*J Bangladesh Agril Univ 23(4): 491–497, 2025* https://doi.org/10.3329/jbau.v23i4.86487

ISSN 1810-3030 (Print) 2408-8684 (Online)

**Journal of Bangladesh Agricultural University**

Journal home page: http://baures.bau.edu.bd/jbau

## Research Article

# Bioefficacy of Selected Biorational Insecticides against Whitefly, *Bemisia tabaci* Gennadius in Brinjal

**Mohammad Mahir Uddin✉, Most. Hasna Hena, Md. Mahbubur Rahman and Gopal Das**

Department of Entomology, Bangladesh Agricultural University, Mymensingh-2200, Bangladesh

**ARTICLE INFO**

**Article history**
Received: 22 September 2025
Accepted: 21 December 2025
Published: 30 December 2025

**Keywords**
Buprofezin, Botanical, Insecticide, Efficacy, Management

**Correspondence**
Mohammad Mahir Uddin
✉: mahir@bau.edu.bd

OPEN ACCESS

**ABSTRACT**

Whitefly (*Bemisia tabaci* Genn.) is a serious sucking pest which causes significant damage of brinjal in Bangladesh. An experiment was conducted at the Entomology Field Laboratory, Bangladesh Agricultural University, Mymensingh during October to March to evaluate the efficacy of selected biorational insecticides *viz.* Award 40 SC (Buprofezin); Neem oil extract (Azadiractin); Bioneem plus 1% (Azadiractin); Suspend 5 SG (Emamectin benzoate); Tracer 45 SC (Spinosad) and Imidagold 20 SL (Imidacloprid) against whitefly in brinjal. the research was done in RCBD design with three replications of each treatment. Three sprays were applied on the pest infested plants and data were collected on 3, 5 and 7 days after each spray. Data were collected on no. of nymph & adult leaf$^{-1}$, total no. of infested leaf & twig plant$^{-1}$. Among the tested biorational insecticides, Buprofezin showed the best efficacy in reducing pest population after all sprays. In case of percent reduction of nymph on leaf over control, a remarkable decrease of 77.81%, 67.53% and 79.13% was observed from 1$^{st}$, 2$^{nd}$ and 3$^{rd}$ sprays, respectively. In case of percent reduction of adult whitefly on leaf over control, 71.33%, 67.76% and 57.72% was recorded after 1$^{st}$, 2$^{nd}$ and 3$^{rd}$ sprays, respectively. The highest reduction of leaf and twig infestation was also noticed in Buprofezin treated plots. Mean percent reduction of infested leaf over control was 48.81%, 53.19% and 49.46% from 1$^{st}$, 2$^{nd}$ and 3$^{rd}$ sprays, respectively. The mean percent reduction of twig infestation over control was 41.21%, 36.42% and 31.76% after 1$^{st}$, 2$^{nd}$ and 3$^{rd}$ sprays, respectively in Buprofezin treated plants and 48.21%, 34.38% and 17.62% after 1$^{st}$, 2$^{nd}$ and 3$^{rd}$ sprays, respectively in Bio-neem plus treated plants. Therefore, Buprofezin could be used as the best management practice for whitefly in brinjal ecosystem.



## Introduction

Brinjal (*Solanum melongena* L.) plays an important role in human life. Due to its nutritive value, consisting of minerals like iron, phosphorous, calcium and vitamins like A, B and C, unripe fruits are used primarily as vegetable (Kalawate *et al.*, 2012; Singh *et al.*, 2016). Brinjal is one of the most important vegetables in South Asia, which accounts for almost 50% of the world's area under cultivation (Alam *et al.*, 2003). Among the vegetable crops grown in Bangladesh, brinjal is the most popular vegetables grown widely (Rashid *et al.,* 2013). Though brinjal is an important summer vegetable, it is being grown in all the seasons throughout the year under irrigated condition (Kalawate *et al.*, 2012). Hence it is subjected to attack by a number of insect pests right from nursery stage till harvesting (Regupathy *et al.,* 1997). The average yield of brinjal in Bangladesh is very low. There are many reasons responsible for such poor yield. These include biotic factors as insect pests and pathogens (Rashid *et al.,* 2013). Undoubtedly, brinjal shoot and fruit borer is the most destructive pest of brinjal (Chakraborti and Sarkar, 2011; Jagginavar *et al.*, 2009). It has also been reported that whitefly (*Bemisia tabaci* Genn.) (Hemiptera: Aleyrodidae) is another important sucking pest of brinjal that causes a considerable damage to the brinjal plant (Mandal *et al.*, 2010). Both nymphs and adults suck the cell sap from the lower leaf surface through their piercing and sucking mouth parts. Due to sucking the sap, yellow spots appear on the leaves followed by crinkling, curling and drying and finally yield reduction occur severely (Das and Islam, 2014). On the other hand, the insect is a vector of various viruses and their honey dew attracts black sooty mold which inhibits photosynthesis thus reducing the yield. On the other hand, this pest is the potential vector of various viruses and their honeydew attracts black sooty mould which inhibits photosynthesis thus reducing the yield (Das and Islam, 2014). Pesticides are supposed to be a

