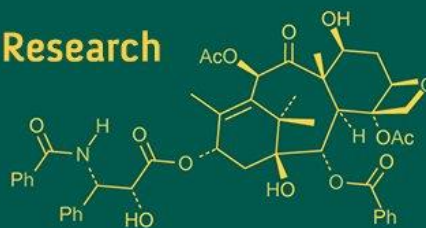
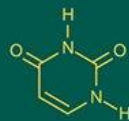
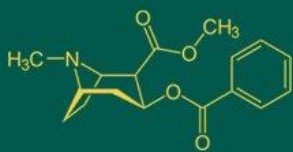


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## Seasonal incidence of shoot fly damage on maize and its correlation with weather factors

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**Abstract**

The present research was carried out at Entomology Research Farm, College of Agriculture, Gwalior, M.P during *Kharif* 2024 and *Kharif* 2025. Gwalior is located in the Gird region of Madhya Pradesh. Result revealed that percent dead heart caused by shoot fly was throughout the study period during *Kharif* 2024 and *Kharif* 2025. The first appearance of shoot fly dead heart was recorded during 31<sup>st</sup> SMW (8.15% and 9.26% in *Kharif* 2024 and *Kharif* 2025, respectively. It persisted in the crop till 37<sup>th</sup> SMW with 8.89% in *Kharif* 2024 and 9.63% dead heart *Kharif* 2025. The peak period was observed during 34<sup>th</sup> SMW of 32.59% and 33.70% in both the year *Kharif* 2024 and *Kharif* 2025, respectively. The correlation studies indicated that minimum temperature had significant positive relationship on percent dead heart caused by shoot fly in both years.

**Keywords:** Shoot fly, maize, *Kharif*, dead heart, correlation

**Introduction**

Maize (*Zea mays* L.) is a cereal crop from the Gramineae (Poaceae) family and is one of the most widely grown in the world. It is dubbed the "Queen of Cereals" due to its great adaptability and high output among cereal crops (Singh and Jaglan, 2018) [5]. Maize was first appeared in Central Mexico circa 5000 BC and now-a-days grown in tropical, subtropical and temperate climates. Maize is classified into several types: dent corn, flint corn, pod corn, popcorn, flour corn and sweet corn. Maize, with its diverse applications as food, feed and industrial raw material is essential for world food security and the agricultural economy (Anonymous, 2023) [1].

Maize is grown on over 205 million hectares in nearly 165 countries worldwide, with a production of over 1,225 million tonnes and a productivity of approximately 5.88 tonnes/ha in 2024-2025 (FAO, 2024; USDA, 2024) [2, 7]. Insect pests are responsible for approximately a decrease of 31 percent in maize output, with annual economic losses estimated at 13.2% (Suman *et al.*, 2023). Studies on the ecology and dynamics of maize pest populations have been limited to three major insect pests: *C. partellus*, *S. inferens* and *A. soccata* (Suman *et al.*, 2023) [6]. Maize insect pests include stem borer, aphids, cob borer, shoot fly and fall armyworm.

It is a polyphagous insect pest from the Noctuidae family that infects a variety of crops, including maize, rice, sorghum, millet, sugarcane and cotton. The pest was first identified in Africa in 2016 and quickly expanded across numerous nations, inflicting significant economic damage (Ganiger *et al.*, 2018) [3]. Therefore, keeping in mind the above facts, the current research work was undertaken on maize.

**Material and methods**

The maize crop was sown on 25<sup>th</sup> July, 2024 and 25 July, 2025 with DMRH - 1410 variety, with a spacing of 60 cm x 20 cm. Observations of dead heart caused by shoot fly (%) was recorded once in a standard week on total plants in the plot, which was initiated immediately after germination and continued till crop maturity.

**Statistical analysis****i. Correlation and regression**

Correlation and regression between independent variables (abiotic factors) and dependent variable *i.e.* insect population were computed by using the formula as suggested by Snedecor and Cochran (1967).

$$\text{Correlation 'r'} = \frac{\sum xy - \frac{\sum X \sum y}{n}}{\sqrt{\frac{\sum X^2 - (\sum X)^2}{n} \frac{\sum y^2 - (\sum y)^2}{n}}}$$

Where;

| r          | = Correlation coefficient                  |
|------------|--------------------------------------------|
| $\sum xy$  | = Sum of product of both variables x and y |
| $\sum x$   | = Sum of variable x                        |
| $\sum y$   | = Sum of variable y                        |
| $\sum x^2$ | = Sum of square of variable x              |
| $\sum y^2$ | = Sum of square of variable y              |
| n          | = Number of observations                   |

