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Effect of weather parameters on seasonal incidence of yellow stem borer [*Scirpophaga incertulas* (Walker)] on paddy

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Abstract
The present investigation was conducted to study the effect of weather parameters on incidence of yellow stem borer [(*Scirpophaga incertulas* Walker)] in paddy, during the *Kharif* season of 2024–25 at the Central Research Farm, Department of Entomology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. While study of incidence it was revealed that the initial infestation of dead hearts commenced in the 35th standard meteorological week (SMW) with an average 4.33% incidence, peaking at 27.33% in the 40th SMW under conditions of high temperature, humidity, low rainfall, and moderate sunshine. A positive but non-significant correlation was observed between dead hearts infestation and all meteorological parameters except sunshine, which showed a negative nonsignificant correlation. White earhead symptoms first appeared in the 39th SMW with an average 9.42% incidence and peaked at 28.44% in the 43rd SMW. White earhead infestation exhibited a highly negative significant correlation with minimum temperature and rainfall, while maximum humidity and sunshine showed significant positive correlations. Minimum humidity had a negative significant impact, indicating that environmental conditions played a crucial role in influencing the infestation dynamics of yellow stem borer in paddy.

Keywords: Incidence, standard meteorological week, yellow stem borer.

1. Introduction
Rice (*Oryza sativa* L.) is an important staple food crop of Asia and a primary staple diet of over half of the world population. (Anonymous, 2021) [1]. Rice is obtained from paddy grain. And is often called as the "grain of life" Timsina *et al.*, (2023) [20]. India is one of the world's largest producers of white rice, accounting for 20 per cent of the world rice production. Kinjale *et al.*, (2021) [7]. India has the largest area of 46.38 million hectare with production of 130.29 MT which ranks second in production next to China and contributing 43 per cent of total food grain production and 46 per cent of total cereal production and continues to play a vital role in the national food grain supply Anonymous (2022) [2].
Two major factors responsible for poor yield of paddy are adverse weather and pest epidemic. Among the various biological constraints, insect-pest problem is one of the major constraints accountings for 50% damage at vegetative, 30% at reproductive and 20% at ripening stage of rice. Due to insect-pests attack the average yield reduction in rice is 40%. About 21% of the global production of is lost to insect pests. Thorat *et al.*, (2023) [14].
Approximately 300 species of insect pests attack paddy crop and amongst them only 23 species cause notable damage Pasalu and Katti (2006) [15]. Paddy crop is attacked by several insect pests from nursery to harvest. Pests complex have been grouped in various categories based on their nature of damage like sucking pests which include brown plant hopper (*Nilaparvata lugens* Stal.), white backed plant hopper (*Sogatella furcifera* Horvath), green leaf hopper (*Nephotettix nigropictus* Stal.) and gundhi bug (*Leptocorisa varicornis* Thunb.); the defoliater insects like grasshopper, army worm, leaf folder, case worm, two horned caterpillar and rice hispa etc. Kinjale *et al.*, (2021) [7].
Yellow stem borer, *Scirpophaga incertulas* (Walker) is a monophagous pest of paddy which is the most destructive pest and found almost all region of world. Symptoms of this pest is identified by 'dead heart' in hill at vegetative stage and 'white earhead' in panicle at reproductive stage Patel and Singh (2017) [16]. The extent of yield losses in paddy due to yellow stem borer has been estimated about 20-70 per cent Sharma *et al.*, (2018) [13].
Knowledge of the seasonal incidence and population build up trend is essential to ensure timely preparedness to tackle impending pest problems and prevent crop losses. Hence, the

present study was undertaken to study the effect of weather parameters on the seasonal incidence of yellow stem borer [*Scirpophaga incertulas* (Walker)] on paddy in order to minimize yield losses in paddy.

2. Materials and Methods

The experiment was conducted during *Kharif* season 2024 at Central Research Farm, Naini, Prayagraj, Uttar Pradesh, India, in three plots each of 5m×3m, the rice variety PB 1121 was sown in plots, with a spacing of 25 cm × 15 cm with a recommended package of practices excluding plant protection to study the effect of weather parameters on seasonal incidence of yellow stem borer. The soil of the experimental site was well drained and medium high.

