Field evaluation of promising biorational pesticides against brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee

Islam, T., Das, G. and Mahir Uddin, M.

ABSTRACT

In the present study, efficacy of three bacterial fermented biopestcides *viz*., spinosad, emamectin bennzoate and abamectin and one insect growth regulator, buprofezin were evaluated against the infestation of brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* (Guen) during January to July 2015. Biopesticides were applied either individually or in some selected combinations *viz*., buprofezin + emamectin benzoate, buprofezin + abamectin, buprofezin + spinosad and data were collected on different parameters such as percent shoot infestation, percent fruit infestation and marketable fruit yield. It was found that all the treatments significantly reduced percent shoot (15.66-63.99% reduction) and fruit infestation (17.27-70.75% reduction) and increased marketable fruit yield over control (12.87-84.33% increase). The best result was found in case of combined treatment buprofezin + emamectin benzoate treated plots (70.75% shoot and 63.99% fruit protection; highest marketable fruit yield of 9.94 t/ha) whereas the least protection was obtained from buprofezin (1 mL/L) treated plots (17.27% shoot and 15.66% fruit protection; lowest marketable fruit yield of 6.05 t/ha). The present study revealed that the selected biorational pesticides could be used both singly and in combination for the successful management of *L. orbonalis.*

MS History: 01.05.2016 (Received)-28.08.2016 (Revised)- 11.10.2016 (Accepted)

Key words: Abamectin, brinjal, buprofezin, Emamectin, spinosad, production.

Citation: Islam, T., Das, G. and Mahir Uddin, M. 2016. Field evaluation of promising biorational pesticides against brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. *Journal of Biopesticides*, 9 (2): 113-118.

INTRODUCTION

Brinjal (*Solanum melongena* Linn.) is one of the most important vegetable crops in South-East Asia (Thapa, 2010). Its worldwide cultivation is more than 1,600,000 ha and production is 50 million Mt (FAO, 2012) and it covers about 15% of the total vegetable cultivation area of Bangladesh (Rahman, 2005). Brinjal is susceptible to attack of various insects from seedling to senescence. Among these insect pests brinjal shoot and fruit borer, *Leucinodes orbonalis* Guen. (Lepidoptera: Pyralidae) is the most destructive pest and is considered to be the limiting factor in quantitative as well as qualitative harvest of brinjal fruits (Latif *et al.*, 2010; Chakraborty and Sarkar, 2011; Dutta *et al.*, 2011; Saimandir and Gopal, 2012). The pest is very active during the rainy and summer season and may cause 85 to 90 % damage (Misra, 2008; Jagginavar *et al.*, 2009; Thapa, 2010). The larvae bore into tender shoots at the vegetative stage causing withering and drooping of young shoots (CABI, 2007). But once fruit setting has been initiated, shoot infestations become very negligible (Kumar and Dharmendra, 2013). A single larva can infest 4 to 7 fruits during its life span (Jayaraj and Manisegaran, 2010).

Chemical control is the most common practice in Bangladesh to control *L. orbonalis* as well as to produce blemish-free brinjal fruits. More accurately, 98% brinjal-growers in Jessore district (southern part of Bangladesh) relied exclusively on the use of conventional pesticides and they used those pesticides 140 times or more in the 6-7 month cropping season (AVRDC, 2003). Brinjal being a vegetable crop, use of conventional chemical insecticides leaves considerable toxic residues on the fruits and it also increases 40-50% production cost in Bangladesh (SUSVEG-Asia, 2007). In addition, sole dependence on chemical insecticides for controlling *L. orbonalis* may lead to insecticide resistance, secondary pest outbreak, pest resurgence, environmental and health hazards etc.

Therefore, some most promising biorational pesticides with greater selectivity and considerably lower risks to human, wildlife and the environment could be possible alternatives for managing BSFB. Hence the present study was planned to assess the relative efficacy of three bacterial fermented biopestcides *viz.*, spinosad, emamectin benzoate and abamectin and one insect growth regulator called buprofezin under field conditions. All these biopesticides were reported to be effective against lepidopteran pest management (Misra, 2008; Lopez *et al.*, 2010, Shah *et al*., 2012; Das and Islam, 2014). In the present study biopesticides were evaluated as individual treatments and in some selected combinations to assess the interaction of buprofezin with other bacterial fermented biopesticides.

