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EFFECT OF CERTAIN ECO-FRIENDLY INSECTICIDES ON *EARIAS VITTELLA* (MAJOR INSECT) OF OKRA CROP IN CENTRAL REGION OF UTTAR PRADESH, INDIA

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Abstract

Application of Spinosad 45 SC found most effective against okra fruit boere *Earias vittella* followed by fipronil 5 SC over other treatment in both the experimental year zaid 2014 and 2015, accounts lowest larval population (0.90 and 0.85/plant), lowest per cent average fruit infestation (6.10 and 6.03%) and highest per cent population reduction (71.62 and 57.84%), respectively over control while, highest larval population (1.38 and 1.47/plant), highest per cent average fruit infestation (10.55 and 6.80%) and lowest per cent population reduction (21.62 and 18.92%), respectively was found in *Azadirachtin* treated plot among treatments. Minimum percent shoot damage (16.66 and 16.67%) and per cent fruit damage (1.27 and 0.84), respectively was found in Spinosad treated plot.

Key words : Okra, pest, *Earias vittella*, eco-friendly insecticides, per cent reduction.

Introduction

Vegetable based industries are emerging as powerful engine for economic growth in rural India as an excellent choice for cash crop. India is second largest producer of vegetable in the world accounting for about 10 per cent of world production. In India, vegetables were cultivated in 9355.00 m ha with an annual production of 163388.00 MT in 2014 (Anonymous, 2014a) and productivity 17.30 MT/ha in 2013 (Anonymous, 2014b) and the okra is cultivated 524.00 m ha with an annual production of 6203.00 MT (Anonymous, 2015b) and productivity 11.90 MT/ha in 2013-14 (Anonymous, 2014c). Okra is alone vegetable member of family malvaceae, which is grown on commercial scale in central Uttar Pradesh and tropical and subtropical area of the country. Its fruits are used for preparation of various delicious dishes as fried, stew and cooked and soups. Dried fruits are used in paper manufacturing industries and plant extract is used for purification of cane juice gur making. Okra contains carbohydrate, proteins and vitamin 'C' in large quantities (Abeboye and Oputa, 1996).

The productivity of okra is low due to many factors in which the attack of shoot and fruit borer, *E. vittella* and *Earias insulana* (Boisduval), Aphid (*A. gossypii*) and Jassid, *A. biguttula biguttula* are most serious pests of okra and cause 45.00-57.10% damage to fruits (Shrinivasan and Krishna Kumar, 1983 and Nderitu *et al*., 2008). The sucking pest complex of okra consisting of aphids, leaf hoppers, whiteflies, thrips and mites causes 17.46% yield loss and failure to control them in initial stages was reported to cause 54.04% yield loss (Chaudhary & Daderch, 1989 and Anitha & Nandihalli, 2008). The idea of controlling pests by using various agro-techniques in combination with selective use of insecticides making compatible with other components of the management of okra pests are gaining importance as the most effective measure.

Like other crops, okra is also attacked by number of insect-pests, mites and nematodes (Chaudhary and Dadheech, 1989). The jassids and shoot & fruit borer is the important insect pest of okra and therefore, present investigation is carried out with these two insect-pests.

In order to prevent the crop losses due to attack of spotted boll worms, various conventional insecticides have been recommended, which are hazardous and harmful to human being due to their presence in fruit as residue. The insecticides also affect the population of parasites, predators and non targeted organisms, which are beneficial to the farmers. Generally, the wide spectrum insecticides also lead the pest resurgence and secondary

Table 1 :

S. no.	Common name	Trade name	Formulations	Dose (a.i./ha)	Source of Availability
1.	*Azadirachtin*	Azacel	1000 (ppm)	1500 ml	Biotech, International Ltd.,New Delhi
2.	*Bacillus thuringiensis*	Biolep	500 IU per mg	500gm	Biotech, International Ltd.,New Delhi
3.	Spinosad	Tracer	45SC	75gm	Dow Agro Science India Pvt. Ltd. Mumbai
4.	Imidacloprid	Ultimo	17.8 SL	22.25gm	Sudarsan Chemicals Industries Ltd., Pune (M.S.) India
5.	Fipronil	Regent	5 SC	75gm	Bayer Crop Science Pvt Ltd. Mumbai, India)
6.	Control (water spray)		-	-	-

pest outbreak. However, some entomologists have found that the use of novel insecticides, bio-insecticides and Neem based insecticides is advantageous in several ways over synthetic insecticides and safer to mammals, natural enemies and beneficial insects. The bio-pesticides could be used with other chemical insecticides and these are effective at low doses than synthetic insecticides.