**Cite This Article**
Uddin, M.M., Hena, M.H., Rahman, M.M. and Das, G. 2025. Bioefficacy of Selected Biorational Insecticides against Whitefly, *Bemisia tabaci* Gennadius in Brinjal. *Journal of Bangladesh Agricultural University*, 23(4): 491–497. https://doi.org/10.3329/jbau.v23i4.86487

quick solution as they are the essential tool in enhancing agricultural production (Mehmood *et al.,* 2001). Although insecticidal control is one of the common means against whitefly, many of the insecticides applied are not effective in the satisfactory control of the pests (Das and Islam, 2014). Brinjal being a vegetable crop, use of broad-spectrum insecticides will leave considerable toxic residues on the fruits. Beside this, sole dependence on several broad-spectrum insecticides for the control of these pests has led to insecticidal resistance (Harish *et al*., 2011). It is urgently needed to find out an alternative of the synthetic chemical insecticides from selected new generation biorational insecticides. Hence, it is essential to evaluate the efficacy of different new generation insecticides against whitefly in brinjal. Investigation was carried out to evaluate the bio-efficacy of selected biorational insecticides against whitefly on brinjal under field condition in order to support sustainable vegetable production and to avoid environmental hazards and fit these molecules as a component of integrated pest management and resistance management strategies.

## Materials and Methods

The experiments were conducted in the Entomology Field Laboratory, Department of Entomology, Bangladesh Agricultural University, Mymensingh during the period of October to March. At first the land was prepared by ploughing and cross ploughing followed by laddering. All stubbles and weeds were removed carefully. The whole experimental field was divided into three equal blocks. Each of the blocks had 7 equal plots and finally a total of 21 plots were made. The size of a unit plot was 3.20 m X 2.10 m. Two adjacent unit plots and blocks were separated by 40 cm and 50 cm apart, respectively. Plots were allocated randomly and they were separated in such way so that impact of every treatment can be quantified. After final land preparation the unit plots were further spaded and all plots were prepared with proper proportions of manure and fertilizers. Brinjal variety "Singnath" was used for the experiment. About 25-30 days old healthy and disease free brinjal seedlings were collected from Horticulture Farm, Bangladesh Agricultural University, Mymensingh. The collected seedlings were transplanted in experimental plots at the rate of 6 seedlings per plot. After transplanting, all recommended agronomic practices were applied. Seven treatments viz. $T_1$= Award 40 SC @ 0.2ml/L of water, $T_2$= Neem oil extract @ 2ml/L of water, $T_3$= Bioneem Plus 1% @ 3ml/L of water, $T_4$= Imidagold 20 SL @0.25 ml/L of water, $T_5$= Suspend 5 SG @ 1.0 g/L of water, $T_6$= Tracer 45 SC @ 0.5 ml/L of water, $T_7$= Untreated control was laid out in a Randomized Complete Block Design (RCBD) with three replications of each. A total of three sprays were applied on the pest infested plants. First spraying was done at 45 days after transplantation; and next two sprays were done at 15 days interval. Data on the following parameters, no. of nymph of whitefly leaf$^{-1}$, no. of adult whitefly leaf$^{-1}$, total no. of infested leaf plant$^{-1}$ and total no. of infested twig plant$^{-1}$ were recorded on one day before first spray and at 1, 3 and 7 days after each spray. Finally, the effect of treatments on whitefly was determined by calculating the mean number of whitefly leaf$^{-1}$. The percent reduction of whitefly population in the treated plots was also calculated from cumulative mean number of whiteflies over control using the following formula (Zaman, 2009).

$$\text{\% reduction of whitefly on leaf} = \frac{Wc - Wt}{Wc} \times 1000$$

Where,

Wt = Cumulative mean no. of whitefly in treated leaf

Wc = Cumulative mean no. of whitefly in control leaf

Data of the total number of twig and infested twig were estimated from each plot before and after application of treatments. A total of three sprays were applied and data were collected for each spray. Based on these data, the percentage of twig infestation was calculated using the following formula (Khatun *et al.,* 2015).

$$\text{\% infested twig} = \frac{Po}{\mathrm{Pr}} \times 100$$

Where,

Pr = Total no. of twig per plant

Po = No. of infested twig per plant

Finally, mean percentage of twig infestation was calculated for each of the treatments from the three replicated plots. Similarly, mean percentage of leaf infestation was calculated for each of the treatments from the three replicated plots using above formula. The recorded data were compiled and tabulated for statistical analysis. Analysis of variance (ANOVA) was done with the help of computer package MSTAT-C. The mean differences among the treatments were adjudged with Duncan's Multiple Range Test (DMRT) and Least Significant Difference (LSD) when necessary.

