Research Article

International Journal for Asian Contemporary Research (IJACR)

www.ijacr.net

Management of Brinjal Shoot and Fruit Borer (*Leucinodes orbonalis* Guenee) using Selected Insecticides in Farmer's Fields at Bandarban Hill Tracts, Bangladesh

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Article info

Received: 12 June, 2021
Accepted: 12 July, 2021
Published: 14 July, 2021
Available in online: 14 July, 2021

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Link to this article: https://www.ijacr.net/upload/ijacr/2021-13-1014.pdf

Abstract

Brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae) is the most prevalent and destructive pest of brinjal in Bangladesh as well as in Asia. The study was conducted during the 2015-2016 and 2016-2017 cropping season at Bandarban hill and valleys of Chattogram, Bangladesh to develop sustainable and eco-friendly management techniques for cultivating brinjal to control brinjal shoot and fruit borer (BSFB). The study was conducted following randomized complete block design (RCBD) having seven treatments combination. Each treatment was replicated three times. Among the treatments, T3 reduced the highest infestation of shoot and fruit by 95.96% and 94.85% over control, respectively. The highest brinjal yield (31.56 ton/ha) and the highest moth captured (75.88) throughout the season were achieved by the same treatment. Spraying of voliam flexi 300SC @ 0.5 ml Liter-1 water at 10 days an interval+hand collection & destruction of infested fruits and larvae+pheromone trap+nappy trap goes to be the foremost effective treatment to manage brinjal shoot and fruit borer in the hilly areas of Bandarban.

Keywords: Brinjal, Management, BSFB, *Leucinodes orbonalis*, Yield, Bandarban valley.

Introduction

Brinjal (*Solanum melongena* L.) is a lot of eatables among wide grownup vegetables in many components of the planet (Mahanta & Kalita, 2020). Among the solanaceous family vegetables, brinjal, is the foremost typical, popular, and principal vegetable crop grownup in several geographical components in Bangladesh. It is a year round vegetable of Bangladesh. In Bangladesh, about 70% of the complete vegetables are produced in Rabi season and fewer than 30% at intervals during the Kharif season (Hossain & Awrangeb 1992). Nayar *et al*. (1995) reported that among 53 species of insect pests of brinjal, brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae), is the

major and most destructive one in Bangladesh and throughout Asia. Larvae bore into shoots throughout the vegetative stage and later in flowers and fruits, as a result it's become unfit for consumption. The yield loss caused by this pest is gigantic and varies from 37% to 63% in a large portion of India (Dhankar, 1988), up to 67% once a year in Bangladesh (Islam & Karim, 1991). Latif (2007) founded that Nimbicidene and Flubebdiamite were relatively safe for natural enemies and insect pest management of brinjal. The effectiveness of the insecticides is greatly influenced by under field conditions. Farmers use huge quantities of chemical insecticides one by one or along to urge blemish-free fruits, that fetch premium costs at intervals the market. Around 25 to 80 times sprays measure undertaken for effective management of BSFB (Latif, 2007). Lack of resistant cultivars and effective biological management agents and different nonchemical pest management measures have junction rectifiers to the use of nephrotoxic chemicals for its management. Despite numerous unwell effects of the chemical pesticides, pesticide use is still conducive to tackling this pest. Realizing the intense pest standing of the primary shoot and fruit borer, few promising and wide suggested pesticides were incorporated at intervals this investigation. The aim of this study was to analysis the comparative effectiveness of seven insecticides against BSFB in each season and conjointly to hunt out the foremost effective insecticide (s) for suppressing BSFB under field conditions

