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Nikhil Lella
Department of Entomology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Anoorag R Tayde
Assistant Professor, Department of Entomology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Kommoji Phani Sai
Ph.D. Scholar, Department of Entomology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Nikhil Lella
Department of Entomology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Comparative efficacy of insecticides, NSKE and karanj oil against shoot and fruit borer, *Earias vittella* (Fabricius.) on okra

Nikhil Lella, Anoorag R Tayde and Kommoji Phani Sai

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Abstract
A field trail was conducted at Central Research Farm, SHUATS, Naini, Prayagraj, U.P, during *kharif* season of 2021. The field was laid in Randomised block Design with seven treatments replicated thrice *viz,* Neem oil 3%, Indoxacarb 14.5% SC, Lambda cyhalothrin 5% EC, NSKE 5%, Emamectin benzoate 5SG, Karanj oil 2%, Flubendiamide 480 SC along with control plot. The results after first and second revealed that among the different treatments, Emamectin benzoate 5SG (10.82% and 11.64%) recorded lowest percent infestation of *Earias vittella* followed by Flubendiamide 480 SC (15.92% and 17.25%), Indoxacarb 14.5SC (17.06% and 18.45%), Lambda cyhalothrin 5% EC (18.13% and 18.52%), Neem oil 3% (20.44% and 20.69%), NSKE 5% (21.44% and 21.12%) and Karanj oil 2% (24.16% and 23.61) was the least effective among all treatments with percent shoot and fruit infestation respectively. Among all treatments studied, the best and most economical treatment was Emamectin benzoate 5SG (1:5.60), Flubendiamide 480 SC (1:5.44), Indoxacarb 14.5SC (1:5.33), Lambda cyhalothrin 5% EC (1:5.08) followed by Neem oil 3% (1:4.89), NSKE 5% (1:4.81) and the least cost benefit ratio was observed in Karanj oil 2% (1:4.66) when compared to control plot (1:2.82).

Keywords: Botanicals, *Earias vittella,* Emamectin benzoate, Flubendiamude, Karanj oil, NSKE, Okra

Introduction

Okra (*Abelmoschus esculentus* L.) belongs to family Malvaceae, 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 and is one of the most common and popular vegetable grown in tropical and subtropical regions in India. (Pachole *et al.*, 2017) [8].

Okra fruits are considered as good source of protein besides carbohydrates, minerals and fats. Its fruits and fibre from stall are used in paper industry. The nutritive value of okra/100g of edible portion contains carbohydrates (1.5%), protein (2.0g), total fat (0.1g), dietary fibre (9%), folates (88mcg), niacin (1.00mg), pantothenic acid (0.245mg), riboflavin (0.060 mg).thiamine (0.200 mg), vitamin C (21.1mg), vitamin A (375 IU), vitamin E (0.36mg), vitamin K (53mcg), sodium (8mg), potassium (303mg), calcium (81mg), copper (0.094mg), iron (0.80 mg), magnesium (57 mg), phosphorus (63mg), selenium (0.7mcg), zinc (0.60mg).carotene (225mcg) and lutein and zeaxanthin (516mcg). (Source: USDA National Nutrient data base, 2021) [12].

Globally India ranks first in okra production of around 5794.0 thousand tonnes (72% of total world production) having area of 564.0 thousand hectares with an annual production of 6371 thousand million tonnes and productivity of 12.9 million tonnes/ha. Andhra Pradesh is the leading okra producing state which has production of around 884.2 thousand tonnes from an area of 79.90 thousand hectares, with a productivity of 15 tonnes/ha.

Kamble *et al.*, (2014) [4] reported shoot and fruit borer infestation on okra as 32.14 percent on number basis and 31.31 percent on weight basis. The adult female of okra shoot and fruit borer, *Earias vitella* 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 and the shoot will become wilted and dry. 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 seasons (Srinivasan and Gowder, 1960) [11].

Materials and Methods

The experiment was conducted during kharif season 2021 at Central Research Farm, SHUATS, Naini, Prayagraj, Uttar Pradesh, India, in a Randomized Block Design with seven treatments along with controlled plot replicated three times using variety Kasturi in a plot size of (2mx2m) at a spacing of (45x30cm) with a recommended package of practices excluding plant protection. The soil of the experimental site was well drained and medium high. The climate of the experimental site is sub-tropical characterized by normal rainfall. Research field is situated at an elevation of 98 meters above sea level at 25°87" North latitude and 80°05" East longitudes. The extremes of both summer and winter are experienced while the minimum temperature in winter was 4 °C and the maximum temperature reaches up to 45 °C in summer.

The observations on infestation of *Earias vitella* were record visually per plant from five randomly selected plants and tagged plants in each plot. The insecticides were sprayed at recommended doses when percent infestation reaches ETL (5% fruit infestation) level. Number of infested shoots and fruits from 5 randomly selected plants per plot was counted and recorded at weekly interval after careful examination on the presence of borer and excreta at both vegetative and reproductive stage, which was further converted into percent infestation. Observations were recorded on the number of infested shoots and fruits in each plot a day on 3rd, 7th and 14th days after spraying on selected plants in a plot.

