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Research Article

FIELD BIO-EFFICACY OF NEWER INSECTICIDES AGAINST EGGPLANT FRUIT AND SHOOT BORER, *LEUCINODES ORBONALIS* GUENEE

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Abstract

Eggplant fruit and shoot borer (EFSB), *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae) is a key insect pest of eggplant in all eggplant growing areas of Nepal. A field experiment was carried out in Khumaltar, Lalitpur during summer season of 2014 using eight treatments as, i) Abamectin 1.9 EC @ 1.5 ml/lit; ii) Spinosad 45 SL @ 0.25 ml/lit; iii) Emamectin Benzoate 5 SG @ 0.3 gm/lit; iv) Tozen @ 0.33 ml/lit; v) Karanjin 2 EC @ 2ml/lit; vi) Borer Gourd (*Bacillus thuringiensis* var. *Kurstaki* 10⁸ CFU/ml + *Beauveria bassiana* 10⁸ CFU/ml + *Verticillium lecanii* 10⁸ CFU/ml + *Metarhizium anisopliae* 10⁸ CFU/ml) @ 2 ml/lit; vii) Chlorantraniliprole 18.5 EC @ 0.25 ml/lit and viii) Untreated check to test efficacy of newer bio-rational insecticides against *L. orbonalis*. The treatments were arranged in randomized complete block design (RCBD) with three replications. The result showed that the fruit infestation percent on number and weight basis was significantly the lowest in Chlorantraniliprole (6.57 and 6.31) and Spinosad (12.08 and 11.15) treated plots as compared to other treatments. The Chlorantraniliprole treated plot recorded the maximum marketable yield (32.03 mt/ha) followed by Spinosad (30.93 mt/ha) with 34.39 percent and 29.77 percent increase in marketable fruit yield over untreated check, respectively. Hence, the use of Chlorantraniliprole and Spinosad could be one of the better options for effective management of *L. orbonalis*.

Key words: Bio-efficacy; Biorational insecticides; Chlorantraniliprole; IPM; Spinosad

Introduction

Eggplant fruit and shoot borer, *Leucinodes orbonalis* Guenee (Lepidoptera: Pyralidae) is a destructive and first ranked insect pest constraint of eggplant production in almost eggplant growing areas of the world including Nepal (Mainali *et al.*, 2013; Mainali, 2014). This insect has gained the potential status of pest due to larva's unique nature of feeding on monophagous diet aided by homing and tunneling behavior ultimately enables insects to face the challenges of chemical pesticides (Hanur *et al.*, 2014). It causes reduction of the marketable yield as well as content of vitamin C up to 80 percent (Sharma, 2002).

Farmers rely exclusively on use of synthetic insecticides in order to combat the pest (Mainali *et al.*, 2014). Ghimire (2001) reported that farmers apply insecticides 10-12 times in winter and 25 to 30 times or even more in summer and rainy season crop. The dose of insecticide was used much higher than recommended level during fruiting and harvesting time. This trend of using insecticides with increased dose and frequency caused negative impacts on farmer's health (Mainali *et al.*, 2014). Besides, it results development of pest resistance and environmental contamination (Kabir *et al.*, 1996) and soaring up of the input cost (Orden *et al.*, 1994; SUSVEG, 2007). Ultimately,

this situation leads to the reluctant of the farmers on growing eggplant (Gapud and Canapi, 1994). In such situation, the uses of bio-rational products are very much desirable (worthwhile) to growers and consumers.

The recent advance of the science is deliberately providing breakthrough in pest management by producing bio-rational products. With this background, an attempt was made to test efficacy of newer bio-rational products against *L. orbonalis* to deliver on-hand eco-friendly technology to fulfill the farmers need in mid-hill valley of Nepal.

Materials and Methods

The field experiment was carried out at Entomology Division, Nepal Agricultural Research Council (NARC), Khumaltar, Lalitpur field during summer season of 2014. The Hybrid variety of eggplant i.e. Namdhari was seeded on March 20, 2014 and the seedlings were transplanted on May 5 2014 in 60 cm*50 cm crop geometry. Eighteen seedlings were planted on each plot (size 5.4 meter square). The plots were set in randomized complete block design (RCBD) with eight treatments namely, i) Abamectin 1.9 EC @ 1.5 ml/lit; ii) Spinosad 45 SL @ 0.25 ml/lit; iii) Emamectin Benzoate 5 SG @ 0.3 gm/lit; iv) Tozen @ 0.33 ml/lit; v) Karanjin 2 EC @ 2ml/lit; vi) Borer Gourd

(*Bacillus thuringiensis* var. *Kurstaki* 10^8 CFU/ml + *Beauveria bassiana* 10^8 CFU/ml + *Verticillium lecanii* 10^8 CFU/ml + *Metarhizium anisopliae* 10^8 CFU/ml) @ 2 ml/lit; vii) Chlorantraniliprole 18.5 EC @ 0.25 ml/lit and viii) Untreated check (control). The treatments were replicated thrice. The compost and inorganic fertilizer was applied @ 20 mt/ha and 80:40:40 kg NPK/ha, respectively.