Materials and methods

The experiments were conducted in hills and valleys of Bandarban hill district of Chattogram, Bangladesh during 2015-16 to 2016-17. The study covered a large area under vegetable cultivation at different locations of Bandarban hill districts and the farmers in these localities (Kamolongpara Latitude-22º14′3.84″N; Longitude-92º11′45.69″E and Bakichara latitude-22º13′42.51″N; Longitude-92º11′4.69″E at Kuhalong union of Bandarban sadar) have been growing brinjal since long past (Figure 1). The study area was selected based on thought of the adequate road communication, farmer's perspective on co-operation and management practices used to control the insect pests of vegetables. The experiments were ordered to go into a randomized complete block design (RCBD) with seven treatments. Each treatment was replicated three times. Details application of different treatments were as follows: T_1 = spraying voliam flexi 300SC @ 0.5 ml Liter^{-1} water at 10 days an interval**,** T_2 = spraying spinosad 45SC @ 0.4 ml Liter^{-1} water at 10 days an interval+nappy trap**,** T_3 = spraying voliam flexi 300SC @ 0.5 ml Liter^{-1} water at 10 days an interval+hand collection & destruction of infested fruits and larvae+pheromone trap+nappy trap**,** T_4 = spraying ripcord 10EC @ 1.0 ml Liter^{-1} water at 10 days an interval**,** T_5 = **s**praying ripcord 10EC @ 1.0 ml Liter^{-1} water at 10 days an interval+pheromone trap**,** T_6 = Farmer's practices**,** T_7 = Untreated control. The distance between block to block that of the plot to plot was 1.0 m. The unit plot size was 5.0 ×5.0 m^2. Every block was divided into seven (07) equal plots as well as one untreated control plot. Fertilizer application and intercultural operations were applied as suggested by FRG (2012) as per the recommendation for brinjal or aubergine. Planting materials of brinjal or aubergine were collected from the BARI regional station at Hathazari, Chattogram.

Figure 1. Photo showing study area of Bakichara and Kamalongpara, Bandarban in Google Map during 2015-2016 to 2016-2017.

A small seed bed measuring 5 m x 1 m was prepared within the nursery bed at farmer's field of the study area. Seedlings having thirty (30) days old were planted within the plots with maintaining recommended spacing. Weeding within the plots was done as and once necessary. The insecticides were applied with the help of Knapsack sprayer. The primary application of treatments was done after fourth (4th) week of transplanting and later applications were made at 10 days intervals. Precautions were taken to avoid drift to the adjacent plots. Data were collected on the following parameters: number of insects infested shoots plant^{-5}**,** number of healthy shoots plant^{-5}**,** number of insects infested fruits plant^{-5}**,** number of healthy fruits plant^{-5}**,** number of insect leaves^{-1} stem^{-1} flower^{-1} fruit^{-1}**,** number of insects captured trap^{-1}**,** healthy yield plot^{-1}, infested yield plot^{-1}**,** total yield plot^{-1}**,** yield increase over control because of treatment applications. The impact of various treatments in controlling BSFB infestation becomes measured on the premise of infestation of shoots and fruits of brinjal or aubergine and plot yield was converted to hectare.

Application of treatments

Spraying Voliam Flexi 300SC

Voliam flexi 300SC may even be a foliar applied insecticide having dual modes of action that controls key lepidopterous insects and listed suck and chew insect pests. Foliar application of voliam flexi exhibits wonderful translaminar and regionally systemic movement into plant part also as accumulation on the leaf surface. Penetration into the leaf tissue forms a reservoir of active ingredient that winds up in extended residual management. Effective crop protection results from fast feeding inhibition. Thiamethoxam + Chlorantraneliprol (voliam flexi 300SC) at the concentration of 0.5 ml liter^{-1} of water was applied. Spraying using supply by Knapsack sprayer. The spraying was was done at the afternoon to avoid bright sun and drifting caused by sturdy wind and killing of pollinating bees. Voliam flexi 300SC was applied in selected plotsexcept untreated control.

Spraying Ripcord 10EC

Ripcord 10EC may be a synthetic pyrethroid insecticide. Its common name is cypermethrin. One ml of ripcord 10EC was mixed with 1 litre of water to form the formulation. This formulation was sprayed uniformly on the whole plant to urge complete coverage heading in the right portion of plant with Knapsack sprayer. The spraying was given in the afternoon to avoid bright sun and drifting caused by sturdy wind and killing of pollinating bees. Ripcord 10EC was applied in targeted treatment plots.

