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# Weather Parameter's Impact on Population Fluctuation of Insect Pests in Sunflower

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## 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.

*Keywords: Correlation; impact; parameter; population fluctuation; sunflower; significant.*

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## 1. 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 [1]. 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* Fabracius and *Helicoverpa armigera* Hubner are the most economically important sunflower pest [2]. The yield of the sunflower crop could occasionally be reduced by up to 30% due to the severity of seedling pests [3]. Ghante et al. [4] 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. [4] reported that whitefly population have non-significant and positive relation with rainfall and relative humidity, negative and non-significant relation with naximum temperature and bright sunshine hour in sunflower. Sunshine hour have positive non-significant relation with leaf hopper [5]. Dhurva and Soni [6] 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. Stared 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.

## 2. 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:

$$r = \frac{\sum xy - \frac{\sum x.\sum y}{N}}{\sqrt{\left(\sum x^2 - \frac{(\sum x)^2}{N}\right)\left(\sum y2 - \frac{(\sum y)^2}{N}\right)}}$$

Where,

r = Co-efficient of correlation x = Mean
y = Independent variables N = Number of observations

## 3. RESULTS AND DISCUSSION

### 3.1 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. [4] 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 [7] reported that maximum temperature shows non significant positive correlation with whitefly population.

**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*

### 3.2 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.

### 3.3 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. [8] 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 [9].

### 3.4 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 [5].

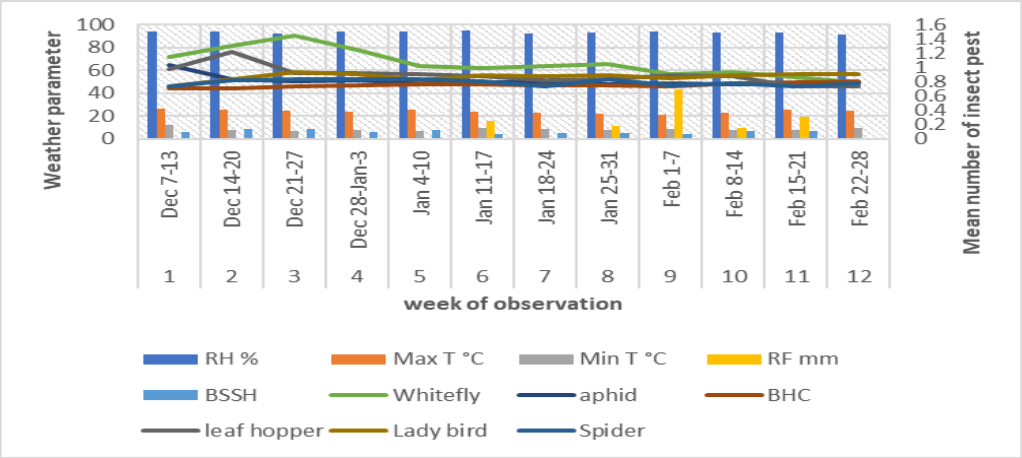


**Fig. 1. Population fluctuation of insect pests with weather parameters**

**Table 2. 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 |

**Table 3. 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 = 8.4867 x - 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 = 8.4867 x - 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) |
|---|---|---|---|---|---|
| ***Bemisia tabaci*** | -0.310 | 0.353 | 0.161 | -0.459 | **0.643*** |
| ***Aphis gossypii*** | 0.354 | **0.587*** | **0.581*** | -0.381 | 0.397 |
| ***Spilosoma obliqua*** | -0.069 | -0.072 | **-0.602*** | 0.007 | -0.499 |
| ***Amrasca biguttula biguttula*** | -0.112 | 0.313 | **0.589*** | -0.235 | 0.565 |
| **Coccinellid beetle** | -0.560 | -0.346 | -0.507 | 0.059 | -0.128 |
| ***Lycosa tista*** | -0.562 | 0.072 | 0.131 | -0.351 | 0.311 |

### 3.5 Weather Parameters Impact on Incidence of *Coccinelid 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. [10] reported that coccinella in cucumbers was positively correlated with temperature and negatively correlated with humidity. Dhurva and Soni [6] in rice ecosystem reported that maximum temperature, minimum temperature, rainfall and sunshine hours showed negative non significant relationship with the population of ladybird.

### 3.6 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.

## 4. 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.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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