## Results

### *Efficacy of selected biorational insecticides on the population of whitefly nymph in brinjal*

Whitefly nymph number was recorded after first spray which was significantly ($p<0.01$) reduced in all the plots treated with selected biorational insecticides in comparison to untreated control plots (Table 1). The lowest mean number of whitefly (0.71/leaf) was recorded in Buprofezin ($T_1$) treated plants followed by Bio-neem plus ($T_3$) (1.59 /leaf). Similar trend was observed after second and third sprays, where

Buprofezin ($T_1$) proved the most effective treatment in respect of mean number followed by Bio-neem plus ($T_3$). In respect of cumulative mean number, minimum infestation was recorded in Buprofezin treated plots (0.62/leaf) which was about four times lower than untreated control plots. On the other hand, maximum number was observed in Neem oil treated plots (1.66/leaf) although it was about two times lower and significantly effective comparing to untreated plots. The mean number of nymph in Bio-neem plus (1.11/leaf), Emamectin benzoate (1.21/leaf), Spinosad (1.49/leaf) and Imidacloprid (1.51/leaf) treated plots were found a bit less than Neem oil treated plots and these were observed moderately effective among the tested biorational and chemical insecticides in the experiment.

Regarding the percentage of reduction of whitefly nymph, Buprofezin ($T_1$) was found to be the most toxic molecule causing 74.49% reduction and Neem oil was least toxic causing only 31.69% reduction. The order of effectiveness of these treatments was Buprofezin> Bio-neem plus> Emamectin benzoate> Spinosad> Imidacloprid> Neem oil. However, Imidacloprid ($T_4$) was significantly superior only to Neem oil with the 37.86% reduction of nymph population. Hence among biorationals tested Buprofezin, Bio-neem plus, Emamectin benzoate and Spinosad exhibited promising efficacy against whitefly nymph population and may be the best suited to be part of IPM component to suppress whitefly nymph in brinjal ecosystem.

**Table 1: Efficacy of selected biorational insecticides on the whitefly nymph in brinjal**

| Treatments | Pre-treated no. | Mean number of nymph leaf$^{-1}$ | | | | | | | | | | | | Cumulative mean | % reduction over control |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after 1st spray | | | | Days after 2nd spray | | | | Days after 3rd spray | | | | | |
| | | 3 | 5 | 7 | Mean | 3 | 5 | 7 | Mean | 3 | 5 | 7 | Mean | | |
| $T_1$ | 2.50 b | 0.23c | 1.24cd | 0.66d | 0.71 | 0.70e | 0.97cd | 0.93d | 0.87 | 0.00 | 0.50d | 0.36c | 0.29 | 0.62 | 74.49% |
| $T_2$ | 1.70 c | 2.33a | 3.60a | 1.93c | 2.62 | 2.63b | 0.93cd | 1.40bc | 1.65 | 1.20a | 0.37d | 0.53c | 0.70 | 1.66 | 31.69% |
| $T_3$ | 3.07a | 0.43c | 1.77c | 2.57b | 1.59 | 2.30c | 0.63d | 0.36e | 1.10 | 0.67b | 0.77cd | 0.50c | 0.65 | 1.11 | 54.32% |
| $T_4$ | 1.70 c | 1.37b | 2.47b | 2.00c | 1.95 | 3.23a | 1.30bc | 1.17cd | 1.90 | 0.53b | 0.97bc | 0.53c | 0.68 | 1.51 | 37.86% |
| $T_5$ | 3.03 a | 0.77c | 1.20d | 2.87b | 1.61 | 0.53e | 1.57b | 1.43bc | 1.18 | 0.47b | 0.60cd | 1.43ab | 0.83 | 1.21 | 50.21% |
| $T_6$ | 3.33a | 2.02a | 1.30cd | 1.87c | 1.73 | 2.00d | 1.60b | 1.53b | 1.71 | 0.70b | 1.27ab | 1.11b | 1.03 | 1.49 | 38.68% |
| $T_7$ | 1.30 d | 2.08a | 3.27a | 4.24a | 3.20 | 3.07a | 2.67a | 2.30a | 2.68 | 1.27a | 1.43a | 1.53a | 1.41 | 2.43 | - |
| P-Value | 0.01 | 0.01 | 0.01 | 0.01 | - | 0.01 | 0.01 | 0.01 | - | 0.01 | 0.01 | 0.01 | - | - | - |
| LS | ** | ** | ** | ** | - | ** | ** | ** | - | ** | ** | ** | - | - | - |

