J. Soils and Crops 35 (1) 111-115, June 2025
ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

EFFICACY OF CONVENTIONAL INSECTICIDES AND BIO-PESTICIDES AGAINST SHOOT AND FRUIT BORER OF OKRA

Marina Techi[1], Punam Bagang[2], Saxena Raviprakash Narayan[3], Yashi Umbrey[4] and Bai Koyu[5]

ABSTRACT

A field experiment was conducted in Nyorch village, Yupia, Papum Pare district of Arunachal Pradesh, during spring-summer season of 2022. The study aimed to monitor the incidence of okra shoot and fruit borer and to evaluate the effectiveness of certain biorational insecticides. Average population of shoot and fruit borer infestation was first observed to be 2.57% at 10th Standard Meteorological Week (SMW) which gradually increased and reached to its peak level by 17th SMW with an average population of 44.71% infestation. Thereafter, the population declined as temperature decreased. The population of shoot and fruit borer showed positive correlation with increasing temperature (T_{max} = 37.17). Effect of test for all the six treatments *viz.*, B.t.k (*Bacillus thuringiensis* var. *kurstaki*), Neem oil, *Verticillium lecanii, Beauveria bassiana*, Spinosad 45% SC and Emamectin benzoate 5% SG showed reduced infestation as compared to the untreated control. However, the population of shoot and fruit borer (*Earias vittella*) reduced after three sprays and revealed that the treatment Spinosad 45% SC (80.05%) was significantly the most effective insecticide to control okra shoot and fruit borer followed by Emamectin benzoate (76.99%), B.t.k (*B. thuringiensis* var. *kurstaki*) (56.90%), *B. bassiana* (48.79%), Neem oil (47.43%) and *V. lecanii* (41.73%).

(Key words: Shoot and fruit borer, okra, standard meteorological week, insecticides)

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) is locally known as Bhendi and as Lady's finger worldwide. It is believed to have originated in Ethiopian region of Africa. It belongs to the family Malvaceae and is an annual vegetable grown in tropical and subtropical regions. Okra requires a long, warm and humid growing period. It is sensitive to frost and extremely low temperatures. Higher yield of okra can be achieved through Integrated Nutrient Management practices where application of chemical fertilizer is reduced and Organic manure and biofertilizer is increased (Mal *et al.*, 2013). For normal growth and development, a temperature between 24°C and 28°C is preferred. It is grown on sandy to clay soils with a pH of 6.0 - 6.8. The shoot and fruit borer is one of the the main pests of Okra. The larva bores into shoot or fruit and start eating on internal contents causing withering of plant and reduction in marketable value of the fruit. Various insecticides like cypermethrin, endosulfan, quinalphos, imidacloprid, etc. have been recommended for the management of these pests in okra (Bhargava and Bhatnagar, 2001). During early vegetative growth period, young larva bore into the tender shoots and feeds inside resulting in wilting and drying of shoots. In the later stage, the caterpillars bore into the fruits and the infested plants bear deformed and small pods. Bore holes are plugged with excreta. The damaged fruits are rendered unfit for human consumption, as well as for seed purposes.

India employs 66% of Indians and contribute 14% GDP (Tripathi *et al.,* 2023). India has the challenging task of feeding a global population of 17.7% (Anonymous, 2021). Frequent and excessive uses of conventional insecticides for the management of these pests have often resulted in development of pesticide resistance, pest resurgence and outbreak of secondary insect pests making the treatment less effective. Therefore, there is an urgent need to use safe and effective biodegradable pesticides with less toxicity on non-target organisms. In this regard, the biologically active natural plant products such as biorationals and less toxic insecticides may play a significant role. Good agricultural practices employ biopesticides for improved yield, higher farm income, safe food and friendly environment as well

