SEASONAL INCIDENCE OF MAJOR INSECT PESTS OF OKRA AND CORRELATION WITH ABIOTIC FACTORS

Meena*, N.B., [1]Meena, A. K. and Naqvi, A.R.

Department of Entomology, College of Agriculture (SK Rajasthan Agricultural University), Bikaner-334006
[1]MaharanaPratap University of Agriculture and Technology, Udaipur -313001 (Rajasthan)
Email: rajeshpatho@gmail.com

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Abstract The field experiment was conducted at the Agronomy farm, College of Agriculture, (SKRAU), Bikaner, Rajasthan during summer, 2009 to study the seasonal incidence of major insect pests of okra and correlation with abiotic factors and revealed that the incidence of jassid started two weeks after germination of okra (third week of March), population increased rapidly and reached to its peak in the first week of April. The infestation of whitefly started in the third week of March and remained throughout the growth period. The infestation of shoot borer started in the fourth week of March and remained upto second week of May, being maximum in the first week of April. The infestation of shoot borer declined after fruit setting and completely disappeared thereafter. The infestation of fruit borer was recorded in the third week of April (seven weeks after germination) and remained upto last week of June with a maximum in the first week of May.Jassid, whitefly and fruit borer population was had not significant with maximum & minimum temperature, relative humidity and rainfall, while maximum and minimum temperatures had negative significant effect on the shoot borer infestation.

Keywords: Seasonal incidence, Abiotic factors, Jassid, Whitefly, Shoot, Fruit borer

INTRODUCTION

Okra, *Abelmoschusesculentus* (L.)Moench commonly known as bhindior lady's finger, belongs to family Malvaceae. It is a popular fruit vegetable crop due to its high nutritive and medicinal values and is said to be originated from tropical Africa. In India, it is cultivated throughout the year and occupied 0.31 million hectares area with an annual production of 3.65 million tonnes (5), whereas, Rajasthan occupied 4456.0 hectares area with an annual production of 11447.0 tonnes (4). The okra plant has medicinal values and useful in curing many diseases of human beings (stone in kidney, leucorrhoea, backache and goiter). Moreover, the fully ripened fruits and stem containing crude fibers are used in paper industry, while roots and stem are used for purification of sugarcane juice in Jaggery (*Gur*) manufacture in India.

Insect pests are the main constraint in the successful cultivation of okra. The okra crop is attacked by number of insect pests right from germination to harvesting of the crop *viz.*;jassid*(Amrascabiguttulabiguttula* Ishida*);* whitefly *(Bemisiatabaci*Genn.*);* aphid *(Aphis gossypii* Glover*);* shoot and fruit borer *(Eariasinsulana*Boised and *E. vitella*Fab.*);* leaf roller *(Syleptaderogata*Fab.*);* red cotton bug *(Dysdercuskoenigii* Fab.*);* mite *(Tetrantchustelarius* Linn.*);* green plant bug *(Nezaraviridula* Linn.*)* and green semilooper*(Anomisflava* Fab.*)* (17). Among the insect pests jassid*(A.biguttulabiguttula* Ishida*);* whitefly *(B.tabaci*Genn.*)* and shoot and fruit borer *(E.insulana*Boised and *E. vittella* Fab.*)* are considered as major pests (16)(11).

Jassids and whiteflies are cosmopolitan in distribution and found where ever okra is grown. The nymphs and adults of these pests suck the cell sap from the plant and inject some toxic substance resulting in curling of leaves and stunted plant growth. Whitefly transmits viral diseases and acts as vector especially "yellow veins mosaic" (25).Severe infestation causes burning of leaves which fall down later on. This results in drastic reduction (40-46%) in yield (24).

The larvae of shoot and fruit borer, bore into the growing shoots, flower buds, flowers and fruits of okra, thereby killing the plants or causing heavy shedding of flower buds. The infested fruits become distorted and rendered unfit for human consumption and procurement of seeds. The borers have been reported to cause 24.16 to 26.00 per cent damage to okra shoots (38) and 40 to 100 per cent loss to fruits (26) (34) in India.

