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EFFICACY OF SOME BOTANICALS AGAINST INFESTATION OF LEAFHOPPER (*AMRASCA BIGUTTULA BIGUTTULA*) IN BRINJAL

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Abstract: Brinjal (*Solanum melongena*) is a popular vegetable crop in Bangladesh cultivated all the year round. Infestation of different insect pests is a serious issue which hampers the production of brinjal. As the farmers in Bangladesh applying different chemical insecticides without following proper dosage or pre-harvest interval to control insect infestation, pesticide residue remains even after harvest and different health hazards are increasing after consuming these vegetables. The present study was conducted to assess some non-toxic botanicals against leafhopper (*Amrasca biguttula biguttula*) in brinjal which is one of the most devastating sucking insect pest in both summer and winter. Infestation of leafhopper was observed highest during vegetative stage. Application of neem oil performed best to reduce the mean number of leafhopper 5.73/plant in this experiment. Highest 57.73%, 50.83% and 49.19% reduction over control regarding to the number of leafhopper per plant was observed in case of neem oil application, tobacco leaf extract application and neem leaf extract application respectively. Application of neem oil and tobacco leaf extract gave 59.13% and 43.19% percent reduction over control regarding to the leaf infestation by leafhopper per plant respectively. Application of garlic extract, mustard seed extract and papaya leaf extract also observed effective to control the infestation of leafhopper in brinjal. As incidence of leafhopper has a negative impact on the yield of brinjal, use of botanicals can be a good alternative to control this insect.

Keywords: brinjal (*Solanum melongena*); chemical insecticides; leafhopper (*Amrasca biguttula biguttula*); infestation; botanicals.

INTRODUCTION

Brinjal also known as eggplant is a very common vegetable crop in Bangladesh as well as in many countries in Asia. In Bangladesh, during Kharif season of 2022-23 total production of brinjal was 235421.41 Mt. (BBS, 2023). Brinjal is a nutritive vegetable containing carbohydrate, ascorbic acid, anthocyanin , fat, protein and different minerals *viz.* K, Na, Ca, P, Mg, Zn, Fe, Mn, Cu (Quamruzzaman *et al.*, 2020). Succession of different insect pests is found in brinjal field from transplanting to harvest (Soren *et al.*, 2020). Brinjal shoot and fruit borer (BSFB), leafhopper (*Amrasca biguttula biguttula*), aphid (*Aphis gossypii)*, whitefly (*Bemisia tabaci*), and mealy bugs are found mostly in destructive phase field during summer season (Mollah *et al., 2023;* Kapil *et al*, 2022). Minimum and maximum temperature were found positively correlated with leafhopper number where as relative humidity and rainfall were found negatively correlated (Mahmood *et al.*, 2002). In any other countries, leafhopper (*Amrasca biguttula biguttula*) has been reported as a serious pest of brinjal and its activity started soon after transplanting (Mahmood *et al.*, 2002). Both nymph and adult of leafhopper cause serious damage to the plant by sucking cell sap from the lower surface of the leaves which leads to chlorosis, necrotic spots and curling the edge of the leaf resulting in droop off the leaves (Ghosh and Karmakar, 2021). Host range of this insect is wide *e.g.* okra, cotton, brinjal, beans, castor, cucurbits, hollyhock, potato, sunflower, malvaceous plants, amaranth, groundnut, sugar beet, pigeon pea, calendula flower, jute, soybean, niger, kenaf, common bean, radish, tomato, sorghum, mung bean, cowpea, maize etc (Ghosh and Karmakar, 2021). In optimal environmental condition, yield loss increases up to 60-70% due to leafhopper infestation (Sultana *et al.*, 2016).

In Bangladesh, chemical pesticides are used by the farmers to control leafhopper and other sucking pests in the field. Insecticide resistance and secondary pest outbreak are caused due to the overuse of these chemical pesticides (Bass *et al.*, 2014). Mortality of non-target organisms (Mollah *et al*, 2017), beneficial predators (Mollah *et al.*, 2012) or parasitoids (Mollah and Khatun, 2023) are observed as the detrimental effect of overuse of chemical insecticides. Use of non-hazardous, plant-based or microbial-origin bio-insecticides can provide environment friendly for pest control and also found effective, safe for non-target organisms and natural enemies (Mollah *et al.*, 2022). In an experiment by Kunbhar *et al.*, 2018, some botanicals were found effective against leafhopper of brinjal. Keeping these factors under consideration, the present study aimed to find out the efficacy of some botanicals against leafhopper infesting brinjal under field condition.