1. P.G. Student, Dept. of Entomology, Faculty of Agricultural Sciences, Rajiv Gandhi University, Rono Hills, Doimukh, Arunachal Pradesh – 791112
2. Asst. Professors, Dept. of Entomology, Rajiv Gandhi University, Rono Hills, Doimukh, Arunachal Pradesh – 791112 (Corresponding author)
3. Asst. Professors, Dept. of Entomology, Rajiv Gandhi University, Rono Hills, Doimukh, Arunachal Pradesh – 791112
4. Asst. Professor, Dept. of Plant Pathology, Faculty of Agricultural Sciences, Rajiv Gandhi University, Rono Hills, Doimukh, Arunachal Pradesh – 791112
5. Guest Faculty, Dept. of Economics, Faculty of Agricultural Sciences, Rajiv Gandhi University, Rono Hills, Doimukh, Arunachal Pradesh – 791112

(Modak *et al.*, 2023). Hence, the investigation on population dynamics of okra shoot and fruit borer and it's management using insecticides was carried out.

MATERIALS AND METHODS

The experiment was conducted in Nyorch village, Yupia, Papum Pare district of Arunachal Pradesh, during spring-summer season of 2022 in Randomized Block Design (RBD) with seven treatments including control and three replications. The okra variety F1 DADA was sown during 2nd fortnight of February in 2022. The distance between row to row and plant to plant was followed 45 cm x 30 cm and the size of the plot was 2 m x 1.5 m. All the recommended agronomic practices were followed to raise healthy crops from each plot. To assess the incidence of okra shoot and fruit borer (*Earias vitella*), the number of larvae plant^{-1} were counted and recorded at weekly intervals on 25 randomly selected plants. The daily weather data, starting from 12th March 2022 to 14th May 2022, on weather variables such as minimum and maximum temperatures, morning and evening relative humidity, rainfall, evaporation, bright sunshine hours were correlated with the mean larval population using the Pearson's correlation coefficient;

$$r = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2]\,[N\Sigma Y^2 - (\Sigma Y)^2]}}$$

Where,

r= Simple correlation coefficient

x = Independent variable i.e., abiotic component

y= Number of observations

N= Dependent variable i.e., pest

Efficacy of conventional insecticides and bio-pesticides

The six treatments including control namely B.t.k *(Bacillus thuringiensis* var. *kurstaki*), Neem oil, *Verticillium lecanii, Beauveria bassiana*, Spinosad 45% SC and Emamectin benzoate 5% SG were tested against shoot and fruit borer of okra. All the treatments were given as a foliar spray by using knapsack sprayer. The application of the treatments was initiated after the population of okra shoot and fruit borer reached Economic Threshold Level i.e., 5.3% infestation (35 DAS). The treatments were applied 3 times, first just after the occurrence of pests and the second, third and fourth thereafter at 15 days intervals. The infested shoots and fruits were recorded at the weekly interval from 5 randomly selected plants from each plot using the following formula:

$$\text{Per cent shoot infestation} = \frac{\text{No. of infested shoots}}{\text{Total no. of shoots}} \times 100$$

$$\text{Per cent shoot infestation} = \frac{\text{No. of infested fruits}}{\text{Total no. of fruits}} \times 100$$

RESULTS AND DISCUSSION

The data on population of shoot and fruit borer was recorded at weekly intervals from 12th of March 2022 (9th Standard Meteorological Week, SMW) to 14th of May 2022 (18th SMW) are presented in Table 1. The highest pest population was observed as 44.71 during 7th of May (17th SMW) when the temperature was T_{max} 37.17^{0}C and T_{min} 20.37^{0}C, relative humidity (RH morning 77.42% and RH evening 35.00%), rainfall (0 mm), evaporation (5.8 mm) and sunshine hours (10.11 hrs). While the lowest population was recorded with 2.57 on 19th of March (10th SMW) when the weather conditions were as T_{max} (30.4^{0}C) and T_{min} 17.51^{0}C, RH morning 92.71%, RH evening 66.85%, rainfall 0 mm, evaporation 3.08 mm and sunshine hours (8.55 hrs).

