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Seasonal Dynamics of Major Insect Pests of Rice Crop and Impact of Various Abiotic Factors on Their Incidence

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was carried out at research cum instructional farm to study the seasonal dynamics of major insect pests of rice, during *Kharif*, 2022. The peak population and infestation of major insect pests *viz*., rice hispa (19.56 per cent per hill), yellow stem borer dead heart incidence (11.98 per cent per hill) was recorded during 37th SMW whereas, yellow stem borer white ear heads incidence (16.17 per cent per hill) was recorded during 43rd SMW, rice leaf folder (12.96 per cent per hill) and brown planthopper (20.97 insects per hill) were recorded during 40th SMW. The hispa damage showed significant positive correlation with minimum temperature. The dead heart incidence of yellow stem borer had significant positive correlation with minimum temperature where

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as white ears incidence had showed significant negative correlation with minimum temperature, evening relative humidity and significant positive correlation with sunshine hours. The leaf folder damage showed significant positive correlation with evening relative humidity. The population of brown planthopper had significant negative correlation with rainfall.

Keywords: Seasonal dynamics; abiotic factors; correlation; significant.

1. INTRODUCTION

"Rice, *Oryza sativa* (Linnaeus) belonging to the family Gramineae, is one of the important cereal crops, as it is the staple food for more than 65 per cent of the world population" [1]. More than 3.5 billion people rely on rice as it accounts for more than 20 per cent of their daily calories [2]. With 80 per cent carbohydrates, 7-8 per cent protein, 3 per cent fat, 3 per cent fibre, rice is a good source of energy [3]. "An approximate yield loss of 52 per cent is observed every year due to biotic factors, out of which 21 per cent is mainly due to insect pest attack. More than 100 species of insect attack, out of which 20 cause economic damage. Among them, it includes brown planthopper, white backed plant hopper, yellow stem borer, rice leaf folders, rice hispa etc" [4].

"Rice Brown Planthopper (BPH) *Nilaparvata lugens* (Stal.) is an economic important pest as they damage plants directly by sucking the plant sap and by ovipositing in plant tissue causing plant wilting or hopper burn" [4]. "The yellow stem borer *Scirpophaga incertulas* (Walker), which is monophagous and most damaging pest produces the characteristic symptom of damage causing 'Dead heart' at vegetative stage and 'white ear' at reproductive stage leading to significant economic losses" [5]. "The rice leaf folder *Cnaphalocrocis medinalis* (Guenee), which was considered as a minor pest, has assumed major pest status during last two decades" [6]. "The larvae fold the leaves and scrape the green tissues of the leaves and cause scorching and leaf drying. Rice hispa *Dicladispa armigera* (Oliver) scrapes the upper surface of the leaf blades leaving only the lower epidermis and it also tunnels through the leaf tissues" [6].

In development of sustainable crop protection strategies, knowledge of seasonal abundance, distribution of insect pests and effect of weather parameters on incidence of insect pest is necessary [7]. So recent times have seen a focus on ecologically based pest management techniques. Seasonal incidence studies are useful for determining the need-based application of pesticides as it clearly reveals the insect's peak activity as well as insect free periods during crop growth. The current investigation was carried out to estimate seasonal dynamics and impact of abiotic factors on major insect pests of rice.

2. MATERIALS AND METHODS

The experiment was conducted at Research cum Instructional Farm at IGKV, Raipur during *Kharif,* 2022. Variety MTU-1010 was taken for the study. Seedlings of sufficient age were transplanted with spacing of 20x15 cm and carried out all other agronomical practices as recommended for rice crop. No chemical pesticides were applied throughout the crop period for natural incidence of pest on the crop.

A bulk plot of 600 m2 was raised to study the seasonal dynamics of major insect pests. The nursery was raised adjacent to the main experiment plot so as to study the population build-up of the pests. The incidence of pest population was recorded at 7 days interval from the seedling stage to maturity stage of the crop.

Weekly meteorological data of maximum and minimum temperature, relative humidity, rainfall and sunshine hours were collected from Department of Agrometeorology, IGKV Raipur (C.G.) to work out correlation between occurrence of insect pests and weather parameters.

2.1 Per Cent Incidence of Major Pests was Computed as Per the Formulae

In case of rice hispa, *Dicladispa armigera*, the percent leaf damage was calculated by observing the number of damaged leaves per hill and total number of leaves per hill from 10 randomly selected hills [8].

$$\text{Percent leaf damage} = \frac{\text{Number of damage leaves}}{\text{Total number of leaves}} \text{ x } 100$$

In case of Yellow Stem Borer (YSB), *Scirpophaga incertulas*, the percent incidence was calculated by observing the number of dead hearts/white ears per hill and the total number of tillers/panicles per hill from 10 randomly selected hills [9].

$$\text{Percent Incidence} = \frac{\text{Number of dead hearts / white ears}}{\text{Total number of tillers/ panicles}} \text{ x } 100$$

In case of leaf folder, *Cnaphalocrocis medinalis*, the percent leaf damage was calculated by observing the number of damaged leaves per hill and total leaves per hill from 10 randomly selected hills [10].

$$\text{Percent leaf damage} = \frac{\text{Number of damage leaves}}{\text{Total number of leaves}} \text{ x } 100$$

In case of brown planthoppers (BPH), *Nilaparvata lugens*, the number of motile (adult and nymphs) stages from 10 randomly selected hills were recorded, averaged and expressed in per hill basis [11].

