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Original Research Article

Studies on the Seasonal Incidence of Major Insect Pests and its Natural Enemies on Okra and Their Correlation with Weather Parameters

Anurag Potai* and Gajendra Chandrakar

Department of Entomology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh-492012, India
**Corresponding author*

A B S T R A C T

An experiment was conducted to observe the "Studies on the seasonal incidence of major insect pests and their natural enemies on okra" during *kharif* season of 2016 at Horticulture farm, Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, Chhattisgarh. Major activity period of jassid (*Amrasca biguttula biguttula*) was observed from August 2016 to October 2016 with one distinct peak during 39th SMW (Standard Week) (10.36 jassid/ per plant) and *Aphis gossypii* was observed from August 2016 to October 2016 with one distinct peak 40th SMW (39.24 Aphid/ per plant), respectively. While *Bemisia tabaci* was appeared second week of August to last week of October 2016 with one distinct peak 38th SMW (4.89 whitefly/ per plant), Thrips (*Thrips tabaci*) was observed from August 2016 to October 2016 with one distinct peak during 38th SMW (4.23 thrips/ per plant). Shoot and Fruit borer, *Earias vittella* observed from second week of August 2016 up to crop maturity 44th SMW with one distinct peak 40th SMW (3.54 % fruit infestation).

Keywords

Jassid, Aphid, Whitefly, Thrips, Shoot and fruit borer, Natural enemies and Weather parameters.

Introduction

Amongst the various vegetable grown Okra *Abelmoschus esculentus* L. (Moench) belongs to family Malvaceae, is an economically important vegetable crop grown in tropical and sub-tropical parts of the world. This crop is suitable for cultivation as a kitchen garden crop as well as on large high-tech commercial farms. It is grown commercially in India, Turkey, Iran, Western Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, Burma, Japan, Malaysia, Brazil, Ghana, Ethiopia and the Southern United States. Vegetables constitute an important food item, supplying vitamins, carbohydrates and minerals needed for a balanced diet (Randhawa, 1974; Masood Khan *et al.*, 2001).

There are several constraints in the cultivation of okra. Many of the pests occurring on cotton are also found on okra crop. As high as, 72 species of insects have been recorded on okra (Srinivas Rao and Rajendran, 2003), of which, the sucking pests comprising of leafhopper, *Amrasca biguttula biguttula* (Ishida), whitefly, *Bemisia tabaci* (Gennadius) and mite, *Tetranychus urticae* (Boisduval) cause significant damage to the crop. Leafhopper, a polyphagous, pest has been a serious pest on okra causing heavy loss during these years. High population of leafhopper significantly sucks cell sap usually from ventral surface of the leaves and inject toxic saliva into plant tissues, turning the leaves to

yellowish and curl upward (Singh *et al.*, 2008). Whitefly (*B. tabaci*) nymphs and adults remove significant amount of cell sap from the leaves to reduce the plant vigour. They are responsible for transmitting yellow vein mosaic virus also. Red spider mites scratch the leaf tissues and lap the oozing out sap. Heavy webbing caused by the mite make it difficult to control.

Among the vegetable crops grown in India, Okra is an important crop grown throughout the year. Fruit and shoot borer, *Earias vittella* is the key pest of okra and requires regular control measures to produce a profitable crop. The avoidable losses in yield and fruit damage due to this pest have been estimated from 36-90% (Misra *et al.*, 2002).

Materials and Methods

The experimental site was conducted at Horticulture farm, Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya (IGKV) Raipur, Chhattisgarh. During *Kharif* season, 2016-17. Major insect pest population at weekly interval was recorded on randomly selected 10 plants per plot. The population of aphid (*Aphis gossypii*), jassid (*Amrasca biguttula biguttula*), whiteflies (*Bemisia tabaci*) and thrips (*Thrips Tabaci*) was recorded on three leaves (upper, middle and lower leaves of the plant). The incidence of shoot and fruit borer (*Earias vittella* Fab.) was recorded by counting infested plants and fruits on 10 random plants.

Results and Discussion

Okra jassid *Amrasca biguttula biguttula* (Ishida)

Periodical observations (Table 1) on the incidence of major insect pest on okra revealed that the incidence of jassid appeared in the second week of August (33^{th} SMW) with the population of 2.89 jassid/ plant, with the weather parameters of maximum (28.7^{o}C) and minimum (21.6^{o}C) temperatures, relative humidity I (89%) and II (77%), rainfall (11.6 mm) and wind velocity (9.4Km/h), respectively were prevailed during the week. The population of jassid reached to10.36 jassid/plant during fourth week of September (39^{th} SMW) where the weather parameters of maximum (30.0^{o}C) and minimum (24.5^{o}C) temperatures, relative humidity I (97%) and II (89%), rainfall (134.6mm) and wind velocity (2.8Km/h) were prevailed, respectively. Population of jassid was further declined 3.22 jassid/plant during last week of September (44^{th} SMW) with a seasonal mean of 6.76 jassid/plant.

