Study of theAbiotic Factors Affecting Amplitude Fluctuation in the Incidence of Major Pest of Rice in Uttar Pradesh

ABSTRACT

An experiment was conducted at Students Instructional Farm, Acharya Narendra deva University of agriculture and technology Kumarganj, Ayodhya (U.P.).during *Kharif* season 2021.The incidence that, the yellow stem borer, leaf folder, green leaf hopper, BPH and gundhi bug were recorded. The highest dead heart per cent of yellow stem borer was recorded on rice at 36th SMW (12.97 per hill) and white ear per cent (7.41 per hill) in 44th SMW, leaf folder 41st and 32nd SMW (6.75 & 0.10 per hill), green leaf hopper 43th and 32nd SMW (3.25 & 0.20 nos./hill), BPH 44th and 34th SMW (9.84 & 0.15 nos./hill) and gundhi bug 45th and 40th SMW (1.37 & 0.20 per hill).

Yellowstem borer (dead heart) was showed non-significant positive correlation withrainfall, minimum, maximum temperature and sun shine however, relative humidity showed significant positive correlation with dead heart. White ear showed that non-significant negative correlation with rainfall while, minimum, maximum temperatureand relative humidity significant negative correlation however, sun shine showed non-significantly positive correlation with white ear. Leaf folder incidence showednon-significant positive correlation with rainfall and relative humidity, maximum and minimum temperature showed non-significant negative correlation,however sun shine showed significant positive correlation. The incidence of green leaf hopper, showed minimum, maximum temperaturesignificant negative correlation, while relative humidity and rainfall showed non-significant negative correlation however, sun shine showed significant positive correlation. The population of BPH was significant negative correlated with minimum, maximum temperature, while relative humidity and rainfall showed non-significant negative correlation however, sun shine showed significant positive correlation. The incidence of gundhi bug, showedsignificant negative correlation with minimum, maximum temperature and relative humidity correlationwhile rainfall and sun shine showed non-significant negative correlation and non-significant positive correlation respectively.

Key word: Rice,Dead heart, Population, Correlation, Abiotic factors

INTRODUCTION

Rice (*Oryza sativa L*.) belonging to the family Gramineae is the principle staple food crop in India. It holds the key to our country ability to produce enough food for our people. It

is primarily a high energy or high calorific food. It contains about 77% starch, 7-8% protein and fractional percentage of fat, minerals and crude fibre. According to the data released by the government of India, the annual production of rice in India is 115.63 million ton during 2018–19 (Anonymous, 2019). It is cultivated all over the tropic, sub-tropic and temperate country all over the world. Rice is of two types i.e. aromatic and non-aromatic. Out of these aromatic rice contributes a tiny low portion in rice production. Rice is cultivated besides Pakistan, Iraq, Iran, Afghanistan, Bangladesh, Myanmar, Indonesia, and Vietnam together with India. Haryana, Punjab, Uttarakhand and Western U.P. are the most basmati rice producing state of India (Kumar and Singh, 2020).

The insects that cause damage to the paddy plant from its seedling stage to till harvesting are classified as major and minor pests. Among major pests, the stem borers, leaf folder, hoppers, Gandhi bug, etc. are serious pest. The stem borer is a serious pest of paddy in all the rice growing areas such as in India, Pakistan, Burma, Sri Lanka, China, Japan, Philippines and Indonesia. The larva is a damaging stage of stem borers which feed on only the internal tissue of stem and cause dead heart and white ear head at vegetative and reproductive stages of crop respectively as symptoms in plant. The adult stage of stem borer (moth) never causes any damage. In the life cycle of stem borer there are four stages, namely egg, larva, pupa and adult.

