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Seasonal incidence of major insect pests of rice (*Oryza sativa* L.) and its correlation with weather parameters

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Abstract

The present investigation was carried out to study the seasonal incidence of major insect pests of rice (*Oryza sativa* L.) at the Agricultural Research Farm, Institute of Agricultural Sciences, BHU, Varanasi. The studies revealed that the pest activity commenced from 31st Standard meteorological week (SMW) and continued to 49th SMW. The leaf folder reaches a peak level at 49th standard week with 17.6 larva/10 hills. The dead heart noticed to reaches the peak level of infestation during the 42nd standard week with 6.23 per cent of dead. The rice white ear reaches the peak level of infestation during 49th standard week with 10.93%. The rice brown plant hopper reaches the peak level during the 41st standard week with 19.33 insects per 10 hills. The correlation of yellow stem borer for dead heart shows significant positive correlation with the relative humidity and non-significant negative correlation with highest temperature, significant negative correlation with minimum temperature, average temperature, rainfall. The correlation of % white ears shows non-significant negative correlation with rainfall, significant negative correlation for maximum temperature, minimum temperature, average temperature, and relative humidity. The correlation of rice leaf folder shows non-significant negative correlation with rainfall, significant positive correlation with relative humidity, non-significant positive correlation for highest temperature, lowest temperature and temperature average. The correlation of rice brown plant hopper shows non-significant negative correlation with rainfall, highest temperature, lowest temperature and temperature average.

Keywords: Seasonal incidence, rice leaf folder, yellow stem borer, brown plant hopper, relative humidity

Introduction

Rice (*Oryza sativa* L.) is one of the major cereal crops in the world and it forms the daily food for more than 65% of the total population in India. Rice can be cultivated practically anywhere, from steep hill to the mountain regions by utilization of water- in a controlled terrace systems. One of the important dilemma of rice farming in India is the incursion of insect pests at different growth stages of the crop. 52% of the absolute world production of rice is lost per year due to the devastation caused by the biotic factors, nearly 21% loss due to incursion of different insect pests [1]. In India, nearly the 220 species of the different insect pests which feed on the crop rice [2]. The rice crop is subjected to sustain damage by considerable number of pests among them the yellow stem borer *Scirpophaga incertulas* (Walker) is the principle devastator causing 'deadheart' and 'white ear' leading to major economic damage [3]. Rice leaf folder, *Cnaphalocrocis medinalis* (Guenee) is the major insect pests in the subcontinent of India [4]. Rice Brown planthopper, *Nilaparvata lugens* (Stal.), the most destructive sucking pest of rice and it causes huge yield losses in every year in the paddy grown regions in Asia [5]. BPH sucks the nutrients from the phloem tissues of rice plants. Usually, large number of BPH causes damage plants to become dry and brown. The condition is called "hopper burn symptom". Even though the high population of the planthopper is not abundant to kill the rice plants, rice BPH feeding may significantly decrease yields [6]. Damage to the rice crop is caused directly by feeding on the phloem and indirectly by transmitting plant viral disease like grassy stunt viruses [7]. It is necessary to quantify and verify, by the critical experiments, the theoretical relationships, normally proposed in rice insects between the abiotic factors and the population dynamics. Knowledge of insect-pests population dynamics is essential for developing sustainable crop protection strategies. Hence, population dynamics of major pests of rice were studied and its correlated with the different weather parameters.

2. Material and Methods

2.1 Experimental layout

The present investigation was conducted for the study of seasonal incidence of major pests of rice. Weekly observations were recorded from 30th standard week on variety HUR105 (Malviya sugandith dhan105) of rice at Agricultural Research Farm, Institute of Agricultural Sciences, BHU, Varanasi. Total experimental plot size measured 3m x 3m. The seedlings were transplanted in the experimental plot with spacing 15cm between plant to plant and 20 cm row to row. For insect-pests population, visual counts of the numbers of insects/10 hills in plot were taken. Observations on incidence of insects were taken on hill basis. Ten plants (hill) were randomly selected from plot planted with HUR105 (Malviya sugandith dhan105) for recording incidence of insects. The observations continued till harvest of the crop. The observations were recorded at morning hours. For the ease of analysis and findings, various abiotic weather data were recorded simultaneously from the metrological observatory. The seasonal incidence of major pests of rice was correlated with abiotic factors.

