



ISSN (E): 2277-7695  
ISSN (P): 2349-8242  
NAAS Rating: 5.23  
TPI 2023; 12(7): 2593-2596  
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[www.thepharmajournal.com](http://www.thepharmajournal.com)

Received: 12-05-2023

Accepted: 17-06-2023

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## Effect of weather parameters on the development of French bean anthracnose in Jammu sub-tropics

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### Abstract

An experiment was conducted during the cropping season of 2021 and 2022 to assess the influence of several meteorological parameters on the development of anthracnose disease in 'Falguni' variety of french bean. The influence of two-year meteorological data i.e. temperature relative humidity, sunshine hours and rainfall were analyzed and correlated with the disease severity. The results revealed that the initial disease severity was recorded in the 16<sup>th</sup> standard meteorological week (SMW) which was 2.86 per cent during the first year and was 1.09 per cent in the second year. However, during both the years temperature showed a positive and significant correlation with the disease severity. On the basis of two-year weather data, co-efficient of determination ( $R^2$ ) revealed a strong relationship among the disease severity and the selected weather variables viz., temperature, relative humidity, sunshine hours and rainfall that contributed 94 and 99 per cent variation towards disease severity during the year 2021 and 2022, respectively.

**Keywords:** French bean, anthracnose, Falguni, weather parameters, disease severity

### 1. Introduction

French bean (*Phaseolus vulgaris* L.) is an important leguminous crop, belonging to Fabaceae family and is also known by the names rajmash, snap bean, common bean or haricot bean (Maibam *et al.*, 2015) [6]. The sustainable crop productivity is severely affected by enormous disease limiting factor. Among diseases, anthracnose caused by the fungus *Colletotrichum lindemuthianum* is the predominant seed borne disease that requires a serious attention as it is responsible for high yield losses which may nearly be 80 to 100 per cent under highly conducive conditions (Silva *et al.*, 2007; Sharma *et al.*, 2007) [8,9]. The plant is susceptible to anthracnose at all the crop growth stages and the susceptibility increases with age of the crop (Champion *et al.*, 1973; Fernandez *et al.*, 2000) [2,3].

Environment factors like temperature, moisture, relative humidity, sunshine hours and rainfall play a vital role in the development and spread of disease. This disease is a major problem in areas having cool and wet weather conditions (Goodwin, 2003; Yusuf and Sangchota, 2005; Kumar *et al.*, 1999) [4, 12, 5]. The progress of the disease is usually favored by moderate temperature ranging between 19-25 °C, relative humidity of more than 70 per cent accompanied by regular rainfall (Kumar *et al.*, 1999) [5]. However, the information available on the effect of weather factors responsible for anthracnose development is scanty. Hence, keeping this in view, a study was carried out to determine the effect of various weather parameters viz., temperature (°C), relative humidity (%), sunshine (hours) and rainfall (mm) on the development of the disease in french bean variety 'Falguni'.

### 2. Material and methods

The experiment was conducted during the cropping season of 2021 and 2022 at the experimental farm of Division of Plant Pathology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha. The experimental site lies at 32.65°N latitude and 74. 80°E longitude with an elevation of 349 m above mean sea level. The experiment was carried out with three replications in a plot size of 2 × 1.5 m<sup>2</sup> with row to row spacing of 30-45 cm and plant to plant spacing of 10-15 cm following all the standard agronomic practices (Anonymous, 2020) [1]. The relationship of various weather parameters viz., temperature (°C), relative humidity (%), sunshine (hours) and rainfall (mm) with disease severity was assessed in french bean variety "Falguni". The progress of the disease was observed at weekly interval from the time of disease initiation till the crop reached to its physiological maturity. The meteorological data was collected from the Agromet Research Centre, SKUAST-Jammu,

Chatha. Disease severity was subjected to correlation as well as multiple regression analysis with several meteorological factors in order to determine the relationship between these factors and progress of disease.