Method of Recording Observation

The experimental area was kept free from insecticide spray throughout the crop season in order to record the seasonal incidence of rice yellow stem borer. The observations of yellow stem borer, *Scirpophaga incertulas* infestation was recorded at weekly interval till harvesting. The borer incidence was assessed by counting number of dead hearts in the initial stage of damage and number of white ear heads at later stage from ten randomly selected spots consisting of ten hills each as well as from all the clumps in each plot. The weekly meteorological data was recorded at Meteorology Department, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh during the *Kharif* season 2024, between July to November period was utilized for this purpose Kakde and Patel (2014) [6].

$$\% \text{ Dead hearts} = \frac{\text{Total nomber of dead hearts}}{\text{Total number of tillers}} \times 100$$

[Chatterjee and Mondal (2014)] [3]

$$\% \text{ White earheads} = \frac{\text{Total nomber of white ears}}{\text{Total number of tillers with panicle}} \times 100$$

[Chatterjee and Mondal (2014)] [3]

3. Results and Discussion

3.1. Dead hearts

The present study on *Scirpophaga incertulas* infestation during the *Kharif* season of 2024 revealed that the initial incidence of dead hearts occurred at 35th Standard Meteorological Week (SMW), with an average infestation of 4.33%. This observation aligns with earlier findings by Patel *et al*., (2018) [12] and Reddy *et al*., (2020) [17], who reported the onset of yellow stem borer activity around this period.

A gradual increase in infestation was observed, peaking at 27.33% during the 40th SMW. This peak coincided with specific meteorological conditions-maximum temperature of 35.86 °C, minimum temperature of 26.31 °C, relative humidity maximum and minimum of 88.71% and 58%, respectively, 0.2 mm rainfall, and 6.31 hours of sunshine, which are conducive to pest activity and larval development. Similar environmental influence on peak pest buildup was reported by Sharma and Singh (2017) [18], who emphasized the role of high humidity and warm temperatures in enhancing yellow stem borer populations.

Correlation analysis indicated a positive but non-significant association between temperature (both maximum and minimum) and per cent dead hearts infestation. These results are consistent with Kumar *et al*., (2016) [8], who noted that although temperature facilitates pest development, it alone may not trigger significant outbreaks. Relative humidity also showed a positive but non-significant correlation, supporting the observations of Mahato *et al*., (2019) [10], who suggested that humidity favors infestation. Rainfall, despite being a critical factor for egg hatching and larval survival as noted by Tripathi *et al*., (2021) [21], did not show a significant influence in this study, possibly due to the minimal precipitation (0.2 mm) during the peak period. Sunshine hours exhibited a negative, non-significant correlation with infestation, suggesting that increased solar exposure may reduce microclimatic humidity, thereby suppressing pest activity, as previously reported by Das *et al*., (2015) [4].

Overall, the findings highlight that while certain weather parameters contribute to pest dynamics, none showed statistically significant correlation with infestation levels. This suggests that yellow stem borer incidence is regulated by a multifactorial interplay of environmental, biological, and agronomic variables. Therefore, integration of weather-based forecasting into IPM frameworks, as advocated by Singh *et al*., (2022) [19], may enhance the precision and effectiveness of pest management strategies.

3.2. White earheads

Monitoring of *Scirpophaga incertulas* during the *Kharif* season of 2024 revealed the initial incidence of white earhead symptoms at the 39th Standard Meteorological Week (SMW), with 9.42% average infestation. Infestation levels gradually increased and peaked at 28.44% during the 43rd SMW. The peak period coincided with distinct meteorological conditions like maximum temperature of 36.83 °C, minimum temperature of 21.17 °C, 91% maximum and 53.3% minimum relative humidity, absence of rainfall, and 9.11 hours of sunshine, highlighting the potential influence of these factors on pest development and survival during the reproductive stage of rice.

Correlation analysis indicated a negative but non-significant relationship between maximum temperature and infestation, while minimum temperature showed a highly significant negative correlation. These findings suggest that lower night-time temperatures may suppress larval development or reduce pest activity, in partial agreement with Kumar *et al*., (2016) [9], who noted that extreme deviations, especially in minimum temperature, can reduce stem borer infestation. Maximum relative humidity exhibited a positive and significant correlation with infestation, implying favorable conditions for larval survival and oviposition during panicle development. Similar trends were observed by Mahato *et al*., (2019) [11] and Sharma and Singh (2017) [18], who reported that elevated humidity supports stem borer population buildup. In contrast, minimum relative humidity demonstrated a significant negative correlation, indicating that dry morning or evening conditions may hinder pest persistence.

