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POPULATION DYNAMICS AND COMPARATIVE EFFICACY OF CERTAIN CHEMICALS AND BIOPESTICIDES AGAINST OKRA SHOOT AND FRUIT BORER (*EARIAS VITELLA*)

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ABSTRACT

The occurrence of shoot and fruit borer (*Earias vitella*), commenced from 36th standard week (August fourth week) with an average infestation of 2.50% and then the population gradually increased and reached to its peak level by 42st standard week(October third week) with an average population of 49.86%. There after declined trend was observed as temperature decreased. It was found that the infestation of shoot and fruit borer (*Earias vitella*) increased with increasing maximum temperature. Eight treatments i.e., Neemoil@3%, Spinosad 45%SC@0.005ml/L, *Metarhizium anisopliae* @4 g/L, *Verticilium lecanii*@4/L, Dimethoate30EC@2ml/L Cypermethrin10EC@2ml/L, Dimethoate+Neemoil, Cypermethrin+Neemoil, were evaluated against shoot and fruit borer, *Earias vittella*. Minimum percent of shoot infestation, percent fruit infestation and B:C ratio were observed in cypermethrin with (3.60%, 6.34% and 1:5.01) respectively, which is followed by spinosad (4.79%, 6.88% and 1:4.85) < Cypermethrin+Neemoil (7.70%, 8.91% and 1:3.72) < Dimethoate (8.26%, 9.29%,d 1:4.47) < Dimethoate+Neemoil (8.71%, 9.57%, and 1:3.65) Neemoil (11.63%, 11.92% and 1:3.16) < *Verticilium lecanii* (11.98%, 12.36% and 1:2.58) < *Metarhizium anisopliae* (12.17%, 12.85% and 1:2.38) < untreated control(water spray) (17.66%, 34.70% and 1:1.44) respectively.

INTRODUCTION

Okra (Abelmoschus esculentus (L) Moench) is one of the most important vegetable belonging to the family Malvaceae. Though it is mainly used as a fresh vegetable, it is also consumed as canned, dehydrated or frozen forms. It is having a potential exports accounting for 60 percent of fresh vegetable (Sharman and Arora, 1993). One of the major constraints in the okra production is insect pests. The crop is attacked by several insect pests since seedling to maturity. Out of 56 insect species attacking the crop, the shoot and fruit borer appeared to be the most serious inflicting 45-57.1% damage to fruits (Srinivasan and Krishnakumar, 1983).It is reported that okra is infested severely by many pests during warm and rainy season such as leaf hopper and shoot and fruit borer (Gandhale *et al.*, 1987; Clement and David 1989; Madan *et al.*, 1996). Indiscriminate and injudicious uses of conventional insecticides for management of these insect pests have been causing different environmental hazards including resurgence, resistance and residue problem in food stuff. Therefore, the present experiment was conducted to evaluate some bio-pesticides along with chemical insecticides for an effective integrated management of shoot and fruit borer in okra, along with a brief study of the population dynamics of the pest.

MATERIALS AND METHODS

The experiment was conducted during Kharif season 2015 at the Field of Horticulture of "Sam Higginbottom Institute of Agriculture, Technology and Sciences" Allahabad, Uttar Pradesh, India, in a randomised block design with nine treatments replicated three times using variety VRO-6(Kashi Pragathi) in a plot size of (2.25m x 1.5m) at a spacing of (45x30cm) with recommended package of practices excluding plant protection. For population dynamics of the shoot and fruit borer, the population was recorded in weekly interval starting from the appearance of the pest. The observation of the pests was recorded from five randomly selected plants from every plot. The data was statistically analysed by correlation analysis between weather parameters and shoot and fruit borer.

Three insecticidal sprays were administrated at 20 days interval starting from 35 days after sowing. The insecticide treatments include Neemoil@3%, Spinosad 45%SC@0.005ml/L, *Metarhiziumanisopliae* @ 4g/L, *Verticilium lecanii*@4/L, Dimethoate 30 EC@2ml/L, Cypermethrin10EC@2ml/L, Dimethoate+Neemoil, Cypermethrin+Neemoil, along with untreated control. The spraying was done after the population reaching its ETL. The incidence of the borer on the shoot and the fruit were recorded from the five randomly selected plants. Observations were recorded one day before spray 3rd, 7th, 14th days after spraying. The assessment of the shoot damage was done by calculating the number of damaged shoots and total number of the healthy shoots observed from five randomly selected plants per plot and expressed in percentage. Okra fruits were harvested at weekly intervals. The percent fruit damage was assessed at each picking by counting the total number of affected fruits from each plot. The extent of the damage was computed by using the formulae;

Percent shoot infestation

$$\text{Per cent shoot damage} = \frac{\text{Number of infested shoots}}{\text{Total number of shoots}} \times 100$$

Percent fruit infestation

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

$$\text{Percent reduction in population} = \frac{\text{Population in treatment - Population in control}}{\text{Population in control}} \times 100$$

The total yield of the marketable fruits obtained from different treatments was calculated and converted by considering the additional cost (cost of insecticides and operational charges) and benefit (compared to untreated control) in the respective treatments.

