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Effect of Some Integrated Pest Management (IPM) Packages Against Brinjal Shoot and Fruit Borer and its Consequence on Yield

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Abstract: A study was conducted to evaluate the comparative effectiveness of three IPM packages on the basis of infestation level of brinjal shoot and fruit borer on shoots and fruits of eggplant. The IPM package 1 consisting of mechanical control on grafted eggplant; IPM package 2 comprising kerosene, neem oil and wild *Ipomoea* extract application on non-grafted eggplant; IPM package 3 containing Cymbush application on grafted eggplant and untreated plants. The grafted plants treated with Cymbush resulted significantly lowest shoot and fruit infestation compared to those of other treatments. Significantly the highest yield was obtained in plants treated with Cymbush. IPM packages with grafted plants produced more fruits than non-grafted ones. The diameter and weight of individual fruit was higher in plants under IPM package 1 and 3 utilizing grafted eggplant in late fruiting stage.

Key words: Grafted eggplant, brinjal shoot and fruit borer, *S. torvum*, wild *Ipomoea*, fruit bearing capacity

Introduction

The eggplant is attacked by a dozen of insect pest among which the most serious and destructive one is the brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* Guenee (Alam and Sana, 1962; Butani and Jotwani, 1984; Nair, 1986; Chattopadhyay, 1987). The incidence of the pest occurs either sporadically or in outbreak every year throughout this country wherever eggplant is grown (Alam, 1969) as well as in the Indian sub-continent (Dhankar, 1988). As a result of its attack, considerable damage can be observed every year affecting adversely the quality and yield of the crop. Incidence of BSFB in brinjal could cause damage as high as 12-16% on shoots and 20-63% on fruits (Alam, 1969). Peswani and Lal (1964) estimated 9.7 and 20.7% loss of fruit by weight and number, respectively. The yield loss caused by this pest has been estimated up to 67% in Bangladesh (Islam and Karim, 1991) and up to 63% in Haryana, India (Dhankar *et al.*, 1977).

The research on the different non-chemical approaches like cultural, mechanical, biological, host plant resistance, etc. undertaken by the researchers throughout the world is fragmentary. Thus, the use of chemical insecticides is still the main practice to combat this pest. Use of these expensive toxic chemicals kills the beneficial insects, causes environmental pollution, develop resistance, resurgence, upset and hazards to man, animal, fish and wild life.

Application of IPM package consisting of different control measures to manage this menacing pest has not yet been investigated. The objective of this study is to evaluate these IPM packages and to find out suitable one to manage BSFB at tolerable level.

Materials and Methods

A study was conducted at the Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh to evaluate the comparative effectiveness of three IPM packages on the basis of infestation level of brinjal shoot and fruit borer on shoots and fruits of eggplant during August, 1995 to March, 1996.

This study was conducted in the field with 4 treatments including a control laid out in a randomized complete block design (RCBD) according to Gomez and Gomez (1984).

Plant materials used

Root stock: The wild eggplant *S. torvum* was used as rootstock for grafting cultivated eggplant. This wild species has resistance against fusarium and bacterial wilt as well as root-knot nematode (Ali *et al.*, 1994). The species can be identified by the presence of a few spines on the leaves though the morphology of leaves is similar to those of cultivated eggplant. Its flowering generally starts with the beginning of rainy season. Once flowering started it continues to fruit almost round the year. Five to more than fifty small white flowers may appear in a cluster. Detection of mature fruit is difficult because it remains green even at ripening. However, ripen fruits drop easily even by mild touch. Fruits are full of small seeds which have strong and long lasting dormancy. A treatment of GA_3 @ 100 $mg1^{-1}$ of water for 24 hours is necessary to break this dormancy. GA_3 can be dissolved by adding a few drops of absolute ethanol and then mix it with water slowly for preparing a required quantity of solution (Ali *et al.*, 1994).

Scion: Variety "Singnath" (*S. melongena* L.) was used as scion for grafting on wild *Solanum* as described earlier. The grafted seedlings were utilized to test IPM packages consisting of mechanical and chemical (Cymbush 10 EC) treatments individually. Normal eggplant seedlings were transplanted for testing other IPM package consisting of kerosene, neem oil and extract of wild *Ipomoea* application as well as untreated control.

Description of treatments under IPM packages

Package 1: Eggplant grafted on *S. torvum* as rootstock and collection and destruction of infested shoots and fruits : Eggplants were grafted on *S. torvum* as described. After establishment of grafting, plant was transplanted in the field. Fifteen days after transplanting, clipping of infested shoots by sharp razor blade was done and destroyed them by burring. At fruiting stage removal and destruction of both infested shoots and fruits were carried out. This operation was done at 15 days interval and continued till the last but one harvest in randomly selected four plots targeted for IPM package 1.

