

Comparative Efficacy and Economic Feasibility of Certain Bio Rational Insecticides and Endosulfan against *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae) in Eggplant

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Abstract: *Leucinodes orbonalis* Guenee, or BSFB is a serious pest of eggplant (*Solanum melongena* L.). Due to increasing levels of resistance of *L. orbonalis* to different insecticides there is an urgent need to test new botanical insecticides so to have a sustainable environment. A field trial was conducted at Vegetable Research Farm, Collage of Agriculture, Central Agriculture University, Imphal for two consecutive years of 2008-09 and 2009-10. To investigate the comparative efficacy of three botanicals, two bio-pesticides and one conventional insecticide against the shoot and fruit borer *L. orbonalis* Guenee in brinjal crop. The result revealed that Endosulfan 35 EC @ 1000 ml/ha proved to be the most effective treatment against the pests and it was at par with Vijayaneem (Azadirachtin 1500 ppm) @ 1000 ml/ha. The mean fruit yield ranged between 23.87 and 19.23 t/ha in the insecticide treatments the highest being in Endosulfan, followed by Vijayaneem (21.66 t/ha), Neembecidine (Azadirachtin 300 ppm) @ 1000 ml/ha (20.52 t/ha) and Neemagold (Azadirachtin 1000 ppm) @ 1000 ml/ha (20.18 t/ha) which do not differ significantly from each other. The lowest mean fruit yield of 17.40 t/ha was obtained from the plot of untreated control plots. The cost benefit ratio varied from 1:5:14 to 1:12:20 in different insecticidal treatments, the highest being accrued from Endosulfan with a record of maximum monetary benefit of Rs. 31,87,00/ha, closely followed by Vijayaneem (1:12:20) with its net profit of Rs. 28,052,00/ha.

Keywords: Endosulfan, eggplant, insecticide, *Leucinodes orbonalis*, *Solanum melongena*

1. Introduction

The eggplant (*Solanum melongena* L.) also known as brinjal is one among the most popular and economically important vegetable in Asia. It is grown all over the world. However, the brinjal shoot and fruit borer *Leucinodes orbonalis* has become a major limiting factor in successful cultivation in Manipur, India causing an extensive damage on these crop. Larvae bore into the young shoots and feeds on internal tissues of plants resulting in wilting of the shoots, which reduces number, growth and size of fruit. Even the slightly damaged fruit are unfit for marketing [1]. Thus, caused considerable yield loss of eggplant every year throughout the cultivation. The losses due to the borer has been estimated to be at the ranges of 26.3 to 62.5 %, notwithstanding, the fact that eggplant growers mostly depends on pesticides to combat this noxious pest [2]. According to Alam et al. [3] over 95 % of farmers (Gujarat) applied more than 40 sprays per season and 86 % sprayed their crop (Uttar Pradesh) two or three times a week.

Brinjal is a consumable vegetable crop all over the world. The use of highly persistent synthetic organic insecticides for control of insect pest resulted not only in the development of insecticide resistances in the insect, but also leave toxic residue on fruits causing serious health hazards to consumers. These considerations have prompted the pathologists during recent years to look for alternative bio-rational pest control materials like botanical and microbial agents for effective management of insect pest complex economically with minimum adverse impact on the

environment. They are easily biodegradable and do not leave any harmful toxic residue, besides conserving natural enemies like parasitoids and predators.

Among the botanical insecticides, neem formulations have been reported to give good control of insect pest attacking brinjal crop [4]. In India neem based insecticides are evaluated in many of the insect pest and similar efforts are still in progress. Although, there are also various botanical insecticides and bacterial formulations available in the market which are evaluated and found effective against brinjal shoot and fruit borer that are safe and do not pose any problem to resistance in insect, no earlier studies were made on such insecticidal management of *L. orbonalis* under Manipur agro climatic conditions. Therefore, this study was undertaken with the objectives to investigate the effectiveness for controlling the pest in the field in different seasons of the year in Manipur, India.

2. Materials and Methods

The field trial was experimented at the Vegetable Research Farm, College of Agriculture, Central Agricultural University, Imphal for two consecutive years of 2008-09 and 2009-10 to compared the field efficacy of three botanical (Nimbecidine, Vijayaneem and Neemagold) and two biopesticides Delfin (Bt. formulation), and Larvocel (*Beauveria bassiana* formulation) with one conventional insecticides (Endosulfan) against the *L. orbonalis* in brinjal crop. A separate field experiment was laid-out in randomized block design (RBD) with 7 (seven) treatments

