Journal of Food Legumes
36(2 & 3): 173-177, 2023
DOI: 10.59797/jfl.v36.i2.149

Research paper

Effect of meteorological parameters on the dynamics of wilt and pod borer severity in pigeonpea of Bundelkhand region of Uttar Pradesh

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Handling Editor:
Dr. MH Kodandaram, ICAR-Indian Institute of Pulses Research, Regional Station, Dharwad, India

Received: *7 September 2023*
Accepted: *25 September 2023*

ABSTRACT

The weather parameters play a predominant role in determining the course and severity of insect pests and pathogens in different crops. Wilt and pod borer are the most devastating biotic stresses, causes huge losses from the vegetative stage until harvest. The present study was aimed to analyze the seasonal dynamics of wilt and pod borer incidence in relation to critical weather parameters in pigeonpea from the Bundelkhand region, a pulses basket of Uttar Pradesh. The fusarium wilt (*Fusarium udum*) and pod borer (*Helicoverpa armigera*) incidence were found to be major biotic stresses in pigeonpea from 2017-18 to 2020-21. The wilt disease commenced at 48 MSW and the mean incidence ranged from 0.0 to 25.5 percent. The pod borer incidence started at 01 MSW, and the larval population ranged from 0.5 to 1.40 larvae/plant. Though the correlation between pest incidence and weather parameters was found to be non-significant. The wilt and pod borer incidence were positively correlated with Tmax (r= 0.35 and 0.33), Tmin (r= 0.39 and 0.37), rainfall (r= 0.43 and 0.41) and negatively correlated with relative humidity (r= -0.32 and -0.26). The regression analysis indicated variability in wilt and pod borer incidence due to temperature, humidity and rainfall. The information generated on the pest dynamics of wilt and pod borer in pigeonpea under the influence of weather parameters may be helpful in devising the forecasting models as well as the management practices well in advance so as to avoid yield losses.

Key words: Bundelkhand region, Pigeonpea, Pod borer, Weather variability, Wilt

INTRODUCTION

Pigeonpea (*Cajanus cajan* L.) has an unique place in Indian farming systems and India, contributing more than 70% of the total world production (Jorrin *et al*., 2021). India is the largest producer and consumer of pigeonpea in the world (Singh *et al*., 2020). In India, pigeonpea is the second most important pulse crop next to chickpea. During 2020-21, the country produced 5.96 mt of pigeonpea from 7.0 m ha of land (FAO, 2022). The crop is mostly grown under rainfed conditions or with limited irrigation. Poor crop management practices by resource-poor farmers, coupled with unpredictable environmental conditions, lead to lower crop productivity. Pigeonpea is highly susceptible to a number of phytopathogens (Agrawal *et al.,* 1987; Goyal *et al.,* 1991; Mishra *et al*., 2020a, 2020b, 2021), among which wilt-causing *Fusarium udum* is considered the most important soil-borne fungal pathogen, causing considerable economic loss in India and all over the world (Yadava *et al.,* 1981; Mishra *et al*., 2016; Naik *et al.,* 2017). Further, about 250 species of insect pests have been reported to infest pigeonpea at various stages of crop growth (Lal, 1988). Among the insect pests, pod borer [*Helicoverpa armigera* (Hubner)] causes enormous losses in grain yield ranging from 30 to 100 per cent (Adgkar *et al*., 1993). In India, a considerable extent of yield in pigeonpea is lost due to pod borer. Pigeonpea is a highly preferable and suitable host for the development of *H. armigera* (Tripathi and Singh, 1989; Valand and Patel, 1992). The weather conditions play a predominant role in determining the incidence and severity of insect pests and diseases (Zayan, 2019). The change in climate and regional variation in agronomic practices influenced the pest scenario of crops in a given locality (Meena and Bhatia, 2014; Jakhar *et al*., 2016). Changes in climatic parameters significantly affect crop production as well as the dynamics of insect pests and diseases (Pareek *et al.,* 2017) and

these changes cause deviations in farming practices to cope with the effects of these changes and prevent a decline in productivity (Raza *et al*., 2019). Bundelkhand is the major pulse-growing region of India, commonly known as the pulse bowl of the country (Sharma and Sisodia, 2018; Pandey *et al*., 2019). The Bundelkhand region contributes to 8.4% of total pulse production in the country (Kumar *et al*., 2017). Hence, the study of the dynamics of pests and diseases under prevailing weather conditions is important for understanding the incidence of pests in different agro-climatic conditions. In this context, the present study was undertaken to establish the relationship between major biotic stresses of pigeonpea, *viz*., wilt disease, pod borer incidence, and weather parameters from the Bundelkhand region of Uttar Pradesh, India.