$T_1$= Award 40 SC @ 0.2ml/L, $T_2$= Neem oil extract @ 2ml/L, $T_3$= Bioneem Plus 1% @ 3ml/L, $T_4$= Imidagold 20 SL @0.25 ml/L, $T_5$= Suspend 5 SG @ 1.0 g/L, $T_6$= Tracer 45 SC @ 0.5 ml/L, $T_7$= Untreated control; In column, means followed by same letters are not statistically different and means followed by different letters are statistically different. ** Means significant at 1% level of probability; LS means level of significance

### *Efficacy of selected biorational insecticides on the number of adult whiteflies in brinjal*

Whitefly adult number recorded after first spray indicated that it was significantly ($P<0.01$) reduced in all the plots treated with the tested biorational insecticides in comparison to untreated control. Data recorded on 3rd, 5th and 7th days after first spray revealed that minimum number of whitefly adults (1.23 adults/leaf) was in Buprofezin ($T_1$) followed by Bio-neem plus ($T_3$) (3.03 adults/leaf) treated plots. Similar trend was observed after second spray, where Buprofezin ($T_1$) (0.78 adults/leaf) proved most effective treatment in keeping the lowest number of whitefly in respect of mean population followed by Bio-neem plus ($T_3$) (1.08 adults/leaf). But after third spray it was revealed that the minimum number of whitefly adult was in Imidacloprid ($T_4$) (1.21 adults/leaf) that was followed by Buprofezin ($T_1$) (1.23 adults/leaf).

In respect of cumulative mean, minimum number was recorded in Buprofezin treated plots (1.08 adults/leaf) which was about three times lower than untreated control plots. On the other hand, maximum infestation was occurred in Spinosad treated plots (2.57 adults/leaf) and significantly effective comparing to untreated plots. The mean adult whitefly number in Bio-neem plus (1.80 adults/leaf), Imidacloprid (1.97 adults/leaf), Emamectin benzoate (2.06 adults/leaf) and Neem oil (2.12 adults/leaf) treated plots were found a little less than Spinosad treated plots and these were observed moderately effective among the tested biorational and chemical insecticides in the experiment.

Regarding the percentage of reduction of whitefly adult, Buprofezin ($T_1$) was found to be the most toxic molecule causing 62.37% reduction and Spinosad was the least toxic causing only 10.45% reduction. The order of effectiveness of these treatments was Buprofezin > Bio-neem plus > Imidacloprid > Emamectin benzoate > Neem oil > Spinosad. However, the Imidacloprid ($T_4$) was significantly superior to Emamectin benzoate, Neem oil and Spinosad with the percentage of reduction 31.36%. Hence among biorationals tested Buprofezin and Bio-neem plus exhibited promising efficacy against whitefly adult population and may be the best suited to be part of IPM component to suppress the population of adult whitefly in brinjal ecosystem.

**Table 2: Efficacy of selected biorational insecticides on the number of adult whiteflies in brinjal**

| Treatments | Pre-treated no. | Mean number of adult leaf$^{-1}$ | | | | | | | | | | | | Cumulative mean | % reduction over control |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after 1st spray | | | | Days after 2nd spray | | | | Days after 3rd spray | | | | | |
| | | 3 | 5 | 7 | Mean | 3 | 5 | 7 | Mean | 3 | 5 | 7 | Mean | | |
| $T_1$ | 3.60 c | 1.33 d | 1.50 e | 0.86 d | 1.23 | 1.17c | 0.37 d | 0.80 c | 0.78 | 0.57e | 1.40 b | 1.73 b | 1.23 | 1.08 | 62.37 % |
| $T_2$ | 5.03 b | 2.50 b | 5.00 a | 2.43 c | 3.31 | 2.30a | 1.50 b | 0.83 c | 1.54 | 1.53c | 1.50 b | 1.53 bc | 1.52 | 2.12 | 26.13 % |
| $T_3$ | 6.00 a | 1.96 c | 2.33 d | 4.80 a | 3.03 | 1.37bc | 1.07 c | 0.80 c | 1.08 | 1.27cd | 1.50 b | 1.08 c | 1.28 | 1.80 | 37.28 % |
| $T_4$ | 2.77de | 2.60 b | 3.36 c | 3.23 b | 3.06 | 2.33 a | 0.93 c | 1.63 b | 1.63 | 1.09d | 1.47 b | 1.08 c | 1.21 | 1.97 | 31.36 % |
| $T_5$ | 3.36 c | 3.37 a | 2.13 d | 3.07 b | 2.86 | 1.53 b | 1.47 b | 1.40 b | 1.47 | 2.07 b | 2.23 a | 1.27 bc | 1.86 | 2.06 | 28.22 % |
| $T_6$ | 2.47 e | 2.27 bc | 5.37 a | 2.40 c | 3.35 | 2.50 a | 1.53 b | 1.63 b | 1.89 | 2.50 a | 2.27 a | 2.67 a | 2.48 | 2.57 | 10.45 % |
| $T_7$ | 3.20cd | 3.20a | 4.36 b | 5.30 a | 4.29 | 2.50 a | 2.20 a | 2.53 a | 2.41 | 1.40cd | 1.33 b | 3.00 a | 1.91 | 2.87 | - |
| P-value | 0.01 | 0.01 | 0.01 | 0.01 | - | 0.01 | 0.01 | 0.01 | - | 0.01 | 0.01 | 0.01 | - | - | - |
| LS | ** | ** | ** | ** | - | ** | ** | ** | - | ** | ** | ** | - | - | |