MATERIALS AND METHODS

Field experiments were conducted in the field laboratory of the Department of Entomology, Bangladesh Agricultural University (BAU), Mymensingh, during January to July 2015. The field experiments were consisted of nine treatments using four biorational pesticides. Treatments were: T_1-Suspend 5 SG (Emamectin Benzoate) @ 1g/L, T_2-Benten 1.8 EC (Abamectin) @ 1mL/L, T_3-Libsen 45 SC (Spinosad) @ 1mL/L, T_4-Award 40 SC (Buprofezin) @ 1mL/L, T_5-Award 40 SC @ 2mL/L, T_6- Award 40 SC (1mL/L) + Suspend 5 SG (0.5 g/L), T_7- Award 40 SC (1mL/L) + Benten 1.8 EC (0.5 mL/L), T_8- Award 40 SC (1mL/L) + Libsen 45 SC (0.5 mL/L), and T_9-untreated control. All the treatments were laid out in the Randomized Complete Block Design (RCBD). The whole experimental field was about 23 m in length and 9 m in width which was then divided into 3 equal blocks. Each of the blocks had 9 equal plots and finally a total of 27 plots were made in the specified area for conducting the experiments. The size of a unit plot was 2 m X 2 m. Two adjacent unit plots and blocks were separated by 60 cm and 80 cm apart, respectively. Brinjal variety, amjhuri which is a local cultivar, was selected for the experiment. Cowdung and other chemical fertilizers were applied as recommended by Rashid (1993) for eggplant at the rate of 15000 kg cowdung and 250, 150, 125 kg of urea, TSP and MP respectively per hectare. After treatment application, data on percent shoot infestation were collected at 7 and 14-days and four sprayings of treatments were done at 15 days interval. Spraying of insecticides were done in the morning using a high clearance sprayer equipped with a compressed air charged spray system calibrated to deliver 10 gpa through TX-6 hollow cone nozzles (2/row). Fruit picking was done after 14 days of treatment application. The number of total and infested shoot and fruit was calculated for each plot (4plants/plot) and the percentage of infested shoot and fruit was calculated using the following formula:

Infested shoot or fruit (%) = Po/Pr X 100

where,

Pr = Total number of shoot or fruit per plot

P_o = Number of infested shoot or fruit per plot

Finally, mean percentage of shoot and fruit infestation was calculated for each of the treatments from the three replicated plots.

The recorded data were compiled and tabulated for statistical analysis. Analysis of variance was done with the help of computer package MSTAT. The mean differences among the treatments were adjudged with Duncan's Multiple Range Test (DMRT). Least significant difference (LSD) was determined at the probability level of 5% to decide the significance of individual treatment effect.

RESULTS AND DISCUSSIONS

It was observed that each of the treatments was significantly effective against brinjal shoot and fruit borer compared to control. The highest percentage of shoot infestation was observed in case of untreated control which was ranged from 11.49% to 49.04% where the cumulative mean of infestation was 29.06% (Table 1).

Among individual treatments, the lowest percentage of shoot infestation was observed from emamectin benzoate treated plots which were followed by abamectin, spinosad, higher and lower doses of buprofezin respectively.

Table 1. Mean percentage of shoot infestation caused by *L. orbonalis* at different sprayings against different treatments