### 3. Results

The development of disease with respect to weather parameters viz., temperature, relative humidity, sunshine and rainfall in variety ‘Falguni’ during the year 2021 and 2022 is presented in the table 1. The initial disease severity of 2.86 and 1.09 per cent in 2021 and 2022 was observed in 16<sup>th</sup>

Standard Meteorological Week (SMW) when the mean temperature was 22.22 and 27.92 °C, relative humidity was 52.50 and 36.35 per cent, sunshine was 3.38 and 6.70 hours, and rainfall was 11.00 and 4.60 mm during 2021 and 2022, respectively. Maximum terminal disease severity of 23.08 per cent (2021) and 21.35 per cent (2022) was recorded in 23<sup>rd</sup> SMW with average temperature of 33.35 and 33.62 °C, relative humidity of 45.50 and 36.35 per cent, sunshine of 8.00 and 8.20 hours, and rainfall of 15.00 mm and 0.00 mm during the year 2021 and 2022, respectively.

**Table 1:** Anthracnose disease development on french bean variety “Falguni” with respect to weather parameters during 2021 and 2022

| SMW              | Disease Severity (%) |       | Temperature (°C) |       | Relative humidity (%) |       | Sunshine (hours) |      | Rainfall (mm) |       |
|------------------|----------------------|-------|------------------|-------|-----------------------|-------|------------------|------|---------------|-------|
|                  | 2021                 | 2022  | 2021             | 2022  | 2021                  | 2022  | 2021             | 2022 | 2021          | 2022  |
| 16 <sup>th</sup> | 2.86                 | 1.09  | 22.22            | 27.92 | 52.50                 | 36.35 | 3.38             | 6.70 | 11.00         | 4.60  |
| 17 <sup>th</sup> | 4.37                 | 3.56  | 25.49            | 29.45 | 39.65                 | 30.35 | 10.60            | 9.20 | 8.00          | 0.00  |
| 18 <sup>th</sup> | 7.65                 | 5.95  | 28.81            | 29.17 | 40.57                 | 40.05 | 6.20             | 5.10 | 2.00          | 2.00  |
| 19 <sup>th</sup> | 10.87                | 10.21 | 26.90            | 30.78 | 51.50                 | 40.17 | 5.60             | 7.10 | 27.00         | 2.00  |
| 20 <sup>th</sup> | 12.16                | 13.58 | 27.82            | 31.95 | 40.72                 | 30.51 | 8.57             | 7.60 | 2.80          | 0.00  |
| 21 <sup>st</sup> | 16.58                | 15.88 | 27.38            | 30.10 | 36.00                 | 45.44 | 8.30             | 6.30 | 20.20         | 24.80 |
| 22 <sup>nd</sup> | 19.96                | 17.91 | 29.97            | 31.20 | 45.65                 | 39.70 | 6.60             | 7.30 | 32.60         | 16.80 |
| 23 <sup>rd</sup> | 23.08                | 21.35 | 33.35            | 33.62 | 45.50                 | 36.35 | 8.00             | 8.20 | 15.00         | 0.00  |

#### 3.1 Correlation coefficient

The correlation study between disease severity and weather parameters (Table 2) revealed that the disease severity had positive and highly significant correlation with temperature (0.861\*\* and 0.877\*\*) during the cropping season of 2021 and 2022, respectively. Relative humidity had negative and

non-significant correlation (-0.153 and -0.066) during 2021 and 2022, respectively. While, disease severity had non-significant but positive correlation with sunshine hours (0.220 and 0.136) and rainfall (0.523 and 0.361) respectively, during 2021 and 2022.

