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Incidence of Rice Insect Pests in Agro-Climatic Conditions of Sarojani Nagar, Lucknow, Uttar Pradesh

Amrita Singh[1*]; Princess Tiwari[2]

[*1]Associate Professor, PG Department of Zoology, BSNV PG College, (University of Lucknow), Lucknow, Uttar Pradesh, India-226001
[2]Research Scholar, PG Department of Zoology, BSNV PG College, (University of Lucknow), Lucknow, Uttar Pradesh, India-226001
*Corresponding Author

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Abstract— *Rice (Oryza sativa) is one of the most important staple food crops in the world, feeding more than half of the global population. Uttar Pradesh is one of the major rice-growing regions, contributing significantly to the country's total rice production. Uttar Pradesh creates a congenial environment for the multiplication and survival of various pest species. The present study was conducted from 10 August 2025 to 11 November 2025 over a continuous period during the Kharif season, in Sarojani Nagar, Lucknow, Uttar Pradesh. The selected field was an ideal location for assessing natural pest incidence under real farming conditions. Regular field visits were carried out once every week to maintain uniformity in observation frequency. Each survey included a systematic walkthrough of the rice field to observe pest activity, plant damage symptoms, and changes in pest population. Observations were taken weekly at different crop phenological stages. Yellow Stem Borer, Brown Plant-hopper, Rice Hispa, Grasshopper, and Rice Water Weevil were observed. Overall, data showed that pest incidence peaked during periods of high humidity and moderate- to-high temperature and declined as conditions became drier. This clearly indicates that warm and humid conditions significantly enhanced pest activity, whereas dry and cooler conditions suppressed most pests.*

Keywords— Rice Pests, Staple Food, Kharif Season, Uttar Pradesh, Agricultural Entomology, Pest Management.

I. INTRODUCTION

Rice (*Oryza sativa*) is one of the most important staple food crops in the world, feeding more than half of the global population. It is cultivated in 117 countries and serves as a staple food for 2.7 billion people in Asia alone (Kumar et al., 2006). India occupies the number one position in the world with regard to area under rice (44.6 million ha) and ranks second with regard to production (93.3 million tons, 2006–2007) (Ministry of Agriculture and Farmers Welfare, 2007). Rice holds a central position in the agricultural economy, serving as both a key food grain and a major source of livelihood for millions of farmers (Food and Agriculture Organization, 2004). Among the Indian states, Uttar Pradesh is one of the major rice-growing regions, contributing significantly to the country's total rice production (Directorate of Rice Research, 2015). The crop is cultivated across diverse agro-climatic zones of the state, ranging from the fertile plains of eastern Uttar Pradesh to the irrigated tracts of western regions.

The term "pest" refers to any organism that causes harm or damage to crops, animals, humans, or stored products (Pedigo & Rice, 2014). In agriculture, pests are organisms that interfere with crop production and reduce both the quantity and quality of agricultural produce (Hill, 2008). Rice pests are those organisms that attack rice plants during different stages of growth and adversely affect crop health, grain quality, and productivity (Pathak & Khan, 1994).

The warm and humid climatic conditions prevalent during the rice-growing season in Uttar Pradesh create a congenial environment for the multiplication and survival of various pest species (Pathak & Khan, 1994). Changes in rainfall patterns, seasonal temperature fluctuations, and high relative humidity further affect pest population dynamics, often resulting in sudden outbreaks (Heong & Hardy, 2009). Farmers across the state frequently report significant losses due to pests such as stem borers

(*Scirpophaga incertulas*), leaf folders (*Cnaphalocrocis medinalis*), plant hoppers (*Nilaparvata lugens*), gall midge (*Orseolia oryzae*), rice hispa (*Dicladispa armigera*), and various rice bugs (Bentur et al., 2021), which not only reduce crop vigor but also directly impact grain formation and quality. In severe cases, pest infestation can lead to substantial yield reductions, threatening the livelihood and food security of rural communities (Bottrell & Schoenly, 2012).

The intensity and diversity of rice pests also vary across different districts of Uttar Pradesh depending on cropping patterns, water availability, soil type, and local management practices (International Rice Research Institute, 2013). With increasing dependence on high-yielding varieties and continuous rice cultivation, the pest spectrum has broadened over the years. Indiscriminate use of chemical pesticides has further complicated the situation by causing pest resistance, resurgence, and negative impacts on beneficial organisms.

