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Assessment of bio-pesticides against shoot and fruit borer *Earias vittella* (Fab.) of okra

Dr. RP Sharma and RK Verma

Abstract
The present On Farm Trail was conducted during *kharif* 2019 at eight farmers field of Madhepura district under supervision of Krishi Vigyan Kendra, Madhepura, BAU, Sabour (Bhagalpur) to asses the efficacy of bio-pesticides against shoot and fruit borer, *Earias vittella* (F.) on okra. All the treatments were found to be superior over the untreated control. The results revealed that two sprays of Emectin benzoate 5 SG @ 1 gm/5 liter water was found to be most effective in managing the fruit borer infestation on okra followed by Spinosad 45 SC @1ml/5 L.
Finally, concluded that Emectin benzoate 5SG @ 1g/ 5liter of water could be a better alternative for sustainable management of shoot and fruit borer in okra. Farmers may be advised to use this insecticide for the effective management of fruit borer of okra (*E. vittella)* and for better yield.

Keywords: *Earias vittella* (Fab.), insecticides, yield

Introduction
Okra (Lady's finger or bhindi), *Abelmoschus esculentus* (L.) Moench is2nd most popular cultivated vegetable for Bihar and mainly cultivated for its immature fruits. Okra fruits have nutritious as well as fibrous dietary value. Though, it is mainly used as a fresh vegetable, it is also consumed as canned, dehydrated or frozen forms (Schippers R., 2002) [1]. Among vegetables, it occupies an important position and is grown extensively throughout India. Okra is grown in an area of 0.36 million hectares with a production of 3.52 million tonns of fruits with a productivity of 9.83 tonnes per hectare in India (Anonymous. 2007) [2]. One of the major constraints for the low productivity of okra is its high vulnerability to attack by pests. Intensity of damage caused by pests also varies from season to season. During summer, okra fruits fetch a higher price in the market, but the pest attack is comparatively more which results in a lower yield of marketable fruits than other seasons (Radake SG & Undirwade RS., 1981 [3].
Among all pests, shoot and fruit borer, *Earias vittella* (Fab.) is the one of the most destructive pest of okra and damage is done in two ways. First, the terminal portion of growing shoots is bored by caterpillars, which move down by making tunnels inside. As a result, the shoot drop downward or dry up. Secondly, the larvae enter the fruits by making holes, rendering them unfit for human consumption. According to an estimate this pest can cause 36-90% loss in fruit yield of okra (Misra *et al*., 2002) [4]. The affected fruits are rendered unfit for human consumption, as well as for procurement of seed.
A continuous monitoring of all important pests in field condition is essential for assessing the incidence and development of insect pests and for devising suitable pest management strategies. Some cultural practices are adopted to prevent the damage of insect pests, but still no method has been devised to control these devastating insects. Though many non-chemical control strategies are advocated under the IPM umbrella, still farmers rely on chemical insecticides. Keeping this in view, the present investigation was undertaken to evaluate the efficacy of certain insecticides against okra shoot and fruit borer.

Materials and Methods
A field trial was conducted on farmers plot of Madhepura district under On Farm Trail of Krishi Vigyan Kendra, Madhepura, Bihar during *Kharif*2019 in randomized block design with four treatments on eight farmers plot (replications) including untreated control. Okra variety Ankur-41 was sown in plots of 5 × 4 m with spacing of 45× 30 cm. The recommended fertilizer dose (N:P:K-120:60:60 kg/ha) was applied by broadcasting method.

