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Evaluation of Bio-Rational Pesticides, against Brinjal Fruit and Shoot Borer, *Leucinodes orbonalis* Guen. On Brinjal at Allahabad Agroclimatic Region

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A B S T R A C T

The present investigation was conducted during July to December 2016 at Central Research Farm, SHUATS, Naini, Allahabad. Three applications of seven insecticides viz Neem oil 0.15 EC, Spinosad 45 SC, Emamectin benzoate 5 SG, *Beauveria bassiana* 2x10^8 CFU, *Verticillium lecanii* 2x10^8 CFU, *Metarhizium anisopliae* 2x10^8 CFU, Cypermethrin 10 EC were evaluated against shoot and fruit borer, *Leucinodes orbonalis*. Minimum per cent of shoot infestation, fruit infestation and B:C ratio were recorded in cypermethrin (check) with (6.69%, 9.33% and 1:8.01) followed by spinosad (13.2%, 10.66% and 1:7.63) < Emamectin benzoate (14.03%, 14.60% and 1:7.54) < Neem oil (16.96%, 15.79% and 1:6.01) < *Beauveria bassiana* (17.92%, 20.12% and 1:.501) < *Metarhizium anisopliae* (20.43%, 20.88% and 1:5.06) < *Verticillium lecanii* (*Lecanicillium lecanii*) (24.74%, 23.43% and 1:4.84) < untreated control (25.34%, 32.15% and 1:3.73) respectively.

Introduction

Botanically brinjal is known as *Solanum melongena L*. (2n=24) popularly known as eggplant belongs to family Solanaceae and India is its center of origin and diversity (Bahaduri, 1951). Brinjal is one of the most commonly grown vegetable crop of the country.

India produces about 7.676 MT of brinjal from an area of 0.472 M ha with an average productivity of 16.3 mt/ha. The brinjal producing states are Odisha, Bihar, Karnataka, West Bengal, Andhra Pradesh, Maharashtra and Uttar Pradesh. Brinjal has ayurvedic medicinal properties and white brinjal is good for diabetic patients. It is also a source of vitamins A, C and minerals. (Source: NCPAH).

The brinjal crop is attacked by about 140 species of insect pests (Dwivedi *et al.*, 2014). BSFB, *L. orbonalis* (Lepidopetra: Pyralidae) is the key pest throughout Asia (Purohit and Khatri, 1973; Kuppuswamy and Balasubramanian, 1980; Alam *et al.*, 2003). In India, this pest has a countrywide distribution and has been categorized as the most destructive and most serious pest causing huge losses in brinjal (Patil, 1990). *Leucinodes orbonalis* Guenee (Lepidoptera: Pyraustidae), causes significant losses to the tune of 70% (Sandanayake and Edirisinghe, 1992). Due to its fast reproductive potential, quick turn over of generation and most common cultivation of brinjal in both wet and dry season, this pest poses a serious threat. In India, damage levels of pest have been noticed in different regions resulting considerable damage to the fruits. It is generally severe in the July transplanted crop and estimated economic injury level to 6% infestation (AVRDC, 2003).

Farmers mainly follow the chemical method as it produces quick results. High-frequency application of chemicals is the common scenario. However, these chemicals, in many cases, invited the problems of pesticide resistance, resurgence, secondary pest outbreak, environmental contamination, residual toxicity and toxicity to beneficial organisms and disturbance in homeostasis of natural populations (Suadrshan and Pijush, 2010; Bhusan *et al.,* 2011).

Information on efficacy of bio-rational against insect pest of brinjal is meager and therefore the present study was carried out.

Materials and Methods

The experiment was conducted at field of Department of Entomology, Naini Agricultural institute, SHUATS, Allahabad during kharif season of 2016. The trial was laid out in randomized block design with eight treatments and three replications. The brinjal variety Banaras round was transplanted on 30 July, 2016 at 60 x 45 cm spacing. The plot size was kept 2 x 2 m. All recommended packages and practices were followed to raise the crop, except plant protection measures. The bio-rational treatments viz. Neem oil (0.15 EC), Spinosad (45%SC), Emamectin benzoate (5%SG), *Beauveria bassiana* ($2x10^8$), *Verticillium lecanii* ($2x10^8$), *Metarhizium anisopliae* ($2x10^7$), Cypermethrin (10EC), Untreated(Control), were evaluated.

From each plot five plants were selected randomly and labeled for recording observations. As soon as the infestation of pest on shoot was initiated, the observations on total number of shoots and number of infested shoots (firs spray) and fruit infestation (second and third spray) of five observational plants from each treatment replication wise were recorded at 3, 7 and 14 days after imposing treatments. The data recorded in the different treatments were subjected to statistical analysis after suitable transformation by following standard procedures of RBD experiment.

