Efficacy evaluation of some bio-insecticides against green leafhopper (Amrasca biguttula biguttula Ishida) infesting brinjal

Md. Mahi Imam Mollah

Department of Entomology, Patuakhali Science and Technology University, Patuakhali, Bangladesh

Abstract

In Bangladesh, brinjal (Solanum melongena L.) is an important vegetable crop due to its year-round cultivation, high demand for consumption, and nutritional value. The main obstacle to the successful cultivation and production of brinjal is insect pests. The current study was carried out in the winter, when green leafhoppers (Amrasca biguttula biguttula), one type of sucking insect pest, are most prevalent. Early in the vegetative stage, an infestation of green leafhoppers (GLH) was noted; as the canopy size increased, so did their numbers. The consumption of brinjal with its peel poses a health risk due to possible contamination with toxic chemical insecticides. We assess a few non-toxic or minimally toxic bio-insecticides against GLH in order to tackle this crucial problem. Fizimite, one of the bio-insecticides, was found to be effective against GLH in a sodium lauryl ether sulfate preparation. Fizimite decreased the amount of GLH in the plant by 85.8%, the amount of leaf infestation by 77.84%, and the amount of GLH-infected brinjal leaf abundance by 54.34%. But Voliam Flexi, a chemical control, was also discovered to be successful against GLH. Fizimite may therefore be a non-toxic, bio-rational substitute for Voliam Flexi, a synthetic, toxic medication used to control GLH.

Introduction

Brinjal (Solanum melongena L.), also known as eggplant or aubergine is a vitamin, mineral, phenol, and antioxidant-rich vegetable (Gurbuz et al., 2018). This vegetable is cultivated throughout the world because of heat insensitivity, and genetic or morphological diversity (Chapman, 2020) with a production of 55,197,878 tons from a 1,847,787 ha area (FAO, 2019). However, insect pests are the major impediment to the successful cultivation and production of brinjal (Mollah et al., 2022a). Insect infestation starts at the seedling stage and continues up to the final harvest. About 140 species of insect and arachnid pests are reported to infest brinjal throughout the world (Sharma and Tayde, 2017). In Bangladesh, green leafhopper (Amrasca biguttula biguttula), aphid (Aphis gossypii), whitefly (Bemisia tabaci), thrips (Thrips tabaci), shoot and fruit borer (Leucinodes orbonalis G.), and from arachnid, red spider mite (Tetranychus macfurlanei) are most prevalent (Dutta et al., 2017). Among these, brinjal shoot and fruit borer (BSFB), leafhopper, whitefly, and mealy bugs are most common, prevalent, and destructive in the summer season (Kapil et al., 2022; Mollah et al., 2023) while aphids are most common in both winter and summer seasons in brinjal and leguminous vegetables causing low yield (Mollah, 2022; Mollah et al., 2017a; Mollah et al., 2013a; 2013b). Both adults and nymphs of leafhoppers and other leaf suckers cause serious damage to leave by sucking cell sap from the lower surface of the leaves causing chlorosis and necrotic spots. Finally, the entire plant turns brown and shows burn symptoms and ultimately the leaves droop off. The indirect effect of leafhoppers includes honey-
weeding, mulching, and fertilizations were performed whenever
row distance. All the intercultural operations including irrigation,
planted maintaining 0.8 m plant-to-plant distance and 0.8 m row-to-
the soil and fertilized properly for successful crop production.

The climate is characterized by the alternate hot and cold sea-
2023). The climate is characterized by the alternate hot and cold sea-
ance of some microbial and plant-origin bio-insecticides against
green leafhoppers infesting brinjal plant. This area possesses
Agriculture substation, Barisal, Bangladesh to evaluate the perform-
Location, soil characteristics, and land preparation
Experimental design, planting, and treatment
A randomized complete block design with three replications was
Data collection and presentation
Data collection started at the early vegetative stage before bio-

Percent leaf infestation = \[\frac{\text{Number of infested leaves}}{\text{Total number of leaves}} \times 100\]

Percent reduction over control = \[\frac{\text{Mean value of the control – mean value of the treatment}}{\text{Mean value of the control}} \times 100\]

Statistical analysis and presentation of data
For processing, calculating, and arranging the collected raw
data, Microsoft Excel was used. PROG GLM in the SAS program
(SAS, 2002) was used for the analysis of variance (ANOVA) for all
the continuous variables data. The least significant difference test at
0.05 level of type I error was applied to compare the means. Every treatment was replicated thrice in three individual plants. Each bar represents the mean value of the replications and error bars represent the standard deviation. Graphical data were prepared using Sigma Plot 12.5 software.