Given these challenges, field-based assessments of pest incidence and their seasonal abundance are essential for understanding the current pest scenario in the study area. Systematic documentation of pests in major rice-growing areas provides valuable insights into their prevalence, observed life stages, and relationships with climatic factors, including temperature, rainfall, and humidity. This information is crucial for developing Integrated Pest Management (IPM) strategies, promoting sustainable agriculture, and helping farmers reduce economic losses (Dhaliwal et al., 2010).

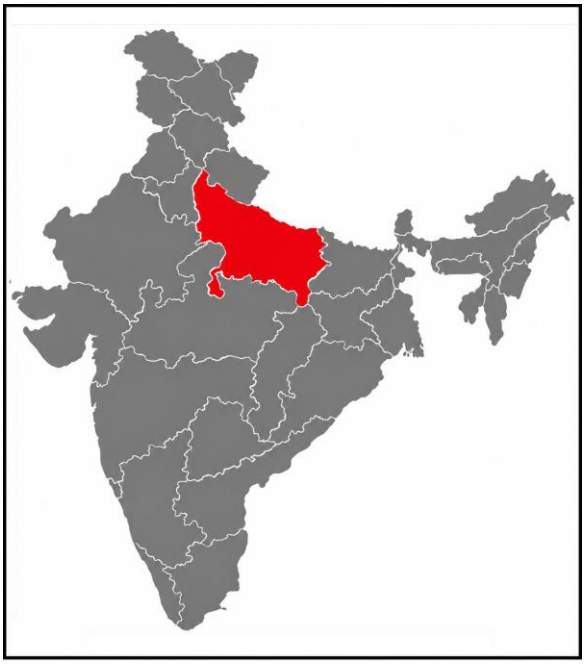
II. MATERIALS AND METHODS

2.1 Study Area

The present study was conducted in Sarojani Nagar, Lucknow, Uttar Pradesh (Fig. 1), one of the major rice-growing regions of the central Gangetic plains. Sarojani Nagar lies between 26.85°N latitude and 80.95°E longitude, with an average elevation of approximately 123 meters above sea level (Mapcarta.com). The district is characterized by fertile alluvial soils, moderate rainfall, and a predominantly subtropical climate, all of which support extensive rice cultivation during the Kharif season.

Climatically, Lucknow experiences hot summers, a humid monsoon season, and mild winters. The rice-growing period generally coincides with the monsoon months, during which the area receives most of its annual rainfall. The average temperature during the cropping season ranges from 28°C to 34°C (India Meteorological Department, 2025), accompanied by high relative humidity conditions favorable for the proliferation of numerous rice pests. These climatic factors directly influence the abundance and activity of insects such as stem borers, leaf folders, plant hoppers, and various defoliators.

For the purpose of this research, field observations were carried out in a rice field (Fig. 2) belonging to a local farmer, who granted permission to conduct regular surveys. The selected field is representative of typical paddy cultivation practices followed by farmers in the region, including the use of common rice varieties, traditional irrigation practices, and standard agronomic inputs. This made the field an ideal location for assessing natural pest incidence under real farming conditions.



Map 1: Showing Uttar Pradesh in India



Map 2: Showing Lucknow in Uttar Pradesh



Map 3: Showing Sarojani Nagar in Lucknow

FIGURE 1: Location Map of Study Area







FIGURE 2: Study Area

2.2 Survey Period and Sampling Schedule

The field survey for the present study was conducted from 10 August 2025 to 11 November 2025 over a continuous period during the Kharif season, coinciding with the active growth stages of the rice crop when major pests typically appear. The survey duration extended from the early vegetative stage to the grain-filling stage, allowing comprehensive monitoring of pest incidence across different crop stages.

2.2.1 Survey Period

Regular field visits were carried out once every week to maintain uniformity in observation frequency. Each survey included a systematic walkthrough of the rice field to observe pest activity, plant damage symptoms, and changes in pest population. During each visit, weekly climatic data, including temperature, relative humidity, and rainfall, were also recorded, as these factors significantly influence pest abundance. This fixed weekly interval ensured that the data captured both gradual population changes and sudden pest appearances, providing a consistent temporal pattern for comparison with weather variables.

2.2.2 Sampling Method

A visual field sampling approach was employed to assess pest incidence (Table 1). During each survey, the field was divided into four observational zones (North, South, East, and West) to ensure thorough and unbiased coverage. From each zone, a set number of rice plants (typically 10–15 plants per zone) were randomly examined, resulting in a representative sample of the entire field (International Rice Research Institute, 2013).

