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Seasonal incidence and weather-based population dynamics of yellow stem borer (*Scirpophaga incertulas* Walker) in rice ecosystems of western Uttar Pradesh

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Abstract

The present investigation was conducted during Kharif 2025 at the Crop Research Centre, Sardar Vallabhbhai Patel University of Agriculture and Technology (SVPUAT), Meerut, Uttar Pradesh, to study the seasonal incidence of yellow stem borer (*Scirpophaga incertulas* Walker) in relation to abiotic factors in basmati rice. Weekly observations on dead heart (DH) and white ear head (WEH) incidence were recorded from the 29th to the 44th Standard Meteorological Week (SMW), and the corresponding meteorological data were collected to determine their relationship with pest incidence. Yellow stem borer infestation was first observed during the 30th SMW and persisted up to the 44th SMW. The infestation gradually increased, reaching a peak of 6.80% during the 38th SMW, after which it declined towards crop maturity. Correlation analysis revealed that yellow stem borer incidence had a significant positive association with maximum temperature ($r = 0.521$)*. In contrast, minimum temperature ($r = 0.108$ NS) showed a non-significant positive association, whereas morning relative humidity ($r = -0.281$ NS), evening relative humidity ($r = -0.143$ NS), and rainfall ($r = -0.400$ NS) exhibited non-significant negative associations with pest incidence. These findings indicate that seasonal fluctuations in yellow stem borer incidence were influenced by prevailing weather conditions, particularly maximum temperature. The information generated from the present study may be useful for weather-based pest forecasting and the timely implementation of integrated pest management (IPM) strategies for sustainable basmati rice production under the Western Plain Zone of Uttar Pradesh.

Keywords: *Scirpophaga incertulas*, Seasonal incidence, Dead heart, White ear head

Introduction

Rice (*Oryza sativa* L.) is the principal cereal crop in Asia and serves as a staple food for more than half of the world's population, contributing significantly to food security and rural livelihoods (Bhandari *et al.*, 2023; Tagliapietra *et al.*, 2024)^[2, 16]. However, rice productivity is severely affected by several insect pests, among which stem borers are considered one of the most destructive groups causing substantial yield losses (Savary *et al.*, 2000; Chintalapati *et al.*, 2023)^[3, 11]. Among the stem borer species, the yellow stem borer, *Scirpophaga incertulas* (Walker) (Lepidoptera: Crambidae), is the most economically important pest in irrigated and rainfed lowland rice ecosystems across South and Southeast Asia (Dale, 1994; Newton and Dixon, 1990)^[4, 7]. The larval stage feeds internally within the rice stem, making it difficult to control because the larvae remain protected from natural enemies and contact insecticides. Infestation during the vegetative stage results in the formation of dead hearts, whereas attack during the reproductive stage produces white ear heads, both of which considerably reduce grain yield and productive tillers (Dale, 1994; Savary *et al.*, 2000)^[4, 11]. The importance of yellow stem borer has increased with the adoption of high-yielding rice cultivars, intensive fertilizer application and continuous rice cultivation (Heong *et al.*, 2015)^[6]. In addition, favourable climatic conditions, particularly higher temperatures and humidity, enhance pest survival, development and population build-up, leading to increased infestation. Although chemical insecticides have been widely used for its management, their indiscriminate application has resulted in insecticide resistance, pest resurgence and ecological imbalance (Heong *et al.*, 2015)^[6].

Consequently, integrated pest management (IPM) approaches combining cultural practices, host-plant resistance, biological control, pheromone-based monitoring and judicious use of selective insecticides have gained considerable importance. A thorough understanding of the seasonal occurrence and ecological relationship of *S. incertulas* with weather parameters is essential for developing effective forecasting systems and sustainable management strategies. Therefore, the present study was undertaken to investigate the seasonal incidence of yellow stem borer in relation to abiotic factors under the agro-climatic conditions of the Western Plain Zone of Uttar Pradesh.

