1.66cd	3.33b	3.66b	3.33bc	3.33ab	3.33ab	2.00bc	6.66ab	7.66	5.66ab
Emamectin	5.00ab	2.66bc	0.33d	1.00b	1.66b	1.00c	2.33ab	2.33ab	2.00bc	5.33bc	5.00	5.33ab
Control	6.00a	9.33a	11.33a	11.67a	7.33a	11.33a	4.66a	3.66a	3.33a	8.66a	7.66	7.33a
Level of sig.	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.05	0.01	NS	0.01
CV (%)	24.80	25.82	34.65	39.63	40.59	35.19	43.89	33.80	26.78	27.46	32.32	26.80

Different letters in a column indicate the significant ($p \leq 0.01$, $p \leq 0.05$) different among the mean; DAT- Days after treatment.

Mean number of adult plant^{-1}: The numbers of adult plant^{-1} under various biorationals were counted at different time intervals. Variation in numbers of adult plant^{-1} among various biorationals varied significantly ($p<0.01$) after both 3DAT and 7 DAT in 1st spray. But variation was non-significant at 5DAT (Table 1). After 1st spray, the lowest number of adult plant^{-1} at 3 DAT was observed in Karanja & Buprofezin (2.33) which was statistically similar to Neem (2.66), indicated that Karanja and Buprofezin have strong controlling effect on okra jassid compared to control (7.00). Similarly, at 5 and 7 DAT, the lowest number of adult was observed at *Beauveria* (3.66, 4.00), respectively. It revealed that the *Beauveria* had strong efficacy in controlling okra jassid in comparison to their control (9.33, 13.33), respectively (Table 1).

The numbers of adult plant^{-1} under various biorationals were counted at different time intervals. Variation in numbers of adult plant^{-1} among various biorationals varied significantly ($p<0.01$) after both 3rd and 2nd spray (Table 3 & 2). After 2nd spray, the lowest number of adult plant^{-1} at 3 DAT was observed in Neem (0.66) which was statistically similar to Emamectin (1.00) and

Buprofezin (2.00), indicated that Neem has strong controlling effect on okra jassid compared to control (11.67). Similarly, at 5 and 7 DAT, the lowest number of adult was observed at Emamectin (1.66, 1.00), respectively. It revealed that the Emamectin had strong efficacy in controlling okra jassid in comparison to their control (7.33, 11.33), respectively (Table 2).

After 3rd spray, the efficacy of different biorationals in managing okra jassid was significant ($p<0.01$). The lowest number of adult was observed at Buprofezin both at 3 (0.66) and 5 DAT (1.66), respectively, which was statistically similar to Emamectin (1.00, 2.00), *Beauveria* (1.00, 2.33) and Spinosad (0.66, 3.66), respectively (Table 3). This indicated that the Buprofezin had good controlling effect on okra jassid and the other biorationals such as Emamectin, *Beauveria* and Spinosad had moderate effect in managing okra jassid in comparison to their control (Table 3).

Table 3. Efficacy of different biorational insecticides on the incidence of okra jassid and curled leaf/plant^{-1} & plot^{-1} at 3rd spray.

Treatment	3rd spray											
	Mean no. of nymph plant^{-1}			Mean no. of adult plant^{-1}			Mean no. of curled leaf plant^{-1}			Mean no. of curled leaf plot^{-1}		
	3 DAT	5 DAT	7 DAT	3 DAT	5 DAT	7DAT	3DAT	5 DAT	7DAT	3DAT	5DAT	7 DAT
Neem	4.00b	2.00b	1.66	1.66c	3.00bc	2.33c	1.33	1.00d	0.66	3.00b	3.33b	3.33de
Mahogany	0.00e	2.33b	3.00	2.66bc	2.33bc	2.66c	2.00	1.66bcd	1.66	3.33b	7.00a	7.00ab
Karanja	3.66bc	2.66ab	3.00	4.66a	4.00ab	5.00b	1.33	1.33cd	1.00	3.33b	3.33b	4.66cd
Spinosad	2.66cd	2.33b	0.66	0.66c	3.66bc	1.66c	1.66	3.33a	2.33	4.33ab	6.66a	3.00de
Buprofezin	2.33d	1.33b	3.33	0.66c	1.66c	2.33c	2.00	3.00ab	2.33	6.00a	4.66ab	5.00bcd
Beauveria	2.66cd	1.66b	2.00	1.00c	2.33bc	3.33bc	1.00	2.33abcd	1.00	4.33ab	3.00b	2.33e
Emamectin	3.33bcd	1.66b	1.00	1.00c	2.00bc	1.66c	1.33	2.66abc	1.66	4.33ab	5.33ab	5.66abc
Control	6.66a	4.33a	4.00	4.00ab	5.66a	7.66a	2.66	3.00ab	3.00	6.33a	7.66a	7.33a
Level of sig	0.01	0.01	NS	0.01	0.01	0.01	NS	0.05	NS	0.01	0.01	0.01
CV (%)	15.79	32.12	54.63	37.41	24.77	24.49	54.77	33.33	75.37	21.38	22.88	17.56

Different letters in a column indicate the significant ($p\leq0.01$, $p\leq0.05$) different among the mean.