2.3 Sampling Design and Procedure

To ensure uniform coverage, five sampling points were selected (Fig. 3) across the field along an X-shaped transect method (Dyck & Pathak, 1974; Arida & Tiongco, 2010), each at least 5 m away from the field boundary. At each point, 10 rice hills were visually examined (50 hills per visit in total) (IRRI, 2013).

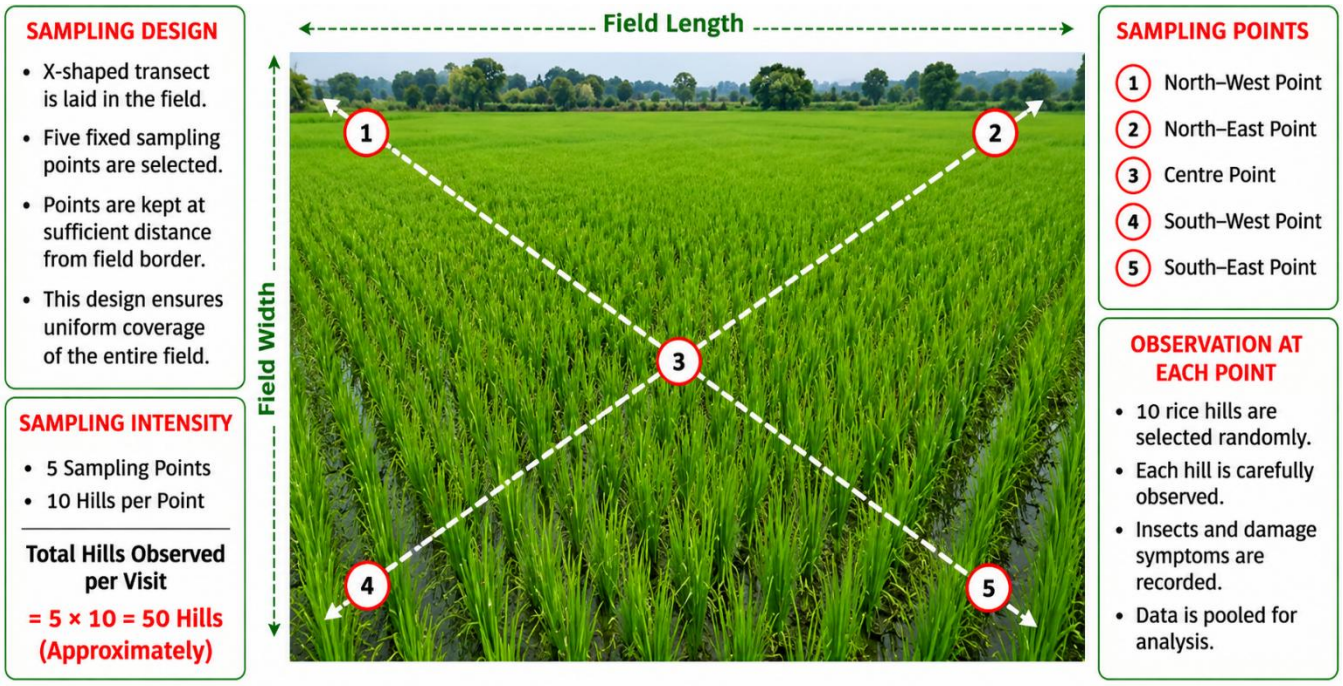


FIGURE 3: X-Shaped Transect Sampling Method

(Image Source: Adapted From Philrice, 2023)

TABLE 1
FIELD SAMPLING DESIGN

Sampling component	Description
Study Area	Sarojani Nagar, Lucknow, Uttar Pradesh
Crop season	Kharif, 2025
Nature of study	Field-based observational study
Sampling type	Random visual sampling
Observation frequency	Weekly
Survey duration	14 weeks
Field coverage method	X-shaped transect sampling
Observational zones	North, South, East and West
Number of sampling points	5
Number of hills observed per point	10 rice hills
Total hills observed per visit	Approximately 50 hills
Pest observation method	Visual inspection
Nature of pest incidence	Natural infestation

2.4 Pest Observation and Documentation

Pest detection was carried out primarily through visual inspection of leaves, stems, sheaths, tillers, and panicles. Photographs were taken of each pest and associated damage using a smartphone camera. Each photograph was labeled with date, sampling point, crop stage, and observation notes. Pest identification was done following Chapman (2012) and Tembhare (2023).