So, present evaluation were under taken to eco-friendly management of Shoot and fruit borer *Earias vittella*.

Materials and Methods

To evaluate the effect of certain eco-friendly insecticides on major insect pests of okra in central region of U.P., the experiments was conducted in two consecutive years *i.e.* Zaid season of 2014 and 2015 at Vegetable Research Farm, CSAUAT, Kalyanpur, Kanpur (U.P.), India. Geographically, Kanpur is situated in the sub-tropical alluvial tract of central plains of Ganga-Yamuna at $26^0$26' north and 80^0-24' east longitude at the elevation of 125.9 above sea level. The mean annual rain fall is about 800 mm in this area. The experiment is laid out in RBD with four treatment in six replication with a plot size 3x2.25 including control and Field border, Block border cum Irrigation Channel, Sub irrigation channel and Plot border are 1.00 metre, 1.5 metre, 1 metre and 0.5 metre, respectively. All the treatments were allotted randomly in each replication. Normal agronomic practices were adopted to keep the field free from weeds to increase soil aeration and to conserve the moisture. The registered formulations and insecticides used in this study are given in table 1.

The insecticidal spray solutions were prepared by the following formula :

$$\text{Amount of insecticidal formation} = \frac{\text{Concentration required(\%)} \times \text{Volume required (litre)}}{\text{Concentration of toxicant in insecticidal formulation}}$$

First spraying was applied after one month of sowing followed by 15 days interval of each spraying. The effect of insecticides was studied against pest complexes (*Earias vittella* and *Amarasca biguttula biguttula*), their natural enemies and their effect on plants was also recorded.

The concentration of *B.t.*, neem product (Azadirachtin), Spinosad, Imidacloprid and Fipronil were sprayed on the basis of active ingredient. Desired amount of insecticides was measured by micro pipette and solution prepared in plastic containers in required water just at the spraying in the field with the help of Knapsack sprayer. The data pertaining to efficacy of different insecticides against *E. vitella* during zaid 2014 and 2015 after first spray has been given in table 2. The efficacy data was recorded by counting the larvae per/plant after 3, 7 and 14 days of spraying. The efficacy was also assessed on the basis of per cent fruit infestation and per cent reduction over control.

Results and Discussion

Efficacy of different insecticides during *zaid* 2014

It is evident from table that Spinosad 45 SC was found the promising insecticide which resulted minimum larval count 0.94, 0.93 and 0.92 larvae per plant after 3, 7 and 14 days respectively followed by Fipronil 5 SC larval count 1.22, 1.23 and 1.22 at 3, 7 and 14 days interval respectively of first spraying. But azadirachtin, a Neem compound was found least effective group with 1.56, 1.41 and 1.36 larvae per plant after 3, 7 and 14 days of spraying respectively against control plot, which were 1.94, 1.93 and 2.02 larvae per plant after 3, 7 and 14 days of water spraying. Mishra *et al.* (2002) also showed that neemarin in the form of *Azadirachtin* has given a moderate level of control of the fruit borer with 16.9 per cent decrease in fruit infestation. On the other hand, in the present investigation author reported least effectiveness of neem products like neemarin, nimbicidine and didiherbal with the per cent reduction over control in

Table 2 : Efficacy of different insecticides during Zaid - 2014.