Mean number of curled leaf plant^{-1}: The number of curled leaf plant^{-1} varied significantly ($p<0.05$) after 3 & 5 DAT in 1st spray among various biorationals. After 1st spray, the lowest number of curled leaf plant^{-1} was observed at *Beauveria* (1.33) followed by Neem, Mahogany and Emamectin (2.66) at 3 DAT. At 5 & 7 DAT the lowest number of curled leaf plant-1 was also found in *Beauveria*. The data revealed that the *Beauveria* has good controlling effect on okra jassid compared to their control. The moderate mean number curled leaf plant^{-1} was observed in Karanja, Spinosad, and Buprofezin (2.00) indicating the moderate efficacy of these biorationals in controlling okra jassid in comparison to their control at 5 DAT (Table 1).

The number of curled leaf plant^{-1} varied significantly ($p<0.01$, $p<0.05$) after both 3rd and 2nd spray among various biorationals. After 2nd spray, the lowest number of curled leaf plant^{-1} was observed at Neem (0.66, 1.66, and 1.33) at 3, 5 and 7 DAT, respectively. The data revealed that the Neem has good controlling effect on okra jassid compared to their control. The moderate mean number curled leaf plant^{-1} was observed in Mahogany (2.00), Spinosad (2.33), Emamectin (2.00) and Karanja (2.66) indicating the moderate efficacy of these biorationals in controlling okra jassid in comparison to their control at 7 DAT (Table 2).

After 3rd spray, the variation in number of curled leaf plant^{-1} was insignificant at 3 and 7 DAT. At 5 DAT, the number of curled leaf plant^{-1} varied significantly ($p<0.01$) among different biorationals. The lowest number of curled leaf plant^{-1} was observed in Neem (1.00) which was statistically similar to Karanja (1.33). This data revealed that the good efficacy of Neem in controlling okra jassid (Table 2). These results were similar with the findings of Jayakumar (2002), who reported that spraying Neem oil + Garlic extract minimized the incidence of aphid and jassid on okra.

Mean number of curled leaf plot^{-1}: The number of curled leaf plot^{-1} did not vary significantly 1st spray among various biorational insecticides and control also. After 1st spray, the lowest number of curled leaf plot^{-1} was observed at Neem (5.00, 4.66, and 4.33, respectively) at 3, 5 & 7 DAT. But the highest number of curled leaf plot-1(8.33, 7.66 & 7.00, respectively) was the highest in control plots after 3, 5 & 7 DAT. The data revealed that the Neem has good controlling effect on okra jassid compared to their control (Table 1).

The number of curled leaf plot^{-1} varied significantly ($p<0.01$) after both 3rd and 2nd spray among various biorational insecticides. After 2nd spray, the lowest number of curled leaf plot^{-1} was observed at Neem (2.33, 3.00), which was statistically similar to Spinosad (2.66, 2.33) at 3 and 7 DAT, respectively. The data revealed that the Neem has good controlling effect on Okra jassid compared to their control. The moderate mean number curled leaf plot^{-1} was observed in Mahogany (4.66), Spinosad (2.33), Emamectin (5.33) and Karanja (4.33) indicating the moderate efficacy of these biorationals in controlling okra jassid in comparison to their control at 7 DAT. The variation in number of curled leaf plot^{-1} was insignificant at 5 DAT (Table 2).

After 3rd spray, the variation in number of curled leaf plot^{-1} was statistically significant ($p<0.01$) at 3, 5 and 7 DAT. The lowest number of curled leaf plot^{-1} was observed in Neem (3.00) which was statistically similar to Karanja (3.33) and control (3.33). At 7 DAT, the lowest number of curled leaf plot^{-1} was observed in *Beauveria* (2.33) which was statistically similar to Neem (3.33). This data revealed that the good efficacy of Neem in controlling okra jassid (Table 3). These results were supported by the findings of Gosalwad (2006) who observed that Spinosad 0.005% was the most effective treatment for the control of the aphid and jassid of okra.

Conclusion

An experiment on damage assessment and eco-friendly management of okra jassid had been conducted in the field Laboratory, Department of Entomology, Bangladesh Agricultural University, Mymensingh during February to June 2016. Eight treatments including control (Neem oil, Mahogany oil,Karanja oil, Spinosad, Buprofezin, Emamectin benzoate,*Beauveria bassiana*) were selected to conduct an experiment to identify suitable biorational(s) for jassid management. After the application of stated biorationals data were recorded at different time intervals. Considering the mean number of nymph plant^{-1}, mean number of adult plant^{-1} and the mean number of curled leaf plant^{-1} among various biorationals varied significantly ($p<0.01$, $p<0.05$) after 1st, 2nd and 3rd spray. All the biorationals showed significant effect in controlling okra jassid at all three sprays. Finally, it could be concluded that *Beauveria bassiana* followed by Neem oil, Buprofezin and Emamectin benzoate had strong efficacy in controlling okra jassid in comparison to their control. Therefore, in botanical control approach Neem oil could be added as an effective controlling agent whereas in bio-control method *Beauveria bassiana,* Buprofezin and Emamectin benzoate could be used.

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