Original Research Article

Impact of weather parameters on incidence of white fly population and soybean yellow mosaic virus disease

Abstract:

A field experiment was carried out at the field of Jawaharlal Nehru Krishi Vishwa Vidyalaya in Jabalpur during the 2022-23 *Kharif* season to investigate the population changes of *Bemisiatabaci* and YMD incidence on the soybean crop variety JS-335 with weather parameter. Soybean Yellow Mosaic Disease showed a negative but non-significant relationship with the highest temperature and negatively significant correlation (-0.627*) with the lowest temperature. Additionally, 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 *Bemisiatabaci* Gen. This disease is highly damaging and widely prevalent in the soybean crop in India. Soybean crop was grown in area of 11.44 mha with a total production 13.9 mt and productivity 882 kg ha^{-1} 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^{-1} (SOPA, 2021-22).Yellow mosaic disease, which is spread by the Whitefly (*Bemisiatabaci*), leads to losses from the vegetative growth phase up 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 degrees Celsius, with the most favorable temperature for development being 27 degrees Celsius. At a temperature of 25 degrees Celsius, 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 degrees Celsius, 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 maximum 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). 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 $Y = b_0 + b_1X_1 + b_2X_2 + ... + bnXn$. 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,…, bn denote the partial regression coefficients. Finally, X_1, X_2,…,Xn represent the different weather parameters involved in the analysis.

Materials and methods:

These studies were carried out at the field of Jawaharlal Nehru Krishi Vishwa Vidyalaya in Jabalpur during the 2022-23 *Kharif* season. The information gathered from Soybean Yellow Mosaic Virus Disease Studies was put through the methods listed below in order to draw conclusions. The data on the Yellow Mosaic Disease of the soybean yellow mosaic virus with its vector whitefly, *B. tabaci*, were evaluated to correlation analysis. The formula was used to calculate the correlation between the two variables.

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

For the information on the Survey of SYMVD, Transmission and Vector population of whiteflies and healthy soybean plants, the mean of various parameters were calculated.

$$\mathbf{Mean}(\bar{X}) = \frac{\sum \mathbf{X}}{\mathbf{n}}$$

Where, $\bar{X}$ = Mean of n Values

X = an observation

n = Number of observation in the sample

$\sum X$ = Sum of all observations

Table 1: Weekly basis meteorological data

Observation	Weeks	T max.	T min.	RH max.	RH min.	Rainfall (mm)
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

Result and discussion:

Percentage of SYMD Incidence with temperature maximum and relative humidity maximum had negative non–significant correlation while temperature Minimum had negative significant correlation (-0.627*) at 0.05 level and relative humidity Minimum and rainfall had positive non-significant correlation (Table-2).

The Population of Whitefly with Rainfall had negatively significant correlation (-0.752**) at 0.01 level while with temperature (maximum and Minimum) had positively non-significant correlation and with relative humidity (maximum and Minimum) had negatively non-significant correlation (Table-3).Similar type of findings were observed byBorah 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 2: Correlation coefficient between weather parameters (X) and number of *Bemisiatabaci*.

Parameter	White fly	Temperaturemaximum	Temperature Minimum	relative humidity maximum	relative humidity minimum	Rainfa
White fly	1					
Temperature maximum	0.114^{NS}	1				
TemperatureMinimum	0.393^{NS}	0.741^{**}	1			
relative humidity maximum	-0.752^{**}	-0.529^{NS}	-0.490^{NS}	1		
relative humidity minimum	-0.465^{NS}	-0.696^{*}	-0.424^{NS}	0.627^{*}	1	
Rainfall	-0.103^{NS}	-0.658^{*}	-0.723^{*}	0.401^{NS}	0.255^{NS}	1

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

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

Table 3: Correlation coefficient between weather parameters (X) and SYMD.

Parameter	Per cent Disease Incidence	Temperature maximum	Temperature Minimum	relative humidity maximum	relative humidity minimum	Rainfall
Per cent Disease Incidence	1					
Temperaturemaximum	-0.361^{NS}	1				
TemperatureMinimum	-0.627*	0.741**	1			
relative humidity maximum	-0.085^{NS}	-0.529^{NS}	-0.490^{NS}	1		
relative humidity minimum	0.266^{NS}	-0.696*	-0.424^{NS}	0.627*	1	
Rainfall	0.266^{NS}	-0.658*	-0.723*	0.401^{NS}	0.255^{NS}	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 28th week to 38th week randomly from the field with respective to weather data (Table-4).

