

Weather parameter's impact on population fluctuation of insect pests in sunflower

Abstract

The population trend of insect pest of sunflower was studied at North bank plain zone of river Brahmaputra, Biswanath district in the state of Assam during 2021-2022. The simple correlation study showed bright sunshine hour had a positive and significant correlation with the whitefly population relative humidity had a positive and significant correlation with the *Aphis gossypii* and *Amrasca biguttula biguttula* Ishida population; *A. gossypii* had positive and significant relation with maximum temperature and *Spilosoma obliqua* had negative and significant relation with relative humidity

Key word- correlation, impact, parameter, population fluctuation, sunflower, significant

Introduction

In India, sunflower is cultivated on 4.006 million hectares, producing 2.840 million tones with a productivity of 709 kg/ha (Average of 2014-15 to 2018-19). In 2021, Karnataka was a leading producer of sunflower with a yield of 3.04 lakh tonnes from an area of 7.94 lakh hectares (Anonymous 2021). Poor seed setting and a large percentage of chaffy seeds in the capitulum's centre are two of the main causes of sunflower low output (Ramulu *et al.*, 2011). The sunflower habitat is related with a diverse ecosystem of both harmful and beneficial insect species. *Amrasca biguttula biguttula* Ishida, *Thrips palmi* Karny, *Bemisia tabaci* Gennadius, defoliators *Spilosoma oblique* Walker, *Spodoptera litura* Fabricius, *Plusia orichalcea* Fabracious and *Helicoverpa armigera* Hubner are the most economically important sunflower pest (Irum, 2009). The yield of the sunflower crop could occasionally be reduced by up to 30% due to the severity of seedling pests (Basappa and Bhatt 1998). Ghante *et al.*, (2020) reported that the correlation between whitefly population and weather parameters are significant and negative correlation was observed between nymphal population and minimum temperature in sunflower.

Ghante *et al.*, 2020 reported that whitefly population have non-significant and positive relation with rainfall and relative humidity, negative and non-significant relation with maximum temperature and bright sunshine hour in sunflower. Sunshine hour have positive non-significant relation with leaf hopper (Dabhi and Koshiya, 2014). Dhurva and Soni (2020) in rice ecosystem reported that maximum temperature, minimum temperature, rainfall and sunshine hours showed negative non significant relationship with the population of ladybird.

Hence, it is demonstrated that numerous circumstances at distinct locations have an impact on the pest population, meteorological regression models were created. Stated this would be useful in determining when the pest population would likely increase, assisting in early warning and prompt treatment before infestation under favorable condition. Information can be used to target the best pest management strategies for the various zones.

Materials and Methods

Field experiment was conducted on sunflower variety NFSH-1001 (sunlight). Weekly observation was recorded at different stages of the crop for insect infestation till the harvesting of the crop. Data collected from 30 plots, from each plot five plants were randomly selected and from each plant, nine leaves were randomly selected (three from upper canopy, three from middle canopy and remaining three from lower canopy). After that the insect pest was observed visually from each randomly selected plant at weekly intervals. Five plants were randomly chosen and the entire plant was inspected, and the population was tallied every week in the case of large insects and natural enemies like spiders and ladybird beetles.

Meteorological data *viz.*, temperatures (maximum and minimum), relative humidity and total rainfall were recorded for the entire period of the experiment from Department of Agricultural Meteorology, BNCA, Assam Agricultural University. The mean insect pest population observed during the period of investigation was correlated with all the weather parameters by using SPSS-20 software 28. Correlation coefficient was calculated with the following formula

$$r = \frac{\sum xy - \frac{\sum x \cdot \sum y}{N}}{\sqrt{\left(\sum x^2 - \frac{(\sum x)^2}{N}\right) \left(\sum y^2 - \frac{(\sum y)^2}{N}\right)}}$$

Where,

r = Co-efficient of correlation x = Mean

y = Independent variables N = Number of observations

Results and Discussion

1. Weather parameters impact on incidence of *Bemisia tabaci*

Whitefly population had a positive and significant correlation (r = 0.634) with bright sunshine hour. Bright sunshine hour has positive impact on whitefly population. When bright

sunshine hour increases mean population of whitefly also have positive impact. Maximum temperature and relative humidity have positive and non significant relation. The minimum temperature and rainfall had negative and non significant correlation with mean whitefly population. The studies got support from Ghante *et al.*, (2020) reported that the correlation between whitefly population and weather parameters are significant and negative correlation was observed between nymphal population and minimum temperature in sunflower. Bhatt *et al.*, (2018) reported that whitefly have positive and significant correlation with sunshine hour in okra. Ghosh (2014) reported that maximum temperature shows non significant positive correlation with whitefly population.

2. Weather parameters impact on incidence of *Aphis gossypii*

Relative humidity ($r=0.581$) and maximum temperature ($r=0.587$) had a positive and significant correlation with the population of aphid, when relative humidity and maximum temperature increase population of aphid significantly increase. Minimum temperature and bright sunshine hour had a positive but non significant correlation. Rain fall have negative non significant correlation with mean aphid population.