MATERIALS AND METHODS

Selection of project villages and base line survey

Base line survey was conducted during *kharif* and *rabi* seasons during 2017-18 to 2020-21 to identify the most potential villages and areas of pigeonpea production in Hamirpur district of Bundelkhand region of Uttar Pradesh. The farmers were chosen on the basis of their interest while priorities had been given to those who were already pulse growers. In the areas of Kurara, Maudaha, Muskara and Sumerpur, 4-5 villages were randomly selected from each block and 3-4 fields in each villages were randomly selected for data collection.

Collection of weather parameters

The weather parameters *viz*., temperature (^{0}C), rainfall (mm) and relative humidity (%) were collected from automatic data logger system and different sources (https://weather.com, https://mausam.imd.gov.in/imd) and further verified from Indian Metrological Department data base. The data on different weather parameters were collected from October 2017-18 to April 2020-21 and converted to monthly averages to find out their association with the monthly mean wilt incidence and pod borer infestation in pigeonpea.

Collection of wilt disease and pod borer incidence

The wilt and pod borer incidence were recorded from each plot (10m x 10m) at weekly interval starting from the first occurrence of pest and diseases. The pod borer larval count was recorded from 100 randomly selected plants from each plot and wilt incidence (%) at monthly intervals at various stages of crop growth namely; seedling, flowering and maturity stage from each location. Cumulative incidence of all stages was calculated using the formula;

$$Percent\ wilt\ incidence = \frac{\text{Number of infected plants}}{\text{Total number of plants observed}} \times 100$$

Statistical analysis

The pest and disease incidence and weather parameters were subjected to correlation and regression analysis in SPSS 16.0 to understand the degree of relationship between them.

RESULTS AND DISCUSSION

Incidence of wilt and pod borer

The wilt incidence was recorded during the *kharif* season of 2017-18 to 2020-21 and mean monthly wilt incidence (pooled) is depicted in Fig. 1. The incidence of wilt disease was commenced from 48 MSW (Meteorological Standard Week) i.e. November, and peak incidence was observed in 10 MSW i.e. March. During all the years of observation, generally the disease initiated at flowering stages of crop in the last week of October and gradually increased with the scarcity of moisture in the soil. The mean wilt incidence was ranged from 0-25.5 percent during all years of observations. The median wilt incidence for each year is presented in box plots (Fig. 2). Whereas, the maximum wilt incidence (25.5 percent) was recorded during the year 2016-17.

The occurrence of pod borer started during first Meteorological Standard Week (MSW) in the month of January and the highest larval population was recorded in March first week i.e. 9th MSW. The mean larval population ranged from 0.50 to 1.40 per plant during all the year of experimentation (Fig. 1 & 2). The maximum pod borer incidence of 1.40 larval/plant was observed during the year 2017-18.

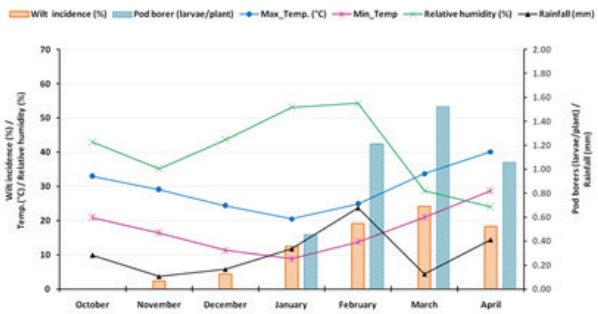

Fig. 1. The mean wilt and pod borer incidence from 2017-18 to 2020-21 under the influence of various weather parameters

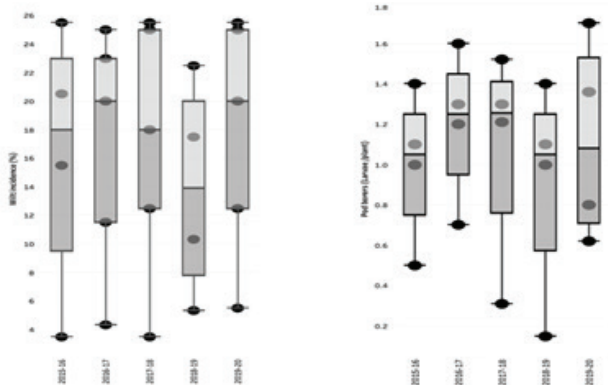

Fig. 2. Boxplot of wilt and pod borer incidence from 2015-16 to 2019-20. The line in the box indicated median value. The box boundaries are upper and lower quartiles whiskers represented minimum and maximum values.

