Plant Archives Vol. 15 No. 2, 2015 pp. 805-808 *ISSN 0972-5210*

COMPARATIVE EFFICACY OF SOME BIOPESTICIDES AGAINST SHOOT AND FRUIT BORER, *LEUCINODES ORBONALIS* GUENEE IN BRINJAL

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Abstract

A field experiment was conducted to determine the comparative efficacy of *Bacillus thuringiensis*, *Beauveria bassiana*, neemarin (neem oil), neemarin- *Bt-Bb*, *Bt-Bb-Bt*, spinosad 45 SC and chlorpyriphos 20 EC against shoot and fruit borer, *Leucinodes orbonalis* in brinjal at Crop Research Center, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.), India during *Kharif* 2014. All the treatments were found effective in reducing the infestation of shoot and fruit borer in comparison to control. Application of spinosad 45 SC @ 200 ml/ha was the most effective treatment in reducing the shoot and fruit damage at all observational interval and it was followed by chlorpyriphos 20 EC @ 1 lit/ha and neemarin @ 3 lit/ha.

Key words : Efficacy, biopesticides, *Leucinodes orbonalis*, brinjal.

Introduction

Brinjal (*Solanum melongena* L.) is an important vegetable crop of India, grown throughout the year. The crop is highly sensitive and a potential host for several insect pests. Among them, attack of shoot and fruit borer (*Leucinodes orbonalis* Guenee) is important one. The larvae of this insect bore into tender shoot causing shoot wilt and feeds on young fruits rendering them unfit for consumption. In India, this insect has been reported to inflict losses to the tune of 20.7 to more than 90% in different parts of the country (Raja *et al*., 1999). A number of chemical insecticides have been reported to be effective against this pest (Singh and Nath, 2007; Gautam *et al*., 2008 and Tiwari *et al*., 2011), but they are regarded as ecologically unacceptable. Brinjal being a vegetable crop, use of chemical insecticides will leave considerable toxic residues on the fruits. Therefore, there is an increased social pressure to replace them gradually with biopesticides which are safe to human and non target organisms. In this context, present studies were undertaken.

Materials and Methods

The experiment was carried out during *Kharif* 2014 at Crop Research Center, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.), India; in a randomize block design with three replications. Thirty days old seedling of brinjal variety Pusa purple round were planted at 60 × 60 cm in a plot of 20 m^2. In all, there were eight treatments including control. All the agronomic practices, except the package recommended for insect pest management were adopted to raise a good crop. Each treatment in the form of spray was applied twice during the crop season. For the control of shoot damage, first spray was given at 30 days after transplanting, while for the fruit damage control, first spray was applied at 45 days after transplanting. The subsequent second spray was applied at an interval of 15 days. Observations on shoot and fruit damage were recorded on five randomly selected plants one day before and 3, 7 and 14 days after each application of treatments. Yield of healthy fruits was taken at each picking.

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Results and Discussion

Effect of treatments on shoot damage caused by *L. orbonalis*

The results revealed that all the treatments were significantly effective in reducing the infestation of *L. orbonalis*. Pre-treatment observations recorded one day before first spray, the shoot damage ranged from 7.16 to 9.15 per cent and it was non-significant among all the

treatments (table 1). On 3rd day after first spray, the minimum shoot damage (4.31 per cent) was recorded in the treatment spinosad @ 200ml/ha and it was significantly lower among all the treatments. It was followed by chlorpyriphos @ 1 lit/ha and neemarin @ 3 lit/ha having shoot damage of 4.89 and 5.21 per cent, respectively. The treatment neemarin -*Bt* - *Bb* had 5.47 per cent shoot damage followed by *B. bassiana* @ 2500gm/ha, *B. thuringiensis* @ 500gm/ha and *Bt* - *Bb* - *Bt*. Maximum shoot damage (11.73 per cent) was recorded in control plot.

Seventh day after first application, spinosad @ 200ml/ha was observed best with minimum shoot damage (2.63 per cent). The next treatments in order were chlorpyrifos @ 1 lit/ha and neemarin @ 3 lit/ha, which recorded shoot damage 3.15 and 3.61 per cent, respectively and were significantly superior over rest of the treatments in respect of reducing infestation. The rest treatments like neemarin-*Bt*- *Bb* (3.85 per cent), *B. bassiana* @ 2500gm/ha (3.89 per cent), *B. thuringiensis* @ 500gm/ha (4.23 per cent), and *Bt* - *Bb* – *Bt* (4.48 per cent) proved less effective but these were significantly superior over control. The maximum shoot damage (11.89 per cent) was recorded in control plot. Shoot damage increase slightly in all the treatments on 14th day after first application. The minimum shoot damage (6.39 per cent) was again recorded with spinosad @ 200ml/ha and it was significantly superior over rest of the treatments. The other treatments to follow were chlorpyrifos @ 1 lit/ha (7.28 per cent), neemarin @ 3 lit/ha (8.17 per cent), neemarin-*Bt*- *Bb* (8.50 per cent) *B. bassiana* @ 2500gm/ha (8.64 per cent), *B. thuringiensis* @ 500gm/ha (8.90 per cent), and *Bt* - *Bb* – *Bt* (9.25 per cent). The highest per cent shoot damage (12.51 per cent) was recorded in control plot.