In order to prevent the loss caused by insects and to produce a quality crop, it is essential to manage the pest population at an appropriate time with suitable measures. Thorough knowledge of seasonal activity of different insect pests determines the predisposing climatic factors affecting their population dynamics.

MATERIAL AND METHOD

In order to study the seasonal incidence of major insect pests of okra and correlation with abiotic factors, the experiment was laid out in a Randomized Block Design (RBD). The seeds of okra, variety VarshaUphar, were sown in last week of February, 2009 in the plots measuring 3.0 X 2.1 sq. meter

*Corresponding Author

keeping 30 cm row-to-row and 15 cm plant-to-plant distance.

Population estimation

The crop was kept under constant observation for appearance of pests. The population of different insect pests was recorded at weekly intervals right from germination of the crop to harvesting. The pest population was recorded on five randomly selected and tagged plants per plot in early hours (before 8 AM) when insects had minimum activity. The methods used for recording the population of major insect pasts have been described below.

Jassid (*Amrascabiguttulabiguttula* Ishida)

The population of jassid was recorded by counting both nymphs and adults on five randomly selected and tagged whole plants in initial stage of the crop and on three leaves per plant each from upper, middle and lower portion as suggested by(30).

Whitefly (*Bemisiatabaci*Genn.)

For estimation of whitefly population, the observations were recorded on whole plant in initial stage and on 3 leaves from the upper, middle and lower portion of 5 tagged plants in each replication. The population was counted by holding the base of the leaves in between fore finger and thumb and twisted the leaves gently until the entire underside of leaf was clearly visible (6). Population was estimated with least disturbances at early hours of the day.

Shoot and fruit borer (*Eariasspp*.)

The infestation of shoot borer was recorded on 5 randomly selected and tagged plants by visual counting of the shoots, started two weeks after germination of the crop to last picking of the fruits. The per cent shoot infestation was calculated by counting the total number of shoots and the number of damaged shoot showing yellowish and drupping symptoms.

In case of fruit borer, the observations were recorded on per cent infestation of the fruits both on number and weight basis at each picking started from 19 April, till last picking of the fruits. The per cent infestation of fruits on number basis was calculated by counting the infested and healthy fruits separately from 5 tagged plants. The weight of both healthy and infested fruits were taken separately and level of infestation in percentage was worked out

Meteorological data

Weekly data of atmospheric temperature (maximum and minimum), relative humidity and total rainfall were obtained from meteorological observatory, Agricultural Research Station, Bikaner.

Absolute number of pest population per 15 leaves for jassid and whitefly and per cent infestation of shoots and fruits (both on number and weight basis) have presented graphically. Simple correlation was computed between jassid and whitefly population and per cent infestation of shoots and fruits (both on number and weight basis) and weather parameters like minimum and maximum temperature, average relative humidity and total rainfall.

RESULT AND DISCUSSION

Jassid

In the present investigation, the incidence of jassid commenced after two weeks of germination i.e. in the third week of March. The present results are in agreement with those of(19), who reported appearance of jassids on okra crop two weeks after sowing,(22), who observed initiation of jassid on okra in the 13^{th} standard week also support the present investigation. However, findings of (3) do not corroborate the present results who reported the initiation of jassid in the first week of April on okra.

The population increased rapidly and reached to its peak (21.50 jassids/15 leaves) in the first week of April. The present results corroborate with that of (14), who observed peak population of jassids in the middle of April. Similarly,(22) reported that peak period of activity in the third week of April, partially support the present findings. Contrary to the present findings, the peak period of incidence of jassid was reported during third week of June and fourth week of July by (12). The peak population of jassid was reported from fourth week of May to last week of June (3), which does not supported the present investigation.