2.2 Collection of Insects

A bulk plot of 150 m² was raised near to the research field in order to study the seasonal occurrence of major pests of rice. The pest population observation was taken at a weekly interval from the initiation of pest and it continued till the maturity of the crop. The existence of pests was recorded randomly on 10 selected hills in the field. In order to study the effect of abiotic factors (meteorological parameters) on pest populations, infestations or plant injuries, the meteorological data on maximum and minimum temperature, relative humidity (morning and evening), rainfall and sunshine hours were taken from the Agriculture Research Farm, B.H.U., Varanasi and which is correlated with the existence of the pest population.

2.3 Observation and Analysis

In case of paddy hopper the number of (nymphs and adult) hoppers on all the 10 hills were recorded [8]. The total count was averaged and expressed on per hill basis. In case of yellow stem borer counts were taken on a number of dead hearts/white ears and the total number of tillers/panicle from 10 selected hills [9]. The % incidence (dead heart/ white ears) was calculated as follows.

$$\text{Dead heart (\%)} = \frac{\text{No. of dead heart}}{\text{Total no. of dead heart}} \times 100$$

$$\text{White ear (\%)} = \frac{\text{No. of white ears}}{\text{Total number of tillers with panicles}} \times 100$$

For leaf folder the damaged leaves and total leaves from 10 randomly selected hills were observed in each plot [10]. The % of leaf infected was calculated as follows.

$$\% \text{ leaf damage} = \frac{\text{No. of damaged leaves}}{\text{Total number of leaves}} \times 100$$

3. Results and Discussion

3.1 To study the seasonal incidence of insect-pests of rice crop

The occurrence of dead heart noticed in the 32nd standard

week that is, twenty-five days after transplanting. The continuing rise of % dead heart to 4.86% was observed from the 38th standard week at last, it reaches the peak level of infestation during the 42nd standard week with 6.23% of dead heart later the gradual occurrence of the dead heart was decreased when the initiation of panicle starts [11] (Table 1, Fig 1). From 42nd standard week, the occurrence of white ears was observed in the research field with 6.65% damage. The continuing rise of white ears was observed and it reaches to the peak level of infestation of 10.93% during 49th standard week [12] (Table 1, Fig 1). The initial occurrence of rice leaf folder was noticed on the 31st standard week as 1.90 larvae per 10 hills. The larval population gradually increases and it reaches a peak level at 40th standard week with 17.60 larva/10 hills. Later on, the population of leaf folder gradually decreases and the least population observed during the 49th standard week the with 1.34 larva per 10 hills [13] (Table 1, Fig 1). The initial occurrence of rice BPH was noted during the 31st standard week as 2.2 insects/10 hills. The gradual increase in the pest population was noticed and it reaches the peak level during the 41st standard week with 19.33 insects per 10 hills (Table 1, Fig 1).

3.2 Correlation coefficient values between weather parameters and rice insect-pests

The correlation was carried in order to catch out on the relationship between the amount of dead hearts in % and the major weather factors. The outcomes reported a non-significant negative correlation with highest temperature ($r = -0.49$), significant negative correlation with minimum temperature ($r = -0.81$), significant negative correlation with the average temperature ($r = -0.79$), a significant negative correlation with rainfall ($r = -0.51$), significant positive correlation for RH ($R = 0.59$) and significant negative correlation for range wind speed ($r = -0.89$), negative non-significant correlation observed for wind speed maximum ($r = -0.24$) and minimum ($r = -0.14$) respectively. However, the relationship between the % white ears damage and major weather factors reported that there is non-significant negative correlation with rainfall ($r = -0.47$), significant negative correlation for maximum temperature ($r = -0.51$), minimum temperature ($r = -0.93$), average temperature ($r = -0.89$) and relative humidity ($r = -0.93$) and a significant negative correlation with wind speed range ($r = -0.51$), wind speed minimum ($r = -0.54$) and negative non-significant correlation for wind speed maximum ($r = -0.42$) [14] (Table 2)

The correlation analysis showed that the rice leaf folder population showed non-significant negative correlation with rainfall ($r = -0.28$) and a non-significant positive correlation with RH ($r = 0.34$), non-significant positive correlation for highest temperature ($r = 0.007$), lowest temperature ($r = 0.06$) and temperature average ($r = 0.08$), while non-significant negative correlation observed for wind speed range ($r = -0.47$), non-significant positive correlation for wind speed minimum ($r = 0.14$) and non-significant negative correlation for wind speed maximum ($r = -0.07$) [15] (Table 2).

