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Comparative Efficacy of Some Biorational Insecticides for Management of Shoot and Fruit Borer (Earies Vittella Fab.) on Okra

KEYWORDS: Biorational, insecticides, Earies vittella (Fab.) etc.

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ABSTRACT *A field experiment was conducted during pre-kharif (2012 and 2013) at Jaguli Instructional farm, B.C.K.V., West Bengal, India to evaluate the efficacy of seven biorational insecticides viz., Bacillus thuringiensis, Emamectin benzoate, Spinosad, Chlorofenapyr, Beauveria bassiana, Neem and Verticillium lecanii against Shoot and Fruit Borer (Earias vittella). Two years mean data with respect to effect of different treatments against E. vittella infestation at 15 days interval for each spray revealed significantly minimum shoot and fruit infestation that Spinosad 45% SC@ 50 g a.i/ha (5.62%) followed by Chlorfenapyr @ 100 g a.i/ha (6.16%), Emamectin benzoate 5% SG @ 12 g a.i./ ha (6.89), B. thuringiensis @1000ml/ha (7.56%), Beauveria bassiana @ 300 g a.i./ha (8.30%), Verticillium lecanii @ 1000 ml/ha (8.64%) and neem 10000 ppm @ 3 g a.i./ha (9.37%). The effect of Spinosad 45 SC @50 g a.i/ha treatments on marketable fruit yield (72.18q/ha) on weight basis of okra revealed most effective after each picking, compared to untreated control during both the seasons of field trail.*

INTRODUCTION

Okra (Abelmoschus esculentus L.) is one of the widely grown vegetable crop (Javed et al., 2009). India ranked first in production in world; major okra producing Indian sates are Uttar Pradesh, Bihar, Odisha, West Bengal, Andhra Pradesh, Karnataka and Assam with average production of okra in India is about to 57.84 lakh tons and productivity 11.6 tons/ha during 2010-11 (Pal et al.,2013) The yield and quality of okra is hampered severely by the attack of various insect pests of which shoot and fruit borer, Earias vittella (Fab.) is most serious as it spent the entire larval period within shoot and fruit and passes the entire damaging stage as true internal borer. Enormous conventional insecticides have been used extensively for the control of okra shoot and fruit borer which has resulted a progressive decrease in the effectiveness as well as development of resistance on the pest. So, today there is a great demand for safer and more ecologically acceptable biorational insecticides as a part of IPM programs affecting specifically harmful pests, while sparing beneficial insect species and other organisms. With the above views the present study has been carried out as attempt to test the effectiveness of seven biorational insecticides in controlling E. Vittella (Fab.) in okra.

MATERIALS AND METHODS

Field experiment was conducted during pre-kharif season of 2012 and 2013 at Jaguli instructional farm under B.C.K.V., West Bengal, India in a randomized block design with eight treatments replicated three times using variety "Vijay" in plot of size (2.5m x 2.5m) at spacing of 60 x 60 with recommended package of practices excluding plant protection. The insecticide treatments included two doses of Bacillus thuringiensis, Emamectin benzoate 5% SG, Chlorfenapyr 10% SC, Spinosad 45 % SC , Beauveria bassiana, Neem, Verticillium lecanii at 1000 ml/ha, 12 g a.i/ha, 100g a.i/ha, 50 g a.i/ha, 300g a.i/ha, 3 g a.i/ ha, 1000 ml/ha, respectively (Table 1) along with an untreated control. The insecticides are sprayed after a sufficient borer population built up and thereafter two sprays at 15 days interval with a high volume knapsack sprayer using 500 litres of spray fluid per hectare. The control plot was sprayed with water only. The incidence of borer on shoot and fruit were recorded from five randomly selected plants. The mean shoot and fruit infestation recorded one day before spray, after 7 and 14 days of each insecticide application. The healthy and infested fruits were taken into account along with total fruit yield per plot. The extent of damage was computed using the following formula used by Rahman et al. (2013).

$$\text{Per cent shoot/fruit infestation} = \frac{\text{Number of infested shoots/fruits}}{\text{Total number of shoots/fruits}} \times 100$$

The data thus obtained were subjected to statistical analysis after making necessary transformation. The total yield per plot was recorded and computed to hectare.

