Original Research Article

"Efficacy of selected insecticides against shoot and fruit borer, *Eariasvittella*(Fabricius.) on okra"

ABSTRACT

A field experiment was conducted in *Kharif*season of 2022 at CentalResearch Farm (CRF), SHUATS, Uttar Pradesh, India. The experiment was laid in Randomised Block Design with seven treatments each replicated thrice viz.,Indoxacarb 14.5% SC (T1), Deltamethrin 2.8% EC (T2), Karanjin oil (T3), *Metarhiziumanisopliae* $1*10^8$ CFU (T4), Neem oil 5% (T5), Emamectin benzoate 5% SG (T6), Spinosad 45% SC (T7) and control plot (T8). The data on percent infestation of *Eariasvittella* after first and second spray revealed that all the treatments were significantly superior over control. Among all treatments, Deltamethrin 2.8% EC (17.745% & 13.608 %) recorded lowest percent infestation of *Eariasvittella*, followed by Emamectin benzoate 5% SG (18.837% &15.777%), Spinosad 45% SC (19.610% & 16.565%), Indoxacarb 14.5% SC (20.092% & 18.147%), Neem oil 5% (20.602% &18.900%), Karanjin oil 5% (22.080% & 21.639%), *Metarhiziumanisopliae* $1*10^8$ CFU (22.710% & 21.837%) was the least effective among all treatments with percent shoot and fruit infestation respectively. While, the highest yield 129 q/ha was obtained from the treatment Deltamethrin 2.8% EC as well as B:C ratio (1:5.45)obtained high from this treatment. It was followed by Emamectin benzoate 5% SG (1:5.31), Spinosad 45% SC (1:5.19), Indoxacarb 14.5% SC(1:4.93), Neem oil 5% (1:4.76), Karanjin oil 5% (1:4.64) and *Metarhiziumanisopliae* $1*10^8$CFU(1:4.58), as compared to control plot (1:3.01).

Keywords: Botanicals,*Eariasvittella*,Deltamethrin,Emamectin benzoate, Karanjin oil, *Metarhiziumanisopliae* $1*10^8$CFU , Okra.

1.Introduction

Okra[*Abelmoschusesculentus*L.]anativeofSouth-Africaandcommonlyknownas'Bhendi', is an annual malvaceous vegetable crop, especially grown in tropical and subtropicalclimates.Itisverypopularsummervegetableforhomegardeningwhileitisalsogrowncommercially throughout the world especially in Indo-Pakistan sub- continent. It is cultivated a

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lostthroughout the year except one or two cold months, due to favorable climatic conditions for itscultivation, Particularly in states of Uttar Pradesh, Madhya Pradesh, Karnataka and Maharashtra.The production of okra is mostly taking out in all over in India. There are a nine species of okrawhich are cultivated in India *i.e. Abelmoschusangulosus, Abelmoschuscancellatus, Abelmoschuscriniturs, Abelmoschusficulneus, Abelmoschusmanihottetraphyllus, Abelmoschusmanihot*spp.*,tetraphyllus*var. *Pungens, Abelmoschusmoschatus*spp. *moschatus, Abelmoschusmoschatus*spp.*tuberosus***.**

Indiaisthe second largest producer of vegetables after China. Majority ofIndians arevegetarian, with a per capita consumption 135 g per day as against the recommended 300 g per day.It isstill veryless than recommendeddiet level**(Dhandapani*et al.*, 2003)[2].**

Vegetables possess high nutritive value, supply vitamins and minerals which are deficient inother food materials. Okra is rich source of vitamins, minerals and other nutritive ingredients. It'sseeds containing good quality edible oil and high protein which are used to complement otherprotein. Okra pod contains mucilage, which is comprised of mixture of pectin and carbohydrates,which is used as thickener in food industries. The predominant elements found in this vegetable areK, Mg, Na, Ca, Fe, etc. Fresh fruits contain water (90.17 g), carbohydrate (703 g), protein (2 g),calcium (81 mg), sugars (1.20 g), phosphorus (0.04 mg), iron (0.0051mg), dietary fiber (3.2 g), fat(0.10 g), vitamin A-58 IU, vitamin B-63 IU and vitamin C16 mg/100g. **(source: USDA NationalNutrient data base, 2021)[21].** It also contains iodine and potash. In addition, mucilaginous extract ofgreen stemofokra is usedfor clarifyingsugarcanejuiceinjaggerypreparation.