MATERIALS AND METHODS

The experiment was conducted during Kharif-1 (March, 2023 to June, 2023) at Sher-e-Bangla Agricultural University, Dhaka, Bangladesh to evaluate the efficacy of some botanicals against leafhopper attacking brinjal. The experimental field was in AEZ 28 (Madhupur Tract). Specific geographic location was in 23°77′ N latitude and 90°33′ E latitude at a height of 4m above from the sea level. BARI Begun-8 was used in this experiment. Randomized Complete Block Design (RCB) was followed in this experiment with three replication and seven treatments. Different intercultural operations were done at regular interval. Fertilizers and manure were applied as per recommendation.

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Treatments

Seven treatments including control were practiced in this experiment. With every treatment, two to three drops of liquid dishwasher was used as surfactant Botanical based treatments and their doses used in this experiment were as follows:

T_1= Spraying of Neem oil @ 3.0 ml/L of water

T_2= Spraying of Tobacco leaf extract @ 5 ml/L of water

T_3= Spraying of Garlic extract @ 3.0 ml/L of water

T_4= Spraying of Papaya leaf extract @ 5.0 ml/L of water

T_5= Spraying of Neem leaf extract @ 3.0 ml/L of water

T_6= Spraying of mustard seed extract @ 5.0 ml/L of water

T_7= Untreated control

Data collection

Data collection was started from the early vegetative stage and continued up to harvesting stage. Number of leafhopper per plant at different growth stages of the plant, number of infested leaves per plant, number of healthy leaves per plant, percent reduction over control, yield were recorded.

The number and weight of infested brinjal for each treated plot and untreated control plot were recorded and the percent reduction of brinjal infestation in number and weight was calculated using the following formula:

$$\% \text{ Reduction over control} = \frac{X_2 - X_1}{X_2} \times 100$$

Where, X_1 = The mean value of the treated plot

X_2 = The mean value of the untreated plot

Statistical analysis and presentation of data

MSTAT-C software was used for analysis of variance after square root transformation. ANOVA was made by F variance test and Duncan Multiple Range Test (DMRT) was used for pair comparisons.

RESULTS AND DISCUSSION

Number of leaf leafhopper

Number of leafhopper per plant at vegetative stage, early fruiting stage, mid fruiting stage and late fruiting stage was observed and recorded. Presence of leafhopper was comparatively higher in vegetative stage (Table-1).Mean number of leafhopper per plant was lowest in case of neem oil application (T_1) (5.73/plant), tobacco leaf extract application (T_2) (6.66/plant) and neem leaf extract application (T_5) (6.88/plant) respectively (Table-1). Highest percent reduction over control was 57.73% in case of neem oil application (T_1). Lowest Percent reduction over control was 40.18% in case of papaya leaf extract application (T_4) (Table-1). In terms of reducing the percent of number of leafhopper per plant, the efficiency of botanicals applied in this experiment was neem oil application, tobacco leaf extract application, neem leaf extract application, garlic extract application, mustard seed extract application and papaya leaf extract application respectively.

Table 1.

Effect of botanicals on the number of leaf hopper in brinjal

Treatments	No. of Leaf hopper per plant					
	Vegetative stage	Early fruiting stage	Mid fruiting Stage	Late fruiting stage	Mean	Incidence reduction over control (%)
T_1	8.24 f	7.17 f	3.91 f	3.58 f	5.73 f	57.73
T_2	9.19 e	8.36 e	4.86 e	4.23 e	6.66 e	50.83
T_3	9.68 c	8.81 c	5.33 c	5.16 c	7.25 c	46.51
T_4	10.55 b	9.31 b	6.75 b	5.80 b	8.10 b	40.18
T_5	9.31 d	8.62 d	5.07 d	4.53 d	6.88 d	49.19
T_6	10.13 b	9.11 b	6.33 b	5.66 b	7.81 bc	42.38
T_7	14.24 a	14.76 a	13.26 a	11.92 a	13.55 a	-
CV (%)	0.76	0.62	1.00	1.68	0.53	-
LSD (0.05)	0.13	0.09	0.11	0.16	0.08	-