RESULT AND DISCUSSION

Shoot infestation

The results regarding the shoot damage in okra caused by Earias spp. in different treatments after application showed a highly significant difference among treatments (Table 1 and 2) in both years of experiment (2012 and 2013). Highest suppression of E. vittella shoot infestation was observed from Spinosad among all the treatments. During 2012, at 7 days after spraying, Spinosad recorded the lowest (5.00%) shoot infestation which was at par with Chlorfenapyr (5.29%). This was followed by Emamectin benzoate (5.50%), B.t. (5.75%), B. bassiana (6.56 %) at par with V. lecanii (6.70%) and neem (7.85%). In comparison, untreated plots (control) produced highest 19% shoot damage (Table 1). Whereas, at 14 days after first spray, Spinosad recorded

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lowest (4.17%) shoot infestation and closely followed by Chlorfenapyr (4.91%), Emamectin benzoate (5.01%) which is at par with B.t. (5.15%), B. basiana (6.21%), V. lecanii (7.00%) and neem (7.25%) compared to untreated control (22.65%).

During 2013, there was no significant variation among the treatments one day before spray. At 7 days after imposing the treatment, all the biorational insecticides tested were found to be significantly superior over control at 5 % level (Table 2). Among them Spinosad recorded the lowest (5.63%) shoot infestation followed by Chlorfenapyr (6.81%), Emamectin benzoate (7.09%) at par with B.t. (7.43%), B. bassiana (8.12%), V. lecanii (8.45%) and neem (9.80%) compared to untreated control (21.20%). Observations recorded on 14 days after spray showed similar trend with that observations on of 7 days after treatment (Table 2). The lowest (4.23%) shoot infestation was recorded in spinosad at par with chlorfenapyr (5.12%), followed by emamectin benzoate (6.62%), B.t. (8.10%), B. bassaina (8.67%), V. lecanii (9.20%) and neem (9.30%). Apparently the highest shoot infestation was recorded in untreated control.

Fruit infestation

Means comparison of the data regarding fruit damage in okra caused by Earias spp. revealed highly significant differences between treatments (Table 1 and 2) in both years of experiment (2012 and 2013). The application of Spinosad proved comparatively most effective among all the treatments. The efficacy of treatments against fruit borer showed significant reduction of borer infestation on fruit and showed superior performance over control at 5% level. During 2012, among the chemicals Spinosad exhibited lowest infestation at 7 and 14 days (5.47% and 6.17% respectively) after spraying (mean of two sprays) followed by Chlorfenapyr (5.62% and 6.25%), Emamectin benzoate (6.15 % and 7.43%), B.t. (6.41% and 7.81%), B.bassiana (8.20% and 8.01%), V. lecanii (8.15% and 8.50%) and neem (8.46% and 8.75%). Whereas during 2013, spinosad exhibited lowest infestation at 7 and 14 days (6.87% and 7.43%respectively) after spraying was closely followed by Chlorfenapyr (7.18 & 8.13%), Emamectin benzoate (8.21 & 9.18%), B.t. (9.62 & 10.21%), B. bassiana (9.86 & 10.76%), V. lecanii (10.23 & 10.95%) and neem (12.60 & 11.00%). The all treatments reduced fruit infestation significantly compared to control plot (25.65 & 29.45%).

Table 1. Bioefficacy of some biorational insecticides against fruit and shoot borer of okra (Earias sp) & on yield during 2012