Rainfall showed a highly significant negative correlation with white earhead infestation. The absence of rainfall during the peak infestation period may have supported moth activity and uninterrupted oviposition. These observations align with Tripathi *et al*., (2021) [22], who reported that continuous or intense rainfall negatively affects pest survival by disrupting life stages and washing away neonate larvae. Sunshine hours were positively and significantly correlated with infestation. Extended sunlight duration may enhance adult moth visibility, activity, and mating, leading to increased oviposition, as reported by Das *et al*., (2015) [5].

Overall, the results highlight a complex interaction between

meteorological parameters and white earhead infestation. While factors such as high relative humidity and prolonged sunshine favor pest buildup, others like low minimum temperature and rainfall exhibit suppressive effects. These insights underscore the need for integrating weather-based forecasting tools into IPM strategies, as recommended by Singh *et al*., (2022) [19], to enable timely interventions and minimize yield losses in rice ecosystems.

Table 1: Incidence of per cent dead hearts infestation by yellow stem borer [*Scirpophaga incertulas* (Walker)] on paddy during *Kharif* season of 2024

Month	SMW	% Dead hearts Infestation	Temperature (°C)		Relative Humidity (%)		Total Rainfall (mm)	Sunshine (hrs)
			Max.	Min.	Max.	Min.		
July	31	0.00	36.70	27.70	67.67	55.50	8.50	5.90
August	32	0.00	33.51	27.37	81.29	61.10	9.17	5.51
	33	0.00	33.29	27.26	81.71	59.00	8.74	4.17
	34	0.00	33.80	27.11	91.29	65.90	13.10	0.83
	35	2.03	32.89	26.74	86.57	61.40	7.34	4.16
September	36	3.79	34.91	27.49	81.00	57.10	2.77	7.80
	37	5.70	35.83	27.14	79.29	62.40	0.00	8.31
	38	7.87	33.86	26.71	85.71	68.60	13.40	4.57
	39	22.54	34.83	27.17	88.71	70.00	9.87	4.00
October	40	27.33	35.86	26.31	88.71	58.00	0.20	6.31
	41	0.00	36.20	25.00	92.29	58.1	0.00	8.77
	42	0.00	36.46	22.69	92.86	48.4	0.00	9.08
	43	0.00	36.83	21.17	91.00	53.3	0.00	9.11
	44	0.00	31.89	20.51	91.14	67.00	0.00	5.06
November	45	0.00	31.31	19.86	91.29	52.60	0.00	8.51
	46	0.00	31.17	19.09	91.43	51.09	0.00	8.40
	Result	1.00	0.24^{NS}	0.32^{NS}	0.06^{NS}	0.36^{NS}	0.06^{NS}	-0.17^{NS}
	Mean	4.33	34.33	24.96	86.37	59.34	4.57	6.28
	Standard deviation	8.44	1.91	3.13	6.75	6.38	5.22	2.40
	Standard error	4.06	0.33	0.63	0.73	0.83	2.44	0.96

SMW: Standard Meteorological Week, **NS:** Non-significant correlation, **Max.:** Maximum, **Min.:** Minimum