All the cultural practices were carried out as per recommendations. Observation on shoot and fruit borer incidence was recorded on fifteen randomly selected okra plants from each plot. In total 2 insecticidal sprays, one immunity builder (KEM) along with one untreated control were maintained in the investigation (Table 1). The two insecticidal sprays were applied at 15 days interval, starting soon after the pest incidence in the crop. The second spray was given 20 days after the first spray. Observation on per cent fruit infestation was recorded 1 day before and 4, 8, 12, 16 and 20 days after each insecticidal application on number and weight basis. Further, the number and weight of healthy and damaged fruits were also recorded 1 day before spray and 4, 8, 12, 16 and 20 days after each spray. The total yield of marketable fruits obtained from different treatments was calculated and converted to per hectare yield. The data collected were subjected to Randomized Design for their significance (Gomez KA & Gomez AA, 1984) [5].

Table 1: Treatments including insecticides with their doses

Treatment	Treatment Detail	Dose
T1	Emectin benzoate 5 SG @ 1 gm/5L	1 gm/5L
T2	Spinosad 45 SC @1ml/5 L	1ml/5 L
T3	KEM @ 2 ml/ L	2 ml/ L

Results

(a) Effect of insecticides on per cent fruit infestation

Data recorded on per cent fruit infestation revealed that one day before first spray percent fruit infestation ranged from 6.09% (T0) to 6.81% (T1) on a number basis. However, on weight basis percent fruit infestation ranged from 5.82% (T3) to 6.30% (T1). After a time span of first spray, per cent fruit infestation kept on increasing and it was recorded that after 20 days of first spray, maximum per cent fruit infestation of 20.45% and 18.20% was recorded in untreated control on the number and weight basis respectively. However, in treatments with insecticidal sprays, after 20 days of first spray minimum per cent fruit infestation of 10.72% and 9.54% was recorded in treatment T1 on number and weight basis respectively. This was followed by treatment T2 where 10.94% and 9.74% fruit infestation was recorded on the number and weight basis respectively after 20 days of first spray.

Before one day of second spray maximum per cent fruit infestation of 19.42% and 19.99% was observed in untreated control on the number and weight basis respectively. However, minimum per cent fruit infestation of 9.73% and 9.50% was recorded in treatment T1 on number and weight basis respectively before one day of second spray. After 20 days of second spray, minimum fruit infestation of 16.48% and 14.34% respectively on number and weight basis was observed in treatment T1, followed by T2 and respectively 17.07% and 14.95% fruit infestation was recorded on the number and weight basis after 20 days of second spray. However, in untreated control per cent fruit infestation kept on increasing rapidly and 40.14% and 38.14% fruit infection was recorded on the number and weight basis respectively after 20 days of second spray (Details on Table 2 and Table 3).

(b) Effect of insecticides on number of healthy and damaged fruits

It was observed that 1 day before the spray per cent fruit infestation ranged from 5.20 (T0) to 5.89% (T1) and number of healthy and diseased fruits ranged from 26.10 (T2) to 28.75 (T0) and 1.45 (T1) to 1.73 (T0) respectively. However, 4 days after first spray an average number of healthy and diseased fruits ranged from 36.95 (T0) to 40.85 (T1) and 1.23 (T1 and T2) to 3.00 (T0) respectively. Further observations were also recorded after 8, 12, 16 and 20 days after first spray and it was observed that after 8 and 12 days of the spray average number of healthy fruits ranged from 37.23 (T0) to 42.86 (T1) and damaged fruits number ranged from 2.85 (T1) to 6.36 (T0). There were remarkable reductions in average number of infected fruits in insecticidal treatments in comparison to the control (T0) observe 0n 4 day after second spray of insecticide. Minimum average number of infested fruit 2.55 was recorded in both T1 & T2 which was reduced to1.00 20 day after second spray. In untreated control (T0) healthy fruit gradually reducing from 22.00 to 4.25 while infected fruit significantly reduced from 6.70 to2.75 from 4day after second spray to 20 day after second spray. So far total number of fruits is concern maximum 368.25 (T1) and minimum 302.71 (T0) recorded while minimum number of infected fruit 25.70 and maximum 61.00 number of infected fruits recorded in T1 and T0, respectively. Data on total number of healthy and infected fruit showed treatment T1 (Emectin benzoate 5 SG @1gm/5 liter water) is best option for reducing pest infestation among bio-pesticide tested followed by T2 (Spinosad 45 SC @ 1 ml/ 5 liter water. (Detail on Table 4 &5).