The population declined gradually and completely disappeared in the second week of June. The slight variation in the commencement and peak period of incidence may probably be due to the difference in agroclimatic conditions of the locality and date of sowing of the crop.

Correlation between jassid incidence and abiotic factors

The incidence of jassid started at 34.3 ^{0}C maximum and 16.0^{0}C minimum temperature and 23.5 per cent relative humidity. The jassid population increased gradually and reached to its maximum (21.50 jassids/15 leaves) at 30.8^{0}C maximum, 17.5 ^{0}C minimum temperatures and 56.0 per cent relatively humidity. The present results are in agreement with(14), who reported highest population of jassids in between 30-36^{0}C temperature and upto 80 per cent relatively humidity. The maximum population of jassid was reported at more than 70 per cent relatively humidity by (28) and at 37^{0}C maximum temperature by (29) do not support the present findings.

A non-significant negative correlation was observed between jassid population and maximum, minimum temperatures, relatively humidity and rainfall. The present results are in agreement with that of (23), who found a non-significant correlation between

maximum and minimum temperatures, relative humidity and rainfall with jassid population on okra crop. However, (33) observed significant negative correlation with maximum temperature and positive correlation with minimum temperature and relative humidity, partially support the present investigation. The present findings do not corroborate with those of(29), who reported positive significant correlation between temperature and jassid population. (36)found positive correlation between jassid population and temperature, relatively humidity and rainfall and (31), who reported significant positive correlation between leafhopper population and rainfall, relative humidity, while it was negative with mean temperature, do not support the present investigations.

Whitefly

The infestation of whitefly started in the third week of March i.e. two weeks after germination at 16.0^{0}C minimum temperature and 23.5 percent relative humidity, when there was 34.3^{0}C maximum temperature. The present results are in conformity with that of (20), who reported that the incidence of whitefly started on okra crop two weeks after sowing. However, (7) reported that whitefly population initiated on about one month old okra crop. (9)reported the appearance of whitefly started at the end of April and (3) observed the incidence of whitefly from first week of April, partially support the present investigation. The difference in the incidence may probably be due to the difference in sowing time.

The population reached to its maximum in the first week of April, being 18.66 whiteflies/15 leaves.(3)reported peak population in the last week of April, support the present findings. Contrary to the present finding(7) observed peak population on 43rd day old crop, (20) found after 11 weeks of sowing at 35.0^{0}C maximum, 21.2^{0}C minimum and 62.0 per cent relative humidity do not support the present results. The difference in peak period may probably be due to the difference in sowing time and agro-climatic conditions of the location.

The population persisted in low numbers till harvesting of the crop i.e. by first week of June. The present results corroborate with that of (9), who reported persistence of whitefly population till harvesting of the crop.

Correlation between whitefly incidence and abiotic factors

The incidence of whitefly started at 34.3^{0}C maximum and 16.0^{0}C minimum temperature and 23.5 per cent relative humidity, which increased gradually. The maximum infestation (18.66 whiteflies/15 leaves) was observed at 30.8^{0}C maximum, 17.5 ^{0}C minimum temperature and 56.0 per cent relative humidity. The present results are not in agreement with that of (20), who reported that the incidence of whitefly started on okra crop when there was 31.4^{0}C maximum, 23.6^{0}C minimum temperature and 83.0 per cent relative humidity and reached to peak when there was 35.5^{0}C maximum, 21.2^{0}C minimum temperature and 62.0 per cent relative humidity. However, (37) who reported that whitefly population was accelerated with increase in relative humidity, support the present investigation. No significant effect was recorded between whitefly population and maximum, minimum temperatures, relative humidity and rainfall. However, it was negative with maximum and minimum temperature and rainfall, whereas, positive to relative humidity. The present results are in partial agreement with that of (20), who reported a non-significant negative correlation with minimum temperature, relative humidity and rainfall, whereas, it was positive significant with maximum temperature. Similarly (23) also found a non-significant correlation with abiotic factors, is partially in the line of present investigation.