S. no.	Treatments	Larval population count after days of spraying									
		First spraying					Second spraying				
		3 days	7 days	14 days	% fruit infestation (Aveg.)	% reduction over control	3 days	7 days	14 days	% fruit infestation (Aveg.)	% reduction over control
1.	Azadirachtinl@1500ml/ha	1.56(1.43)	1.41(1.38)	1.36(1.35)	10.65**(3.56)	22.42	1.53(1.42)	1.43(1.38)	1.38(1.37)	10.55**(3.48)	21.62
2.	Bt.(biolep) @500g.a.i./ha	1.26(1.33)	1.44(1.39)	1.27(1.33)	9.20(2.66)	41.54	1.26(1.32)	1.45(1.40)	1.25(1.32)	8.40(2.27)	48.87
3.	**SpinosadTracer@75g. a.i./ha**	**0.94(1.20)**	**0.93(1.19)**	**0.92(1.18)**	**6.27(1.28)**	**71.86**	**0.93(1.19)**	**0.92(1.18)**	**0.90(1.18)**	**6.10(1.26)**	**71.62**
4.	Imidacloprid@22.25g. a.i./ha	1.27(1.33)	1.25(1.32)	1.22(1.31)	7.72(1.92)	57.80	1.27(1.34)	1.28(1.34)	1.15(1.28)	7.72(1.95)	56.08
5.	FipronilRegent@75g. a.i./ha	**1.22(1.31)**	**1.23(1.31)**	**1.22(1.31)**	**7.70(1.90)**	**58.24**	**1.21(1.30)**	**1.25(1.32)**	**1.20(1.30)**	**6.10(1.28)**	**71.17**
6.	Control	1.94(1.56)	1.93(1.55)	2.02(1.58)	12.12(4.55)	-	1.93(1.55)	1.96(1.57)	2.00(1.58)	11.96(4.44)	-
	S.E.M±	0.036	0.034	0.034	0.09	-	0.036	0.039	0.039	0.038	-
	C.D. P=0.05	0.11	0.10	0.10	0.103	-	0.11	0.12	0.12	0.29	-

** Angular transformed values.

Note: The values given in parenthesis are Square root transformed value.

Table 3 : Efficacy of different insecticides during Zaid - 2015.

S. no.	Treatments	Larval population count after days of spraying									
		First spraying					Second spraying				
		3 days	7 days	14 days	% fruit infestation (Aveg.)	% reduction over control	3 days	7 days	14 days	% fruit infestation (Aveg.)	% reduction over control
1.	Azadirachtin@1500ml/ha	1.61(1.45)	1.39(1.37)	1.78(1.50)	6.55**(1.40)	29.30	1.55(1.43)	1.55(1.43)	1.47(1.40)	6.80**(1.50)	18.92
2.	Bt.(biolep) @500g.a.i./ha	1.17(1.29)	1.35(1.36)	1.22(1.31)	6.03(1.21)	38.89	1.28(1.33)	1.15(1.28)	1.20(1.30)	6.10(1.26)	31.90
3.	Spinosad@75g. a.i./ha	**0.75(1.12)**	**0.81(1.14)**	**0.91(1.18)**	**5.59(0.91)**	**54.04**	**0.77(1.13)**	**0.74(1.12)**	**0.85(1.40)**	**6.03(0.78)**	**57.84**
4.	Imidacloprid@22.25g. a.i./ha	1.02(1.23)	1.05(1.24)	0.98(1.21)	6.30(1.35)	31.81	0.96(1.20)	0.94(1.20)	0.85(1.16)	5.75(1.03)	44.32
5.	Fipronil@75g. a.i./ha	**0.88(1.17)**	**0.84(1.16)**	**0.86(1.16)**	**6.04(1.22)**	**38.38**	**0.85(1.16)**	**0.83(1.15)**	**0.90(1.18)**	**5.29(0.86)**	**53.51**
6.	Control	1.74(1.49)	1.96(1.56)	2.12(1.62)	7.72(1.98)	-	1.68(1.47)	1.88(1.54)	2.13(1.62)	7.50(1.85)	-
	S.E.M±	0.034	0.034	0.034	0.039	-	0.043	0.039	0.042	0.034	-
	C.D. P=0.05	0.10	0.10	0.10	0.11	-	0.13	0.12	0.13	0.10	-

** Angular transformed values.

Note: The values given in parenthesis are Square root transformed value.

Table 4 : Efficacy of eco- friendly insecticidal treatments in relation to fruit damage, shoot infestation and yield of okra during *Zaid* season 2014 & 2015.

S. no.	Treatment	Dose (g a.i./ha)	Year 2014			Year 2015		
			Fruit damage (%)	Shoot damage (%)	Yield (q/ha)	Fruit damage (%)	Shoot damage (%)	Yield (q/ha)
1.	*Azadiractin* 1000 ppm	500ml	3.50 (10.63)	60.0 (50.85)	75.30	1.45 (6.56)	56.67 (48.85)	75.99
2.	Bt. (biolep)	500	2.46 (8.74)	43.33(41.15)	81.06	1.19 (5.23)	50.00 (45.10)	81.57
3.	Spinosad 45 SC	75	**1.27 (6.25)**	**16.66 (23.84)**	**96.75**	**0.84 (5.23)**	**16.67 (23.85)**	**98.54**
4.	Imidacloprid 17.8 SL	22.25	1.93 (7.72)	33.33 (35.21)	87.57	1.23 (6.03)	40.0 (39.23)	88.42
5.	Fipronil 5 SC	75	**1.59(6.85)**	**23.33 (28.78)**	**93.68**	**1.04 (5.20)**	**26.67 (30.99)**	**95.22**
6.	Control	-	4.49 (11.99)	70.00 (57.00)	70.05	1.91(6.30)	73.33 (58.80)	70.05
	SE ±		0.06	3.21	0.77	0.036	3.26	0.820
	CD at 5%		0.19	8.61	2.32	0.10	8.21	2.47