(c) Effect of insecticides on weight of healthy and damage fruits

Table 6 and Table 7 revealed that data recorded on weight basis, fruit infestation per cent 1 day before spray was recorded from 4.82% (T3) to 5.30% (T1). However, average healthy fruit weight one day before first spray of bio-insecticides varies from 216.00 g (T2) to 236.25 g (T1) which was increased maximum up to 447.25 g (T1) followed by 431.00 g (T2) at 12 day after spray. While, under untreated control, average healthy fruit weight increased from 232.25 g to 353.75 g only in 12 days duration of first spray. Again, average weight of infected fruits kept on increasing in untreated control (T0) from 12.10 g to 53.53 g in 12 days of the length of first spray. However, from 12 day after spray to 20 day after spray weight of healthy fruit decreases from 447.25g to 328.00 g in T1 treatment whereas, untreated control (T0) weight decreases from 353.75g to 270.70g. Weight of infected fruit also declined from 16.67 g to 15.93g (T1) at 12 DAS to 20 DAS while in untreated control it varies from 53.33g to 51.57 g. This may probably due old aged plant and smaller size of fruit.

The minimum average infected fruit weight of 13.18 g was recorded in treatment T1 followed by T2 (19.50 g) after second spray of insecticides. After 20 days of second spray of insecticides the maximum average infected fruits weight of 45.77 g was recorded in untreated control. Further, maximum average healthy fruits weight of 163.03 g after 20 days of second spray was recorded in T1 followed by T2 (111.82 g). The maximum healthy fruit yield (73.26 q/ha) and lowest infected fruit yield (4.36 q/ha) was recorded in treatment T1 and this was followed by treatment T2 where healthy and infected fruit yield was recorded as 70.93 q/ha and 4.71 q/ha respectively. A maximum total yield of 77.62 q/ha including healthy and diseased fruit both, was also recorded in treatment T1 (Details on Table 7).

In this way, treatment T1 where spraying of Emectin benzoate 5 SG @ 1 gm/liter water sparay was reduced the infected fruits weight but also enhance the average healthy fruits weight with yield and proved most effective on fruit weight & fruit number basis.

Table 2: Efficacy of some insecticidal treatments on per cent fruit infestation against okra shoot and fruit borer after first spray

Treatment	Per cent fruit infestation on number and weight basis											
	1 DBS		4 DAS		8 DAS		12 DAS		16 DAS		20 DAS	
	NB	WB	NB	WB	NB	WB	NB	WB	NB	WB	NB	WB
T1 Emectin benzoate 5 SG @ 1 gm/5L	6.81	6.30	4.01	3.76	3.79	3.07	5.89	4.82	8.82	7.86	10.72	9.54
T2 Spinosad 45 SC @1ml/5 L	6.40	6.22	4.08	3.84	3.66	3.30	6.00	5.18	8.96	8.25	10.94	9.74
T3 KEM @ 2 ml/ L	6.10	5.82	8.44	7.81	5.90	5.15	7.71	6.71	10.75	9.90	13.79	12.27
T0 (No treatment)	6.09	5.90	8.76	8.16	11.33	10.80	14.26	13.75	17.26	16.80	20.45	18.20
CD@ 5%	0.17	0.11	1.32	1.21	1.81	1.81	1.99	2.10	2.00	2.09	2.28	2.03
SEm(+-)	0.05	0.04	0.45	0.41	0.61	0.62	0.68	0.71	0.68	0.71	0.78	0.69

D.B.S. = Days before spray; D.A.S. = Days after spray
N.B. = Number basis; W. B. = Weight basis

Table 3: Efficacy of some insecticidal treatments on per cent fruit infestation against okra shoot and fruit borer after second spray