The healthy marketable yield obtained from different treatments was collected separately and weighed. The cost of insecticides used in this experiment was recorded during season of 2020-2021. The cost of botanicals used was obtained from nearby market. The total cost of plant protection consisted of cost of treatments, sprayer rent and labour charges for the spray. There were two sprays throughout the research period and the overall plant protection expenses were calculated. Total income was realized by multiplying the total yield per hectare by the prevailing market price, while the net benefit is obtained by subtracting the total cost of plant protection from total income. Benefit over the control for each sprayed treatment was obtained by subtracting the income of the control treatment from that of each sprayed treatment.

Results and Discussion

Efficacy of different insecticides on the percent infestation of okra shoot and fruit borer showed that all the treatments were significantly superior in reducing the infestation of shoot and fruit borer resulting in increasing the yield, significantly as compared to control. On third day after spray lowest percent infestation of 8.77 was recorded in Emamectin benzoate 5SG followed by Flubendiamide 480 SC (15.18) and Indoxacarb 14.5SC (15.39) treated plots, respective that differed significantly with other treatment plots but statistically at par with each other. The lowest percent infestation was recorded in Emamectin benzoate 5SG (10.64 and 13.06) treated plots followed by Flubendiamide 480 SC (15.84 and 16.72) and Indoxacarb 14.5SC (16.77 and 19.02) respectively on 7th and 14th day after spray. (Table 1).

Emamectin benzoate 5SG treated plots recorded lowest percent infestation in all observations on 3rd, 7th and 14th day after spray with 10.53, 12 and 12.4 followed by Flubendiamide 480 SC (16.33, 16.77 and 18.64). These results are supported by Sandip *et al.*, (2007) [9] and Govindan *et al.*, (2012) [2], reported that Emamectin benzoate 5SG proved superior over other insecticides in reducing percent infestation of okra shoot and fruit borer. Ameta *et al.*, (2010) [1] found Flubendiamide 480 SC as the most effective treatment.

The yields among the treatments were significant. The highest yield was recorded in Emamectin benzoate 5SG (138.5q/ha), followed by Flubendiamide 480 SC (135.6 q/ha), Indoxacarb 14.5SC (132.84 ha), Lambda cyhalothrin 5% EC (124.9q/ha), Neem oil 3% (121.7q/ha), NSKE 5% (118.3 q/ha) and Karanj oil 2% (109.2 q/ha) as compared to control plot (67q/ha). These findings are supported by Sandip *et al.*, (2007) [9], Nilam and Patel (2012) [7], and Govindan *et al.*, (2012) [2]. Among the treatments studied, the best and most economical treatment was Emamectin benzoate 5SG (1:5.60), followed by Flubendiamide 480 SC (1:5.44), Indoxacarb 14.5SC (1:5.33), Lambda cyhalothrin 5% EC (1:5.08), Neem oil 3% (1:4.89), NSKE 5% (1:4.81) and Karanj oil 2% (1:4.66) as compared to control plot (1:2.82). These findings are supported by Shridhara *et al.*, (2018) [10], Jat and Ameta (2013) [3] and Lal *et al.*, (2008) [5].

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Table 1: Efficacy of insecticides, NSKE and karanj oil on percent shoot and fruit infestation of shoot and fruit borer on okra

Sr. No.	Treatments	Percent shoot and fruit infestation of shoot and fruit borer on okra						Yield (q/ha)	B:C Ratio
		First spray			Second spray				
		3 DAS	7 DAS	14 DAS	3DAS	7 DAS	14 DAS		
T_1	Neem oil 3%	21.05^{b}	19.42^{cd}	20.84^{cd}	21.61^{b}	19.93^{bc}	20.52^{cd}	121.7	1:4.89
T_2	Indoxacarb 14.5% SC	15.39^{c}	16.77^{de}	19.02^{de}	17.00^{c}	19.14^{cd}	19.21^{d}	132.8	1:5.33
T_3	Lambda cyhalothrin 5% EC	17.6^{c}	18.36^{cde}	18.43^{de}	18.03^{c}	18.09^{cd}	19.45^{cd}	124.9	1:5.08
T_4	NSKE 5%	21.29^{b}	19.78^{c}	23.24^{bc}	21.69^{b}	19.98^{bc}	21.7^{c}	118.3	1:4.81
T_5	Emamectin Benzoate 5% SG	8.77^{d}	10.64^{f}	13.06^{f}	10.53^{d}	12.00^{e}	12.4^{e}	138.5	1:5.60
T_6	Karanj oil %	23.86^{ab}	23.63^{b}	25.00^{b}	23.82^{b}	22.45^{b}	24.55^{b}	109.2	1:4.66

T_7	Flubendiamide 480 SC	15.18[c]	15.84[e]	16.72[e]	16.33[c]	16.77[d]	18.64[d]	135.6	1:5.44
T_0	Control	25.91[a]	28.27[a]	29.27[a]	33.36[a]	34.6[a]	36.82[a]	67	1:2.82
	F-test	S	S	S	S	S	S	…..	…..
	S. Ed (±)	1.03	0.91	0.94	1.16	0.87	0.79	…..	…..
	C.D. (P = 0.5)	3.13	2.75	2.84	3.53	2.65	2.41	…..	…..

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