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Bioefficacy of Newer and Biorational Insecticides against Shoot and Fruit Borer, *Earias* spp. on Okra

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A B S T R A C T

An experiment was conducted on bioefficacy of newer and biorational insecticides against shoot and fruit borer on okra. Efficacy of insecticides tested against *Earias spp* on okra indicated that the minimum per cent infestation of shoot and fruit borer was found in the treatment of indoxacarb (1.36%) followed by spinosad (1.75%), emamectin benzoate (2.57%) and fipronil (2.98%). The acetamiprid, acephate, dimethoate/ malathion and NSKE registered 3.25, 4.23, 4.81 and 5.28 per cent infestation of shoot and fruit borer and existed in moderate group of efficacy. The treatments of *B. bassiana* with 6.80 per cent infestation proved least effective followed by *Btk* (6.17%).

Introduction

Okra, *Abelmoschus esculentus* (L.) Moench commonly known as *bhindi* or lady's finger (family: Malvaceae) is a popular fruit vegetable crop and said to be originated from Africa. It is an important summer and rainy season vegetable crop grown throughout the world.

In India, it is cultivated throughout the country occupying an area of 507 thousand hectares with an annual production of 5853 thousand metric tones during 2014-15 (Anonymous, 2015). In Rajasthan, it is grown in an area of 4.21 thousand hectares with an annual production to the tune of 16.64 thousand metric tonnes (Anonymous, 2015).

The crop, right from germination to harvesting is attacked by about 72 species of insect pests (Rao and Rajendran, 2003). Among them, the shoot and fruit borer (*E. insulana* and *E. vittella*) is one of the most serious pests of okra. The larvae bore into the terminal growing shoots, floral buds, flowers and fruits of okra, resulting in cessation, withering and drying of infested shoots, tender leaves and heavy shedding of floral buds and flowers. The infested fruits become malformed and are rendered unfit for human consumption as well as for procurement of the seeds. The borer has been reported to cause 24.6 to 26.0 per cent damage to okra shoots (Pareek *et al.*, 1986; Zala *et al.*, 1999) and 40

to 100 per cent loss to fruits (Dhawan and Sidhu, 1984; Kumawat, 1997; Shah *et al.*, 2001; Pareek and Bhargava, 2003; Shinde *et al.*, 2007).

The chemical control has been suggested by many workers to combat with the insect pests of okra (Samuthiravelu and David, 1991; Manjanaik *et al.*, 2002) but due to one or other reasons, could not become panacea in protection of the crop. The use of insecticides have undoubtedly resulted in the maximum production but the proliferation of insecticides and their unilateral utilization have created many problems such as development of resistance in insect pests to insecticides, resurgence of insect pests, outbreak of secondary insect pests, insecticidal residues etc. The heavy dependence on highly toxic insecticides leads to produce toxicity hazards to environment. Keeping the point in view, field trials on management of *Earias spp* through different newer and biorational insecticides in okra were conducted and the results are presented.

Materials and Methods

Investigation on the bioefficacy of newer and biorational insecticides was carried out at the experimental farm, Niche Area of Excellance, Swami Keshwanand Rajasthan Agricultural University, Bikaner (Rajasthan) during *kharif* 2013 and 2014. The experiment was laid out in simple randomized block design (RBD) with eleven treatments including untreated control, each replicated thrice. The plot size was kept 3.0 x 2.25 m^2 keeping row to row and plant to plant distance of 45 and 30 cm, respectively. The okra variety, Parbhani Kranti was used in experiment and was sown on 5th July, 2013 and 2014.

Three foliar sprays of all the insecticides were given at three weeks interval. The spray was done by using knap sack sprayer. Utmost care was taken to check the drift of insecticides by putting polythene check screen around each plot at the time of spraying. The quantity of water used for plot was increased depending on the growth of the crop. The quantity of spray solutions required for full coverage in first, second and third insecticidal application were 500, 600 and 650 litres per hectare, respectively.

The shoot damage (due to shoot and fruit borer) was recorded at weekly interval while fruit damage at each picking. The yield data were recorded at each picking and were converted per hectare. The data on shoot and fruit borer, *Earias* spp. were recorded on five randomly selected and tagged plants throughout the crop period by visual count of the plant in which the top portion was damaged, started after two week of sowing to last picking of the fruits.

The per cent shoot infestation was calculated by counting the total number of shoots and the number of damaged shoots. In case of fruit borer, the observations were recorded on infestation of fruits both on number and weight basis at each picking starting from 13th August, 2013 and 15th August, 2014 till last picking of fruits during two consecutive years. The per cent infestation of fruits on number basis was calculated by counting the infested and healthy fruits separately from selected tagged plants.

The weight of both healthy and infested fruits was taken separately and level of infestation was worked out in per cent.

The data on per cent infestation of shoots and fruits of okra (*kharif*, 2013, *kharif*, 2014 and pooled) were transformed into angular values and subjected to analysis of variance. The healthy fruits of all the pickings in each treatment were pooled together to work out the total yield.

Results and Discussion

Shoot damage by *Earias* spp.

The treatment of indoxacarb with 1.36 per cent infestation of shoot was found to be the most effective followed by spinosad (1.75%), emamectin benzoate (2.57%) and fipronil (2.98%) based on pooled data of *Kharif* 2013 and 2014 in the present investigation (Table 1).

Dabhi *et al.,* (2012) reported indoxacarb @ 0.0075% had significantly superior over other treatments in controlling *E. vittella* in okra, corroborates with the present findings.