Spraying Spinosad 45SC

Exactly 0.4 ml of Spinosad 45SC was mixed with 1 litre of water to make the formulation. This formulation was sprayed uniformly on the entire plant to get complete coverage on target portion of plant with Knapsack sprayer. The spraying was done in the afternoon to avoid bright sun and drift caused by sturdy wind and killing of pollinating bees. Spinosad 45SC was applied in targeted treatment.

Pheromone Trap (Plastic pot)

The pheromone, 'methyl eugenol' or 'cue lure' used for teasel gourd plants simply case of BSFB phero was used that mimics the scent of female flies that pulls the male flies and traps them in massive numbers resulting to mating disruption. Simple plastic containers developed by BARI scientists cited to as 'BARI trap' or popularly mentioned as 'Magic trap' were prepared for deployment of the pheromones (Figure 2). The rectangular plastic container of 3-liter capacity with 20-22 cm tall was utilized in the experiment. A triangular hole measuring 10-12 cm height and 10-12 cm base was cut in any two opposite sides. The lower part of the triangular hole was 3 cm above rock bottom of the container. Water containing with two-three drops of detergent was maintained within the trap throughout the season. Pheromone-soaked cotton or lure was tied within the trap with thin wire. BSFB adults enter the trap and fall into the detergent contaminated water and die.

Figure 2. Photo showing the pheromone trap within the field and insects captured in pheromone trap.

Water within the trap was replenished usually to assure the trap isn't dry. A pheromone dispenser was maintained and continued throughout the cropping season. This operation was done in targeted plots, starting from 30 days before full maturity and continued until last harvest.

Nappy trap

Shrimp, crabs and other small aquatic organisms are used to make Nappy. After these organisms are collected and grinded until they fall off, the paste is used to attract insect pests with its odor and catch a large number of insects. A rectangular plastic container with a capacity of 3 liters and a height of 20-22 cm was used for this operation. A triangular hole with a height of 10-12 cm is cut on the opposite sides, and the bottom surface is 10-12 cm (Figure 3).

Figure 3. Photo showing the nappy and insects captured in nappy trap.

The base of the triangular hole was 3 cm above rock bottom of the container. The water within the nappy stays

within the trap throughout the season. All BSFB adults will fall under traps, fall under the water, and die. Water inside the trap was replenished to make sure the nappy trap isn't dry. This process is carried out on the farm using Nappy traps as a treatment, starting 30 days before full maturity and continuing to the final harvest.

Hand collection and destruction of infested fruits and larvae

Due to the poor mobility of insects, they can be easily collected by hand and adults, eggs and larvae were killed by hand (Figure 4). This happens from 10.30 am to 11.00 am. 3:30 pm to 4:00 pm. When the insect activity in plants is high ,it was carried out twice on plots used for treatment measures.

Figure 4. Hand collection and destruction of infested fruits and larvae.

Shoot infestation

The total numbers of shoots and the amount of infested shoots were recorded from randomly selected 5 plants per plot at weekly intervals. Percent shoot infestation was calculated using the subsequent formula:

$$\%\ Shoot\ infestation = \frac{Number\ of\ infested\ shoots}{Total\ number\ of\ shoots} \times 100$$

Fruit infestation and yield per hectare

After harvesting the fruits every 7 days, separate healthy and infected fruits, record the weight of healthy and infected fruits in each plot of every treatment, and harvested 14 times during the fruiting season. Use the subsequent formula to calculate the fruit infection rate by number and weight:

$$\%Fruit\ infestation(by\ number) = \frac{Number\ of\ infested\ fruits}{Total\ number\ of\ fruits} \times 100$$

$$\%Fruit\ infestation(by\ weight) = \frac{Weight\ of\ infested\ fruits}{Weight\ of\ total\ fruits} \times 100$$