Materials and Methods

Experimental Site

The experiment was conducted during the *Kharif* 2025 season at the Crop Research Centre (CRC), Sardar Vallabhbhai Patel University of Agriculture and Technology (SVPUAT), Modipuram, Meerut, Uttar Pradesh, India. The experimental farm is located at 29°01' N latitude and 77°45' E longitude, with an altitude of 237 m above mean sea level, representing the Western Plain Zone of Uttar Pradesh. The experiment was conducted in an untreated field under natural infestation conditions.

Crop Establishment

The experiment was conducted using the basmati rice variety Pusa Basmati-1509. Twenty-five-day-old seedlings were transplanted during the third week of July 2025 (transplanting date: 25 July 2025) at a spacing of 20 × 15 cm. The crop was raised following the recommended agronomic practices of SVPUAT, Meerut. A fertilizer dose of 120:60:40 kg N:P₂O₅: K₂O ha⁻¹ was applied according to the university recommendations. No insecticidal treatments were applied throughout the crop season to permit natural infestation of yellow stem borer.

Sampling Method and Recording of Yellow Stem Borer Incidence

Seasonal incidence of the yellow stem borer, *Scirpophaga incertulas* (Walker), was recorded at weekly intervals from the 29th to the 44th Standard Meteorological Week (SMW). Five hills were selected randomly from the untreated observation area during each observation. During the vegetative stage, infestation was assessed by recording dead hearts (DH), whereas during the reproductive stage, infestation was recorded as white ear heads (WEH). Previously recorded damaged tillers were removed after each observation to avoid repeated counting of the same infestation.

The percentage infestation was calculated using the following formulae:

$$\text{Dead hearts (\%)} = \frac{\text{Number of dead hearts}}{\text{Total number of tillers observed}} \times 100$$

$$\text{White ear heads (\%)} = \frac{\text{Number of white ear heads}}{\text{Total number of productive tillers observed}} \times 100$$

Meteorological Observations

Weekly meteorological data, including maximum temperature (°C), minimum temperature (°C), mean

temperature (°C), morning relative humidity (%), evening relative humidity (%), mean relative humidity (%) and rainfall (mm), were obtained from the Agro-meteorological Observatory, Department of Soil Science, SVPUAT, Modipuram, Meerut. Weather data corresponding to each Standard Meteorological Week were used to study their relationship with yellow stem borer incidence.

Statistical Analysis

The relationship between yellow stem borer incidence and weather parameters was analysed using Pearson's correlation coefficient (r). Weekly pest incidence data were correlated with the corresponding meteorological variables to determine the influence of abiotic factors on seasonal population dynamics. Statistical analyses were performed using OPSTAT statistical software (Version 16.0, CCS Haryana Agricultural University, Hisar, India) and the significance of correlation coefficients was tested at the 5% probability level ($P \leq 0.05$).

Result

The seasonal incidence of yellow stem borer (*Scirpophaga incertulas* Walker) was monitored from the 29th to the 44th Standard Meteorological Week (SMW) during *Kharif* 2025 and the observations are presented in Table 1 and Fig. 1. The pest infestation first appeared during the 30th SMW (21-27 July) with 1.35% dead heart (DH). Thereafter, infestation gradually increased, reaching 2.20% during the 31st SMW, 2.85% during the 33rd SMW and 3.90% during the 34th SMW. A temporary decline (1.45%) was observed during the 35th SMW, followed by a steady increase from the 36th SMW onwards. The highest infestation (6.80% DH/WEH) was recorded during the 38th SMW (15-21 September), when the prevailing weather conditions included a maximum temperature of 35.1°C, minimum temperature of 25.0°C, morning relative humidity of 83.7%, evening relative humidity of 73.1% and 8.0 mm rainfall. Thereafter, infestation gradually declined to 6.30% during the 39th SMW, 5.62% during the 40th SMW, 3.76% during the 41st SMW, 2.15% during the 42nd SMW, 1.73% during the 43rd SMW and finally 1.05% during the 44th SMW. No infestation was recorded during the 29th SMW.

