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Short communication

Seasonal incidence, varietal screening and management of shoot and fruit borer infesting okra in Kangra valley of Himachal Pradesh

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ABSTRACT

The present investigation was carried out as two year trials at farmer's fields in village Kachhiari (Kangra) in Himachal Pradesh to study the seasonal incidence, varietal susceptibility and management of *Earias vittella* (Fabricius) infesting okra crop through insecticides, biopesticides and a bioagent. Studies revealed that the okra shoot infestation varied between 1.78 to 2.24% during first year and 0.82 to 1.56% during second year, while the fruit infestation varied between 1.83 to 35.85% and 1.23 to 29.64% during the respective years. Peak fruit infestation (%) as well as peak larval population per fruit was observed in third to fourth week of August during the two seasons. Among the 10 okra varieties/ hybrids screened for relative susceptibility to *E. vittella*, Tulsi and Varsha Uphar registered lower mean per cent fruit borer infestation as well as higher yield as compared to the rest. Among the different treatments, cypermethrin (0.01%), endosulfan (0.07%) and *Bacillus thuringiensis* var. *kurstaki* (1.96 × 10^7 IU ha^{-1}) + endosulfan (0.035%) sprays were found efficacious against the pest.

Key words: *Earias vittella*, okra, seasonal incidence, integrated pest management.

Okra (*Abelmoschus esculentus* (L.) Moench), is an important warm season vegetable crop cultivated extensively in tropical and sub-tropical regions of the world. In Himachal Pradesh, the crop is grown during summer and rainy seasons in low and mid hills occupying an area of 1,792 thousand ha with an annual production of 22,474 thousand metric tonnes (Anon, 1), which is lower than some other northern states. One of the major reasons for low yield is the wide array of insect-pests that attack this crop right from germination till harvesting. Among these, shoot and fruit borer, *Earias vittella* (Fabricius) is the major restraining factor in okra cultivation. The larvae infest vegetative and reproductive stages of crop causing ample reduction in yield.

The knowledge regarding the seasonal incidence, varietal resistance and management of this pest through insecticides and biopesticides on okra is lacking in Kangra valley of Himachal Pradesh. Keeping this in view, the present study was undertaken Two years study was conducted at farmer's fields, Kachhiari (Kangra) in Himachal Pradesh situated at an altitude of 760 m amsl. Okra crop was sown in first week of April during both the years with a row to row and plant to plant spacing of 60 cm × 15 cm, respectively following all agronomic practices except pesticide application The daily meteorological data were obtained from the Agrometeorological Observatory of the Department of Agronomy, CSK HPKV, Palampur and Shivalik Hill Agricultural Research and Extension Centre, Kangra. To study the seasonal incidence of pest on crop, variety Pusa Sawani was grown in 10 plots each measuring 3 m × 3 m. In each plot, observations were recorded on 10 randomly selected plants at weekly intervals under natural infestation condition. Total number of shoots along with the infested ones were counted and expressed as per cent shoot infestation at different sampling dates. At each picking carried out at weekly intervals, per cent fruit infestation was determined by counting total number of fruits along with the infested ones. The mean larval population was also calculated at each picking. The population build-up data so obtained were subjected to correlation analysis with various abiotic factors, *viz*., maximum and minimum temperature (ºC), relative humidity (%) (averaged for the preceding 7 days) and total rainfall (mm).

To screen okra germplasm against *E. vittella*, seeds of 10 varieties/ hybrids were sown in plots each measuring 3 m × 2 m. The experiment was conducted in a randomized block design replicated thrice. Observations were taken on fruit infestation by counting total number of fruits along with the infested ones harvested from all the plants in a plot in each replication at weekly intervals throughout the crop season under natural infestation condition. Data were expressed as the mean of five observations taken at the peak pest activity. Also, the weight of healthy fruits was recorded per plot variety-wise at

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each picking and based on the data of cumulative pickings, total yield (q ha^{-1}) was worked out. The varieties were categorized as per the mean rating given by Bhalla *et al*. (2). To study the field efficacy of insecticides and biopesticides, four commercially available synthetic pesticides, two commercially available biopesticides, one laboratory reared egg parasitoid and four combinations (all at half the recommended dosages) were applied to the crop (var. Pusa Sawani). The experiment was laid out in a randomized block design each plot measuring 4.2 m × 3 m and replicated thrice. The spraying was done in third week of June during first year and second week of June during second year. Two releases of egg parasitoid were made, first at 7 days before spray and second at 7 days after spray. The pre treatment fruit infestation (No. basis) was determined one day before spray and at 7 and 14 days after spray by harvesting all the fruits (healthy + infested) from each plot. The weight of healthy fruits was recorded in each plot throughout the crop season and total yield (q ha^{-1}) was determined for each treatment. Data obtained under different experiments were subjected to statistical analysis (Gomez and Gomez, 4).