Package 2: Non-grafted eggplant treated with kerosene and neem oil up to flower initiation stage and application of *Ipomoea* extract at fruiting stage: Kerosene was applied after 15 days of transplanting and neem oil was sprayed in the following day. Kerosene was sprayed by mixing with sour yogurt as surfactant and water in ratio of 1:1:100. Similarly the neem oil was sprayed

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by mixing it with Trix (washing detergent) as adjuvant at the ratio of 2:1. Application of kerosene and neem oil was made at 15 days interval and continued till the flower initiation. And it was followed by the application of *Ipomoea* extract at 15 days interval till the last but one harvest. These control measures under IPM package 2 were applied as explained earlier in four randomly selected plots proposed for this package. The spray preparation of *Ipomoea* extract is explained following the steps given below:

- Two kg fresh leaves of wild *Ipomoea* was taken from the collected plants.
- Leaves were cut into pieces maintaining 2-5 cm size.
- Cut leaves were placed in a plastic bucket.
- Eight liters of water was added to the bucket.
- Sixteen ml of Effective Microorganisms-4 (EM-4) and 16 ml of molasses were added in the leaves to accelerate the extraction.
- The top of the mixture was covered with black vinyl sheet and a heavy weight lid was placed on it to press down the materials and to avoid the presence of air inside the bucket.
- The mixture was kept in warm place in the laboratory for 5 days to allow rapid extraction of leaves. Mixture was stirred time to time by opening lid and vinyl sheet to allow escape of air bubbles.

The above mixture was filtered and the extract was diluted 100 times in water. The extract is now ready for field application.

Package 3: Eggplant grafted on *S. torvum* as rootstock and use of a selective insecticide, Cymbush 10 EC: Eggplants were grafted on *S. torvum* as described. After establishment of the grafted plants, 15 days after transplanting, the field application of cypermethrin (Cymbush 10 EC) was made at 15 days interval and continued till the last but one harvest. This application was done in another four randomly selected plots targeted for IPM package 3.

Control comprising non-grafted eggplant without any pest control measure: Non-grafted seedlings were transplanted in the rest four plots kept for untreated control which received no pest control measure. However, equal volume of plane water, which used for other plots was sprayed at the same intervals as followed in case of treated plots.

Data collection: The comparative effectiveness of the IPM packages in reduction of shoot and fruit borer infestation was evaluated on the basis of some pre-selected parameters. Those were number of infested shoots, number of infested fruits per plant, number of healthy and infested fruits, yield per plant, intensity of attack, diameter and length and healthy and infested fruit weight.

Data analysis: The data were analyzed for important parameters like yield, extent of damage by BSFB, number of fruits per plant and their size, statistically. The analysis of variance of different parameters were performed and the range test of the means were done by using Duncan's Multiple Range Test (DMRT) using MSTAT computer programme. The data transformation was done where appropriate using square root transformation procedure.

Result and Discussion

Extent of shoot and fruit infestation and its effect on yield: Among the four treatments including control the lowest shoot infestation (0.26) was found in plots treated with IPM package 3 consisting of grafted eggplants sprayed with Cymbush and was statistically significant from other treatments. This was followed by plants treated with IPM package 1 comprising mechanically controlled eggplant grafted on *Solanum torvum* (Table 1). The infestation level of eggplant treated with kerosene, neem oil and wild *Ipomoea* extract as IPM package 2 was third in position but was statistically different from untreated control.

The shoot infestation level was comparatively lower on grafted eggplant treated either by chemical or mechanical means (Table 1). Alam *et al*. (1994) also obtained significantly lower level of shoot infestation by BSFB on eggplant grafted on *S. torvum*. The overall level of BSFB infested shoot is lower in the study plot because of the lower temperature level at vegetative stage during the months of October and November. The scientist of Bangladesh Agricultural Research Institute (BARI) found 8.65% shoot infestation in 1981 in the untreated plots with a cultivar Singnath.

Significantly higher infestation of fruits was found in IPM package 1 and 2 but the lowest infestation of fruits was found in eggplants treated with the control measure of IPM package 3 (Table 1). Fruit infestation level of plants under IPM package 1 and 2 was not significantly different from those of the control plots but numerically lower than the later. The Entomologist of Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh received 10.09% fruit infestation on the untreated cultivar Singnath in 1984 and 1.08 ± 0.23% fruit infestation on Cymbush 10 EC treated plants in 1990-91.

Significantly the highest yield of eggplant was obtained in the plots treated with Cymbush on grafted eggplant (IPM package 3) followed by IPM package 1 comprising mechanically controlled grafted eggplants. This was followed by IPM package 2 consisting of kerosene, neem oil and wild *Ipomoea* extract treated eggplants. The yield of eggplant treated with package 1 and 2 are statistically similar but are significantly higher than those of untreated non-grafted eggplant. Bangladesh Agricultural Research Institute (Anonymous, 1993) also obtained the lowest level of infestation (15.82%) and the highest eggplant production (5772.92 kg ha^{-1}) compared to other treatments when Cymbush (1 ml/l) was routinely applied in the field.