The statistically analyzed data (Table 2) revealed that jassid incidence had negative non-significant correlation with maximum temperature (r= -0.11) and positive but non-significant correlation with minimum temperature (r=0.48). The positive highly significant correlation with morning RH (r=0.75**) and positive but non-significant correlation with evening RH (r=0.37).

There was positive highly significant correlation with rainfall (r=0.77**) and negative non-significant correlation with wind velocity (r= -0.36), respectively.

Khating *et al.*, (2016) reported that the incidence of leafhoppers (r = -0.060), was negatively non-significant correlated with maximum temperature. Mahmood *et al.*, (2002) reported that the incidence of leaf hopper showed positive correlation with maximum and minimum temperatures. Singh *et al.*, (2013) findings that leafhopper showed negative correlation with maximum and minimum temperatures.

Okra aphid *Aphis gossypii* (Glover)

Aphid appeared on the crop during second week of August (33th SMW) with the population of 2.42 Aphid/plant. The weather parameters of maximum (28.7^{o}C) and minimum (21.6^{o}C) temperatures, relative humidity I (89%) and II (77%), rainfall (11.6 mm) and wind velocity (9.4 Km/h), respectively were prevailed during the period. The population of aphid reached to39.24 aphid /plant during third week of October (40th SMW) where the weather parameters of maximum (26.5^{o}C) and minimum (24.8^{o}C) temperatures, relative humidity I (95%) and II (72%), rainfall (48.2mm) and wind velocity (2.7 Km/h) were prevailed, respectively. Population of aphid was further declined to19.12 aphid/plant during first week of Nov (44th SMW), with maximum (30.6^{o}C) and minimum (19.8^{o}C) temperatures, relative humidity I (85%) and II (51%) along with a seasonal mean of (23.80) aphid/plant.

Aphid population was noticed negative non-significant correlation with maximum temperature (r=-0.16) and minimum temperature (r=-0.02) and significant positive correlation with morning RH (r=0.64*) and negative non-significant correlation with evening RH(r=-0.09). On the other hand positive correlation with rainfall (r=0.41) and negative non-significant correlation with wind velocity (r=-0.7), respectively.

Present findings are in line with the findings of Slosser *et al.,* (1998) who reported that, population of *A. gossypii* increased during the months of August and October. Patel and Rote (1995) reported that, Aphid population was peak in the second fortnight of October followed by first and second fortnight of November. Konar *et al.,* (2013) reported that the aphid population is non-significant negatively correlated with maximum and minimum temperature.

Okra whitefly *Bemisia tabaci* (Genn.)

The appearance of white fly on okra during the second week of August (33th SMW) with the population of 2.23 white fly/plant, with the weather parameters of maximum (28.7^{o}C) and minimum (21.6^{o}C) temperatures, relative humidity I (89%) and II (77%), rainfall (11.6mm) and wind velocity (9.4Km/h) respectively were prevailed during the week. The population of white fly reached to 4.89 white fly /plant during third week of September (38 SMW) where the weather parameters of maximum (32.2^{o}C) and minimum (24.9^{o}C) temperatures, relative humidity I (94%) and II (69%), rainfall (91.6mm) and wind velocity (2.5Km/h) were prevailed, respectively. Thereafter, there was a gradual decrease of pest intensity (1.54/plant). The nymphs and adults whitefly population ranged from 2.23 to 4.89/plant during August to September months.

Whitefly incidence had positive but non-significant correlation with maximum temperature (r = 0.13) and positive higher significant correlation with minimum temperature (r = 0.82**), on the other hand positive higher significant correlation with rainfall (r = 0.75**) and positive significant correlation with morning (r = 0.67*) and evening (r = 0.59*) RH and non-significant negative correlation with wind velocity (r = -0.03), respectively.

Watson *et al.,* (2003) who reported the temperature above 30 ^{o}C increased the rate of egg laying above 40 ^{o}C reduced the length of life cycle of *B. tabaci* to less than two weeks. Netam *et al.,* (2007) observed that whitefly population was recorded through the crop growing season during *Karif* and

Rabi 2002 and 2003. Singh *et al.,* (2003) reported that the whitefly population gradually increased and reached the peak level of 12.4 whitefly/plant during fourth week of September. Selvaraj *et al.,* (2010) they revealed that the population of whitefly had significantly positive correlation with minimum temperatures.

