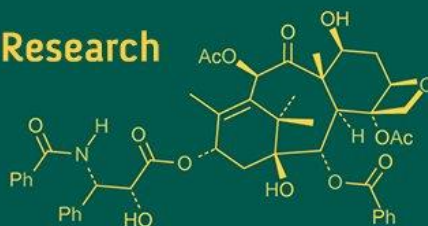


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Seasonal incidence of major insect pests of rice in Bastar region

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Abstract

A field investigation was carried out at the Research-cum-Instructional Farm of Shaheed Gundadthur College of Agriculture and Research Station (SGCARS), Jagdalpur, Bastar, Chhattisgarh, during Kharif 2024, to study the seasonal incidence of major insect pests of rice (cv. Swarna) and their relationship with prevailing weather parameters. Observations recorded from the 32nd to 47th Standard Meteorological Week (SMW) revealed the occurrence of yellow stem borer (*Scirpophaga incertulas*), gall midge (*Orseolia oryzae*), leaf folder (*Cnaphalocrocis medinalis*) and whorl maggot (*Hydrellia sasakii*) as the major insect pests. Dead heart incidence of yellow stem borer peaked at 6.93% during the 40th SMW, while white ear head incidence peaked at 11.27% during the 44th SMW. Silver shoot incidence due to gall midge peaked at 38.53% during the 41st SMW, leaf folder damage peaked at 10.54% during the 37th SMW, and whorl maggot damage peaked at 15.32% during the 35th SMW. Correlation analysis revealed that minimum temperature significantly influenced the incidence of dead heart ($r = 0.683$), white ear head ($r = -0.744$), silver shoot ($r = 0.661$) and whorl maggot ($r = 0.787$), while evening relative humidity and rainfall also showed significant associations with whorl maggot incidence. Leaf folder damage showed no significant correlation with any individual weather parameter, suggesting the influence of other factors such as crop stage and natural enemy activity. The findings provide a useful basis for forecasting pest outbreaks and planning need-based insecticidal interventions in the Bastar Plateau zone.

Keywords: Rice, seasonal incidence, yellow stem borer, gall midge, leaf folder, whorl maggot, correlation, weather parameters

Introduction

Rice (*Oryza sativa* L.) is the staple food of more than 65 per cent of the world's population and contributes about 15 per cent of global calorie intake (Mathur *et al.*, 1999) [13]. India accounts for nearly 24 per cent of world rice production, and Chhattisgarh, popularly known as the "Rice Bowl of India", is the sixth largest rice-producing state in the country. The rice crop is attacked by more than 100 species of insects, of which about 20 are of economic importance (Pathak and Khan, 1994) [17]. Among these, the yellow stem borer, *Scirpophaga incertulas* (Walker), is the most dominant and destructive pest, causing dead heart and white ear head symptoms and yield losses ranging from 25 to 70 per cent (Satpathi *et al.*, 2012) [23]. The rice leaf folder, *Cnaphalocrocis medinalis* (Guenée), once considered a minor pest, has assumed major pest status over the last two decades (Nanda *et al.*, 2000) [14], while gall midge, *Orseolia oryzae* (Wood-Mason), and whorl maggot, *Hydrellia sasakii*, inflict significant additional losses, particularly during the vegetative and tillering stages of the crop.

The extent of damage caused by these pests is closely governed by the prevailing weather conditions, which influence pest emergence, multiplication, and population build-up at different crop growth stages (Krishnaiah and Varma, 2011) [11]. Knowledge of the seasonal incidence pattern of major insect pests and their relationship with abiotic factors is, therefore, fundamental to developing reliable pest forecasting models and to planning timely, need-based insecticide application, thereby minimizing indiscriminate chemical use and associated problems such as resistance development and destruction of natural enemies (Dhurwey and Deole, 2021) [6]. Considering the economic importance of rice in the Bastar Plateau region of Chhattisgarh and the paucity of location-specific information on pest dynamics under this agro-climatic zone, the present investigation was undertaken to study the seasonal incidence of major insect pests of rice and their correlation with prevailing weather parameters.