Results and Discussion

Efficacy of different insecticides on the incidence of *L. orbonalis* is presented in table 1. The results showed that all the treatments were significantly superior in reducing the infestation of shoot and fruit borer resulting in increasing the yield, significantly as compared to control. The first spray was given after 30 days of transplanting. The minimum shoot damage (6.69%) was recorded in the plot treated with (Check) Cypermethrin (10 EC) @ 2 ml/lit followed by Spinosad (45 SC) @ 0.2 ml/lit, where 13.20 per cent shoot damage was recorded Emamectin benzoate (5% SG) @ 0.1 ml/lit was also effective which gave 14.03 per cent shoot damage. The next treatments in order of effectiveness were Neem oil (0.15 EC) @ 6 ml/lit, *Beauveria bassiana* ($2x10^8$ CFU) @ 2 g/lit and *Metarhizium anisopliae* ($2x10^8$ CFU) @ 2 g/ml in which 16.69, 17.92 and 20.49 per cent shoot damage was recorded, separately. The maximum shoot damage (25.34%) was recorded in control plot.

The second spray was applied after 15 days of first spray and third spray was applied after 15 days of second spray and data fruit damage per cent was recorded. The pooled data for second and third spray shows that minimum fruit per cent damage recorded in (check) Cypermethrin (10 EC) was 0.933 followed by Spinosad (45 SC) 10.66, Emamectin benzoate (5% SG) 14.60, Neem oil (0.15 EC) 15.79, *Beauveria bassiana* ($2x10^8$ CFU) 20.12 and *Metarhizium anisopliae* ($2x10^8$ CFU) 20.88. The highest per cent fruit damage was recorded in control 32.15. The present findings are in agreement with the results of many researchers (Farman *et al.*, 2016 ; Sharma *et al.*, 2010 and Rahman *et al.*, 2014), who also reported that cypermethrin as most effective chemical and is comparable to spinosad.

Table.1 Efficacy of certain bio-rational pesticides against shoot and fruit borer of brinjal during Kharif Season of 2016 (Pooled data of shoot infestation 1^{st} Spray; fruit infestation 2^{nd} and 3 rd spray)

Treatments		Shoot infestation	Fruit infestation		Pooled mean of fruit infestation
		Mean of 1^{st} Spray	**Mean of 2^{nd} Spray**	**Mean of 3^{rd} Spray**	
T_1	**Neem oil** 0.15EC @ 2ml/lit	16.96 **(24.10)**	15.59 **(23.23)**	15.98 **(23.55)**	15.79
T_2	**Spinosad** 45 SC @0.2ml/lit	13.20 **(21.29)**	11.34 **(19.65)**	9.98 **(18.41)**	10.66
T_3	**Emamectin benzoate** 5SG @ 0.1ml/lit	14.03 **(21.98)**	14.10 **(22.05)**	15.09 **(22.84)**	14.60
T_4	***Beauveria bassiana*** $2x10^8$ CFU @ 2g/lit	17.92 **(25.04)**	19.37 **(26.09)**	20.87 **(27.17)**	20.12
T_5	***Verticillium lecanii*** $2x10^8$ CFU @ 2g/lit	24.74 **(29.83)**	22.74 **(28.48)**	24.12 **(29.41)**	23.43
T_6	***Metarhizium anisopliae*** $2x10^8$ CFU @ 2g/lit	20.49 **(26.90)**	20.19 **(26.68)**	21.57 **(27.66)**	20.88
T_7	**Cypermethrin** 10EC @ 2ml/lit	06.69 **(14.96)**	08.99 **(17.37)**	09.67 **(18.11)**	09.33
T_8	**Untreated (Control)**	25.34 **(30.21)**	30.22 **(33.34)**	34.07 **(35.71)**	32.15
Overalll Mean		**17.42**	**17.82**	**18.92**	**18.37**
F- test		**S**	**S**	**S**	**S**
S. Ed. (±)		**00.674**	**00.674**	**02.165**	**01.022**
C. D. (P = 0.05)		**01.429**	**01.429**	**04.590**	**02.167**

* Figures in parenthesis are arc in sin transformed values

Fig.1 Efficacy of certain bio-rational pesticides against shoot and fruit borer of brinjal during Kharif season of 2016 (Pooled data of shoot infestation 1st Spray; fruit infestation 2nd and 3 rd spray)

