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Insect pest complex of okra and seasonal abundance of fruit borer complex in low hills of Himachal Pradesh

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Abstract

Studies were conducted to investigate insect pest complex and seasonal abundance of borer complex of okra in the low hills of Himachal Pradesh during 2021. Fourteen insect pests were found damaging okra crop throughout the cropping season, out of which okra shoot and fruit borer (*Earias vittella* (Fabricius), *Earias insulana* Boisduval) and American bollworm (*Helicoverpa armigera* (Hubner)) caused direct damage to fruits. *E. vittella* was found to be the predominant fruit borer species. Maximum fruit infestation by *H. armigera* (23.5%) was observed during second week of July. Fruit infestation by okra shoot and fruit borer began in the first week of August and peaked (49.9 and 28.6 % at two locations) during second week of September. Fruit infestation by okra shoot and fruit borer showed highly significant negative correlation with maximum and minimum temperature while relative humidity and rainfall had non-significant correlation.

Key words: Okra, shoot and fruit borer, insect complex, *Earias vittella, Helicoverpa armigera*

Okra (*Abelmoschus esculentus* L. (Moench) is an important vegetable crop grown all over the country during spring-summer and rainy season. It is quite popular vegetable crop because of easy cultivation, dependable yield, adaptability to varying moisture conditions and for fetching good returns to growers. Okra is grown over an area of 521 thousand hectares with production of 6355 thousand metric tons in India (Anonymous 2022), while in Himachal Pradesh, it occupies an area of 3.92 thousand hectares with production of 60.95 thousand metric tons and productivity of 15.55 metric tons per hectare (Anonymous 2021). Cultivation of okra is good source of livelihood to farmers but the crop is also prone to attack by different insect pests which are the major limiting factors in attaining potential yield. The crop is subjected to ravages by a large number of insect pests (twenty-eight insect pest species at Tripura reported by Nair *et al*. (2017) throughout its growth. Among these insect pests, leaf hopper (*Amrasca bigutulla bigutulla* Ishida), whitefly (*Bemisia tabaci* Gennadius), aphids (*Aphis gossypii* Glover) and shoot and fruit borer (*Earias vittella* (Fabricius)) are the major pests of okra (Patil *et al*. 2023) causing serious damage to the crop. The fruit borer complex result in both quantitative and qualitative loss to the crop. Okra shoot and fruit borer, *Earias* spp. (Lepidoptera: Noctuidae) is the most notorious insect pest. The threat posed by *E. vittella* to cotton and okra cultivation has been reported as early as 1906 (Lefroy 1906). The insect result in fruit infestation of 40.12 -52.43 per cent in various parts of the country (Brar *et al*. 1994; Meena *et al*. 2019; Rathore *et al*. 2021; Nandaniyan *et al*. 2022).

The larva cause damage by boring into terminal growing shoot resulting in drooping of shoot downwards, finally its withering and drying; while attack on fruits render them unfit for human consumption and fruits become deformed. The pest incidence and damage varies according to

geographical location, crop, season and prevailing environmental conditions. Therefore, regular monitoring of insect pests under field conditions is pertinent for timely forecast and for utilizing the information in formulating pest management programme. Hence study was conducted on seasonal abundance of major fruit borer of okra to generate information about initiation of pest attack and peak period of pest activity. Insects are influenced by a large number of environmental factors including temperature, relative humidity, rainfall, etc. In the present scenario of climate change, the insect pest situation is also being changed with the variation in abiotic factors. Since weather conditions prevailing in a region play an important role in the occurence and subsequent buildup of pest's population study, so the study was undertaken. In Himachal Pradesh no such systematic work on borer complex infesting okra had been undertaken so far, hence studies were undertaken to generate consolidated information on seasonal abundance and population build-up of the borer complex in okra.