Shoot borer

The infestation of okra shoot borer started in the fourth week of March (3 weeks after germination) and remained upto second week of May, being maximum (18.10%) in the first week of April. The infestation declined after fruit setting and completely disappeared thereafter. The present investigations are in partial agreement with those of (35), who reported that infestation of okra shoot borer commenced 2 to 3 weeks after germination. (8)reported that infestation of shoot borer started 12,6 and 4 weeks after germination, respectively, does not corroborate the present findings. Slight variation in the onset of infestation may probably be due to the difference in the climatic conditions of the locality. The maximum shoot borer infestation 18.10 per cent was recorded in the present experiment as compared to 1.7 per cent (10), 24.16 per cent (28), 8.5 per cent (35) and 0.00 to 3.32 per cent (32) in different regions of the country. This variation in the infestation may probably be due to local climatic conditions, date of sowing and intensity of pest population.

Correlation between shoot borer infestation and abiotic factors

The infestation of shoot borer on okra started when there was 34.0^{0}C and 16.9^{0}C, maximum and minimum temperatures, respectively and 43.5 per cent average relative humidity, which increased abruptly. The maximum infestation (18.10%) was recorded at 30.8^{0}C maximum, 17.5^{0}C minimum temperature and 56.0 per cent average relative humidity. The present results are in the line of work of (13), who observed maximum larval development of *Earias* spp. at a temperature range of 15-30^{0}C. The maximum and minimum temperatures showed significant negative effect on the infestation of shoot borer. The present results are in agreement with (15),

who observed significant negative correlation with maximum temperature and shoot borer infestation. Similarly, (27) also reported significant negative correlation between pest infestation and minimum temperature also corroborate the present investigation. Findings of (18), who reported non-significant positive correlation between maximum temperature and shoot borer infestation does not support the present results.

In the present studies the average relative humidity had positive, whereas, rainfall had negative non-significant correlation with shoot borer infestation. The present results are not in agreement with those of (27), who reported negative significant correlation with relative humidity and shoot borer infestation, whereas, (15), who found positive significant correlation with rainfall. The findings of (27), who reported positive significant effect of relative humidity and negative significant effect of rainfall on shoot borer infestation, support the present investigation.

Fruit borer

The infestation of fruit borer was observed in the third week of April (seven weeks after germination) and remained upto last week of June. The infestation increased gradually and reached to its maximum in the first week of May, being 21.97 per cent on number and 19.77 per cent on weight basis during the study period. Thereafter, the infestation of *Earias*spp. started declining and persisted upto last week of June. The present results are in partial agreement with those of (1), who reported that the incidence of the fruit borer started six weeks after germination of okra crop. (21)reported the initiation of fruit infestation during second week of March with maximum during first week of April does not corroborate the present findings. (32)reported maximum infestation of okra fruits after 12-13 weeks of germination, support the present investigation. However, (2) observed peak infestation on 10 weeks old okra crop is not in the line of present work. The difference in the seasonal incidence may probably be due to local climatic conditions and difference in date of sowing.

Correlation between fruit borer infestation and abiotic factors

The infestation of fruit borer started at 37.3^0C maximum, 22.3^0C minimum temperatures and 16.1 per cent average relative humidity. Maximum, minimum temperatures, average relative humidity and rainfall had non-significant positive effect on the fruit borer infestation. The present results are in agreement with those of (29), who reported that infestation of pests on fruits was not influenced by any of the environmental factors. (15), reported positive significant correlation with minimum temperature, relative humidity and rainfall, whereas, significant negative correlation with maximum temperature does not support the present investigations.

