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Bioefficacy of Coragen against Shoot and Fruit Borer, *Earias vittella* (Fab.) in Okra

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A B S T R A C T

A field experiment was conducted on Okra, *Abelmoschus esculentus* (L.) to evaluate some newer groups of insecticides against shoot and fruit borer, *Earias vittella*. The experiment was lay out in RBD with three replication comprising eight treatments i.e. Indoxacarb @75g a.i/ha, Coragen@30g a.i/ha, Spinosad@100g a.i/ha, Profenophos@750g a.i/ha, Thiodicarb@750g a.i/ha, *Bacillus thuringiensis*@75g a.i/ha, Azadirachtin @ 2.5lit /ha including untreated control were taken for compression. The Coragen treated plot recorded lowest mean fruit damage (6.29 and 6.83%) followed by Spinosad (7.17 and 7.47%) and in control (30.96 and 33.14%). The maximum yield was recorded in treatment Coragen (118.02 and 117.10 q/ha) followed by Spinosad (115.65 and 114.85 q/ha) as compare to control (68.80 and 68.10 q/ha) respectively during *Kharif*, 2012 and *Kharif*, 2013. The highest cost benefit ratio was obtained in Coragen treated plot (1:9.27) followed by Indoxacarb (1:8.08), Spinosad (1:7.89) respectively. The Coragen treatment was more effective to reduce the infestation of fruit as well as to provide highest okra yield.

Introduction

Okra (*Abelmoschus esculentus* L. Moench.) is one of the important malvaceaeous vegetable crops grown all over India and various tropical and subtropical parts of the world. It is called lady's finger in England, gumbo in the United States of America and Bhindi in India. India has area under okra 511 thousand ha and production 5849 thousand MT during 2015-16. About 13 insect pests have been recorded that are known to cause damage to okra (Mandal *et al.,* 2006). Among all pests, shoot and fruit borer, *Earias vittella* (Fabricius) is the most destructive pest of okra as young larva bores into tender shoot in early vegetative growth of plants and grown up larva damages fruits resulting in serious loss in yield. It is one of the major limiting factors in the production of quality fruits of okra (Kharbade *et al.,* 1998). The infestation to okra accounted for nearly 22.5% in Uttar Pradesh (Verma *et al.,* 1985). *Earias vittella* causes considerable damage at vegetative and reproductive stages and acts as major constraints in the production of marketable fruits of okra.

Materials and Methods

The experiment was conducted during the *Kharif* seasons 2012 and 2013 at Students

Instructional Farm, NDUA&T, Kumarganj, Faizabad (UP).The seed of okra (variety-Arka Anamika) was sown in the month of last week of June in both season and all the agronomic and cultural practices recommended for its cultivation were followed as per the requirement. The crop was sown in the plots of 4.5 m x 3 m with row to row and plant to plant spacing 60 cm x 45 cm respectively. Eight treatments including untreated control were taken for experimentation. The experiment was lay out in RBD and replicated thrice comprising Indoxacarb @75g a.i/ha, Coragen@30g a.i/ha, Spinosad@100g a.i/ha, Profenophos@750g a.i/ha, Thiodicarb@750g a.i/ha, *Bacillus thuringiensis*@75g a.i/ha, Azadirachtin @ 2.5lit /ha. All the treatments were applied three times at fortnightly interval using knapsack sprayer. Observation on damage and healthy fruits were recorded separately at each picking to find out the per cent fruit damage. After the last picking, total of all pickings of individual plots produce were calculated to work out the yield of the treatment. Yield of green healthy fruits of each plot was converted into quintal per hectare. The economics of treatment was calculated in term of cost: benefit ratio on the basis of pooled data of fruit yield. All the data were subjected to standard statistical analysis after arc sine transformation to draw the conclusion. The per cent fruit damaged and cost: benefit ratio were calculated by using the following formulae.

$$\text{Per cent fruit damage} = \frac{\text{Number of damaged fruit}}{\text{Total number of fruit}} \times 100$$

$$\text{Cost : benefit ratio} = \frac{\text{Monetary gain over control (Rs/ha)}}{\text{Cost of plant protection (Rs/ha)}}$$