Correlation analysis indicated that yellow stem borer infestation was significantly and positively associated with maximum temperature ($r = 0.521$). However, minimum temperature ($r = 0.108$ NS) exhibited a non-significant positive correlation, while morning relative humidity ($r = -0.281$ NS), evening relative humidity ($r = -0.143$ NS), and rainfall ($r = -0.400$ NS) showed non-significant negative correlations with pest infestation.

The present findings are in agreement with Pal *et al.* (2023) [8], Hatwar *et al.* (2021) [5], Sharma *et al.* (2018) [12] and Samrit *et al.* (2019) [10], who also reported similar seasonal occurrence and weather-dependent population dynamics of yellow stem borer under different rice-growing regions.

Discussion

The present study revealed that the incidence of yellow stem borer (*Scirpophaga incertulas* Walker) commenced during the vegetative stage of the rice crop, gradually increased with crop growth, reached its peak during the middle of the season and declined towards crop maturity. Similar seasonal trends have been reported by Samrit *et al.* (2019) [10], Sharma *et al.* (2018) [12] and Sulagitti *et al.* (2018) [15] who

observed maximum yellow stem borer infestation during September-October.

Correlation analysis indicated that yellow stem borer incidence was positively associated with maximum temperature, whereas minimum temperature, morning relative humidity and rainfall exhibited negative associations. Evening relative humidity showed a positive relationship with pest incidence. These findings are in agreement with Hatwar *et al.* (2021) ^[5], Singh *et al.* (2020) ^[14] and Pallavi *et al.* (2018) ^[9], who also reported that higher temperatures favoured yellow stem borer activity, while rainfall and lower temperatures generally suppressed pest incidence. Similar observations were reported by Balaji and Vijaykumar (2025) ^[1] under different transplanting conditions.

Conclusion

The present study demonstrated that the incidence of yellow stem borer (*Scirpophaga incertulas* Walker) in basmati rice

commenced during the early vegetative stage, gradually increased with crop growth, reached its peak during the middle of the crop season and declined towards maturity. The seasonal incidence of the pest was influenced by prevailing weather conditions. Correlation analysis indicated that maximum temperature favoured yellow stem borer incidence, whereas minimum temperature, morning relative humidity and rainfall exhibited negative associations, while evening relative humidity showed a positive association. The findings suggest that abiotic factors play an important role in determining the seasonal abundance of yellow stem borer. Therefore, regular pest surveillance together with weather-based forecasting can facilitate timely implementation of integrated pest management (IPM) practices, thereby minimize yield losses and improve sustainable rice production under the Western Plain Zone of Uttar Pradesh.

Table 1: Seasonal incidence of yellow stem borer (*Scirpophaga incertulas*) in relation to abiotic factors

SMW	Date	DH/WEH (%)	Temperature (°C)			Relative Humidity (%)			Rainfall (mm)
			Maximum	Minimum	Mean	RH (%) Morning	RH (%) Evening	Mean	
29th	14 - 20 July	0.00	33.6	27.0	30.3	82.1	73.1	77.6	94.0
30th	21 - 27 July	1.35	33.4	26.7	30.05	86.1	73.0	79.6	32.4
31th	28 July - 03 Aug	2.20	32.9	25.9	29.4	92.4	80.3	86.4	52.8
32th	04 - 10 Aug	1.95	33.4	26.8	30.1	91.1	74.4	82.8	37.0
33th	11 - 17 Aug	2.85	33.7	25.8	29.75	92.7	76.9	84.8	21.0
34th	18 - 24 Aug	3.90	33.7	25.9	29.8	81.3	69.9	75.6	7.0
35th	25 - Aug	1.45	29.9	24.8	27.35	96.0	82.4	89.2	201.8
36th	01-Sep	3.70	34.1	25.0	29.55	90.9	80.4	85.7	41.2
37th	08-Sep	5.20	34.2	25.5	29.85	87.4	76.4	81.9	8.4
38th	15-Sep	6.80	35.1	25.0	30.05	83.7	73.1	78.4	8.0
39th	22-Sep	6.30	35.7	25.0	30.35	78.1	58.1	68.1	0.0
40th	29-Sep	5.62	31.5	22.4	26.95	88.6	73.6	81.1	35.0
41th	06-Oct	3.76	31.5	19.2	25.35	84.1	62.6	73.4	0.0
42th	13-Oct	2.15	32.7	19.2	30.35	85.4	65.0	75.2	0.0
43th	20-Oct	1.73	31.1	16.9	24	84.4	63.7	74.1	0.0
44th	27-Oct	1.05	29.8	17.9	23.85	85.4	64.7	75.1	0.0