The first spray of treatments started after two month of transplantation (July, 3 2014) and repeated at 15 days interval. In total, eight fruit pickings were done from July 10, 2014 to October 25, 2014. The shoot infestation was observed. From each plot, the market-sized fruits were harvested during each picking. The separation, counting and weighing of infested and non-infested fruits were done and then fruit infestation percent was calculated on number and weight basis by using following formula,

$$\text{Fruit infestation \% (by number)} = \frac{\text{Infested fruits number}}{\text{Total number of fruits}} \times 100$$

$$\text{Fruit infestation \% (by weight)} = \frac{\text{Infested fruit weight (kg)}}{\text{Total fruit weight (kg)}} \times 100$$

Then, average fruit infestation percent was worked out. The marketable yield was calculated by weighing non-infested fruits of each picking. The yield per plot was converted to mt/ha.

Above data was analyzed by using descriptive and inferential statistics. For this, the data from all experimental plots were recorded, tabulated and managed in spreadsheet. For heterogeneous data, transformation (Arc-sine) was worked out as suggested by Gomez and Gomez (1984). Then, the computer software GENSTAT-Discovery Edition was used to analyze the data. For significant differences

among the treatments, Duncan Multiple Range Test (DMRT) was used to differentiate treatments effect at $p < 0.05$ as described by Duncan (1951).

While comparing the yield from different treatments percent increase in marketable yield over untreated check (control) was calculated by using following the formula,

$$\text{Increase in yield over control (\%)} = \frac{[T - UC]}{UC} \times 100$$

Where, T = Marketable yield from treatment plot; UC = Marketable yield from untreated check plot

Results and Discussions

None of the shoots of eggplant was damaged due to *L. orbonalis*. It may be due to Hybrid variety used in the experiment, which had many hairy, spines like structure throughout the shoot region. Probably, this characteristic of the host plant is unattractive to the *L. orbonalis* for oviposition, feeding or shelter (Antixenosis mechanism of Host Plant Resistance). However, fruit infestation was started right from the fruit initiation and it was in increasing trend up to the final harvest.

The fruit infestation by number basis revealed that the treatment Chlorantraniliprole excelled all other treatments. The other best treatment Spinosad was at par difference with it. On weight basis, the Chlorantraniliprole and Spinosad significantly ($p < 0.01$) excelled over all other treatments in regards of attaining lower fruit infestation and maximum protection (Table 1). The highest marketable yield (32.03 mt/ha) was recorded on Chlorantraniliprole treated plots with 34.39 percent increase in yield over untreated check followed by Spinosad, Abamectin, Karanjin, Tozen, respectively. However, minimum yield is observed in Borer Gourd treated plots and untreated check (Table 2).

Table 1: Mean percent of fruit infestation by *Leucinodes orbonalis* Guenee under Lalitpur condition, 2014

Treatments	Mean percent infestation \pm SE	
	Fruit	
	By number	By weight
Abamectin 1.9 EC @ 1.5 ml/lit	25.32 ^c \pm 5.46 (29.87)	25.23 ^b \pm 4.15 (29.93)
Spinosad 45 SL @ 0.25 ml/lit	12.08 ^{ab} \pm 1.05 (20.29)	11.15 ^a \pm 0.81 (19.47)
Emamectin Benzoate 5 SG @ 0.3 gm/lit	28.27 ^c \pm 2.85 (32.04)	27.72 ^b \pm 2.34 (31.71)
Tozen @ 0.33 ml/lit	21.11 ^{bc} \pm 0.32 (27.35)	20.91 ^b \pm 0.83 (27.20)
Karanjin 2 EC @ 2ml/lit	28.52 ^c \pm 0.54 (32.28)	27.35 ^b \pm 0.35 (31.53)
Borer Gourd @ 2ml/lit	28.95 ^c \pm 3.30 (31.88)	26.29 ^b \pm 4.40 (30.58)
Chlorantraniliprole 18.5 EC @ 0.25 ml/lit	6.57 ^a \pm 0.87 (14.75)	6.31 ^a \pm 0.71 (14.48)
Untreated check	31.72 ^c \pm 3.89 (34.18)	32.07 ^b \pm 3.48 (34.40)
CV (%)	15.1	14.4
LSD at 5%	7.37	6.92
Probability	<0.01	<0.01