Five species of rice stem borers have been identified which are available in South East-Asia namely; Dark headed stem borer *Chilo polychrysus*(Meyrick), Yellow stem borer *Scirpophagaincertulas*(Walker), Pink stem borer *Sesamiainferens*(Walker), Stripped stem borer *Chilo supressalis*(Meyrick) and White borer *Scirpophagainnotata*(Walker) (DRR, 2006). Yellow stem borer is the most destructive insect pests of rice crop (Mahar *et al.*, 1985) and responsible for an annual yield loss of 10-15% with local catastrophic outbreaks causing up to 60% damage (Daryaei, 2005).

The yellow stem borer *Scirpophagaincertulas* is considered to be the main and destructive pest of rice resulting in an annual yield loss of 27-34 per cent (Prasad *et al.*, 2007). The larval feeding of stem borer and their subsequent inter nodal penetration during vegetative and reproductive stages of rice results in characteristic symptom of dead hearts and white ears, respectively (Sherawat *et al.*, 2007). Globally, YSB alone causes yield losses of 10 mt accounting for 50 per cent of all insecticides usage in rice field. (Huesing and English, 2004)

MATERIAL AND METHODS

The present investigation were conducted during *Kharif* season 2021 at student's instructional farm, A.N.D. University of agriculture and Technology, Kumarganj, Ayodhya (U.P.).

Experimental Site

Geographical location of experiment site fall subtropical climatic zone of Indo-Gangetic plains and situated at 26.47°N latitude and 82.12°E longitude at an altitude of 113 meters from mean sea level. The region receiving mean rainfall about 1200mm, about 80 per cent of total rainfall is received from mid-June to end of September and periods is known as monsoon months. The winter months are very cold, whereas summer months are hot and dry. Westerly hot winds start from end of April and continue till the onset of monsoon.

The location is situated almost in the center of Indo-Gangetic belt, having 5091sq. km area which forms distinct subdivision of India. The nearest sea is the way of Bengal, which is at a more than 800km distinct from the site. The soil type of area is sandy to loam textured, alkaline type, typical to Gangetic plain.

Experimental layout

It was laid out in randomized block design (RBD). Twenty-four days old seedlings were transplanted in the main field of NDR 2065 at the spacing of 20 x 15 cm. The plot size 4 m × 3 m. the variety was NDR 2065 and spacing is 20 × 15 cm.

Determination of incidence of major insect pests of rice

Yellow stem borer :

Observation was started after ten days of transplanting of crop and continued at weekly interval till the harvesting of crop for calculating the per cent damage, total number of tillers /panicle and damage tillers / panicle (DH/WE) was counted on 10 randomly selected hill in each plot. The incidence of per cent dead hearts (% DH) and per cent white ears (%WE) were recorded at the peak infestation during the vegetative stage and reproductive stage of the rice crop. The data was converted into per cent (DH/WE) with the help of the appropriate formula given earlier.

(a) $$\text{DH \%} = \frac{\text{No .of dead hearts in 10 hills}}{\text{Total number of tillers (dead hearts + healthy tillers) in 10 hills}} \times 100$$

(b) $$\text{WE (\%)} = \frac{\text{Total no .of WE in 10 hills}}{\text{Total no .of panicles (WE + healthy panicles) in 10 hills}} \times 100$$

Observations on leaf folder:

In case of leaf folder, total number of leaves and number of damaged leaves caused by leaf folder were counted on 10 randomly selected plants (hills) with observed in each plot in seven days interval to calculate percentage of leaf-damage caused by the respective pest species. Mean of 10 plants were calculated.

$$\% \text{ Leaf damage (LDLF)} = \frac{\text{Total no.of damaged leaves (LDLF) in 10 hills}}{\text{Total no.of leaves (damaged + healthy) in 10 hills}} \times 100$$

Observations on Green leaf hopper, Brown plant hopper and Gundhi bug:

In case of Brown plant hopper (BPH) and Green leaf hopper (GLH) the number of motile (adult and nymph) stages of BPH on all the 10 randomly hills was recorded and total count was averaged and expressed in per hill and for the observations of Gundhi bug, the population was recorded by sweeping insect colleting nets five times across each treatment and the number of nymphs and adults were counted.