Weight of healthy and BSFB infested fruits and its influence on the yield: The total weight of fruits harvested from IPM package 3 treated plots was higher compared to those of package 1 and 2. The yield of eggplant harvested from the plots of IPM package 1 and 2 were statistically similar but numerically higher than those harvested from the untreated control (Table 2). The percent of infested fruits was higher in eggplants of untreated control plots. Significantly the lowest level of BSFB infested fruits was obtained from IPM package 3 plots consisting of grafted eggplants sprayed with Cymbush. This was followed by statistically similar rate of BSFB infested fruits of packages 1 and 2 treated plots. Ara (1995) obtained the highest yield (39.42 t ha^{-1}) and the lowest BSFB infested fruits (14.22%) in plots with cultivar "Uttara" grafted with *S. torvum*.

Fruit bearing capabilities and fruit size at different reproductive stages of eggplant treated with various IPM packages: At early fruiting stage, significantly the highest number of fruits were produced in Cymbush treated grafted eggplant under IPM package 3 and this was statistically similar with mechanically controlled grafted eggplant of IPM package 1 and kerosene, neem oil, wild *Ipomoea* extract treated eggplant under IPM package 2 (Table 3). Significantly the lowest number of fruits were harvested from the untreated non-grafted eggplant. Similar trend was observed in case of fruit diameter. The less number of fruits in control plots at this stage might be due to heavy shoot infestation at early stage and intensive fruit infestation that negatively influence the shape and diameter of the fruits for its malformation (Table 3). However, no significant difference in length and individual fruit weight was found in this fruiting stage.

At mid fruiting stage significantly higher fruit number was found in Cymbush treated grafted eggplant under IPM package 3 and statistically similar number of fruits were found in plots of IPM package 1, 2 and untreated control. Statistically identical diameter of individual fruits was found in plants under IPM package 1, 2 and 3. Like early fruiting stage no significant difference was found in length and weight of individual fruit of IPM packages and control plots.

Table 1: Effectiveness of IPM packages on the extent of shoot and fruit infestation caused by brinjal shoot and fruit borer (BSFB) and yield performance

Treatments for IPM packages		BSFB infested shoot per plant (no.)	BSFB infested fruits (%)	Yield per plant (g)
Pack 1	Mechanical control on grafted eggplant	0.65c	5.52a	1335.0b
Pack 2	Use of kerosene, neem oil, *impmea* extract on non-grafted eggplant	1.20b	5.53a	1326.0b
Pack 3	Use of Cymbush on grafted plant	0.26d	1.83b	1777.0a
Untreated	Non-grafted plant without any control measure	2.05a	6.96a	990.4c

Means following by same letters are not statically different at 5% level by DMRT

Table 2: Weight of healthy and BSFB infested fruits and its influence on the yield of eggplant harvested from the plots treated with various IPM packages

Treatment for IPM package	Total weight of fruit (g)	Weight of healthy fruit (g)	Weight of infested fruits (g)	Percent of Infested fruit	Yield per hectare (ton)
Pack 1:	26680.00	25035	1645.00	6.17 (2.46)b	37.06b
Pack 2;	26513.75	25050	1463.75	5.52 (2.34)b	36.82b
Pack 3:	35542.50	35005	537.50	1.51 (1.14)c	49.36a
Untreated	20010.00	18205	1805.00	9.02 (3.02)a	27.79b

Values followed by same letters are not statistically different at 5% level by DMRT. Figures in parentheses are the percent transformed values following the square root transformation. BSFB : Brinjal shoot and fruit borer (*L. orbonalis* Guenee)

Table 3: Fruit bearing capabilities and fruit size at early, mid and late reproductive stages of eggplant treated with various IPM packages

Treatments for IPM packages	Reproductive stages of eggplant: Early				Mid				Late			
	Fruit number	Diameter* (cm)	Length (cm)	Weight (g)	Fruit number	Diameter* (cm)	Length (cm)	Weight (g)	Fruit number	Diameter* (cm)	Length (cm)	Weight (g)
Pack 1:	24.00ab	3.008ab	26.82a	104.5a	210.8b	2.735a	24.90a	94.08a	123.8ab	1.945ab	16.43a	53.11ab
Pack 2:	28.25ab	3.128a	28.73a	104.2a	200.8b	2.755a	25.59a	94.90a	103.8b	1.890bc	15.70a	51.98ab
Pack 3:	35.75a	3.092ab	30.31a	104.6a	294.0a	2.760a	26.26a	96.38a	136.3a	2.000a	16.57a	58.40a
Untreated:	22.25b	2.915b	29.61a	95.99a	180.0b	2.588b	25.23a	88.98a	101.3b	1.815c	15.65a	48.21b

* = Diameter (cm) measured at the widest point of the fruit

At late fruiting stage significantly the higher number of fruits were harvested from the plants under IPM package 3 and it was statistically similar to those of plants under IPM package 1. Fruit numbers of IPM package 1, 2 and control plots were statistically similar. A similar and higher diameter of individual fruit was found in plots of IPM package 3 and IPM package 1. This was followed by diameter of individual fruits of IPM package 2 and untreated control. Statistically no significant difference in length among the treatments was found in late fruiting stage. Statistically similar but numerically higher weight of individual fruit was found in plants under IPM packages 3, 1 and 2 plots compared to control. Significantly lower weight of individual fruit was obtained in untreated control plots compared to those fruits under three IPM packages.

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