The correlation analysis showed that the rice brown plant hopper population showed non-significant negative correlation with rainfall ($r = -0.42$) and a non-significant positive correlation with RH ($r = 0.13$), non-significant negative correlation for highest temperature ($r = -0.01$), lowest temperature ($r = -0.11$) and temperature average ($r = -0.06$) (Table 2)

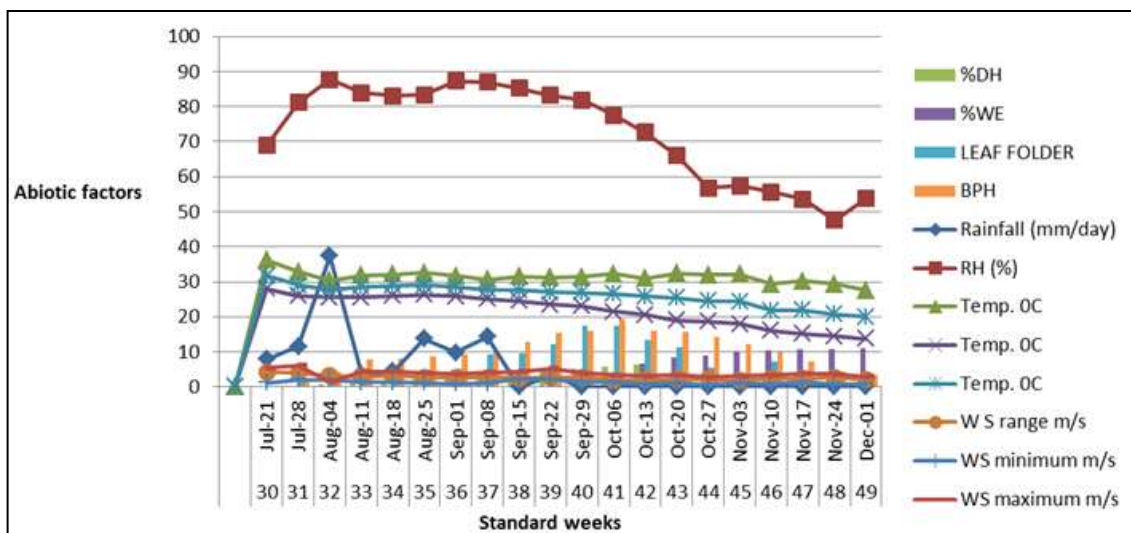


Fig 1: Influence of abiotic factors on the abundance of major insect pests of rice

Table 1: Influence of abiotic factors on seasonal incidence of various insect pests on rice (Kharif 2018)

