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Short Communication

Role of abiotic factors on the seasonal variation in infestation of the major insect pests of rice (*Oryza sativa* L.) in Odisha

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Throughout the world, rice (*Oryza sativa* L.*)* is an important cereal crop and half of global population depends on it for their nutritional requirement. In India, it is grown in almost one-fourth of its cropped area and provides food to about half of its population. It is cultivated in diverse agro-ecosystems such as irrigated, upland, rainfed low land, semi deep water and deep water as well as coastal saline regions. Large scale cultivation of high yielding varieties has led to infestation of several insect pests. More than 100 species of insect pests infest the rice crop at different growth phases and 20 species of them can cause serious damage (Heinrichs *et al.,* 2017). Rice yellow stem borer (YSB), *Scirpophaga incerulas* (Walk.), Asian rice gall midge (GM), *Orseolia oryzae* (Wood-Mason), plant hoppers both brown plant hopper (BPH), *Nilaparvata lugens* (Stål) and white backed plant hopper (WBPH), *Sogatella furcifera* (Horvath), and leaf folder, *Cnaphalocrocis medinalis* Guenee are very important and responsible for huge economic rice crop losses (Seni and Naik, 2018).

The infestation of major insect pests of crop plants depends on the prevailing weather conditions in an area (Mardi *et al.,* 2009; Seni and Naik, 2018; Jasrotia *et al*., 2019; Seni, 2020). Sambalpur in Odisha is considered as one of the endemic locations for gall midge in India (Mathur and Krishnaiah, 2004). Beside gall midge, stem borer, plant hoppers and leaf folder cause heavy damage to rice crop in this region (Seni and Naik, 2018). It was observed that in 2017 rice crop was heavily damaged by the plant hoppers in Odisha, whereas in 2018 hoppers infestation was minimal. For this diverse reason, an attempt was made to find out the role of abiotic factors for variation in infestation of major insect pests of rice in 2017 and 2018 in the region.

The study was conducted in the experimental farm of Regional Research and Technology Transfer Station (RRTTS) of Odisha University of Agriculture and Technology, Chiplima, Sambalpur during wet seasons (July to December) in 2017 and 2018. The research station is situated at $20^0$21'N latitude and $80^0$55'E longitude in Dhankauda block of Sambalpur district at an altitude of 178.8 m above MSL. The experiment was conducted with rice cultivar Jaya. The variety was sown in the first week of July and transplanting was done after 25 days of sowing at 15 cm x 20 cm hill spacing. Weeds were removed from the field by hand. Fertilizers were applied in the field as per recommended doses (N: P_2O_5: K_2O @ 80:40:40 kg/ha) and no plant protection measures were taken during crop growth period. Observations on the infestation of YSB produced dead heart/white ear head (DH/WEH), GM produced silver shoot (SS), leaf folder damage leaves (LFDL), plant hoppers number per hill were taken on 10 randomly selected hills per plot and were recorded at weekly intervals, 10 days after transplanting to harvesting stage. From 46th standard meteorological week, WEH data were taken. Then percentage of dead hearts/ white ears/ silver shoot/ leaf folder damage leaves wereworked out.

The data on various weather parameters during the crop growing period were taken from the meteorological observatory located in the RRTTS, Chiplima, Sambalpur. Then, the data on infestation of major insect pests of rice were pooled for 2017 and 2018 and analyzed by correlation and regression analysis using SPSS 16.0 statistical package.

From the Fig. 1 it was evident that the infestation of yellow stem borer, *S. incertulas* started from 34th standard meteorological week (SMW) and it continued till 49th SMW. The maximum activity of stem borers was observed between 43rd to 45th SMW and 48th to 49th SMW (November-December). Between this, the peak infestation (7.71 % of WEH) was found in 49th SMW. The correlation co-efficient between stem borer infestation and weather parameters showed that the maximum and minimum temperature, morning as well as evening relative humidity and rainfall had

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Table 1: Correlation between stem borer producing dead heart/white ear head, gall midge producing silver shoot, leaf folder producing damage leaves and plant hoppers in rice and abiotic factors

Weather parameters	Stem borer	Gall midge	Leaf folder	Plant hoppers
Max. temp. (^{0}C)	-0.232	0.763**	0.766**	-0.467
Min. temp. (^{0}C)	-0.460	0.787**	0.635**	-0.569*
Morning relative humidity (%)	-0.273	-0.565*	-0.800**	0.167
Evening relative humidity (%)	-0.219	-0.615**	-0.725**	0.116
Rainfall (mm)	-0.817**	0.155	0.004	-0.762**

*-Significant (p<0.05), **-Highly significant (p< 0.01)

Table 2: Monthly weather data of Chiplima, Sambalpur, Odisha during 2017 and 2018

Month	SMW	Temperature				Relative humidity (%)		Rainfall (mm)	
		Max (°C)		Min (°C)					
		2017	2018	2017	2018	2017	2018	2017	2018
July	27-30	32.0	30.5	25.5	18.6	68-88	72-90	419.0	919.2
August	31-35	32.9	28.8	25.2	17.6	76-94	81-91	307.0	540.2
September	36-39	33.5	32.5	25.3	19.5	75-90	58-82	263.0	262.8
October	40-43	32.5	32.5	24.3	21.2	62-89	65-84	24.7	0.0
November	44-48	30.1	30.5	18.7	18.5	70-91	78-90	51.2	0.0
December	49-52	28.48	26.6	14.9	12.6	77-89	73-76	27.0	85.4