2.5 Environmental Data Recording

To study the influence of weather on pest populations, weekly meteorological parameters were recorded during each visit. These included:

- Average Temperature (°C)
- Rainfall (mm)
- Relative Humidity (%)

Values were obtained from the nearest reference weather station for Lucknow and supplemented with on-field observations (cloud cover, rainfall events, etc.). These data were later tabulated and compared with weekly pest abundance patterns.

III. OBSERVATION AND RESULT

The seasonal incidence of major insect pests of rice was recorded (Table 2; Fig. 5) continuously from 10 August 2025 to 11 November 2025 (Week 1 to Week 14). Observations were taken weekly at different crop phenological stages, and the data were correlated with concurrent weather parameters including temperature, rainfall, and relative humidity (RH).

3.1 Weekly Pest Incidence Pattern

3.1.1 Yellow Stem Borer (YSB) – *Scirpophaga incertulas*

YSB infestation began early in the season. During Week-1, only a single larva was recorded in the early vegetative stage. By Week-2 and Week-3, the population remained low (1 larva/hill), but a gradual increasing trend was visible.

A significant rise was observed during the tillering stage (Week-4 and Week-5), where 2–3 larvae/hill were recorded. The highest peak incidence occurred during Week-6 and Week-7, with 3 larvae/hill, coinciding with late tillering and booting, both stages known to be highly vulnerable to stem borer attacks.

After Week-8 (panicle initiation), YSB incidence started declining. By grain filling (Week-11), only 1 larva/hill remained, and infestation dropped to zero from the milky to maturity stage (Week-12 onwards).

Overall Pattern: YSB showed a bimodal increase, first at early tillering and later at booting, driven by favorable humidity (80–83%) and high rainfall (>250 mm) during these weeks.



***Scirpophaga incertulas* (Larvae)**



Yellow Stem Borer *Scirpophaga incertulas*

3.1.2 Brown Plant Hopper – *Nilaparvata lugens*

BPH was absent in the first two weeks but appeared during Week-3 at low levels (1 hopper/hill). A sharp increase was recorded in Week-4, where 3 hoppers/hill, the highest of the season, were recorded. This spike coincided with 83% RH and moderate rainfall (168 mm).

From Week-5 to Week-9, BPH population fluctuated between 1–2 hoppers/hill, maintaining a moderate but persistent presence through the tillering-to-panicle initiation stages.

Post flowering (Week-10 onwards), hopper incidence progressively decreased and reached zero by the milky stage.

Overall Pattern: BPH exhibited a strong correlation with high humidity (80–88%), and declined sharply once RH dropped below 70%.



Brown Plant Hopper (BPH)

3.1.3 Rice Hispa – *Dicladispa armigera*

Rice hispa showed low-level presence throughout the season. The pest was absent in the initial two weeks and first appeared in Week-4, with 1 adult/hill. A similar trend (1 adult per observation) continued until Week-8. The highest activity (though still low: 1–2 adults) occurred between Week-6 to Week-8, corresponding with cloudy, humid weather and abundant foliage.

Hispa populations reduced after flowering stage (Week-10 onwards) and disappeared by the milky stage.

Overall Pattern: Hispa remained a minor, sporadic pest during the entire season without causing major leaf scraping damage.



Rice Hispa– *Dicladispa armigera*

3.1.4 Grasshopper

Grasshopper infestation was visible from Week-2, recording 1 individual. The population gradually increased and showed moderate numbers (1–2/plant) during Week-4 to Week-8, overlapping with the vegetative and tillering stages.

The population dropped significantly after Week-9, and zero incidence was recorded after flowering, as hardening of leaves and reduction in moisture made the crop less suitable for feeding.

Overall Pattern: Grasshopper was present mainly in the early growth phases, probably migrating from adjacent bunds and weeds.



Grasshopper

3.1.5 Rice Water Weevil (RWW) – *Lissorhoptrus oryzophilus*

RWW showed low activity during the season. Infestation was noted only from Week-4 to Week-7, with 1–2 larvae observed in puddled, waterlogged conditions.

The pest disappeared completely from Week-9 onwards, coinciding with the decreasing water stagnation and reduction in soil moisture.

Overall Pattern: RWW incidence was confined to early flooded conditions and remained the least significant pest in the field.