Determination the correlation between the abiotic factors

The incidence of Major Insect pest of Rice will be correlated with the meteorological observation. Meteorological data will be obtained from Meteorological department Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya.

Determination of correlation coefficient

The data recorded on the occurrence on insect pest was statistically analyzed in order to determine the correlation coefficient between occurrence of insect-pests and weather factors.

RESULTS AND DISCUSSION

Incidence of Major Insect Pests of Rice

Incidence of yellow stem borer

The incidence of dead hearts (DH %) and white ear heads (WE %) due to yellow stem borer were recorded from one week after transplanting at weekly interval according to standard weeks till before harvesting. The data presented in Table no.1 revealed that, the incidence of stem borer was initiated from 32nd standard meteorological week (SMW) i.e. second week of August with 0.67 percent dead hearts and gradually attained peak infestation at 36th SMW (12.97% DH) i.e. first week of September. Furthermore, the fluctuations in the incidence of stem borer were evident, which again reached second peak at 39th SMW during last week of September with maximum dead hearts (10.62% DH). Then incidence of yellow stem borer was again fluctuated and decreased. Thereafter, incidence of yellow stem borer was continued till harvesting up to 44th SMW (7.41% WE). Similarly, 3.66 percent white ear

head was recorded before harvesting during 45th SMW. The present findings on seasonal incidence were agreement with the results, Kharat (2006), Adiroubane and Raja (2006), Kakde and Patel (2014), Patel and Singh (2017), Sulagatti*et al.* (2017), Samrit *et al.* (2019).

Incidence of leaf folder

Periodical observations on the incidence of folded leaves/damaged leaves due to leaf folder were recorded at weekly interval according to standard metrological weeks. The data presented in Table no.1 revealed that the incidence of leaf folder was initiated from second week of August (32rd SMW) with 0.10 percent damaged leaves and reached peak level during third week of September i.e. 37th SMW with 3.80 percent damaged leaves. Furthermore, the fluctuation in the incidence were recorded, which again reached second peak infestation during second week of October (41th SMW) with 6.75 percent damaged leaves. Then damage of leaf folder was gradually declined to 0.5 percent at the maturity of crop (45th SMW).The present results are in accordance with the result of Alvi *et al.* (2003), Subhash *et al.* (2004), Sankpal (2011), Boopathi (2012), Kakde and Patel (2015), Patil *et al*. (2020).

Incidence of green leaf hopper

The data presented in Table no.1 revealed that the green leaf hopper population initiated from 32nd SMW and remain continued till harvesting (45th SMW). The population of green leaf hopper was very low (0.2 nos./hill) at initiation in second week of August (32nd SMW) and then it gradually increases to attained peak during last week of October (43th SMW) with population of 3.25 nos./hill. Further, the population of green leaf hopper was declined and observed till harvesting i.e., second week of November (45th SMW) with population of 1.13 nos./hill. The present study is in accordance with Kumar and Patil (2004), Shamim *et al*. (2009), Bisen *et al*. (2019).

Incidence of Brown plant hopper

The data presented in Table no.1 revealed that the brown plant hopper population was initiated from 34th SMW and remain continued till harvesting 45th SMW. The population of brown plant hopper was very low (0.15 nos./hill) at initiation in the last week of August (34th SMW) and then it gradually increases and attained peak during first week of November (44th SMW) with population of 9.84 nos./hill. Further the population is observed till harvesting i.e., second week of November (45th SMW) with population of 4.68 nos./hill.The present findings are in accordance with the finding of Choudhary *et al*. (2014), Soni, & Tiwari (2016), Patil *et al*. (2020)**.**

Incidence of Gundhi bug

The data presented in Table no.1 revealed that the incidence of gundhi bug was initiated from first week of October (40th SMW) with population of 0.20 nos./hill. Then it gradually increases and attained peak during first week of November (44th SMW) with population of 0.75 nos./hill. Thereafter, the incidence observed till harvest of the crop (45th SMW) with population of 1.37 nos./hill. The present study is in accordance with and Krishnhaiah*et al*., (2008), Sulagitti*et al*. (2017), Gupta *et al.* (2018).