the range of 14.64-21.37. Other treatments performed intermediary results. In this way Spinosad 45 SC performed better in terms of per cent reduction with the value of 71.86 followed by Fipronil 5 SC with a value of 58.24 over control while Azadirachtin showed 22.42 per cent reduction over control. The other treatmentns Imidacloprid 17.8 SL and Bt. accounts 57.8 and 41.54 percent reduction, respectively over control after first spray of insecticides.

In case of per cent fruit infestation, the range was 1.28 to 3.53 and among these, Spinosad application resulted into minimum per cent fruit infestation (1.28%) followed by (1.90%) fipronil treatment. Statistically the treatments show significant value at the level of 5 per cent test of significance in the context of 3, 7 and 14 days after spraying and percentage fruit infestation as well as percentage reduction over control (table 2). It is also clear from the table that all the treatments were superior over control in all set of observation with significant values.

The sequence of effectiveness on the basis of per cent fruit infestation was as) Spinosad > Fipronil > Imidacloprid > Bt. (biolep and Azadirachtin). The range of per cent fruit reduction over control was 22.42 to 71.86 per cent.

Interestingly, similar result was noticed in second spray where spinosad spray resulted 0.93, 0.92 and 0.90 larvae per plant after 3, 7 and 14 days of second spray followed by fipronil 1.21, 1.25, and 1.20 larvae per plant after 3, 7 and 14 Days interval. The percent reduction over control was also found similar with value of 71.62 and 71.17 in spinosad and fipronil respectively over control. Distinctly Bt shown better result in 2nd spray as compared to first spray with a value of 48.87 percent over control. Other treatment also shown more or less similar to the first spray in *zaid* 2014. Accordingly percent fruit infestation was noticed at low extent with a value of 6.10 in case of spinosad and fipronil followed by Imidacloprid (7.72), Bt (8.40) and Azadirachtin (10.55), respectively. So, Fipronil, Imidacloprid, Bt. (biolep) were also effective after the Spinosad and gave almost at par values, this formed second effective group of insecticides. Azadirachtin resulted 21.62 per cent reduction over control and 3.48 per cent fruit infestation. neem product resulted least per cent of fruit reduction over control and maximum fruit infestation but it was less than control.

The sequence of effectiveness on the basis of per cent fruit infestation was as Spinosad > Fipronil > Imidacloprid > Bt. (biolep) and Azadirachtin. The range of per cent fruit reduction over control was 21.62 to 71.62 per cent.

Efficacy fo different insecticides during *zaid* -2015

After the first spray of different chemicals against *E. vitella* during *Zaid* (2015) the data obtained has been presented in table 3. It is evident from the table that again Spinosad was found the promising insecticide, which gave minimum larval count as 0.75, 0.81 and 0.91 larvae per plant after 3, 7 and 14 days of first spray followed by Fipronil and Imidacloprid which were second and third ranked with respect of minimum larval count as 0.88, 0.84 and 0.86 after 3, 7 and 14 days of sprayings. Statistically, Spinosad, Fipronil and Imidacloprid were significantly at par as shown in the table 3. It is also evident from table that neem product like Azadiractin,

was least effective insecticide as the results larval count obtained after 3, 7 and 14 days of spray.