RESULTS AND DISCUSSION

Studies on the incidence of *Earias vittella* population with weather parameters are given table1. The incidence of shoot and fruit borer on okra during *kharif* season 2015 commenced from 36thstandard week with the average percent infestation of 2.50. The shoot and fruit borer population gradually increased and reached a peak level of 49.86% 42nd standard week. Thereafter, declining trend was observed and population of shoot and fruit borer reached 34.41% during 48th standard week. Similar, Observations are reported by Meena *et al.* (2010). Similarly, Bishara (1968) reported the fruit borer infestation to peak during October and November on cotton

The result on efficacy of insecticides on shoot and fruit borer infestation of okra as well as healthy marketable fruit yield with cost benefit ratio has been presented in Table 5. The result revealed that all the treatments proved significantly effective in controlling the shoot and fruit borer infestation over untreated plot as evidence from data collected on its incidence both on shoot and fruits. Among the treatments, lowest percent infestation of shoot and fruit borer was recorded in cypermethrin (6.34 %) followed by spinosad (6.88%), which are at par with each other followed by the treatments Cypermethrin + Neemoil(8.91%), Dimethoate (9.29%) which are also at par with each other, followed by next effective treatment

Table 1: Population dynamics of shoot and fruit borer [*Earias vittella* (Fabricus)] during *Kharif* season of 2015

Standard week	Shoot and Fruit Borer (%infestation)	Temperature Max.	Min.	Humidity % Morning	Evening	Rainfall (mm)	Wind Velocity	Sunshine (hr/day)
32	0.00	34.08	27.74	90.57	55.42	2.20	1.33	5.82
33	0.00	35.97	27.51	92.42	53.42	5.00	1.28	5.34
34	0.00	33.22	27.00	92.85	58.28	12.48	2.22	4.80
35	0.00	35.45	27.42	90.71	54.85	11.85	2.55	5.74
36	2.50	36.42	27.20	89.71	45.42	0.00	1.68	7.97
37	6.06	37.48	27.37	86.71	47.14	0.00	2.17	8.70
38	11.73	35.65	28.05	86.28	55.71	0.60	1.17	7.11
39	17.53	36.42	27.80	90.71	47.14	0.20	1.84	7.17
40	22.64	36.11	27.85	89.00	50.14	0.00	1.56	8.45
41	37.54	35.77	27.82	90.85	51.57	0.00	1.35	8.68
42	49.86	35.85	23.88	78.28	51.40	0.00	0.96	8.57
43	48.12	36.00	20.57	93.00	50.71	0.00	0.71	8.65
44	44.42	35.25	19.71	91.57	29.71	0.64	0.51	6.65
45	46.94	33.57	20.08	90.71	57.00	0.00	0.48	8.31
46	40.40	32.57	19.48	90.71	59.57	0.00	0.49	8.42
47	38.09	33.60	16.02	91.14	52.85	0.00	0.61	8.17
48	34.41	31.42	12.00	90.85	53.42	0.00	0.57	8.28
	r =	-0.256	-0.669	-0.169	-0.169	-0.576	-0.792	0.668
	t =	-0.990	-3.372	-0.643	-0.642	-2.637	-4.855	3.359

Table 2: Efficacy of synthetic insecticides and biopesticides on shoot and fruit borer (*Earias vitella*) in okra (*Abelmoschus esculentus* Moench) (First spray)