Shinde *et al.,* (2011) reported spinosad 0.005 per cent followed by indoxacarb 0.01 per cent and profenophose 0.08 per cent as the most effective insecticides in controlling okra shoot and fruit borer, support the present findings. Naik and Kumar (2014) tested different insecticides and reported spinosad 45 SC @ 0.005% most effective against shoot and fruit borer (Table 2).

Patra *et al.,* (2009) determined the field efficacy of emamectin benzoate and recorded the lowest shoot infestation of shoot and fruit borer, conform the present findings.

Parthiban *et al.,* (2014) reported emamectin benzoate 5 WG (125 and 150 g/ha) as best insecticide and reduced more than 90 per cent population of *E. vittella* on okra corroborate the present findings.

The treatments of acetamiprid, acephate, dimethoate and NSKE registered 3.25, 4.23, 4.81 and 5.28 per cent infestation of shoot and existed in moderate group of efficacy. Das *et al.,* (2001) evaluated the bio-efficacy of different pesticides and observed 12.42 and 14.25 infestation in acetamiprid and acephate, respectively partially support the present findings. Rana (1983) and Dangi and Ameta (2005) tested acephate 0.05 per cent (750 g/ha) on okra was found most effective on the basis of per cent shoot and fruit infestation partially support the present findings.

The treatments of *B. bassiana* with 6.80 per cent infestation of shoot proved least effective followed by *Btk* (6.17%). Lal (1997), Singh *et al.,* (1998) and Awasthi *et al.,* (2006) evaluated the bio-efficacy of *B. thuringiensis* and four insecticides against okra shoot and fruit borer and reported *B. thuringiensis* as less effective, conform the present findings.

The results were not corroborated with those of Sarode and Gahbane (1998), Patil *et al.,* (2004) and Shinde *et al.,* (2007) who reported neem seed kernel extract ineffective in controlling the shoot and fruit borer.

Fruit damage by *Earias* spp.

Based on the pooled date of *Kharif* 2013 and 2014, the treatment of indoxacarb (3.86 and 4.10%), was found to be the most effective followed by spinosad (4.30 and 4.76%), emamectin benzoate (4.64 and 5.08%) and acetamiprid (5.16 and 5.30%) damage both on number and weight basis, respectively.

Dhanalakshmi and Mallapur (2010) reported emamectin benzoate 5 SG @ 0.2 g/l (7.82% damage) as most effective insecticide followed by spinosad 45 SC @ 0.1 ml/l (9.9% damage) and indoxacarb 14.5 SC @ 0.3 ml/l (10.74% damage) against fruit borer of okra, to some extent corroborate with the present findings.

Hirekurubar and Ambekar (2008) reported indoxacarb as the most effective treatment in reducing the okra shoot and fruit borer damage by registering 5.14 and 4.16% damage on number and weight basis, respectively support the present findings.

Table.1 Bioefficacy of newer and biorational insecticides against shoot and fruit borer, *Earias* spp. on okra (*kharif*, 2013)

S. No.	Treatments	Conc. (%)/ Dosage	Mean per cent infestation of shoots after								Mean
			First spray				Second spray				
			1 Day	3 Day	7 Day	15 Day	1 Day	3 Day	7 Day	15 Day	
1.	Acetamiprid 20 SP	0.004	3.10	2.37	3.68	4.66	3.17	2.12	2.98	3.36	3.18
			(10.14)	(8.86)	(11.06)	(12.47)	(10.26)	(8.37)	(9.94)	(10.56)	(10.27)
2.	Fipronil 5 SC	0.01	1.86	0.95	2.00	3.10	2.02	1.52	1.77	2.00	3.78
			(7.84)	(5.59)	(8.13)	(10.14)	(8.17)	(7.08)	(7.65)	(8.13)	(11.20)
3.	Acephate 75 SP	0.037	4.00	3.23	4.13	5.73	4.64	3.54	3.81	4.73	4.23
			(11.54)	(10.35)	(11.73)	(13.85)	(12.44)	(10.84)	(11.26)	(12.56)	(11.86)
4.	NSKE	5.0	5.11	4.36	4.84	6.79	5.77	4.38	4.49	5.91	5.21
			(13.06)	(12.05)	(12.71)	(15.10)	(13.90)	(12.08)	(12.23)	(14.07)	(13.19)
5.	*Bt* var. *kurstaki*	1 ml l^{-1}	5.56	4.59	5.26	6.94	7.13	6.60	6.79	8.33	6.40
			(13.64)	(12.37)	(13.26)	(15.27)	(15.49)	(14.89)	(15.10)	(16.78)	(14.65)
6.	*Beauveria bassiana*	1 g l^{-1}	6.00	5.13	5.73	7.18	7.31	6.69	7.04	8.69	6.72
			(14.18)	(13.09)	(13.85)	(15.54)	(15.69)	(14.99)	(15.39)	(17.14)	(15.03)
7.	Indoxacarb 14.5 SC	0.01	1.43	0.39	1.44	2.36	1.12	0.73	0.97	1.62	1.26
			(6.87)	(3.58)	(6.89)	(8.84)	(6.07)	(4.90)	(5.65)	(7.31)	(6.44)
8.	Emamectin benzoate 5 SG	15 g a.i. ha^{-1}	2.72	1.57	2.67	4.22	2.12	1.66	2.12	2.47	2.44
			(9.49)	(7.20)	(9.40)	(11.85)	(8.37)	(7.40)	(8.37)	(9.04)	(8.99)
9.	Spinosad 2.5 SC	0.01	1.78	1.12	1.75	2.89	1.33	1.00	1.47	1.83	1.65
			(7.67)	(6.07)	(7.60)	(9.79)	(6.62)	(5.74)	(6.96)	(7.77)	(7.37)
10.	Dimethoate 30EC/ Malathion 50EC	0.03/ 0.05	4.81	3.70	4.87	6.00	4.87	3.75	4.97	5.14	4.76
			(12.67)	(11.09)	(12.75)	(14.18)	(12.75)	(11.17)	(12.88)	(13.10)	(12.61)
11.	Control (untreated)		7.11	7.50	8.16	8.72	8.14	8.26	8.54	9.41	8.23
			(15.46)	(15.89)	(16.60)	(17.18)	(16.58)	(16.70)	(16.99)	(17.86)	(16.67)
	S.Em. ±		1.07	0.99	1.06	1.19	1.25	1.12	1.16	1.28	1.14
	CD (=0.05)		3.15	2.93	3.13	3.50	3.69	3.31	3.41	3.77	3.38