Table 1. Seasonal incidence of jassid, whitefly and shoot borer on okra in relation to abiotic factors

S. No	Date of observation	Temperature (^{0}C)		Avg. R.H. (%)	Total rainfall (mm)	Mean population* per 15 leaves		Shoot borer infestation* (%)
		Max.	Min.			Jassid	Whitefly	
1.	18.03.09	34.3	16.0	23.5	000.0	7.00	3.00	0.00
2.	25.03.09	34.0	16.9	43.5	001.0	19.83	15.66	4.49
3.	01.04.09	30.8	17.5	56.0	002.0	21.50	18.66	18.10
4.	08.04.09	35.1	22.1	29.5	000.0	19.50	13.16	12.99
5.	15.04.09	35.9	20.1	30.5	000.0	18.00	14.33	13.40
6.	22.04.09	39.2	23.6	19.0	000.0	17.16	11.83	10.33
7.	29.04.09	40.2	25.7	15.0	000.0	16.00	9.66	8.53
8.	06.05.09	42.1	27.4	26.5	000.0	18.83	13.83	2.40
9.	13.05.09	41.4	27.5	23.5	000.0	14.66	10.00	1.71

10.	20.05.09	46.1	30.5	24.5	000.0	12.83	9.00	0.00
11.	27.05.09	45.3	30.4	23.0	002.0	7.00	7.33	0.00
12.	03.06.09	40.6	27.3	45.0	033.0	2.66	9.33	0.00
13.	10.06.09	42.0	27.3	29.0	000.0	0.00	5.33	0.00
14.	17.06.09	41.2	24.2	40.0	024.0	0.00	2.33	0.00
15.	24.06.09	41.5	28.2	33.0	000.0	0.00	1.00	0.00

*Average of three replications

Table 2. Seasonal incidence of fruit borer on okra in relation to abiotic factors

S. No.	Date of observation	Temperature (^{0}C)		Avg. R.H. (%)	Total rainfall (mm)	Mean* per cent infestation of fruits	
		Max.	Min.			Number basis	Weight basis
1.	19.04.09	37.3	22.3	16.1	000.0	5.58	5.42
2.	22.04.09	41.5	25.2	18.5	000.0	6.59	6.49
3.	25.04.09	37.7	24.8	21.8	000.0	6.92	6.69
4.	28.04.09	41.1	25.1	8.6	000.0	8.10	8.01
5.	01.05.09	44.7	29.0	18.1	000.0	13.19	12.77
6.	04.05.09	43.2	27.8	24.5	000.0	19.17	18.74
7.	07.05.09	37.8	25.8	32.3	000.0	21.97	19.77
8.	10.05.09	39.0	27.5	24.6	000.0	12.63	10.22
9.	13.05.09	41.6	27.9	22.1	000.0	9.20	8.25
10.	16.05.09	46.1	29.2	28.0	000.0	12.50	11.43
11.	19.05.09	46.2	30.7	21.8	000.0	6.74	6.19
12.	22.05.09	46.0	30.3	23.3	000.6	17.21	17.05
13.	25.05.09	45.4	31.3	21.6	000.0	16.04	13.27
14.	28.05.09	44.5	31.1	27.5	000.0	17.73	16.64

15.	31.05.09	41.0	25.7	48.0	008.6	18.57	17.44
16.	03.06.09	38.5	27.2	47.6	002.3	12.71	10.97
17.	06.06.09	41.4	28.6	36.5	000.0	0.00	0.00

*Average of three replications

Table 3. Correlation coefficient of major insect pests population/infestation of okra with abiotic factors

S.No	Abiotic components	Jassid	Whitefly	Shoot borer	Infestation of fruit borer	
					Number basis	Weight basis
1.	Maximum Temperature (^{0}C)	-0.486 NS	-0.498 NS	-0.690*	0.182 NS	0.210 NS
2.	Minimum Temperature (^{0}C)	-0.417 NS	-0.377 NS	-0.538*	0.265 NS	0.243 NS
3.	Relative humidity (%)	-0.019 NS	0.300 NS	0.224 NS	0.285 NS	0.252 NS
4.	Rainfall (mm)	-0.492 NS	-0.228 NS	-0.294 NS	0.302 NS	0.307 NS

NS= Non-significant
* Significant at 5 % level

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