Treatments		Concentration/ Dose	% Shoot Infestation 1 DBS	3 DAS	7 DAS	10 DAS	Mean
T_0	untreated	-	14.926(22.706)	17.306(24.586)	17.763(24.929)	17.940(25.052)	17.666(24.852)
T_1	Neemoil	3 ml/L	13.563(21.602)	11.326(19.666)	11.723(20.021)	11.866(20.384)	11.633(20.255)
T_2	Spinosad	0.05 ml/L	14.140(22.079)	4.550(12.311)	3.686(11.067)	5.470(13.514)	4.566(12.305)
T_3	*Metarhizium anisopliae*	4 g/L	13.080(21.187)	11.900(20.176)	12.046(20.305)	12.576(20.766)	12.174(20.415)
T_4	*Verticilium lecanii*	4 g/L	14.890(22.695)	11.866(20.142)	11.943(20.219)	12.136(20.384)	11.986(20.225)
T_5	Cypermethrin	2 ml/L	14.223(22.153)	3.243(10.377)	3.573(10.893)	4.000(11.531)	3.603(10.937)
T_6	Cypermethrin + Neemoil	1 + 1.5 ml/L	14.500(22.376)	7.506(15.902)	7.860(16.281)	7.760(16.177)	7.706(16.199)
T_7	Dimethoate	2 ml/L	15.350(23.065)	7.963(16.388)	8.336(16.785)	8.486(16.938)	8.266(16.708)
T_8	Dimethoate + Neemoil	1 + 1.5 ml/L	14.916(22.701)	8.473(16.920)	8.716(17.175)	8.960(17.414)	8.713(17.175)
Overall mean		-	14.39	9.348	9.516	9.91	9.590
F- test		-	NS	S	S	S	S
S. Ed. (±)		-	1.039	0.219	0.224	0.253	0.235
C. D. (P = 0.05)		-	2.203	0.465	0.477	0.538	0.50

Table 3: Efficacy of synthetic insecticides and biopesticides on shoot and fruit borer (*Earias vitella*) in okra (*Abelmoschus esculentus* Moench) (Second spray)

Treatments	Concentration/	% Fruit Infestation Dose	1 DBS	3 DAS	7 DAS	10 DAS	Mean
T_0	untreated	-	28.193(32.016)	33.723(35.492)	34.660(36.048)	36.250(37.006)	34.876(36.195)
T_1	Neemoil	3 ml/L	23.236(28.793)	11.873(20.157)	12.466(20.673)	12.996(21.128)	12.435(20.644)
T_2	Spinosad	0.05 ml/L	19.963(26.364)	6.563(14.846)	6.856(15.175)	7.070(15.411)	6.826(15.146)
T_3	*Metarhizium anisopliae*	4 g/L	27.690(31.612)	12.320(20.546)	13.240(21.331)	13.813(21.810)	13.123(21.237)
T_4	*Verticilium lecanii*	4 g/L	24.486(29.599)	12.190(20.428)	12.753(20.923)	13.246(21.347)	12.643(20.825)
T_5	Cypermethrin	2 ml/L	18.693(25.617)	5.666(13.773)	6.683(14.983)	7.006(15.347)	6.456(14.703)
T_6	Cypermethrin + Neemoil	1 + 1.5 ml/L	20.733(26.948)	8.916(17.376)	9.383(17.832)	9.750(18.192)	9.346(17.808)
T_7	Dimethoate	2 ml/L	21.470(27.510)	9.133(17.908)	9.750(17.990)	9.903(19.294)	9.593(18.397)
T_8	Dimethoate + Neemoil	1 + 1.5 ml/L	22.830(28.504)	9.450(17.908)	9.543(17.990)	10.923(19.294)	9.972(18.394)
Overall mean		-	23.032	12.203	12.814	13.439	12.807
F-test		-	NS	S	S	S	S
S. Ed. (±)		-	3.063	0.776	1.165	1.039	0.284
C. D. (P = 0.05)			-	6.496	1.646	2.472	2.205 0.604

Figures in paranthesis are arcsin transformed values; DBS-Days before spray, DAS-Days after spray

Table 4: Efficacy of synthetic insecticides and biopesticides on shoot and fruit borer (*Earias vitella*) in okra (*Abelmoschus esculentus* Moench) (Third spray)