A similar trend of efficacy was recorded after second application at each time interval. On 14th day after second application spinosad @ 200ml/ha again proved most effective treatments with 0.48 per cent shoot damages and it was significantly superior over rest of treatments. It was followed by chlorpyrifos. The treatment neemarin @ 3lit/ha had 0.98 per cent shoot damage followed by *B. bassiana* @ 2500gm/ha (1.02 per cent shoot damage), *Bt* - *Bb* – *Bt* (1.04 per cent shoot damage), neemarin-*Bt*- *Bb* (1.11 per cent shoot damage) and *B. thuringiensis* @ 500gm/ha (1.12 per cent shoot damage). The maximum shoot damage (4.69 per cent) was recorded in control plot. The order of effectiveness of these treatments was spinosad > chlorpyrifos > neemarin > *B. bassiana* > *Bt* - *Bb* – *Bt* > neemarin-*Bt*- *Bb* > *B. thuringiensis*.

Effect of treatments on fruit damage caused by *L. orbonalis*

Pre-treatment observations recorded one day before first application indicated that the fruit damage was homogeneous throughout the experiment field and ranged from 8.31 to 10.23 per cent and it was non-significant (table 2). Data recorded on 3rd day after first application, all the treatments were found significantly superior over control. The minimum fruit damage was recorded with spinosad @ 200ml/ha (3.71 per cent) and it was significantly superior to rest of treatments. It was followed by chlorpyrifos with 4.13 per cent fruit damage. The next treatments in order were neemarin @ 3 lit/ha (4.63 per cent), *B. bassiana* @ 500gm/ha (4.83 per cent), *Bt* - *Bb* – *Bt* (4.96 per cent), *B. thuringiensis* @ 500g m/ha (5.19 per cent) and neemarin-*Bt*- *Bb* (5.36 per cent) The highest fruit damage (11.29 per cent) was recorded in control plot.

A perusal of table 2 reveals that after seventh day of first spray, the fruit damage decline slightly in all the treatments and ranged from 3.16 to 4.74 per cent. The minimum fruit damage (3.16 per cent) was again recorded with spinosad @ 200ml/ha while the maximum fruit damage (11.82 per cent) was in control. The other treatments *i.e.* chlorpyrifos @ 1 lit/ha, neemarin @ 3 lit/ha, *Bt* - *Bb* – *Bt, B. bassiana* @ 2500gm/ha, *B. thuringiensis* @ 500gm/ha and neemarin-*Bt*- *Bb* were recorded 3.28, 3.89, 4.21, 4.23, 4.65 and 4.74 per cent fruit damage, respectively and these treatments were found significantly superior to control. The data recorded on 14th day of first application revealed that spinosad @ 200ml/ha maintained its effectiveness and gave the best performance (6.67 per cent fruit damage) and it was followed by chlorpyrifos 20EC @ 1 lit/ha. The other treatments in order were neemarin @ 3 lit/ha, *B. bassiana* @ 2500gm/ha, *Bt* - *Bb* – *Bt*, *B. thuringiensis* @ 500gm/ha and neemarin-*Bt*- *Bb* with 6.85, 7.28, 7.36, 7.47, 8.87 and 8.94 per cent fruit damage, respectively. The maximum fruit damage of 11.92 per cent was recorded in untreated control.

A similar trend of treatments in reduction of fruit damage was recorded after second spray and all the treatments were found better than the control. On 14th day after second application, the spinosad @ 200 ml/ha maintained its effectiveness and gave the best performance (7.01 per cent fruit damage) and it was significantly superior over rest of the treatments. The next effective treatment was chlorpyrifos @ 1 lit/ha (7.33 per cent) followed by neemarin @ 3 lit/ha (7.64 per cent), *B. bassiana* @ 2500 gm/ha (7.93 per cent), *B.*

Table 1: Efficacy of different treatments on shoot damage caused by shoot and fruit borer, *L. orbonalis*.