Okra Thrips *Thrips tabaci* (L.)

The incidence of *Thrips tabaci* (L.) was first recorded during the second week of August (33thSMW) with the population of 2.48 /plant, with the weather parameters of maximum (28.7^{o}C) and minimum (21.6^{o}C) temperatures, relative humidity I (89%) and II (77%), rainfall (11.6mm) and wind velocity (9.4Km/h), respectively were prevailed during the week. The population of thrips reached to its peak 4.23 thrips/ plant during third week of September (38th SMW) were the weather parameters of maximum (32.2^{o}C) and minimum (24.9^{o}C) temperatures, relative humidity I (94%) and II (69%), rainfall (91.6mm) and wind velocity (2.5Km/h) were prevailed, respectively, along with a seasonal mean of 2.88 thrips/ plant.

Okra thrips population showed negative non-significant correlation with maximum temperature (r= - 0.05) and positive higher significant correlation with minimum temperature (r= 0.82**) and positive higher significant correlation with rainfall (r= 0.76**) and positive significant correlation with morning RH (r=0.67*) and evening RH (r= 0.68*) and non-significant positive correlation with wind velocity (r= 0.14), respectively.

Vennila *et al.,* (2007a and b) reported that high temperature and scanty rainfall aggravate the severity of sucking pests and also reported *Thrips tabaci* has population peaks during dry spell with high temperature and low humidity which are optimum for population build up.

Shoot and fruit borer *Earias vittella* (Fab.)

The incidence of shoot and fruit borer *Earias vittella* (Fab.) was first recorded during the second week of August (33th SMW) with the population of 0.78 larvae/plant. The weather parameters of maximum (28.7^{o}C) and minimum (21.6^{o}C) temperatures, relative humidity I (89%) and II (77%), rainfall (11.6mm) and wind velocity (9.4Km/h) respectively were prevailed during the week. The population of shoot and fruit borer reached to 3.54 larvae/plant during first week of October (40th SMW) where the maximum (26.5^{o}C) and minimum (24.8^{o}C) temperatures, relative humidity I (95%) and II (72%), rainfall (48.2mm) and wind velocity (2.7Km/h) were prevailed, respectively. It remained active throughout the cropping period of okra, along with a seasonal mean of 2.28 larvae/plant.

The present study indicated that in the agro climatic condition of Raipur okra suffered with as many as five insect pest species, out of which only one pest species *viz.* shoot and fruit borer *Earias vittella* (fab.) of okra exhibited as major pests caused extremely severe damage to shoots and fruits and this is categorized under key pests of okra.

During the experimental period it was observed that shoot and fruit borer of okra was showed negative non-significant correlation with maximum temperature (r= -0.16) and positive correlation with minimum temperature (r= 0.13) and positive but non-significant correlation with rainfall (r= 0.43) and positive higher significant correlation with morning RH (r=0.77**) and negative correlation with evening RH (r= -0.005), on

the other hand negative but significant correlation with wind velocity (r= -0.63*) was observed.

Srinivasan (1993) reported shoot and fruit borer *E. vittella* and *E. insulana* Boisd. as serious pest on okra. Devasthali and Saran (1997) reported that the okra was infested by fruit borer (*Earias vittella* Fab.) from the age of 11 days till maturity. Yadvendu (2001) reported the, declining trend was observed and population of shoot and fruit borer reached its lowest of being an average of 1.9 per plant during fifth week of October.

Seasonal incidence of natural enemies

Natural enemies like lady bird beetles, and spider have also been recorded in the present investigation though there presence was very small numbers during the season.

Lady bird beetle

Two species of lady bird beetle *Menochilus sexmaculata* and *Coccinella septumpunctata* were recorded as major bio-agents. They made their first appearance on the crop in the second week of August (33th SMW) with 0.26 grub and adult per plant. The weather parameters i.e., maximum (28.7^{o}C) and minimum (21.6^{o}C) temperatures, morning (89%) and evening (77%) RH, rainfall (11.6mm), wind velocity (9.4Km/h), respectively were observed. Lady bird beetle were observed by feeding on nymph and adult of aphid and jassid. Peak activity (1.27 grub/adult/plant) of the predatory beetles were observed in the third week of September (38th SMW) wherein maximum (32.2^{o}C) and minimum (24.9^{o}C) temperatures with morning (94 %) and evening (69%) RH, rainfall (91.6mm) and wind velocity (2.5Km/h) were prevailed respectively. With a seasonal mean of 0.85 beetle per plant were noticed.