SW	Month and Date	Rainfall (mm/day)	RH (%)	Temp. °C			W S Range m/s	WS Minimum m/s	WS Maximum m/s	Yellow stem borer		Leaf Folder %	BPH
				maximum	minimum	Average				%DH	%WE		
30	July 21	7.85	68.95	36.21	28.07	31.76	4.21	1.21	5.42	0.00	0.00	0.00	0.00
31	July 28	11.49	81.11	32.92	25.97	29.12	4.04	2.11	6.15	0.00	0.00	1.90	2.20
32	August 4	37.43	87.68	30.32	25.63	27.64	3.21	2.12	1.43	0.75	0.00	2.80	4.30
33	August 11	3.69	83.90	31.85	25.61	28.68	3.00	1.30	4.33	1.41	0.00	3.90	7.70
34	August 18	4.42	83.00	32.08	25.94	28.87	3.05	1.31	4.36	1.65	0.00	4.40	8.20
35	August 25	13.69	83.40	32.51	26.30	29.04	2.76	1.13	3.90	3.32	0.00	5.00	8.80
36	September 1	9.73	87.27	31.70	25.83	28.56	2.58	0.96	3.72	3.87	0.00	5.20	9.20
37	September 8	14.28	87.02	30.68	25.10	27.73	2.78	1.06	4.08	4.56	0.00	9.40	10.00
38	September 15	0.08	85.17	31.48	24.49	27.60	2.49	2.22	4.38	4.86	0.00	9.70	12.83
39	September 22	3.04	83.24	31.24	23.58	27.08	2.61	2.22	5.22	5.56	0.00	12.35	15.5
40	September 29	0.01	81.88	31.43	23.12	26.93	2.736	1.44	3.94	5.35	0.00	17.6	16.00
41	October 6	0.00	77.53	32.29	21.46	26.64	1.88	1.44	3.33	5.82	0.00	17.55	19.33
42	October 13	0.08	72.63	31.02	20.66	25.86	2.05	0.95	3.03	6.23	6.65	13.3	16.00
43	October 20	0.00	66.07	32.36	18.98	25.36	2.08	1.23	3.36	0.00	8.43	11.2	15.64
44	October 27	0.14	56.73	31.92	18.66	24.60	2.41	0.56	2.83	0.00	8.965	5.4	14.23
45	November 3	0.00	57.37	32.15	17.94	24.43	1.77	1.23	3.08	0.00	10.23	4.00	12.32
46	November 10	0.00	55.62	29.32	16.12	21.83	2.46	0.95	3.39	0.00	10.52	7.20	9.85
47	November 17	0.00	53.63	30.27	15.24	21.86	2.41	1.30	3.78	0.00	10.75	2.00	7.25
48	November 24	0.00	47.62	29.40	14.51	20.81	2.86	0.90	3.73	0.00	10.87	1.55	4.23
49	December 01	0.00	53.70	27.54	13.68	20.052	2.07	0.95	2.91	0.00	10.93	1.34	3.54

S.W: Standard week, D.H: Dead heart, W.E: White ear, Temp: Temperature, WS: Wind speed, RH: Relative humidity

Table 2: Correlation coefficient (r) of insect pest population on rice with prevailing weather parameters (Kharif 2018)

	rainfall (Mm/Day)	RH (%)	Temp °C Maximum	Temp °C Minimum	Temp °C Average	WS Range M/s	WS Min M/s	WS Max M/s	% DH	% WE	% Leaf Folder	BPH
Rainfall (mm/day)	1											
RH (%)	0.52	1										
T max 0C	0.07	0.34	1									
Tmin 0C	0.53	0.88	0.66	1								
T avg 0C	0.43	0.81	0.79	0.97	1							
W S range	0.47	0.32	0.48	0.61	0.59	1						
WS min m/s	0.32	0.54	0.14	0.44	0.38	0.31	1					
WS max m/s	-0.27	0.25	0.50	0.43	0.47	0.59	0.32	1				
%DH	-0.51*	0.02	-0.49*	-0.81**	-0.79**	-0.89**	-0.14	-0.24	1			
%WE	-0.47*	-0.93**	-0.51*	-0.93**	-0.89**	-0.51*	-0.54*	-0.42	0.37	1		
% Leaf Folder	-0.28	0.34	0.007	0.06	0.08	-0.47	0.14	-0.07	0.90	-0.24	1	
BPH	-0.42	0.13	-0.01	-0.11	-0.06	-0.70**	-0.02	-0.23	0.94	-0.008	0.88	1

* Correlation is significant at the 0.05 level

** Correlation is significant at the 0.01 level

4. Conclusion

The above research on major insect pests of rice revealed that, the occurrence of rice yellow stem borer with dead heart symptom noticed during vegetative stage and it reached peak% damage was 42nd week (6.23%) and during the reproductive stage of the crop white ear head occurs and dead heart% reaches peak level during 49th standard week with (10.93%). The initial occurrence of rice leaf folder during 31st standard week (2.80%) and it reaches the peak level of infestation during the 40th standard week (17.6%) when the crop has high succulent in nature the infestation increases and leaf folder population didn't get affected by RH and lowest, highest and average temperature. The initial occurrence of rice brown plant hopper during 31st standard week (2.2) and it reaches the peak level during the 41st standard week (19.33), further the population decreases gradually when the crop produce the earhead and BPH population also not affected by RH and lowest, highest and average temperature. These results are most benefitted in order to take the pest management at right time

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