Materials and Methods

The present study on insect pest complex associated with okra and seasonal abundance of fruit borer complex of okra was conducted in district Hamirpur (Himachal Pradesh). Insect pests infesting okra were recorded during *kharif*, 2021 throughout the cropping season. Observations on population and plant infestation of insect pest complex of okra were recorded on thirty plants at weekly interval to find the relative infestation of the insects in okra. The studies were also conducted to record seasonal abundance of borer complex at two locations of district Hamirpur i.e. Bara and Sujanpur Tira. For this, summer and rainy season crop was raised at farmer's field at Sujanpur Tira and Krishi Vigyan Kendra Hamirpur at Bara as per recommended package of practices of university except insect pest management. Observations were recorded on healthy and infested shoots and fruits to work out per cent shoot infestation and fruit infestation by okra shoot and fruit borer on number basis. *H. armigera* was observed feeding on fruits of okra and per cent fruit infestation was worked out. The data was recorded on sixty plants at four days interval with the initiation of insect incidence till crop maturity.

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

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

The data on fruit infestation was subjected to correlation studies with prevailing weather parameters (maximum temperature (ºC), minimum temperature (ºC), mean relative humidity (%) and rainfall (mm)) by working out simple correlation analysis (Chandel 1999).

Results and Discussion

Insect pests associated with okra crop

The studies revealed that fourteen identified insect pests belonging to four orders and eleven families infested okra crop in district Hamirpur (Table 1, Plate 1). Among them, okra shoot and fruit borer, *Earias* spp. was associated with okra from vegetative to late fruiting stage and caused considerable direct damage to shoots and fruits. Blister beetle (*Mylabris pustulata* Thunberg), shoot weevil (*Alcidodes affaber* Aurivillius), aphid (*Aphis gossypii* Glover), jassid (*Amrasca biguttula biguttula* Ishida) and American bollworm, (*Helicoverpa armigera* Hubner) were also of economic importance while rest of the insects were not encountered regularly and didn't cause serious damage to the crop. Singh and Joshi (2003) recorded fifteen insect-pests including *E. vittella, A. biguttula biguttula, Aphis* sp., *M. pustulata, Nezara virudula* (Linnaeus), *Bagrada cruciferarum* Kirkaldy, *H. armigera*, *Spodoptera litura* (Fabricius) and *Dysdercus koenigii* Fabricius on okra in Paonta valley of Himachal Pradesh. In Jammu, thirteen insect pests were observed on okra, among which *A. biguttula biguttula, Bemisia tabaci* Gennadius and *E. vittella* were reported as major insect pests (Ahmad *et al*. 2010). Kumar *et al*. (2014) found nine species of insects including shoot and fruit borer, jassid, *H.*

Table 1. Insect complex associated with okra in mid hills of Himachal Pradesh

Order	Common name	Scientific name	Family	Stage of crop	Relative infestation
Coleoptera	Blister beetle	*Mylabris pustulata* (Thunberg)	Meloidae	Flowering to late fruiting	++
	Flea beetle/ Leaf eating beetle	*Podagrica fuscicornis* (Linnaeus)	Chrysomelidae	Vegetative to late fruiting	+
	Shoot weevil	*Alcidodes affaber* Aurivillius	Curculionidae	Late fruiting to maturity	++
Hemiptera	Jassid	*Amrasca biguttula biguttula* (Ishida)	Cicadellidae	Vegetative to late maturity	++
	Aphid	*Aphis gossypii* Glover	Aphididae	Vegetative to late fruiting	++
	Red cotton bug	*Dysdercus koenigii* Fabricius	Pyrrhocoridae	Vegetative to mid fruiting	+
	Dusky cotton bug	*Oxycarenus laetus* (Kirby)	Lygaeidae	Vegetative to mid fruiting	+
	Painted bug	*Bagrada cruciferarum* Kirkaldy	Pentatomidae	Vegetative to mid fruiting	+
	Green potato bug	*Nezara viridula* (Linnaeus)	Pentatomidae	Vegetative to mid fruiting	+
	Whitefly	*Bemisia tabaci* Gennadius *Trialeurodes vaporariorum* Westwood	Aleyrodidae	Vegetative to late fruiting	+
Lepidoptera	Tobacco caterpillar	*Spodoptera litura* (Fabricius)	Noctuidae	Vegetative to early fruiting	+
	American bollworm	*Helicoverpa armigera* (Hubner)	Noctuidae	Vegetative to early fruiting	++
	Okra shoot and fruit borer/ Spotted bollworm	*Earias vittella* (Fabricius) *Earias insulana* Boisduval	Noctuidae	Vegetative to late fruiting	+++
Thysanoptera	Onion thrips	*Thrips tabaci* Lindeman	Thripidae	Flowering	+

