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Influence of Weather Factors on the Incidence of Major Insect Pests of Sesame (*Sesamum indicum* L.*)*

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Population dynamics of major pests *viz.*, web worm, *Antigastra catalaunalis* (Duponchel), leaf hoppers *Orosius albicinctus* (Distant) and gallfly *Asphondilia sesami* (Felt) infesting sesame was studied in Coimbatore, Tamil Nadu, India during *Rabi* and *Kharif* seasons of the year 2020. Correlation between the pest population, percent damage and weather parameters was analyzed and regression equations were developed. The incidence of leaf hoppers, web worm and gallfly on sesame crop during *Rabi* season started on 4th, 3rd and 7th Standard meteorological week (SMW) respectively. The peak attained on 8th,11^{th,} and 11th SMW with population of leafhoppers and damage by web worm and gallfly (2.01/plant,60.04 percent and 49.68 percent) respectively during *Rabi* season. In case of leafhopper and web worm, minimum temperature (r=0.031r=0.373) had non-significant positive correlation whereas mean relative humidity (r=-0.02) registered non-significant negative correlation with leaf hopper and web worm significant negative correlation Gall

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fly incidence showed significant positive correlation with maximum and minimum temperature. Whereas in *Kharif* season, incidence of leafhoppers, web worm and gallfly on sesame crop started on 33rd, 32nd and 37th SMW respectively. The peak activity and incidence was noticed during 37th, 39th and 40th SMW for leafhoppers, web worm and gallfly respectively. The correlation between weather parameters and incidence of major pests followed a similar pattern to *kharif* season. Regression analysis data revealed that the multiple non-linear regression equations are sufficient to predict the pest population with prevailing weather parameters.

Keywords: Sesame; weather parameters; pest incidence; correlation; regression analysis.

1. INTRODUCTION

Sesame, (*Sesamum indicum* L.) is one of the oldest cultivated oilseed crops. India ranks second in sesame production even though the area under sesame was the highest. In India, during 2019, sesame was grown in an area of 19.47 lakh hectares with production of 8.66 lakh tonnes and productivity of 445 kg/ha [1]. The yield potential of sesame has not been fully realized due to number of biotic and abiotic factors. Among the various biotic factors, the attack of insect pests is the major limiting factor in achieving higher productivity. The crop is attacked by 29 species of insect pests in different stages of its growth [2] Although it is a short duration crop, it is known to suffer from severe insect pest infestation. Among insect pests damaging sesame crop in various parts of the world, the most important pests in India are web worm, *Antigastra catalaunalis* Duponchel (Pyralidae:Lepidoptera); gall fly, *Asphondilia sesami* Felt (Cecidomyiidae: Diptera); and leaf hopper, *Orosius albicinctus* Distant (Cicadellidae: Hemiptera).

These pests occur in almost regular intervals on sesame at different stages of the crop and cause heavy damage. In designing appropriate management schedules, the awareness of the seasonal occurrence of insect pests at various stages of crop growth would be beneficial to understand the population dynamics of pests. This would in turn provide an insight into the peak cycles which would be helpful in formulating appropriate timely management strategies. Hence the present study was contemplated to observe the seasonal incidence of major pests infesting sesame and its relationship with weather parameters under unprotected irrigated condition.

2. MATERIALS AND METHODS

A fixed plot survey was conducted during *Rabi* season from January 2020 (3rd SMW) to April 2020 (13th SMW) and *Kharif* season from August 2020 (32nd SMW) to October 2020 (42st SMW) at Thondamuttur (10.9899º N; Latitude, 76.8409º E Longitude) in Coimbatore district of Tamil Nadu state in Southern India to record the incidence of major pests infesting sesame under unprotected condition. Five spots were marked using quadrate method. The incidence of major pests of sesame was recorded in the early hours between 7:00 am and 9:00 am on ten randomly selected plants using standard sampling methods. Observations were taken at weekly intervals during the study period from germination till the maturity of the crop.

The population data for sesame leaf hoppers was recorded at three plant canopy levels *viz.,* lower, middle, and top leaves. Ten plants were selected randomly per spot from five random spots in the plot and data on leafhopper population were collected and the mean population was calculated [3].

