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IMPACT OF SEASONAL WEATHER PATTERNS ON YELLOW STEM BORER *SCRIPOPHAGA INCERTULAS* (WALKER) AND RICE LEAF FOLDER *CNAPHALOCROCIS MEDINALIS* (GUENEE) INCIDENCE IN BASMATI RICE

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ABSTRACT

The experiment was carried out in a randomized block design with three replications during the *Kharif* season, 2023 at the Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut. The first incidence of the rice stem borer was recorded in the second week of August and reached its peak (7.14 per cent dead hearts) during the second week of September when the average temperature and relative humidity were 27.9°C and 83.0 per cent, respectively. The first incidence of the rice leaf folder was recorded in the second week of August and reached a maximum level in the first week of October with mean temperature and relative humidity at 27°C and 64.6 per cent, respectively. There was a positive correlation between dead hearts and evening RH, morning RH, minimum and maximum temperatures. The correlation of the rice leaf folder and yellow stem borer was positive with minimum temperature and maximum temperature and negative with RH and rainfall
Keywords **:** Seasonal incidence, Rice stem borer, rice leaf folder, dead hearts, white ears, Basmati rice, weather factors.

Introduction

Rice (*Oryza sativa* L.) is the second most important cereal crop after wheat, feeding about 45 per cent of the world's population and contributing 15 per cent to global calorie intake (Anonymous, 2018). India ranks as the largest rice-growing country, while China holds the position as the largest rice producer globally. In recognition of its importance, the year 2004 was designated as the "International Year of Rice." Approximately 85 per cent of the world's rice is grown and consumed in Asia (Kakde and Patel, 2015). Rice is considered a healthy cereal due to less content of fat and cholesterol. It is an excellent component of a balanced diet, providing essential carbohydrates, proteins, vitamins, and minerals such as thiamine, niacin, iron, riboflavin, calcium and fiber, while having a low sugar content. Rice is also gluten-free, making it a suitable option for individuals with gluten sensitive and diabetic patients (Laskowski *et al*., 2019). In India, rice is grown on approximately 43.86 million hectares, with a production of about 115.60 million tonnes and an average productivity of 2390 kg/ha. India contributes around 21.81 per cent of the world's total rice production. Uttar Pradesh is the second-largest rice-producing state, following West Bengal, with an area of 5.87 million hectares under rice cultivation, producing 12.17 million tonnes annually, with an average productivity of 2072 kg/ha (Anonymous, 2018). Basmati rice, primarily known for its aroma, fragrance, taste, and fine grains is predominantly cultivated in the western parts of Uttar Pradesh, Uttarakhand, Punjab and Haryana, which together

account for 90 per cent of the total Basmati production in India. Basmati cultivation has gained popularity in western Uttar Pradesh due to the favourable climatic conditions and higher economic returns, especially for export-quality rice. Recognizing the importance of the crop and the availability of irrigation resources, the Government of India has identified western Uttar Pradesh as a potential Basmati rice export zone (Siddiq *et al*., 2012). However, both abiotic and biotic factors significantly limit rice production and productivity. Abiotic stresses such as extreme temperatures, salinity, submergence, drought and oxygen stress contribute to yield reductions, with more than 45 per cent crop damage attributed to these factors. Among biotic stresses, major insect pests such as stem borers, leaf folders, plant hoppers, and gall midge are widespread. Yellow stem borers in particular are prevalent in almost every rice field and season (Bray *et al*., 2000). These biotic and abiotic factors play a crucial role in influencing pest population dynamics, with temperature directly affecting growth, survival, reproduction, development and dispersal (Karuppaiah and Sujayanad, 2012).