GloballyIndiaranksfirstinokraproduction5794thousandtons(72%oftotalworldproduction) having area of 564 thousand hectares with an annual production of 6371 thousandmillion tons and productivity of 12.9 million tons / ha. The crop is grown throughout India,Andhra Pradesh is the leading okra producing state which has production of around 884.2 thousandtons from an area of 79.9 thousand ha, with a productivity of 15 tons / ha. It is followed by westBengal(862.1thousandtonsfrom74thousandwith11.7tons/haproductivity**.**InUttarPradesh,area, production and productivity of okra is 48.2 thousand ha, 177.26 thousand tones, 8 tons/harespectively.**(NHB 2021-22)[13].**

Of the various reasons for low productivity, heavy damage inflicted by insect pests is a keylimiting factor. **(Nayar*et al.*, 1976)[14]**reported more than three dozen insect pests are attacking okra.Among these pest's fruitborer,*E.vittella*(Fab.)andjassid*Abiguttulabiguttula*Ishidaaremajorbioticconstraintstowards

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achievingthepotentialyield.Okra crop also suffers damage by other insect pests *viz*., theaphid,*Aphisgossypii*Glover;thefruitborers. *Helicoverpaarmigera*Hub.; whitefly, *Bemisiatabaci*Genn.;and red spider mite, *Tetranychuscinnabaris*that appears occasionally. Infestation by sucking insectpests hampers crop growth apart from transmitting pathogenic diseases.

Okra is grown during summer and *Kharif*seasons. Among insect pests infesting okra, shootand fruit borer, [*Eariasvittella*(Fabricius)] is one of the serious pests causing 40-50 percent damageto okra fruits during both season *Earias*spp. alone causes damage ranging from 52.33 to 70.75percent**(PareekandBhargava, 2009)[16].**

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. *Eariasvittella*layseggsindividuallyonleaves,floralbudsandontenderfruits.Smallbrown caterpillars bore into the top shoot and feeds inside the shoot before fruit formation. Theshoot wilt and dry as a result the damaged plant develops branches. Later on caterpillars bore into thefruits and feed inside as a result the infested plant bears smaller and deformed pods. A larva attacksa number of stems and pods one after another. Damaged plant tissues serve as entrance for diseasecausing microorganisms such as fungi. The moth is yellow green and having a narrow light longitudinal green band in the middle of forewing. The damage due to fruit borer accounts nearly 22.5% in Uttar Pradesh; 25.93% to 40.91% in Madhya Pradesh, 45% in Karnataka.

OBJECTIVES

1.Toevaluatetheefficacyof selected insecticidesagainstshootandfruit borer, *Eariasvittella*(Fabricius.)on okra during kharif season 2022.

2.ToCalculateCost–Benefitratio[B:Cratio]oftreatments

2.MATERIALS AND METHODS

The experiment was conducted during *kharif*season 2022 at Central Research Farm(CRF), Uttar Pradesh, India, in a randomized block design with eight treatments replicated threetimes using variety ArkaAnamika in a plot size of (2m×1m) at a spacing of (45×30cm) with arecommended package of practices excluding plant protection. The soil of the experimental site iswelldrainedand medium high. The climate of the experimental site is sub-tropical characterized by normal rainfall. Theexperiment was conducted at Central Research Farm (CRF), Uttar Pradesh, during the *kharif*season of 2022-23. Prayagraj is situated at an elevation of 78 meters above sea level at 25.87 Northlatitude and 81.15° E longitudes. This region has a sub-tropical climate prevailing in the South-Eastpart of U.P. with both the extremes in temperature, i.e., the winter and the summer. In cold winters,thetemperaturesometimesislowas32°FinDecember-Januaryandveryhotsummerwithtemperature reaching up to 115°F in the months of May and June. During winter, frosts and duringsummer, hot scorching winds are also not uncommon. The average rainfall is around 1013.4(cm)withmaximumconcentrationduringJulytoSeptembermonths with occasional showersinwinters.

"The observations on infestation of *Eariasvittella* were recorded 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% of shoot damage and 10% fruit damage) level" Shirale*et al*. Number of infested shoots and fruits from 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 7th nand 14th days after spraying on selected plants in a plot.

The following insecticides used in this field trail are Indoxacarb 14.55 SC @ 0.25ml/L, Deltamethrin 2.8%EC @ 1.25ml/L, Karanjin oil 5% @ 5ml/L, Metarhiziumanisopliae(1×10^{8}CFU) @ 4g/L, Neem oil 5% @ 5ml/L, Emamectin benzoate 5%SG @ 0.25g/L, Spinosad 45%SC @ 0.4ml/L along with control plot. The basal application of fertilizers was done manually and

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insecticides were applied with the help of knapsack sprayer by considering ERTL level for making spray decisions.

The healthy marketable yield obtained from different treatments was collected separately from different teretments was collected seperatwely and weighed. The cost of insecticides used in this experiment was recorded during kharif season of 2022. The cost of botanicals used was obtained from near by market. The total cost of plant protection consisted of cost of tgreatments, 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 eachsprayed treatment was obtained by subtracting the income of the control treatment from that of each sprayed treatment.