The leaf damage by *A. catalaunalis* was assessed based on the total number of leaves and affected leaves on ten randomly selected plants in five spots and the per cent leaf damage was worked out [4].

$$\text{Per cent leaf damage} = \frac{\text{Number of affected leaves}}{\text{Total number of leaves}} \times 100$$

The flower damage by gallfly *A. sesami* was assessed based on the total number of flower and affected flowers on ten randomly selected plants in five spots and the per cent flower damage was worked out [4].

$$\text{Per cent flower damage} = \frac{\text{Number of affected flowers}}{\text{Total number of flowers}} \times 100$$

The data on population of major pests were presented standard week-wise from initial appearance till crop maturity. Weather data pertaining to maximum and minimum temperature (ºC); relative humidity (%) and

rainfall (mm) were collected for the standard weeks from the Agricultural Meteorological Research Centre, Tamil Nadu Agricultural University, Coimbatore.

3. RESULTS AND DISCUSSION

The standard week wise mean population of leaf hoppers, damage by web worm and gallfly and the along with weather parameters are presented in Table 1 (*Rabi*) and Table 2 (*Kharif*).

3.1 Leaf Hoppers

Incidence of leaf hoppers during *rabi* season was observed from 4th standard meteorological week (SMW) with an average population of 0.14 /plant. The population steadily increased and peaked during 8th SMW with an average population of 2.01/ plant. Later, the population decreased till the 12th SMW with average population of 0.70/plant. Among all the weather parameters, maximum temperature (r=0.126), minimum temperature (r =0.031) showed non-significant positive correlation with leaf hopper population. The correlation between the pest population and relative humidity, rainfall was non-significantly negative (Table 3). Incidence of leaf hoppers during *kharif* season commenced from 33rd SMW with an average population of 0.12 /plant. The population steadily increased and peaked during 37th SMW with an average population of 3.05/ plant. Later, the population decreased till the 41st SMW with average population of 0.15/plant. All the weather parameters, except maximum and minimum temperature, showed non-significant negative correlation whereas rainfall and relative humidity showed non-significant positive correlation with leaf hopper population. The correlation between the pest population and maximum temperature was non-significantly negative (Table 4). Mishra et al. [5] have also reported similar trends in population dynamics of leaf hoppers in sesame.

3.2 Web Worm

The studies on the seasonal incidence of web worm revealed that this pest was first recorded on sesame in the 3rd standard week and remained active on the crop up to 13th standard week. During this activity period, percent leaf damage by web worm ranged from 4.00 % to 39.30 %. The percent damage was found highest in 11th standard week (60.04%) (Table 1). Among all the weather parameters, minimum temperature (r = 0.373) showed non-significant positive correlation with web worm leaf damage. A significant positive correlation was observed between webworm damage and maximum temperature (Table 3). The studies on the seasonal incidence of web worm revealed that the pest was first recorded on sesame in the 32nd standard week and remained active on the crop up to 42th standard week. During the activity period of the pest, percent damage by web worm ranged from 7.00 to 27.50 per plant. The pest damage was found highest in 39th standard week (63.67%). Among all the weather parameters, minimum temperature (r = -0.281) showed non-significant negative correlation with web worm damage. The correlation between the pest damage and rainfall was non-significantly positive in *kharif* season (Table 4). Kumar and Goel [6] also reported similar impact of climatic factors on the population dynamics of *A. catalaunalis.*

3.3 Gall Fly

The peak activity was observed on 11th SMW with incidence of 49.68 % during *rabi* and 50.03 % during *kharif*. The gallfly incidence declined on 12th SMW during *rabi* and 41th SMW for the *kharif* season. Gall fly incidence was significantly negative correlated with relative humidity while it was non-significant with rainfall (r= - 0.831) and (r=- 516), while they had significant positive relationship with maximum and minimum temperature (r = 0.846 and r=624) in *rabi* (Table 3). Gall fly exerted a non-significant negative correlation with all the weather parameters in Kharif season (Table 4). Present findings are in accordance with those of Goncalves et al. [7] who reported that the minimum temperature was positively correlated with gall fly population and negative correlation with rainfall and relative humidity.

3.4 Regression Analysis

The multiple nonlinear regression equation fitted with weather factors in prediction leaf hopper population and web worm, gallfly is presented in the Tables 5 and 6 respectively for *rabi* and *kharif* seasons.