Methods and Materials

The experiment was conducted during the *Kharif* 2023 at the Crop Research Centre (CRC) of Sardar Vallabh Bhai Patel University of Agriculture and Technology, Modipuram, Meerut. This site is situated approximately 10 km from Meerut city along the Delhi-Dehradun highway, with coordinates between 77°15' E and 70°30' E longitude and 28°43' N and 29°17' N latitude at an elevation of 237 meters above sea level. The Meerut district encompasses a total area of 2,564 km². The climate in Meerut is semi-arid and sub-tropical, characterized by extremely hot summers with temperatures reaching up to 45°C in May and June and cold winters, where temperatures can drop to around 3°C with occasional ground frost. The average annual rainfall is approximately 800 mm, predominantly occurring from July to September, with additional cyclonic showers possible from December to January or late spring. Meteorological data for the experimental period, including temperature, relative humidity and rainfall were obtained from the meteorological laboratory of the Soil Science Department at Sardar Vallabh Bhai Patel University. The experimental design was a randomized block design with three replications and included eight treatments, including a control. Each treatment plot measured 4 x 3 m². Irrigation channels were provided to separately irrigate the small plots. Rice variety Pusa Basmati-1509 was sown on July 25, 2023 in plots of 5 x 8 m² for seasonal incidence of yellow stem borer and rice leaf folder. Prior to sowing, seeds were treated with *Trichoderma viride* to protect against fungal diseases. An intensive survey was conducted to monitor the seasonal incidence of rice stem borer and rice leaf folder. Random sampling involved tagging ten hills per untreated plot, with observations recorded weekly. The incidence of dead hearts and white ear heads due to rice stem borer attack was documented, and larval populations of rice leaf folder were counted per hill from one-week post-transplantation until harvest. Meteorological data for the crop season 2023 were collected from the Department of soil science, Sardar Vallabhbhai Patel university of agriculture and technology, Meerut. The correlation between pest populations and meteorological variables temperature, relative humidity and rainfall was analysed using simple correlation techniques (Gomez and Gomez, 1984).

Result and Discussion

The data presented in Table 1 and Figure 1 indicate that rice stem borer infestation began during the 32th standard week, with 3.12 per cent dead hearts observed. The infestation reached its peak during the vegetative stage in the 37th standard week with 7.14 per cent dead hearts. At the white ear heads stage, the peak infestation occurred in the 40th standard week, with 5.68 per cent white ear heads. During the peak of dead heart infestation (32th standard week), temperatures ranged from 26.4°C to 33.9°C, relative humidity ranged from 70.7 per cent in the evening to 77.9 per cent in the morning and 15 mm rainfall was recorded. At the peak of white ear heads infestation (37th standard week), temperatures ranged from 23.9°C to 31.9°C, relative humidity ranged from 77.7 per cent in the evening to 88.3 per cent in the morning, and 148.2 mm rainfall was recorded. Correlation analysis (Table 3) revealed a significant positive correlation between dead hearts and morning relative humidity (RH) (r = -0.3110) and evening RH (r = -0.0907), as well as a positive correlation with maximum temperature (r = 0.4213) and a significant positive correlation with minimum temperature (r = 0.3998).

Rice leaf folder

The data presented in Table 2 and Figure 2 indicate that rice leaf folder infestation began in the 32th standard week, with an initial count of leaf damage 3.76 per cent During this period, maximum and minimum temperatures were 33.9°C and 26.4°C, respectively, with morning and evening relative humidity (RH) at 77.9 per cent and 70.7 per cent, respectively. The pest population peaked during the 40th standard week, reaching 8.80 leaf damage. At this

peak, maximum and minimum temperatures were 34.3°C and 19.7°C, and morning and evening RH were 74.3 per cent and 54.9 per cent, respectively. Correlation analysis revealed that leaf folder population had a negative correlation with evening RH (r = -0.230), morning RH (r = -0.438), rainfall (r = 0.079) and minimum temperature (r = 0.087). Conversely, there was a positive correlation with minimum temperature (0.240) and maximum temperature (r = 0.440). The incidence of rice stem borer began in August with peak infestation occurring during the first week of October.

The increase in white ear heads was gradual, indicating continued pest activity until crop maturity. Pest incidence was highest during the vegetative phase, characterized by cloudy conditions and occasional rainfall. These results align with findings from Rana *et al*. (2017). which indicated a positive correlation of dead hearts with evening RH, morning RH, minimum temperature and maximum temperature. Additionally, the relationship between white ear heads and relative humidity, minimum temperature, and maximum temperature was negative. These findings are consistent with Justin *et al*. (2013) who noted that lower mean temperatures and rainfall were favourable for pest growth. Chavan *et al.* (2013) also reported a significant negative correlation between rice stem borer incidence and relative humidity during the crop's reproductive stage. Rice leaf folder infestation began in the first week of August and peaked during the first week of October. Pest populations gradually decreased from the third week of October, reaching 4.40 per cent infestation by the third week of November. Notably, leaf folder activity surged rapidly in the second week of September, peaking during the last week of September and continuing until the first week of October. These observations are in agreement with Alvi *et al.* (2003). Correlation analysis showed a positive relationship with minimum temperature and rainfall, while maximum temperature had a negative correlation. These results are consistent with Chakraborthy and Deb (2011), who reported negative correlations between evening RH and rainfall with rice leaf folder incidence.

