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EVALUATION OF SELECTED MANAGEMENT TACTICS AGAINST BRINJAL SHOOT AND FRUIT BORER

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Abstract

The study was conducted to assess the efficacy of some promising pest management tools against Brinjal Shoot and Fruit Borer (*Leucinodes orbonalis* Guenee) under field conditions during summer (February-August 2015). The tested tools were Rambo10 EC (Cypermethrin) @ 1ml L^{-1}, Rekhaphos 20 EC (Chlorpyriphos) @ 2 ml L^{-1}, Kinalux 25 EC (Quinalphos) @ 3 ml L^{-1}, Suntec1.8 EC (Abamectin) @ 0.5 ml L^{-1} and Neem seed kernel extract (NSKE) @ 50 g L^{-1} of water and including coriander as barrier crop (cultural practice) and clipping off infested shoot and fruit (mechanical control) and an untreated control. The shoot infestation varied from 4.28% -12.65%. The lowest shoot infestation was recorded in Rambo10 EC treated plot (4.28%) which followed by Kinalux 25 EC (5.18%) and Neem seed kernel extracts (5.27%). The highest number of healthy (308.29) and the lowest number of infested (78.31) fruits $plot^{-1}$ were harvested from Rambo10 EC treated plot and it increased and decreased the healthy and infested fruit over control 79.24% and 51.66%, respectively. Similarly, the highest healthy (21.58 kg) and the lowest infested (5.09 kg) fruit weight $plot^{-1}$ was recorded from Rambo10 EC treated plot which increased and decreased the healthy and infested fruit weight over control 87.33% and 47.63%, respectively. The fruit yield ranged from 23.60 - 29.63 t ha^{-1}. The yield increase over control was recorded in Rambo 10 EC, Kinalux 25 EC, Rekhaphos 20 EC, Suntec1.8 EC, Neem seed kernel extract, Coriander and mechanical (Clipping off) control 25.55%, 19.32%, 16.10%, 14.96%, 12.33%, 10.89% and 2.92%, respectively.

***Keywords*:** Efficiency, pest management tools, *Leucinodes orbonalis.*

Introduction

Brinjal (*Solanum melongena* L.) is one of the most popular year round vegetables in Bangladesh as well as across the world. The cultivation of brinjal is severely hampered by brinjal shoot and fruit borer (BSFB), *Leucinodes orbonalis* Guenee. It is the most damaging internal feeder of brinjal. It inflicts damage to both shoots and fruits (Srinivasan, 2008). The damage starts soon after transplanting of seedling and continues till the last harvest of the fruit. Effective management practice to combat this menacing pest is much difficult because of its internal feeding behavior. Several management practices have been reported to control BSFB. However, use of insecticide is the only reliable tool for the management of this insect pest when it approaches the economic threshold level (Parkash, 1988). But indiscriminate and non-judicious use of insecticides may result in a series of problems related to both losses of their effectiveness and in the long run development of insect resistance and certain externalities such as pollution and health hazards (FAO, 2003). Moreover, improper dosages resulted in high pesticide costs with little or no appreciable reduction in target pest populations (Alam *et al*., 2003). It may also cause resurgence due to destruction of natural enemies.

Various non-chemical approaches like clean cultivation, mechanical control like hand picking and destroying of infested plant parts particularly shoots and fruits are common practices used for suppressing this insect pest (Ghosh, 1989). Available literature reveals that to control BSFB, chemical insecticides are still vital and a cost effective control method. Due to lack of knowledge and availability of non-chemical pest management approaches, growers of Bangladesh mostly depend on insecticides to keep the crop production steady. Botanical insecticides are plant derivatives which have been demonstrated as repellents, antifeedants, growth inhibitors and chemo-sterilant. Reports indicate that among Organophosphate, Carbamate and Synthetic Pyrethroids, Malathion, Carbaryl, Cypermethrin are frequently used against BSFB. Cypermethrin, a synthetic pyrethroid is popularly used for its quick knock down action

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with the quality of non-phytotoxic and almost non-toxic effect to mammals (Reddy and Joshi, 1992). To avoid total reliance on chemicals, its alternate approaches are needed. There are many effective botanical components available in the country, which may be exploited side by side with the chemical components. Appropriate knowledge and availability of these botanical pest management approaches and their integration with selective chemicals may give better results to control BSFB. Considering the above hypothesis, the present research was conducted to evaluate the suitable IPM tools against brinjal shoot and fruit borer.