Table 1. Seasonal incidence of selected insect pests infesting sesame during *Rabi* 2020

Standard weeks	Leaf hopper adult /plant #	% Web worm leaf damage/plant #	% Gall fly damage #	Temperature (^{0}C)		Relative humidity (%)	Rainfall (mm)
				Max	Min	Morning	
3	0.00	4.00	0.00	27.31	20.23	86.29	0.49
4	0.14	12.00	0.00	29.81	20.33	85.86	0.79
5	0.17	27.00	0.00	30.16	20.70	85.71	0.00
6	0.21	33.54	0.00	30.83	17.64	84.71	0.00
7	1.08	42.32	21.40	31.93	20.49	83.57	0.07
8	2.01	49.54	31.30	31.13	21.73	84.00	0.34
9	1.09	55.46	42.45	34.64	20.00	80.71	0.00
10	0.78	59.63	47.89	34.14	22.50	83.29	0.00
11	0.11	60.04	49.68	34.47	22.04	76.71	0.00
12	0.70	48.40	41.32	35.36	23.57	80.29	0.00
13	0.00	39.30	32.89	36.19	24.72	80.76	0.00

 # Each value is a mean of five random spots @ 10 plants per spot

Table 2. Seasonal incidence of selected insect pests infesting sesame during *kharif* 2020

Standard weeks	Leaf hopper adult /plant #	% Web worm leaf damage/plant	% Gall fly damage/flower	Temperature (^{0}C)		Relative humidity (%)	Rainfall (mm)
				Max	Min	Morning	
32	0.00	7.00	0.00	29.60	23.07	82.71	3.29
33	0.12	17.00	0.00	30.24	23.83	81.71	0.00
34	0.21	29.00	0.00	32.57	23.57	85.86	0.07
35	0.29	31.00	0.00	33.36	22.79	85.14	5.00
36	1.47	45.00	0.00	31.36	23.43	85.57	6.14
37	3.05	57.00	32.21	29.03	22.96	83.86	1.00
38	1.07	59.65	45.67	29.29	23.21	80.00	4.64
39	0.11	63.67	49.56	30.86	23.21	85.00	3.29
40	0.19	58.00	50.03	32.21	22.43	84.71	0.00
41	0.15	42.50	42.46	30.79	23.43	80.14	3.07
42	0.00	27.50	39.47	31.00	22.79	82.00	2.07

 # Each value is a mean of five random spots @ 10 plants per spot

Table 3. Correlation between the incidence of selected insect pests on sesame with meteorological parameters during *Rabi* 2020

Pest	Temperature(°c)		Relative humidity	Rainfall
	Maximum	Minimum		
Leaf hopper	0.126	0.031	-0.02	-0.057
Web worm damage %	0.798**	0.373	-0.745**	-.697*
Gallfly damage %	0.846**	0.624*	-0.831**	-0.516

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

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

Table 4. Correlation between the incidence of selected insect pests on sesame with meteorological parameters during *Kharif* 2020

Pest	Temperature(°c)		Relative humidity	Rainfall
	Maximum	Minimum		
Leaf hopper	-0.448	-0.045	0.106	.101
Web worm damage %	-0.086	-0.281	0.103	.126
Gallfly damage %	-0.253	-0.435	-0.350	-.110

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

Table 5. Regression analysis between incidence of selected insect pests infesting sesame and weather parameters during *Rabi* 2020

Pests	Regression equation	Regression coefficient
Leaf hopper	X=-7.454(C)+0.120(Max)-0.048(Min)+0.062(RH)+0.231(RF)	R^2=0.050
Web worm damage %	X=83.024(C)+3.666(Max)-1.585(Min)-1.523(RH)-16.532(RF)	R^2=0.722
Gallfly damage %	X=140.041(C)+3.135(Max)+1.446(Min)-2.995(RH)+2.084(RF)	R2=0.780

Table 6. Regression analysis between incidence of selected insect pests infesting sesame and weather parameters during *kharif* 2020

Pests	Regression equation	Regression coefficient
Leaf hopper	X=1.844(C)-0.567(Max)-0.243(Min)+0.262(RH)+0.054(RF)	R^2=0.454
Web worm damage %	X=315.080(C)-3.900(Max)-13.902(Min)+1.971(RH)+1.151(RF)	R^2=0.147
Gallfly damage %	X=1140.82(C)-2.323(Max)-30.627(Min)-3.992(RH)-1.328(RF)	R^2=0.411

4. CONCLUSION

It is concluded that the maximum temperature, relative humidity and rain fall exerted positive regression while minimum temperature exerted negative regression with leafhopper. Web worm incidence had positive regression with maximum temperature whereas negative regression with minimum temperature, rainfall and relative humidity. Gall fly incidence registered positive regression with maximum, minimum temperature and rainfall whereas negative regression with relative humidity in *rabi* season. During *kharif* season, negative regression was observed between maximum, minimum temperature with all pests. This information may be utilized for devising effective management tactics for these pests and achieving higher yields in sesame.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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