Original Research Article

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

ABSTRACT

A field trail was conducted at Central Research Farm (CRF), Naini, Prayagraj during *Kharif* from Jully to November 2021 in Randomized Block Design (RBD) with three replications. Eight treatments were evaluated against *Earias vittella i.e.*, Flubendiamide @480% SC, Indoxacarb @ 14.5% SC, Spinosad @ 45% SC, Chlorantraniliprole 18.5% EC, Neem oil @ 2%, Emamectin benzoate @ 5% SG, Cypermethrin @ 25% EC and untreated Control.Results revealed that, among the different treatments lowest per cent infestation of okra shoot and fruit borer was recorded in Chlorantraniliprole 18.5% EC (8.02%, 5.15%). Emamectin benzoate 5% SG (9.26%, 6.75%) was found to be the next best treatment followed by Flubendiamide @ 480% SC (10.29%, 7.48%), Cypermethrin @ 25% EC (11.41%,9.24), Indoxacarb @14.5% SC (12.32%, 10.00%), Spinosad @ 45% SC (13.13%, 11.53%) whereas Neem oil @ 2% (14.25%, 12.70) was found to be least effective against this pest. Among the treatments studied,Chlorantraniliprole 18.5% EC gave the highest marketing yield and cost benefit ratio (188 q/ha and 1:8.41) followed by Emamectin benzoate 5% SG (176 q/ha and 1:8.41), Flubendiamide@ 480% SC (152 q/ha and 1:7.18), Cypermethrin @ 25% EC (135 q/ha and 1:6.22), Indoxacarb @ 14.5% SC (121.2 q/ha and 1:5.74), Spinosad @ 45% SC (114.6 q/ha and 1:5.29)and Neem oil @ 2% (102.4 q/ha and 1:4.80) as compared to control plot (87.2 q/ha and 1:4.2).

Keywords: *Abelmoschus esculentas*, Cost- Benefit ratio, Chlorantraniliprole, Efficacy, Shoot and Fruit borer, *Earias vittella.*

INTRODUCTION

Okra (*Abelmoschus esculentus* L.) is known by various local names in different parts of the world and is often known as 'Lady's Finger'. Okra is a commercial vegetable crop belongs to family Malvaceae. It originates from Ethiopia and is widely spread all over tropical, subtropical and warm temperate regions of the world (**Singh *et al*., 2014).**

The composition of okra pods per 100 g edible portion is water 88.6 g, energy 144.00 kJ (36 kcal), protein 2.10 g, carbohydrate 8.20 g, fat 0.20 g, fibre 1.70 g, Ca 84.00 mg, P 90.00 mg, Fe 1.20 mg, βcarotene 185.00 µg, riboflavin 0.08mg, thiamin 0.04 mg, niacin 0.60 mg, ascorbic acid 47.00 mg. Protein, carbohydrate and vitamin C contains of okra (**Singh *et al*., 2014).** Okra seed oil is reported to contain Linoleic acid which is one of the essential fatty acid (**Naidu and Kumar 2019).**

Okra is an important vegetable crop providing a good source of income to farmers. India ranked first in okra production in world **(Devi *et al*., 2015).** World production of okra as fresh fruit vegetable is estimated at 6 million tones/year. Globally India ranks first in okra production (72% of the total world production) having area of 533 hectares with an annual production of 6346 million tons and productivity of 11.9 million tons/ha **(Gautam *et al*., 2015).** Major okra producing Indian sates are Uttar Pradesh, Bihar, Odisha, West Bengal Andra 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**(Devi *et al*., 2015).** Uttar Pradesh has an area of (22.93 ha), production (307.29 tonnes), and productivity (13.40 metrictonnes/ha) of okra.

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 andfeeds inside the shoot before fruit formation. The shoot wilt and dry as a result the damagedplant developed 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. Damaged plant tissues serve as entrance for disease causing microorganisms such as fungi**. (Rahman *et al*., 2013).**

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 45% in Karnataka which affects the nutritional quality and makes it unsuitable for human consumption **(Pachole *et al*., 2017).**