Treatment	Per cent fruit infestation on number and weight basis											
	1 DBS		4 DAS		8 DAS		12 DAS		16 DAS		20 DAS	
	NB	WB	NB	WB	NB	WB	NB	WB	NB	WB	NB	WB
T1 Emectin benzoate 5 SG @ 1 gm/5L	9.73	9.50	7.64	6.35	6.18	4.94	8.77	6.95	11.76	12.60	16.48	14.34
T2 Spinosad 45 SC @1ml/5 L	10.35	10.05	7.86	6.74	6.39	5.06	8.73	7.73	12.62	12.99	17.07	14.95
T3 KEM @ 2 ml/ L	13.78	12.9	11.85	11.47	8.71	7.16	10.19	8.76	14.94	12.68	19.16	19.44
T0 (No treatment)	19.42	19.99	22.98	22.37	26.63	26.85	29.87	28.87	34.90	33.78	40.14	38.14
CD@ 5%	2.23	2.43	3.62	3.75	4.95	5.34	5.20	5.31	5.52	5.29	5.71	5.62
SEm(+-)	0.76	0.82	1.23	1.28	1.68	1.82	1.77	1.81	1.88	1.80	1.94	1.91

D.B.S. = Days before spray; D.A.S. = Days after spray
N.B. = Number basis; W. B. = Weight basis

Table 4: Efficacy of some insecticidal treatments on number of healthy and damaged fruits against okra shoot and fruit borer after first spray

Treatment	Fruit infestation %*	Number of healthy and damaged fruit per 15 plants during various fruit pickings**											
		1 DBS		4 DAS		8 DAS		12 DAS		16 DAS		20 DAS	
	N.B.	H.F.	D.F.	H.F.	D.F.	H.F.	D.F.	H.F.	D.F.	H.F.	D.F.	H.F.	D.F.
T1 Emectin benzoate 5 SG @ 1 gm/5L	5.89	28.25	1.45	40.85	1.23	46.75	1.25	48.70	2.70	41.25	3.70	34.75	3.75
T2 Spinosad 45 SC @1ml/5 L	5.48	26.10	1.70	39.75	1.26	45.75	1.25	47.70	2.70	40.70	3.70	34.00	3.75
T3 KEM @ 2 ml/ L	5.16	28.70	1.62	37.85	3.00	43.75	2.25	46.75	3.25	40.25	4.25	33.00	4.75
T0 (No treatment)	5.20	28.75	1.73	36.95	3.00	41.25	4.75	42.70	6.70	36.00	7.00	29.00	7.00
CD@ 5%	0.17	0.63	0.06	0.89	0.51	1.22	0.83	1.32	0.97	1.21	0.79	1.29	0.77
SEm(+-)	0.06	0.21	0.02	0.30	0.17	0.42	0.28	0.45	0.33	0.41	0.27	0.44	0.26

D.B.S. = Days before spray; D.A.S. = Days after spray
H.F. = Healthy fruits; D.F. = Damaged fruits

Table 5: Efficacy of some insecticidal treatments on number of healthy and damaged fruits against okra shoot and fruit borer after second spray

Treatment	Number of healthy and damaged fruit per 15 plants during various fruit pickings											
	4 DAS		8 DAS		12 DAS		16 DAS		20 DAS		Total no. of fruits	
	H.F.	D.F.	H.F.	D.F.	H.F.	D.F.	H.F.	D.F.	H.F.	D.F.	H.F.	D.F.
T1 Emectin benzoate 5 SG @ 1 gm/5L	28.25	2.25	22.75	1.70	16.25	1.70	11.00	1.70	5.70	1.00	368.25	25.70
T2 Spinosad 45 SC @1ml/5 L	27.70	2.25	22.00	1.70	15.75	1.70	11.00	1.70	5.25	1.01	338.70	25.25
T3 KEM @ 2 ml/ L	26.25	3.70	21.70	2.00	15.7	1.75	10.75	1.75	5.70	1.26	331.00	34.00
T0 (No treatment)	22.00	6.70	16.70	6.00	11.75	5.00	7.75	4.00	4.25	2.75	302.71	61.00
CD@ 5%	1.42	1.06	1.39	1.06	1.05	0.83	0.80	0.57	0.34	0.42	13.55	7.40
SEm(+-)	0.48	0.36	0.47	0.36	0.36	0.28	0.27	0.20	0.12	0.14	4.61	2.52