A: *Earias vittella* (Fabricius)

B: *Earias insulana* Boisduval

C: *Helicoverpa armigera* (Hubner)

D: *Alcidodes affaber* Aurivillius

E: *Spodoptera litura* (Fabricius)

F: *Mylabris pustulata* (Thunberg)

G: *Nezara viridula (*Linnaeus*)*

H: *Podagrica fuscicornis (*Linnaeus*)*

I: *Bagrada cruciferarum* Kirkaldy

J: *Dysdercus koenigii* Fabricius

K: *Aphis gossypii* Glover

L: *Bemisia tabaci* Gennadius

M: *Oxycarenus laetus* (Kirby)

N: *Thrips tabaci* Lindeman

O: *Amrasca biguttula biguttula* (Ishida)

Plate 1. Insect complex of okra under mid-hills of H.P.

armigera, white fly, *Aphis gossypii*, semilooper (*Anomis flava* F.), red cotton bug (*Dysdercus cigulatus* F.) and blister beetle on okra at Meerut and severe economic losses were observed due to *E. vittella*. However, Nair *et al*. (2017) reported twenty-eight insect pest species belonging to six orders to infest okra and found okra shoot and fruit borer as major pest at Tripura.

Similar trend on succession of insect pests of okra was observed by Das *et al*. (2021) who reported that aphid, jassid, whitefly and leaf roller remained from vegetative to harvesting stage and red cotton bug and shoot and fruit borer appeared from reproductive to harvesting stage of the crops.

Seasonal abundance of *H. armigera* on okra

H. armigera was found damaging okra fruits at both the locations of study. Among the two borers infesting okra, *H. armigera* appeared first in summer crop than *Earias* spp. The incidence of *H. armigera* was first observed during the 4th week of June at Sujanpur Tira and 3rd week of July at Bara (2.5 and 1.6 % fruit infestation) (Table 2). The infestation continued up to end of July at Sujanpur Tira and second week of August at Bara. The peak fruit infestation was observed during the second week of July and first week of August (23.5 % and 16.7 % fruit infestation). So it can be inferred that *H. armigera* appeared early and the pest remained associated with crop for about a month only. In contrary, Ghuge *et al*. (2020) noticed *H. armigera* incidence during third week of August which peaked during second week of September.

Seasonal abundance of *Earias* spp. on okra

The infestation of okra shoot and fruit borer was noticed in rainy season crop only and commenced 15-16 weeks after sowing at Sujanpur Tira and Bara with initial symptoms visible as drooping of shoots during last week of July. The perusal of data presented in Table 3 revealed that peak shoot infestation (8.1 and 7.1 %) was observed in first and second week at Sujanpur Tira and Bara, respectively. A similar observation on initiation of shoot and fruit borer at fourth week of July was reported by Ghuge *et al*. (2020) at Parbani. However, Badiyala and Raj (2013) observed peak fruit infestation (35.85 %) in third to fourth week of August at Kangra valley of Himachal Pradesh. Chandra and Singh (2012) observed maximum shoot damage of 20.2 per cent and fruit damage of 30.9 per cent at Uttar Pradesh. In the present study, infested fruits when reared under laboratory conditions for adult emergence revealed prevalence of two species *E. vittella* and *E. insulana*, most predominant being *E. vittella*.