MATERIALS AND METHODS

The experiment was conducted at Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P) during the *Kharif* season of 2021 with a recommended package of practices excluding plant protection. The Okra seedlings of variety 'Arka anamika' were seeds sowing at 45 cm x 30 cm spacing. The experiment was laid down in Randomized Bock Design (RBD) with eight treatments replicated thrice with each plot size of 2m X 2m and proper irrigation was provided. The treatments comprising of, Flubendiamide 480% SC, Indoxicarb 14.5% SC, Spinosad 45% SC, Chlorantraniliprole 18.5% SC, Neem oil 2%, Emamectin benzoate 5 SG and Cypermethrin 25% EC were applied two times spraing using knapsack sprayer in 15 days of interval. From each plot five plants were randomly selected and labeled for recording observations. theinfestation of pest on shoot was initiated, the observations on total number of shoots and number of infested shoots and fruit infestation of five observational plants from each treatment replication wise were recorded at 3rd, 7th and 14th days after imposing treatments. The data recorded in the different treatments were subjected to statistical analysis after suitable transformation by following standard procedures of RBD experiment. After the last picking, total of all pickings of individual plots produce were calculated to work out the yield of the treatments.Yield of healthy fruits was converted into quintal per hectare.

The observations on the per cent infestation were recorded visually per plant from five randomly selected and tagged plants in each plot. The insecticides were sprayed at recommended doses when larval population reaches its ETL level. which was further converted into per plant population and subsequent observation was recorded at 3rd, 7th and 14th days after spraying on same plants.

The desired concentration of insecticidal spray solution of desired concentration for each treatment was freshly prepared each and every time at the site of experiment, just before the start of spraying operations. The quantity of spray materials required for crop was gradually increased as the crop advanced in age.

The healthy marketable yield obtained from different treatments was collected separately and weighted. The cost of insecticides used in this experiment was recorded during *Kharif* season. The cost of botanicals used was obtained from nearby market. The total cost of plant protection consisted of cost of treatment, sprayer, rent and labour charges for the spray. There are two sprays throughout the research period and the overall plant protection expenses was 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 the 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.

Cost benefits of treatment

Cost effectiveness of each treatment assessed based on net returns. Net return of each treatment should be worked out by deducting total cost of the treatment from gross returns. Total cost of production includes both cultivation as well as plant protection charges.

RESULTS AND DISCUSSION

Okra (*Abelmoschus esculentus* L.) is known by various local names in different parts of the world and is often known as 'Lady's Finger'. Okra is a commercial vegetable crop belongs to family Malvaceae. Okra crop suffers heavy damage by a number of insect pest viz., the jassid, *Amresca biguttulla bigutulla* (Ishida), aphid, *Aphis gossypii* (Glover), Okra fruit borers, *Earias spp*., whitefly, *Bemisia tabaci* (Genn.). Among these pests shoot and fruit borer *Earias vitella* (Fab.) is the most destructive pest of okra as the larva bores in to young shoots and fruits.

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 developed branches. Later 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. Damaged plant tissues serve as entrance for disease causing microorganismssuch as fungi**.** It is reported that about 69% losses in marketable yield due to attack of this insect pest. A number of chemical insecticides have been found effective against this pest in different parts of the country.

The first spray was given 30 days of transplanting. The percent infestation of shoot and fruit borer in okra after first spray (shoot) revealed that all the chemical treatments were significantly superior over control. Among all the treatments lowest population of okra shoot and fruit borer was recorded in Chlorantraniliprole 18.5% EC (6.585%). Emamectin benzoate 5% SG (8.005%) was found to be the next best treatment followed by Flubendiamide @ 480% SC (8.885%), Cypermethrin @ 25% EC (10.325%), Indoxacarb @ 14.5% SC (11.160%), Spinosad @ 45% SC (12.330%) and Neem oil @ 2% (13.475%) was found to be least effective against this pest. (Table 1)

The second spray was applied after 15 days of first spray and data on percent fruit damage was recorded. The pooled data for second spray shows minimum percent fruit damage in

Chlorantraniliprole 18.5% EC (5.15%), Emamectin benzoate 5% SG (6.75%) and Flubendiamide @ 480% SC (7.48%) recorded lowest population of *Erias vittella* which was significantly superior over control followed by Cypermethrin @ 25% EC (9.24%), Indoxacarb @ 14.5% SC (10%), Spinosad @ 45% SC (11.53%) and Neem oil @ 2% (12.70%) showed the least effectiveness among all treatments. (Table 1)