The populations of *E. vittella* showed highly significant and positive correlation to T_{max}, T_{min} and evaporation (r = 0.842** r = 0.860** and r = 0.979**). The morning RH showed highly significant negative correlation (r = -0.797**). The evening RH (r = -0.683*) had significantly negative correlation. The rainfall had shown non-significant positive correlation (r = 0.393NS) and sunshine had shown non-significant negative correlation (r = -0.132NS). It indicates that when the temperature is increased, the shoot and fruit borer infestation is also increased. The results were in accordance with Dhandge *et al.* (2018), who reported that the population of okra shoot and fruit borer showed a significant positive correlation with maximum and minimum temperature while negatively correlating with bright sunshine as sunny days with low relative humidity is unfavourable for the growth of insect. Kumar and Singh (2021) also obtained similar results *i.e*., positive correlation with maximum and minimum temperature and relative humidity (r = 0.512, 0.286 and 0.217, respectively).

Efficacy of conventional insecticides and bio-pesticides

The results of conventional insecticides and bio-pesticides on okra against shoot and fruit borer on 3rd, 7th and 14th day after each spray are documented in Table 3.

Pre-spray count

The population of shoot and fruit borer in okra crop prior to application of treatments extended from 13.72 to 15.68.

First spray

On 3rd day after first spray, the population varied from the lowest 4.33 (spinosad 45% SC) to the highest of 16.71 (in untreated control). Among all the treatments, spinosad 45% SC treatment was significantly most effective to reduce the population of okra shoot and fruit borer followed by Emamectin benzoate, Neem oil, *B. thuringiensis*, *B. bassiana* and *V. lecanii*. Seven days after first spray, the shoot and fruit borer population in the treatment with spinosad 45% SC was the minimum with 3.78 followed by Emamectin benzoate, *B. thuringiensis, B. bassiana*, Neem oil and *V. lecanii*. The peak population was recorded in untreated control with 18.38. Fourteen days after first spray, the shoot and fruit borer population in the treatment with spinosad 45% SC was the least with 5.02. The peak population was recorded in untreated control with 20.01.

Second spray

Three days after second spray, the population of shoot and fruit borer in the treatment with spinosad 45% SC

Table 1. Influence of weather parameters on the population of okra shoot and fruit borer, *Earias vittela*

SMW	Date	Weather parameters				Rainfall (mm)	Evaporation (mm)	Bright sunshine (hr.)	% Pest infestation
		Temperature (^{0}C)		Relative humidity (%)					
		Max.	Min.	Morn.	Even.				
9	12- March	29.41	15.51	85.37	54.50	0	3.15	9.51	0
10	19- March	30.40	17.51	92.71	66.85	0	3.08	8.55	2.57
11	26- March	30.40	17.45	88.00	54.00	0	2.81	6.86	7.12
12	02- April	34.05	18.82	79.71	40.57	0	3.82	8.40	16.65
13	09- April	34.48	16.67	87.42	42.42	0	4.34	8.06	22.35
14	16- April	35.52	18.97	81.14	43.28	0	5.14	8.97	39.18
15	23- April	36.51	20.31	78.71	41.14	0	5.37	6.30	43.23
16	30- April	34.34	20.00	78.14	41.00	0.11	5.45	7.21	38.10
17	07- May	37.17	20.37	77.42	35.00	0	5.80	10.11	44.71
18	14- May	32.27	21.42	81.42	53.71	0.28	5.37	7.67	41.26

Table 2. Correlation coefficient between population of shoot and fruit infestation in Okra with weather parameters during Spring-Summer 2022

Season	Weather parameter	Correlation coefficient (r) Pest infestation (%)
Spring-Summer 2022	Max. Temp (^{0}C)	0.842^{**}
	Min. Temp (^{0}C)	0.860^{**}
	Morning RH (%)	-0.797^{**}
	Evening RH (%)	-0.683^{*}
	Rainfall (mm)	0.393^{NS}
	Evaporation	0.979^{**}
	Sunshine	-0.132^{NS}

Note: *Level of significance P = 0.01
**Level of significance P = 0.05

Table 3. Influence of different spray schedule of insecticides on the infestation of okra shoot and fruit borer