$T_1$= Award 40 SC @ 0.2ml/L, $T_2$= Neem oil extract @ 2ml/L, $T_3$= Bioneem Plus 1% @ 3ml/L, $T_4$= Imidagold 20 SL @0.25 ml/L, $T_5$= Suspend 5SG @ 1.0 g/L, $T_6$= Tracer 45 SC @ 0.5 ml/L, $T_7$= Untreated control; In column, means followed by same letters are not statistically different and means followed by different letters are statistically different. ** Means significant at 1% level of probability; LS means level of significance

*Efficacy of selected biorational insecticides on the leaf infestation of brinjal plants*

Whitefly infested leaf was recorded after first, second and third spray which was significantly ($p<0.01$) reduced in all the plots treated with selected insecticides in comparison to untreated control. Observation after first and second spray revealed that minimum number of infested leaf plant$^{-1}$ (1.50 and 0.88 leaf plant$^{-1}$, respectively) was in Buprofezin ($T_1$) followed by Neem oil ($T_2$) (1.70 and 1.13 leaf plant$^{-1}$, respectively). Observations on third spray, minimum number was in Buprofezin (0.94 leaf plant$^{-1}$) that was followed by Bio-neem plus (1.09 leaf plant$^{-1}$).

In respect of cumulative mean number, minimum infestation was recorded in Buprofezin treated plots (1.10 leaf plant$^{-1}$) which were about two times lower than untreated control plots. On the other hand, maximum infested leaf per plant was found in Spinosad treated plots (1.77 leaf plant$^{-1}$). The mean number of infested leaf in Bio-neem plus (1.34 leaf plant$^{-1}$), Neem oil (1.42 leaf plant$^{-1}$), Imidacloprid (1.52 leaf plant$^{-1}$) and Emamectin benzoate (1.66 leaf plant$^{-1}$) treated plots were found a bit less than Spinosad treated plots and these were observed moderately effective among the tested insecticides in the experiment.

Regarding the percentage reduction of infested leaf, Buprofezin again proved the most effective in keeping the lowest number of infested leaf having 50.45% reduction and Spinosad was the least effective having only 20.27% reduction. The order of effectiveness of these treatments was Buprofezin> Bio-neem plus> Neem oil> Imidacloprid> Emamectin benzoate> Spinosad. The positive control Imidacloprid was significantly superior only to Emamectin benzoate and Spinosad with the percentage of reduction 31.53%. Therefore, among the biorational insecticides tested Buprofezin, Neem oil and Bio-neem plus exhibited promising efficacy against whitefly and may be incorporated as a part of IPM component to manage whitefly in brinjal ecosystem.

*Efficacy of selected biorational insecticides on the reduction of infested twig of brinjal plants*

Comparing the mean data of three sprays, infested twig significantly reduced in all the plots treated with applied insecticides in comparison to untreated control. Observation after first spray revealed that minimum number of infested twig (4.59 plant$^{-1}$) was in Bio-neem plus treated plots followed by Buprofezin (5.21 plant$^{-1}$). Observations after second spray revealed that the least number of infested twigs was in Buprofezin (4.68 plant$^{-1}$) followed by Bio-neem plus (4.83 plant$^{-1}$). After third spray, Buprofezin (5.89 plant$^{-1}$) showed best efficacy in keeping infestation lower which was followed by Imidacloprid (6.33 plant$^{-1}$).