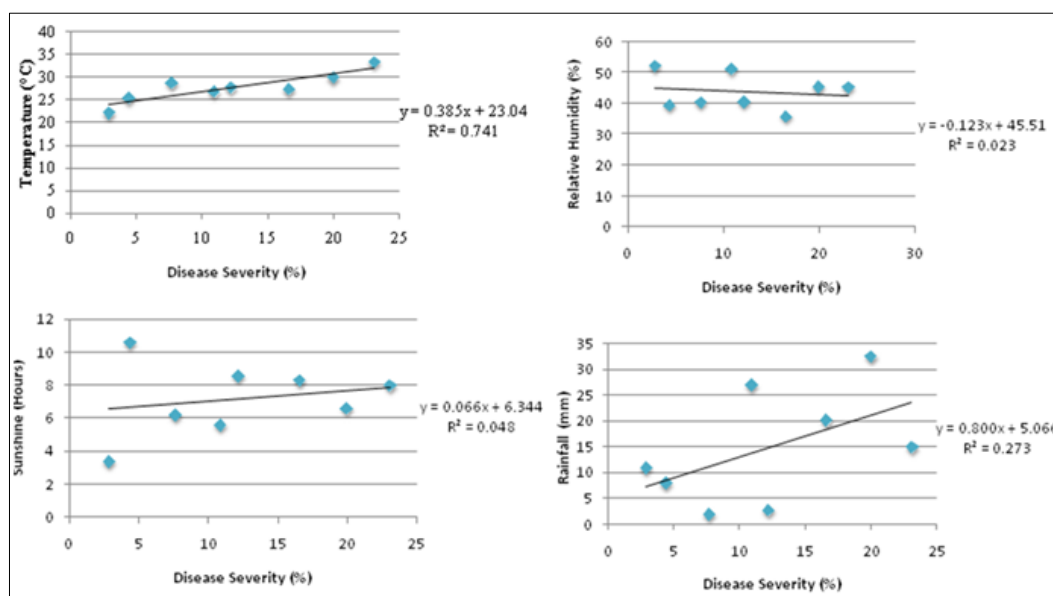
**Table 2:** Correlation between anthracnose disease severity and weather parameters

| Year | Temperature (°C) | Relative humidity (%) | Sunshine (hours) | Rainfall (mm) |
|------|------------------|-----------------------|------------------|---------------|
| 2021 | 0.861**          | -0.153                | 0.220            | 0.523         |
| 2022 | 0.877**          | -0.066                | 0.136            | 0.361         |

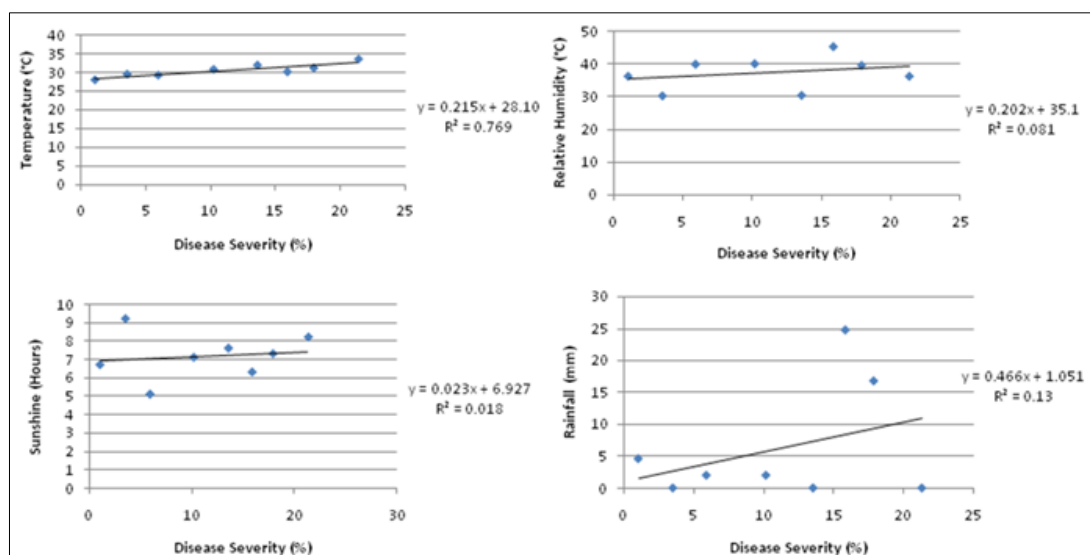
#### 3.2 Regression analysis

Regression relationship between the disease severity and various weather parameters viz., temperature, relative humidity, sunshine hours and rainfall at individual level

revealed that during both the years i.e. 2021 and 2022, temperature showed positive correlation with disease severity and confirmed its role in the disease development (Figure 1 and Figure 2).