Treatments	Dose (g a.i./ha)	Mean % of shoot infestation (Mean of 2 sprays)			Mean % of fruit infestation (Mean of 2 sprays)			Overall mean shoot & fruit infestation	% protection over control	Yield (q/ha)	Increased yield over control (q/ha)
		Before spray	7DAA	14DAA	Before spray	7DAA	14DAA				
B.t. (Bacithrin SC)	1000 ml/ha	12.33 (20.41)	5.75[cde] (13.77)	5.15[cd] (13.01)	9.30 (17.62)	6.41[c] (14.56)	7.81[b] (16.11)	6.28	69.95	69.20	131.83
Emamectin benzoate 5%S G	12	12.80 (20.81)	5.50[de] (13.46)	5.01[cd] (12.83)	9.00 (17.33)	6.15[cd] (14.25)	7.38[bc] (15.64)	6.01	71.24	72.25	142.04
Chlorfenapyr (Intrepid10%SC)	100	12.45 (20.51)	5.29[e] (13.19)	4.91[cd] (12.70)	8.75 (17.08)	5.62[cd] (13.61)	6.25[c] (14.37)	5.52	73.60	73.55	146.40
Spinosad (Spintor 45%SC)	50	11.70 (19.86)	5.00[e] (12.82)	4.17[d] (11.69)	8.60 (16.92)	5.47[d] (13.42)	6.17[c] (14.27)	5.20	75.11	78.85	164.15
B. bassiana (Traps SC)	300	13.10 (21.07)	6.56[cd] (14.73)	6.21[bc] (14.32)	9.35 (17.67)	8.20[b] (16.51)	8.01[b] (16.32)	7.25	65.33	65.55	119.60
Neem@10000 ppm	3	13.25 (21.19)	7.85[b] (16.15)	7.25[b] (15.50)	10.25 (18.53)	8.46[b] (16.78)	8.75[b] (17.08)	8.08	61.35	60.35	102.18
Verticillium lecani (Life line SC)	1000 ml/ ha	12.55 (20.60)	6.70[bc] (14.89)	7.00[b] (15.23)	9.75 (18.06)	8.15[b] (16.46)	8.50[b] (16.82)	7.59	63.70	63.20	111.73
Untreated control	water	11.85 (19.99)	19.00[a] (25.68)	22.65[a] (28.25)	9.25 (17.57)	17.35[a] (24.45)	24.60[a] (29.56)	20.90	-	29.85	-
S Em		NS	0.42	0.55	-	0.36	0.52				
CD at 5% (P =0.05)		NS	1.30	1.67	-	1.09	1.60				

Figures in parentheses are angular transformed values; DAA- Days after application
Figures in the same column with similar alphabets do not differ significantly by DMRT (P=0.05)

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Table 2. Bioefficacy of some biorational insecticides against fruit and shoot borer of okra (Earias sp) & on yield during 2013

Treatments	Dose (g a.i./ ha)	Mean % of shoot infestation (Mean of 2 sprays)			Mean % of fruit infestation(Mean of 2 sprays)			Overall mean shoot & fruit infestation	% protection over control	Yield (q/ha)	Increased yield over control (q/ha)
		Before spray	7DAA	14DAA	Before spray	7DAA	14DAA				
B.t.(Bacithrin SC)	1000 ml/ha	16.60 (23.88)	7.43^{cde} (15.70)	8.10^{bc} (16.41)	13.40 (21.32)	9.62^{cd} (17.93)	10.21^{b} (18.50)	8.84	64.57	56.50	113.61
Emamectin benzoate 5% S G	12	17.61 (24.65)	7.09^{de} (15.32)	6.62^{c} (14.79)	12.75 (20.77)	8.21^{de} (16.52)	9.18^{bc} (17.50)	7.77	68.86	59.70	125.71
Chlorfenapyr (Intrepid10%SC)	100	17.80 (24.79)	6.81^{e} (15.01)	5.12^{d} (12.98)	12.75 (20.77)	7.18^{e} (15.42)	8.13^{c} (16.44)	6.81	72.71	61.20	131.38
Spinosad (Spintor 45%SC)	50	17.20 (24.34)	5.63^{f} (13.62)	4.23^{d} (11.78)	12.55 (20.60)	6.87^{e} (15.08)	7.43^{c} (15.70)	6.04	75.79	65.50	147.64
B. bassiana (Traps SC)	300	16.21 (23.58)	8.12^{cd} (16.43)	8.67^{b} (17.00)	13.80 (21.65)	9.86^{c} (18.17)	10.76^{b} (19.01)	9.35	62.53	54.20	104.91
Neem@10000 ppm	3	15.75 (23.22)	9.80^{b} (18.11)	9.30^{b} (17.62)	14.85 (22.51)	12.60^{b} (20.64)	11.00^{b} (19.23)	10.67	57.23	48.12	81.92
Verticillium lecani (Life line SC)	1000 ml/ ha	16.12 (23.51)	8.45^{c} (16. 77)	9.20^{b} (17.53)	14.25 (22.02)	10.23^{c} (18.52)	10.95^{b} (19.18)	9.70	61.12	51.90	96.22
Untreated control	water	17.33 (24.44)	21.20^{a} (27.24)	23.50^{a} (28.82)	14.50 (22.23)	25.65^{a} (30.25)	29.45^{a} (32.70)	24.95	-	26.45	-
S Em		NS	0.43	0.54	-	0.52	0.59				
CD at 5% (P=0.05)		NS	1.33	1.63	-	1.58	1.81				