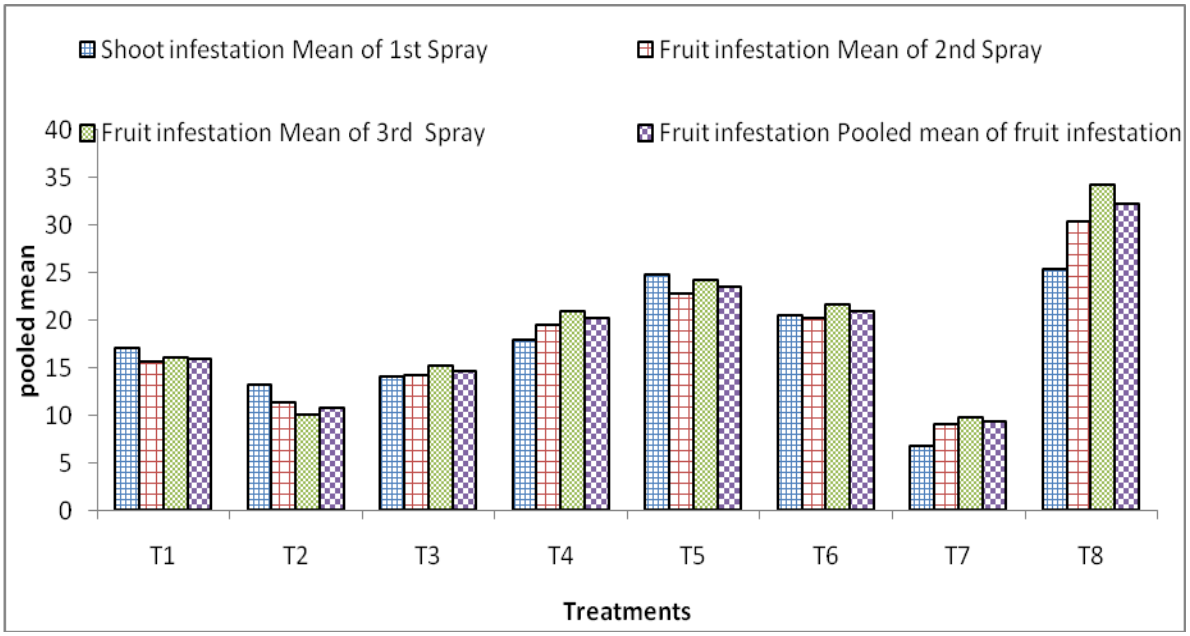

Table.2 Economics of cultivation

S. No:	Treatment	Yield of q/ha	Total cost of yield (Rs)	Common cost (Rs)	Treatment cost (Rs)	Total cost (Rs)	B:C ratio
T1	**Neem oil** 0.15EC @ 2ml/lit	163.83	**245745**	**36285**	4550	**40835**	1:6.01
T2	**Spinosad** 45 SC @0.2ml/lit	197.22	**295830**	**36285**	2815	**39100**	1:7.63
T3	**Emamectin benzoate** 5SG @ 0.1ml/lit	190.27	**285405**	**36285**	1550	**37835**	1:7.54
T4	***Beauveria bassiana*** 2x10^8 CFU @ 2g/lit	126.38	**189570**	**36285**	1550	**37835**	1:5.01
T5	***Verticillium lecanii*** 2x10^8 CFU @ 2g/lit	122.22	**183330**	**36285**	1550	**37835**	1:4.84
T6	***Metarhizium anisopliae*** 2x10^8 CFU @ 2g/lit	127.77	**191655**	**36285**	1550	**37835**	1:5.06
T7	**Cypermethrin** 10EC @ 2ml/lit	204.16	**306240**	**36285**	1950	**38235**	1:8.01
T8	**Neem oil** 0.15EC @ 2ml/lit	90.4	**135600**	**36285**	------	**36285**	1:3.73

*Cost of yield Rs/ha = 1500

The yields among the treatment were significant. The highest yield and benefit cost ratio was recorded in Cypermethrin (check) (204.16/ha and 1:8.01) supported by (Rahman *et. al.,* 2014); calculated the CBR 1:8.14, (Bhavat and Magar, 2017) concluded that ICBR was highest in cupermethrin. Followed by Spinosad (197.22q/ha and 1:7.63), Emamectin benzoate (190.27q/ha and 1:7.54), Neem (163.83q/ha and 1:6.01) were best three among bio-rational. Spinosad is a valuable pesticide in the management of *L. Orbonalis*. This was supported (Kushwaha and Painkar 2016; Ramesh, S. *et al.*, 2014) and these can be used alternatively for the management of brinjal pests (Table 2 and Fig. 1).

From the critical analysis of the present findings it can be concluded that pesticides (bio-rational) like spinosad 45% SC followed by Emamectin benzoate 5% SG, Neem oil 0.15 EC and *Beauveria bassiana* $2x10^8$ were showing good result against *Leucinodes orbonalis* and can be used instead of chemical insecticides which causes environmental and ecological dent. It also has potential to be included in integrated pest management.

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