Table 1 : Effect of weather parameters on yellow stem borer (*Scirpophaga incertulas*) of Basmati rice *Kharif* 2023

Standard Week	Mean yellow stem borer population (DH/WEH %)	Temp. Max.	Temp. Min	Morning RH %	Evening RH %	Rainfall (MM)
30th	0	33.9	25.2	88.0	76.3	110.0
31th	0	33.8	26.3	86.0	72.4	64.5
32th	3.12	33.9	26.4	77.9	70.7	15.0
33th	4.65	35.0	26.2	85.7	71.4	18.3
34th	5.00	32.9	25.7	89.6	79.3	90.6
35th	5.26	35.0	25.9	74.7	62.6	0.0
36th	6.02	36.1	24.6	76.3	59.0	0.0
37th	7.14	31.9	23.9	88.3	77.7	148.2
38th	6.74	33.3	24.5	80.0	71.0	0.0
39th	4.70	33.9	22.7	82.7	67.1	2.0
40th	5.68	34.3	19.7	74.3	54.9	0.0
41th	3.68	34.7	20.0	76.4	55.9	0.0
42th	2.27	31.9	17.2	81.9	54.4	24.0
43th	0.00	31.0	15.5	79.1	61.0	0.0
44th	0.00	30.9	14.9	89.7	68.7	0.0

Table 2 : Effect of weather parameters on Rice leaf folder (*Cnaphalocrosis medinalis*) of Basmati rice during *Kharif* 2023

Standard week	Leaf folder damage per cent	Temp. Max.	Temp. Min	Morning RH per cent	Evening RH per cent	Rainfall (MM)
30th	0.00	33.9	25.2	88.0	76.3	110.0
31th	0.00	33.8	26.3	86.0	72.4	64.5
32th	3.76	33.9	26.4	77.9	70.7	15.0
33th	4.87	35.0	26.2	85.7	71.4	18.3
34th	5.63	32.9	25.7	89.6	79.3	90.6
35th	6.30	35.0	25.9	74.7	62.6	0.0
36th	7.10	36.1	24.6	76.3	59.0	0.0
37th	7.60	31.9	23.9	88.3	77.7	148.2
38th	8.10	33.3	24.5	80.0	71.0	0.0
39th	8.40	33.9	22.7	82.7	67.1	2.0
40th	8.80	34.3	19.7	74.3	54.9	0.0
41th	6.70	34.7	20.0	76.4	55.9	0.0
42th	4.40	31.9	17.2	81.9	54.4	24.0
43th	0.00	31.0	15.5	79.1	61.0	0.0
44th	0.00	30.9	14.9	89.7	68.7	0.0

Table 3 : Corelations:

Insect pests	Temperature (℃)		Relative Humidity per cent Morning	Relative Humidity per cent Evening	Rainfall (mm)
	Minimum	Maximum			
Yellow stem borer (Percent DH/ percent WE)	0.3998	0.4213	-0.3110	-0.0907	-0.0015
Leaf folder	0.240	0.440	-0.438	-0.230	-0.158

