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Sachin Harilal Pachole
Department of Entomology, Sam Higginbottom university of Agriculture, Technology and Sciences, Allahabad, U. P. India

Sasya Thakur
Department of Entomology, Sam Higginbottom university of Agriculture, Technology and Sciences, Allahabad, U. P. India

Sobita Simon
Department of Entomology, Sam Higginbottom university of Agriculture, Technology and Sciences, Allahabad, U. P. India

Correspondence
Sachin Harilal Pachole
Department of Entomology, Sam Higginbottom university of Agriculture, Technology and Sciences, Allahabad, U. P. India

Comparative bioefficacy of selected chemical insecticides and biorationals against shoot and fruit borer, (*Earias vittella* Fabricius) on okra [*Abelmoschus esculentus* (L.) Moench]

Sachin Harilal Pachole, Sasya Thakur and Sobita Simon

Abstract

The field trial was conducted at the Central field, Department of entomology SHUATS, Allahabad during *Kharif* from August to November 2016 investigation entitled "Comparative bioefficacy of selected chemical insecticides and Biorationals against shoot and fruit borer, *[Earias vittella* (Fabricius)] of okra. Seven treatments were evaluated against *Earias vittella* i.e., T_1 Spinosad 45% SC@ 0.05%, T_2 Imidacloprid 17.8% SL@ 0.3 ml/l, T_4 Neemoil@3%, T_3 *Verticilium lecanii*, T_5 *Beauveria bassiana*, T_6 NSKE 5%, T_7 Neem leaf extract 5% were evaluated against shoot and fruit borer, *Earias vittella.* The best and most economical treatment was T1 spinosad 45 SC (1:5.92), followed by T2 (1:4.87), T3 (1:4.40), T4 (1:4.65), T5 (1:4.28), T6 (1:3.84), T7 (1:3.15), as compared to control T0 (1:2.31). Spinosad 45SC, Imidacloprid 17.8 % SL, *Beauveria bassiana*, and Neem oil recorded the minimum shoot infestation by 5.01, 9.89, 11.40 and 11.85 percent respectively. In fruit infestation Spinosad 45 % SC, Imidacloprid 17.8 % SL, *Beauveria bassiana*, and neem oil recorded by 7.03, 9.00, 11.77 and 12.99 percent, respectively. The highest yield was noticed in Spinosad 45SC (197.22 q/ha) and Imidacloprid 17.8% SL (156.25 q/ha).

Keywords: Cost- benefit ratio**,** Biorationals, Chemical insecticide, Imidacloprid, *Earias vittella*.

Introduction

Okra (*Abelmoschus esculentus* L.) belongs to family Malvaceae or Mallow, which is locally known as Bhendi and Lady's finger worldwide. It is very popular summer vegetable for home gardening while it is also grown commercially throughout the world especially in Indo-Pakistan sub-continent. It is probably originated in Ethiopian region of Africa. Sustained maintenance of good health in third world countries, particularly in children food, enrichment through fruits and vegetables is necessary. India stands second in vegetable production next to China and having area of 4.98 lakh hectares with an annual production of 57.84 lakh tonnes and productivity of 11.6 tonsha^{-1}. It is also cultivated in Nigeria, Sudan, Pakistan, Ghana, Egypt, Benin, Saudi Arabia, Mexico and Cameroon). India ranks first in okra production (72% of the total world production) having area of 533 hectares with an annual production of 6346 million tonnes and productivity of 11.9 million tonsha^{-1} (source: FAO 2015) [2]. In India, Andhra Pradesh is the leading okra producing state which has production of around 1184.2 thousand tonnes from an area of 78.90 thousand ha, with a productivity of 15 tonsha-^{1}. It is followed by West Bengal 862.1 thousand tonnes from 74.00 thousand ha with 11.70 tonsha-^{1}productivity. In Uttar Pradesh area, production and productivity of okra is 12.19 ha, 148.64 tones, 12.2 metric tonnes per hectare, respectively the economic importance of okra cannot be overemphasized. Okra is considered a prized vegetable due to its high nutrient value Okra contains carbohydrate, proteins and vitamin c in large quantities. One of the important limiting factors in the cultivation of okra is insect pests. Many of the pests occurring on cotton are found to ravage okra crop. Okra is susceptible to the attack of various insects from seedling to fruiting stage as high as 72 species of insects have been recorded on okra of which, okra shoot and fruit borer *Earias vittella*, okra jassid, cut worm, white fly, aphids etc. causes significant damage to the crop. Among these okra shoot and fruit borer (OSFB), *Earias vittella* is the most serious pest which cause direct damage to tender shoots and fruits. It is reported that about 69% losses in marketable yield due to attack of this insect pest. The damage due to fruit borer accounts for nearly 22.5% in Uttar Pradesh, 25.93% to 40.91% in Madhya Pradesh (Verma *et al*., 1985**)** [6]**,** 45% in Karnataka which affects the nutritional quality and makes it unsuitable for human consumption. The adult female of okra shoot and fruit borer, *Earias vittella* lays eggs individually on leaves, floral buds and on tender fruits.