The cumulative plot yield of healthy, infested and total fruits of 14 harvests were transformed into healthy, infested and total yield per ha in tons. The percent increase and decrease of yield over control was computed by using the subsequent formula:

$$\%\ Increase\ of\ healthy\ fruits\ over\ control = \frac{\%\ Treatment\ infestation - \%\ Control\ infestation}{\%\ Treatment\ infestation} \times 100$$

$$\%\ Decrease\ of\ infested\ fruits\ over\ control = \frac{\%\ Control\ infestation - \%\ Treatment\ infestation}{\%\ Control\ infestation} \times 100$$

After harvesting, the weights of healthy and infested fruits were separately recorded. The whole production of every treatment was calculated and determined the yield (t ha^{-1}). The percent yield increase over control was computed by using the subsequent formula:

$$\%\ Increase\ of\ yield\ over\ control = \frac{Yield\ of\ treated\ plot - Yield\ of\ control\ plot}{Yield\ of\ control\ plot} \times 100$$

Statistical Analysis of data

Field data were recorded and make a table for statistical analysis. The analysis of variance was performed supported the Random Complete Block Design (RCBD) using R software version 3.2 (20141031) (package ="Agricolae") (De Mendiburu, 2009). Duncan's multiple range test (DMRT) was used to separate processing. Therefore, the significance level of the least significant difference (LSD) test with a significance level of 5% was used to evaluate the difference between the mean pair (Steel *et al*., 1997).

Results and Discussion

Effect of different management techniques against BSFB on the yield of brinjal or aubergine varied considerably at Bandarban district.

Figure 5. Showing the stages of BSFB (*Leucinodes orbonalis*) and its damage symptoms in brinjal plant.

The lowest level of shoot and fruit infestation by BSFB at Bandarban district (table 1 and figure 5) was recorded from T_3 treatment that was significantly difference not up to all other treatments. The infested shoot and fruits were presented in Figure 5.

This treatment T_3 (spraying voliam flexi 300SC @ 0.5 ml Liter^{-1} water at 10 days an interval+ hand collection & destruction of infested fruits and larvae+pheromone trap+nappy trap) gave the highest reduction of shoot (95.96%) and fruit infestation (94.85%) of brinjal over untreated control followed by T_2 (spraying spinosad 45SC @ 0.4 ml Liter^{-1} water at 10 days an interval+nappy trap), T_5 (spraying Ripcord 10EC @ 1.0 ml Liter^{-1} water at 10 days an interval + pheromone trap), T_1 (spraying voliam flexi 300SC @ 0.5 ml Liter^{-1} water at 10 days an interval), T_4 (spraying ripcord 10EC @ 1.0 ml Liter^{-1} water at 10 days an interval) and T_6 (Farmer's practices) having significant difference among them. Gangwar *et al*. (2014) allotted out an experiment in Meerut, state and located that spinosad 45SC was handiest in reducing damage to shoots and fruits with the best yield (253. 30 q / ha), followed by Novaluron 10EC (242.30 q / ha). Treatment T_3 (spraying voliam flexi 300SC @ 0.5 ml Liter^{-1} water at 10 days' interval+hand collection & destruction of infested fruits and larvae+pheromone trap+nappy trap) produced about 75% (79.76-83.47%) yield over untreated control compared to other treatments (Table 1).

Wankhede *et al*. (2010) evaluated that emamectin treatment was the foremost effective one with 5.0 & 4.8 % shoot damage in kharif, 2007 and 2008 trials, respectively. Minimum fruit infestation (11.51; 11.44 and 12.39; 12.44) on variety and weight basis and highest yield of healthy fruits (24.06, 23.14 t ha^{-1}) was additionally discovered in emamectin, between the two (02) cropping seasons. Brinjal shoot and fruit borer infestation bit by bit accumulated with the age of crop once environmental temperature increased. Among the management tactics T_3 (spraying voliam flexi 300SC @ 0.5 ml Liter^{-1} water at 10 days an interval+ hand collection & destruction of infested fruits and larvae+pheromone trap+pappy trap) gave best result by reducing maximum population of brinjal shoot and fruit borer also produced higher fruit yield compared to other treatments (Table 1). The order of effectiveness of six treatments over untreated control was $T_3>T_2>T_5>T_1>T_4>T_6$.