* Mean of three replications; Figures in parentheses are angular transformed values

Table.2 Bioefficacy of newer and biorational insecticides against shoot and fruit borer, *Earias* spp. on okra (*kharif*, 2014)

S. No.	Treatments	Conc. (%)/ Dosage	Mean per cent infestation of shoots after								Mean
			First spray				Second spray				
			1 Day	3 Day	7 Day	15 Day	1 Day	3 Day	7 Day	15 Day	
1.	Acetamiprid 20 SP	0.004	3.87	2.80	3.58	4.00	3.00	2.80	2.98	3.54	3.32
			(11.35)	(9.63)	(10.91)	(11.54)	(9.97)	(9.63)	(9.94)	(10.84)	(10.50)
2.	Fipronil 5 SC	0.01	2.18	1.46	2.38	3.11	2.11	1.43	1.96	2.87	2.19
			(8.49)	(6.94)	(8.87)	(10.16)	(8.35)	(6.87)	(8.05)	(9.75)	(8.51)
3.	Acephate 75 SP	0.037	4.23	3.39	4.97	5.27	4.26	3.71	3.88	4.23	4.24
			(11.87)	(10.61)	(12.88)	(13.27)	(11.91)	(11.11)	(11.36)	(11.87)	(11.89)
4.	NSKE	5.0	5.43	4.32	4.53	6.12	5.25	4.96	5.66	6.54	5.35
			(13.48)	(12.00)	(12.29)	(14.32)	(13.25)	(12.87)	(13.76)	(14.82)	(13.38)
5.	*Bt* var. *kurstaki*	1 ml l^{-1}	5.75	4.65	4.94	7.25	6.00	5.22	6.44	7.20	5.93
			(13.87)	(12.45)	(12.84)	(15.62)	(14.18)	(13.21)	(14.70)	(15.56)	(14.10)
6.	*Beauveria bassiana*	1 g l^{-1}	6.72	5.54	5.86	8.07	7.14	6.24	7.07	8.42	6.88
			(15.02)	(13.61)	(14.01)	(16.50)	(15.50)	(14.47)	(15.42)	(16.87)	(15.21)
7.	Indoxacarb 14.5 SC	0.01	1.69	0.49	1.10	2.57	1.54	0.74	1.21	2.38	1.47
			(7.47)	(4.01)	(6.02)	(9.23)	(7.13)	(4.93)	(6.32)	(8.87)	(6.95)
8.	Emamectin benzoate 5 SG	15 g a.i. ha^{-1}	3.07	2.44	3.19	3.67	2.66	1.69	1.78	3.00	2.69
			(10.09)	(8.99)	(10.29)	(11.04)	(9.39)	(7.47)	(7.67)	(9.97)	(9.44)
9.	Spinosad 2.5 SC	0.01	1.87	0.88	1.75	2.97	1.76	1.26	1.57	2.83	1.86
			(7.86)	(5.38)	(7.60)	(9.92)	(7.62)	(6.45)	(7.20)	(9.68)	(7.84)
10.	Dimethoate 30EC/ Malathion 50EC	0.03/ 0.05	5.00	4.13	4.99	5.82	4.95	3.87	4.82	5.30	4.86
			(12.92)	(11.73)	(12.91)	(13.96)	(12.86)	(11.35)	(12.68)	(13.31)	(12.74)
11.	Control (untreated)		7.75	8.00	8.49	9.70	7.65	8.25	8.39	9.75	8.50
			(16.16)	(16.43)	(16.94)	(18.15)	(16.06)	(16.69)	(16.84)	(18.19)	(16.95)
	S.Em. ±		1.13	1.03	1.07	1.25	1.16	1.09	1.16	1.27	1.15
	CD (=0.05)		3.34	3.05	3.17	3.68	3.41	3.22	3.41	3.74	3.38

* Mean of three replications; Figures in parentheses are angular transformed values

Table.3 Bioefficacy of newer and biorational insecticides against shoot and fruit borer, *Earias* spp. on okra (Pooled, *kharif*, 2013 and 2014)