3. RESULTS AND DISCUSSION

3.1 Periodic Prevalence of Rice Hispa, *Dicladispa armigera* in Correlation to Abiotic Variable

The rice hispa appeared during 32nd SMW *i.e*., 2nd week of August with a mean per cent leaf damage of 4.3 per cent per hill. The population build up gradually and reached to its peak in the 2nd week of September (37th SMW) with a mean per cent leaf damage of 19.56 per cent per hill. Present findings are more or less similar with that of Priyanka et al. [8] who studied the seasonal fluctuation of insect pests in rice crop and showed that incidence of rice hispa initiated in the 35th SMW *i.e.,* during the first week of September with 8.12 per cent leaf damage increasing up to 17.81 per cent during 36th SMW *i.e*., second week of September, there after declined.

The findings indicated that the population and damage of rice hispa showed non-significant negative correlation with sunshine hours (r = -1.367). While, non-significant positive correlation with maximum temperature (r = 0.145), rainfall (r = 0.099), morning relative humidity (r = 0.149), evening relative humidity (r =0.441). The results indicated that the hispa damage showed significant positive correlation with minimum temperature (r = 0.491) Present findings are similar with that of Yadav et al. [12] who reported correlation studies between insect pest incidence of rice crop and weather parameters and revealed that the population and damage of rice hispa showed significant positive correlation with minimum temperature (r = 0.463) where as non-significant positive correlation with rainfall (r = 0.263) and maximum temperature (r = 0.171).

3.2 Periodic Prevalence of Yellow Stem Borer, *Scirpophaga incertulas* in Correlation to Abiotic Variable

The per cent dead hearts incidence appeared during 32nd SMW *i.e*., 2nd week of August with a mean per cent incidence of 2.31 per cent per hill. The population build up gradually and reached to its peak in the 2nd week of September (37th SMW) with a mean per cent incidence of 11.98 per cent per hill. The per cent white ear heads incidence appeared during 41st SMW *i.e*., 2nd week of October with a mean per cent incidence of 6.5 per cent per hill. The population build up gradually and reached to its peak in the last week of October (43rd SMW) with a mean per cent incidence of 16.17 per cent per hill.

The findings indicated that the dead hearts incidence had non-significant positive correlation with maximum temperature (r = 0.122), rainfall (r = 0.109), morning relative humidity (r = 0.089) and evening relative humidity (r = 0.437). It also showed non-significant negative correlation with sunshine hours (r = -0.144) and significant positive correlation with minimum temperature (r = 0.489). The incidence of white ear heads showed non-significant negative with maximum temperature (r = -0.176), rainfall (r = -0.465) and morning relative humidity (r = -0.426). It also showed significant negative correlation with minimum temperature (r = -0.774), evening relative humidity (r = -0.807) and significant positive correlation with sunshine hours (r = 0.771).

Present findings are in line up with Sulagitti et al. [13] revealed that yellow stem borer outbreaks begin in late July (31st SMW) with per cent dead hearts incidence and also reported that per cent dead hearts incidence had significant positive correlation with minimum temperature (r = 0.756). Patil et al. [14] reported that per cent incidence of dead hearts of yellow stem borer was reached to its peak in second week of September (37th SMW) and also reported that per cent incidence of white ear heads of yellow stem borer had significant negative correlation with evening relative humidity (r = - 0.578). Present findings are similar with Kalita et al. [15] and Chavan et al. [16] reported that the maximum White Ear Heads (WEH) were recorded in second fortnight of October.

Table 1. Seasonal dynamics of major insect pests infesting rice crop during *Kharif*, 2022