Treatments	Pre-count	1st Spray			2nd Spray			3rd Spray			Pooled Mean	Per cent reduction over control (%)
		3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS		
B. t. k (*Bacillus*	14.06	11.12	12.90	8.76	6.43	9.44	12.42	8.62	6.21	9.15	9.46	56.90
***thuringiensis*)**	(3.75)	(3.33)	(3.59)	(2.96)	(2.54)	(3.07)	(3.52)	(2.94)	(2.49)	(3.02)		
Neem oil	14.42	10.91	13.26	10.98	8.71	12.65	14.13	10.23	12.64	10.36	11.54	47.43
	(3.80)	(3.30)	(3.64)	(3.31)	(2.95)	(3.56)	(3.76)	(3.20)	(3.56)	(3.22)		
Verticilium lecanii	13.72	12.34	14.73	11.82	10.01	11.72	13.72	11.91	13.72	15.17	12.79	41.73
	(3.70)	(3.51)	(3.84)	(3.44)	(3.16)	(3.42)	(3.70)	(3.45)	(3.70)	(3.89)		
Beauveria bassiana	14.97	11.72	13.14	9.16	7.91	10.31	12.10	9.63	12.91	14.24	11.24	48.79
	(3.87)	(3.42)	(3.62)	(3.03)	(2.81)	(3.21)	(3.48)	(3.10)	(3.59)	(3.77)		
Spinosad 45% SC	15.68	4.33	3.78	5.02	3.56	5.79	3.95	5.39	4.06	3.54	4.38	80.05
	(3.96)	(2.08)	(1.94)	(2.24)	(1.89)	(2.41)	(1.99)	(2.32)	(2.01)	(1.88)		
Emamectin benzoate	15.28	5.86	4.21	6.64	5.14	7.23	5.21	5.78	2.74	2.68	5.05	76.99
5% SG	(3.91)	(2.42)	(2.05)	(2.58)	(2.27)	(2.69)	(2.28)	(2.40)	(1.66)	(1.64)		
Control	13.81	16.71	18.38	20.01	21.28	23.53	25.02	26.67	27.30	18.62	21.95	
	(3.72)	(4.09)	(4.29)	(4.47)	(4.61)	(5.05)	(5.00)	(5.16)	(5.22)	(4.32)		
SE(m) ±	1.02	0.78	0.62	0.67	0.62	0.52	0.52	0.78	0.63	0.30		
CD at 5%	-	2.34	1.86	2.01	1.85	1.56	1.55	2.33	1.87	0.90		

Note: Figures in parenthesis are square root transformed values, DAS- Days after spray was the minimum with 3.56 followed by emamectin benzoate, *B. thuringiensis*, *B. bassiana*, neem oil and *V. lecanii*. The untreated control plot had shown the maximum population of 21.28. Seven days after second spray, the population of shoot and fruit borer in the treatment with spinosad 45% SC was the lowest with 5.79 followed by emamectin benzoate, *B. thuringiensis*, *B. bassiana*, *V. lecanii* and neem oil. The untreated control plot had shown the maximum population of 23.53. Fourteen days after second spray, the population of shoot and fruit borer in the treatment with spinosad 45% SC was the lowest with 3.95 followed by emamectin benzoate, *B. bassiana*, *B. thuringiensis*, *V. lecanii* and neem oil. The untreated control plot had shown the maximum population of 25.02.

Third spray

Three days after third spray, the population of shoot and fruit borer in the treatment with spinosad 45% SC was the minimum with 5.39 followed by emamectin benzoate, *B. thuringiensis*, *B. bassiana*, neem oil and *V. lecanii*. The untreated control plot had shown maximum population with 26.67. Seven days after third spray, the shoot and fruit borer population in the treatment with emamectin benzoate 5% SG was the least with 2.74 followed by spinosad, *B. thuringiensis*, neem oil, *B. bassiana*, and *V. lecanii*. The untreated control plot had recorded the maximum population of 27.30. Fourteen days after third spray, the shoot and fruit borer population in the treatment with emamectin benzoate 5% SG was the minimum with 2.68 followed by spinosad, *B. thuringiensis*, neem oil, *B. bassiana*, and *V. lecanii*. The untreated control plot had shown the maximum population of 18.62.

The effect of all the conventional insecticidal and bio-pesticidal treatments was significantly superior to untreated control. Spinosad 45% SC (80.05%) was significantly most effective to reduce the population of okra shoot and fruit borer followed by Emamectin benzoate (76.99%), *B. thuringiensis* (56.90%), *B. bassiana* (48.79%), Neem oil (47.43%) and *V. lecanii* (41.73%).