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Materials and Methods

The investigation was carried out at the Research-cum-Instructional Farm of Shaheed Gundadhoor College of Agriculture and Research Station (SGCARS), Jagdalpur, Bastar, Chhattisgarh (494001), during Kharif 2024. Bastar district lies in the sub-humid climatic zone of Chhattisgarh, situated between 17°45' and 20°34' N latitude and 80°15' and 82°15' E longitude, at an altitude of 550 to 850 m above mean sea level, within the Bastar Plateau agro-climatic zone, the southernmost zone of the state, characterized by heavy rainfall, comparatively lower temperature and higher relative humidity (average annual rainfall 1200-1400 mm). Weekly meteorological data recorded during the crop growth period (32nd to 47thSMW) at the Meteorological

Observatory of SGCARS, Jagdalpur, are presented in Table 1. The crop received a total rainfall of 603.1 mm, with a weekly average of 37.69 mm. Rainfall was mainly distributed between late August and September, peaking at 157.3 mm during the 36thSMW (3-9 September) and 75.2 mm during the 37thSMW, and declined progressively from the 40thSMW onward, ceasing completely during late October and November. The maximum and minimum temperatures during the period ranged from 28.1 °C to 32.9 °C and 10.8 °C to 22.6 °C, with seasonal means of 30.75 °C and 20.20 °C, respectively. Morning relative humidity (RH-I) ranged from 85.9 to 93.4%, and evening relative humidity (RH-II) ranged from 37.3 to 85.9%, with seasonal means of 90.98% and 61.78%, respectively.

Table 1: Weekly meteorological data recorded during the crop growth period of Kharif, 2024

SMW	Period	Max. Temp. (°C)	Min. Temp. (°C)	RH-I (%)	RH-II (%)	Rainfall (mm)
32	6 Aug - 12 Aug	29.2	22.2	90.9	78.6	135.8
33	13 Aug - 19 Aug	31.5	22.6	93.4	72.3	84.1
34	20 Aug - 26 Aug	29.6	22.2	92.0	73.6	42.0
35	27 Aug - 2 Sep	30.1	22.2	91.6	70.4	43.1
36	3 Sep - 9 Sep	30.0	22.2	93.4	85.9	157.3
37	10 Sep - 16 Sep	29.8	22.4	91.9	70.4	75.2
38	17 Sep - 23 Sep	31.5	22.2	91.7	68.1	13.4
39	24 Sep - 30 Sep	30.9	22.6	90.9	74.6	20.0
40	1 Oct - 7 Oct	32.9	22.1	89.9	59.0	0.0
41	8 Oct - 14 Oct	32.5	21.3	90.6	57.4	1.3
42	15 Oct - 21 Oct	32.3	21.0	88.6	52.6	21.7
43	22 Oct - 28 Oct	30.7	19.5	93.4	54.0	0.0
44	29 Oct - 4 Nov	31.6	19.4	90.7	43.4	9.2
45	5 Nov - 11 Nov	30.8	15.9	85.9	41.0	0.0
46	12 Nov - 18 Nov	30.5	14.6	91.3	37.3	0.0
47	19 Nov - 25 Nov	28.1	10.8	89.4	50.0	0.0
	Seasonal mean	30.75	20.20	90.98	61.78	37.69*
	Total	-	-	-	-	603.1

Mean weekly rainfall for weeks with rainfall during the observation period. SMW = Standard Meteorological Week; RH-I = morning relative humidity; RH-II = evening relative humidity.

The study was conducted on rice variety Swarna, transplanted on 24 July 2024 at a spacing of 20 × 15 cm in a plot of 700 m². Observations on major insect pests were recorded at weekly intervals (Standard Meteorological Week) from 10 randomly selected hills, starting from the third week after transplanting until crop harvest. Yellow stem borer incidence was recorded as per cent dead heart during the tillering stage and per cent white ear head during the panicle initiation stage, computed as the number of dead hearts/white ear heads divided by the total number of tillers, multiplied by 100. Gall midge incidence was expressed as per cent silver shoot, calculated as the number of silver shoots divided by the total number of tillers, multiplied by 100. Leaf folder and whorl maggot incidence were recorded as per cent leaf damage, based on the number of damaged leaves relative to the total number of leaves, multiplied by 100.