Influence of weather parameters on wilt and pod borer incidence

The weather parameters *viz*., maximum and minimum temperatures (Tmax, Tmin), relative humidity (RH) and rainfall had variable association with wilt and pod borer incidence. Though none of the weather parameters significantly correlated with wilt incidence (Fig. 3). The incidence of diseases was positively correlated with Tmax (r=0.35), Tmin (r=0.39) and rainfall (r=0.43); and negatively with RH (-0.32). Pod borer was positively correlated with Tmax (r=0.33), Tmin (r=0.37) and rainfall (r=0.41) and negatively correlated with relative humidity (-0.26) (Fig. 3).

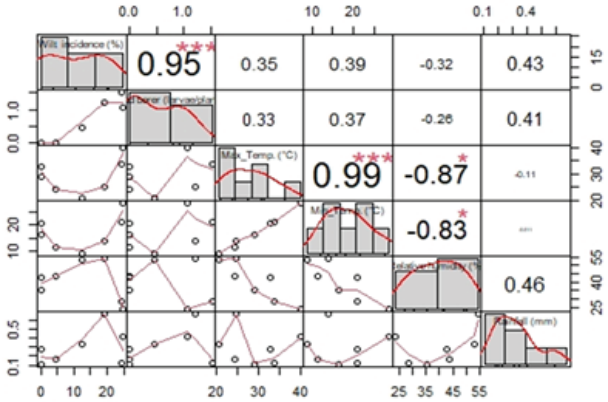

Fig. 3. The correlation matrix of incidence of wilt and pod borer and weather parameters

The relationship between weather parameters and, wilt and pod borer are depicted in fig. 4. Among the various weather parameters, the coefficient of determination was highest (R^2=0.18) when independent variable was rainfall. Present findings confirmed the similar results in diseases of pulse crops (Durairaj *et al*., 2002; Kumar *et al.* 2018; Mishra *et al*., 2019; 2020c; Chhetri and Ranjana Devi, 2014; Sagar *et al*., 2018). The findings of previous studies (Singh and Bhargava, 1981; Reddy *et al*., 1990) also indicated that the temperature is one of the important factors which favour the development of disease and insect pest severity in pulses.

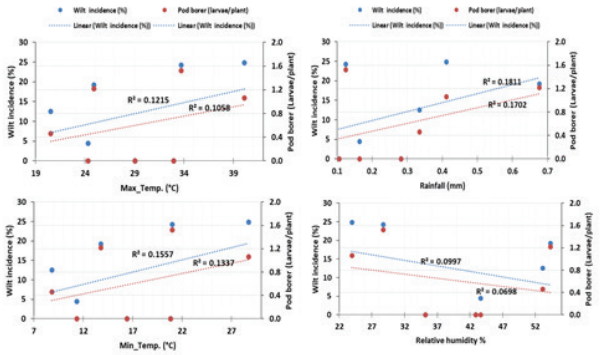

Fig. 4. The relationship between wilt and pod borer incidence with weather parameters

CONCLUSION

The results of present study revealed that, weather parameters play a vital role in wilt and pod borer infestation in pigeonpea. Correlation matrix showed that, temperature and rainfall are the key factors for the development of wilt and pod borer incidence. The wilt disease incidence initiated at the flowering stages of crop (last week of November) and gradually increased with fluctuation of temperature. The maximum incidence of wilt and pod borer was recorded in the month of March. Temperature and rainfall are positively correlated with both wilt & pod borer, whereas, relative humidity were negatively correlated. These findings would be helpful in developing a forecasting model to predict the occurrence of wilt and pod borer in pigeonpea for Bundelkhand region of Uttar Pradesh.

ACKNOWEDGEMENT

The authors are grateful to Indian Institute of Tropical Meteorological (IITM), Pune for financial support and Director, ICAR-IIPR, Kanpur for providing necessary facilities and infrastructures to conduct the experiment.

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