Table 1. Effect of different management practices against BSFB on shoot, fruit infestation and yield of brinjal at Bandarban during 2015-2016 and 2016-2017

Treatments	Shoot infestation by BSFB (%)	Reduction of shoot infestation over control (%)	Fruit infestation by BSFB (%)	Reduction of fruit infestation over control (%)	Marketable yield of brinjal (ton/ha)	Increase of yield over control (%)
T_1	5.98 d	64.47 d	6.21 d	64.08 d	26.34 d	53.22 d
T_2	2. 62 f	84.43 b	2.96 f	82.88 b	29.21 f	69.80 b
T_3	0.68 g	95.96 a	0.89 g	94.85 a	31.56 g	83.47 a
T_4	7.12 c	57.69 e	7.42 c	57.09 e	24.36 c	41.63 e
T_5	4.13 e	75.46 c	4.88 e	71.78 c	27.59 e	60.41 c
T_6	12.76 b	24.18 f	13.21 b	23.60 f	18.92 b	10.00 f
T_7	16.83 a	--	17.29 a	--	17.21 a	--
CV (%)	**8.34**	**5.78**	**7.95**	**5.45**	**2.03**	**5.96**

Data are the average of six observations from 3 replications. In a column, means having same letter(s) are statistically similar at 5% level of significance by DMRT.

Mean range of captured adults per trap accumulated with the raise of plant age and reached to a peak. Thereafter population decreased with the progress of the cropping season. The data are furnished in Table 2. The adult catches over time disclosed that pheromone and nappy practices) having significant difference among them. Alam *et al*. (2003) and Cork *et al*. (2003) found that biological pest management in Asia is currently exchange pesticides, that is in step with the results of Satpathy *et al*. (2005) applied IPM methods, specifically pruning and removing infected branches, removing perforated fruits, putting in 12 pheromone traps per hectare and reducing the discharge of *T. chilonis* and therefore the use of pesticides. Marketable fruit yield of brinjal and percent increase of yield over untreated control in different treatments at Bandarban district is presented in Table 1. The highest yield (31.56 t ha^{-1}) was recorded from T_3 (spraying voliam flexi 300SC @ 0.5 ml Liter^{-1} water at 10 days interval+hand collection & destruction of infested fruits and larvae+pheromone trap+nappy trap) followed by T_2 (spraying spinosad 45SC @ 0.4 ml Liter^{-1} water at 10 days interval+nappy trap), T_5 (spraying ripcord 10EC @ 1.0 ml Liter^{-1} water at 10 days interval+pheromone trap), T_1 (spraying voliam flexi 300SC @ 0.5 ml Liter^{-1} water at 10 days interval),

Table 2. Adult moth captured (mean±SE) in different management practices in a period upto 56 days of using trap in plot where pheromone and nappy trap were used.

Treatments	Up to 7 days	Up to 14 days	Up to 21 days	Up to 28 days	Up to 35 days	Up to 42 days	Up to 49 days	Up to 56 days	Total captured/ trap
T_2	6.33±0.09	6.12±0.05	5.42±0.08	5.01±0.03	4.98±0.20	4.78±0.11	4.50±0.05	3.87±0.26	41.01±0.32
T_3	11.65±0.71	9.72±0.10	9.31±0.18	9.24±0.46	8.74±0.20	8.67±0.17	7.85±0.45	10.7±0.73	75.88±1.68
T_5	8.25±0.51	8.13±0.34	7.84±0.59	7.70±0.13	6.45±0.39	6.28±0.19	5.11±0.27	4.32±0.18	54.08±3.42
CV (%)	**30.81**	**22.58**	**26.11**	**29.26**	**28.18**	**29.83**	**30.66**	**60.67**	**30.91**

Data are the average of six observations from 3 replications. In a column, means having same letter(s) are statistically similar at 5% level of significance by DMRT.