For yellow stem borer:

$$\text{Percent dead heart} = \frac{\text{Number of dead heart or white ear}}{\text{Total number of tillers}} \times 100$$

For gall midge per cent:

$$\text{Percent silver shoot} = \frac{\text{Number of silver shoots}}{\text{Total number of tillers}} \times 100$$

For leaf folder per cent:

$$\text{Percent damage leave} = \frac{\text{Number of damaged leaves}}{\text{Total number of leaves}} \times 100$$

For whorl maggot per cent

$$\text{Percent damage leave} = \frac{\text{Number of damaged leaves}}{\text{Total number of leaves}} \times 100$$

The data on seasonal incidence of insect pests were correlated with the corresponding weather parameters (maximum and minimum temperature, morning and evening relative humidity, and rainfall) using the simple correlation coefficient (r), computed following the procedure of Draper and Smith (1998) [7].

$$r = \frac{\text{Cov}(X, Y)}{\sigma_X \sigma_Y} = \frac{\sum_{i=1}^n (X - \bar{X}) \cdot (Y - \bar{Y})}{\sqrt{\sum_{i=1}^n (X - \bar{X})^2} \cdot \sqrt{\sum_{i=1}^n (Y - \bar{Y})^2}}$$

Where,

- X = Mean of first factor
- Y = Mean of second factors
- n = Total number of observations
- r = Correlation coefficient

Results and discussion

Table 2: Major insect pests of rice recorded during Kharif 2024

S.No.	Common name	Scientific name	Family	Order	Time of occurrence
1	Yellow stem borer	<i>Scirpophaga incertulas</i> (Walker)	Pyralidae	Lepidoptera	Nursery - panicle stage
2	Gall midge	<i>Orseolia oryzae</i> (Wood-Mason)	Cecidomyiidae	Diptera	Tillering stage
3	Leaf folder	<i>Cnaphalocrocis medinalis</i> (Guenee)	Pyralidae	Lepidoptera	Nursery - panicle stage
4	Whorl maggot	<i>Hydrellia sasakii</i>	Ephydriidae	Diptera	Nursery -Tillering stage

Yellow stem borer, *Scirpophaga incertulas* (Walker)

Yellow stem borer activity commenced during the 32ndSMW (6-12 August) with 1.45% dead heart incidence, increased gradually to 4.20% by the 36thSMW, and peaked at 6.93% during the 40thSMW (1-7 October), coinciding with the mid-tillering stage. Thereafter, dead heart incidence declined to 5.71% (41stSMW) and 1.71% (42ndSMW), disappearing completely by the 45thSMW. White ear head damage appeared later, beginning at 4.30% in the 43rdSMW, peaking at 11.27% during the 44thSMW (coinciding with panicle emergence), and declining to 6.35% by the 47thSMW.

These trends are consistent with the findings of Bhowmick *et al.* (2019) ^[4], who reported that stem borer incidence is strongly influenced by minimum night temperature, and Singh and Reddy (2020) ^[28], who recorded peak dead heart incidence during mid-tillering under warm, moderately humid conditions. Patel *et al.* (2021) ^[16] similarly observed that white ear head formation is highly stage-specific, occurring mainly during panicle initiation and heading.

Gall midge, *Orseolia oryzae* (Wood-Mason)

Gall midge Silver shoot incidence was recorded at a moderate 18.20% during the 32ndSMW, fluctuated during the 33rd and 34thSMW (16.40% and 15.85%), and rose sharply from the 38thSMW onward to peak at 38.53% during the 41stSMW (8-14 October), coinciding with favourable temperature (32.5 °C) and high relative humidity. Infestation thereafter declined sharply to 14.30% (42ndSMW) and 8.70% (43rdSMW), disappearing completely from the 44thSMW onward. The seasonal mean silver shoot incidence was 14.51%.

The predominance of gall midge during the late tillering to early reproductive stage is in agreement with Bentur *et al.* (2012) ^[2] and Hussain and Prakash (2019) ^[8], who reported peak gall midge damage during the reproductive stage owing to availability of tender tillers. The decline toward season's end corroborates Ramesh *et al.* (2020) ^[19] and Sathish *et al.* (2021) ^[24], who attributed reduced late-season activity to declining humidity and increasingly tough plant tissue.

Studies on the seasonal incidence of major insect pests of rice were conducted at SGCARS, Jagdalpur, Bastar, during Kharif 2024 on the variety Swarna, from August till crop maturity, along with the prevailing weather conditions (Table 3). Yellow stem borer, *Scirpophaga incertulas* (Walker); gall midge, *Orseolia oryzae* (Wood-Mason); leaf folder, *Cnaphalocrocis medinalis* (Guenee); and whorl maggot, *Hydrellia sasakii*, were recorded as the major insect pests during the crop growth period (Table 2).