To Find out the Correlation between Incidence of Major Insect Pest with Abiotic Factors.

Yellow stem borer with weather parameters

The correlation co-efficient analysis data (Table no.2) of stem borer (dead heart) incidence showed that rainfall (r= 0.226), non -significant positive correlation while, minimum temperature (r= 0.325), maximum temperature (r= 0.120) non-significant positive correlation and relative humidity (r= 0.560) had significant positive correlation with stem borer. However, sun shine (r= 0.204) showed non-significantly positive correlation with stem borer at 5 % significant level.

The correlation co-efficient analysis data (Table no.2) of stem borer (white ear) incidence showed that rainfall (r= -0.298), non -significant Negative correlation while, minimum temperature (r=-0.894), maximum temperature (r= -0.785) significant negative correlation and relative humidity (r= -0.799) had significant negative correlation with stem borer. However, sun shine (r= 0.195) showed non-significantly positive correlation with stem borer at 5 % significant level. The result of the present study are in agreement with Pandey *et al*. (2001), Patel and Singh (2017), Sulagatti*et al*. (2017), Pallavi *et al.* (2018), Sharma *et al*. (2018), Shyamrao& Raghuraman (2019).

Correlation of leaf folder with weather parameters

The correlation co-efficient analysis data (Table no.2) indicated that rainfall (r = 0.888) non-significant positive correlation relative humidity (r=-0.185) non-significant negative correlation and with leaf folder incidence. and maximum temperature (r=-0.098) had non- significant negative correlation and minimum temperature (r= -0.124) had non-significant negative correlation However sun shine (0.720) showed significant positive correlation with leaf folder incidence at 5 % significant level. The present study is in accordance with Subhash *et al.* (2004), Kharat (2006), Sankpal (2011), Boopathi (2012) and Jasrotia*et al.* (2019).

Correlation of green leaf hopper with weather parameters

The correlation co-efficient analysis data revealed that relative humidity (r= -0.094) non-significant negative correlation population of green leaf hopper and rainfall (r=-0.205) non-significant negative correlation and minimum temperature (r= -0.513) had significant negative correlation and maximum temperature (r= -0.482) had significant negative correlation with population of green leaf hopper. However sun shine (0.627) had significant positive correlation with population of green leaf hopper. The result of the present study is in agreement with Shamim *et al.* (2009) and Satheesha *et al.* (2020).

Correlation of brown plant hopper with weather parameters

The correlation co-efficient analysis data revealed that, the relative humidity (r=-0.451) had non-significant negative correlation with population of brown plant hopper. and rainfall (r= -0.225) non-significant negative correlation and maximum temperature (r= -0.696) had significant negative correlation with population of brown plant hopper minimum temperature (r= -0.760) showed significant negative correlation However sun shine (0.633) significant positive correlation with population of brown plant hopper at 5% significant level. The present findings are in accordance with the Choudhary *et al*. (2014).

Correlation of Gundhi bug with weather parameters

The correlation co-efficient analysis data revealed that, the relative humidity (r=-0.608) had significant negative correlation with population of Gundhi bug and minimum temperature (r= --0.906) had significant negative correlation while maximum temperature (r= -0.668) significant negative correlation and rain fall (r=-0.313) had non-significant negative correlation However sun shine (0.321) had significant positive correlation with population of Gundhi bug. The present study is in accordance with Sulagitti*et al.* (2017), Singh *et al.* (2018).