S. No.	Treatments	Conc. (%)/ Dosage	Mean per cent infestation of shoots after								
			First spray				Second spray				Mean
			1 Day	3 Day	7 Day	15 Day	1 Day	3 Day	7 Day	15 Day	
1.	Acetamiprid 20 SP	0.004	3.49	2.59	3.63	4.33	3.09	2.46	2.98	3.45	3.25
			(10.76)	(9.25)	(10.98)	(12.01)	(10.12)	(9.02)	(9.94)	(10.70)	(10.39)
2.	Fipronil 5 SC	0.01	2.02	1.21	2.19	3.11	4.13	1.48	1.87	2.44	2.98
			(8.17)	(6.30)	(8.51)	(10.15)	(11.73)	(6.98)	(7.85)	(8.98)	(9.94)
3.	Acephate 75 SP	0.037	4.12	3.31	4.55	5.50	4.45	3.63	3.85	4.48	4.23
			(11.70)	(10.48)	(12.32)	(13.56)	(12.18)	(10.98)	(11.31)	(12.22)	(11.87)
4.	NSKE	5.0	5.27	4.34	4.69	6.46	5.51	4.67	5.08	6.23	5.28
			(13.27)	(12.02)	(12.50)	(14.72)	(13.58)	(12.48)	(13.02)	(14.45)	(13.28)
5.	*Bt* var. *kurstaki*	1 ml l^{-1}	5.66	4.62	5.10	7.10	6.57	5.91	6.62	7.77	6.17
			(13.76)	(12.41)	(13.05)	(15.45)	(14.85)	(14.07)	(14.90)	(16.18)	(14.38)
6.	*Beauveria bassiana*	1 g l^{-1}	6.36	5.34	5.80	7.63	7.23	6.47	7.06	8.56	6.80
			(14.61)	(13.35)	(13.93)	(16.03)	(15.59)	(14.73)	(15.40)	(17.01)	(15.12)
7.	Indoxacarb 14.5 SC	0.01	1.56	0.44	1.27	2.47	1.33	0.74	1.09	2.00	1.36
			(7.17)	(3.80)	(6.47)	(9.03)	(6.62)	(4.92)	(5.99)	(8.13)	(6.70)
8.	Emamectin benzoate 5 SG	15 g a.i. ha^{-1}	2.90	2.01	2.93	3.95	2.39	1.68	1.95	2.74	2.57
			(9.80)	(8.14)	(9.86)	(11.46)	(8.89)	(7.44)	(8.03)	(9.52)	(9.22)
9.	Spinosad 2.5 SC	0.01	1.83	1.00	1.75	2.93	1.55	1.13	1.52	2.33	1.75
			(7.76)	(5.74)	(7.60)	(9.86)	(7.14)	(6.10)	(7.08)	(8.78)	(7.61)
10.	Dimethoate 30EC/ Malathion 50EC	0.03/ 0.05	4.91	3.92	4.93	5.91	4.91	3.81	4.90	5.22	4.81
			(12.80)	(11.41)	(12.83)	(14.07)	(12.80)	(11.26)	(12.78)	(13.21)	(12.67)
11.	Control (untreated)		7.43	7.75	8.33	9.21	7.90	8.26	8.47	9.58	8.36
			(15.82)	(16.16)	(16.77)	(17.67)	(16.32)	(16.70)	(16.91)	(18.03)	(16.81)
	S.Em. ±		1.10	1.01	1.07	1.22	1.21	1.11	1.16	1.27	1.15
	CD (=0.05)		3.25	2.99	3.15	3.59	3.56	3.26	3.41	3.75	3.38

* Mean of three replications; Figures in parentheses are angular transformed values

Table.4 Bioefficacy of newer and biorational insecticides against shoot and fruit borer, *Earias* spp. on okra (Number basis) (*kharif*, 2013)

S. No.	Treatments	Conc. (%)/ Dosage	Mean per cent infestation of fruits after								
			Second spray				Third spray				Mean
			1 Day	3 Day	7 Day	15 Day	1 Day	3 Day	7 Day	15 Day	
1.	Acetamiprid 20 SP	0.004	4.16	3.70	5.34	7.53	4.52	3.24	5.79	7.65	5.24
			(11.77)	(11.09)	(13.36)	(15.93)	(12.27)	(10.37)	(13.92)	(16.06)	(13.23)
2.	Fipronil 5 SC	0.01	5.72	4.26	6.64	7.90	5.29	4.11	6.80	8.00	6.09
			(13.84)	(11.91)	(14.93)	(16.32)	(13.30)	(11.70)	(15.12)	(16.43)	(14.29)
3.	Acephate 75 SP	0.037	6.88	5.18	7.77	8.29	5.54	4.30	6.86	8.25	6.63
			(15.21)	(13.16)	(16.19)	(16.73)	(13.61)	(11.97)	(15.18)	(16.69)	(14.93)
4.	NSKE	5.0	7.49	6.33	8.92	9.24	6.35	5.20	6.97	8.43	7.37
			(15.88)	(14.57)	(17.38)	(17.70)	(14.60)	(13.18)	(15.31)	(16.88)	(15.75)
5.	*Bt* var. *kurstaki*	1 ml l^{-1}	8.68	7.09	7.12	10.00	8.14	7.42	7.76	9.21	8.18
			(17.13)	(15.44)	(15.48)	(18.43)	(16.58)	(15.81)	(16.17)	(17.67)	(16.62)
6.	*Beauveria bassiana*	1 g l^{-1}	9.17	8.00	8.30	10.41	9.00	8.15	8.43	9.76	8.90
			(17.63)	(16.43)	(16.74)	(18.82)	(17.46)	(16.59)	(16.88)	(18.20)	(17.36)
7.	Indoxacarb 14.5 SC	0.01	3.15	2.08	4.78	5.04	3.43	2.66	5.40	6.23	4.10
			(10.22)	(8.29)	(12.63)	(12.97)	(10.67)	(9.39)	(13.44)	(14.45)	(11.68)
8.	Emamectin benzoate 5 SG	15 g a.i. ha^{-1}	3.98	3.00	5.10	6.74	4.19	3.76	5.63	7.02	4.93
			(11.51)	(9.97)	(13.05)	(15.05)	(11.81)	(11.18)	(13.73)	(15.36)	(12.83)
9.	Spinosad 2.5 SC	0.01	3.45	2.73	4.87	6.60	4.66	3.20	5.81	6.52	4.73
			(10.70)	(9.51)	(12.75)	(14.89)	(12.47)	(10.30)	(13.95)	(14.79)	(12.56)
10.	Dimethoate 30EC/ Malathion 50EC	0.03/ 0.05	7.17	6.20	8.88	9.00	6.20	5.00	6.66	8.23	7.17
			(15.53)	(14.42)	(17.34)	(17.46)	(14.42)	(12.92)	(14.96)	(16.67)	(15.53)
11.	Control (untreated)		10.96	12.34	13.65	15.27	11.23	12.14	14.60	16.55	13.34
			(19.33)	(20.57)	(21.68)	(23.00)	(19.58)	(20.39)	(22.46)	(24.01)	(21.42)
	S.Em. ±		0.84	0.82	0.86	0.96	0.86	0.82	0.87	0.94	0.87
	CD (=0.05)		2.50	2.45	2.56	2.84	2.58	2.44	2.61	2.78	2.59