Leaf folder, *Cnaphalocrocis medinalis* (Guenee)

Leaf folder infestation was recorded throughout the crop growth period, commencing at 1.03% during the 32ndSMW and rising progressively to a peak of 10.54% during the 37thSMW, a period marked by high relative humidity (above 90% RH-I) and substantial rainfall. Damage subsequently declined to 4.35% by the 41stSMW, showed a minor resurgence (6.93-8.05%) during the 42nd-43rdSMW, and gradually declined toward crop maturity to 4.42% by the 47thSMW. The seasonal mean leaf damage was 5.80%.

Padmanabhan and Mohan (2016) ^[15], who reported that canopy closure and moisture retention under humid conditions favour larval survival. Chakraborty *et al.* (2017) ^[5] and Sontakke *et al.* (2018) ^[30] similarly noted that high humidity and moderate temperature favour leaf-folding activity, while the decline toward maturity aligns with Rahman *et al.* (2021) ^[18], who attributed reduced larval folding ability to leaf hardening with advancing crop age. Sahu and Kujur (2019) ^[21] and Sahu *et al.* (2020) ^[22], working under similar Bastar Plateau conditions in Jagdalpur, also reported that fluctuating humidity and intermittent rainfall favour leaf folder build-up.

Whorl maggot, *Hydrellia sasakii*

Whorl maggot infestation was comparatively higher at the start of the season, recording 9.84% damage during the 32ndSMW and peaking at 15.32% during the 35thSMW, before declining steadily through the vegetative and reproductive stages to negligible levels by the 47thSMW. A mild resurgence noted during the 41stSMW (6.34%) could be attributed to favourable humidity and light drizzling conditions supporting larval establishment.

These observations agree with Roy and Dutta (2015) ^[20], Thakur and Mishra (2017) ^[31], who recorded peak whorl maggot activity 25-45 days after transplanting under cloudy, humid conditions, with a sharp decline thereafter due to leaf hardening. Behera *et al.* (2018) ^[1] and Kale *et al.* (2023) ^[9] similarly reported early crop infestation peaking within the first 30-40 days after transplanting, consistent with the present findings.

Table 3: Seasonal incidence of major insect pests of rice in relation to weather parameters during Kharif 2024

SMW	Period	Dead heart (%)	White ear head (%)	Silver shoot (%)	Leaf folder damage (%)	Whorl maggot damage (%)	Max. Temp. (°C)	Min. Temp. (°C)	RH-I (%)	RH-II (%)	Rainfall (mm)
	6 Aug-12 Aug	1.45	0.00	18.20	1.03	9.84	29.2	22.2	90.9	78.6	135.8
33	13 Aug-19 Aug	2.10	0.00	16.40	2.45	8.92	31.5	22.6	93.4	72.3	84.1
34	20 Aug-26 Aug	2.68	0.00	15.85	3.12	8.10	29.6	22.2	92.0	73.6	42.0
35	27 Aug-2 Sep	3.12	0.00	12.02	6.32	15.32	30.1	22.2	91.6	70.4	43.1
36	3 Sep-9 Sep	4.20	0.00	14.25	8.75	14.10	30.0	22.2	93.4	85.9	157.3
37	10 Sep-16 Sep	4.17	0.00	12.80	10.54	11.45	29.8	22.4	91.9	70.4	75.2
38	17 Sep-23 Sep	5.01	0.00	20.30	7.29	8.42	31.5	22.2	91.7	68.1	13.4
39	24 Sep-30 Sep	6.73	0.00	25.60	6.03	7.05	30.9	22.6	90.9	74.6	20.0
40	1 Oct-7 Oct	6.93	0.00	35.22	5.13	5.68	32.9	22.1	89.9	59.0	0.0
41	8 Oct-14 Oct	5.71	0.00	38.53	4.35	6.34	32.5	21.3	90.6	57.4	1.3
42	15 Oct-21 Oct	2.97	0.00	14.30	6.93	5.10	32.3	21.0	88.6	52.6	21.7
43	22 Oct-28 Oct	1.71	4.30	8.70	8.05	5.20	30.7	19.5	93.4	54.0	0.0
44	29 Oct-4 Nov	0.29	11.27	0.00	7.04	3.25	31.6	19.4	90.7	43.4	9.2
45	5 Nov-11 Nov	0.00	10.02	0.00	6.38	0.00	30.8	15.9	85.9	41.0	0.0
46	12 Nov-18 Nov	0.00	7.56	0.00	5.04	0.00	30.5	14.6	91.3	37.3	0.0
47	19 Nov-25 Nov	0.00	6.35	0.00	4.42	0.00	28.1	10.8	89.4	50.0	0.0
	Seasonal mean	2.94	2.47	14.51	5.80	6.80	30.75	20.20	90.98	61.79	-

