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Effect of Weather Parameters on Population Fluctuation of Sucking Pests and their Predators on Okra Crop

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A B S T R A C T

A field trial was conducted during the *kharif*, 2016 at Vegetable Research Centre, Pantnagar to study the correlation of the sucking pest population *viz.* leafhopper (*Amrasca bigutullabigu tulla* Ishida), whitefly (*Bemisiatabaci* Gennadius) and aphids (*Aphis gossypii* Glover) and their predators mainly *Coccinella* spp. and spiders with the prevailing weather conditions. The peak densities of insect pests and their predators were attained in September-October. A simple correlation coefficient was worked out between the sucking pests and their predators with the weather parameters. A negative significant correlation (r= -0.711*) of leafhopper population was observed with wind velocity, while positive non-significant correlation (r= 0.051) was observed with the sunshine hours. The aphid population was non-significantly correlated with weather parameters. Whitefly population was negatively and significantly correlated with wind velocity ($r = -.718^{**}$). Among the predators there was a non-significant correlation of *Coccinella* with weather parameters while spider population was negatively and significantly correlated with wind velocity (r = -0.582*).

Introduction

Okra *Abelmoschus esculentus* L. (Moench) is the most popular and commercially grown vegetable crop in India. It is a short duration crop grown throughout India. It is an important cash crop providing a good source of income and livelihood to the farmers.

In India total area and production under okra was reported to be 530.8 thousand hectare and 63.50 lakh tonnes during the year 2012-13 (Anonymous, 2013). In Uttarakhand, okra occupies 3.3 thousand hectare area with a production 26.7 thousand tonne (Anonymous, 2016).

Okra has high nutritional, industrial and medicinal values (Nadkarni, 1927 and Chauhan, 1972). It is the rich source of vitamins, minerals like Fe, Mn, Zn, Ni (Bhatt *et al.,* 2018). Medicinally, okra is useful in spermatorrhoea, genito-urinary disorder and chronic dysentery. It also cures ulcers and provides relief from hemorrhoids. The composition of okra pods per 100 g edible portion is: energy 144.00 kJ (36 kcal), water 88.6 g, protein 2.10 g, fat 0.20 g, carbohydrate

8.20 g, fiber 1.70 g, Ca 84.00 mg, P 90.00 mg, Fe 1.20 mg, β-carotene 185.00 µg, riboflavin 0.08 mg, niacin 0.60 mg, thiamin 0.04 mg and ascorbic acid 47.00 mg (Gemede *et al.*, 2014).

Insect pests constitute an important constraint in the successful cultivation of the crop (Bhatt and Karnatak, 2018). The yield of okra is drastically hampered by the attack of various pests like shoot and fruit borer, American bollworm or fruit borer, whitefly, leafhopper, aphids, leaf roller, blister beetle, dusky cotton bug, red spider mite etc. (Kumar *et al.*, 2002). The key insect-pests causing the economic losses in okra are: leaf hopper, fruit borer, whitefly, thrips and shoot and fruit borer (Solangi and Lohar, 2007).

The control of pest population by biological agents is an ecofriendly pest management strategy. Some of the biological agents or predators found in okra agro-ecosystem are ladybird beetle *(Coccinella* spp.*)*, green lacewing *(Chrysoperla carnea), Eocanthecona* spp., spiders, reduviid bug, etc. Among all the coleopteran predators *Coccinella septempunctata* and *Chelomenes sexmaculata* are the most widespread biological control agents since, they are effective against the soft-bodied insects like whitefly, leafhopper, aphids and the lepidopteran larvae (Singh *et al.*, 2013). Spiders also play a prominent role in minimizing the pest population (Khuhro *et al.*, 2013). However, the level of infestation and the losses caused by these pests vary from region to region as well as the season in which the crop is grown. Broadly, their infestation depends upon the environmental conditions i.e. temperature, rainfall, wind speed and relative humidity either positively or negatively.

The present study was conducted to study the relation between the weather parameters and the pest population. Thus, the knowledge of an impact of weather parameters in the sucking pest and their predator population will help in devising an effective pest management strategy.

Materials and Methods

The present investigation was carried out at the Vegetable Research Centre, GBPUAT, Pantnagar, Udham Singh Nagar (Uttarakhand) during the *kharif* season, 2016. Arka Anamika variety of okra was sown on 30th July, 2016. The experiment was laid out in a Randomized Block Design (RBD) in four replications. The plot size was 5 × 4 m^2. The row to row and plant to plant spacing was 60cm and 40cm respectively. Each plot consisted of six rows with eleven plants in each row. All the agronomic practices recommended to raise the okra crop were followed uniformly in each experimental plot. The observations were initiated at the seedling emergence of the crop and were continued till the final harvesting of the crop. The data was recorded at the morning hours (7-10 am) since the winged insects at that time were sluggish hence, were easily countable. The observations were taken at the weekly intervals. The sucking pest complex were visually recorded by *In situ* counts on three randomly selected leaves *viz.* each from upper, middle, and lower portion of plant randomly on five plants excluding the border rows from each plot till the final harvesting. To study predator population five plants were randomly selected and the number of predator *viz.* coccinellids and spiders per plant were recorded weekly. The data collected on the sucking pests and their predators was correlated with the weather parameters following standard meteorological week (SMW).