trap used in this study was effective with a maximum recorded 75.88 nos of moth catches per trap among the module of spraying voliam flexi 300SC @ 0.5 ml Liter^{-1} water at 10 days' interval+hand collection & destruction of infested fruits and larvae+pheromone trap+nappy trap. Jat and Prik (2001) and Misra (1993) reported that nimbiciden is that the effective insecticide against BSFB and has the lower yield, however Srinibvasan *et al*. (1998) reported high production of endosulfan by Nimbiciden (13.02 tons/ha). Awal *et al*. (2014) observed that the mortality of Tracer45 SC, Bactoil, Proclaim5 SG, and BSFB larvae was significantly higher than that of fourth instar BSFB larvae. Bactoil and Tracer45 SC are relatively harmless to natural enemies, so they were terribly appropriate for the integrated pest management (IPM) of Brinjal BSFB (Awal *et al*., 2015).

Experiment conducted by Chaterjee (2009) showed that trap+ mechanical removal + application of botanicals was the only module for the management of fruit and shoot borer with considerable yield increment of the crop. A complete of 54.08 and 41. 01 moth was captured at intervals the module of spraying ripcord 10EC @ 1.0 ml Liter^{-1} water at 10 days an interval+pheromone trap and spraying spinosad 45SC @ 0.4 ml Liter^{-1} water at 10 days an interval+nappy trap, respectively (Table 2). Mandal and Gupta (2004) ascertained that mechanical removal is effective at the low end of the pest population.

Conclusion

Therefore, it's going to be all over here that the voliam flexi 300SC @ 0.5 ml Liter^{-1} water at 10 days an interval+hand collection & destruction of infested fruits and larvae+pheromone trap+nappy trap may be used in protecting the brinjal crop against BSFB and that assure the highest yield per plants throughout the cropping seasons at Bandarban hill district in Bangladesh. This treatment can be called ecofriendly because pheromone and nappy trap in combination with hand picking were used to control brinjal shoot and fruit borer. The results obtained inside this study recommend that the appliance of spraying voliam flexi 300SC @0.5 ml Liter^{-1} water at 10 days an interval+hand collection & destruction of infested fruits and larvae+pheromone trap+nappy trap performed the best in making certain higher healthy fruit yield additionally total fruit yield of brinjal compared to untreated control throughtout the experimental period.

Acknowledgements

The authors are appreciative to the authority of the Department of Entomology, Patuakhali Science and Technology University for giving the chance to conduct experimental research in farmer's field at Bandarban hill district in Chattogram, Bangladesh. Also, we tend to terribly appreciative to the Krishi Gobeshona Foundation (KGF) for providing the fund for conducting the research work smoothly.

Conflict of interest

There is no conflict of interest among the authors.

References

Alam, S.N., Rashid M.A., Rouf, F.M.A., Jhala, R.C., Patel, J.R. & Satpathy, S. (2003). Development of an integrated pest management strategy for eggplant fruit and shoot borer in South Asia. *Technical Bulletin, Asian Vegetable Research and Development Centre*. Shanhua, Taiwan, 28:56.

Awal, A., Rahman, M.M., Alam, M.Z., Khan, M.M.H., Kabir, A.K.M.R. & Uddin, M.S. (2014). Efficacy of seven insecticides on the larvae of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee under laboratory condition. *Journal of Patuakhali Science and Technology University*, 5(1): 37-43.

Awal, A., Rahman, M. M., Alam, M. Z. and Khan, M. M. H. (2015). Diversity and equitability of insect pests and natural enemies in brinjal field treated with insecticides. *Jahangirnagar University Journal of Biological Sciences*, 4(1):71-80.

Chaterjee H. (2009). Pheromone for the management of brinjal fruit and shoot borer, *Leucinodes orbonalis*, Guenee, *Karnataka Journal of Agriccultural Sciences,* 22 (3): 594-596.