Table 4: Observations of Whiteflies and Incidence of Yellow mosaic disease

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

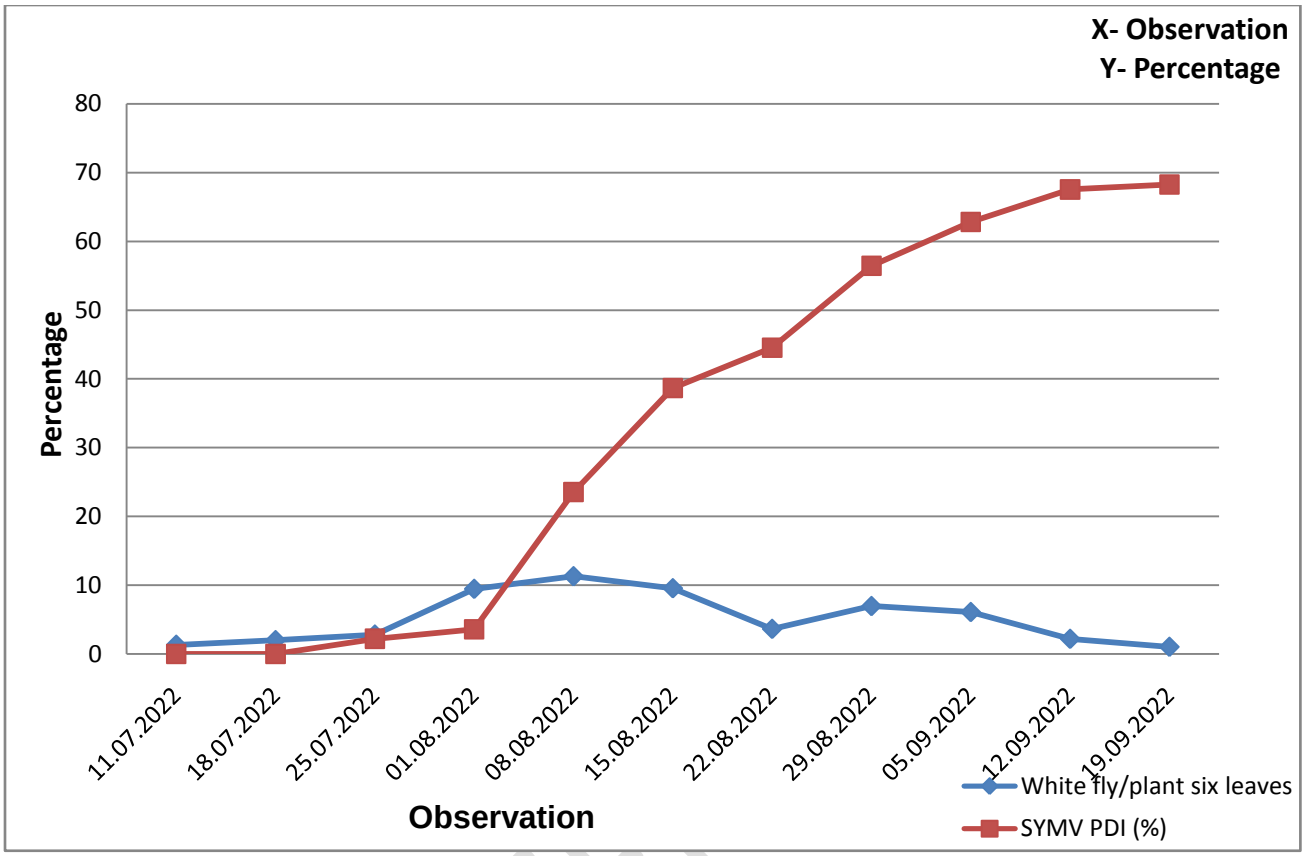

Fig. 1: Correlation between population of Whiteflies and % of disease incidence

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.

References:

Anonymous. 2022-23. Annual Report, Indian Institute of Soybean Research, Indore, 4p.

Borah RK, Nath PD. 1995. Evaluation of an insecticide schedule on the incidence of white fly [*Bemisiatabaci*Genn.] and yellow vein mosaic virus in Okra. Indian J Virol. 11(2):65-67.

Chahal SK, Dhaliwal LK, Kaur L and Singh SP. 2009. Incidence of yellow mosaic virus as influenced by weather in mung. J. Agrometerology11: 146-149.

Gupta KN, Varma RK. 2015. Ecological traits of yellow mosaic disease in relation to epidemics in soybean. JNKVV Res Journals 49 (2): 256-261.

Kaur L, Gill KK, Kingra PK, Sirari A, Singh G and Kumar D. 2014. Identifying environmental factors impacting yellow mosaic virus disease of green gram (*Vigna radiata* L.) Wilczek. Arch. Phytopathology Plant Protection 47(2): 178–184.

Marabi RS, Chaukikar K, Bhowmick AK. 2017. Population dynamics of Whitefly (*Bemisiatabaci*)and incidence of *Mungbean Yellow Mosaic India Virus* (MYMIV) on blackgram. International Journal Bio-resource and Stress Management 8(6): 846–852.

Meena BM, Srivastava CP, Sharma RP. 2010. Seasonal incidence of pod virus in whitefly on long duration pigeon pea. Ann. Pl. Protec. Sci. 18:394-399.

Meena RS, Ameta OP, Meena BL.2013. Population dynamics of sucking pests and their correlation with weather parameters in chilli, *Capsicum annum* L. Crop. The Bioscan. 8(1):177-18

Meti M and Kenganal M. 2017. Epidemiology of mungbean yellow mosaic virus in relation to Whitefly dynamics and weather parameters. International Journal of Current Microbiology Applied Science 7(9): 2368–2375.

Pandey R, Sharma K, Chaudhari D, Rai M. 2008. Effect of weather parameters on incidence of *Bemisiatabaci*and *Myzuspersicae*on potato. 16(1):78-80.

Patel R, Marabi RS, Nayak MK, Tomar DS and Srivastava AK. 2021. Population dynamics of major sucking insect pests of mungbean [*Vigna radiata*(L.) Wilczek] in relation to weather parameters. J. Entomol. Zool. Stud. 9(2): 324-328.