

## Original Research Article

### **Impact of weather parameters on incidence of white fly population and yellow mosaic disease (YMD) in soybean**

#### **Abstract:**

A field experiment was carried out at the field of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur during the 2022-23 *Kharif* season to investigate the dynamics of *Bemisia tabaci* and YMD incidence on the soybean crop variety JS-335 with weather parameter. Incidence of YMD showed a negative but non-significant relationship with the highest temperature and negatively significant correlation (-0.627\*) with the lowest temperature. There was a non-significant positive correlation between the disease and the lowest relative humidity as well as rainfall. In terms of Whitefly population, there was a significant negative correlation (-0.752\*\*) with rainfall, indicating that as rainfall increased, Whitefly population decreased.

**Keywords:** Soybean, Weather, Yellow Mosaic Virus, Whitefly, Correlation

#### **Introduction:**

Soybean, scientifically known as *Glycine max* (L.) Merrill with a chromosome count of 40 is commonly referred to as the "Golden Bean" due to its versatile applications and beneficial health properties. One of the significant challenges faced in soybean cultivation in India is its vulnerability to yellow mosaic disease (YMD), which is transmitted by the whitefly *Bemisia tabaci* Gen. This disease is highly damaging and widely prevalent in the soybean crop in India. Soybean crop was grown in an area of 11.44 mha with a total production of 13.9 mt and productivity of 882 kg ha<sup>-1</sup> in India in the year 2022-23 (IISR, Indore Annual report, 2022). In Madhya Pradesh, the total area is 939 lakh ha, total production is 55.68 Lakh mt and Yield is 52.29 kg ha<sup>-1</sup> (SOPA, 2021-22). In India, YMD is causing yield losses varied from 10 to 88% in soybean annually. Management of YMD in a particular region depends largely on the management of vector (*Bemisia tabaci*) population. It necessitates in-depth investigation on the relationship of whitefly population and prevalence of the virus. Finding the degree of relationship between YMD and weather factors helps in developing the weather-based prediction rule for its peak incidence. Yellow mosaic disease, which is spread by the Whitefly (*Bemisia tabaci*), leads to losses from the vegetative growth phase to pod formation in plants (Gupta and Varma, 2015). The prevailing weather conditions have an impact on every disease or insect. The vector's growth takes place within a temperature range of 10 to 32°C with the most favorable temperature for development being 27°C. At a temperature of 25°C, it takes an average of 23.6 days for *B. tabaci* to

go from an egg to an adult. However, when the temperature reaches 36<sup>0</sup>C, the eggs do not successfully hatch (Butler et al., 1983).

The highest temperature had a notably favorable impact, whereas evening relative humidity had a distinctly unfavorable influence on the whitefly population. In terms of correlation, morning and evening relative humidity exhibited a positive association, while wind speed displayed a positive correlation that was not statistically significant (Jha and kumar 2017). The analysis reveals a noteworthy connection between weather factors and the population of whiteflies. Specifically, there is a strong positive correlation between whitefly population and maximum temperature, indicating that as temperatures raise, so does the whitefly population. Conversely, there is a negative correlation between whitefly population and both minimum temperature and rainfall, suggesting that higher minimum temperatures and increased rainfall are associated with a decrease in whitefly population (Meti and kenganal 2018).

### Materials and methods:

These studies were carried out at the fields of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur during *Kharif* 2022-23. The information of incidence of soybean yellow mosaic disease and whitefly population were gathered by randomly throwing 1m×1m coudrate in field and average of whitefly count on 6 leaves per plant randomly selected respectively o soybean variety JS-335. The studies was put through the methods listed below in order to draw conclusions. The data on the yellow mosaic disease caused by yellow mosaic virus and vectors, whitefly was evaluated for correlation analysis. Following formula was used to calculate the correlation between the two variables.

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

The following formula was used for record incidence of SYMD (Singh and Singh, 2000).

$$\text{Percentage of disease incidence} = \frac{\text{Total number of infected plants}}{\text{Total number of plants}} \times 100$$

**Table 1: Disease rating scale (Source: AICRP, Annual report 2022-23).**

Scale	Description	Disease reaction
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<b>0</b>	No symptoms on plants	Highly resistant (HR)
<b>1</b>	1 % plant exhibiting mosaicing of leaves symptoms	Resistant (R)
<b>3</b>	1.1-10 % plants exhibiting mosaicing and Yellow discolouration symptoms	Moderately resistant (MR)
<b>5</b>	10.1-25 % plants exhibiting mosaicing and Yellow discolouration symptoms	Moderately susceptible (MS)
<b>7</b>	25.1-50 % plants exhibiting m mosaicing and Yellow discolouration symptoms	Susceptible (S)
<b>9</b>	>50 % plants exhibiting mosaicing and Yellow discolouration reduced flowers and pods	Highly susceptible (HS)