Figures in the parentheses indicate arcsine-transformed values (ASIN (SQRT (X/100)) \times 57.296) for fruit infestation; Means followed by same alphabet do not differ significantly by DMRT at $p < 0.05$; SE = Standard Error; Borer gourd referred the commercial product containing *Bacillus thuringiensis* var. *Kurstaki* 10^8 CFU/ml plus *Beauveria bassiana* 10^8 CFU/ml plus *Verticillium lecanii* 10^8 CFU/ml plus *Metarhizium anisopliae* 10^8 CFU/ml

Table 2: Effect of treatments on yield of eggplant fruit under Lalitpur condition, 2014

Treatments	Marketable fruit yield (mt/ha)	Increase in yield over untreated check (%)
Abamectin 1.9 EC @ 1.5 ml/lit	30.58 ^a	28.33
Spinosad 45 SL @ 0.25 ml/lit	30.93 ^a	29.77
Emamectin Benzoate 5 SG @ 0.3 gm/lit	28.14 ^{ab}	18.06
Tozen @ 0.33 ml/lit	27.06 ^{ab}	13.55
Karanjin 2 EC @ 2ml/lit	30.45 ^a	27.76
Borer Gourd @ 2ml/lit	24.15 ^b	1.32
Chlorantraniliprole 18.5 EC @ 0.25 ml/lit	32.03 ^a	34.39
Untreated check	23.83 ^b	-
CV (%)	10.4	-
LSD at 5%	5.19	-
Probability	0.025	-

Means followed by same alphabet do not differ significantly by DMRT at $p < 0.05$; Borer gourd referred the commercial product containing *Bacillus thuringiensis* var. *Kurstaki* 10^8 CFU/ml plus *Beauveria bassiana* 10^8 CFU/ml plus *Verticillium lecanii* 10^8 CFU/ml plus *Metarhizium anisopliae* 10^8 CFU/ml

The finding is similar to researchers like Sajjan and Raffae (2015). They reported that the synthetic chemical targeting ryanodine receptor (Chlorantraniliprole, Cyantraniliprole and Flubendiamide) and Spinosad treatments were effective to give maximum protection of eggplant crop from *L. orbonalis* and to secure higher fruit yield than other treatments. The Chlorantraniliprole falls under the class of selective insecticide, anthranilic diamides shows very specific mode of action by interfering the ryanodine insect receptors and cause paralysis of the muscle cells of the insects. By both ingestion and contact, it demonstrates ovicidal and larvicidal activities (Cabrera *et al.*, 2014). This insecticide is primarily active against chewing pest (Dinter *et al.*, 2009). Saha *et al.* (2014) reported that the treatment Rynaxypyr 20 SC (Chlorantraniliprole) 0.006%, Flubendiamide (Fame 480 SC) 0.01%, Spinosad (Spintor 45 SC) 0.0135% and Emamectin Benzoate (Proclaim 5 WG) 0.0025% provided superior control of *L. orbonalis* on eggplant. In separate study, it has been found that the same chemical Rynaxypyr 20% SC @ 40 and 50g a.i./ha gave around 90 percent reduction in fruit damage by both number and weight basis and recorded significantly highest healthy fruit during both winter and summer season (Misra, 2011). Munje *et al.* (2015) reported that the treatment Rynaxypyr 20 EC and Emamectin Benzoate 5 SG were found most effective against *L. orbonalis* amongst the insecticides tested. The Chlorantraniliprole was not only effective to control the pyralid insect but also less toxic to insect predator and parasitoid such as *Chrysoperla carnea* and *Trichogramma evanescens* larvae (Al-kazafy Hassan *et al.*, 2014).

Another author, Devi *et al.* (2015) reported that the fermentation product of the soil bacterium *Saccharopolyspora spinosa*, a bio-insecticide treatment Spinosad 50 gm a.i./ha gave the lowest shoot and fruit infestation (7.92- 11.01% and 11.92-12.98%) and attained significantly maximum marketable yield (168.70 q/ha – 170.05 q/ha) over untreated check during both winter and summer season. Mamun *et al.* (2014) also reported that the treatment Spinosad 45 SP found to be most effective in

terms of recording minimum shoot fruit damage and fruit loss and maximum protection against *L. orbonalis* over all tested treatments. Effectiveness of Spinosad against *L. orbonalis* was also reported by Kalawate and Dethe (2012) and Tayde and Simon (2010) too.

However, Borer Gourd contains *Bacillus thuringiensis* var. *Kurstaki* 10^8 CFU/ml + *Beauveria bassiana* 10^8 CFU/ml + *Verticillium lecanii* 10^8 CFU/ml + *Metarhizium anisopliae* 10^8 CFU/ml, this treatment shows bio-efficacy almost equivalent to untreated check (control). This unexpected performance is probably due to the inappropriate storage and handling of bio-pesticides on storage and transportation in market system of Nepal.

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