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RESEARCH ARTICLE

Effect of Abiotic Factors on the Incidence of Major Pests of Okra (*Abelmoschus esculentus*) and Natural Enemies

D. Deepika[1], T. Abdul Razak[2], K. Elanchezhyan[3] and M.I. Manivannan[4]
Department of Agricultural Entomology
Agricultural College and Research Institute, Killikulam

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ABSTRACT

The present research was aimed to study the seasonal incidence of major sucking pests and the natural enemies on okra *Abelmoschus esculentus* under field condition at the Department of Agricultural Entomology, Agricultural College and Research Institute, Killikulam. The crop had revealed the incidence of sucking pests *viz.,* aphid, jassid, whitefly, mites along with natural enemies like spiders and coccinellids. The incidence of jassid first commenced in 43rd SMW (0.30/3 leaves), aphids and whitefly in 44th SMW (0.10 and 0.35/3 leaves), mite was found in first SMW (25.53/cm^2/leaf area). *Earias* infestation was found during 49th SMW (7.29 per cent). Natural enemies such coccinellids and spiders were observed during 45th (0.05/plant) and 43rd SMW (0.05/plant) respectively.

Keywords*: Aphids, Jassids, Whitefly, Mites, Coccinellids, Spiders.*

Okra *A. esculentus* is cultivated throughout the year except for some cold month due to unfavorable climatic conditions (Memon *et al.,* 2004). It is a useful plant cultivated for its edible fruit as its other parts like leaves, flower petals, stems and roots are used as a food, biofuel, medicine in different parts of the world. It has high nutritious as well as dietary value. Its nutritive value is higher than tomatoes, eggplant and most cucurbits except bitter gourds (Nonnecke, 1989).

The productivity of *A. esculentus* is low due to many factors and one of the most important factors is the occurrence of insect pests. Aphid (*Aphis gossypii*), shoot and fruit borer, *Earias insulana* (Boisduval) and *Earias vittella* and Jassid, *Amrasca biguttula biguttula* are the most serious pests of okra *A. esculentus* and cause 45.00-57.10% damage to fruits (Srinivasan and Kumar, 1983; Nderitu *et al.* 2008). T Boopathi *et al.* (2011) noticed that the incidence of *A. biguttula biguttula* from last week of May to till the final harvest *i.e.* first week of August. The peak level of incidence was noticed during the first week of July. Das *et al.* (2011) studied the impact of weather factors on pests and diseases of okra. Correlation studies showed that T_{max} had a significant effect on jassid population. Two species of spotted bollworms, *Earias vittella* (Fabricius) and *E. insulana* (Boisduval) have been reported on okra (Satpute *et al.*, 2005). According to (Anjali *et al.,* 2012) pest abundance and distribution changes with abiotic factors and therefore meteorological parameters play a pivotal role in the biology of any pest. Pest activity and abiotic factors has an interaction which plays an important role in forming a management strategy that helps in the forecast of pest incidence. The present study was aimed to study the seasonal occurrence of insects and the effect of abiotic factors on the population of insect pests.

MATERIAL AND METHODS

The present investigation was carried out in the experimental field of Department of Horticulture, Agricultural College and Research Institute, Killikulam during *rabi* season 2017. Seasonal incidence of major insect pests of okra *A. esculentus* in relation to weather parameters was studied during the season. Populations of Aphids, Jassids and Whiteflies (nymphs + adults) were recorded on three leaves per plant *viz*., each from upper, middle and lower plant canopy. Shoot and fruit borer (*Earias sp.*) was recorded on the basis of per cent fruit damage. These observations were recorded in untreated plots. Observations of weather data (Maximum & Minimum temperature, morning & evening relative humidity, wind speed, sun shine hours, total rainfall per week, rainfall etc.) were recorded on weekly basis from Meteorological observatory at AC & RI, Killikulam (Table.1). Statistical analyses of correlation of the insect pest with the weather (abiotic) factors were worked out by using the formula as suggested by Gomez and Gomez, (1984).

Corresponding author's email: deepikabsc12@gmail.com

$$r = \frac{Sxy}{[(Sx2)\,(Sy2)]^{1/2}}$$

Where,

r = Simple correlation coefficient

Sx2 = Correlated sum of squares for meteorological parameters

Sy2 = Correlated sum of squares for pest incidence

Sxy = Correlated sum of squares of cross products

RESULTS AND DISCUSSION

Jassid

The incidence of jassids (Table. 2) was noticed from early stage to harvestable stage of the crop. Jassid population was initially noticed at the range of 0.3-9.05/3 leaves during the early stage of the crop and attained peak during (12.75/plant) 48th SMW. After that the population abruptly decreased in the remaining weeks and it was in the range of 1.00 – 5.55/3 leaves. Jassid showed a highly significant correlation (Table.3) with evening relative humidity (r = 0.779).