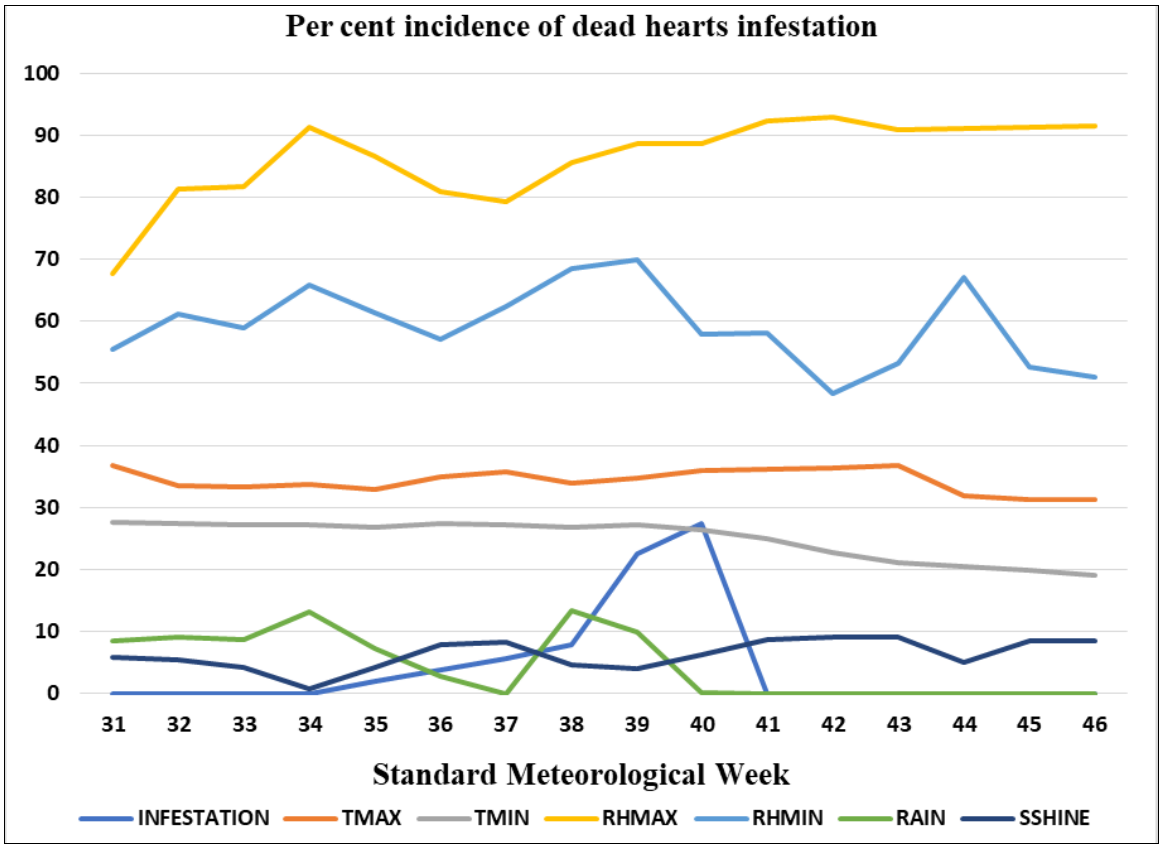

Fig 1: Per cent incidence of dead hearts infestation by yellow stem borer [*Scirpophaga incertulas* (Walker)] on paddy during *Kharif* season of 2024

Table 2: Incidence of per cent white earheads infestation by yellow stem borer [*Scirpophaga incertulas* (Walker)] on paddy during *Kharif* season of 2024

Month	SMW	% White earheads Infestation	Temperature (°C)		Relative Humidity (%)		Total Rainfall (mm)	Sunshine (hrs)
			Max.	Min.	Max.	Min.		
July	31	0	36.7	27.7	67.67	55.5	8.5	5.9
August	32	0	33.51	27.37	81.29	61.1	9.17	5.51
	33	0	33.29	27.26	81.71	59	8.74	4.17
	34	0	33.8	27.11	91.29	65.9	13.1	0.83
	35	0	32.89	26.74	86.57	61.4	7.34	4.16
September	36	0	34.91	27.49	81	57.1	2.77	7.8
	37	0	35.83	27.14	79.29	62.4	0	8.31
	38	0	33.86	26.71	85.71	68.6	13.4	4.57
	39	3.63	34.83	27.17	88.71	70	9.87	4
October	40	5.96	35.86	26.31	88.71	58	0.2	6.31
	41	7.79	36.2	25	92.29	58.1	0	8.77
	42	27.40	36.46	22.69	92.86	48.4	0	9.08
	43	28.44	36.83	21.17	91	53.3	0	9.11
	44	27.31	31.89	20.51	91.14	67	0	5.06
November	45	25.53	31.31	19.86	91.29	52.6	0	8.51
	46	24.65	31.17	19.09	91.43	51.09	0	8.4
	Result	1.000	-0.192^{NS}	-0.954^{**}	0.611^{*}	-0.526^{*}	-0.678^{**}	0.552^{*}
	Mean	9.42	34.33	24.96	86.37	59.34	4.57	6.28
	Standard deviation	12.26	1.91	3.13	6.75	6.38	5.22	2.41
	Standard error	4.00	0.33	0.63	0.73	0.83	2.44	0.96