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2.1 Data Analysis:

Percentshootinfestation:

$$\text{Percentshootdamage} = \frac{\text{Numberofinfested shoots} \times 100}{\text{Total numberofshoots}}$$

Percentfruitinfestation:

$$\text{Percentfruitdamage} = \frac{\text{Numberofdamagedfruits} \times 100}{\text{Total numberof fruits}}$$

Benefit cost Ratio :

Benefit cost ratio = Gross Returns /Total cost incurred

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 7th and 14thdays after first spray lowest percent infestation was recorded in Deltamethrin 2.8% EC (17.300 and 18.190) followed by Emamectin benzoate 5%SG (18.333 and 19.340) and Spinosad 45%SC (19.597 and 19.623) treated plots respectively that differed significantly with other treatment plots but statistically at par with each other(Table 1).

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Deltamethrin2.8%EC treated plots recorded the lowest percent infestation in all observations on 7th and 14thdays after second spray with (13.803 and 13.413) followed by Emamectin benzoate 5%SG (16.437 and 15.117) and Spinosad 45%SC (16.883 and 16.247).These results are supported by **Mane (2007)[9]** and**Shinde*et al.*, (2007)[19],**reported that Deltamethrin 2.8% EC proved superior over other insecticides in reducing percent percent infestation of okra shoot and fruit borer. **Govindan*et al.*, (2013)[3] and Shyamrao*et al.*, (2018)[20]**, found Emamectin benzoate5%SG as the most effective treatment.

The yields among the treatments were significant. The highest yield was recorded in Deltamethrin 2.8%EC (129 q/ha) followed by Emamectin benzoate 5%SG (126 q/ha), Spinosad 45% SC (123.33 q/ha), Spinosad 45%SC (123.33 q/ha), Indoxacarb 14.5%SC (117.5 q/ha), Neem oil 5% (113.33 q/ha), Karanjin oil 5%(110.17q/ha) and Metarhiziumanisopliae 1*10^{8}CFU (106.91q/ha) as compared to the control plot (68.33 q/ha). These findings are supported by**Shinde*et al.*, (2011)[19], Sandip*et al.*, (2007)[18], Maurya*et al.*, (2014)[11],Madhuri and Kumar (2022)[8], Rani andKumar (2022)[17].**

Among the treatments studied, the best and most economical treatment was Deltamethrin 2.8%EC (1:5.45), followed by Emamectin benzoate 5%SG (1:5.31), Spinosad 45%SC (1:5.19), Indoxacarb 14.5%SC (1:4.93), Neem oil 5% (1:4.76), Karanjin oil 5% (1:4.64) and Metarhiziumanisopliae 1*10^{8} CFU (1:4.58), as compared to control plot (1:3.01). These findings are supported by**Shinde*et al.*, (2011)[19], Lachattiwar and Meena (2014)[7], Dhaka *et al.*, (2016)[1], Kaveri and Kumar (2020)[5], Kulkarni andKumar (2022)[6] and Manikanta and Kumar (2022)[10].**

Table 1: Efficacy of insecticides, NSKE and karanj oil on percent shoot and fruit i

S.No.	Treatments	Percent shoot and fruit infestation of shoot and fruit borer on okra				Yield (q/ha)	B:C Ratio
		First spray		Second spray			
		7 DAS	14 DAS	7 DAS	14 DAS		
T_1	Indoxacarb 14.5% SC	20.173	20.010	18.747	17.547	117.5	1:4.93
T_2	Deltamethrin 2.8% EC	17.300	18.190	13.803	13.413	129	1:5.45
T_3	Karanjin oil 5%	21.567	22.593	21.890	21.387	110.17	1:4.64
T_4	*Metarhiziumanisopliae* $1*10^8$ CFU	22.780	22.640	22.167	21.507	106.91	1:4.58
T_5	Neem oil 5%	20.467	20.737	19.573	18.227	113.33	1:4.76
T_6	Emamectin Benzoate 5% SG	18.333	19.340	16.437	15.117	126	1:5.31
T_7	Spinosad 45%SC	19.597	19.623	16.883	16.247	123.33	1:5.19
T_0	Control	25.810	26.153	34.600	36.817	68.33	1:3.01
	F-test	S	S	S	S	…..	…..
	S. Ed (±)	1.02	0.98	1.04	1.58	…..	…..
	C.D. (P = 0.5)	3.089	2.982	3.160	4.785	…..	…..