Results and Discussion

The results obtained during the course of study for the population fluctuation of pests and their predators and their correlation with

weather parameters viz. temperature (maximum and minimum), relative humidity, wind velocity, rainfall and sunshine hours has been summarized in table 1.

Population fluctuation of sucking pests

Leafhopper (*Amrasca bigutullabigu tulla* Ishida) first appeared in the field with an average population of 1.31 / 3 leaves in the 34th SMW. The buildup of leafhopper population was in a gradual manner and it attained its peak (11.13 / 3 leaf) in the 40th SMW (1st week of October) when the maximum and minimum temperature, morning and evening relative humidity, wind velocity and sunshine hours was 32.5^{0}C, 24.9^{0}C, 88% (morning), 66% (evening), 2.5 km/hr, 3.1 hrs and the rainfall was recorded in traces. Thereafter, there was a subsequent decrease in its population. The above findings are in accordance with Kumar *et al.,* (2017) who while carrying out the experiment on *kharif* okra also recorded the first incidence of leafhopper at 21 DAS (3 weeks old crop) attaining the peak population at tenth week after the sowing and it was found till the crop was harvested. Anitha and Nandihalli (2008) also reported the first appearance of leafhopper in the first week of August (34th SMW) and the maximum population was observed during the first week of October (40th SMW). Whitefly (*Bemisia tabaci* Gennadius) first appeared in the field with an average population of 1.20/ 3 leaves in the 34th SMW. The buildup of whitefly population was in a gradual manner and it attained its peak (12/ 3 leaves in the 40th SMW (1st week of October) when the maximum and minimum temperature, morning and evening relative humidity, wind velocity and sunshine hours was 32.5^{0}C, 24.9^{0}C, 88% (morning), 66% (evening), 2.5 km/hr, 3.1 hrs and the rainfall was recorded in traces. The results of present study coincide with the findings of Anitha and Nandihalli (2008) who reported the first occurrence of whitefly (6.43 whiteflies/ 3 leaf) on okra in the first week of August (34th SMW) and it remained persistent throughout the crop growing season. Selvaraj *et al.*, (2010) also noticed the peak incidence of whitefly from mid-August to mid-October. Aphids (*Aphis gossypii* Glover) first appeared in the field with an average population of 5.14 / 3 leaves in the 35th SMW. It attained its peak (23.08 / 3 leaves) in the 39th SMW (last week of September) when the maximum and minimum temperature, morning and evening relative humidity, wind velocity and sunshine hours were 32.2^{0}C, 23.2^{0}C, 87% (morning), 62% (evening), 2.9 km/hr, 8.8 hrs and the rainfall was recorded to be 3.4 mm. These findings collaborate with the observations of Singh *et al.*, (2013) who noticed the first population of aphids on okra on the 35th SMW, 35 DAS with an average aphid population of 1.42 aphids per leaf that increased in due course of time and reached to its maximum of 25.87 per leaf during the 40th SMW in the first week of October, thereafter following a considerable decrease in its population (1.00 aphids/ plant) in 47th SMW. Konar *et al.,* (2013) reported the peak population of aphids in the first week of September (39.28 aphids/ 3 leaves) on okra.

Population fluctuation of predators

Among the predators population the spiders and coccinellids first appeared in the field with an average population of 0.33 spider/ plant and 0.22 *coccinella*/ plant in the 33rd and 34thSMW, respectively. The population of spider and *coccinella* attained their peak (3.16 spider/ plant and 3.01 *coccinella*/ plant) in the 39th SMW (last week of September) when the maximum and minimum temperature, morning and evening relative humidity, wind velocity and sunshine hours were 32.2^{0}C, 23.2^{0}C, 87% (morning), 62% (evening), 2.9 km/hr, 8.8 hrs and the rainfall was recorded to be 3.4 mm.