Max.: Maximum, **Min.:** Minimum, **NS:** Non-significant correlation, **SMW:** Standard Meteorological Week, **-highly significant correlation, *- significant correlation

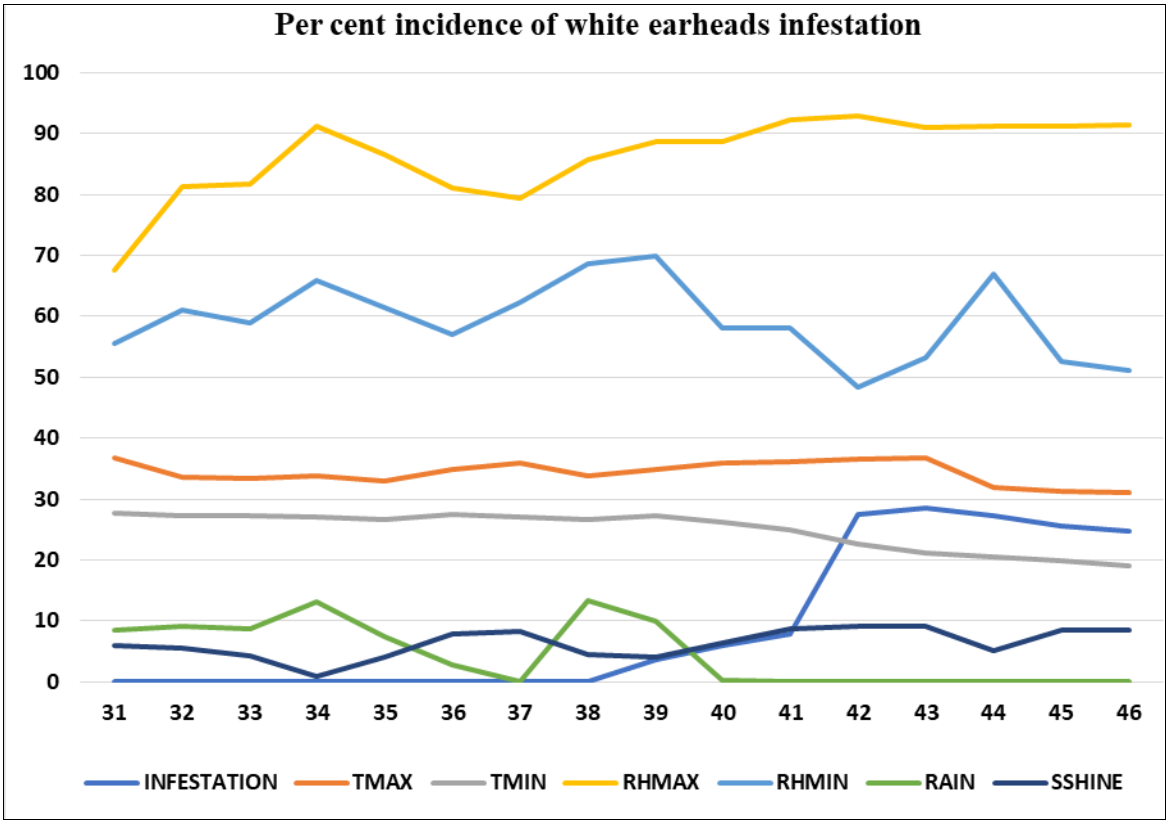

Fig 2: Per cent incidence of white earheads infestation by yellow stem borer [*Scirpophaga incertulas* (Walker)] on paddy during *Kharif* season of 2024

Conclusion

The present study underscores the complex interplay between meteorological parameters and the incidence of yellow stem borer [(*Scirpophaga incertulas* Walker)] in rice during the *Kharif* season of 2024. While infestation trends showed temporal alignment with specific weather conditions such as high relative humidity, moderate temperatures, and sunshine duration; none of the parameters exhibited consistent or strong statistical correlations across both vegetative (dead hearts) and reproductive (white earheads) stages. These findings suggest that pest incidence is regulated by a multifactorial system involving environmental, biological, and agronomic factors. Therefore, incorporating weather-based forecasting into integrated pest management (IPM) strategies is essential for improving the timing and effectiveness of control measures, thereby reducing crop losses and enhancing rice productivity.

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