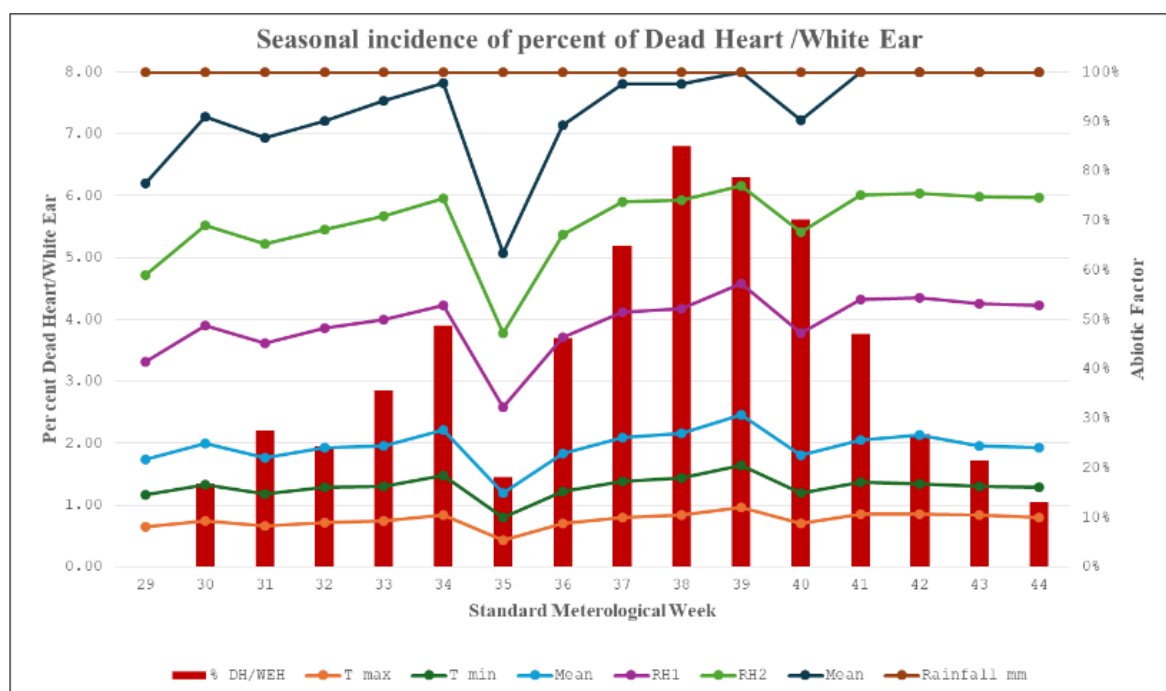


Fig 1: Seasonal incidence of dead heart, white ear, and abiotic factors

Table 2: Association of yellow stem borer with weather variables during cropping season of Kharif, 2025

Weather Variables	Correlation Coefficient
Maximum Temperature (°C)	0.521*
Minimum Temperature (°C)	0.108 ^{NS}
Morning Relative Humidity (%)	-0.281 ^{NS}
Evening Relative Humidity (%)	-0.143 ^{NS}
Rainfall (mm)	-0.400 ^{NS}

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