Rice Water Weevil (RWW) – ***Lissorhoptrus oryzophilus***

3.1.6 Cereal Leaf Beetle – *Oulema melanopus*

Cereal leaf beetle was observed during the early vegetative and tillering stages of the rice crop. The pest first appeared during Week-1 with a population of one individual per plant and remained present up to Week-8. The highest cereal leaf beetle activity was recorded during Week-4 and Week-5 (tillering stage), when approximately three individuals per plant were observed.

From Week-9 onwards, no significant cereal leaf beetle activity was observed.

Overall Pattern: Cereal leaf beetle acted as a minor foliage feeder during the vegetative phase of the rice crop and caused limited leaf damage without resulting in significant economic losses.



Cereal Leaf Beetle– *Oulema melanopus*

3.1.7 Red Pumpkin Beetle – *Aulacophora foveicollis*

Red pumpkin beetle was recorded only during the initial vegetative stage of the rice crop. The pest was first observed during Week-1 and continued up to Week-2 with a very low population density.

After Week-2, the pest was completely absent from the field throughout the remaining crop growth stages.

Overall Pattern: Red pumpkin beetle exhibited negligible infestation and was considered an occasional visitor with no measurable impact on rice productivity.



Red Pumpkin Beetle– *Aulacophora foveicollis*

3.1.8 Gundhi Bug – *Leptocorisa acuta*

Gundhi bug was first observed during Week-4 at the tillering stage with a low population density. The population remained low from Week-4 to Week-8 and gradually increased as the crop entered the reproductive phase. A noticeable increase in infestation was recorded during panicle initiation and flowering stages. The highest population was observed during Week-12 (milky stage). This stage provided suitable feeding conditions as the insects fed on developing grains by sucking their contents. The pest population declined towards harvest (Week-14).



Gundhi Bug– *Leptocorisa acuta*

The weekly pest incidence data (Fig. 4) indicated that Yellow Stem Borer maintained the highest and most persistent infestation throughout the cropping season. Gundhi bug was one of the most abundant pests. Brown Planthopper ranked as the second most abundant pest during the investigation. Grasshopper and cereal leaf beetle showed moderate abundance during the vegetative phase of the rice crop. Rice water weevil and rice hispa showed the least abundance throughout the season and remained minor pests under field conditions. Red pumpkin beetle exhibited the lowest abundance among all the pests observed in the study.

TABLE 2
WEEKLY PEST INCIDENCE REPORT

Weeks	Crop Stage	Yellow Stem Borer	Brown Plant Hopper	Rice Hispa	Grasshopper	Rice Water Weevil	Cereal Leaf Beetle	Red Pumpkin Beetle	Gundhi Bug	Major Damages Observed
Week-1	Early Vegetative	0	0	0	0	0	1	1	0	—
Week-2	Early Vegetative	1	0	0	1	1	2	1	0	Discoloured areas on the leaf sheath with tiny holes
Week-3	Vegetative	1	1	0	1	1	2	0	0	Discoloured patches with leaf curling and holes
Week-4	Tillering	2	3	0	1	1	3	0	1	Central leaf damage, minor chewing
Week-5	Tillering	2	1	1	1	1	3	0	1	Folded leaves, early scrapping
Week-6	Late Tillering	3	1	1	2	2	2	0	1	Leaf folding, hopper burn beginning
Week-7	Booting	3	1	1	1	1	1	0	1	Dead hearts, severe chewing
Week-8	Panicle Initiation	3	2	1	1	1	1	0	1	Stem tunnelling, early whitened signs
Week-9	Panicle Initiation	2	2	1	1	1	0	0	2	Whiteheads forming, increased pest activity
Week-10	Flowering	2	1	1	0	0	0	0	2	Stem borers weaken the plants and create entry points for diseases
Week-11	Grain Filling	1	2	0	0	0	0	0	2	Various fungal growth can be seen
Week-12	Milky Stage	1	0	0	0	0	0	0	4	Fungal spores, mosses can be seen
Week-13	Dough Stage/Mature Stage	0	0	0	0	0	0	0	3	Sooty mould appeared
Week-14	Harvested	0	0	0	0	0	0	0	1	Sooty mould appeared