D.B.S. = Days before spray; D.A.S. = Days after spray
H.F. = Healthy fruits; D.F. = Damaged fruits

Table 6: Efficacy of some insecticidal treatments on weight of healthy and damaged fruits against okra shoot and fruit borer after first spray

Treatment	Fruit infestation %*	Weight of healthy and damaged fruits per 15 plants during various fruit pickings (g)											
		1 DBS		4 DAS		8 DAS		12 DAS		16 DAS		20 DAS	
	W.B.	H.F.	D.F.	H.F.	D.F.	H.F.	D.F.	H.F.	D.F.	H.F.	D.F.	H.F.	D.F.
T1 Emectin benzoate 5 SG @ 1 gm/5L	5.30	236.25	13.27	344.25	9.08	415.10	8.75	447.25	16.67	383.70	28.45	328.00	18.73
T2 Spinosad 45 SC @1ml/5 L	5.22	216.00	12.07	332.00	9.79	405.06	9.70	431.00	20.33	383.25	29.00	317.00	19.70
T3 KEM @ 2 ml/ L	4.82	229.00	11.85	319.25	23.28	389.25	16.75	423.00	26.33	366.70	35.75	309.45	32.00
T0 (No treatment)	4.97	232.25	12.10	313.25	24.00	362.75	39.70	353.75	53.33	313.70	58.75	270.70	60.75
CD@ 5%	0.11	4.41	0.32	6.94	4.13	11.48	7.26	20.75	8.35	16.62	7.16	12.53	9.85
SEm(+-)	0.04	1.50	0.11	2.36	1.40	3.90	2.47	7.06	2.84	5.65	2.43	4.26	3.35

D.B.S. = Days before spray; D.A.S. = Days after spray
W.B. = Weight basis; H.F. = Healthy fruits; D.F. = Damaged fruits

Table 7: Efficacy of some insecticidal treatments on weight of healthy and damaged fruits against okra shoot and fruit borer after second spray

Treatment	Weight of healthy and damaged fruits per 15 plants at the time of fruit pickings (g)														
	4 DAS		8 DAS		12 DAS		16 DAS		20 DAS		Total fruit weight per 15 plants (Kg.)		Total fruit yield (q/ha)		
	H.F	D.F	H.F.	D.F	H.F	D.F	H.F	D.F	H.F.	D.F.	H.F	D.F.	HF	DF	Total
T1 Emectin benzoate 5 SG @ 1 gm/5L	277.70	18.70	216.25	11.25	165.25	12.25	104.25	15.00	51.70	8.70	2.96	0.15	73.26	4.36	77.62
T2 Spinosad 45 SC @1ml/5 L	266.25	19.70	219.75	12.00	160.70	13.00	105.70	15.70	46.70	8.00	2.87	0.16	70.93	4.71	75.44
T3 KEM @ 2 ml/ L	254.25	32.00	214.00	16.25	159.00	15.25	105.25	15.25	47.75	11.75	2.81	0.25	69.47	6.15	75.62
T0 (No treatment)	212.25	60.75	161.00	58.70	118.70	47.75	74.00	38.00	38.75	23.75	2.45	0.48	60.41	11.91	72.31
CD@ 5%	14.37	9.86	14.05	11.50	10.88	8.64	7.82	5.71	2.73	3.68	0.11	0.08	2.83	1.76	1.10
SEm(+-)	4.89	3.35	4.78	3.91	3.70	2.94	2.66	1.94	0.93	1.25	0.04	0.03	0.96	0.60	0.38