Small brown caterpillars bore into the top shoot and feeds inside the shoot before fruit formation. The shoot wilt and dry as a result the damaged plant develop branches. Later on caterpillars bore into the fruits and feed inside as a result the infested plant bears smaller and deformed pods. A larva attacks a number of stems and pods one after another. Okra is grown during summer and *Kharif* seasons. Among insect pests infesting okra, shoot and fruit borer *Earias vittella* (Fabricius) is one of the serious pests causing 40-50 per cent damage to okra fruits during both season (Srinivashan and Gowder, 1960) [5] *Earias* Spp. alone causes damage ranging from 52.33 to 70.75 percent (Pareek and Bhargava, 2009).

Therefore, the present experiment was conducted to evaluate some biopesticides along with chemical insecticides for an effective integrated management of shoot and fruit borer in okra, along with a brief study of the population dynamics of the pest.

Materials and methods

The experiment was conducted during *Kharif* season 2016 at the Central Field of "Sam Higginbottom University of Agriculture, Technology and Sciences" Allahabad, Uttar Pradesh, India, in a randomized block design with eight treatments, using variety VNR-22 (Komal) in a plot size of (2m x 1m) at a spacing of (45x30cm) with recommended package of practices excluding plant protection. For seasonal incidence of the shoot and fruit borer, the incidence was recorded in weekly interval starting from the appearance of the pest. The observation of the pests was recorded from five randomly selected plants from every plot. The data was statistically analyzed by correlation analysis between weather parameters and shoot and fruit borer. Three insecticidal sprays were administrated at 15 days interval starting from 35 days after sowing. The treatments include Spinosad 45SC @ 0.05%, Imidacloprid 17.8% SL@ 0.3 ml, *Verticilium lecanii*, Neemoil@3%, *Beauveria bassiana*, NSKE (5%), along with untreated control. The spraying was done after the population reaching its ETL. The incidence of the borer on the shoot and the fruit were recorded from the five randomly selected plants. Observations were recorded one day before spray, 3rd, 7th, 14th days after spraying. The assessment of the shoot damage was done by calculating the number of damaged shoots and total number of the healthy shoots observed from five randomly selected plants per plot and expressed in percentage. Okra fruits were harvested at weekly intervals. The percent fruit damage was total number of affected fruits from each plot. The total yield of the marketable fruits obtained from different treatments was calculated and converted by considering the additional cost (cost of insecticides and operational charges) and benefit (compared to untreated control) in the respective treatments.

Results and discussion

In case of shoot and fruit borer, all the three sprays revealed that among the biopesticides Spinosad 45S was found to be more effective followed by selected chemical insecticide (neo nicotinoid) i.e. Imidacloprid 17.8% SL among all other treatments. Treatments Neem oil, *Verticilium lecanii, Beauveria bassiana* and NSKE were at par with each other and followed next effective treatments. Neem leaf extract recorded as least effective among the treatments but significant and superior over control.

Spinosad 45SC, Imidacloprid 17.8 SL, *Beauveria bassiana*, and Neem oil recorded the minimum shoot infestation by 5.01, 9.89, 11.40 and 11.85 percent respectively. In fruit infestation Spinosad 45 SC, Imidacloprid 17.8 % SL, *Beauveria bassiana*, and neem oil recorded by 7.03, 9.00, 11.77 and 12.99 percent, respectively. cost benefit ratio was worked out, interesting result was achieved. Among the treatment studied, the best and most economical treatment was T1 spinosad 45 SC (1:5.92), followed by T2 Imidacloprid 17.8 SL (1:4.87), T4neem oil (1:4.65). From the critical analysis of the present findings, it can concluded that Biorationals and Chemical insecticides like Spinosad 45SC followed by Imidacloprid 17.8SL, Neem oil and *Verticilium lecanii* are showing good result against *Earias vittella* and can be a part of integrated pest management as an effective tool under chemical control.

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Table 1: Efficacy of selected chemical insecticides and biorationals against shoot and fruit borer (*Earias vittella*) on okra (*Abelmoschus esculentus* Moench*)* (First Spray) (35 DAS*)

% Shoot Infestation (First Spray)						
Treatments		**Before**	**3 DAS**	**7 DAS**	**14 DAS**	**Mean**
T_1	Spinosad 45 % SC	14.14	4.55	3.68	6.80	5.01
T_2	Imidacloprid 17.8 SL	13.65	6.80	10.67	11.11	9.89
T_3	Verticilium lecanii	14.89	11.86	11.94	13.12	12.31
T_4	Neem oil	13.56	11.32	11.72	12.50	11.85
T_5	Beauveria bassiana	14.80	10.50	11.50	12.20	11.40
T_6	NSKE	14.50	12.50	12.80	14.50	13.27
T_7	Neem leaf extract	13.80	12.50	14.80	16.50	14.60
T_0	Untreated	14.50	15.80	16.80	17.50	16.70
F- test		NS	S	S	S	S
S. Ed. (±)		3.372	0.885	0.767	1.400	0.747
C. D. (P = 0.05)		7.148	1.875	1.627	2.386	1.584