Between the various treatments, there were notable yields. Chlorantraniliprole 18.5% EC (188 q/ha) produced the maximum yield. **Reddy *et al*., (2019)** first supported these findings, and then **Dash *et al*., (2019)** supported them for emamectin benzoate 5% SG (176 q/ha). After Cypermethrin @ 25% EC (135 q/ha), which is consistent with the same results of **Padwal and Kumar (2013),** the next-best therapy was Flubendiamide @ 480% SC (152 q/ha). These findings were corroborated by **Deepak *et al*., (2017).** According to studies by **Patra *et al*., (2007)** was similar finding to the Indoxacarb @ 14.5% SC (121.2 q/ha). **Pachole *et al*., (2017)** validated the comparable conclusion that Spinosad @ 45% SC (114.6 q/ha) was effective, and the lowest yield was Neem oil @ 2% (102.4 q/ha), which is in line with findings by **Archunan and Pazhanisamy (2020)** and the control plot (92.6 q/ha). (Table 1)

An intriguing outcome was obtained after calculating the cost-benefit ratio. The most effective and affordable treatment of all those examined was chlorantraniliprole 18.5% EC (1:8.59). **Shrivastava *et al*., (2017)** followed by Emamectin benzoate5% SG (1:8.41), which are in agreement with **Birah and Raghuraman's (2011)** findings, made comparable findings Following Flubendiamide @ 480% SC (1:7.18), which was obtained in a manner similar to that of **Deepak *et al*., (2017)**, Cypermethrin @ 25% EC (1:6.22), which was obtained in a manner similar to that of **Javed *et al*., (2018).** The following treatment, Indoxacarb @ 14.5% SC (1:5.74), was similar to the results of **Bajad *et al*., (2014).** Spinosad @ 45% SC (1:5.29) was the following course of treatment, which is consistent with **Sarkar *et al*., (2015)** Additionally, Neem oil at 2% showed the lowest benefit-cost ratio (1:4.80), which is similar to the findings from **Subbireddy *et al*., (2018)** and the control plot (1:4.2). (Table 1)

Table no. 1 To evaluate the selected chemical insecticides and neem oil on per cent infestation of shoot and fruit borer, *E. vittella* of okra

S.No.	Treatments	% Infestation of okra shoot and fruit borer							Yield (q/ha)	C:B ratio
		First spray				Second spray				
		1DBS	3DAS	7DAS	14DAS	3DAS	7DAS	14DAS		
T_1	Flubendiamide @ 480% SC	14.63	10.58^{a}	06.75^{a}	09.16^{a}	07.070^{a}	04.29^{a}	09.38^{a}	152	**1:7.18**
T_2	Indoxacarb @ 14.5% SC	15.25	12.31^{b}	09.48^{b}	12.34^{b}	09.24^{b}	07.40^{b}	11.01^{b}	121.2	**1:5.74**
T_3	Spinosad @ 45% SC	15.39	13.24^{c}	10.39^{bc}	13.50^{bc}	10.82^{bs}	08.96^{bc}	12.82^{bc}	114.6	**1:5.29**
T_4	Chlorantraniliprole 18.5% EC	13.23	08.13^{d}	03.37^{c}	07.33^{bc}	04.35^{bcd}	02.68^{bcd}	06.25^{bcd}	188	**1:8.59**
T_5	Neem oil @ 2%	15.58	14.07^{e}	12.63^{cd}	14.69^{cd}	11.49^{cd}	09.90^{bcd}	14.69^{bcd}	102.4	**1:4.80**
T_6	Emamectin benzoate @ 5% SG	14.47	09.09^{e}	05.18^{de}	08.30^{de}	06.67^{de}	03.57^{cd}	08.46^{cde}	176	**1:8.41**
T_7	Cypermethrin @ 25% EC	14.86	11.25^{f}	08.37^{ef}	11.15^{de}	08.05^{de}	06.84^{d}	10.89^{de}	135	**1:6.22**
T_8	Control	15.84	17.03^{g}	19.77^{f}	20.97^{e}	22.89^{e}	24.12^{d}	26.96^{e}	87.2	**1:4.2**
	F-test	NS	S	S	S	S	S	S		

	S. Ed (±)	00.91	00.33	01.13	01.42	01.55	02.43	01.84		
	C.D. (P = 0.5)	-	00.72	02.42	03.05	03.32	05.21	03.45		

CONCLUSOION

From the analysis of the present findings, it can be concluded that Chlorantraniliprole 18.5% EC is more effective in controlling population of okra shoot and fruit borer and also give the highest cost benefit ratio and marketable yield i.e. (135 q/ha and 1:6.22), followed by Emamectin benzoate 5% SG was found to be the next best treatment followed Flubendiamide @ 480% SC, Cypermethrin @ 25% EC, Indoxacarb @ 14.5% SC, Spinosad @ 45% SC and Neem oil @ 2% was found to be least effective against this pest. Future study may be conducted to validate the findings.

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