including one untreated control, each replicated thrice. The test brinjal variety "Pusa purple long" was grown at 50 x 50 spacing on 15th December of 2009 and 2010. The test insecticides comprised of three neem derivatives (Nimbecidine, Vijayneem, and Neemgold), one bacterial formulation (Delfin) one fungal formulation (Larvoce) and recommended organic synthetic insecticide (Endosulfan) which were evaluated. Normal water was given as control. Five (5) weeks old seedlings were up rooted and soaked the seedling roots in the solution of chloropyrifos 20 EC at 0.02 % concentration for 20 minutes then transplanted in the insecticidal treatments plots. The test insecticides were applied as foliage spray by a high volume hand compression knapsack sprayer thrice at 15 days interval commencing from the 30 days after transplanting. Observations on % shoot and fruit infestation were recorded one day ahead of first spray (per-treated count.) and seven and fifteen days after treatment (post-treated count) from the twelve randomly selected plants of each plot. For % fruit damage at each picking borer attacked determined and borer free fruits of individual plots were sorted out by recording their number and weight. The % fruit infestation was computed on the basis of the cumulative data of all pickings. The total weight of healthy and infested fruit for all picking was pooled and to yield per plot was computed and converted to tonnes per hectare (t/ha). Avoidable yield loss was computed

in each of the treatments by using formula suggested by Pawar et al. [5]. Cost benefit ratio for each of the insecticidal treatments was determined by taking into account the cost of the insecticides used, pump hiring charge paid and price of the additional yield obtained due to insecticidal treatments.

3. Result and Discussion

The management of insect pest using biopesticides are proved to be a cornerstone in integrated pest management to overcome the pesticide resistance problems. The shoot and fruit infestation data in different insecticidal treatments are the mean of three foliar applications which revealed that application of all the six insecticidal treatments result in significant reduction of the borer and demonstrated their superior over untreated control significantly during both the years (Table 1). The result based on two years pooled mean shoot and fruit damage by *L. orbonalis* revealed that a variation of 16.65 to 29.95 % shoot damage in 2008-09 and 20.87 to 27.24 % in 2009-10 whereas 19.46 to 27.91 % in 2008-09 and 20.00 to 32.63 % fruit damage in the plots treated with the bio rational products against 14.30%-17.11% shoot damage and 15.64%-17.87% fruit damage in Endosulfan @ 1000 ml/ha treated plot (Table-1).

Table 1: Effect of certain bio - rational insecticides and Endosulfan on shoot and fruit damage in brinjal by *L. orbonalis* (pooled mean data of 2008 - 09 and 2009 - 10).

Treatment	Dose	Shoot damage%		fruit damage%		Fruit yield
		2008-09	2009-10	2008-09	2009-10	
T1=Nimbecidine (Azadirachtin 300ppm)	2000ml/ha	23.86 (29.27)	27.24 (31.44)	23.59 (29.06)	26.34 (30.85)	20.52
T2= Vijayneem (Azadirachtin 1500ppm)	1000ml/ha	16.65 (24.04)	20.87 (27.20)	19.46 (26.21)	20.00 (27.57)	21.66
T3= Larvoce (Beauveriarabssianas var.)	2.00 kg/ha	26.32 (30.85)	24.50 (29.67)	24.69 (29.80)	27.82 (31.82)	19.29
T4= Neemgold (Azadirachtin 1000ppm)	1000ml/ha	24.63 (29.73)	25.99 (30.66)	22.50 (28.32)	22.43 (29.60)	20.18
T5= Delfin (Bacillus Thuringiensis var.)	1.5 kg/ha	29.95 (31.31)	25.24 (30.07)	27.91 (31.88)	32.63 (34.82)	19.23
T6= Endosulfan 35EC	1000ml/ha	14.30 (22.22)	17.11 (24.43)	15.64 (25.03)	17.87 (25.03)	23.87
T7= Control		38.47 (38.68)	35.13 (36.33)	32.63 (34.28)	36.26 (37.05)	17.40
CD (P= 0.05)%		0.53	0.69	0.63	0.41	0.26
SE _d ±		0.24	0.39	0.31	0.18	0.59

Maximum shoot damage (29.95% and 27.24%) and fruit damage (27.91% and 32.63%) were recorded in both the years. The results obtained on the effectiveness of Endosulfan against the shoot and fruit borer were found to be consistent with the finding as report by Krishna et al. [6].

Endosulfan @ 0.035% was found to be most effective with a recording shoot damage of 8.71% to 9.83%. The effectiveness of Endosulfan against the borer might be due to its quick down effect. From the present result all the five bio rational products provided satisfactory control of *L.*

orbonalis. The extent of shoot and fruit damage based on pooled mean of two years data revealed that Vijayaneem @ 1000 ml/ha recorded significantly lower mean shoot and fruit damage than two neem derivatives i.e., Neembecidine @ 2000 ml/ha and Neemagold @ 1000 ml/ha and two microbial products Delfin @ 1.5 kg/ha and Larvozel @ 2.00 kg/ha. The performance of Vijayaneem in reducing the borer infestation was at par with that of Endosulfan. The two neem derivatives had a better efficacy against the borer than that of microbial products in brinjal. Gahukar and Balpande [7] also reported that application of new neem oil based formulation contained 300 ppm Azadirachtin at two concentrations (4ml and 8ml/l of water) was found to be significantly superior to other insecticidal treatments including Endosulfan. According to Basu [8], Neemazal (5% Azadirachtin) was found to be the most effective insecticide in minimizing the borer population @ 1ml/l of water with a record of lowest shoot and fruit damage.