Our findings corroborate with Devi *et al.* (2014) where Spinosad 45% SC treatment had significantly minimum shoot and fruit infestation of 5.62% followed by Chlorfenapyr, Emamectin benzoate 5% SG, *B. thuringiensis, B. bassiana, V. lecanii* and neem oil. Also results by Choudhury *et al.* (2021) showed that the rate of shoot and fruit infestation was the lowest in the Spinosad-treated plot (3.80%) and was the highest in the control plot (20.67%). Gosalwad and Kawathekar (2009) found minimum fruit infestation (5.56%) with the application of Spinosad 45 SC followed by Abamectin 1.9 EC (7.25%).

From the present investigation, it can be inferred that the incidence of *E. vitella* was first recorded during 10th SMW which gradually increased and reached to its peak level by 17th SMW with an average population of 44.71% infestation. Thereafter, the population declined as temperature decreased. Correlation studies revealed that the populations of *E. vittella* showed highly significant and positive correlation to T_{max}, T_{min} and evaporation while the morning and evening RH showed significant negative correlation with shoot and fruit borer damage. It indicates that when the temperature is increased, the shoot and fruit borer infestation is also increased. Also, Spinosad outperformed other conventional insecticides and bio-pesticides in terms of overall effectiveness against okra shoot and fruit borer. All treatments outperformed the untreated control plot. Indiscriminate and injudicious use of chemical insecticides has caused many environmental hazards. Therefore, judicious use of insecticides that have low toxicity to non-target organisms and environment can effectively be used to manage insect pests.

REFERENCES

Anonymous, 2021. MoSPI., (https://statisticstimes.com/demographics/couy/india-population.php)

Bhargava, K.K. and A. Bhatnagar, 2001. Bioefficacy of imidacloprid as a seed dresser against sucking pests of okra. Pest Manag. Econ. Zoo. **9**(1):31–34

Choudhury, M., A. Razzak, M. Mondal, A. U. Khan, M. Hossain, M.O.K. Azad and M.T. Naznin, 2021. Evaluation of biological approaches for controlling shoot and fruit borer (*Earias vitella* F.) of okra grown in Peri-Urban area in Bangladesh. Hort. **7**(1): 7.

Devi, L.L., T.M. Ghule, A.K. Senapati and M.L. Chatterjee, 2014. Comparative efficacy of some biorational insecticides for management of shoot and fruit borer (*Earias vittella* Fab.) on okra. Indian Jr. Appl. Res. **4**(9): 7-10.

Dhandge, S.R., K.D. Shah, J. Dulera and V.R. Virani, 2018. Seasonal Incidence of Okra Shoot and Fruit Borer and its Relation with Weather Parameters. Int. J. Agric. Sci. **10**(14): 6654-6656.

Gosalwad, S.S. and B.R. Kawathekar, 2009. Efficacy of insecticides against okra fruit borer (*Earias vittella* Fabricius). J. Plant Prot. Res. **6**(2): 59-63.

Kumar, R. and P.P. Singh, 2021. Population Dynamics of Shoot and Fruit Borer *Earias Vitella* on Okra. Indian J. Entomol. **83**(4): 680-682.

Mal, B., P. Mahapatra, S. Mohanty and H.N. Mishra, 2013. Growth and yield parameters of Okra (*Abelmoschus esculentus*) influenced by Diazotrophs and Chemical fertilizers. J. Agri. Sci. **76**(8): 477-480.

Modak, M.K., R. Mallick and S.K. Das, 2023. The Effect of Improved Agricultural Practice on Soil Nutrient Status and Some Beneficial Microbial Status in Rice-Lentil-Okra Cropping System in Gangetic Alluvial Zone of West Bengal. J. Soils and Crops, **33**(2): 433-437.

Tripathi, G., R. Saini, S. Kanga, S.K. Singh and P. Roy, 2023. Estimation of wheat crop acreage, health and yield using remote sensing and GIS techniques in Alwar district of Rajasthan. J. Soils and Crops, **33**(1): 30-39.

Rec. on 28.08.2024 & Acc. on 12.09.2024