Table 1. Weekly meteorological data for the crop season rabi 2017-2018

Month	SMW	Period	Max temp (^{0}c)	Min Temp (^{0}c)	Relative humidity		Wind speed (km/hr)	Rainfall (mm)	Sunshine (hrs)
					Morning (%)	Evening (%)			
October	43	Oct 22 - Oct 28	34.10	22.50	70.10	58.20	5.10	2.00	8.60
November	44	0ct 29 - Nov 4	21.20	21.20	84.00	63.40	4.20	137.00	3.10
	45	Nov 5- Nov 11	22.00	22.00	82.00	66.10	3.90	28.00	4.10
	46	Nov 12- Nov 18	23.00	23.00	73.20	58.40	3.10	0.00	8.50
	47	Nov 19- Nov 25	21.90	21.90	83.80	70.40	4.10	16.00	4.00
December	48	Nov 26 - Dec 2	30.90	17.90	87.40	84.00	5.10	204.00	5.10
	49	Dec 3 - Dec 9	30.50	18.40	74.70	75.70	5.10	0.00	5.10
	50	Dec 10 - Dec 16	31.20	18.40	81.70	75.00	5.00	23.00	5.00
	51	Dec 17 - Dec 23	30.70	19.70	83.70	65.70	5.60	3.00	5.60
	52	Dec 24 - Dec 31	35.20	22.00	82.50	53.70	9.60	0.00	9.60
January	1	Jan 1- Jan 7	31.70	21.40	68.40	55.70	4.80	0.00	7.30
	2	Jan8 - Jan 14	31.00	20.00	85.20	59.50	6.30	0.00	5.40
	3	Jan 22 - Jan 28	32.00	20.00	81.20	42.40	7.90	0.00	8.20
	4	Jan 29 - Feb 4	31.70	20.30	86.10	46.80	5.80	0.00	7.30
February	5	Feb 5 - Feb 11	37.50	21.70	73.50	42.20	8.60	35.00	9.60

SMW- Standard Meterological Week

The jassids incidence was relatively more during early stage of the crop. The crop phenology and weather parameters such as, rainfall and evening relative humidity prevailing during that stage i.e. during third week of October 2017 to fourth week of November (43rd - 48th SMW of 2017) favored the buildup of this sucking pest in okra *A. esculentus*. This is also evident from the correlation studies (Table.3) however the jassid incidence was drastically reduced from the 49th SMW. This could be due to the physical effect (washout) of jassid population by the good rainfall received during 48th SMW followed by very low to nil rainfall in the subsequent weeks. Khating *et al.* (2016) reported that, the incidence of leaf hoppers was non-significantly correlated (r = -0.060) with maximum temperature.

Aphid

The infestation of aphids on okra *A. esculentus* crop sown during *rabi* 2017 initiated during second week after sowing i.e., during the first week of November 2017. The population of aphids started increasing gradually and reached its peak (29.20/plant) during 49th SMW (Table. 2). After that, the population showed a declining trend and reached its minimum (0.15/3leaves/plant) during 13th week after sowing. During *rabi* 2017, the

aphids showed positive correlation with maximum temperature, evening relative humidity and rainfall (r = 0.177, 0.674, 0.116).

Whitefly

The infestation of whitefly on okra *A. esculentus* was found during the second week of the crop with an average population of 0.35/plant during the 44th SMW. There was no steady growth in whitefly population and found sparse throughout the season. In *rabi* 2017 the peak infestation was observed during 48th and 49th SMW (Table.2). In *rabi* 2017, the weather parameters such as maximum temperature, relative humidity (morning and evening) and rainfall showed positive correlation except minimum temperature (r = -0.454) and sunshine hours (r = - 0.314) with the whitefly population.

Table 2. Seasonal incidence of major pests and natural enemies on okra during rabi 2017