* Mean of three replications ; Figures in parentheses are angular transformed values

Table.5 Bioefficacy of newer and biorational insecticides against shoot and fruit borer, *Earias* spp. on okra (Number basis) (*kharif*, 2014)

S. No.	Treatments	Conc. (%)/ Dosage	Mean per cent infestation of fruits after								Mean
			Second spray				Third spray				
			1 Day	3 Day	7 Day	15 Day	1 Day	3 Day	7 Day	15 Day	
1.	Acetamiprid 20 SP	0.004	4.45	3.90	5.25	5.60	4.46	3.40	6.42	7.12	5.08
			(12.18)	(11.39)	(13.25)	(13.69)	(12.19)	(10.63)	(14.68)	(15.48)	(13.02)
2.	Fipronil 5 SC	0.01	5.81	4.55	6.44	6.83	5.02	4.62	6.69	7.87	5.98
			(13.95)	(12.32)	(14.70)	(15.15)	(12.95)	(12.41)	(14.99)	(16.29)	(14.15)
3.	Acephate 75 SP	0.037	5.98	4.05	6.64	6.98	6.29	5.78	7.14	8.07	6.37
			(14.15)	(11.61)	(14.93)	(15.32)	(14.52)	(13.91)	(15.50)	(16.50)	(14.61)
4.	NSKE	5.0	7.29	6.00	6.27	8.92	7.66	6.57	6.77	9.29	7.35
			(15.66)	(14.18)	(14.50)	(17.38)	(16.07)	(14.85)	(15.08)	(17.75)	(15.73)
5.	*Bt* var. *kurstaki*	1 ml l^{-1}	8.26	7.12	7.90	9.56	8.12	7.45	7.84	10.36	8.33
			(16.70)	(15.48)	(16.32)	(18.01)	(16.56)	(15.84)	(16.26)	(18.78)	(16.77)
6.	*Beauveria bassiana*	1 g l^{-1}	9.11	8.46	8.98	10.22	9.37	8.40	8.97	11.42	9.37
			(17.57)	(16.91)	(17.44)	(18.64)	(17.82)	(16.85)	(17.43)	(19.75)	(17.82)
7.	Indoxacarb 14.5 SC	0.01	2.77	1.90	3.89	4.72	3.17	2.82	4.56	5.21	3.63
			(9.58)	(7.92)	(11.38)	(12.55)	(10.26)	(9.67)	(12.33)	(13.19)	(10.98)
8.	Emamectin benzoate 5 SG	15 g a.i. ha^{-1}	3.59	2.96	4.59	5.02	4.00	3.19	5.08	6.37	4.35
			(10.92)	(9.91)	(12.37)	(12.95)	(11.54)	(10.29)	(13.03)	(14.62)	(12.04)
9.	Spinosad 2.5 SC	0.01	3.05	2.80	4.00	4.80	3.29	2.89	4.78	5.36	3.87
			(10.06)	(9.63)	(11.54)	(12.66)	(10.45)	(9.79)	(12.63)	(13.39)	(11.35)
10.	Dimethoate 30EC/ Malathion 50EC	0.03/ 0.05	6.25	5.09	7.72	8.00	6.56	5.85	7.74	8.59	6.98
			(14.48)	(13.04)	(16.13)	(16.43)	(14.84)	(14.00)	(16.15)	(17.04)	(15.31)
11.	Control (untreated)		12.16	13.67	15.25	17.45	12.41	14.79	16.62	18.28	15.08
			(20.41)	(21.70)	(22.99)	(24.69)	(20.63)	(22.62)	(24.06)	(25.31)	(22.85)
	S.Em. ±		1.02	0.99	1.03	1.11	1.03	1.00	1.05	1.20	1.05
	CD (=0.05)		3.02	2.95	3.08	3.30	3.08	2.97	3.15	3.57	3.14

* Mean of three replications; Figures in parentheses are angular transformed values