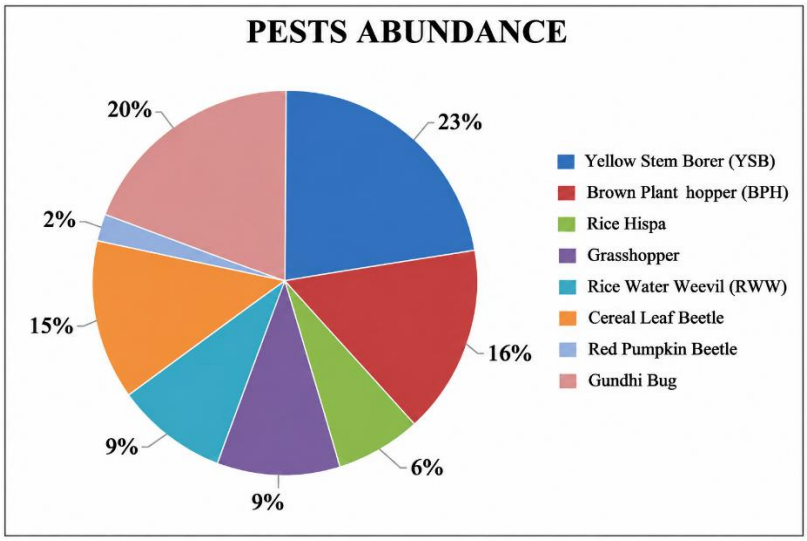


FIGURE 4: Comparative Abundance of Major Rice Pests Recorded During the Study Period

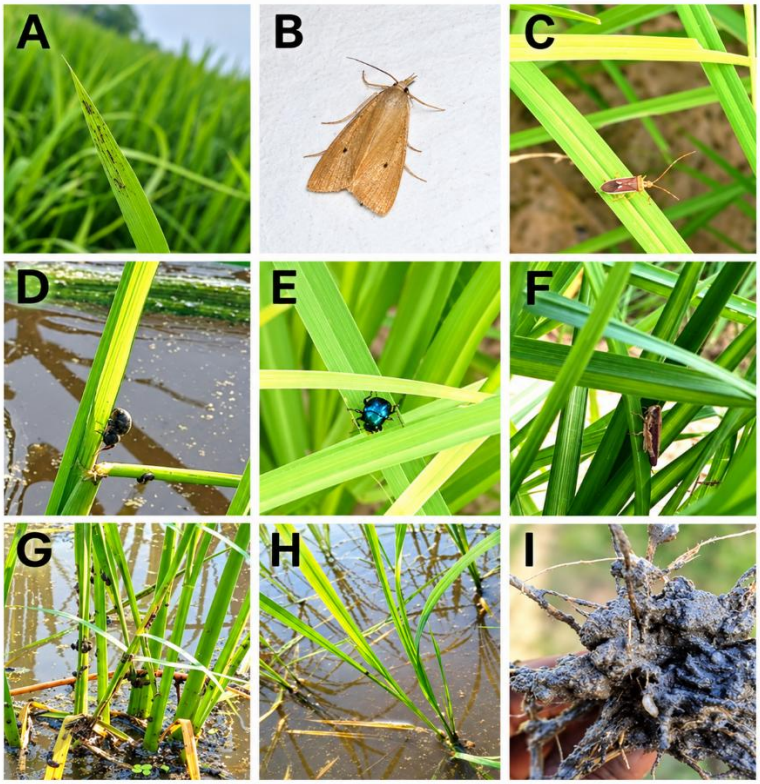


FIGURE 5: A&B – *Scirpophaga incertulas* (YSB), C – *Leptocorisa oratoria* (Gundhi Bug), D&E – *Dicladispa armigera* (Rice hispa), F – Grasshopper, G&H – *Nilaparvata lugens* (Brown planthopper), I – *Lissorhoptrus oryzophilus* (Rice water weevil)

3.2 Crop Stage-wise Pest Dynamics

The seasonal incidence of pests showed (Fig. 6) clear variation across different crop growth stages in the rice field of Sarojani Nagar. During the early vegetative stage (Week 1–3), the crop remained tender and highly succulent, which favoured early invasion by primary colonizers such as the Yellow Stem Borer (YSB) and Grasshoppers. YSB appeared at low intensity (1 larva/hill), while grasshoppers were seen feeding on the soft green leaves. The continuous presence of high rainfall (165–286 mm) and elevated humidity (76–88%) during these weeks created a favourable micro-climate for pest establishment. Other pests such as Brown Plant Hopper (BPH), Rice Hispa, and Rice Water Weevil were either absent or very low, as the plant canopy was yet to develop fully.