**Fig 1:** Regression relationship between disease severity and weather parameters (temperature, relative humidity, sunshine hours and rainfall) during 2021



**Fig 2:** Regression relationship between disease severity and weather parameters (temperature, relative humidity, sunshine hours and rainfall) during 2022

**3.2.1 Multiple linear regression**

Multiple regression analysis of weather parameters with disease severity for both the years was calculated and presented in table 3. The best fitted regression equation for the disease in Falguni variety was found to be

$$Y = -27.945 + 1.701X_1 - 0.212X_2 - 0.247X_3 + 0.271X_4$$

and

$$Y = -98.771 + 3.854X_1 - 0.107X_2 - 0.859X_3 + 0.378X_4$$

during 2021 and 2022, respectively. The equation from the data revealed that when there was increase in one unit of temperature and rainfall, the per cent disease severity

increased by 1.701 and 0.271 units respectively, in 2021, 3.854 and 0.378 units respectively, in 2022. However, when there was an increase in one unit of relative humidity, per cent disease severity decreased by 0.212 and 0.107 units respectively, during 2021 and 2022. Thus, it was concluded that temperature and rainfall played a significant role in the epidemiology of french bean anthracnose. The multiple regression analysis clearly showed that temperature, relative humidity, sunshine and rainfall were the important factors for the development of the disease and contributed 94 per cent variation in 2021 and 99 percent variation in the second cropping season (2022).

**Table 3:** Multiple linear regression equation for French bean anthracnose on different weather parameters

| Year | Multiple Linear Regression equation                       | Coefficient of determination (R <sup>2</sup> ) |
|------|---|--|
| 2021 | $Y = -27.945 + 1.701X_1 - 0.212X_2 - 0.247X_3 + 0.271X_4$ | 0.94   |
| 2022 | $Y = -98.771 + 3.854X_1 - 0.107X_2 - 0.859X_3 + 0.378X_4$ | 0.99   |

Where, X<sub>1</sub>= Temperature, X<sub>2</sub>= Relative humidity, X<sub>3</sub>= Sunshine hours and X<sub>4</sub>= Rainfall.

**Discussion**

Weather factors viz., temperature, relative humidity, sunshine and rainfall played a significant role in the progression of anthracnose disease in variety Falguni. Regression models were developed for predicting unit increase or decrease in the disease that could influence disease severity.

The experimental results revealed that maximum disease severity was observed in 2021 and the initial infection starts from the 16<sup>th</sup> SMW when the temperature was 22.22°C. Temperature had a positive and highly significant correlation with the development of disease during both the years (2021 and 2022). Our findings are in accordance with prior findings of Rathava (2017) [7] who reported significant and positive correlation of minimum temperature with disease intensity. He further found that minimum temperature and rainfall to be more important in the development of disease in comparison with the other weather parameters. Thakur and Khare (1993) [10] found that the disease intensity had positive correlation with rainfall. Earlier, Tu (1981) [11] found that high field temperature does not limit the infection and spread of disease. However, prolonged high temperature reduces the disease severity but disease spread occurred continuously when field

temperatures reached a range of 25 °C to 35 °C. Goodwin (2003), reported that temperature range of 13-26 °C favors the initial infection.

**Conclusion**

The disease was found to have maximum disease severity in the year 2021 as compare to severity recorded in 2022. Temperature had positive and highly significant correlation with the development of disease during the cropping season of both the years. The coefficient of determination (R<sup>2</sup>) revealed that the weather parameters (temperature, relative humidity, sunshine and rainfall) contributed upto 94 and 99 per cent towards disease severity during the years 2021 and 2022, respectively.

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