SMW	Duration	Temperature (ºC)		Rainfall (mm)	Relative humidity (%)		Sunshine hours	% leaf damage of hispa/ hill	% incidence of YSB/ hill		% leaf damage of leaf folder/hill	No. of BPH population/ hill
		Max.	Min.		Morn.	Even.			%DH/ hill	%WEH/ hill		
29	July 16-22	29.7	25.1	97.6	90	82	0.8	0	0	0	0	0
30	23-29	31.6	25.6	29.2	90	75	3.2	0	0	0	0	0
31	30-05	33.8	25.7	40.6	89	61	3.7	0	0	0	0	0
32	Aug 06-12	30.5	24.5	212.4	92	76	2.8	4.3	2.31	0	3.69	0
33	13-19	30	25	104.6	90	74	4.7	9.47	6.98	0	7.64	0.32
34	20-26	30.9	24.6	43	88	68	3.2	12.36	8.04	0	8.52	4.64
35	27-02	33.3	25.5	67	91	68	6.9	16.87	9.96	0	9.06	5.52
36	Sep 03-09	32.4	25.5	32.4	91	68	5.3	18.45	11.46	0	10.34	10.98
37	10-16	30.6	24.8	39.4	86	71	4.2	19.56	11.98	0	11.84	11.04
38	17-23	30.8	24.2	73.2	93	74	2.9	13.38	7.26	0	12.43	11.76
39	24-30	31.5	24	26	92	71	3.6	11.43	6.33	0	11.98	17.32
40	Oct 01-07	31.6	24.5	11.8	88	72	6.1	10.5	5.98	0	12.76	20.97
41	08-14	31.3	23.9	40	91	64	5.8	9.8	3.12	6.5	5.16	18.04
42	15-21	31.6	22.8	7.4	91	59	6.9	0	0	9.86	3.47	17.59
43	22-28	30.8	17.5	0	85	35	9.5	0	0	16.17	0.16	16.32
44	Oct 29-04	30.2	16.2	0	88	37	8	0	0	10.01	0	8.98
45	Nov 05-11	31.5	16.7	0	89	37	7.2	0	0	4.5	0	0

(SMW-Standard Meteorological Week, YSB-Yellow Stem Borer, DH-Dead Hearts, WEH-White Ear Heads, BPH- Brown Planthopper)

Table 2. Correlation of coefficient (r) for major insect pests of rice with abiotic factors during *kharif*, 2022

Insect Pests		Weather Parameters					
		Temperature (ºC)		Rainfall (mm)	Relative humidity (%)		Sunshine hours
		Maximum	Minimum		Morning	Evening	
Rice hispa		0.145	**0.491***	0.099	0.149	0.441	-0.137
Yellow stem borer	**% DH**	0.122	**0.489***	0.109	0.089	0.437	-0.144
	% WEH	-0.176	**-0.774***	-0.465	-0.426	**-0.807***	**0.771***
Rice leaf folder		0.066	0.475	0.059	0.228	**0.493***	-0.169
Brown planthopper		0.032	-0.125	**-0.489***	-0.084	-0.150	0.436

(Significant at 5% level)*

3.3 Periodic Prevalence of Rice Leaf Folder, *Cnaphalocrocis medinalis* in Correlation to Abiotic Variable

The rice leaf folder appeared during 32nd SMW *i.e.,* 2nd week of August with a mean per cent leaf damage of 3.69 per cent per hill. The population build up gradually and reached to its peak in the first week of October (40th SMW) with a mean per cent leaf damage of 12.96 per cent per hill. The incidence of per cent leaf damage of leaf folder had non-significant positive correlation with maximum temperature (r = 0.066), minimum temperature (r = 0.475), rainfall (r = 0.059) and morning relative humidity (r = 0.228). And it had non-significant negative correlation with sunshine hours (r = -0.169) and significant positive correlation with evening relative humidity (r = 0.493).

Present findings are similar with that of Sulagitti et al. [13] and Patil et al. [14] reported that leaf folder infestation was commenced during first fortnight of August and reached its peak level during first week of October. And also revealed that leaf folder damage had significant positive correlation with evening relative humidity (r = 0.580).

3.4 Periodic Prevalence of Rice Brown Planthopper, *Nilaparvata lugens* in Correlation to Abiotic Variable

The population of brown planthopper appeared during 33rd SMW *i.e.,* 3rd week of August with a mean population of 0.32 insects per hill. The population build up gradually and reached to its peak in the first week of October (40th SMW) with a mean population of 20.97 insects per hill. It had non-significant positive correlation with maximum temperature (r = 0.032) and sunshine hours (r = 0.436) and non-significant negative correlation with minimum temperature (r = -0.125), morning relative humidity (r = -0.084), evening relative humidity (r = -0.150). It also showed significant negative correlation with rainfall (r = -0.489).

Present findings are similar with Mohanta et al. [17] reported that initial occurrence of brown planthopper was observed during 33rd SMW with mean population of 1 insect per hill. Later it increased gradually and reached maximum during 40th SMW with mean population of 17.33 per hill. Patil et al. [14] and Seni et al. [18] reported in his correlation analysis that population of BPH had significant negative correlation with rainfall (r = - 0.488)

4. CONCLUSION

Thus, the present study revealed that the peak population and infestation of major insect pests *viz*., rice hispa, yellow stem borer dead heart incidence was recorded during 37th SMW whereas yellow stem borer white ear heads incidence was recorded during 43rd SMW, rice leaf folder and brown planthopper were recorded during 40th SMW. Correlation analysis also seen could be helpful for proper and timely management of the major pests of rice.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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