The infestation of *E. vittella* was first observed on shoots in third week of May during first year (Fig. 1), while the fruit infestation was first observed in last week of May. The peak fruit infestation was recorded in fourth week of June due to favourable weather factors. Thereafter, *E. vittella* infestation on fruits declined because of heavy rainfall received subsequently. The larval population followed a similar trend to that of fruit infestation. The favourable meteorological range recorded during the peak pest activity in the current study get support from the research results of Kashyap and Verma (5). During second year, the shoot infestation followed an analogous trend. By first week of June, no shoot infestation was found and the pest started damaging fruits only (Fig. 2). The fruit infestation was observed from fourth week of May to second week of July. Maximum fruit infestation was recorded in third week of June concurring with congenial weather parameters. Maximum temperature registered a significant positive correlation with per cent fruit infestation as well as larval population (Table 1). The relative humidity however, showed a significant negative correlation with per cent fruit infestation during first year only. In addition, rainfall and larval population were significantly and negatively correlated during second year. The present correlation results are supported by Zala *et al*. (9), and Bhat (3).

Based on the pooled statistics of two seasons (Table 3), Tulsi was found to be resistant, while Varsha Uphar, Parbhani Kranti, Arka Anamika, Harbhajan and Panchaali were rated as moderately resistant. The moderately susceptible group included Shagun, P-8, Pusa Makhmali and Pusa Sawani, while none fell in the category of either highly resistant or susceptible. Maximum healthy fruit yield was obtained in Tulsi followed by Varsha Uphar during both the years, while minimum was obtained on Pusa sawani and Pusa Makhmali (Table 2). High level of susceptibility to *E. vittella* reported in Pusa Sawani variety in the current investigation has formerly been demonstrated by Vyas and Patel (8). Earlier, Bhat (3) had rated Varsha Uphar as fairly resistant (6-10% fruit infestation) and Shagun as highly susceptible (>20%) which is in tune to the present results. The variation in yield among the varieties could be accredited to the genotypic variations, environmental difference and relative susceptibility of varieties to various pests and diseases. During first year, lowest mean fruit infestation by *E. vittella* was found in cypermethrin which was significantly superior to the rest at 7 days after spray followed by endosulfan and *B. thuringiensis* + endosulfan, All the treatments were significantly superior over untreated check. At 14 days after spray, cypermethrin lost its superiority to *B. thuringiensis* + endosulfan, however, both were statistically on par. Endosulfan and *B. thuringiensis* showed moderate level of mean fruit infestation by *E. vittella*. All

Table 1. Correlation coefficient (r) between abiotic factors, per cent fruit infestation and larval population of okra borer.

Abiotic factor	First year		Second year	
	Fruit Infestation (%)	Larval population	Fruit infestation (%)	Larval population
Temperature (°C)				
Maximum	0.7793**	0.6726*	0.6918*	0.7687**
Minimum	0.3603	0.2506	-0.4682	-0.4142
RH (%)	-0.6066*	-0.5306	-0.5785	-0.5787
Rainfall (mm)	-0.5206	-0.6235*	-0.4380	-0.5147

*, ** Significant at 5 and 1% significance levels

Table 2. Relative susceptibility of okra varieties to shoot and fruit borer.

Variety	Per cent fruit infestation*		Healthy fruit yield (q ha^{-1})**	
	First year	Second year	First year	Second year
	Mean	Mean		
Arka Anamika	11.80 (3.56)	11.94 (3.58)	75.81	70.47
Harbhajan	13.91 (3.83)	13.36 (3.76)	65.53	61.72
P-8	19.55 (4.48)	18.72 (4.40)	47.45	44.33
Panchaali	14.58 (3.93)	12.77 (3.67)	71.33	68.56
Parbhani Kranti	9.53 (3.24)	8.22 (3.03)	67.62	63.80
Pusa Makhmali	21.71 (4.76)	20.70 (4.63)	38.30	37.20
Shagun	17.74 (2.36)	15.95 (4.05)	68.92	65.68
Tulsi	4.59 (2.88)	3.79 (2.19)	93.03	87.72
Varsha Uphar	7.41 (4.98)	6.65 (2.76)	84.04	80.43
Pusa Sawani	24.02 (4.29)	23.41 (4.93)	45.34	42.95
CD at 5%	0.43	0.48	3.64	2.63

*Mean of 5 observations and 3 replications; ** Mean of 3 replications; Figures in parentheses are square root transformed values

the treatments were significantly superior over untreated check w.r.t. fruit yield (Table 4). The order of treatments with respect to yield was cypermethrin > *B. thuringiensis* + endosulfan > endosulfan > azadirachtin > imidacloprid > malathion > *T. chilonis* + *B. thuringiensis* > *T. chilonis* + endosulfan > *B. thuringiensis* > *T. chilonis* + imidacloprid > *T. chilonis*. During second year also (Table 4), almost parallel trend in the efficacy of treatments was observed. The efficacy of cypermethrin and *B. thuringiensis* + endosulfan (Mandal *et al*., 6; Rai and Satpathy, 7) in reducing *E. vitella* incidence on okra has earlier been reported.