Results and Discussion

Fruit damage

The per cent damage fruit on number basis showed significant differences among all the treatments (Tables 1 and 2). Minimum fruit damage by *Earias* spp on okra was recorded in treatment (T2) coragen (5.50 and 6.38%) followed by T3 (spinosad), T1 (indoxacarb), T4 (profenophos),T5 (thiodicarb),T6 Bt, T7 (Azadirachtin) in which (6.27 and 7.12), (7.15 and 7.80), (12.33 and 13.85), (12.68 and 14.00), (13.75 and 15.78), (15.75 and 16.14) per cent fruit damage respectively in compared to unprotected check (30.32 and 28.70) after Ist spraying at 7th and 15th days of treatments in *Kharif*, 2012 and the similar damage pattern was also recorded in *Kharif*, 2013. Data recorded at 7th and 15th days after IInd spray showed significant differences in all the treatment in compared to unprotected check in both Kharif seasons. Treatment (T2) was most effective (6.78 and 7.35%) followed by T3>T1> T4>T5> T6> T7 in which (7.15 and 7.95), (7.60 and 8.50), (12.50 and 15.50), (12.66 and 16.20), (15.25 and 17.25) and (15.80 and 17.50) per cent fruit damage were noticed during the *Kharif*, 2012 while (7.10 and 7.65), (7.25 and 8.15), (8.05 and 9.30), (12.85 and 16.12), (13.50 and 17.15), (15.75 and 17.50) and (16.30 and 18.50) per cent damaged fruit respectively during *Kharif*, 2013. After the III spray treatments T2 had the least fruit damage (5.60 and 6.12 %) followed by T3, T1, T4, T5, T6, T7 in which (6.80 and 7.70), (7.12 and 8.00), (11.75 and 12.15), (12.05 and 13.50), (13.16 and 15.55), (14.00 and 17.75) and (31.60 and 30.50) per cent fruit damaged were recorded, respectively during *Kharif*, 2012. While in *Kharif*, 2013 it was T2> T3> T1> T4> T5> T6> T7 and T8 with respective fruit damage of (5.80 and 6.40), (7.12 and 7.90), (7.50 and 8.30), (11.09 and 13.77), (12.15 and 14.20), (13.25 and 16.25), (15.60 and 18.50) and (36.10 and 31.12) per cent, respectively.

The pooled mean per cent fruit infestation varied from 6.29 to 30.96 per cent. Coragen T2 was most effective (6.29%) which was at par with treatment T3 spinosad (7.17%) and T1 indoxacarb (7.70%) followed by T4

profenophos (13.01%), T5 thiodicarb (13.52%), T6 Bt (15.12%) and T7 azadirachtin (16.16%) as compared to control (30.96%) respectively during *Kharif* 2012. In *Kharif* 2013, percent fruit infestation on number basis varied from 6.83 to 33.14 per cent. The minimum fruit damage of (6.83%) was recorded in T2 coragen, while T3 spinosad (7.47%) was second effective treatment followed by T1 indoxacarb (8.22%), T4 profenophos (13.41%), T5 thiodicarb (14.46%), T6 Bt (15.90%) and T7 azadirachtin (17.03%) as compared to control 33.14 per cent fruit infestation.

The overall pooled mean of both *Kharif* seasons based on fruit damage showed the maximum fruit damage was recorded in treatment T7 azadirachtin (16.60%) and minimum (6.56%) in T2 coragen followed by T3 spinosad (7.32%), T1 indoxacarb (7.96%), T4 profenophos (13.21%), T5 thiodicarb (13.99%), T6 Bt (15.51%) as compared to control (32.05%). The coragen was most effective treatment followed by spinosad and indoxacarb and azadirachtin was least effective treatment.

These finding collaborated with the result of Sandip *et al.,* (2009), Singh *et al.,* (2010) and Chowdary, *et al.,* (2010) who had reported that the Coragen (rynaxypyr) 20 SC @ 30 g a.i. /ha and Coragen 20 SC @ 20 g a.i. /ha were superior to check the fruit damage and higher okra yield followed by spinosad @ 56 g a.i/ha. Gosalwad and Kawathekar (2009) reported that the minimum fruit infestation was observed in spinosad 45% SC @ 30 g a.i. /ha Shinde *et al.,* (2011) noticed that Spinosad 0.005% and indoxacarb 0.01% were the most effective insecticides in controlling okra shoot and fruit borer. Highest yield of healthy okra fruit was observed in spinosad @0.005 percent. Singh *et al.,* (2010) reported that the Indoxacarb 14.5% SC proved to be the most effective treatment against shoot and fruit borer, *Earias vittella* F. in and it was *at par* with spinosad. Mandal *et al.,* (2006) reported that the *Bacillus thuringensis* @ 500 g /ha and found to be the least effective treatment while, the Meena *et al.,* (2011) reported Azadirachtin (5ml/lit.) was least effective followed by NPV (0.010%) and *B.t.* (0.012%). The findings of these workers are also agreement with the present study.