**Results**

**Infestation and pattern of infestation in brinjal field at the vegetative stage**

The present study found that GLH infested the lower surface of the brinjal leaf (Figure 1A) and the infestation starts from the early vegetative stage. In the infested plants, GLH abundance increased in most cases with the increase in plant age and canopy size although exceptions were found in some cases (Figure 1B). The abundance or number of GLH was different among the plants grouped under different treatments. The maximum number of GLH was observed in T6 which was followed by T7, T4, T5, T3, and T2 while the least was in T1 (Figure 1B).

**Effect of bio-insecticides on GLH infestation in brinjal plant**

Application of bio-insecticides significantly (F=219.6; df=6, 14; P<0.001) affects the GLH infestation in the brinjal plant. The highest GLH individual was recorded from Fytoclean (7.44 GLH/plant) treated plants which were statistically similar to Biomax M (6.77 GLH/plant), and Fytomax (6.44 GLH/plant) (Figure 2A). In contrast, the lowest GLH individual was observed in Fizimite (2.66 GLH/plant) treated plants (Figure 2A). Moreover, very few GLH (0.33 GLH/plant) were observed in the chemical control Volium flexi-treated plants. However, the maximum number of GLH was recorded from untreated control plants (18.77 GLH/plant) (Figure 2A). Thus, the maximum reduction of GLH over untreated control was achieved from Fizimite (85.88%) which was followed by Spinomax (76.33%), Fytomax (65.68%), and Biomax (63.91%) while the minimum was obtained from Fytomax (60.36%) of the applied bio-insecticides (Figure 2B). However, the chemical insecticide Volium Flexi provided a 98.23% reduction of GLH over untreated control (Figure 2B).

Similarly, bio-insecticides have a significant (F=219.6; df=6, 14; P<0.0001) effect on the reduction of leaf infestation by GLH (Figure 3). Among the bio-insecticides, the lowest infestation in leaf by GLH was obtained from the Fizimite (6.27%) application which was followed by Spinomax (70.10%), Fytoclean (69.54%), and Biomax (57.06%) while the lowest reduction of leaf infestation was achieved from Fytomax (47.8%) application of the bio-insecticides (Figure 3B). However, the chemical control Volium flexi provided a 94.52% reduction of leaf infestation by GLH (Figure 3B).

Bio-insecticides significantly (F=27.49; df=6, 14; P<0.001) control the abundance of GLH in the infested leaf also (Figure 4). Among these, Fizimite (1.29 GLH/infested leaf) and Fytoclean (1.27 GLH/infested leaf) denoted significant differences (P<0.05, least significant difference test) among the treatments.

![Figure 1. Infestation of green leafhoppers in brinjal plant. (A) Green leafhopper-infested brinjal leaf; (B) pattern of leaf infestation. Plants were randomly divided for treatments. Each treatment consists of three replications and each plant was considered a replication. The number of infested and healthy leaves was counted for leaf infestation calculation. Different letters above the error bar denote significant differences (P<0.05, least significant difference test) among the treatments.](image)

