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Relationship of Weather Parameters with Major Insect Pests and their Natural Enemies in Okra, *Abelmoschus esculentus* (L.) Moench

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ABSTRACT

The studies on seasonal abundance of major insect pests and their natural enemies on okra, *Abelmoschus esculentus* (L) Moench were carried out at Research Farm of the Department of Entomology, CCS Haryana Agricultural University during two *kharif* seasons, 2019 and 2020. The population dynamics study of the major insect pests on okra was carried out by counting the leafhoppers nymphs, whiteflies adults, *Erias* and coccinellids at weekly interval from three leaves each from upper, middle and lower leaf of randomly selected five plants. During 2019, the lowest (0.2 nymphs/leaf) and highest population (19.3 nymphs/leaf) of leafhoppers was observed during 39th and 33th standard weeks, respectively whereas, during 2020, the lowest population was observed in 38th standard week and the highest was in 32th standard week. The whitefly infestation initiated during early cropping period and the maximum population was observed in 31th standard week during both years. The coccinellids reached its peak in 29th and 36th standard weeks during 2019 and 2020, respectively. The highest fruit damage of 41.7 and 47.3% were recorded in 39th and 38th standard weeks during 2019 and 2020, respectively. The leafhopper population had positively significant correlation with relative humidity and negatively non-significant correlation with maximum temperature during both the years. There was no significant effect of whitefly population. The coccinellids population had negative correlation with temperature and positive correlation with relative humidity and rainfall during both the years. The fruit borer damage caused by *Earias* spp. was significant and negatively correlated with minimum temperature and evening relative humidity.

Keywords Sucking pests, *Erias*, Seasonal abundance, Population dynamics, Correlation.

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) is an economically important vegetable crop commonly called as bhindi or lady's finger is an annual crop grown throughout the year which is belonging to the family Malvaceae and grown in various regions of tropical and sub-tropical areas of the world. It is common and widely consumed food of Northeastern hilly region of India. It is suitable for cultivation as garden crop as well as on commercial large farms. Okra fruit is rich in vitamins (e.g., vitamin A, vita-

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min C, vitamin B6, folic acid, riboflavin), minerals (e.g., calcium, magnesium, potassium, iron, zinc, phosphorus, and β carotene), carbohydrates, proteins, fats and fiber (Varmudy 2011). The roots and stems are used for clearing cane juice for preparation of jaggery. Dry fruits skin and stems containing fiber are used in manufacture of paper and cardboard industry. It has good nutritional value i.e., per 100 g of edible portion of okra's contain energy of calories 35.0, moisture 89.6 g, carbohydrates 6.4 g, protein 1.9 g, fat 0.2 g, minerals 0.7 g, fiber 1.2 g, sulfur 30 mg, phosphorus 56.0 mg, iron 1.5 mg, potassium 103 mg., magnesium 53 mg, vitamin C 13.10 mg, oxalic acid 8.0 mg (Gopalan *et al.* 2007, Varmudy 2011). Though okra finds its origin in South Africa, India is the largest producer of okra with 73.25% share in world production and 11.60 t/ha productivity meanwhile total area and production under okra was 513 thousand hectares and 6170 thousand tones, respectively (Indian Horticulture database, 2018 - 2019). The production and yield of this valued crop is quite often very much hampered, as high as 72 species of insect have been recorded on okra crop, of which, the sucking pests comprising of Aphids, *Aphis gossypii* (Glover), leafhopper, *Amrasca biguttula biguttula* (Ishida), whitefly, *Bemisia tabaci* (Gennadius) and mite, *Tetranychus cinnabarinus* (Boisduval) causes significant damage to the crop (Sreenivas *et al.* 2019). The leafhopper *A. biguttula biguttula* (Ishida), suck the cell sap usually from lower surface of the leaves and inject toxic saliva into plant tissues, resulting in curling of leaves as a result the plant growth is retarded. The more infestation of the pest causes burning of leaves, which fall later from early stage to maturity (Singh *et al.* 2008). Many of the pests occurring on cotton are found to ravage okra crop. Whitefly (*B. tabaci*), the milky white minute flies; nymphs and adults suck the cell sap from the leaves. The affected leaves are curled and dried and subsequently the infested plants become a stunted. Whiteflies do acts as vector and transmit yellow vein mosaic viral disease from disease plant to healthy plants. Aphids, *A. gossypii* (Glover) is considered as the major pest of okra. It is a polyphagous pest, attacking a wide range of plant belonging to 46 families. The nymphs and adults are found in large numbers and they suck the sap from different parts of plants. Aphids and leafhoppers are important pests in the early stage of the crop, which desap the plants, make them weak and reduce the yield. Failure to control them in the initial stages was reported to cause a yield loss to the tune of 54.04% (Rehman *et al.* 2017). It has been recorded about 63.4 to 88.1% yield losses in okra Haryana were due to leafhopper (Sharma *et al.* 2001). The reduction in plant height, fruit number and fruit weight due to leafhopper infestation were recorded as 47.6, 50.0 and 57.2%, respectively (Chauhan *et al.* 2016).