Fruit yield and cost benefit ratio

All the treatment gave higher fruit yield over unprotected control during both the *Kharif*, seasons (Table 3). The coragen @ 30g a.i. / ha treated plot gave maximum fruit yield (118.02 and 117.10 q/ ha) respectively during *Kharif* 2012 and 2013 followed by T3> T1> T4>T5> T6> and T7 with respective fruit yields of (115.65 and114.85), (105.35 and 104.25), (84.20 and 82.80), (81.60 and 80.84), (77.24 and 76.10) and (73.74 and 72.90) q/ha respectively were significantly superior over unprotected check (68.80 and 68.10 q/ha) during *Kharif* 2012 and 2013. Similar finding was also reported by Umrao *et al.,* (2012), Shimoge and Vemuri (2014) who have reported that the indoxacarb was most effective among all the treatments evaluated against shoot and fruit borer on okra.

Net monitory return in different treatment varied from Rs. 3555 to 65715 per hectare (Table 3). The maximum profit of Rs. 65715/ ha was obtained from the plot treated with T2 coragen followed by T3 spinosad Rs. 61300, T1 indoxacarb Rs 47775, T4 profenophos Rs. 18585, T5 thiodicarb Rs. 14505, T6 Bt Rs. 9930 and least in T7 Azadirachtin Rs. 3555, respectively. The cost benefit ratio (CBR) in different treatment ranged 1:1.95 to 1:9.27, however the highest cost benefit ratio of 1:9.27 per rupee was obtained in T2 treatment followed by T1 (1:8.08) > T3 (1:7.89) > T4 (1:5.66) > T6 (1:4.12) > T5 (1:4.11) and T7 (1:1.95), respectively.

Table.1 Effects of insecticide against *Earias vittella* based on per cent fruit damage on okra (*Kharif*, 2012)

S.No	Treatments	a.i/ha	Pre Treatment	Per cent Fruit Damage DAS (Days After Spraying)						
				Ist Spray		IInd Spray		IIIrd Spray		Mean
				7 DAS	15 DAS	7 DAS	15 DAS	7 DAS	15 DAS	
T_1	Indoxacarb 14.5 EC	75g	21.77 (27.76)	7.15 (15.51)	7.80 (16.21)	7.60 (16.00)	8.50 (16.94)	7.12 (15.47)	8.00 (16.43)	7.70 (16.87)
T_2	Coragen 18.5 SC	30g	19.75 (26.34)	5.50 (13.56	6.38 (14.63)	6.78 (15.09)	7.35 (15.73)	5.60 (13.69)	6.12 (14.32)	6.29 (15.89)
T_3	Spinosad 45 SC	100g	25.94 (30.61)	6.27 (14.50)	7.12 (15.47)	7.15 (15.51)	7.95 (16.38)	6.80 (15.11)	7.70 (16.11)	7.17 (16.46)
T_4	Profenophos 50 EC	750g	21.54 (27.60)	12.33 (20.56)	13.85 (21.85)	12.50 (20.70)	15.50 (23.18)	11.75 (20.05)	12.15 (20.39)	13.01 (19.84)
T_5	Thiodicarb 75 WP	750g	22.70 (28.44)	12.68 (20.86)	14.00 (21.97)	12.66 (20.84)	16.20 (23.73)	12.05 (20.40)	13.50 (21.56)	13.52 (20.09)
T_6	Bt 5%	75g	23.95 (29.27)	13.75 (21.76)	15.78 (23.40)	15.25 (22.98)	17.25 (24.54)	13.16 (21.27)	15.55 (23.22)	15.12 (21.34)
T_7	Azadirachtin 0.03%	2.5lit	26.36 (30.89)	15.75 (23.38)	16.14 (23.69)	15.80 (23.42)	17.50 (24.73)	14.00 (21.97)	17.75 (24.92)	16.16 (22.87)
T_8	Untreated Control	-	28.06 (31.90)	30.32 (33.40)	28.70 (32.39)	30.15 (30.30)	34.50 (35.97)	31.60 (34.20	30.50 (33.52)	30.96 (32.55)
	SEm±		1.40	0.26	0.18	0.39	0.31	0.27	0.23	0.27
	CD at 5%		NS	0.80	0.54	1.17	0.95	0.82	0.70	0.83

*The data in parenthesis is arc sine transformation value
NS- Non significant

Table.2 Effects of insecticide against *Earias vittella* based on per cent fruit damage on okra (*Kharif*, 2013)