3. Weather parameters impact on incidence of *Spilosoma obliqua*

Relative humidity had a negative and significant correlation ($r = - 0.602$) with the population of Bihar hairy caterpillar it means with increase in relative humidity it has negative impact on bihar hairy caterpillar population. Maximum temperature, minimum temperature and bright sunshine hour had negative and non significant correlation. Rainfall has positive and non significant relation with Bihar hairy caterpillar population. Corroborating with the result of present studies Suyal *et al.*, (2018) reported that in soybean crop Bihar hairy caterpillar correlation with different weather parameter relative humidity, maximum temperature and minimum temperature have negative and non significant. The larval population of the Bihar hairy caterpillar displayed a positive correlation, however this relationship was statistically non significant (Patel *et al.*, 2020).

4. Weather parameters impact on incidence of *Amrasca biguttula biguttula*

Relative humidity had a positive and significant correlation ($r = 0.589$) with the population of leaf hopper it means when relative humidity increases population of leaf hopper also significantly increase. Maximum temperature and bright sunshine hour had positive and non significant correlation. Minimum temperature and rainfall have negative and non significant relation with leaf hopper population. The studies are agreed with the findings of Bhatt *et al.*, (2018) reported that minimum temperature and rainfall have negative and non

significant correlation with leaf hopper. Sunshine hour have positive non significant relation with leaf hopper (Dabhi and Koshiya, 2014).

5. Weather parameters impact on incidence of Coccinellid beetle

Relative humidity, maximum temperature, minimum temperature and bright sunshine hour had negative and non significant correlation with ladybird population. Rainfall had a positive and non significant correlation with the population of ladybird. Corroborating with the results of present studies Saha *et al.*, (2018) reported that coccinella in cucumbers was positively correlated with temperature and negatively correlated with humidity. Dhurva and Soni (2020) in rice ecosystem reported that maximum temperature, minimum temperature, rainfall and sunshine hours showed negative non significant relationship with the population of ladybird.

6. Weather parameters impact on incidence of *Lycosa tista*

Relative humidity, maximum temperature and bright sunshine hour had positive and non significant correlation with spider population. Rainfall and minimum temperature have negative non significant correlation.

Table 1. Population fluctuation of insect pests with weather parameters

Week	Date	RH %	Max T °C	Min T °C	RF mm	BSSH	Whitefly	aphid	BHC	leaf hopper	Ladybird	Spider
1	Dec 7-13	94	26.1	11.89	0	5.94	1.14	1.03	0.71	0.98	0.74	0.74
2	Dec 14-20	94	25.5	7.27	0	8.50	1.30	0.84	0.71	1.22	0.84	0.82
3	Dec 21-27	91.86	24.73	6.86	0	8.13	1.45	0.81	0.74	0.92	0.93	0.83
4	Dec 28-Jan-3	93.71	24	7.19	0	5.60	1.24	0.82	0.75	0.92	0.91	0.84
5	Jan 4-10	93.43	25.2	6.91	0	7.39	1.02	0.78	0.76	0.91	0.82	0.83
6	Jan 11-17	94.43	23.24	9.59	15.20	4.49	0.99	0.79	0.76	0.88	0.89	0.81
7	Jan 18-24	92.29	22.91	8.34	0	5.10	1.02	0.79	0.75	0.82	0.88	0.74
8	Jan 25-31	92.71	21.71	7.89	10.80	5.39	1.05	0.76	0.75	0.84	0.89	0.83
9	Feb 1-7	93.86	20.7	8.13	43.20	4.17	0.91	0.77	0.73	0.89	0.85	0.75
10	Feb 8-14	93.29	22.71	8	9.20	6.64	0.93	0.76	0.77	0.87	0.89	0.77
11	Feb 15-21	92.57	25.26	7.93	19.2	7.13	0.86	0.77	0.79	0.73	0.90	0.74
12	Feb 22-28	91.14	24.23	9.53	0.6	0.60	0.79	0.77	0.81	0.73	0.90	0.77

BSSH-Bright sunshine hour, **Whitefly**-Whitefly/leaf, **Aphid**-Aphid/leaf, **BHC**-Bihar hairy caterpillar/leaf, **Leaf hopper**-leafhopper/plant, **Lady bird**- ladybird/plant, **Spider**-Spider/plant

Fig.1. Population fluctuation of insect pests with weather parameters

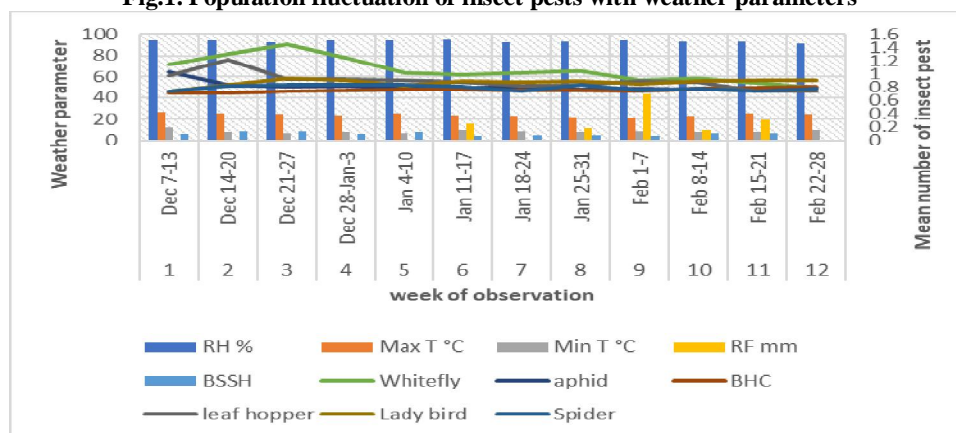


Table2: Simple regression models along with coefficient of determination individual weather variables on *Bemisia tabaci* population fluctuation on sunflower