Treatments	Concentration/	% Fruit infestation Dose	3 DAS	7 DAS	10 DAS	Mean
T_0	Untreated	-	35.486(36.556)	34.383(35.899)	33.723(35.492)	34.536(35.987)
T_1	Neemoil	3 ml/L	11.686(19.980)	11.510(19.834)	11.070(19.435)	11.422(19.757)
T_2	Spinosad	0.05 ml/L	7.940(16.349)	6.436(14.643)	6.490(14.733)	6.953(15.278)
T_3	*Metarhizium anisopliae*	4 g/L	12.656(20.836)	12.686(20.866)	12.416(20.613)	12.586(20.779)
T_4	*Verticilium lecanii*	4 g/L	12.420(20.603)	12.206(20.441)	11.633(19.946)	12.083(20.341)
T_5	Cypermethrin	2 ml/L	6.386(14.632)	6.676(14.846)	5.686(13.795)	6.243(14.469)
T_6	Cypermethrin + Neemoil	1 + 1.5 ml/L	8.783(17.236)	8.383(16.820)	8.293(16.725)	8.483(16.933)
T_7	Dimethoate	2 ml/L	9.480(17.932)	8.923(17.374)	8.596(17.035)	8.996(17.459)
T_8	Dimethoate + Neemoil	1 + 1.5 ml/L	9.566(18.016)	9.096(17.566)	8.906(17.363)	9.183(17.643)
Overall mean		-	12.711	12.255	11.868	12.276
F- test		-	S	S	S	S
S. Ed. (±)		-	0.953	1.063	0.852	0.266
C. D. (P = 0.05)		-	2.023	2.256	1.808	0.565

Figures in paranthesis are arcsin transformed values; DBS-Days before spray, DAS-Days after spray

Table 5: Efficacy of synthetic insecticides and biopesticides on shoot and fruit borer (*Earias vitella*) in okra (*Abelmoschus esculentus* Moench) (II &III Spray pooled mean)

TreatmentNo	Treatment Name	Dose	% Fruit infestation II-Spray	III- Spray	Pooledmean	Yieldq/ha	C:B Ratio
T_0	Untreated	-	34.876(36.195)	34.536(35.987)	34.706(36.093)	30.81	1:1.44
T_1	Neemoil	3 ml/L	12.435(20.644)	11.422(19.757)	11.925(20.206)	69.79	1:3.16
T_2	Spinosad	0.05 ml/L	6.826(15.146)	6.953(15.278)	6.885(15.210)	107.28	1:4.85
T_3	*Metarhizium anisopliae*	4 g/L	13.123(21.237)	12.586(20.779)	12.855(21.000)	52.43	1:2.38
T_4	*Verticilium lecanii*	4 g/L	12.643(20.825)	12.083(20.341)	12.363(20.586)	56.84	1:2.58
T_5	Cypermethrin	2 ml/L	6.456(14.703)	6.243(14.469)	6.345(14.593)	110.71	1:5.01
T_6	Cypermethrin + Neemoil	1 + 1.5 ml/L	9.346(17.808)	8.483(16.933)	8.915(17.360)	82.07	1:3.27
T_7	Dimethoate	2 ml/L	9.593(18.397)	8.996(17.459)	9.295(17.741)	98.62	1:4.47
T_8	Dimethoate + Neemoil	1 + 1.5 ml/L	9.972(18.394)	9.183(17.643)	9.575(18.202)	80.55	1:3.65
	Overall mean	-	12.807	12.276	12.540		
	F- test	-	S	S	S		
	S. Ed. (±)	-	0.284	0.266	0.269		
	C. D. (P = 0.05)	-	0.604	0.565	0.571		

Figures in paranthesis are arcsin transformed values; DBS-Days before spray, DAS-Days after spray

Dimethoate + Neemoil (9.57%). Treatments Neemoil(11.92%), *Verticilium lecanii* (12.36%), *Metarhizium anisopliae* (12.85%) are least effective among all the treatments, and are at par with each other. Cypermethrin was found very effective in reducing per cent shoot infestation, per cent fruit infestation. Same trend was observed by, Singh *et al.*, (2006) who reported that application of Cypermethrin reduced shoot and fruit borer damage. David and Kumarswami (1991) studied that Cypermethrin effective against *Earias vitella* recorded Cypermethrin of 100 g a.i./ha recorded the lowest percentage of shoot and fruit damage. Spinosad the next best treatment is also reported to reduce the percent shoot and fruit infestation remarkably as that of the cypermethrin which is supported by (Sarkar et al. 2015) and (Jat and Ameta 2013).

The result (Table 2) pertaining to yield data and subsequent economic analysis revealed that the maximum marketable yield (110.71 q/ha) of healthy okra fruits and maximum profit (1:5.01) was obtained from plot treated with Cypermethrin. Similar results was found by Singh *et al*. (2006), Pardeshi *et al*. (2011) finding application of Cypermethrinn for the management of okra shoot and fruit borer, *E. vittella* recorded higher yield than other chemicals, followed by spinosad which also reported a profitable yield of 107.2 q/ha these findings are supported by (Jat and Ameta 2013), (Sarkar *et al.,* 2015).

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