Materials and Methods

The experiment was conducted in the experimental field of the Entomology Department at the Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur in summer (February-August 2015). The crop was grown following the recommended practices as described by Rashid (1999) and various intercultural operations such as weeding, thinning, irrigation, mulching, and other operations were done accordingly. Brinjal variety BARI Begun-8 was used in this study. The tested IPM tools were: T_1 = Coriander (*Coriandrum sativum*) as barrier crops (Cultural control), T_2 = Clipping off infested shoot and fruit (Mechanical control), T_3 = Suntec 1.8 EC (Abamectin, a bio-rational insecticide) @ 0.5 ml L^{-1} of water at 15 days interval, T_4 = Neem (*Azadirachta indica*) seed kernel extract (Botanical) @ 50 gm L^{-1} of water at 15 days interval, T_5 = Rambo 10 EC (Cypermethrin, a pyrethroid insecticide) @ 1 ml L^{-1} of water at 15 days interval, T_6 = Rekhaphos 20 EC (Chlorpyriphos, a organophosphate insecticide) @ 2 ml L^{-1} of water at 15 days, T_7 = Kinalux 25 EC (Quinalphos, a organophosphate insecticide) @ 3 ml $L^{-1}$of water at 15 days, T_8 = Untreated control. Experiment was laid out in randomized complete block design (RCBD) with three replications of each treatment. The whole field was divided into three blocks of equal size having 2 m space between the blocks and 1.5 m between the plots. The unit plot size was 3 m x 3 m accommodating 15 pits per plot. The distance between rows was 1m and that between plants 60 cm. Every unit plot had 3 rows with 5 plants at each row. The total number of plants per plot was 15. The effect of different treatments in controlling and reducing BSFB infestation was evaluated on the basis of infestation of shoots and fruits of brinjal and subsequent yield per hectare. The total numbers of shoots as well as the number of infested shoots were recorded from 5 selected plants of each plot at weekly intervals. The rate of shoot infestation was calculated. Fruits were harvested at 7 days intervals and the numbers of healthy and infested fruits $plant^{-1}$ were recorded properly and the weight of healthy and infested fruits was also measured separately $plot^{-1}$ and $treatment^{-1}$. Twelve harvests were done throughout the fruiting season and transformed into total yield ha^{-1} in tons. All the data collected and computed were analyzed statistically. The analysis of variance (ANOVA) of different parameters was done and the means were separated by using the Duncan's Multiple Range Test (DMRT).

Results and Discussion

Effect of different pest management tactics on the shoot infestation

Effects of various treatments on the rate of shoot infestation by BSFB are presented in Table 1. Shoot infestation by BSFB was ranged 4.28-12.65% and the highest shoot infestation was recorded in untreated control (12.65%) and the lowest infestation was caused in Rambo 10 EC (4.28%) treated plot which was followed by Kinalux 25 EC (5.18%) and Neem seed kernel extract (5.27%), the latter two were statistically identical but significantly different from that of Rekhaphos 20 EC (5.66%), Suntec1.8 EC (7.18%), Coriander (09.66%) and Clipping off (11.04%) treated plot, respectively.

Rahman *et al*. (2009) reported that Marshal 20 EC @ 1.5 ml L^{-1} of water achieved the best ensuring the lowest shoot (7.59%) infestation. Islam *et al.* (2019) observed Bioneem @ 1% was effective in reducing 34.13% shoot infestation caused by BSFB over control plot. Rosaih (2001) also stated that NSKE 5% gave the least shoot damage (15.61%). Reduction of rate of shoot infestation over control was calculated and all treatments significantly reduced BSFB infestation over control. The reduction rate ranged 12.73- 66.17% in different treatments. The lowest reduction of shoot infestation over control was found in the treatment of clipping off (12.73%) plot and the highest reduction was caused by Rambo 10 EC (66.17%). On the other hand, Al Mamun *et al*. (2014) reported that 95.60% shoot infestation reduction over control was in treatment with spinosad + pheromone trap. Chatterjee (2009) also found that the application of Azadex (neem based insecticides) was most effective in reducing shoot damage (76.59%) over control. Choi Inhu *et al*. (2004) reported that Proclaim showed 87.00% reduction of shoot infestation over control. Islam *et al*. (1999) calculated 80.00% reduction of shoot infestation over control by Tracer-45 SC**.** The comparisons of the result of the present study with the findings reported by other authors who achieved more than 80% shoot infestation reduction over control. But in the present study, none of the treatments was able to exceed the efficacy reported by others who obtained 80% reduction in shoot infestation over control. However, Kabir *et al*. (1994) obtained similar results where chemical insecticides were not solely effective against the BSFB.