**Table 1. Different treatments used in this study with their pieces of information.**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Active ingredient</th>
<th>Suppliers</th>
<th>Dose</th>
</tr>
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<tbody>
<tr>
<td>T1 = Water</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>T2 = Biomax M 1.2 EC</td>
<td>Abamectin</td>
<td>Russell IPM BD Ltd.</td>
<td>1 mL L⁻¹ water</td>
</tr>
<tr>
<td>T3 = Fizimite 20%</td>
<td>Sodium lauryl ether sulphate</td>
<td>Russell IPM BD Ltd.</td>
<td>1 mL L⁻¹ water</td>
</tr>
<tr>
<td>T4 = Fytomax 0.1%</td>
<td>Azadirachtin</td>
<td>Russell IPM BD Ltd.</td>
<td>5 mL L⁻¹ water</td>
</tr>
<tr>
<td>T5 = Spinomax</td>
<td>Saccharopolyspora spinosa + Btk broth</td>
<td>Russell IPM BD Ltd.</td>
<td>2 mL L⁻¹ water</td>
</tr>
<tr>
<td>T6 = Fytoclean 40%</td>
<td>Potassium salt of fatty acid</td>
<td>Russell IPM BD Ltd.</td>
<td>5 mL L⁻¹ water</td>
</tr>
<tr>
<td>T7 = Volium Flexi 300 SC</td>
<td>Chlorantraniliprole + Thiadiazuron</td>
<td>Syngenta BD</td>
<td>0.5 mL L⁻¹ water</td>
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GLH/infested leaf) showed the lowest GLH abundance in each infested leaf while Biomax M (2.25 GLH/infested leaf) showed the highest abundance of GLH (Figure 4A). However, in the untreated control, GLH abundance was 2.83 GLH/infested leaf and in the chemical control of Voliam flexi, it was 0.22 GLH/infested leaf (Figure 4A). Compared to the untreated control, the maximum reduction of GLH abundance was achieved by Fizimite (54.34%) as well as Fytoclean (54.91%) while the lowest reduction was observed in Biomax M (20.37%) (Figure 4A). However, the chemical control Voliam flexi achieved a 92.16% reduction of GLH (Figure 4B).

Discussion

Leafhopper is a serious pest to brinjal that sucks cell sap and causes chlorosis, necrosis spots, and curling in the edges of the leaf resulting in droop off the leaves (Ghosh and Karmakar, 2021). It also interrupts photosynthesis by honeydew secretion and transmits pathogenic viruses to plants.

Among the treated bio-insecticides, a sodium lauryl ether sulfate preparation, Fizimite 20% was found effective against leafhoppers. It reduces 85.80% leafhopper population in the plant, a 77.84% reduction of leaf infestation, and a 54.34% reduction in the abundance of leafhoppers in the infested brinjal leaf. Sodium lauryl ether sulfate is an anionic highly soluble and non-volatile surfactant that helps to control chewing and sucking pests by physical means. It is effective against hoppers, aphids, mealybugs, whiteflies, spiders, scale, and psyllids (Lewis et al., 2016). Another research by Gayathri and Geetha (2019) reported that applications of bio-pesticide, Buprofezin 25SC reduced 78.78% reduction of the leafhopper population in brinjal leaf. Another study by Ali et al. (2016) reported that neem extracts reduced 55.95 and 68.73% of Jassid/leafhopper populations in brinjal leaf after the first and second spray, respectively. Successive research showed that Datura extract reduced 63.11% and neem extract reduced 68.73% population of Jassid/leafhoppers (Ali et al., 2017). Kunbhar et al. (2018), performed a study with some botanical pesticides (Neem, Tobacco, Trooh) and found that Neem was potent and reduced up to 56.09% of the Jassid population after seven days. The above discussion thus revealed that synthetic bio-pesticides are relatively more potent than botanicals or plant-origin insecticides. We found that the Synthetic bio-pesticide Buprofezin 25 SC provided a 78.78% leafhopper reduction, Fizimite...
The efficacy of bio-insecticides was evaluated against the leafhopper in the brinjal field during the winter season. A sodium lauryl ether sulfate preparation Fizimite 20% found effective against leafhoppers providing an 85.80% reduction of leafhopper population while among the botanical insecticides Neem extract provided a maximum 68.73% reduction of leafhopper population which is much less than Fizimite 20%. As leafhoppers are very active and relatively hard-bodied insects among the sucking insect pests, their control is not so easy. Considering all the issues, it can be concluded that Fizimite 20% is an effective bio-insecticide to control the leafhoppers in brinjal. However, further research on the impact of Fizimite 20% on the physiological process of leafhoppers might enhance the process.

Conclusions

The efficacy of bio-insecticides was evaluated against the leafhopper in the brinjal field during the winter season. A sodium lauryl ether sulfate preparation Fizimite 20% found effective against leafhoppers providing an 85.80% reduction of leafhopper number in the plant. It also provided a 77.84% reduction in leaf infestation by leafhoppers and a 54.34% reduction of leafhopper number in the infested leaf. These results followed the chemical insecticide, Voliam Flexi 300 SC. So, Fizimite 20% can be treated as a non-toxic alternative to chemical insecticides.

References


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