3.1 Fruit Yield

The computation of two years pooled mean fruit yield data (Table 1) indicated that 23.87% and 21.66% higher yield were observed in the plots applied with bio-rational products and Endosulfan respectively when comparison to untreated plots. The fruit yield was increased over control by 19.23% in the plots treated with Delfin (*Bt.* formulation). The increased in yield observed in all the different treatments were mainly attributed to the effective control of the shoot and fruit borer. Endosulfan and Vijayaneem were found more effective against *L. orbonalis* and also obtained higher fruit yield in comparison to other bio-rational products (Table 1). The effectiveness and yield increased potential

observed in different treatments was mainly attributed to the effective control of the shoot and fruit borer. Several past researches have also recorded higher fruit yield in Endosulfan treatment providing effective against *L. orbonalis*. According to Chitra et al. [9] Endosulfan treatment results in the lower borer incidence and the yielded was highest in Andhra Pradesh. Jat and Pareek [10] observed in Rajasthan that Endosulfan not only provide effective control of the borer on brinjal but also resulted in additional yield of 95.86% over untreated control. Our present studies are in agreement with the above findings that the higher fruit yield were observed with treated bio-rational products of neem derivatives (Nimbecidine, Vijayneem, and Neemgold), Delfin, Larvozel and organic synthetic insecticide (Endosulfan).

The neem products particularly Vijayaneem, Neembecidine and Neemagold are recorded the highest yield and support the reports from different authors. Raja et al. [11] also reported that the application of 4% of neem oil (Azadirachtin) prove to be most effective in controlling borer and produced the highest fruit yield of 24.48 t/ha. Further, Srinivassan and Babu [12] showed the efficacy of Neembecidine and Neemagold against the borer recording higher yield of 20.52 and 20.18 t/ha respectively than that of Endosulfan 23.87 t/ha.

3.2 Economic application of bio-rational insecticides and Endosulfan in Brinjal

The effect of pest control in crop by the pest control agents are known to ensure higher crop yields (Table- 2).

Table 2: Cost benefit ration of the different insecticidal treatment in *L. orbonalis* control on brinjal during 2008-2009 and 2009-2010 (based on pooled mean yield data of two years)

Treatment	benefit ration	Dose	Yield increase over control	Total value @20/Kg	Total cost of insecticide+ spray hiring charge	Net profit ratio	Cost benefit ratio
T1=Nimbecidine (Azadirachtin 300ppm)		2000ml/ha	2.85	29,130,00	3,126,00	26,004,00	1:8:31
T2=Vijayaneem (Azadirachtin 1500ppm)		1000ml/ha	4.26	30,350,00	2,298,00	28,052,00	1:12:20
T3=Larvozel (Beauveria bassiana var.)		2.00kg/ha	1.89	16,460,00	3,275,00	13,185,00	1:4:02
T4=Neemagold (Azadirachtin 1000ppm)		1000ml/ha	2.78	25,550,00	3,269,00	22,281,00	1:6:81
T5=Delfin (Bacillus Thuringiensis var.)		1.5 kg/ha	1.83	14,280,00	2,985,00	11,295,00	1:3:78
T6=Endosulfan 35EC		1000ml/ha	6.47	33,975,00	2,105,00	31,870,00	1:15:14
T7=Control							

Market price of brinjal fruit = Rs. 20,000/- tones @ 20 / Kg
 Labours charges for three times insecticides application = Rs. 122 x 3 x 3 = 366.

Sprayer hiring charge for three times of insecticides application = 60 x 3 = 180.

The cost benefit analysis of different insecticidal application revealed that the highest monetary benefit (Rs. 31,870,00/ha) with maximum cost benefit ratio of 1:15:14 were recorded in Endosulfan treatment. Endosulfan gave on an average of profit of Rs. 15.14 as against Rs. 12.20, 8.31, 6.81, 4.02 and 3.78 in Vijayaneem, Neembecidine, Neemagold, Larvocol and Delfin treatment respectively. However, among the bio-rational product Vijayaneem recorded the highest net profit of Rs. 28,052,00/ha with the maximum cost benefit ratio in Endosulfan treatment. Our finding are in agreement with the finding of Patnaik and Singh [13] and Singh and Singh [14], who reported that Endosulfan (0.07%) treatment resulted in the lowest fruit damage by *L. orbonalis* on brinjal and had the highest cost benefit ratio of 1:40:3. The highest cost benefit ratio of 1:12:08 in the Endosulfan treated plots was also reported by Sharma and Chhibber [15] in Uttar Pradesh and Jat and Pareek [10] in Rajasthan.

4. Conclusion

We can conclude from the present study that the bio-rational product like Vijayaneem, Neembecidine, Neemagold, Delfin and Larvocol can be an effective insecticidal agents which when used will give a highest cost benefit ratio taking into consideration of the serious health hazards caused by the organic synthetic insecticide like Endosulfan to consumers.

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