Table 1. Effect of different management tactics on the shoot infestation by brinjal shoot and fruit borer during summer season

IPM tools / components	% shoot infestation	% infestation reduction over control
Coriander (Cultural control)	9.66c	23.64
Clipping off (Mechanical control)	11.04b	12.73
Suntec1.8 EC	7.18 d	43.24
Neem seed kernel extract	5.27f	58.34
Rambo 10 EC	4.28g	66.17
Rekhaphos 20 EC	5.66e	55.26
Kinalux 25 EC	5.18f	59.05
Untreated control	12.65a	-
CV (%)	07.57	-

Means within the same letter(s) within a column do not differ significantly (P=0.05) according to DMRT

Neem seed kernel extract in the present study resulted 58.34% shoot infestation reduction over control compared 62.17% achieved by Rambo 10 EC treated plot. Considering extends of environmental hazards due to application of synthetic chemicals thus, Neem seed kernel extract may be safely accepted in IPM package as one of the component as well as Suntec 1.8 EC reduced 43.24% shoot infestation reduction over control.

Effect of different management components on healthy and infested fruits plot^{-1}

Number of healthy and infested fruits plot^{-1} as influenced by different IPM components were presented in Table 2. All IPM components significantly produced higher number of healthy fruits plot^{-1} ranged from 191.45 -308.29 compared to untreated control (172.05). The highest number of total healthy fruits plot^{-1} was recorded from Rambo 10 EC (308.29) treated plot followed by Kinalux 25 EC (302.92). The increase in number of healthy fruit over control was calculated as 79.24, 76.12, 71.59, 68.97 and 40.87% due to spray with Rambo 10 EC, Kinalux 25 EC, Rekhaphos 20 EC, Suntec1.8 EC and Neem seed kernel extract, respectively. On the other hand, Coriander (as barrier crop) gave only 20.54% and Mechanical (Clipping) control showed 11.31% increase over control. Results of the present study revealed that the most effective treatment was Rambo10 EC and least effective was Mechanical control (Clipping) against BSFB.

The number of infested fruits plot^{-1} was statistically different due to the effect of various IPM tools is presented in Table 2. Number of infested fruits plot^{-1} was the highest in untreated control (163.04) plot which was significantly different from all other treatments. In contrast, the lowest fruit infestation was recorded from the Rambo 10 EC (78.31) treated plot which was statistically different from all other treatments. However, Neem seed kernel extract (98.66), Rekhaphos 20 EC (96.33) and Suntec1.8 EC (96.22) treated plot provided statistical identical results in producing infested fruits plot^{-1} of all stages. The percent reduction of infested fruit plot^{-1}over control was the highest in Rambo 10 EC treated plot (51.66%) and the lowest in Mechanical control (clipping) plot (26.77%). The second highest reduction was found in Suntec1.8 EC sprayed plot (46.60%).

Table 2. Effect of different management tactics against BSFB on number of healthy and infested fruits plot^{-1} of brinjal during summer season

IPM tools	Number of healthy fruits plot^{-1}	% increase of healthy fruits plot^{-1} over control	Number of infested fruits plot^{-1}	% decrease of infested fruits plot^{-1} over control
Coriander (Cultural control)	207.33 f	20.54	106.63 c	34.18
Clipping off (Mechanical control)	191.45 g	11.31	118.64 b	26.77
Suntec1.8 EC	290.62 d	68.97	96.22 d	40.60
Neem seed kernel extract	242.3 e	40.87	98.66 d	39.10
Rambo 10 EC	308.29 a	79.24	78.31 f	51.66
Rekhaphos 20 EC	295.13 c	71.59	96.33 d	40.54
Kinalux 25 EC	302.92 b	76.12	86.99 e	46.30
Untreated control	172.05 h	-	163.04 a	
CV (%)	03.94	-	03.24	

Means within the same letter(s) within a column do not differ significantly (P=0.05) according to DMRT.

The findings of the present study revealed that foliar spray with the tested IPM components resulted substantial reduction in number of infested fruit over control. Among the treatments, Rambo 10 EC was found to be the most effective treatment to suppress BSFB. Similar study was conducted by Kabir (1994) and found almost similar reduction in fruit infestation over control. The present study was also supported the finding of Alagar and Sivasubramaniam (2006) who reported the highest percentage of reduction over control in fruit damage (48.93%) when 5% NSKE was applied.

Effect of different management components on the weight of healthy and infested fruits plot^{-1}

The effect of various IPM components significantly varied on the weight of healthy fruitss plot^{-1} (Table 3). The highest weight of healthy fruits plot^{-1} was harvested from Rambo 10 EC treated plot (21.58 kg) and that was the lowest in untreated control plot (11.52 kg). The second highest weight of healthy fruits plot^{-1} was found in Kinalux 25 EC treated plot (19.69 kg). The percent increase of healthy fruits weight plot^{-1} over control ranged from 27.95-87.33%. The highest increase of fruit was recorded in Rambo 10 EC (87.33%) treated plot and the lowest in Mechanical control (27.95%) applied plot among the treatments. The second highest increase was found in Kinalux 25 EC (70.92%). Conversely, weight of infested fruits plot^{-1} was the highest in untreated control plot (9.72 kg) and significantly the lowest weight of fruit was in Rambo 10 EC (5.09 kg) treated plot. The second highest weight of infested fruit was recorded in Coriander treated plot (8.00 kg).