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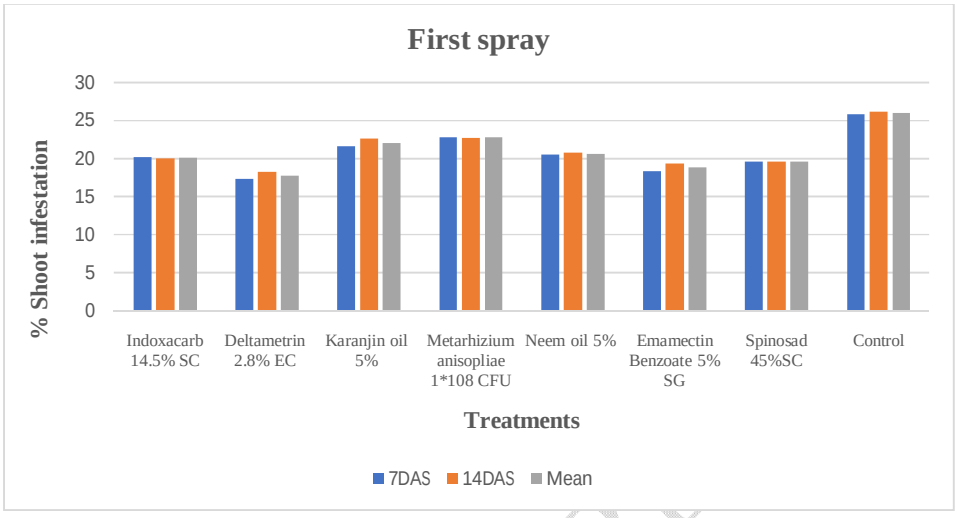

Fig. 1. Efficacy of selected insecticides on percent infeststion of shoot and fruit borer, *Eariasvittella* on okra (First spray)

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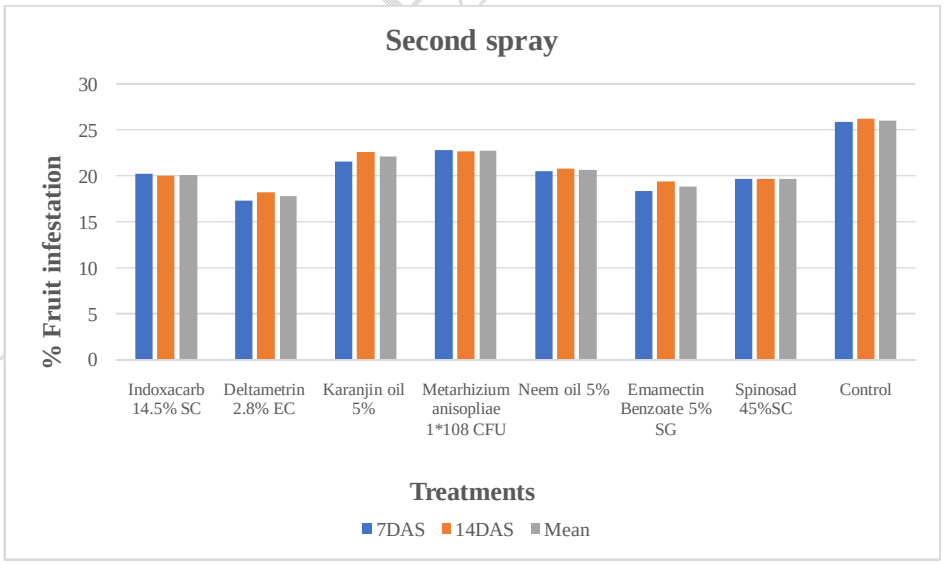

Fig. 2. Efficacy of selected insecticides on percent fruit infestation of shoot and fruit borer, *Eariasvittella* on okra (Second spray)

CONCLUSION

From the critical analysis of the present findings, it can be concluded that, among all the treatments Deltamethrin 2.8%EC is more effective in controlling per cent infestation by okra shoot and fruit borer followed by Emamectin benzoate 5%SG,Spinosad 45%SC , Indoxacarb 14.5%SC , Neem oil 5%, Karanjin oil 5%, *Metarhiziumanisopliae* $1*10^8$ CFU. Among the treatments studied, Deltamethrin 2.8%EC gave the highest cost benefit ratio (1:5.45) and marketing yield (129 q/ha) followed by Emamectin benzoate 5%SG (1:5.31 and 126 q/ha), Spinosad 45%SC (1:5.19 and 123.33 q/ha), Indoxacarb 14.5%SC (1:4.93 and 117.5 q/ha), Neem oil 5% (1:4.76 and 113.33 q/ha), Karanjin oil 5% (1:4.64 and 110.17 q/ha) and *Metarhiziumanisopliae* $1*10^8$ CFU(1:4.58 and 106.91 q/ha) respectively as such more trials are required in future to validate the findings. Therefore, botanicals may be useful in devising proper IPM strategy as an effective tool against okra shoot and fruit borer.

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