Correlation of major insect pests with weather parameters

The seasonal incidence data of the major insect pests were correlated with the prevailing weather parameters, and the correlation coefficients are presented in Table 4.

Table 4: Correlation coefficients between major insect pests of rice and weather parameters

Weather parameter	Dead heart	White ear head	Silver shoot	Leaf folder	Whorl maggot
Maximum temperature (°C)	0.476	-0.113	0.527	0.099	-0.091
Minimum temperature (°C)	0.683*	-0.744*	0.661*	0.064	0.787*
Morning relative humidity (%)	0.209	-0.435	0.165	0.072	0.596**
Evening relative humidity (%)	0.528**	-0.805*	0.475	-0.072	0.869*
Rainfall (mm)	0.054	-0.453	0.071	-0.078	0.704*

* Significant at 1% level; ** Significant at 5% level.

Dead heart incidence exhibited a significant positive correlation with minimum temperature ($r = 0.683$) and evening relative humidity ($r = 0.528$), in agreement with Kalita *et al.* (2009) ^[10] and Singh and Reddy (2020) ^[28], who reported that higher temperature and humidity favour larval survival and tunnelling activity. White ear head incidence, in contrast, showed a significant negative correlation with minimum temperature ($r = -0.744$) and evening relative humidity ($r = -0.805$), consistent with Singh and Reddy (2020) ^[28], suggesting that relatively higher night temperature during the reproductive stage may interfere with adult emergence and oviposition.

Silver shoot incidence showed a significant positive correlation with minimum temperature ($r = 0.661$), corroborating Sharma and Raghuraman (2023) ^[26], who reported that moderate temperature and humidity promote gall midge larval survival and adult emergence. Leaf folder damage, however, showed no significant correlation with any individual weather parameter, indicating that factors such as crop growth stage, varietal susceptibility, and natural enemy activity, as suggested by Shyamrao and Raghuraman (2019) ^[27], may exert a more decisive influence than weather alone.

Whorl maggot incidence was significantly and positively correlated with minimum temperature ($r = 0.787$), evening relative humidity ($r = 0.869$), rainfall ($r = 0.704$), and morning relative humidity ($r = 0.596$), indicating a strong dependence on humid monsoon conditions. These findings are in close agreement with Lakshmi *et al.* (2020) ^[12] and Bhattacharya and Samalo (2018) ^[3], who reported that high

SMW = Standard Meteorological Week; RH-I = morning relative humidity; RH-II = evening relative humidity.

night temperature coupled with humid, intermittent-rainfall conditions favour adult activity and larval survival inside the leaf whorl. Similar associations between rainfall, humidity and whorl maggot population were also reported by Sinha *et al.* (2020) ^[29] and Sharma *et al.* (2019) ^[25].

Conclusion

The present investigation revealed that yellow stem borer, gall midge, leaf folder and whorl maggot were the major insect pests infesting rice under Bastar Plateau conditions during Kharif 2024, with distinct peak periods of incidence: dead heart at the 40th SMW, white ear head at the 44th SMW, silver shoot at the 41st SMW, leaf folder damage at the 37th SMW, and whorl maggot damage at the 35th SMW. Minimum temperature emerged as the most consistent weather parameter influencing pest incidence, showing significant correlation with dead heart, white ear head, silver shoot and whorl maggot populations, while evening relative humidity and rainfall additionally governed whorl maggot build-up. Leaf folder incidence appeared to be governed more by crop and biotic factors than by weather alone. These findings provide a sound basis for forecasting pest emergence and scheduling timely, need-based insecticidal interventions to minimize crop losses in the Bastar Plateau zone of Chhattisgarh.

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