Table.6 Bioefficacy of newer and biorational insecticides against shoot and fruit borer, *Earias* spp. infesting okra (Number basis) (Pooled, *kharif*, 2013 and 2014)

S. No.	Treatments	Conc. (%)/ Dosage	Mean per cent infestation of fruits after								Mean
			Second spray				Third spray				
			1 Day	3 Day	7 Day	15 Day	1 Day	3 Day	7 Day	15 Day	
1.	Acetamiprid 20 SP	0.004	4.31	3.80	5.30	6.57	4.49	3.32	6.11	7.39	5.16
			(11.98)	(11.24)	(13.30)	(14.85)	(12.23)	(10.50)	(14.30)	(15.77)	(13.13)
2.	Fipronil 5 SC	0.01	5.77	4.41	6.54	7.37	5.16	4.37	6.75	7.94	6.03
			(13.89)	(12.12)	(14.82)	(15.75)	(13.12)	(12.06)	(15.05)	(16.36)	(14.22)
3.	Acephate 75 SP	0.037	6.43	4.62	7.21	7.64	5.92	5.04	7.00	8.16	6.50
			(14.69)	(12.41)	(15.57)	(16.04)	(14.08)	(12.97)	(15.34)	(16.60)	(14.77)
4.	NSKE	5.0	7.39	6.17	7.60	9.08	7.01	5.89	6.87	8.86	7.36
			(15.77)	(14.38)	(16.00)	(17.54)	(15.35)	(14.04)	(15.20)	(17.32)	(15.74)
5.	*Bt* var. *kurstaki*	1 ml l^{-1}	8.47	7.11	7.51	9.78	8.13	7.44	7.80	9.79	8.25
			(16.92)	(15.46)	(15.91)	(18.22)	(16.57)	(15.82)	(16.22)	(18.23)	(16.69)
6.	*Beauveria bassiana*	1 g l^{-1}	9.14	8.23	8.64	10.32	9.19	8.28	8.70	10.59	9.13
			(17.60)	(16.67)	(17.09)	(18.73)	(17.64)	(16.72)	(17.15)	(18.99)	(17.59)
7.	Indoxacarb 14.5 SC	0.01	2.96	1.99	4.34	4.88	3.30	2.74	4.98	5.72	3.86
			(9.91)	(8.11)	(12.02)	(12.76)	(10.47)	(9.53)	(12.89)	(13.84)	(11.34)
8.	Emamectin benzoate 5 SG	15 g a.i. ha^{-1}	3.79	2.98	4.85	5.88	4.10	3.48	5.36	6.70	4.64
			(11.22)	(9.94)	(12.72)	(14.03)	(11.68)	(10.74)	(13.38)	(15.00)	(12.44)
9.	Spinosad 2.5 SC	0.01	3.25	2.77	4.44	5.70	3.98	3.05	5.30	5.94	4.30
			(10.39)	(9.57)	(12.16)	(13.81)	(11.50)	(10.05)	(13.30)	(14.11)	(11.97)
10.	Dimethoate 30EC/ Malathion 50EC	0.03/ 0.05	6.71	5.65	8.30	8.50	6.38	5.43	7.20	8.41	7.07
			(15.01)	(13.74)	(16.74)	(16.95)	(14.63)	(13.47)	(15.56)	(16.86)	(15.42)
11.	Control (untreated)		11.56	13.01	14.45	16.36	11.82	13.47	15.61	17.42	14.21
			(19.88)	(21.14)	(22.34)	(23.86)	(20.11)	(21.53)	(23.27)	(24.67)	(22.15)
	S.Em. ±		0.93	0.90	0.95	1.03	0.95	0.91	0.96	1.07	0.96
	CD (=0.05)		2.76	2.70	2.82	3.07	2.83	2.70	2.88	3.17	2.87

* Mean of three replications; Figures in parentheses are angular transformed values

Table.7 Bioefficacy of newer and biorational insecticides against shoot and fruit borer, *Earias* spp. on okra (Weight basis) *kharif*, 2013