With the development of fruits, the pest started infesting them during the first and second week of

Table 2. Seasonal incidence of *Helicoverpa armigera* during 2021

Date	Mean fruit infestation (%)	
	SujanpurTira	Bara
26-June	2.5	0
30-June	5.6	0
04-July	10.0	0
08-July	18.1	0
12-July	23.5	0
16-July	17.6	1.6
20-July	13.1	5.4
24-July	9.5	12.3
28-July	3.7	15.3
01-August	0	16.7
05-August	0	13.4
09-August	0	5.4

Table 3. Seasonal incidence of okra shoot and fruit borer during 2021

Date	Shoot infestation (%)		Fruit infestation (%)	
	Sujanpur Tira	Bara	Sujanpur Tira	Bara
20-July	2.5	-	-	-
24-July	3.5	-	-	-
28-July	5.7	2.7	-	-
01-Aug.	7.3	3.3	5.1	-
05-Aug.	8.1	4.3	7.4	-
09-Aug.	7.3	6.3	11.1	4.1
13-Aug.	3.6	7.1	14.7	5.6
17-Aug.	1.2	5.3	17.7	7.2
21-Aug.	-	2.0	20.9	10.5
25-Aug.	-	-	29.8	13.7
29-Aug.	-	-	36.5	14.5
02-Sept.	-	-	38.6	18.3
06-Sept.	-	-	44.5	20.8
10-Sept.	-	-	47.8	23.5
14-Sept.	-	-	49.9	27.4
18-Sept.	-	-	-	28.6
22-Sept.		-	-	27.1

Mean shoot and fruit infestation recorded on 60 plants

August at two locations. The per cent fruit infestation continued to increase till the maturity of the crop. Further, okra shoot and fruit borer attained its peak fruit infestation during the second week of September at Sujanpur Tira and Bara (49.9 and 28.6 %, respectively). The results are in line with those of Panbude *et al*. (2019) who reported initiation of fruit infestation during first week of August and maximum infestation at second week of September at Nagpur. Since farmer's fields at Sujanpur Tira were devoid of insecticidal spray for several years, this might have accounted for higher build up of the pest in the locality.

Correlation between fruit infestation by okra shoot and fruit borer and abiotic factors

The impact of weather factor on fruit infestation by fruit borer complex (*Earias* spp. and *H. armigera*) on okra during 2021 is presented in Table 4. The results revealed that fruit infestation by okra shoot and fruit borer had highly significant negative correlation with maximum and minimum temperature at Bara and Sujanpur Tira (r= -0.880 to -0.951). Relative humidity and rainfall had non-significant correlation with fruit infestation. The results are in close conformity with the results of Choudhary and Sharma (2020), who

Table 4. Correlation of fruit infestation by borer complex with abiotic factors during 2021

Weather parameters	*Earias* spp.		*H. armigera*	
	SujanpurTira	Bara	SujanpurTira	Bara
Maximum Temperature (°C)	-0.880*	-0.951*	-0.097	-0.656
Minimum Temperature (°C)	-0.923*	-0.925*	0.316	-0.196
RH (%)	0.062	0.534	0.161	0.728
Rainfall (mm)	-0.090	0.284	0.379	0.233

*Values are significant at P=0.05

reported significant negative correlation of fruit infestation with minimum temperature and non-significant relation with rainfall. However, Meena *et al*. (2019) reported that the pest showed a significant positive correlation with maximum temperature, while minimum temperature and evening relative humidity had a significantly negative correlation. Correlation between per cent fruit damage by shoot and fruit borer with maximum temperature was positively non-significant and minimum temperature, morning relative humidity, evening relative humidity and rainfall were negatively non-significant (Patait *et al*. 2023).

Fruit infestation by *H. armigera* showed non-significant relation of weather parameters (maximum temperature, minimum temperature, relative humidity and rainfall). The results are in conformity with those of Sonawane *et al*. (2021) who reported non-significant correlation of incidence of *H. armigera* and minimum temperature. However, LokNath *et al*. (2011) observed that *H. armigera* population had significant positive correlation with rainfall and significant negative relation with temperature. These differences in correlation among earlier workers could be attributed to the differences in insect infestation levels, period of insect activity and prevailing weather conditions in different locations. So, it can be inferred from correlation studies that the population of borer complex of okra is governed by the inherent capacity to increase, under the influence of various environmental factors at different locations.

Conclusion

It is, therefore, evident from the present study that fourteen insect pests infested okra crop throughout the cropping period in low hills of Himachal Pradesh. *E. vittella* was found to be the major insect pest causing significant damage to the crop. There exists a complex interaction between host plant, biotic and abiotic components under field conditions. Hence, there is a need of more elaborative studies to explore their influence on fruit infestation in okra.

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