## 2. Test of significance of correlation coefficient 'r'

For testing the significance of the correlations, they were compared with the table value at (n-2) degree of freedom at 5% and 1% significant level.

$$t = \frac{r}{\sqrt{1-r^2}} \sqrt{n-2}$$

Where;

- t = Calculated 't' value
- r = Correlation coefficient
- n = Number of observations

## 3. Regression

- $\hat{Y} = a + bx$  ( $R^2$ ) Where,
- a = Intercept
- b = Regression coefficient
- $R^2$  = Coefficient of determination

## Results and discussion

### Kharif 2024

Observations of dead heart caused by shoot fly (%) were recorded throughout the study period during Kharif 2024 and are presented in table 1 and figure 1. The first appearance of shoot fly dead heart was recorded during 31<sup>st</sup> SMW (8.15%) and it persisted in the crop till 37<sup>th</sup> SMW (8.89%). The peak period was observed during 34<sup>th</sup> SMW (32.59%), when maximum and minimum temperatures were 35.1°C and 25.9°C, respectively, morning and evening relative humidity were 86.1% and 56.6%, respectively, while the rainfall was 115.4mm per day and evaporation was 1.3mm per day.

The correlation studies indicated that minimum temperature had significant positive relationship on dead heart caused by shoot fly (%) ( $r = 0.54$ ) at 5% level of significance. Whereas, maximum temperature, morning and evening relative humidity, rainfall and evaporation were found to be non-significant positive influence on the dead heart caused by shoot fly (%) (0.09, 0.48, 0.17, 0.28 and 0.09, respectively).

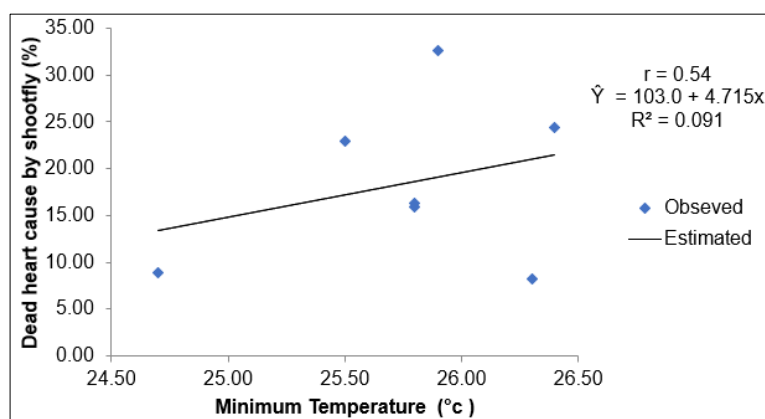


Fig 1: Regression between dead heart cause by shoot fly (%) and minimum temperature.

**Kharif 2025:** Observations of dead heart cause by shoot fly (%) were recorded throughout the study period during Kharif 2025 and are presented in table 3.2 and figure 2. The first appearance of shoot fly was recorded during 31<sup>st</sup> SMW (9.26%) and it persisted in the crop till 37<sup>th</sup> SMW (9.63%). The peak period was observed during 34<sup>th</sup> SMW (33.70%), when maximum and minimum temperatures were 33.3°C and 26.0°C, respectively, morning and evening relative humidity were 87.70% and 58.00%, respectively, while the rainfall was 27.70 mm per day and evaporation was 1.2 mm per day.

The correlation studies indicated that minimum temperature had significant positive relationship on dead heart caused by shoot fly (%)  $r = 0.57$  at 5% level of significance. Whereas, maximum temperature was found to have non-significant positive influence on the dead heart caused by shoot fly (%) (0.23). However, morning and evening relative humidity, rainfall and evaporation were found to have non-significant negative influence on the dead heart caused by shoot fly (%) -0.12, -0.32, -0.10 and -0.23, respectively.