[DAT = Day After Transplanting, in a column, numeric value represents the mean of 3 replications; each replication is derived from 5 plants per treatment; in a column means having similar letter(s) are statistically identical at 0.05 level of probability]

[T_1= Spraying of Neem oil @ 3.0 ml/L of water at 7 days interval; T_2= Spraying of Tobacco leaf extract @ 10 g/L of water at 7 days interval; T_3= Spraying of Garlic extract @ 30 g/L of water at 7 days interval; T_4= Spraying of Papaya leaf extract @ 30 g/L of water at 7 days interval; T_5= Spraying of Neem leaf extract @ 20 g/L of water at 7 days interval; T_6= Spraying of mustard seed extract @ 20 g/L of water at 7 days interval; T_7= Untreated control]

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Leaf infestation by leafhopper in brinjal

Statistically highest number of infested leaves were found in case of untreated control (T_7) and mustard seed extract application (T_6). Number of infested leaves were 17/plant and 16.88/plant in untreated control (T_7) and mustard seed extract application (T_6) respectively (Table 2). Lowest number of infested leaves were found in neem oil application (T_1) (6.33/plant). Percent infestation was lowest in case of neem oil application (T_1) (13.44%) and highest in case of untreated control (T_7) (32.88%) and papaya leaf extract application (T_6) (32.66%). Percent reduction over control was highest in case of neem oil application (T_1) (59.13%). 43.59% infestation reduction over control was observed in tobacco leaf extract application (T_2) which was better after neem oil application. But application of mustard seed extract (T_6) and papaya leaf extract (T_4) was not satisfactory enough to reduce the brinjal leaf infestation percentage over control by leafhopper (Table 2).). In terms of reducing the percent leaf infestation per plant by leafhopper, the efficiency of botanicals applied in this experiment was neem oil application, tobacco leaf extract application, neem leaf extract application, garlic extract application, papaya leaf extract application and mustard seed extract application respectively.

Table 2.

Effect of botanicals on leaf infestation by leaf hopper

Treatments	Infestation of leaves by leaf hopper per plants			
	No. of Leaves	No. of infested leaves	% Infestation	Infestation reduction over control (%)
T_1	47.10 d	6.33 f	13.44 f	59.13
T_2	50.30 c	9.33 e	18.55 e	43.59
T_3	42.47 e	11.33 d	26.68 c	18.87
T_4	41.40 f	12.33 cd	29.78 b	9.43
T_5	59.30 a	14.00 b	23.61 d	28.20
T_6	51.68 b	16.88 a	32.66 a	0.66
T_7	51.70 b	17.00 a	32.88 a	-
CV (%)	0.22	7.38	7.10	-
$LSD_{(0.05)}$	0.19	1.43	2.89	-

[DAT = Day After Transplanting, In a column, numeric value represents the mean of 3 replications; each replication is derived from 5 plants per treatment; in a column means having similar letter(s) are statistically identical at 0.05 level of probability]

[T_1= Spraying of Neem oil @ 3.0 ml/L of water at 7 days interval; T_2= Spraying of Tobacco leaf extract @ 10 g/L of water at 7 days interval; T_3= Spraying of Garlic extract @ 30 g/L of water at 7 days interval; T_4= Spraying of Papaya leaf extract @ 30 g/L of water at 7 days interval; T_5= Spraying of Neem leaf extract @ 20 g/L of water at 7 days interval; T_6= Spraying of mustard seed extract @ 20 g/L of water at 7 days interval; T_7= Untreated control]

Relationship between number of leafhopper and brinjal yield

Correlation study was done to establish the relationship between the number of leaf hopper per plant and the yield (t/ha) of brinjal during the management of this insect. From the study it was revealed that significant correlation was observed between the number of leaf hopper per plant and the yield of brinjal (Figure 1). It was evident from the Figure 1 that the regression equation y = -1.9806x + 33.812 gave a good fit to the data, and the co-efficient of determination (R^2 = 0.5687) showed that, fitted regression line had a significant regression coefficient. From this regression analysis, it was evident that there was a negative relationship between the number of leaf hopper per plant and the yield of brinjal, i.e., the yield decreased with the increase of the number of leaf hopper per plant during the growing season of brinjal.