**Table 3: Efficacy of selected biorational insecticides on the leaf infestation of brinjal plants**

| Treat-ments | Pre-treated no. | Mean number of infested leaf plant$^{-1}$ | | | | | | | | | | | | Cumulative mean | % reduction over control |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after 1st spray | | | | Days after 2nd spray | | | | Days after 3rd spray | | | | | |
| | | 3 | 5 | 7 | Mean | 3 | 5 | 7 | Mean | 3 | 5 | 7 | Mean | | |
| $T_1$ | 4.20a | 0.80c | 2.83bc | 0.87 f | 1.50 | 1.40cd | 0.33c | 0.90d | 0.88 | 0.80c | 1.15ab | 0.86d | 0.94 | 1.10 | 50.45% |
| $T_2$ | 3.53bc | 0.90c | 2.97b | 1.23ef | 1.70 | 1.17d | 1.10ab | 1.13bc | 1.13 | 1.47ab | 1.32ab | 1.47c | 1.42 | 1.42 | 36.04% |
| $T_3$ | 3.30c | 1.60b | 1.40d | 2.13bc | 1.71 | 1.73bc | 0.97b | 1.00cd | 1.23 | 1.53a | 0.87b | 0.87d | 1.09 | 1.34 | 39.64% |
| $T_4$ | 3.50bc | 1.80b | 2.43c | 1.43de | 1.87 | 2.03ab | 1.10ab | 1.43b | 1.52 | 0.94bc | 1.30ab | 1.20cd | 1.15 | 1.52 | 31.53% |
| $T_5$ | 4.30a | 2.34a | 1.86d | 2.30ab | 2.17 | 1.63bc | 0.83b | 2.10a | 1.52 | 1.47ab | 1.27ab | 1.13cd | 1.29 | 1.66 | 25.23% |
| $T_6$ | 4.00ab | 2.40a | 3.27b | 1.83cd | 2.50 | 1.47cd | 1.10ab | 1.27bc | 1.28 | 1.50a | 0.99ab | 2.10b | 1.53 | 1.77 | 20.27% |
| $T_7$ | 3.37c | 2.33ab | 3.77a | 2.70a | 2.93 | 2.20a | 1.30a | 2.13a | 1.88 | 1.30ab | 1.52a | 2.77a | 1.86 | 2.22 | - |
| P-value | 0.01 | 0.01 | 0.01 | 0.01 | - | 0.01 | 0.01 | 0.01 | - | 0.01 | 0.01 | 0.01 | - | - | - |
| LS | ** | ** | ** | ** | - | ** | ** | ** | - | ** | ** | ** | - | - | - |

$T_1$= Award 40 SC @ 0.2ml/L, $T_2$= Neem oil extract @ 2ml/L, $T_3$= Bioneem Plus 1% @ 3ml/L, $T_4$= Imidagold 20 SL @0.25 ml/L, $T_5$= Suspend 5 SG @ 1.0 g/L, $T_6$= Tracer 45 SC @ 0.5 ml/L, $T_7$= Untreated control; In column, means followed by same letters are not statistically different and means followed by different letters are statistically different. ** Means significant at 1% level of probability; LS means level of significance

In respect of cumulative mean number, minimum twig infestation was recorded in Buprofezin treated plots (5.26 plant$^{-1}$) which was about two times lower than untreated control plots. On the other hand, maximum infestation was occurred in Spinosad treated plots (7.72 plant$^{-1}$) but significantly effective comparing to untreated plots. The mean number of infested twig in Bio-neem plus (5.51 plant$^{-1}$), Imidacloprid (5.89 plant$^{-1}$), Emamectin benzoate (6.58 plant$^{-1}$) and Neem oil (6.69 plant$^{-1}$) treated plots were found a bit less than Spinosad treated plots and these were observed moderately effective among the tested insecticides in the experiment.

The positive control Imidacloprid ($T_4$) was significantly superior to Emamectin benzoate, Neem oil and Spinosad with the 28.86% reduction. Therefore, among the biorational insecticides tested Buprofezin and Bio-neem plus exhibited promising efficacy against whitefly population and may be used as a tool for IPM program.

**Table 4: Efficacy of selected biorational insecticides on the twig infestation of brinjal plants**

| Treat-ments | Pre-treated no. | Mean number of infested twig plant$^{-1}$ | | | | | | | | | | | | Cumulative mean | % reduction over control |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after 1st spray | | | | Days after 2nd spray | | | | Days after 3rd spray | | | | | |
| | | 3 | 5 | 7 | Mean | 3 | 5 | 7 | Mean | 3 | 5 | 7 | Mean | | |
| $T_1$ | 7.17b | 5.16 d | 6.17b | 4.30de | 5.21 | 6.33ab | 2.03c | 5.67b | 4.68 | 4.66cd | 6.40b | 6.60b | 5.89 | 5.26 | 36.47% |
| $T_2$ | 6.27bc | 7.37abc | 7.50ab | 5.30cd | 6.72 | 6.67ab | 6.00ab | 6.33ab | 6.33 | 6.67ab | 7.00ab | 7.33b | 7.00 | 6.69 | 19.20% |
| $T_3$ | 6.00 c | 6.33cd | 3.93c | 3.50e | 4.59 | 6.00b | 5.00b | 3.50c | 4.83 | 6.33bc | 6.33b | 8.66ab | 7.11 | 5.51 | 33.45% |
| $T_4$ | 5.83 c | 6.50bcd | 5.66bc | 4.20de | 5.45 | 6.50ab | 5.67ab | 5.50b | 5.89 | 4.33 d | 6.67b | 8.00ab | 6.33 | 5.89 | 28.86% |
| $T_5$ | 6.83bc | 9.00 a | 6.00b | 6.50bc | 7.17 | 6.76ab | 5.00b | 5.00b | 5.59 | 6.33bc | 7.00ab | 7.67b | 7.00 | 6.58 | 20.53% |
| $T_6$ | 5.90 c | 8.33ab | 8.63a | 7.26b | 8.07 | 7.50a | 6.93ab | 7.00a | 7.14 | 6.00bcd | 8.53a | 9.33a | 7.95 | 7.72 | 6.76% |
| $T_7$ | 9.20a | 7.57abc | 9.00a | 10.00a | 8.86 | 7.77a | 7.17a | 7.13a | 7.36 | 8.33 a | 7.00ab | 10.57a | 8.63 | 8.28 | - |
| P-value | 0.01 | 0.01 | 0.01 | 0.01 | | 0.01 | 0.01 | 0.01 | | 0.01 | 0.01 | 0.01 | | - | - |
| LS | ** | ** | ** | ** | | ** | ** | ** | | ** | ** | ** | | | |