S.No	Treatments	a.i/ha	Pre Treatment	Per cent Fruit Damage DAS (Days After Spraying)						
				Ist Spray		IInd Spray		IIIrd Spray		Mean
				7 DAS	15 DAS	7 DAS	15 DAS	7 DAS	15 DAS	
T_1	Indoxacarb 14.5 EC	75g	21.77 (27.81)	7.65 (16.05)	8.50 (16.94)	8.05 (16.48)	9.30 (17.75)	7.50 (15.89)	8.30 (16.74)	8.22 (16.64)
T_2	Coragen 18.5 SC	30g	18.68 (25.56)	6.80 (15.11)	7.25 (15.62)	7.10 (15.45)	7.65 (16.05)	5.80 (13.93)	6.40 (14.65)	6.83 (15.14)
T_3	Spinosad 45 SC	100g	23.61 (29.06)	7.10 (15.45)	7.30 (15.67)	7.25 (15.62)	8.15 (16.59)	7.12 (15.48)	7.90 (16.32)	7.47 (15.86)
T_4	Profenophos 50 EC	750g	22.87 (28.55)	12.60 (20.79)	14.00 (21.97)	12.85 (21.01)	16.12 (23.67)	11.09 (19.43)	13.77 (21.78)	13.41 (21.44)
T_5	Thiodicarb 75 WP	750g	20.23 (26.72)	14.50 (22.38)	15.24 (22.98)	13.50 (21.55)	17.15 (24.46)	12.15 (20.39)	14.20 (22.14)	14.46 (22.32)
T_6	Bt 5%	75g	19.28 (25.95)	15.80 (23.42)	16.85 (24.23)	15.75 (23.38)	17.50 (24.73)	13.25 (21.35)	16.25 (23.77)	15.90 (23.48)
T_7	Azadirachtin 0.03%	2.5lit	24.21 (29.47)	16.00 (23.58)	17.25 (24.54)	16.30 (23.81)	18.50 (25.47)	15.60 (23.26)	18.50 (25.47)	17.03 (24.36)
T_8	Untreated Control	-	23.39 (28.92)	30.50 (33.51)	28.50 (32.26)	34.50 (35.96)	38.10 (38.11)	36.10 (36.92)	31.12 (33.90)	33.14 (35.11)
	SEm±		1.03	0.36	0.35	0.24	0.31	0.35	0.36	0.33
	CD at 5%		NS	1.10	1.06	0.74	0.94	1.08	1.08	1.00

*The data in parenthesis is arc sine transformation value
NS- Non significant

Table.3 Economics of treatments for management of fruit borer in okra during *Kharif*, 2012 and 2013

Treatment	Dose a.i/ha (g)	Quantity required/ ha	Total treatment quantity	Cost of insecticide (Rs/lit)	Cost of treatment (Rs)	Yield (q/ha)	Yield saved over control (q/ha)	Value of saved yield (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	C:B Ratio
Indoxacarb 14.5 EC	75	500ml	1.50 lit	3400	6750	104.80	36.35	54525	157200	47775	1:8.08
Coragen 18.5% SC	30	150ml	0.45 lit	14000	7950	117.56	49.11	73665	176340	65715	1:9.27
Spinosad 45% SC	100	166ml	0.50 lit	14500	8900	115.25	46.80	70200	172875	61300	1:7.89
Profenophos 50%EC	750	1.50 lit	4.50 lit	520	3990	83.50	15.05	22575	125250	18585	1:5.66
Thiodicarb 75% WP	750	1.00 Kg	3.00 Kg	1000	4650	81.22	12.77	19155	121830	14505	1:4.12
Bt 5%	75	1.50 Kg	4.50 Kg	300	3000	76.67	8.22	12330	115005	9330	1:4.11
Azadirachtin 0.03%	2.5 lit/ha	2.50 lit	7.50 lit	280	3750	73.32	4.87	7305	109980	3555	1:1.95
Untreated Control	-	-	-	-	-	68.45	-	-	102675	-	-

Cost of treatment includes labour, rent of sprayer and insecticide.
Labour charge= Rs.100/ labour, Sprayer rent=Rs. 25/day, Market price: okra= Rs. 15/Kg

The T2 coragen treatment was more effective to reduce the shoot and fruit infestation as well as to provide highest okra yield. The present observations are conformity with Kumar *et al.*, (2013) and Bansode *et al.*, (2015) who has reported that indoxacarb 14.5 SC @ 0.5 lit/ha minimized the shoot and fruit damage of 1.6% and 3.3%, respectively against the pest as well as gave maximum marketable yield.

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