S. No.	Treatments	Conc. (%)/ Dosage	Mean per cent infestation of fruits after								Mean
			Second spray				Third spray				
			1 Day	3 Day	7 Day	15 Day	1 Day	3 Day	7 Day	15 Day	
1.	Acetamiprid 20 SP	0.004	4.00	3.52	5.14	7.10	4.33	3.11	5.42	7.12	4.97
			(11.54)	(10.81)	(13.10)	(15.45)	(12.01)	(10.16)	(13.46)	(15.48)	(12.88)
2.	Fipronil 5 SC	0.01	5.61	4.12	6.52	7.76	5.17	3.82	6.44	7.70	5.89
			(13.70)	(11.71)	(14.79)	(16.17)	(13.14)	(11.27)	(14.70)	(16.11)	(14.05)
3.	Acephate 75 SP	0.037	6.72	5.00	7.61	8.02	5.22	4.15	6.39	8.00	6.39
			(15.02)	(12.92)	(16.01)	(16.45)	(13.21)	(11.75)	(14.64)	(16.43)	(14.64)
4.	NSKE	5.0	7.36	6.82	7.00	9.32	6.14	5.00	6.72	8.04	7.05
			(15.74)	(15.14)	(15.34)	(17.78)	(14.35)	(12.92)	(15.02)	(16.47)	(15.40)
5.	*Bt* var. *kurstaki*	1 ml l^{-1}	8.22	6.90	6.94	9.62	7.95	7.06	7.20	8.34	7.78
			(16.66)	(15.23)	(15.27)	(18.07)	(16.38)	(15.41)	(15.56)	(16.79)	(16.19)
6.	*Beauveria bassiana*	1 g l^{-1}	9.00	7.82	8.03	10.05	8.72	8.00	8.11	9.03	8.60
			(17.46)	(16.24)	(16.46)	(18.48)	(17.18)	(16.43)	(16.55)	(17.49)	(17.05)
7.	Indoxacarb 14.5 SC	0.01	3.00	1.95	4.66	5.00	3.31	2.52	5.21	6.00	3.96
			(9.97)	(8.03)	(12.47)	(12.92)	(10.48)	(9.13)	(13.19)	(14.18)	(11.47)
8.	Emamectin benzoate 5 SG	15 g a.i. ha^{-1}	3.84	2.90	5.00	6.65	4.00	3.59	5.22	6.62	4.73
			(11.30)	(9.80)	(12.92)	(14.94)	(11.54)	(10.92)	(13.21)	(14.91)	(12.56)
9.	Spinosad 2.5 SC	0.01	3.34	2.68	4.63	6.45	4.52	3.07	5.70	6.34	4.59
			(10.53)	(9.42)	(12.43)	(14.71)	(12.27)	(10.09)	(13.81)	(14.58)	(12.37)
10.	Dimethoate 30EC/ Malathion 50EC	0.03/ 0.05	7.04	6.06	8.64	8.80	6.00	4.81	6.49	8.00	6.98
			(15.39)	(14.25)	(17.09)	(17.26)	(14.18)	(12.67)	(14.76)	(16.43)	(15.32)
11.	Control (untreated)		10.10	12.00	13.16	14.29	10.25	11.35	13.00	14.50	12.33
			(18.53)	(20.27)	(21.27)	(22.21)	(18.67)	(19.69)	(21.13)	(22.38)	(20.56)
	S.Em. ±		0.85	0.81	0.83	0.93	0.84	0.79	0.84	0.89	0.85
	CD (=0.05)		2.52	2.41	2.48	2.75	2.51	2.37	2.51	2.64	2.52

* Mean of three replications; Figures in parentheses are angular transformed values

Table.8 Bioefficacy of newer and biorational insecticides against shoot and fruit borer, *Earias* spp. on okra (Weight basis) *kharif*, 2014

S. No.	Treatments	Conc. (%)/ Dosage	Mean per cent infestation of fruits after								Mean
			Second spray				Third spray				
			1 Day	3 Day	7 Day	15 Day	1 Day	3 Day	7 Day	15 Day	
1.	Acetamiprid 20 SP	0.004	5.09	4.26	6.29	7.44	4.70	3.95	6.07	7.20	5.63
			(13.04)	(11.91)	(14.52)	(15.83)	(12.52)	(11.46)	(14.26)	(15.56)	(13.72)
2.	Fipronil 5 SC	0.01	6.35	5.27	7.45	8.82	6.11	5.05	7.31	8.55	6.86
			(14.60)	(13.27)	(15.84)	(17.28)	(14.31)	(12.99)	(15.69)	(17.00)	(15.19)
3.	Acephate 75 SP	0.037	7.00	6.73	7.89	8.75	6.90	6.62	7.73	8.65	7.53
			(15.34)	(15.04)	(16.31)	(17.21)	(15.23)	(14.91)	(16.14)	(17.10)	(15.93)
4.	NSKE	5.0	8.94	7.20	7.64	10.27	8.74	7.00	7.06	9.91	8.35
			(17.40)	(15.56)	(16.05)	(18.69)	(17.20)	(15.34)	(15.41)	(18.35)	(16.79)
5.	*Bt* var. *kurstaki*	1 ml l^{-1}	9.00	8.75	8.83	10.76	8.94	8.65	8.69	10.57	9.27
			(17.46)	(17.21)	(17.29)	(19.15)	(17.40)	(17.10)	(17.14)	(18.97)	(17.73)
6.	*Beauveria bassiana*	1 g l^{-1}	10.00	9.75	9.90	11.25	9.47	8.80	9.81	10.89	9.98
			(18.43)	(18.19)	(18.34)	(19.60)	(17.92)	(17.26)	(18.25)	(19.27)	(18.42)
7.	Indoxacarb 14.5 SC	0.01	3.59	2.86	4.79	6.16	3.46	2.69	4.56	5.80	4.24
			(10.92)	(9.74)	(12.64)	(14.37)	(10.72)	(9.44)	(12.33)	(13.94)	(11.88)
8.	Emamectin benzoate 5 SG	15 g a.i. ha^{-1}	4.70	4.05	6.17	7.23	4.58	3.86	5.94	7.00	5.44
			(12.52)	(11.61)	(14.38)	(15.60)	(12.36)	(11.33)	(14.11)	(15.34)	(13.49)
9.	Spinosad 2.5 SC	0.01	4.19	3.90	5.15	6.78	4.02	3.74	5.00	6.67	4.93
			(11.81)	(11.39)	(13.12)	(15.09)	(11.57)	(11.15)	(12.92)	(14.97)	(12.83)
10.	Dimethoate 30EC/ Malathion 50EC	0.03/ 0.05	8.21	7.64	8.22	9.67	8.00	7.56	8.10	9.34	8.34
			(16.65)	(16.05)	(16.66)	(18.12)	(16.43)	(15.96)	(16.54)	(17.80)	(16.79)
11.	Control (untreated)		11.23	12.80	14.21	16.62	11.25	12.10	13.00	15.87	13.39
			(19.58)	(20.96)	(22.15)	(24.06)	(19.60)	(20.36)	(21.13)	(23.48)	(21.46)
	S.Em. ±		1.04	1.03	1.06	1.13	1.01	0.98	1.04	1.09	1.05
	CD (=0.05)		3.08	3.08	3.15	3.36	3.02	2.91	3.13	3.23	3.12