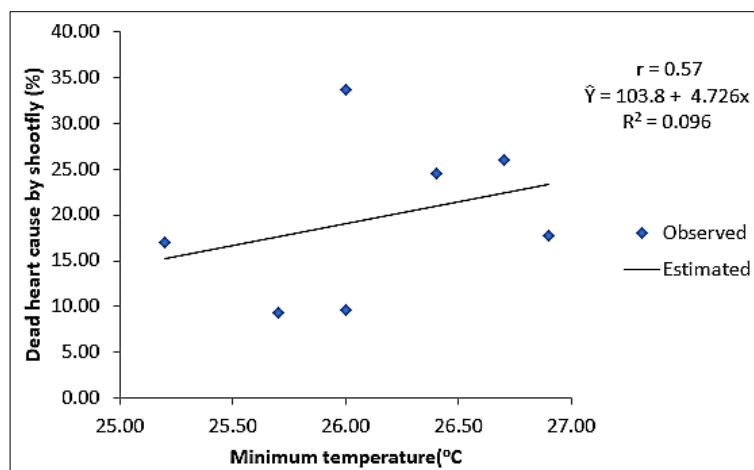


**Fig 2:** Regression between dead heart caused by shoot fly (%) and minimum temperature.

**Table 1:** Seasonal incidence of dead heart caused by shoot fly (%) during *Kharif* 2024 and 2025

| SMW | Dead heart caused by shoot fly (%) |       |
|-----|------------------------------------|-------|
|     | 2024                               | 2025  |
| 31  | 8.15                               | 9.26  |
| 32  | 16.30                              | 17.78 |
| 33  | 24.44                              | 25.93 |
| 34  | 32.59                              | 33.70 |
| 35  | 22.96                              | 24.44 |
| 36  | 15.93                              | 17.04 |
| 37  | 8.89                               | 9.63  |

**Table 2:** Correlation coefficient of dead heart cause by shoot fly (%) on maize during *Kharif* 2024 and *Kharif* 2025

| Weather Parameters            | Per cent dead heart caused by shoot fly |                    |
|-------------------------------|-----------------------------------------|--------------------|
|                               | <i>Kharif</i> 2024                      | <i>Kharif</i> 2025 |
| Maximum temperature (°C)      | 0.090                                   | 0.227              |
| Minimum temperature (°C)      | 0.538*                                  | 0.575*             |
| Morning Relative Humidity (%) | 0.481                                   | -0.123             |
| Evening Relative Humidity (%) | 0.168                                   | -0.320             |
| Rainfall (mm)                 | 0.280                                   | -0.101             |
| Evaporation (mm/day)          | 0.092                                   | -0.230             |

\*significant at 5% level of significance

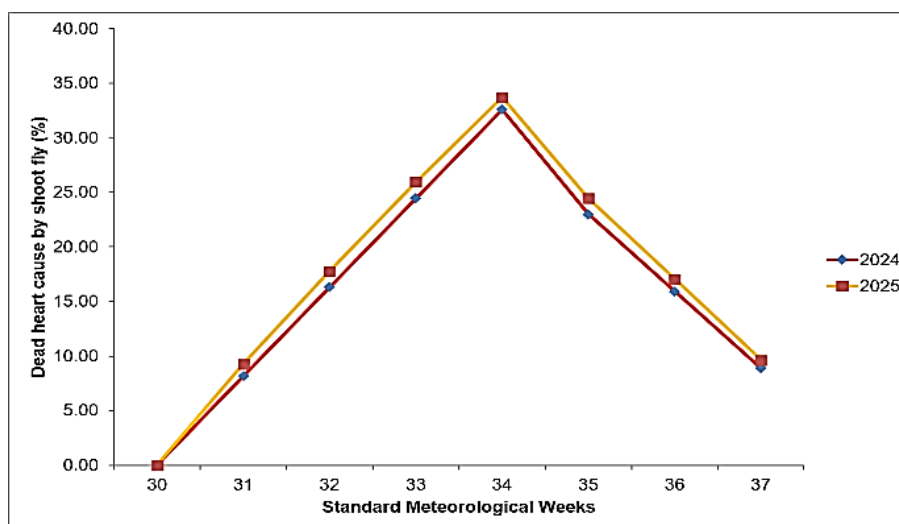


**Fig 3:** Dead heart cause by shoot fly (%) on maize crop during *Kharif* 2024 and *Kharif* 2025 at different SMW

**Conclusion:** The first appearance of dead heart cause by shoot fly (%) was observed during 31<sup>st</sup> SMW, peak period of dead heart cause by shoot fly (%) was recorded during the 34<sup>th</sup> SMW, respectively. It persisted until 37<sup>th</sup> SMW in both the years. The minimum temperature had significant positive

relationship on dead heart cause by shoot fly (%) population in both years.

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