Treatment no.	Treatments	Dose/ha	Shoot damage (per cent)						
			First spray				Second spray		
			1 DBS	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	*Bacillus thuringiensis* var. kurstaki 54% (*Bt*)	500 gm/ha	7.23 (15.57)	6.27 (14.49)	4.23 (11.86)	8.90 (17.34)	6.36 (14.60)	3.89 (11.36)	1.12 (6.07)
T_2	*Beauveria bassiana* 1×10^8 spore/gm (*Bb*)	2500 gm/ha	8.12 (16.53)	6.23 (14.44)	3.89 (11.37)	8.64 (17.08)	5.13 (13.08)	3.62 (10.96)	1.02 (5.79)
T_3	Neemarin (Neem oil) 35% W/W	3 lit/ha	9.28 (17.72)	5.21 (13.18)	3.61 (10.94)	8.17 (16.60)	4.23 (11.86)	3.05 (10.05)	0.98 (5.67)
T_4	Neemarin - *Bt – Bb*	As above	7.22 (15.55)	5.47 (13.51)	3.85 (11.31)	8.50 (16.94)	6.55 (14.82)	3.72 (11.11)	1.11 (6.04)
T_5	*Bt - Bb – Bt*	-do-	7.16 (15.50)	6.50 (14.76)	4.48 (12.21)	9.25 (17.69)	5.32 (13.33)	3.56 (10.87)	1.04 (5.85)
T_6	Spinosad 45SC	200 ml/ha	8.23 (16.65)	4.31 (11.97)	2.63 (9.32)	6.39 (14.69)	3.11 (10.15)	1.68 (7.44)	0.48 (3.97)
T_7	Chlorpyrifos 20EC	1 lit./ha	9.15 (17.58)	4.89 (12.83)	3.15 (10.21)	7.28 (15.64)	3.98 (11.50)	2.02 (8.16)	0.72 (4.86)
T_8	Control	-	8.77 (17.18)	11.73 (20.02)	11.89 (20.16)	12.51 (28.70)	13.65 (21.67)	9.68 (18.12)	4.69 (12.50)
	SEm (±)		0.59	0.11	0.07	0.09	0.06	0.10	0.07
	CD at 5%		N S	0.34	0.22	0.29	0.20	0.31	0.22

Figures in parentheses are angular transformed values, DAS = Days after spray, DBS = Days before spray.

Table 2 : Efficacy of different treatments on fruit damage caused by shoot and fruit borer, *L. orbonalis*.

Treatment no.	Treatments	Dose/ha	Fruit damage (per cent)						
			First spray				Second spray		
			1 DBS	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	*Bacillus thuringiensis* var. kurstaki 54% (*Bt*)	500gm/ha	8.31 (16.74)	5.19 (13.16)	4.65 (12.44)	8.87 (17.32)	6.02 (14.19)	4.87 (12.74)	8.06 (16.48)
T_2	*Beauveria bassiana* 1×10^8 spore/gm (*Bb*)	2500gm/ha	10.21 (18.61)	4.83 (12.69)	4.23 (11.86)	7.36 (15.73)	5.87 (14.01)	4.62 (12.40)	7.93 (16.34)
T_3	Neemarin(Neem oil) 35% W/W	3lit/ha	9.82 (18.22)	4.63 (12.42)	3.89 (11.37)	7.28 (15.64)	5.42 (13.45)	3.67 (11.04)	7.64 (16.03)
T_4	Neemarin - *Bt – Bb*	As above	8.32 (16.73)	5.36 (13.38)	4.74 (12.56)	8.94 (17.39)	5.96 (14.12)	4.84 (12.70)	8.15 (16.58)
T_5	*Bt - Bb – Bt*	-do-	8.86 (17.27)	4.96 (12.86)	4.21 (11.83)	7.47 (15.85)	6.18 (14.38)	5.02 (12.94)	8.14 (16.57)
T_6	Spinosad 45SC	200 ml/ha	9.21 (17.62)	3.71 (11.09)	3.16 (10.23)	6.67 (14.96)	4.56 (12.32)	2.53 (9.14)	7.01 (15.34)
T_7	Chlorpyrifos 20EC	1lit./ha	10.23 (18.62)	4.13 (11.72)	3.28 (10.42)	6.85 (15.16)	5.01 (12.92)	2.94 (9.86)	7.33 (15.70)
T_8	Control	-	10.61 (18.98)	11.29 (19.62)	11.82 (20.10)	11.92 (20.18)	11.99 (20.25)	12.03 (20.28)	12.27 (20.49)
	SEm (±)		0.73	0.04	0.04	0.09	0.05	0.08	0.04
	CD at 5%		NS	0.15	0.13	0.27	0.17	0.25	0.13

Figures in parentheses are angular transformed values, DAS = Days after spray, DBS = Days before spray

thuringiensis @ 500 gm/ha (8.06 per cent), *Bt - Bb – Bt* (8.14 per cent) and neemarin-*Bt- Bb* (8.15 per cent fruit damage), respectively.

It is evident from the above findings that all the treatments were effective in reducing shoot and fruit damage at different intervals after each spray in comparison to untreated control. Spinosad @ 200 ml/ha proved most effective treatment for the control of shoot and fruit borer in present study. The effectiveness of spinosad for the control of *L. orbonalis* has also been reported by Sharma and Kaushik (2010) and Tayde and Simon (2010). Chlorpyrifos 20 EC @ 1 lit/ha was found next effective treatment against *L. orbonalis* in present studies, which is in agreement with the results obtained by Singh and Nath (2007). Neemarin @ 3 lit/ha found effective in present study is in accordance with the report of Raja *et al*. (1999), Yadav and Sharma (2005), Gautam *et al*. (2008), Mane and Kulkarni (2010) and Karkar *et al*. (2014). The efficacy of entmopathogenic fungi *Beauveria bassiana* @ 2500gm/ha and entmopathogen *Bacillus thuringiensis* @ 500gm/ha was also found in reducing the infestation of shoot and fruit borer, which is in conformity with the finding of Joshi *et al*. (2010) and Nayak *et al*. (2013).

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