The reduction in weight of infested fruits over control ranged from 17.70-47.63%. The highest reduction was recorded in Rambo 10 EC (47.63%) treated plot and the lowest in Coriander treated plot (17.70%). The second highest reduction was found in Kinalux 25 EC (41.87%). Results of the study indicated that weight of infested fruit reduction over control was higher in plot sprayed with Rambo 10 EC followed by Kinalux 25 EC and lowest in Coriander treated plot. However, NSKE is an environmentally safe botanical and provided considerable reduction of infested fruit weight (34.05%) and it may be accepted as one of the IPM component of an IPM package against BSFB.

Table 3. Effect of different management tactics against BSFB on the weight of healthy and infested fruits plot^{-1} during summer season

IPM tools	Weight of healthy fruits plot^{-1} (kg)	% increase in healthy fruits weight plot^{-1} over control	Weight of infested fruits plot^{-1} (kg)	% reduction of weight of infested fruits plot^{-1} over control
Coriander as barrier crops	15.55 d	34.98	08.00 b	17.70
Clipping off infested shoot and fruit	14.74 d	27.95	07.12 c	26.75
Suntec1.8 EC	18.45 bc	60.19	05.97 e	38.58
Neem seed kernel extract	17.45 c	51.48	06.41 d	34.05
Rambo 10 EC	21.58 a	87.33	05.09 g	47.63
Rekhaphos 20 EC	18.59 bc	61.37	06.07 e	37.55
Kinalux 25 EC	19.69 b	70.92	05.65 f	41.87
Untreated control	11.52 e	-	09.72 a	-
CV (%)	05.21	-	04.45	-

Means within the same letter(s) within a column do not differ significantly (P=0.05) according to DMRT.

Effect of different management tools on the yield (t ha^{-1}) of brinjal

Effect of different IPM tools on yield (t ha^{-1}) has been evaluated in terms of fruit production and fruit yield obtained in each treatment during the entire cropping season (Table 4). Significantly the highest yield (29.63 t ha^{-1}) was in Rambo 10 EC treated plot and the lowest (23.60 t ha^{-1}) was in untreated control plot. The total yield of Kinalux 25 EC (28.16 t ha^{-1}) was statistically at par with Rambo 10 EC (29.63 t ha^{-1}).

The analysis of the yield increase over control indicated that IPM tool Rambo 10 EC ensured the highest increase (25.55%) over control.

In the present study the Neem seed kernel extract (NSKE) provided appreciable increase of fruit yield (12.33%) over control compared to synthetic chemical insecticides Kinalux 25 EC (19.32%) and Rekhaphos 20 EC (16.10%). As NSKE environment friendly nonhazardous insecticide it would be also recommended safer management of BSFB.

The findings of the present study indicated that among the different IPM tools three insecticides Rambo 10 EC, Suntec1.8 EC and Rekhaphos 20 EC were effective to manage infestation of BSFB in brinjal field. Similar findings have also been reported by other workers (Latif, 2009; Rahman *et al*., 2006, 2009). Daura *et al*., (2003) carried out a

field experiment in Jorhat, Assam, India during rabi season 2002 to evaluate the efficacy of Cypermethrin (0.003, 0.006 and 0.01%) against brinjal shoot and fruit borer and increased fruit yield over the control.

Table 4. Effect of different management tactics on yield of brinjal during summer season

IPM tools	Yield (t ha^{-1})	Increase over control (%)
Coriander	26.17 c	10.89
Clipping off	24.29 d	2.92
Suntec1.8EC	27.13 bc	14.96
NSKE	26.51 c	12.33
Rambo 10EC	29.63 a	25.55
Rekhaphos20E	27.40 bc	16.10
Kinalux 25EC	28.16 ab	19.32
Untreated control	23.60 d	-
CV (%)	7.27	-

Means within the same letter(s) within a column do not differ significantly (P=0.05) according to DMRT.

The results of this study revealed that NSKE showed appreciable result in suppressing BSFB infestation and it had no hazard to health and environment compared to insecticide application and Mechanical control (Clipping off) also had significant role to manage BSFB. Therefore, Rambo 10 EC, Suntec1.8 EC and Rekhaphos 20 EC and NSKE could be used singly or combined in IPM package against Brinjal Shoot and Fruit Borer (*Leucinodes orbonalis* Guenee).

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