**Table 2: meteorological data**

<b>Observation</b>	<b>Weeks</b>	<b>T max.</b>	<b>T min.</b>	<b>RH max.</b>	<b>RH min.</b>	<b>Rainfall (mm)</b>
11.07.2022	28	33.2	24.7	90	67	57.6
18.07.2022	29	30.5	24.6	92	78	53.8
25.07.2022	30	30.5	24.4	93	78	101.0
01.08.2022	31	31.8	25.2	88	67	16.0
08.08.2022	32	31.6	25.0	88	72	53.8
15.08.2022	33	29.4	24.0	89	75	135.7
22.08.2022	34	29.0	23.1	92	74	208.1
29.08.2022	35	31.3	24.1	90	68	97.5
05.09.2022	36	31.9	24.3	87	72	47.0
12.09.2022	37	30.5	24.2	91	79	118.0

19.09.2022	38	29.8	23.6	92	79	39.3
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Karl Pearson's correlation coefficient was employed to assess the relationship between various weather parameters and the severity of a particular disease. The multiple regression equation used took the form of  $Y = b_0 + b_1X_1 + b_2X_2 + \dots + b_nX_n$ . In this equation, Y represents the percentage of disease severity, which is the dependent variable. Here,  $b_0$  represents the constant term (intercept), while  $b_1, b_2, \dots, b_n$  denote the partial regression coefficients. Finally,  $X_1, X_2, \dots, X_n$  represent the different weather parameters involved in the analysis.

### Result and discussion:

The lowest whitefly population was recorded 1.05 with temperature 23.6-29.8°C and relative humidity 79-92% respectively and highest population was recorded 9.57 with temperature 24-29.4°C and relative humidity 75-89% respectively. While the lowest incidence of SYMD was recorded as 0 with temperature 24.6-33.2 °C and relative humidity 67-92% respectively and highest incidence of SYMD was recorded 68.28 with temperature 23.6-29.8°C and relative humidity 79-92% respectively.

Incidence of SYMD with maximum temperature and maximum relative humidity had negative non-significant correlation while minimum temperature had negative significant correlation (-0.627\*) at 0.05 level and with minimum relative humidity and rainfall had positive non-significant correlation (Table-3).

The population of whitefly with rainfall had negatively significant correlation (-0.752\*\*) at 0.01 level while with maximum and minimum temperature had positively non-significant correlation and with relative maximum and minimum relative humidity had negatively non-significant correlation (Table-4). Similar findings were observed by Borah and Nath, (1995), Pandey *et al.*, (2008), Chahal *et al.*, (2009), Meena *et al.*, (2010), Meena *et al.*, (2013), Kaur *et al.*, (2014), Gupta and Varma, (2015), Marabi *et al.*, (2017), Meti and Kenganal (2017), Patel *et al.*, (2021).

**Table 3: Correlation coefficient between weather parameters (X) and number of *Bemisia tabaci*.**

Parameter	White fly	Temperature	Temperature	relative humidity	relative humidity	Rainfall
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		maximum	Minimum	maximum	minimum	
<b>White fly</b>	1					
<b>Temperature maximum</b>	0.114 <sup>NS</sup>	1				
<b>Temperature Minimum</b>	0.393 <sup>NS</sup>	0.741 <sup>**</sup>	1			
<b>relative humidity maximum</b>	-0.752 <sup>**</sup>	-0.529 <sup>NS</sup>	-0.490 <sup>NS</sup>	1		
<b>relative humidity minimum</b>	-0.465 <sup>NS</sup>	-0.696 <sup>*</sup>	-0.424 <sup>NS</sup>	0.627 <sup>*</sup>	1	
<b>Rainfall</b>	-0.103 <sup>NS</sup>	-0.658 <sup>*</sup>	-0.723 <sup>*</sup>	0.401 <sup>NS</sup>	0.255 <sup>NS</sup>	1

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

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

**Table 4: Correlation coefficient between weather parameters (X) and SYMD.**

Parameter	Per cent Disease Incidence	Temperature maximum	Temperature Minimum	relative humidity maximum	relative humidity minimum	Rainfall
<b>Per cent Disease Incidence</b>	1					
<b>Temperature maximum</b>	-0.361 <sup>NS</sup>	1				
<b>Temperature Minimum</b>	-0.627 <sup>*</sup>	0.741 <sup>**</sup>	1			
<b>relative humidity</b>	-0.085 <sup>NS</sup>	-0.529 <sup>NS</sup>	-0.490 <sup>NS</sup>	1		

<b>maximum</b>						
<b>relative humidity minimum</b>	0.266 <sup>NS</sup>	-0.696*	-0.424 <sup>NS</sup>	0.627*	1	
<b>Rainfall</b>	0.266 <sup>NS</sup>	-0.658*	-0.723*	0.401 <sup>NS</sup>	0.255 <sup>NS</sup>	1