Considering the harmful effect of chemical insecticides, USAID-HARVEST (2012) introduced a mixture of botanicals where *Diocorea Hispida*, *Phyllanthus emplica*, *Annona sqamosa*, *Strychnos nux-vomica*, *Datura metel* (datura), *Capsicum frutescens* (chilli), *Azadirachta indica* (neem) , leaf of *Derris elliptica*, Rhizomes of *Alpinia galanga* , *Tinospora crispa*, *Ocimum basilicum* (basil), *Nicotiana tabacum* (tobacco) and *Cuscuta maritime* were used that effectively killed or reduced the most common pest like aphids, whiteflies, leafhopper, thrips, certain beetles, caterpillars etc. In a study by Kunbhar *et al.* (2018) found that neem can reduce the number of leafhopper up to 56.09%. Ali *et al.* (2017) in an experiment found that neem and datura extract can reduce leafhopper population 68.73% and 68.11% respectively. Noorani (2008) evaluated some botanicals in an experiment and found mortality rate of 54.75% of leafhopper in brinjal field with tobacco extract. Garlic bulb spray and garlic oil spray was found effective against thrips and leafhopper infestation respectively by Bissdorf and Weber (2009). They also found insecticidal properties of papaya water extract against white grub. Mustard seed extract was found effective as insect repellent against some horticultural crops (Gupta *et al*., 2021). In this experiment, botanicals show a satisfactory result to control leafhopper infesting brinjal.

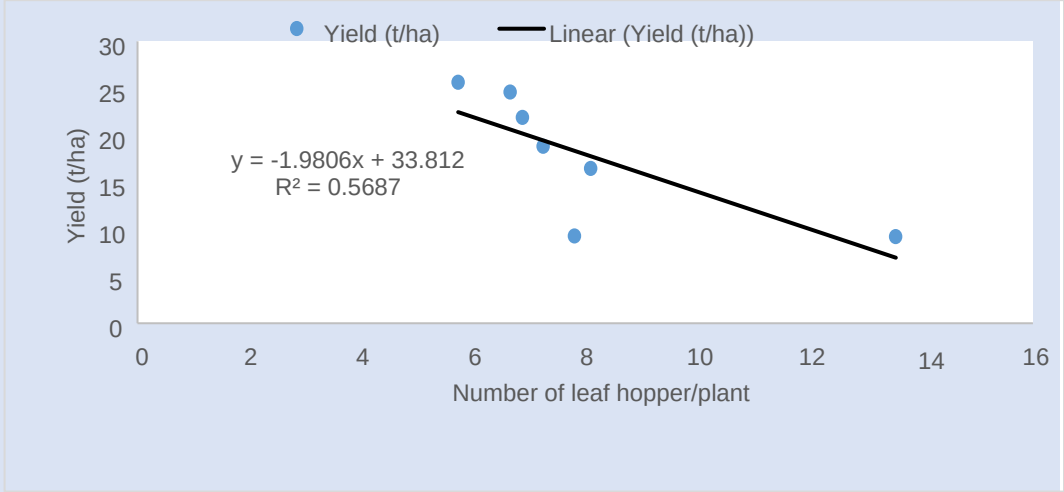

Fig. 1. Relationship between the number of leaf hopper and the yield of brinjal

CONCLUSIONS

The efficacy of botanicals was evaluated in the brinjal field against leafhopper during Kharif-1 (March-June) season. Spraying of neem oil was found effective against this insect. Tobacco leaf extract, garlic extract, neem leaf extract also showed satisfactory results in this experiment. As the infestation of leafhopper has a detrimental effect on the yield of brinjal, neem oil, tobacco leaf extract, garlic extract, neem leaf extract can be a good alternative to chemical insecticides against this insect.

AUTHORS CONTRIBUTIONS

Conceptualization: Nur Mohal Akhter Banu; methodology: Nur Mohal Akhter Banu, Khursheda Akter; data collection: Khursheda Akter; data validation: Nur Mohal Akhter Banu; data processing: Khursheda Akter; writing: Khursheda Akter; review and editing: Nur Mohal Akhter Banu.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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