The fruit borers include shoot and fruit borer *Earias vittella* (Fabricius) are the most horrendous pests causing serious turndown of the produce, in terms of quality as well as of quantity and insect infestation reach up to 11-12% during the month August and September (Pareek and Bhargava 2003, Shah *et al.* 2011). *Earias* spp. damage to the crop are distinguished from other insect pests of okra by their marked tendency for stem boring. The larvae bore into terminal bud of vegetable shoot and move by making tunnels inside. As a result, the wilting of top leaves and the shoots droop downward or dry up main stem. Secondly, the larvae enter the flower buds, flowers and fruits by making holes, rendering them unfit for human consumption. *Earias* spp. alone damage to okra up to 69% losses in yield due to the attack of fruit and shoot borer (Bharat *et al.* 2020).

One of the main reasons for this low production is that okra crop did not obtain due consideration as was given to major cereal crops like rice and some commercial crops like turmeric and ginger. This low productivity may be due to several abiotic and biotic factors and it is well well-known fact that damage by insect pests which attack the plant from seedling to maturity is one of the prime constraints in the realization of optimum yield of the black gram (Sharma *et al.* 2010). Studies on seasonal abundance of insect pests helps in understanding the behavior and ecology of the pests which is helpful for development of proper management strategies depending upon the different stages of the crop pests. Population dynamics of insect pests are considered to be back bone for the eco-friendly management of the pest, but lack of these studies at regional level regarding insect pests in okra in Haryana had triggered to undertake the present study. Therefore, keeping in view of these considerations, present investigations was carried out

with an objective to study the seasonal abundance of major insect pests and their natural enemies on okra in relation with abiotic factors.

MATERIALS AND METHODS

The experiment was conducted at the experimental farm at Research Farm, Department of Entomology, CCS Haryana Agriculture University, Hisar during *kharif* season 2019 and 2020 with following details. The okra variety Pusa Sawani was sown during *kharif* season, 2019 and 2020 with plot size of 25 m^2 and the row to row and plant to plant spacing of 60 and 30 cm, respectively. The crop was grown with recommended package of practices and no plant protection measure applied throughout the crop growth. The observations on the population of sucking pests and natural enemies were recorded 10 days after germination and subsequent observations were recorded at 7 days interval. These plants were examined weekly to check for the presence or absence of coleopteran pests associated with black gram. Observations were taken throughout the cropping season from first appearance of the pest until the harvest of the crop and these observations were taken during early hours of morning from 6 to 9 am and late hours of evening, when most of the insects are less active. Nymphs of leafhopper and adults of whitefly were counted from three leaves (upper, middle and lower canopy) on five randomly selected plants. Whereas natural enemies were recorded by visual observation. The fruit borer populations were recorded at each picking. The weekly meteorological data (maximum and minimum temperature (°C), relative humidity (RH%), rainfall (mm)) during the crop growing period in *kharif* seasons, 2019 and 2020 was collected from the Department of Agrometeorology, CCSHAU, Hisar and the correlation analysis was done by finding out the correlation coefficient, which was calculated by using SPSS software.

RESULTS AND DISCUSSION

The studies on population build-up of major insect pests and natural enemies were conducted on okra variety Pusa Sawani during *kharif* season of 2019 and 2020. Leafhopper occurrence started in 28th standard meteorological week (SMW) and reached to its peak (15.9 nymphs/plant) in the 33rd SMW (Table 1). The leafhopper population disappeared in 39th SMW. Likewise, whiteflies also showed their presence (0.7 adults/plant) in 28th SMW and reached to peak (16.2 adults/plant) in 31st SMW, thereafter started declining and disappeared in 39th SMW. Whereas coccinellids beetles appeared in 29th SMW and remained up to 30th SMW. Again, they showed their presence in 32nd SMW. Their peak population was observed in 29th and 36th SMW. The incidence of *Earias* spp. started in 34th SMW. Maximum fruit damage (41.1 %) was recorded in 38th SMW. Fruit damage varied from 10.8 to 41.1% during fruiting period (Table 1).These observations are supported by Mohanasundaram and Sharma (2011), who recorded the infestation of leafhopper throughout the cropping period. Nath *et al.* (2011)

Table 1. Seasonal abundance of major insect pests and their natural enemies on okra during *kharif* 2019 and 2020.