Treatments	Pre-treated shoot (%)	Mean percent shoot infestation caused by *L. orbonalis* at different sprayings								Cumulative mean	% Protection over control
		First spray		Second spray		Third spray		Fourth spray			
		7 DAS	14 DAS	7 DAS	14 DAS	7 DAS	14 DAS	7 DAS	14 DAS		
T_1	6.05	6.15cde	7.19d	7.15d	8.25e	8.95de	9.44de	10.07e	11.53d	8.59d	70.44
T_2	6.50	6.59cd	6.91d	7.07d	7.97e	8.88de	9.24e	11.93e	13.47e	9.01d	69.00
T_3	5.30	5.24e	7.52d	7.92d	9.36d	10.13d	12.31d	13.21d	15.14d	10.10d	65.24
T_4	5.90	9.13b	12.57b	13.57b	18.40b	21.55b	30.11b	40.48b	46.52b	24.04b	17.27
T_5	6.61	7.44c	9.10c	11.58c	14.43c	16.61c	19.30c	21.56c	27.41c	15.93c	45.18
T_6	6.00	6.09de	7.09d	7.57d	8.22e	9.08de	9.41de	10.26e	10.29d	8.50d	70.75
T_7	5.91	6.14cde	7.39d	7.40d	8.22e	8.05e	10.60de	11.51de	12.86d	9.02d	68.96
T_8	6.10	6.83cd	7.10d	7.06d	7.99e	8.16e	10.45de	11.44de	13.66d	9.09d	68.72
T_9	6.05	11.49a	14.90a	18.14a	24.21a	33.27a	37.69a	43.76a	49.04a	29.06a	
$LSD_{0.05}$	1.597	1.20	0.865	1.17	1.16	1.31	1.92	1.90	2.10	1.82	
SE (±)	0.851	0.645	0.965	1.31	1.96	2.88	3.50	4.46	5.11	2.58	
Level of significance	NS	**	**	**	**	**	**	**	**	**	
CV(%)	15.18	9.62	5.63	6.98	5.66	5.44	6.82	5.87	5.49	7.71	

In a column, means followed by similar letter(s) are not significantly different. DAS: Days After Spraying

Moreover, 70.44, 69.00, 65.24, 45.18 and 17.27% shoots were protected from larval infestation compared to control plots when brinjal plants were treated with emamectin benzoate, abamectin, spinosad, higher and lower doses of buprofezin, respectively. In case of combined treatments, mean percentage of shoot infestation in buprofezin + emamectin benzoate, buprofezin + abamectin and buprofezin + spinosad treated plots was 8.50, 9.02 and 9.09 percent respectively. Interestingly, the percentage of shoot infestation was not reduced remarkably when emamectin benzoate, abamectin and spinosad were applied in combination with buprofezin (Table 1). However, percentage of shoot protection was 70.75, 68.96 and 68.72 from buprofezin + emamectin benzoate, buprofezin + abamectin and buprofezin + spinosad treated plots respectively (Table 1). The results indicated that the combined actions of buprofezin with other biopesticides were slightly additive as compared to individual treatments.

Similar to shoot protection, all the selected biopesticides significantly reduced percent fruit infestation in comparison to control treatment. The highest percentage of infested fruits from all 4 pickings was obtained when brinjal plants were left untreated where the cumulative mean was found 26.63 percent (Table 2). This comparatively lower fruit infestation raised the possibility that the selected variety was moderately resistant to BSFB infestation. The results indicated that all three bacterial fermented biopesticides viz. emamectin benzoate, abamectin and spinosad showed better efficacy than IGR-based biopesticide buprofezin regarding the percentage of fruit infestation. Moreover, 58.58, 54.26 and 53.02% fruits were protected from larval infestation when brinjal plants were treated with emamectin benzoate, abamectin and spinosad respectively (Table 2). The mean percentage of fruit infestation in buprofezin treated plots was recorded 22.46% for the lower dose which was significantly worsens from the higher dose infestation). Therefore, the efficacy of buprofezin was completely dose-dependent. The results of the present study supported the findings of several previous studies. Kumar and Devappa (2006) also found emamectin benzoate to be effective up to last harvest in reducing brinjal shoot and fruit borer infestation. Aprana and Dethe (2012) and Anil and Sharma (2010) reported that emamectin benzoate and spinosad was most effective in reducing BSFB infestation and increasing marketable fruit yield.