SMW	Period	No./3 leaves/plant			RSM no./cm²	FB (% damage)	No./plant	
		Jassid	Aphids	Whitefly			Coccinellids	Spider
43	Oct 22 - Oct 28	0.30	0.00	0.00	0.00	0.00	0.00	0.05
44	0ct 29 - Nov 4	0.90	0.10	0.35	0.00	0.00	0.00	0.05
45	Nov 5- Nov 11	2.90	0.90	0.00	0.00	0.00	0.05	0.10
46	Nov 12- Nov 18	3.80	1.30	0.10	0.00	0.00	0.45	0.45
47	Nov 19- Nov 25	9.05	2.70	0.20	0.00	0.00	0.05	0.25
48	Nov 26 - Dec 2	12.75	12.10	0.35	0.00	0.00	0.10	0.50
49	Dec 3 - Dec 9	5.55	29.20	0.40	0.00	7.29	0.30	0.10
50	Dec 10 - Dec 16	4.70	15.40	0.10	0.00	12.92	0.35	0.45
51	Dec 17 - Dec 23	3.60	5.80	0.15	0.00	18.63	0.05	0.45
52	Dec 24 - Dec 31	1.90	2.55	0.30	0.00	24.50	0.25	0.70
1	Jan 1- Jan 7	1.10	1.30	0.10	25.53	29.02	0.00	0.60
2	Jan8 - Jan 14	2.05	1.15	0.35	56.47	22.89	0.30	0.35
3	Jan 22 - Jan 28	1.00	0.15	0.15	48.80	20.38	0.05	0.20
4	Jan 29 - Feb 4	1.85	0.00	0.05	42.16	19.08	0.05	0.20

RSM- Red Spider Mite, FB- Fruit Borer

SMW- Standard Meteorological Week

Mite

Mite infestation was found during the 11th week after sowing of the crop with an average of 25.53 mites/ cm²/ leaf area. During 12th week the infestation reached its peak and then started declining. At the end of the crop period, the mite infestation was as high as 42.16/cm²/ leaf area.During *rabi* 2017, mite infestation was initially recorded onfirst SMW *i.e* during first week of June 2018 and the peak infestation was noted on succeeding weeks.The maximum mite population was recorded during 16th SMW. It showed a significant negative correlation (Table.3) with evening relative humidity (r = -0.660).

Shoot and fruit borer

The invasion of *E. vitella* on okra *A. esculentus* was observed from first fruit picking (*i.e.,* during 49th SMW of 2017) to till last picking. The peak incidence and infestation of fruits was found during 1st SMW in 2018. After that there was a gradual decrease in per cent fruit borer damage till the end of the crop. Highly significant positive correlation was observed with wind speed (r = 0.667) and non-significant effect was found with relative humidity morning (r = -0.009).

Natural enemies

In *rabi* crop, the population of coccinellid predator *Chilomenes sexmaculata* was first noticed during the third week of the crop. The population was observed throughout the crop period with maximum number of 0.45/plant. During *rabi* 2017, the occurrence of ladybird beetle *C. sexmaculata* started during first week of November and then it gradually increased to reach a maximum of 0.3 – 0.35 beetles/plant (Table.2) during first and second week of December coinciding with peak activity of aphid. However the highest population of ladybird beetle (0.45 beetles/plant) was observed in second week of November. Non-significant effect was found with morning relative humidity (r = - 0. 071).

Table 3. Correlation analysis for major pests during rabi 2017

Parameters	Jassid	Aphids	Whitefly	RSM	FB	Coccinellids	Spiders
Max. Temp.	-0.188	0.177	0.023	0.341	0.643*	0.038	0.377
Min. Temp	-0.461	-0.708**	-0.454	-0.095	-0.164	-0.138	-0.071
RH Mor.	0.367	-0.056	0.347	0.044	-0.009	-0.071	0.012
RH Eve.	0.779**	0.674**	0.379	-0.660*	-0.529	0.197	0.032
Wind Speed	-0.267	-0.077	0.253	0.378	0.667**	0.012	0.352
Rainfall	0.553*	0.116	0.434	-0.312	-0.471	-0.229	-0.022
Sunshine	-0.411	-0.290	-0.314	0.268	0.422	0.170	0.382

** Correlation significant at the 0.01 level (2- tailed)

* Correlation significant at the 0.05 level (2- tailed)

RSM- Red Spider Mite, FB- Fruit Borer

The population of *Lycosa pesudoannulata* was first noticed from the first week of the crop in the period October 2017. Maximum number observed was 0.70 per plant during the last week of December, 2017. Throughout the crop period, the spider population remained sparse and it was in the range of 0.05 – 0.70/ plant. In the *rabi* crop, predatory spider made its first appearance in the first week after sowing of the crop and its population ranged between 0.05 to 0.70/plant throughout the crop period. The *rabi* season data shows that the spider population is coinciding with the fruit borer infestation in *okra*.

CONCLUSION

The incidence of jassid population initiated during the early stage of the crop i.e. 43rd week. Aphids and whitefly was found during 44th week. This clearly shows that the sucking insect population was found during the primary stage of the crop. Mite infestation was found during the later stage of the crop *i.e.* first week. Shoot and fruit borer infestation was noticed during the reproductive stage of crop which showed a highly significant positive correlation with windspeed. Coccinellids and spider showed negative correlation with minimum temperature and rainfall.

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