* Mean of three replications; Figures in parentheses are angular transformed values

Table.9 Bioefficacy of newer and biorational insecticides against shoot and fruit borer, *Earias* spp. on okra (Weight basis) (Pooled, *kharif*, 2013 and 2014)

S. No.	Treatments	Conc. (%)/ Dosage	Mean per cent infestation of fruits after								
			Second spray				Third spray				Mean
			1 Day	3 Day	7 Day	15 Day	1 Day	3 Day	7 Day	15 Day	
1.	Acetamiprid 20 SP	0.004	4.55	3.89	5.72	7.27	4.52	3.53	5.75	7.16	5.30
			(12.31)	(11.38)	(13.83)	(15.64)	(12.27)	(10.83)	(13.87)	(15.52)	(13.31)
2.	Fipronil 5 SC	0.01	5.98	4.70	6.99	8.29	5.64	4.44	6.88	8.13	6.38
			(14.15)	(12.51)	(15.32)	(16.73)	(13.74)	(12.16)	(15.20)	(16.56)	(14.63)
3.	Acephate 75 SP	0.037	6.86	5.87	7.75	8.39	6.06	5.39	7.06	8.33	6.96
			(15.18)	(14.02)	(16.16)	(16.83)	(14.25)	(13.42)	(15.41)	(16.77)	(15.30)
4.	NSKE	5.0	8.15	7.01	7.32	9.80	7.44	6.00	6.89	8.98	7.70
			(16.59)	(15.35)	(15.70)	(18.24)	(15.83)	(14.18)	(15.22)	(17.43)	(16.11)
5.	*Bt* var. *kurstaki*	1 ml l^{-1}	8.61	7.83	7.89	10.19	8.45	7.86	7.95	9.46	8.53
			(17.06)	(16.24)	(16.31)	(18.62)	(16.89)	(16.28)	(16.37)	(17.91)	(16.98)
6.	*Beauveria bassiana*	1 g l^{-1}	9.50	8.79	8.97	10.65	9.10	8.40	8.96	9.96	9.29
			(17.95)	(17.24)	(17.42)	(19.05)	(17.55)	(16.85)	(17.42)	(18.40)	(17.75)
7.	Indoxacarb 14.5 SC	0.01	3.30	2.41	4.73	5.58	3.39	2.61	4.89	5.90	4.10
			(10.46)	(8.92)	(12.55)	(13.66)	(10.60)	(9.29)	(12.77)	(14.06)	(11.68)
8.	Emamectin benzoate 5 SG	15 g a.i. ha^{-1}	4.27	3.48	5.59	6.94	4.29	3.73	5.58	6.81	5.08
			(11.93)	(10.74)	(13.67)	(15.27)	(11.95)	(11.13)	(13.66)	(15.13)	(13.03)
9.	Spinosad 2.5 SC	0.01	3.77	3.29	4.89	6.62	4.27	3.41	5.35	6.51	4.76
			(11.19)	(10.45)	(12.78)	(14.90)	(11.93)	(10.63)	(13.37)	(14.78)	(12.60)
10.	Dimethoate 30EC/ Malathion 50EC	0.03/ 0.05	7.63	6.85	8.43	9.24	7.00	6.19	7.30	8.67	7.66
			(16.03)	(15.17)	(16.88)	(17.69)	(15.34)	(14.40)	(15.67)	(17.12)	(16.07)
11.	Control (untreated)		10.67	12.40	13.69	15.46	10.75	11.73	13.00	15.19	12.86
			(19.06)	(20.62)	(21.71)	(23.15)	(19.14)	(20.02)	(21.13)	(22.93)	(21.01)
	S.Em. ±		0.94	0.92	0.94	1.03	0.93	0.89	0.94	0.99	0.95
	CD (=0.05)		2.80	2.74	2.81	3.06	2.77	2.64	2.82	2.93	2.82

* Mean of three replications; Figures in parentheses are angular transformed values

The treatments of fipronil (6.03 and 6.38%), acephate (6.50 and 6.96%), dimethoate (7.07 and 7.66%) and NSKE (7.36 and 7.77%) damage both on number and weight basis, respectively existed in moderate group of efficacy (Tables 3–9). Singh *et al.*, (2009) applied three spray of acephate 75 SP @ 1500 g a.i./ha against *E. vittella* and recorded minimum fruit damage 13.96 per cent partially conform the present findings. Rana (1983) and Dangi and Ameta (2005) tested acephate 0.05 per cent (750 g/ha) on okra was found most effective on the basis of per cent shoot and fruit infestation, partially support the present findings. Shinde *et al.*, (2007) recorded minimum fruit infestation by *E. vittella* with the application of neem seed powder @ 50 kg a.i./ha, partially support the present findings.

The treatments of *B. bassiana* (9.13 and 9.29%) damage proved least effective followed by *Btk* (8.25 and 8.53%) on number and weight basis, respectively. Kumawat (1997) found *Btk* less effective against shoot and fruit borer corroborate with the present findings.

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