SMW	Temperature (°C)		Relative humidity (%)		Rainfal (mm)	Mean population			Fruit damage (%)
	Maximum	Minimum	Morning	Evening		Leafhopper	Whitefly	Coccinellids	
28	36.6	26.9	81.0	60.2	3.7	1.2	0.7	0.0	0.0
29	33.6	24.8	92.5	72.7	13.8	3.6	3.6	0.5	0.0
30	33.9	26.1	87.7	66.3	2.8	9.8	8.9	0.2	0.0
31	35.1	26.1	85.5	66.4	1.3	13.0	16.2	0.0	0.0
32	35.0	27.3	87.2	64.9	6.9	15.6	12.7	0.1	0.0
33	34.3	26.2	89.6	73.7	2.4	15.9	9.6	0.4	0.0
34	34.1	25.6	88.7	65.8	0.9	8.1	7.5	0.4	10.8
35	35.1	26.5	86.9	59.2	0.0	6.6	7.4	0.2	23.8
36	35.0	26.1	91.3	62.8	4.3	5.0	5.4	0.7	37.0
37	36.7	26.0	87.8	50.3	0.0	3.7	3.9	0.2	39.6
38	36.4	25.0	85.6	48.7	0.5	1.2	1.5	0.0	41.1
39	35.2	23.3	84.4	48.4	0.2	0.1	0.3	0.0	36.4

Table 2. Correlation coefficient between population of leafhopper, whitefly, coccinellids and fruit damage with weather parameters during *kharif,* 2019 and 2020.

Insect pests	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	Morning	Evening	
Leafhopper	-0463	0.560	0.268	0.672*	0.007
Whitefly	-0403	0.522	0.20	0.577*	0.007
Coccinellids	-0.542	0.042	0.874**	0.521	0.417
Fruit borer damage	0.523	-0.447	-0.018	-0.823**	-0.479

also observed the activity of *A. biguttula biguttula* from July to October with peak from mid-August to mid-September. Whereas, Nath *et al.* (2011) recorded the activity of leafhopper, *A. biguttula biguttula* from July to October with peak period from mid-August to mid-September. But Singh *et al.* (2013) observed the peak population during fourth week of September (39th standard week) in Madhya Pradesh. It could be due to various crop season and ecological condition in that reason.

The highest fruit damage by larvae of *Earias* spp. was recorded between 3rd week of August (Table 1). The difference in the per cent fruits damaged across the seasons possibly attributed to the difference in surrounding weather conditions. These findings are supported by earlier worker (Selvaraj *et al.* 2010, Nath *et al.* 2011, Dabhi *et al*. 2017). Minimum temperature showed a non-significant positive effect on fruit damage during 2019 and significantly negative correlation with minimum temperature during 2020. Nath *et al.* (2011) and Dabhi *et al.* (2017) observed a significant negative effect of minimum temperature on the fruit damage by *Earias* spp. Yadav *et al.* (2007) and Sharma *et al.* (2010) reported significant positive effect of minimum temperature on fruit damage. The variation in fruit damage might be due to change in agro-climatic conditions and genotype used for study. The relative humidity morning and evening showed non-significant and significant negative correlation with fruit damage. The rainfall had significant negative correlation with fruit damage during study time. Similar negative effect of rainfall on per cent fruit damage were observed by Yadav *et al.* (2007), Nath *et al.* (2011) and Dabhi *et al.* (2017).

In Table 2, average maximum temperature had negative correlation with leafhopper, whitefly and coccinellid population, while it showed positive correlation with fruit damaged by *Earias* spp. Whereas relative humidity (morning) and rainfall exhibited positive correlation with leafhopper, whitefly and coccinellid population, while it showed negative positive correlation with fruit damaged by *Earias* spp. Relative humidity (evening) had significant positive effect on population of leafhopper and whitefly, highly significant negative effect on fruit damaged by *Earias* spp. These studies are in accordance with findings of Singh *et al.* (2013), Dave and Pandya (2017). Meena *et al*. (2010) from Rajasthan and Singh *et al.* (2013) from Madhya Pradesh reported appearance of coccinellids on the crop started in third week of July and reached to its peak during 29th, 34th and 36th standard week during 2019 and 2020, respectively. Singh *et al.* (2013) observed peak population of coccinellids on okra in the mid-October corresponding with emergence of aphid population.

CONCLUSION

The studies on population build-up of major insect pests and natural enemies were conducted on okra variety Pusa Sawani during *kharif* season of 2019 and 2020 at the research farm of Department of Entomology, CCS Haryana Agricultural University, Hisar. Leafhopper occurrence started in 28th standard meteorological week (SMW) and reached to its peak (15.9 nymphs/plant) in the 33rd SMW. The leafhopper population disappeared in 39th SMW. Likewise, whiteflies also showed their presence (0.7 adults/plant) in 28th SMW and reached its highest peak (16.2 adults/plant) in 31st SMW, thereafter started declining and consequently disappeared in 39th SMW. Among natural enemies, coccinellids beetles first appeared

during 29th SMW and remained up to 30th SMW. Again, they showed their presence in 33rd SMW. Their peak population was observed in 29th and 36th SMW. The incidence of *Earias* spp. started in 34th SMW and consequent maximum fruit damage (41.1 %) was recorded in 38th SMW. Fruit damage varied from 10.8 to 41.1% during fruiting period. The effect of weather factors on population buildup of major insect pests and natural enemies on okra showed that average maximum temperature had negative correlation with leafhopper, whitefly and coccinellid population, while it showed positive correlation with fruit infestation by *Earias* spp. However, relative humidity (morning) and rainfall exhibited positive correlation with leafhopper and coccinellid population, meanwhile it had shown negative correlation with fruit damaged by *Earias* spp.

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