SMW- Standard Met Week, Max – Maximum, Min– Minimum,

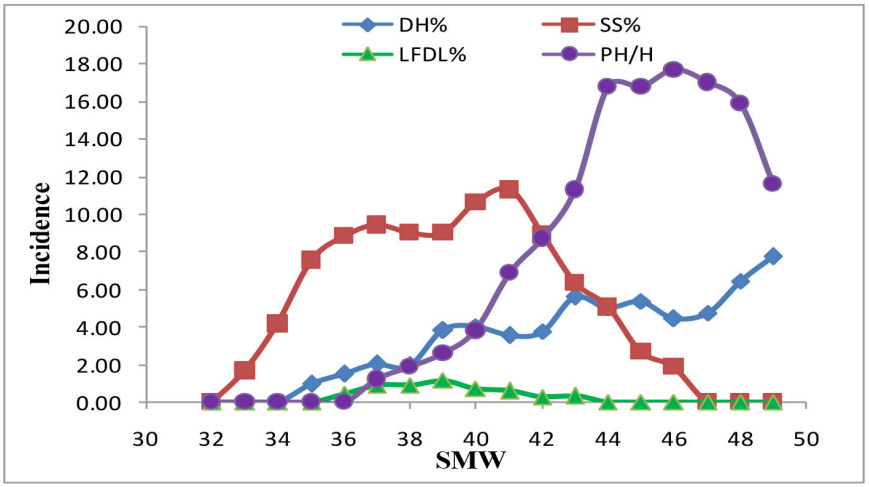

Fig. 1: Seasonal incidence in terms of infestation of major insect pests of rice along with standard meteorological week during 2017 and 2018

negative correlation with *S. incertulas* infestation (Table 1). The findings revealed that rainfall had significant effect on the incidence of stem borer. The present findings are in conformity with the findings of Jasrotia *et al*. (2019) as they also reported the significant negative effect of rainfall on stem borer incidence in rice ecosystem.

The infestation of gall midge was observed from 33rd to 46th SMW (August-November) and during this period, the peak infestation (11.28% of SS) was observed in 41st SMW. The correlation studies between the infestation of gall midge and abiotic factors revealed that the infestation of gall midge was positively correlated with maximum temperature, minimum temperature and rainfall whereas negatively correlated with morning and evening relative humidity (Table 1). These results are in conformity with the findings of Mardi *et al.* (2009) in the study of seasonal activity of the gall midge in Ranchi, India and found that the main active period of the gall midge was from second week of August to last week of October (32nd to 43rd SMW).

It has been found that the infestation of leaf folder initiated from 36th SMW and it continued till 43rd SMW (September-October) as depicted in Fig.1. The maximum infestation of leaf folder was observed in between 37th SMW to 40th SMW. During this period, the highest peak infestation (1.19% of damaged leaves) was found in 39th SMW. The correlation studies between leaf folder infestation and weather factors revealed that the temperature (maximum and

minimum) had positively and significant correlation with leaf folder incidence. The morning and evening time relative humidity had significant negative correlation with leaf folder incidence whereas the correlation between leaf folder infestation and rainfall was found to be positive (Table 1). Zainab *et al.* (2017) also observed that leaf folder infestation had a positive correlation with rainfall in Varanasi, India. The present findings are in accordance with the findings of Jasrotia *et al*. (2019) where they observed that the temperature i.e. both maximum and minimum had significant positive effect on leaf folder infestation in rice ecosystem.

Regarding incidence of plant hoppers, it was observed that the number of plant hoppers per hill was found initially low till 40th SMW, and gradually increased thereafter during successive standard meteorological weeks and reached its maxima during 45th to 48th SMW (November-December) and thereafter hopper population declined in 2017-18. The population of plant hoppers on rice crop was negatively correlated with maximum and minimum temperature and rainfall whereas the morning and evening relative humidity had positive correlation with hoppers population. The present findings are corroborated by the findings of Seni and Naik (2018), where they reported that the population of plant hoppers on rice crop was significantly negatively correlated with both maximum and minimum temperature and rainfall in Sambalpur, Odisha, India during 2015-16. It was observed that heavy population of plant hoppers occurred at Chiplima, Sambalpur in 2017 wet season when compared to 2018 season because of intermittent rainfall events and cloudiness throughout the rice growing period in 2017 (Table 2). Similar type of observation also observed by Chander and Palta (2010) where they reported that early commencement of rainfall in summer and intermittent rainfall in different months of the rice growing period may lead to BPH outbreak. .

Then the regression analysis was done to find out which abiotic factors contributed the most to the variation of stem borer, gall midge, plant hoppers and leaf folder incidence in rice. Regression analysis showed that the rainfall significantly contributed 66.8 per cent, 58.1 per cent variation to the variation of stem borer and plant hoppers, respectively whereas maximum and minimum temperature significantly contributed around 58 per cent and 40 per cent variation to the variation of gall midge and leaf folder infestation, respectively. Likewise, morning relative humidity had significant role in 63.9 per cent variation due to leaf folder infestation in the region. It may be concluded here that the seasonal fluctuation in infestation of major insect pests of rice were heavily depends on various abiotic factors prevailed. Hence, the study may be helpful in formulating area specific population models for the prediction of rice insect pests buildup and forewarning the growers for timely adoption of management practices.

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