Table.1 Population fluctuation of pests and their predators with weather parameters at VRC, Pantnagar, during *kharif*, 2016

Month	Date	SMW	Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)	Sun-shine Hrs.	Wind Velocity (km/hr)	Leafhopper population /3 leaves	Whitefly population/3 leaves	Aphids population/3 leaves	Spiders/ plant	Coccinellids/ Plant
			Max.	Min.	Morning	Evening								
July-Aug	30-05	31	32.7	25.7	86	69	123.0	6.4	6.3	0	0	0	0	0
Aug	06-12	32	32.6	26.3	89	70	40.2	6.0	6.5	0	0	0	0	0
Aug	13-19	33	33.0	25.9	93	69	102.0	4.0	4.2	0	0	0	0.33	0
Aug	20-26	34	33.3	26.3	87	67	1.0	8.1	4.7	1.31	1.2	0	0.52	0.22
Aug-Sep	27-02	35	33.7	25.5	89	65	26.6	5.9	4.5	4.9	2.23	5.14	0.98	0.47
Sep	03-09	36	32.7	25.3	91	68	2.4	5.9	5.7	7.89	4.81	10.96	1.34	0.89
Sep	10-16	37	32.3	24.5	89	71	59.4	4.8	4.0	8.4	7.63	19.75	1.50	1.29
Sep	17-23	38	32.5	24.2	90	66	76.6	6.4	3.6	9.6	8.9	21.31	2.25	2.68
Sep	24-30	39	32.2	23.2	87	62	3.4	8.8	2.9	10.21	10.42	23.08	3.16	3.01
Oct	01-07	40	32.5	24.9	88	66	0.0	3.1	2.5	11.13	12.11	20.17	2.39	2.00
Oct	08-14	41	32.1	19.9	89	61	0.0	7.4	2.7	8.86	9.62	11.69	2.07	1.71
Oct	15-21	42	31.4	17.2	80	47	0.0	7.6	2.2	8.01	6.54	5.82	1.25	0.28
Oct	22-28	43	31.1	13.9	90	37	0.0	7.8	2.3	6.93	4.38	3.96	0.36	0

*Significant at 0.05 level; **Significant at 0.01 level; Max.: Maximum temperature; Min.: Minimum temperature

Table.2 Correlation coefficient of pests and their predator population with weather parameters

Pests/Predators	Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)	Sunshine (hrs)	Wind Velocity (km/hr)
	Max.	Min.	Morning	Evening			
Leafhopper	-0.453	-0.397	-.132	-.293	-.531	.051	-.711**
Whitefly	-0.419	-0.297	-.152	-.167	-.456	.002	-.718**
Aphids	-0.204	0.342	0.038	0.106	-0.218	-0.096	-0.474
Spiders	-0.170	-0.071	-0.086	0.027	-0.390	0.078	-0.582*
Coccinellids	-0.108	0.044	0.013	0.0152	-0.307	0.060	-0.455

*Significant at 0.05 level; **Significant at 0.01 level; Min.: Minimum temperature; Max.: Maximum temperature

The current study is in confirmation with the work of Ghosh (2013) who observed the maximum population of spiders during April-May and August-September (12-21 and 31-39 SMW, respectively) in the okra agro ecosystem. According to Singh *et al.*, (2013) the population of aphidophagous coccinellid predators appeared simultaneously with population of soft bodied insects mainly aphids on okra.

Correlation of weather parameters with the population of sucking pests and their predators

A simple correlation was worked out between the population of sucking pests and their predators that have been indicated in Table 2. A simple correlation was worked out between the sucking pest population and the weather parameters. There was observed a negative non-significant correlation of the leafhopper and whitefly population with all of the remaining weather parameters except that a negative significant correlation (r= -0.711* and r= -0.718*) was observed with the wind velocity and a positive significant correlation (r= 0.051 and r= 0.002) was observed with the sunshine hours. This finding is supported by the study of Dabhi and Koshiya (2014) who also found a positive correlation between the population of leafhopper and bright sunshine hours. Similar results were obtained by Verma *et al.*, (2015) who observed the negative correlation of whitefly population with maximum as well as minimum temperature and wind speed. However, there was observed a non-significant negative

correlation of the aphid population with maximum temperature, rainfall, sunshine hours and wind velocity. A positive correlation (r= 0.342, r= 0.038, r= 0.106) with minimum temperature, morning and evening relative humidity was also observed.

A simple correlation when worked out between the predator population and weather parameters revealed that there was a non-significant correlation of the spider population with all the weather parameters except with wind velocity it had a negative significant correlation (r= -0.582*). In the similar manner, coccinellids population was non-significantly correlated with all the weather parameters. The current observation is supported by Shukla, N. (2014) who also reported a non- significant negative correlation between coccinellids and maximum temperature and a positive correlation with the morning and the evening relative humidity.

The current study deals with the fluctuation in sucking pest population and their predators along with their correlation with weather parameters. In the present study the peak population of sucking pests and their predators was attained in the month of September-October. The pests (leafhopper and whitefly) and predators population was positively correlated with sunshine hours. The findings of the present study might help the farmers of Uttarakhand to bring about the better control of the pests through natural enemies. Moreover, these findings may help to avoid the indiscriminate and injudicious use of pesticides on okra agroecosystem.

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