Activity of okra lady bird beetle showed negative and non-significant correlation with maximum temperature (r= -0.03) and positive but non-significant correlation with minimum temperature (r= 0.26). There was positive significant correlation with morning RH (r= 0.63*) and positive significant with evening RH (r= 0.08) while positive significant correlation with rainfall (r= 0.62*) and negative but significant correlation with wind velocity (r= -0.62*), respectively.

Singh *et al.,* (2013) on okra whitefly and it's natural enemies were aphidophagous predators like coccinellids were more or less with aphid and jassid population.

The maximum population of lady bird beetle (*Coccinella* spp.) was recorded during 3rd week of August and in the second week of December during 2003 and during 1st week of September and December during 2004 (Purohit *et al.,* 2006).

Spider

A predatory spider was found preying upon aphid and jassid. The spider made its first appearance on the crop in the second week of August (33th SMW) with 0.29 spider/plant. The weather parameters like maximum (28.7 ^{o}C) and minimum (21.6 ^{o}C) temperatures with morning (89%) and evening (77%) RH, rainfall (11.6mm) and wind velocity (9.4Km/h), respectively were recorded. There was an increase in spider population and reached to its peak (1.26 spider/plant) during third week of September (38th SMW) were in the maximum (32.2^{o}C) and minimum (24.9 ^{o}C) temperatures, morning (94%) and evening (69%) RH, rainfall (91.6mm), and wind velocity (2.5Km/h), respectively were noticed with a seasonal mean of 0.90 spider/plant.

Table.1 Weekly population of major insect pest of okra during *Kharif* season (2016-17)

Insect pest/natural enemies	SMW/Date of observation(mean population/plant)												Overall mean
	33 13/08/16	34 20/08	35 27/08	36 03/09	37 10/09	38 17/09	39 24/09	40 01/10	41 08/10	42 15/10	43 22/10	44 29/10	
Jassid	2.89	4.11	6.31	8.43	8.31	9.23	10.36	9.16	7.33	6.23	5.52	3.22	**6.76**
Aphid	2.42	5.13	10.21	19.15	24.22	36.21	38.17	39.24	37.16	32.26	22.32	19.12	**23.80**
Whitefly	2.23	3.87	3.68	4.21	4.47	4.89	4.33	3.78	3.42	2.86	2.17	1.54	**3.45**
Thrips	2.48	2.69	3.16	3.75	4.04	4.23	3.76	3.43	2.85	2.43	1.06	0.74	**2.89**
Shoot AND fruit borer	0.78 (s)	1.22 (s)	1.76 (s)	1.96 (s)	2.38 (s)	2.87 (f)	3.34 (f)	3.54 (f)	3.31 (f)	2.82 (f)	2.22 (f)	1.12 (f)	**2.28**
Lady bird beetle	0.26	0.51	0.68	0.93	1.07	1.27	1.03	1.17	0.97	0.89	0.76	0.68	**0.85**
Spider	0.29	0.59	0.83	0.94	1.15	1.26	1.18	1.09	0.93	0.88	0.74	0.87	**0.90**

Table.2 Correlation coefficient between incidence of insect pests, natural enemies and weather parameters

Insect and natural enemies	Temperature ^{0} C		Rainfall	Relative Humidity (%)		Wind velocity (km/h)
	Maximum	Minimum		Morning	Evening	
Jassid	-0.11	0.48	0.77**	0.75**	0.37	-0.36
Aphid	-0.16	-0.02	0.41	0.64*	-0.09	-0.7
Whitefly	0.13	0.82**	0.75**	0.67*	0.59*	-0.03
Thrips	-0.05	0.80**	0.76**	0.67*	0.68*	0.14
Shoot and fruit borer	-0.16	0.13	0.43	0.77**	-0.005	-0.63*
Lady bird beetle	-0.03	0.26	0.62*	0.63*	0.08	-0.62*
Spider	0.05	0.32	0.70*	0.60*	0.18	-0.63*

*Significant at 5% level of significance ** Highly Significant at 1% level of significance

Activity of spider showed positive non-significant correlation with maximum (r= 0.05) and minimum (r= 0.32) temperatures. Positive significant correlation was observed with morning RH (r= 0.60*) and positive correlation with evening RH (r= 0.18) and positive significant correlation with rainfall (r= 0.70*) and negative but significant correlation with wind velocity (r= -0.63*), respectively.

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