$T_1$= Award 40 SC @ 0.2ml/L, $T_2$= Neem oil extract @ 2ml/L, $T_3$= Bioneem Plus 1% @ 3ml/L, $T_4$= Imidagold 20 SL @0.25 ml/L, $T_5$= Suspend 5 SG @ 1.0 g/L, $T_6$= Tracer 45 SC @ 0.5 ml/L, $T_7$= Untreated control; In column, means followed by same letters are not statistically different and means followed by different letters are statistically different. ** Means significant at 1% level of probability; LS means level of significance

## Discussion

From the above results, it is evident that all the treatments were significantly effective in reducing whitefly population in comparison to untreated control. A steady increase of pest population was noticed in untreated plots due to having no insecticidal treatment. Buprofezin was found the most effective treatment in controlling the whitefly population throughout the crop life followed by Bioneem plus in present study. On the other hand, Spinosad was found the least effective treatment.

The effectiveness of the selected insecticides for the control of *B. tabaci* has also been reported by many researchers. The effectiveness of Buprofezin and Azadiractin based insecticides in controlling *B. tabaci* in recent time has also been reported by many researchers. The superiority of Buprofezin in management of whitefly is in agreement with the findings of Islam and Das (2017). They found Buprofezin most compatible among the bio-rational molecules and it could be incorporate safely in the IPM program for brinjal pest management. Akbar *et al*. (2015); Karkar *et al*. (2014) observed Azadirachtin based insecticide sprays performed well in reducing whitefly populations. Thus, these above reports about the effectiveness of Buprofezin and Botanicals are strongly supporting the present findings. Emamecin benzoate was also found effective in present study for whitefly management, which is in agreement with the results obtained by Patel *et al.* (2015). They reported that Emamectin benzoate against brinjal whitefly was found to be most effective to record the lowest infestation whereas Mote and Bhavikatti (2003) suggested that Emamectin benzoate was moderately effective against this pest.

The efficacy of Spinosad was noticed least effective in most of the cases in managing whitefly population. The results on efficacy of Spinosad against whitefly recorded are in accordance with many other earlier reports. Kumar *et al.* (2017) and Akbar *et al.* (2015) observed that Spinosad was least effective in reduction of whitefly population. But according to Rajeshwari *et al*. (2019), Spinosad performed well and they also found that Spinosad 45 SC @ 0.2 ml/L recorded less population of whitefly which is partially different from the present findings.

## Conclusion

From the present study it can be concluded that the application of selected biorationals insecticides showed significant performance in reducing whitefly nymph and adult population as well as infested leaf and twig in comparison to untreated control. Among the biorationals Buprofezin provided the best efficacy in reducing the infestation. On the basis of reduction of infestation, this could be recommended as alternative of the synthetic chemical insecticides in successful management of whitefly.

## References


Akbar, M.F., Rana, H.U. and Khan, M.F.U. 2015. Management of *Bemisia tabaci* Genn. on *Solanum melongena* L. through environmentally friendly bio-insecticides. International Journal of Biology and Biotechnology, 12(3): 393-399. DOI: 10.17582/journal.pjz/2019.51.5.1615.1620

Alam, S.N., Rashid, M.A., Rouf, F.M.A., Jhala, R.C. and Patel, J.R. 2003. Development of an integrated pest management strategy for eggplant fruit and shoot borer in South Asia. Technical Bulletin 28, AVRDC -The World Vegetable Center, Shanhua, Taiwan.

Chakraborty, S. and Sarkar, P.K. 2011. Management of *Leucinodes orbonalis* Guen on eggplant during the rainy season in India. Journal of Plant Protection Research, 51(4): 325–328.
DOI: https://doi.org/10.2478/v10045-011-0053-5

Das, G. and Islam, T. 2014. Relative efficacy of some newer insecticides on the mortality of jassid and white fly in brinjal. International Journal of Research in Biological Sciences, 4(3): 89-93.