Figures in parentheses are angular transformed values, DAA- Days after application
Figures in the same column with similar alphabets do not differ significantly by DMRT (P=0.05)

Fruit yield

Analysis of the data revealed that all the treatments during both years of experiment (2012 and 2013) were associated with significant increase in the fruit yield of okra as compared to the control (Table 1, 2 and 3). During 2012, treatment of Spinosad recorded the highest (78.85 q/ha) fruit yield of okra which was found significantly superior over other treatments (Table 1). The next best was chlorfenapyr (73.55 q/ha) followed by emamectin benzoate (72.25 q/ha), B.t. (69.20q/ha), B.bassina (65.55 q/ha), Verticilium lecanii (63.20q/ha) and neem (60.35q/ha). Equivalent trend of results found during 2013, that the treatment of spinosad recorded the highest (65.50 q/ha) fruit yield of okra followed by chlorfenapyr (61.20 q/ha), emamectin benzoate (59.70 q/ha), B.t. (56.50 q/ha), B. bassiana (54.20 q/ha), V. lecanii (51.90 q/ha) and neem (48.12 q/ha) compared to control plot (26.45 q/ha).

Table 3. Pooled data of effect of biorational insecticides on shoot and fruit infestation and yield of okra against fruit and shoot borer (E. vitella).

Treatment	Dose g.a.i/ha	Shoot and fruit infestation (%)	Yield (q/ ha)
B.t. (Bacithrin SC)	1000ml/ ha	7.56	62.85
Emamectin benzoate 5%S G	12	6.89	65.98
Chlorfenapyr (Intrepid10%SC)	100	6.16	67.38
Spinosad (Spintor 45%SC)	50	5.62	72.18
B. bassiana (Traps SC)	300	8.30	59.88
Neem@10000 ppm	3	9.37	55.28
Verticillium lecani (Life line SC)	1000 ml/ ha	8.64	57.55
Untreated control	water	22.93	28.15

Pooled data of two years of experiment (2012 and 2013) is expressed in a cumulative manner considering percentage shoot and fruit infestation and yield as parameter (Table 3). The result revealed lowest shoot and fruit infestation (5.62%) in conjunction with highest yield of 72.18 q/ha from the application of Spinosad comparing to other treatments. In the present study, all the biorational insecticides were found to be superior in reducing the shoot and fruit damage caused by E. vitella over the control (Untreated). During the investigation, Spinosad (a mixture of spinosad A and spinosyn D are naturally derived group of insecticides molecule Saccharapolyspora spinosa characterized as bacteria) with a novel mode of action having ovicidal & larvicidal properties was proved to be most effective against E. vittella and reported the best insecticides in giving highest per cent protection and yield followed by Chlorfenapyr, Emamectin benzoate, B.t. exhibited high levels of reduction of this borer population. The present

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findings are in conformity with Gosalwad and Kawathekar (2009) who studied and reported spinosad application as most effective and found significantly superior over rest of the insecticide treatments used for management of E. vitella on okra. Other researchers also found same findings in their studies on different crops like cotton, brinjal etc. for management of the pest (Sampath et al. 2008; Sharma & Kaushik 2010 and Ghosh et al., 2010 etc.). This may be due to the fact that Spinosad exhibited more toxic effect to eggs and neonate larvae which were the most susceptible stages of this pest.

CONCLUSION

Based on percentage of shoot as well as fruit damage and fruit yield, treatments of all seven biorational insecticides (Bacillus thuringiensis, Emamectin benzoate 5% SG, Chlorfenapyr 10% SC, Spinosad 45 % SC, Beauveria bassiana, Neem, Verticillium lecanii) recorded reduction in population and infestation, so which can be considered as effective insecticides to control E. vittella infesting okra. Spinosad 45%SC emerged out as highly effective biorational insecticides comparing to others as results @ 50 g a.i/ha two foliar spray applications at 15 days interval produced the highest fruit yield of 72.18 q/ha and the lowest mean shoot and fruit infestation of 5.62%. The result of the present findings may help to orient the management strategies successfully.

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