Weather variable	Simple regression equation	R ² Value
Maximum temperature (°C)	y= 3.0079x + 20.674	0.125
Minimum temperature (°C)	y = 2.3164x + 10.746	0.0963
Relative humidity (%)	y = 0.8334x +92.225	0.0259
Rainfall (mm)	y= -31.02x + 41.013	0.2111
Bright Sunshine hours	y = 7.0043x - 1.6562	0.4027

Table3: Simple regression models along with coefficient of determination of individual weather variables on *Aphis gossypii* population fluctuation on sunflower

Weather variable	Simple regression equation	R ² Value
Maximum temperature (°C)	$y = 12.221x - 13.765$	0.3446
Minimum temperature (°C)	$y = 2.3164x + 10.746$	0.1258
Relative humidity (%)	$y = 7.3592 + 87.03$	0.3377
Rainfall (mm)	$y = -62.948x + 60.168$	0.1452
Bright Sunshine hours	$y = 10.737x - 3.1101$	0.1580

Table 4: Simple regression models along with coefficient of determination of individual weather variables on *Spilosoma oblique* population fluctuation on Sunflower

Weather variable	Simple regression equation	R ² Value
Maximum temperature (°C)	$y = -4.0557x + 26.909$	0.0052
Minimum temperature (°C)	$y = -3.4403x + 10.883$	0.0049
Relative humidity (%)	$y = -20.523x + 108.55$	0.3625
Rainfall (mm)	$y = 3.2361x + 5.7482$	0.000049
Bright Sunshine hours	$y = -36.308x + 33.078$	0.2493

Table 5: Simple regression models along with coefficient of determination of individual weather variables on *Amrasca biguttula biguttula* population fluctuation on Sunflower

Weather variable	Simple regression equation	R ² Value
Maximum temperature (°C)	$y = 3.9126x + 20.375$	0.1166
Minimum temperature (°C)	$y = -1.39x + 9.5347$	0.0151
Relative humidity (%)	$y = 3.6091x + 27.405$	0.2681
Rainfall (mm)	$y = -21.597x + 27.405$	0.0564
Bright Sunshine hours	$y = 8.4867x - 1.7965$	0.3258

Table 6: Simple regression models along with coefficient of determination of individual weather variables on *Coccinella species* population fluctuation on Sunflower

Weather variable	Simple regression equation	R ² Value
Maximum temperature (°C)	$y = -11.076x + 33.493$	0.1202
Minimum temperature (°C)	$y = -15.721x + 21.971$	0.3145
Relative humidity (%)	$y = 9.8586x + 101.68$	0.2574
Rainfall (mm)	$y = 14.966x - 4.8367$	0.0035
Bright Sunshine hours	$y = 8.4867x - 1.7965$	0.3258

Table 7: Simple regression models along with coefficient of determination of individual weather variables on *Lycosta tista* population fluctuation on sunflower

Weather variable	Simple regression equation	R ² Value
Maximum temperature (°C)	$y = 2.9027x + 21.567$	0.00053
Minimum temperature (°C)	$y = -10.742x + 23.874$	0.3162
Relative humidity (%)	$y = 3.2001x + 90.582$	0.0173
Rainfall (mm)	$y = -111.74x + 96.361$	0.1239
Bright Sunshine hours	$y = 16.151x - 6.9895$	0.0968

Table. 8: Correlation coefficient of insect pest population with weather parameters

Insect-Pest	Minimum Temperature (°C)	Maximum Temperature (°C)	Relative humidity (%)	Relative humidity (%)	Bright sunshine hour (hr)
<i>Bemisia tabaci</i>	-0.310	0.353	0.161	-0.459	0.643*
<i>Aphis gossypii</i>	0.354	0.587*	0.581*	-0.381	0.397
<i>Spilosoma obliqua</i>	-0.069	-0.072	-0.602*	0.007	-0.499
<i>Amrasca biguttula biguttula</i>	-0.112	0.313	0.589*	-0.235	0.565
Coccinellid beetle	-0.560	-0.346	-0.507	0.059	-0.128
<i>Lycosa tista</i>	-0.562	0.072	0.131	-0.351	0.311

Conclusion

The study demonstrated that numerous circumstances at distinct locations have an impact on the pest population, meteorological regression models were created. Stared would be useful in determining when the pest population would likely increase, assisting in early warning and prompt treatment before infestation under favorable condition. Information can be used to target the best pest management strategies for the various zones.

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