Harish, D.K., Agasimani, A.K., Imamsaheb, S.J. and Satish, S.P. 2011. Growth and yield parameters in brinjal as influenced by organic nutrient management and plant protection conditions. Research Journal of Agricultural Sciences, 2(2): 221-225.

Islam, T. and Das, G. 2017. Compatibility of selected bio-rational pesticides with the predatory arthropods in brinjal ecosystem. Journal of Bangladesh Agricultural University, 15(2): 234–238. https://doi.org/10.3329/jbau.v15i2.35068

Jagginavar, S.B., Sunitha, N.D. and Biradon, A.P. 2009. Bioefficacy of flubendiamide 480SC against brinjal fruit and shoot borer, *Leucindoes orbonalis* Guen. Karnataka Journal of Agricultural Sciences, 22(3): 712-713.

Kalawate, A. and Dethe M.D. 2012. Bioefficacy study of bio-rational insecticide on brinjal. Journal of Biopesticides, 5(1): 75-80. DOI:10.57182/jbiopestic.5.1.75-80

Karkar, D.B., Korat, D.M. and Dabhi, M.R. 2014. Evaluation of botanicals for their bio-efficacy against insect pests of brinjal. Karnataka Journal of Agricultural Sciences, 27(2): 145-147.

Khatun, N., Howlader, M.T.H. and Das, G. 2015. Efficacy of Abamectin alone or in combination with Benzoate, Lambda-cyhalothrin and Lufenuron against the infestation of cucurbit fruit fly, *Bactrocera cucurbitae* (Coq.). Journal of Entomology and Zoology Studies, 3(5): 311-315.

Kumar, A., Sachan, S.K., Kumar, S. and Kumar, P. 2017. Efficacy of some novel insecticides against whitefly (*Bemisia tabaci* Gennadius) in brinjal. Journal of Entomology and Zoology Studies, 5(3): 424-427.

Kumar, R., Mahla, M.K., Singh, B., Ahir, K.C. and Rathor, N.C. 2017. Relative efficacy of newer insecticides against sucking insect pests of brinjal (*Solanum melongena*). Journal of Entomology and Zoology Studies, 5(4): 914-917.

Mandal, S., Singh, N.J. and Konar, A. 2010. Efficacy of synthetic and botanical insecticide against whitefly (*Bemicia tabaci*) and shoot and fruit borer (*Leucinodes orbonalis*) on brinjal (*Solanum melongena* L.). The Journal of Crop and Weed, 6(1): 49-51.

Mehmood, K., Afzal, M. and Amjad, M. 2001. Non-traditional insecticides: A new approach for the control of okra jassid. Journal of Biological Sciences, 1(1): 36-37. DOI: 10.3923/jbs.2001.36.37

Mote, U.N. and Bhavikatti, S. 2003. Efficacy of chemical and non-chemical insecticides against major pests of brinjal in *Kharif* season. Journal of Applied Zoological Researches, 14(1): 54-56.

Nonnecke, J.L. 1989. Vegetable Production. Van Nostrand Reinhold, New York. pp. 247.

Patel, S., Mandloi, R., Prajapati, S., Saxena, A.K., Parmar, R. and Singh, O.P. 2015. Assessment the efficacy and economics of insecticides and biopesticides against major insect pest combination of brinjal (*Solanum melongena* Linn.). Plant Archives, 15(2): 923-930.

Rajeshwari, G., Sridhar, V., Chakravarty, A.K. and Kumar, S.M. 2019. Studies on efficacy of bio-rational insecticides against major sucking pests, *Amrasca biguttula biguttula* (Ishida), *Bemisia tabaci* (Gennadius) and *Aphis gossypii* (Glover) on brinjal. International Journal of Chemical studies, 7: 584-588.

Rashid, M.H., Khatun, M.J., Mahfuz, M.S., Dash, C.K. and Hussain, M.A. 2013. Seasonal fluctuation of insect pests of brinjal at agricultural research station, Burirhat, Rangpur. International Journal of Experimental Agriculture, 3(1): 4-8.

Regupathy, A., Palanisamy, S., Chandramohan, N. and Gunathilagaraj, K. 1997. A guide on crop pests. Sooriya Desk Top Publishers, Coimbatore. pp. 264.

Singh, J.P., Gupta, P.K., Chandra, U., and V.K. Singh., 2016. Bioefficacy of newer insecticides and biopesticides against brinjal shoot and fruit borer *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae). International Journal of Plant Protection, 9 (1): 1- 7.

Zaman, Y. 2009. Effect of different application methods of Imidacloprid on abundance and management of Jassid in okra. M. Sc. (Entom.) Thesis. Sher-e-Bangla Agricultural University, Dhaka