As the crop entered the tillering stage (Week 4–6), a marked increase in overall pest population was observed. This stage recorded the highest cumulative pest pressure. YSB population rose sharply from 2 to 3 larvae per hill, resulting in noticeable "dead heart" symptoms. Brown Plant Hopper (BPH) also showed a sudden spike during Week 4, reaching its seasonal peak (3 hoppers/hill), aided by very high humidity (83%) and moderate rainfall. During this period, Rice Hispa began scraping the upper leaf surface, and a few adults were consistently observed each week. Water stagnation created by heavy rains (168–302 mm) favoured the appearance of Rice Water Weevil, with 1–2 larvae observed. Grasshoppers remained active due to the abundant green foliage. The dense canopy, flooded field conditions, and warm temperatures (34–36°C) collectively supported the multiplication of almost all pests during this stage.

In the booting and panicle initiation stage (Week 7–8), pest activity continued but became slightly more regulated. YSB remained at high levels (3 larvae/hill), and early signs of whitehead formation were noted. BPH maintained a moderate but persistent presence (1–2 hoppers/hill), indicating favourable survival conditions even as humidity gradually decreased to 67–68%. Rice hispa and Grasshoppers also continued to appear, although their populations remained modest. This period represented the second critical phase of pest incidence because multiple pests were present simultaneously. However, slight reductions in rainfall and relative humidity began to exert natural control on pest multiplication.

With the arrival of the flowering stage (Week 9–10), most pests began showing a noticeable decline. YSB and BPH reduced from their earlier levels, while Rice Hispa almost disappeared from the field. Grasshopper activity also reduced significantly due to the increased hardness and reduced moisture of leaves. Weather conditions began shifting towards dryness, as rainfall dropped to about 112 mm and temperatures started falling to 31–34°C. The reduction in humidity (70–63%) made the environment less favourable for sap-sucking and leaf-scraping insects, contributing to the natural suppression of pest populations during flowering.

Finally, during the grain filling to maturity stage (Week 11–14), pest incidence dropped to minimal or zero. Only a negligible level of YSB (1 larva/hill) was observed in the grain-filling phase, and all pests disappeared completely by the milky and dough stages. The sharp decline was associated with dry weather, low rainfall (12–15 mm), and cooler temperatures (14–22°C minimum). The hardening of plant tissues and reduced swampy conditions also contributed to the disappearance of RWW and other pests. By the time the crop reached maturity and harvest, no active infestation could be seen.

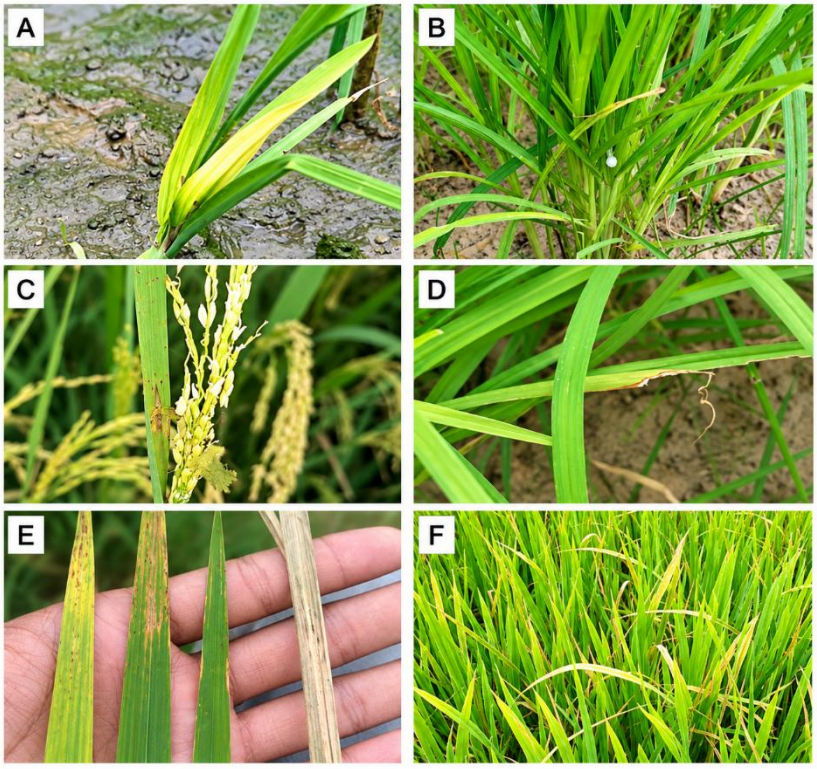


FIGURE 6: Visible impacts of pests: A – Yellowing of leaves (hopper burn – caused by BPH & YSB), B – Rolling & folding of leaves, C – False smut rice spore balls (visible at time of maturation), D – Visible holes and damage to leaves, E – Dead central shoots, F – Whiteheads (entire panicle becomes white)