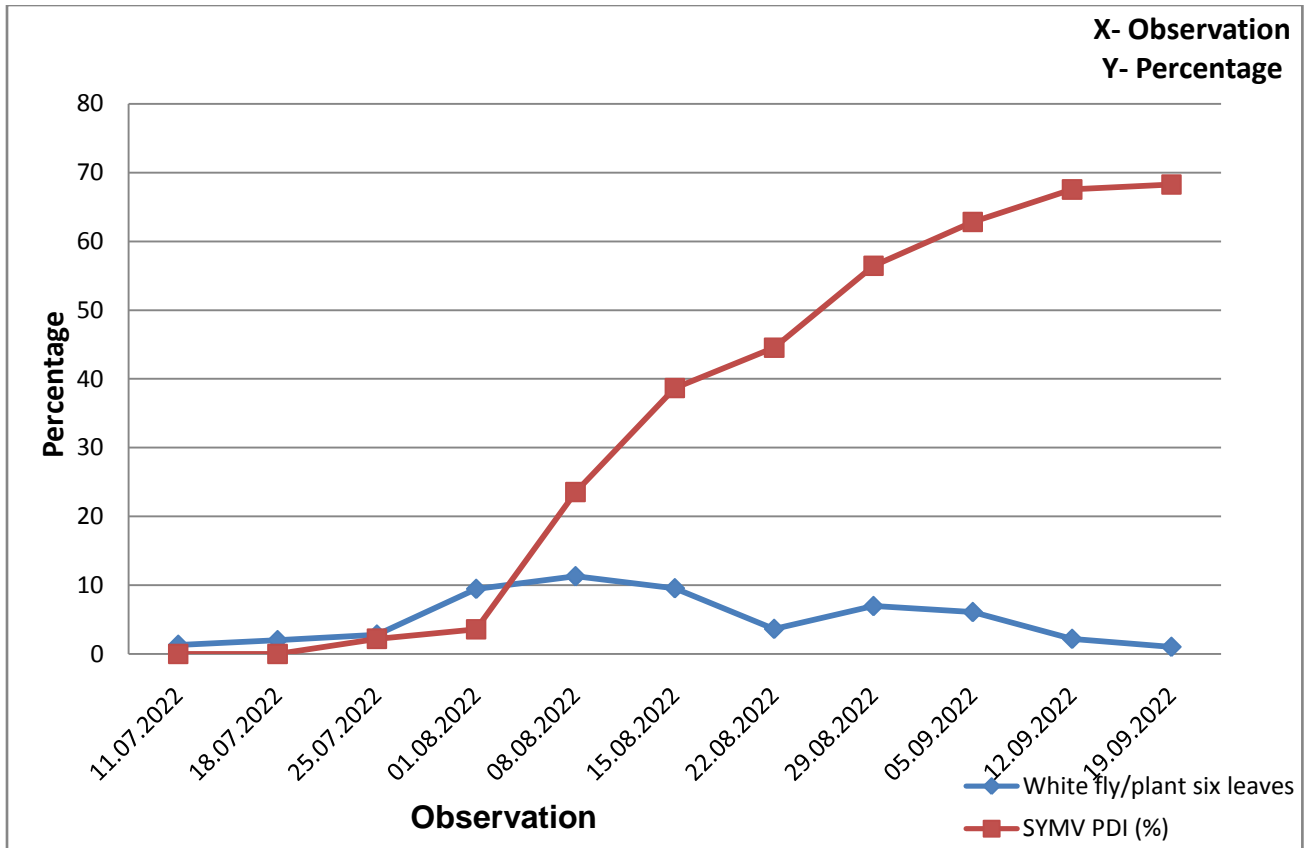
\*. Correlation is significant at the 0.05 level (2-tailed).

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

The observations of population of whitefly per plant six leaves and incidence of disease were recorded in 11 weeks from 28<sup>th</sup> week to 38<sup>th</sup> week randomly from the field with respective to weather data (Table-4).

**Table 5: Observations of Whiteflies and Incidence of Yellow mosaic disease**

<b>Weeks</b>	28	29	30	31	32	33	34	35	36	37	38
<b>Whitefly/six leaves</b>	1.35	2.02	2.83	9.48	11.32	9.57	3.66	6.98	6.11	2.21	1.05
<b>Incidence of YMD</b>	0	0	2.21	3.59	23.56	38.67	44.56	56.46	62.84	67.57	68.28



**Fig. 1: Correlation between population of Whiteflies and % of disease incidence**



**Plate 1: Yellow Mosaic Diseased plant and White fly feeding on Soybean.**

## Conclusion:

It has concluded by the above records that the Population of Whitefly with Rainfall had negatively significant correlation at 0.01 levels while with temperature (maximum and minimum) had positively non-significant correlation and with relative humidity (maximum and minimum) had negatively non-significant correlation. The per cent of SYMD Incidence with temperature maximum and relative humidity maximum had negative non-significant correlation while temperature minimum had negative significant correlation at 0.05 level and relative humidity minimum and rainfall had positive non-significant correlation.

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