In case of combined doses, mean percentage of fruit infestation in buprofezin + emamectin benzoate, buprofezin + abamectin and buprofezin + spinosad treated plots was 9.59, 10.80 and 12.19 percent respectively. More clearly, 63.99, 59.44 and 54.22% fruit protections were obtained from buprofezin + emamectin benzoate, buprofezin + abamectin and buprofezin + spinosad treated plots respectively. These results revealed that percent fruit infestation was not reduced remarkably in combined treatments as compared to individual doses. These might be due to fact that, in all combined treatments biopesticides were applied in half of the recommended doses which ultimately showed trivial additive interaction with buprofezin. Among the individual treatments, the maximum marketable yield was obtained from emamectin benzoate treated plots which were followed by abamectin, spinosad, higher and lower doses of buprofezin respectively (Table 3). Although marketable fruit yield in buprofezin treated plots was significantly better compared to control plots but both the doses of buprofezin were worst treatments as compared to other treatments. This might be due to the fact that buprofezin is an insect growth regulator having very slow mode of action. Das and Islam (2014) reported that buprofezin was moderately effective against BSFB larvae under laboratory conditions but it requires intensive exposure which might not be available in the field conditions. However, among the combined doses the highest amount of marketable fruit yield was obtained from buprofezin + emamectin benzoate treated plots which was followed by buprofezin + abamectin and buprofezin + spinosad treated plots respectively.

Table 2. Mean percentage of fruit infestation by *L. orbonalis* at different pickings

Treatments	Mean percent fruit infestation by *L. orbonalis* at different pickings				Cumulative mean	Protection over control (%)
	1st picking	2nd picking	3rd picking	4th picking		
T_1	11.10de	10.81e	11.91e	10.30f	11.03e	58.58
T_2	12.38cd	11.71de	11.95e	12.36d	12.10d	54.56
T_3	12.34cd	12.22d	14.18d	11.30e	12.51d	53.02
T_4	20.64a	20.01b	25.76b	23.44b	22.46b	15.66
T_5	12.50c	16.34c	18.04c	18.53c	16.35c	38.6
T_6	10.05e	7.80f	10.52f	9.98f	9.59f	63.99
T_7	12.32cd	11.26de	9.02g	10.61ef	10.80e	59.44
T_8	12.61c	11.20de	13.70d	11.25e	12.19d	54.22
T_9	19.46b	27.85a	30.62a	28.57a	26.63a	
$LSD_{0.05}$	1.18	1.19	1.22	0.79	1.07	
SE (±)	0.39	0.40	0.41	0.26	0.36	
Level of significance	**	**	**	**	**	
CV (%)	4.99	4.79	4.37	3.01	4.17	

From the experimental findings it can be said that all three bacterial-fermented biopesticides *viz.* emamectin benzoate, abamectin and spinosad can be applied successfully for the management of BSFB as they provide significant protection of brinjal shoots and fruits over control. Although the IGR-based biopesticide, buprofezin provided significant protection of brinjal as compared to control plots it should not be used solely for the management of BSFB as the percentage of protection was not so satisfactory. Therefore, buprofezin could be used as a component of an IPM program with other control tactics. However, the combined doses of buprofezin with three bacterial fermented biopesticides were slightly more effective than the single doses of each biopesticide which indicated their additive interactions but these combined exposures might cost more as compared to the individual treatments.

Table 3. Yield of marketable brinjal fruits (t/ha) after application of different treatments

Treatments	Total marketable yield	% increase in fruit yield over control
T_1	9.86a	83.96
T_2	9.34ab	74.25
T_3	8.17c	52.43
T_4	6.05e	12.87
T_5	7.36d	37.31
T_6	9.94a	85.45
T_7	9.88a	84.33
T_8	8.81bc	64.37
T_9	5.36e	
$LSD_{0.05}$	0.69	
SE (±)	0.23	
Level of significance	**	
CV (%)	4.81	

In a column, means followed by similar letter(s) are not significantly different.

REFERENCES

Anil, M. and Sharma, P. C. 2010. Bioefficacy of insecticides against *Leucinodes orbonalis* on brinjal. *Journal of Environmental Biology*, **31**: 399-402.

Aparna, K. and Dethe, M. D. 2012. Bioefficacy study of biorational insecticide on brinjal. *Journal of Biopesticides*, **5**(1): 75-80.

AVRDC. 2003. Technical Bulletin No. 28. Asian Vegetable Research and Development Center, Shanhua, Tainan, Taiwan. 55 **P**.