D.B.S. = Days before spray; D.A.S. = Days after spray

W.B. = Weight basis; H.F. = Healthy fruits; D.F. = Damaged fruits

Discussion

Evaluation and assessment of bio-efficacy of many insecticides was done earlier by many researchers against okra shoot and fruit boer (*E. vittella Fab)*. Kuttalam *et al.* (2008) [6] found emamectin benzoate @ 13 and 15 g a.i./ha as effective insecticide in suppressing the larval population. Priya and Misra (2007) [7] recorded lower fruit borer infestation to fruits in the treatment of spinosad. Among the various insecticides evaluated by Chatterjee and Samanta (2009) [8], emamectin benzoate had the lowest shoot and fruit infestation followed by indoxacarb. Shinde and Shetgar (2009) [9] found spinosad 0.005% and indoxacarb 0.01% as most effective insecticides in managing okra shoot and fruit borer. The highest shoot infestation was recorded in untreated check (21.2%). Gupta *et al.* (2009) [10] reported that indoxacarb (70 and 140 g a.i./ha) was found most effective against shoot and fruit borer infesting okra. According to Sinha and Nath (2009) [11], indoxacarb and chlorpyriphos + cypermethrin found effective against *E. vittella*. Pardeshi *et al.* (2010) [12] registered lower infestation of *E. vittella* to okra fruits in the treatment of chlorpyriphos + cypermethrin. Prasad and Prasad, (2004) [13] studied that cypermethrin was most effective against *Earias vittella.* Indoxacarb and spinosad were also found effective while imidacloprid and malathion were least effective in reducing per cent shoot and fruit infestation on number and weight basis. A similar result was found by Misra *et al.*, (2002) [14] and Nachne *et al.* (2003) [15], who showed effectiveness of cypermethrin and indoxacarb, respectively. Chowdary *et al.* (2010) [16], evaluated the efficacy of rynaxypyr (coragen) 20 SC against okra fruit and shoot borer, *Earias vittella* (Fab.). Rynaxypyr 20 SC @ 30 g a.i./ha was proved to be superior in recording less larval populations, lower fruit damage (7.80 and 10.51%) and higher fruit yield (11.60 and 10.89 t/ha), followed by spinosad @ 56 g.a.i/ha, emamectin benzoate @15 g.a.i/ ha and flubendiamide @ 45 g.a.i/ha.

The present findings are in agreement with results of the on farm trail conducted for evaluation of different bio-insecticides against *E. vittella* in okra by Patra *et al.* (2009) [17], the shoot damage ranged between 4.7 to 21.2%. The lowest (4.7%) shoot infestation due to *E. vittella* was recorded in the treatment of emamectin benzoate 5 SG @ 15 g a.i./ha followed by spinosad 2.5 SC @ 50 g a.i./ha (4.9%) and indoxacarb 14.5 SC @ 50 g a.i./ha (5.2%) which support the present investigation.

Conclusion

Shoot and fruit borer is major key pest of okra (*Abelmoschus esculentus* (L.) with significant damage potential that needs exploration of pest management strategies from time to time to keep the pest below ETL.

The present study had indicated that all applied insecticides bio-pesticides were significantly superior over the untreated control for their fruit infestation on number and weight basis. However, on the basis of different tested bio-insecticides Emectin benzoate 5SG @ 1g/ 5liter of water showed best option for controlling shoot and fruit borer of okra (*E. vittella)* followed byS pinosad 45 SC@1 mi/ 5 liter of water. Finally, concluded that Emectin benzoate 5SG @ 1g/ 5liter of water could be a better alternative for sustainable management of shoot and fruit borer in okra. Farmers may be advised to use this insecticide for the effective management offruit borer of okra (*E. vittella)* and forbetter yield.

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