3.3 Influence of Weather Parameters on Pest Incidence

Weather factors played a crucial role in governing the seasonal abundance and activity of major rice pests in the study field at Lucknow. The weekly observations (Table 3) from August to November 2025 clearly indicated that high temperature, frequent rainfall, and elevated humidity during early and mid-crop stages (August–September) created favourable conditions for sap-sucking pests such as leafhoppers and plant hoppers, which thrive at 32–36°C and humidity above 75%. During Weeks 1–6, maximum temperatures remained between 33–36°C with humidity ranging from 76–83%, accompanied by continuous rainfall between 165–302 mm, which supported lush vegetative growth and soft plant tissues, attracting early-season pests like rice hispa and rice leaf folder. Heavy rainfall during Week 5 (302.3 mm) also temporarily reduced visible pest activity due to the wash-off effect but increased humidity afterwards, which again promoted hopper resurgence.

By late September (Weeks 7–8), temperatures stabilized around 35°C, while humidity dropped slightly to 67–68%, conditions highly conducive for the development of Yellow Stem Borer (YSB) and Leaf Folder, both of which showed increased incidence during the tillering-to-booting stage. As the season progressed into October and November (Weeks 9–14), rainfall sharply reduced (from 123 mm to 12–15 mm), and humidity gradually declined to 57–62%, coinciding with grain filling and maturity. These drier conditions led to a noticeable increase in grain pests and panicle-affecting insects, along with occurrences of sooty mould due to honeydew deposition by late-season hoppers. Lower humidity and reduced rainfall also favoured the activity of rice gundhi bug, commonly observed during panicle maturation stages.

Overall, the data showed that pest incidence peaked during periods of high humidity (≥75%) and moderate- to-high temperature (30–35°C), and declined as conditions became drier. Thus, the rice pest population in the study area showed a strong positive correlation with humidity and temperature, while excessive rainfall occasionally suppressed pest abundance but enhanced disease and fungal growth later. These weather trends clearly demonstrate that microclimatic variations significantly influenced pest dynamics throughout the crop growth period.

TABLE 3
WEEKLY WEATHER REPORT

Weeks	Temp (°C)	Rainfall (mm)	Avg. Humidity (%)
10 Aug (Week-1)	Max 34°C, Min 26°C	286.1	80
17 Aug (Week-2)	Max 36°C, Min 29°C	165	81
24 Aug (Week-3)	Max 33°C, Min 26°C	226.4	76
31 Aug (Week-4)	Max 34°C, Min 27°C	168.6	83
7 Sep (Week-5)	Max 36°C, Min 27°C	302.3	80
14 Sep (Week-6)	Max 36°C, Min 27°C	222.1	74
21 Sep (Week-7)	Max 35°C, Min 27°C	128.3	68
28 Sep (Week-8)	Max 35°C, Min 28°C	120	67
5 Oct (Week-9)	Max 34°C, Min 24°C	123	63
12 Oct (Week-10)	Max 31°C, Min 18°C	112.2	70
19 Oct (Week-11)	Max 30°C, Min 17°C	65	69
26 Oct (Week-12)	Max 34°C, Min 21°C	33	61
2 Nov (Week-13)	Max 34°C, Min 22°C	12	60
11 Nov (Week-14)	Max 31°C, Min 20°C	15	57

IV. CONCLUSION

The research shows that the seasonal abundance of major rice pests in Sarojani Nagar, Lucknow was closely linked with changes in temperature, humidity, and rainfall during the crop growth period. High temperatures (33–36°C), frequent rainfall, and humidity above 75% during August and early September created highly favourable conditions for sap-sucking pests like leafhoppers and plant hoppers, along with early infestations of leaf folder and rice hispa. Pest incidence peaked during the

tillering to booting stages (Weeks 4–8), when moderate humidity (67–80%) and warm conditions supported the rapid buildup of Yellow Stem Borer and hopper populations. As rainfall and humidity started declining from October onwards, leaf folder and hopper activity reduced, while late-season pests such as rice gundhi bug and sooty mould became more noticeable during grain filling and maturity stages. Overall, the results indicate that warm and humid conditions significantly enhanced pest activity, whereas dry and cooler conditions suppressed most pests. This clearly establishes that weather parameters played a decisive role in shaping pest dynamics throughout the rice season.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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