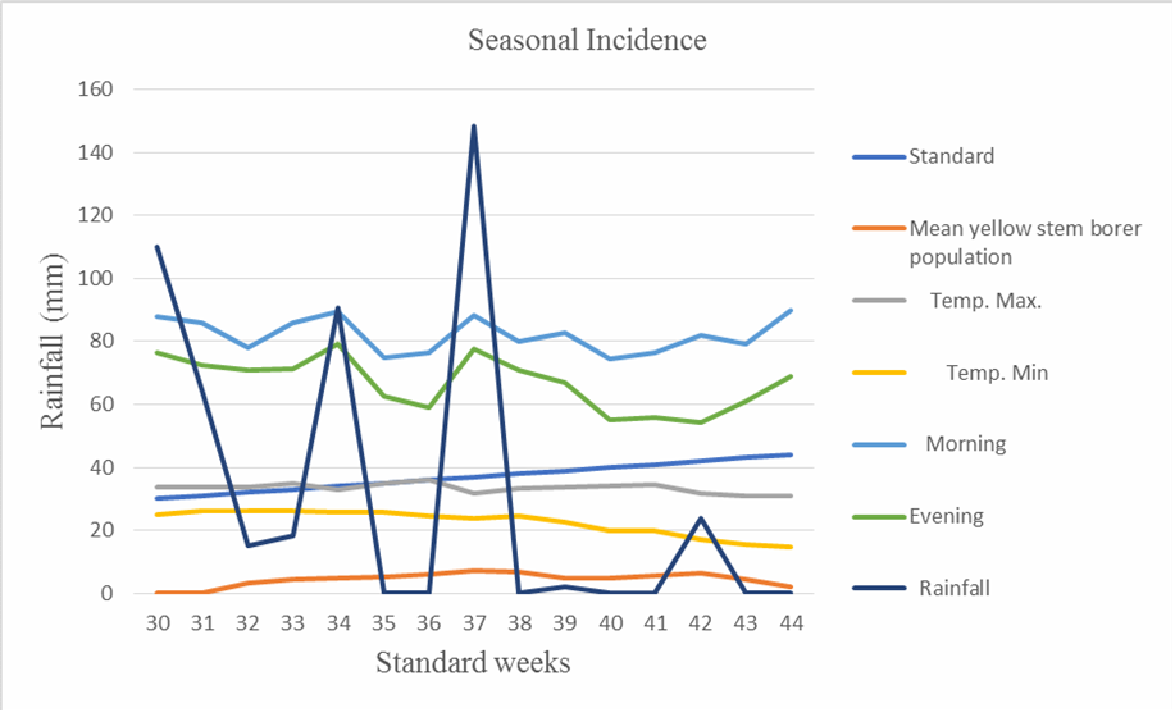

Fig. 1 : Effect of weather parameters on yellow stem borer (*Scirpophaga incertulas*) of Basmati rice *Kharif*, 2023

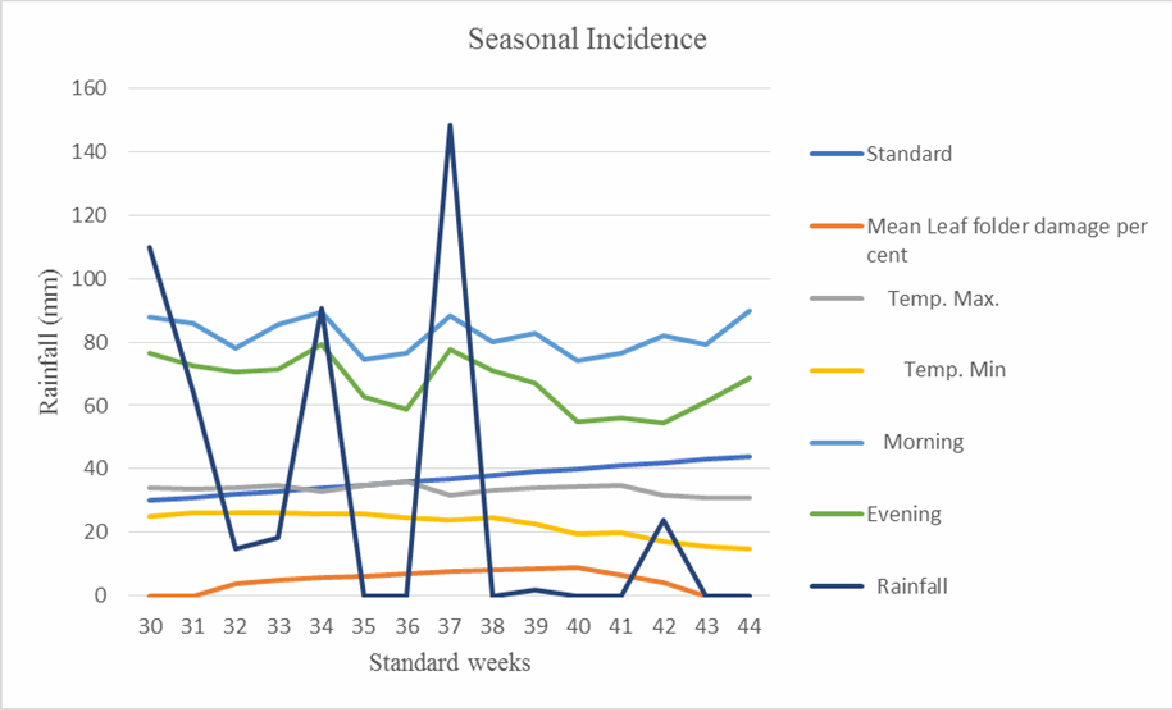

Fig. 2 : Effect of weather parameters on Rice leaf folder (*Cnaphalocrosis medinalis*) of Basmati rice during (*Kharif* 2023)

Conclusion

The study on rice stem borer incidence revealed that the percentage of dead hearts peaked during the 37th standard week, corresponding to the vegetative growth phase of the crop. The highest percentage of white ear heads was observed during the 40th standard week, which aligns with the reproductive growth phase. For the rice leaf folder, the infestation was highest during the 40th standard week when leaf turgidity was elevated. Correlation analysis indicated that the percentage of dead hearts showed a non-significant positive correlation with maximum temperature and minimum temperature. The correlation between rice leaf folder incidence and weather parameters revealed a non-significant positive correlation with maximum and minimum temperature, while rainfall and average humidity showed negative but non-significant correlations.

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