CABI. 2007. Crop Protection Compendium. CAB International. http://www. cabicompendium.org/cpc

Chakraborty, S. and Sarkar, P. K. 2011. Management of Leucinodes orbonalis Guenee on eggplant during the rainy season in India. *Journal of Plant Protection Research*, **51**(4): 325–328.

Das, G. and Islam, T. 2014. Mortality and growth inhibition of brinjal shoot and fruit borer, Leucinodes *orbonalis* (Guen.) by buprofezin, a potent chitin synthesis inhibitor. *Journal of Entomology and Zoology Studies*, **2**(6):282–287.

Dutta, P., Singha, A. K., Das, P. and Kalita, S. 2011. Management of brinjal fruit and shoot borer, *Leucinodes orbonalis* in agroecological conditions of west tripura. *Journal Agriculture Science*, **1**(2): 16–19.

FAO. 2012. FAOSTAT. http://www.fao.org

Jagginavar, S. B., Sunitha, N. D. and Biradar, A. P. 2009. Bioefficacy of flubendiamide 48SC against brinjal fruit and shoot borer, *Leucinodes orbonalis* Guen. *Karnataka Journal of Agricultural Sciences*, **22**(3), 712–713.

Jayaraj, J. and Manisegaran, S. 2010. Management of fruit and shoot borer in brinjal. The Hindu Science Technology Agricultural College and Research Intuition, Madurai.

Kumar, P. and Devappa, V. 2006. Bioefficacy of emamectin benzoate 5% SG (proclaim) against brinjal shoot and fruit borer. *Pestology*, **30**: 17-19.

Kumar, S. and Dharmendra, S. 2013. Seasonal incidence and economic losses of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. *Agricultural Science Digestion*, **33**: 98-103.

Latif, M. A., Rahman, M. M. and Alam, M. Z. 2010. Efficacy of nine insecticides against shoot and fruit borer, *Leucinodes orbonal*is Guenee in eggplant. *Journal of Pest Science*, **83**(4): 391–397.

Lopez, J. A., Amor, F., Bengochea, P., Medina, P., Budia, F. and Vinuela, E. 2011. Short communication. Toxicity of emamectin benzoate to adults of *Nesidiocoris tenuis* Reuter, *Macrolophus pygmaeus* (Rambur) (Heteroptera: Miridae) and *Diglyphus isaea* Walker (Hymenoptera, Eulophidae) on tomato plants. Semi-field studies. *Spanish Journal of Agricultural Research*, **9**(2): 617–622.

Misra, H. P. 2008. New promising insecticides for the management of brinjal shoot and fruit borer, *Lecinodes orbonalis* Guenee. *Pest Management in Horticultural Ecosystems*, **14**(2): 140–147.

Rahman, M. M. 2005. IPM technologies of different crops potential for field trial generated at the Department of Entomology, BSMRAU, Gazipur. Proceedings of the Workshop organized by the DANIDA-DAE-SPPS project and held on March 30 at DAE, Khamarbari, Dhaka, Bangladesh. 31 **P**.

Rashid, M. M. 1993. Shabji Biggan, Bangla Academy, Dhaka.

Saimandir, J. and Gopal, M. 2012. Evaluation of synthetic and natural insecticides for the management of insect pest control of eggplant (*Solanum melongena* L.) and pesticide residue dissipation pattern. *American Journal of Plant Sciences*, **3**(2): 214–227.

Shah, K. D., Bharpoda, T. M. and Jhala, R. C. 2012. Bio-efficacy of newer molecules of insecticides against brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. *AGREES-An International e-Journal*, **1**(2): 186–200.

SUSVEG-Asia. 2007. SUSVEG-Asia Brinjal integrated pest management (IPM). http://susvegasia.nri.org/susvegasiabrinjalipm4.html

Thapa, R. B. 2010. Integrated management of brinjal fruit and shoot borer, *Leucinodes orbonal*is Guen: An overview. *Journal of Agriculture and Animal Science*, **30**(32): 1–16.

***Islam, T., Das, G. and Mahir Uddin, M.**
Department of Entomology, Bangladesh Agricultural University, Mymensingh-2202
*Corresponding author
Email : tarikul.entom@bau.edu.bd