Cork A, Alam SN, Rouf FMA, Talekar NS. (2003). Female pheromone of brinjal fruit and shoot borer, *Leucinodes orbonalis*: trap optimization and preliminary mass trapping trials. *Bulletin of Entomological Research*, 93:107-113.

De Mendiburu. (2009). Una herramienta de analisis estadistico para la investigacion agricola. Tesis. Universidad Nacional de Ingenieria (UNI-PERU). Universidad Nacional Agraria La Molina, Lima-PERU. Facultad de Economia y Planificacion Departamento Academico de Estadistica e Informatica.

Dhankar, B S. (1988). Progress in resistance studies in the eggplant (Solanum melongena L) against shoot and fruit borer (*Leucinodes orbonalis* Guenee) infestation. *Tropical Pest Management*, 34 343-345.

FRG. (2012). Fertilizer Recommendation Guide, Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka 1215. P. 274.

Gangwar, R.K., Singh, D.V., Bhatnagar, A. & Sachan, S.K. (2014). Brinjal shoot and fruit borer management with insecticides. *Indian Journal of Entomology*, 76(2):97-100.

Hossain, A. & Awrangzeb, S.N.H. (1992). Vegetable production policies, present and future directions, pp. 21-30, In: Proceeding on vegetable production and marketing. AVRDC, BARI, BARC and USAID.

Islam, M.N. & Karim, M.A. (1991). Management of the brinjal shoot and fruit borer, *Leucinodes orhonalis* Guenee (Lepidoptera: Pyralidae) in field Annual Research Report 1990-91 Entomology Division,BARI,Joydebpur, Gazipur, pp 44-46.

Jat, K.L. & Preek, B.L. (2001). Field evaluation of ecofriendly insecticides against brinjal shoot and fruit borer (*Leucinodes orbonalis* Guenee), *Indian Journal of Plant Protection*, 29(1-2): 75-85.

Latif, M.A. (2007). Ph. D. Dissertation on, "Effectiveness of some insecticides in managing brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee and their impact on arthropod biodiversity and soil microbial respiration", Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Salna, Gazipur, Bangladesh.

Mahanta, C.L. and Kalita, D. (2020). Nutritional Composition and Antioxidant Properties of Fruits and Vegetables, Academic Press, ISBN 9780128127803, PP:273-287

Misra, H.P. (1993). Chemical control of brinjal shoot and fruit borer *Leucinodes orbonalis* Guen. *Indian Journal of Entomology*, 55(1): 89-91.

Nayar, K.K, Ananthakrishnan, T.N. & David, B.V. (1995). General and Applied Entomology 11 edn Tata McGraw-hill Publ Co Ltd 4/12, Asaf Ali Road, New Delhi-110002, P-557.

Satpathy, S., Shivalingaswamy, T.M., Akhilesh Kumar, Rai, A.B. & Mathura Rai. (2005). Biointensive management of eggplant shoot and fruit borer (*Leucinodes orbonalis* Guen.). *Vegetable Science*, 32(1):103 104.

Srinivasan, G., Babu, P.C.S., Reddy, P.P., Kumar, N.K.K. and Verghese, A. (1998). Advances in IPM for Horticultural crops. Proceedings of the First National Symposium on Pest Management in Horticultural Crops: Environmental implications and thrust, Bangalore, India, 15-17 October, 1997. PP. 87-93.

Steel, R.G.D., Torrie, J.H. & Dickey, D.A. (1997). Principles and Procedures of Statistic a Biometrical Approach. Third Edition. The Mc Graw Hill company, New York.

Wankhede, S.M. & Kale, V.D. (2010). Effect of Insecticides on Brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. *Annals of Plant Protection Sciences*, 18(2):336-339.

To cite this article

Faruq, M.O., Latif, M.A., Khan, M.M.H., Das, G.P., & Uddin, M.R. (2021). Management of Brinjal Shoot and Fruit Borer (*Leucinodes orbonalis* Guenee) using Selected Insecticides in Farmer's Fields at Bandarban Hill Tracts, Bangladesh. *International Journal for Asian Contemporary Research*, 1 (III), 106-112.