***** DAS- Days after spray, DAS*-Days after sowing

Table 2: Efficacy of selected chemical insecticides and biopesticides on shoot and fruit borer (*Earias vittella*) in okra (*Abelmoschus esculentus* Moench) (Second spray) at 55 DAS*

% fruit infestation (second spray)						
Treatments		**Before**	**3 DAS**	**7 DAS**	**14 DAS**	**Mean**
T_1	Spinosad45 % SC	15.50	6.56	6.85	10.50	7.97
T_2	Imidacloprid 17.8 % SL	15.10	8.50	9.20	11.50	9.73
T_3	*Verticilium lecanii*	19.50	11.50	13.50	15.80	13.60
T_4	Neem oil	18.50	11.87	12.46	14.96	13.10
T_5	*Beauveria bassiana*	17.50	10.80	11.50	13.50	11.93
T_6	NSKE	18.20	14.00	15.80	17.80	15.87
T_7	Neem leaf extract	18.61	15.20	17.80	19.80	17.60
T_0	Untreated	19.50	21.80	22.50	23.78	22.69
F- test		NS	S	S	S	S
S. Ed. (±)		3.293	0.763	0.712	0.861	0.463
C. D. (P = 0.05)		6.981	1.617	1.509	1.825	0.982

*****DAS- Days after spray, DAS*-Days after sowing

Table 3: Efficacy of selected chemical insecticides and Biorationals on shoot and fruit borer (*Earias vittella*) in okra (*Abelmoschus esculentus* Moench) (Third spray) at 75 DAS*

% Fruit Infestation (Third spray)						
Treatments		**Before**	**3 DAS**	**7 DAS**	**14 DAS**	**Mean**
T_1	Spinosad 45 %SC	10.50	3.94	4.50	9.80	6.08
T_2	Imidacloprid 17.8 %SL	11.50	6.50	7.80	10.50	8.27
T_3	*Verticilium lecanii*	15.80	9.80	10.50	12.80	11.03
T_4	Neem oil	14.96	11.20	13.20	14.20	12.87
T_5	*Beauveria bassiana*	13.50	10.50	11.50	12.80	11.60
T_6	NSKE	17.80	13.50	14.80	15.50	14.60
T_7	Neem leaf extract	19.80	16.50	17.80	20.50	18.27
T_0	Untreated	23.80	22.80	24.50	27.50	24.93
F- test		NS	S	S	S	S
S. Ed. (±)		4.460	0.927	0.888	1.115	0.669
C. D. (P = 0.05)		9.455	1.966	1.883	2.364	1.419

*****DAS- Days after spray, DAS*-Days after sowing

Table 4: Efficacy of selected chemical insecticides and Biorationals against shoot and fruit borer (*Earias vittella* Fab.) in okra (*Abelmoschus esculentus* (L.) Moench) (II &III Spray pooled mean)

% Fruit Infestation (II & III Spray)				
Treatments		**IInd spray**	**IIIrd spray**	**Overall Mean**
T_1	Spinosad 45% SC	7.97	6.08	7.03
T_2	Imidacloprid 17.8 % SL	9.73	8.27	9.00
T_3	Verticilium lecanii	13.60	11.03	12.32
T_4	Neem oil	13.10	12.87	12.99
T_5	Beauveria bassiana	11.93	11.60	11.77
T_6	NSKE	15.87	14.60	15.24
T_7	Neem leaf extract	17.60	18.27	17.94
T_0	Untreated	22.69	24.93	23.81
F- test		S	S	S
S. Ed. (±)		0.481	0.661	1.090
C. D. (P = 0.05)		1.021	1.401	2.310

Table 5: Economics of Cultivation:

S. No:	**Treatment**	**Yield of q/ha**	**Total cost of yield**	**Common cost**	**Treatment cost**	**Total cost**	**C:B ratio**
01	Spinosad 45 % SC	197.22	295830	46378	3533	49911	1:5.92
02	Imidacloprid 17.8 SL	156.25	234375	46378	1650	48028	1:4.87
03	*Verticilium lecanii*	140.22	210330	46378	1350	47728	1:4.40
04	Neem oil	149.25	223875	46378	1704	48082	1:4.65
05	*Beauveria bassiana*	136.38	204570	46378	1350	47728	1:4.28
06	NSKE	122.25	183375	46378	1312	47690	1:3.84
07	Neem leaf extract	100.2	150300	46378	1200	47578	1:3.15
08	Untreated	71.44	107160	46378	-	46378	1:2.31

Cost of yield per quintal □ 1500

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