From the study, it can be concluded that the appearance as well as peak activity periods of *E. vittella* on okra varied through the two seasons in Kangra valley of Himachal Pradesh. The fruit infestation and population of the pest showed significant correlation with one or the other abiotic factor during both the seasons indicating that weather played an important role in influencing the pest incidence. Varieties Tulsi and Varsha Uphar performed better with respect to resistance level to *E. vittella* as well as yield component as compared to the rest of the varieties. Infestation of the pest was checked by foliar sprays with cypermethrin (0.01%), *B. thuringiensis* (1.96 × 10^7 IU ha^{-1}) + endosulfan (0.035%) and endosulfan (0.07%), but keeping in view the toxic hazards of synthetic chemicals, integrated treatment of *B. thuringiensis* + endosulfan is suggested for effective management of *E. vittella* on okra.

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Table 3. Reaction of okra varieties to *E. vittella* with respect to fruit infestation.

Rating	Mean per cent fruit infestation	Variety(ies)
Highly resistant	< 1.0	-
Resistant	1.0 - 5.0	Tulsi
Moderately resistant	5.1 - 15.0	Varsha Uphar, Parbhani Kranti, Arka Anamika, Harbhajan, Panchaali
Moderately susceptible	15.1 - 30.0	Shagun, P-8, Pusa Makhmali, Pusa Sawani
Susceptible	> 30.0	-

Table 4. Field efficacy of insecticides and biopesticides against *E. vittella* infesting okra at Kachhiari (Kangra), H.P.

Treatment	Dosage	First year			Second year			First year	Second year
		PTF	Mean per cent fruit infestation*		PTF	Mean per cent fruit infestation*		Healthy fruit yield (q ha^{-1})*	
			7 DAS	14 DAS		7 DAS	14 DAS		
Trichogramma chilonis	50000 ha^{-1}	12.19	19.79 (4.56)	14.91 (3.98)	11.07	17.97 (4.35)	14.11 (3.88)	66.62	60.48
Bacillus thuringiensis	3.96 x 10^7 IU ha^{-1}	16.56	13.78 (3.84)	10.98 (3.46)	17.42	12.21 (3.63)	10.39 (3.37)	87.59	85.48
Azadirachtin	0.00045%	17.84	14.32 (3.91)	14.08 (3.87)	17.14	13.14 (3.75)	13.36 (3.78)	107.20	100.71
Malathion	0.05%	18.03	11.67 (3.56)	14.77 (3.96)	16.91	10.69 (3.41)	14.29 (3.91)	100.43	95.54
Endosulfan	0.07%	19.36	6.53 (2.74)	8.29 (3.04)	16.34	5.24 (2.48)	7.72 (2.94)	116.46	111.19
Cypermethrin	0.01%	19.22	5.27 (2.50)	5.98 (2.64)	15.38	4.77 (2.39)	6.14 (2.66)	127.40	122.50
Imidacloprid	5 g kg^{-1} seed	12.68	20.46 (4.63)	19.59 (4.53)	12.60	20.07 (4.58)	19.66 (4.54)	102.35	98.87
T. chilonis + *B. thuringiensis*	25,000 ha^{-1} + 1.98 x 10^7 IU ha^{-1}	14.64	16.18 (4.14)	12.60 (3.68)	13.57	14.38 (3.92)	11.73 (3.56)	97.33	94.36
T. chilonis + Imidacloprid	25,000 ha^{-1} + 2.5 g kg^{-1} seed	13.38	20.21 (4.60)	18.52 (4.41)	13.13	19.47 (4.52)	18.55 (4.42)	84.36	80.43
T. chilonis + Endosulfan	25,000 ha^{-1} + 0.035%	14.42	15.75 (4.09)	16.82 (4.21)	13.38	14.33 (3.91)	s16.42 (4.17)	92.79	90.50
B. thuringiensis + Endosulfan	1.98 x 10^7 IU ha^{-1} + 0.035%	18.67	7.74 (2.96)	5.63 (2.58)	15.93	6.68 (2.75)	5.08 (2.46)	120.62	118.56
Untreated check	-	18.59	28.77 (5.46)	25.46 (5.13)	17.17	26.89 (5.28)	24.36 (5.03)	47.32	43.37
CD at 5%		-	0.20	0.21	-	0.16	0.13	3.42	6.25

PTF = Pre-treatment per cent fruit infestation; *Mean of three replications; DAS = Days after spray; Figures in parentheses are square root transformed values

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