Similar type of sequence was also observed on 3 and 7 days of spray with respect to imidacloprid, were also effective in the form of third group of better insecticide, spray of this insecticide resulted into 1.02, 1.05 and 0.98 larvae per plant, respectively after 3, 7 and 14th days of spray (table 3). Statistically all the treatments were significantly superior over control at 5 per cent level of significance. Percentage reduction over control, there was maximum reduction of 54.04 per cent in Spinosad followed by 38.38 per cent reduction in Fipronil. Therefore, the sequence of effectiveness was Spinosad > Fipronil > Bt> Imidacloprid> Azadirachtin. Singh and Mishra (1988) found that spraying of 0.0025% decamethrin (Deltamethrin), 0.005% fenvalerate, 0.05% endosulfan, 0.005% cypermethrin, 0.1% carbaryl and 0.04% monocrotophos reduced the percentage of fruit damaged by *E. vittella* and *E. insulana* to 0.38, 0.74, 1.94, 1.95, 2.12 and 2.41, respectively in comparison to untreated plot (25.55%).

Same sequence was also obtained from the data obtained on per cent fruit infestation in all these treatments, where Spinosad was Promising insecticide in resulting 5.59 per cent fruit infestation followed by 6.03 per cent in Bt and 6.04 Imidacloprid, respectively. All the treatments were significantly different to the control.

Efficacy of different insecticides against *E. vitella* during *zaid* 2015 after second spray has been presented in table 3. It is evident from the table that Spinosad gave best performance as the larval counts after 3, 7 and 14 days of spray were 0.77, 0.74 and 0.85 larvae per plant. Fipronil was rated second which resulted into 0.85, 0.83 and 0.90 larvae per plant after 3, 7 and 14 days of spray.

The data presented in table 3 also revealed that Imidacloprid, was the third of better insecticide and they registered 0.96, 0.94, 0.85 larvae per plant, respectively, after 3, 7 and 14th days of spray. Microbial compound like Bt. (biolep) was found to be moderately effective insecticide. The larval count in the case of this insecticide was, 1.28, 1.15 and 1.20 respectively, after 3,7 and 14th days of spray. The neem product like Azadirachtin was found least effective group but better than control significantly. Among the Azadirachtin was as the larval count was recorded as 1.55, 1.55 and 1.47 larvae per plant, respectively after3, 7 and 14 days of spray.

The efficacy of different insecticidal treatments is clear when the assessment is done with regard to the per cent reduction of fruit infestation over control. This evident from the table 3 that per cent reduction by Spinosad over control was 57.84 per cent. Fipronil and Imidacloprid and were the next effective insecticides, which resulted in 53.51 per cent and 44.32 per cent reduction, respectively. The sequence of effectiveness on the basis of per cent fruit infestation was as Spinosad > Fipronil > Imidacloprid > Bt. (biolep) and Azadirachtin. The range of per cent fruit reduction over control was as 18.92 to 57.84 per cent.

Statistically all the treatments were significant at the level of 5 per cent test of significant in the context of 3, 7 and 14 days of spraying, respectively and also in percentage fruit infestation, percentage reduction over control as shown in the table 3. The CD values as presented in table 3 are as 0.13, 0.12, 0.13 and 0.10 for larval count after 3, 7, 14 days and per cent fruit infestation, respectively, after second spray.

Results furnished in the aspect of application of biopesticide like spinosad was better followed by fipronil and imidacloprid, formed third of effective insecticides showing moderate efficacy than other treatmetns. This trend persisted in all treatments of experiment laid out in zaid seasons in both set of sprays. fipronil elicited better performance and may be ranked as second of effective insecticides.

Spinosad were ranked as first of promising insecticides, as a results of highest efficacy in all the treatments of experiment concerning in zaid crop. Interestingly the management data of 2014 and 2015 (both the years) showed that the sequence trend of the efficacy was almost similar with some slide variations (tables 2-3).

Looking to the results of investigations of Gupta and Dhari (1980), who have recommended that two sprays of 0.03% monocrotophos within an interval of 15 days starting from two weeks after sowing followed by three sprays of 0.05% endosulfan at 15 days interval after fruit setting found to be the best treatment.

Dabhi *et al.* (2012) tested Indoxacarb @ 0.0075% was found significantly superior over the rest of treatments in controlling fruit damage. The next best effective treatment was profenophos + cypermethrin @ 0.044% which was on par with endosulfan @ 0.07%, chlorpyriphos @ 0.04% and provided protection against *E. vittella* during *Kharif* season.

Significant maximum yield and marketable okra fruits was recorded from the plot sprayed with Spinosad (96.75 qt/ha) followed by fipronil (93.68) Imidacloprid (87.50) respectively and so on in *Zaid* 2014. Similarly in *zaid* 2015 Spinosad (98.54 qt/ha) followed by fipronil (95.22)

Imidacloprid (88.42) registered the highest yield, respectively.

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