CONCLUSIONS

The maximum Stem borer damage (DH) 12.97 per cent were recorded during 36th SW. Minimum dead hearts 0.67 per cent were recorded during 32th SW with minimum temperature. The maximum Stem borer damage (WE) 7.41 per cent were recorded during 44th SW. Minimum White ear 3.66 per cent were recorded during 46th SW. Incidence of leaf folder was initiated from second week of August (32th SMW) with 0.10 percent damaged leaves and reached peak level during third week of September i.e. 37th SMW with 3.80 percent damaged leaves. The green leaf hopper populations initiated from 32nd SMW and remain continued till harvesting (45th SMW). The population of green leaf hopper was very low (0.02 nos./hill) at initiation in second week of August (32nd SMW) and then it gradually increases to attained peak during last week of October (43th SMW) with population of 3.25

nos./hill.The brown plant hopper population was initiated from 34th SMW and remains continued till harvesting 45th SMW. The population of brown plant hopper was very low (0.15 nos./hill) at initiation in the last week of August (34th SMW) and then it gradually increases and attained peak during first week of November (44th SMW) with population of 9.84 nos./hill. The incidence of gundhi bug was initiated from first week of October (40th SMW) with population of 0.20nos./hill. Then it gradually increases and attained peak during first week of November (44th SMW) with population of 0.75 nos./hill.

The stem borer (dead heart) incidence showed that rainfall (r= 0.226), non -significant positive correlation while, minimum temperature (r= 0.325), maximum temperature (r= 0.120) non-significant positive correlation and relative humidity (r= 0.560) had significant positive correlation with stem borer. The correlation of stem borer (white ear) incidence showed that rainfall (r= -0.298), non-significant Negative correlation while, minimum temperature (r=-0.894), maximum temperature (r= -0.785) significant negative correlation and relative humidity (r= -0.799) had significant negative correlation with stem borer and positive correlation with sun shine.The correlation co-efficient analysis indicated that rainfall (r = 0.888) non-significant positive correlation, relative humidity (r=-0.185) non-significant negative correlation with leaf folder incidence. The maximum temperature (r=-0.098) and minimum temperature (r= -0.124) was non-significant negative correlation however, sun shine (0.720) showed significant positive correlation. The correlation co-efficient analysis revealed that relative humidity (r= -0.094) non-significant negative correlation population of green leaf hopper and rainfall (r=-0.205) non-significant negative correlation and minimum temperature (r= -0.513) and maximum temperature (r= -0.482) was showed significant negative correlation, however sun shine (0.627) significant positive correlation with population of green leaf hopper. The correlation co-efficient analysis revealed that, the relative humidity (r=-0.451) and rainfall (r= -0.225) was showed non-significant negative correlation with population of brown plant hopper. The maximum temperature (r= -0.696) and minimum temperature (r= -0.760) showed significant negative correlation, however sun shine (0.633) significant positive correlation with population of brown plant hopper at 5% significant level. The correlation co-efficient analysis revealed that, the relative humidity (r=-0.608), minimum temperature (r=-0.906) and maximum temperature (r= -0.668) was significant negative correlation while, rain fall (r=-0.313) non-significant negative correlation, however sun shine (0.321) significant positive correlation with population of Gundhi bug.

Table 1: Incidence of major insect pests of rice crop during *kharif* 2021

SMW	Yellow stem borer		Leaf folder % damage	GLH (No./hill)	BPH (No./hill)	Gundhi bug (No./hill)	Abiotic factor				
	DH%	WE%					Temprature (^{o}C)		RH (%)	Rainfall (mm)	Sun Shine (hrs)
							Min (^{o}C)	Max. (^{o}C)			
28	0.00	0.00	0.00	0.00	0.00	0.00	27.1	34.8	74.3	00.00	6.7
29	0.00	0.00	0.00	0.00	0.00	0.00	26.8	34.1	80.9	38.0	3.0
30	0.00	0.00	0.00	0.00	0.00	0.00	27.2	34.4	79.6	37.4	4.2
31	0.00	0.00	0.00	0.00	0.00	0.00	26.1	33.2	76.0	3.0	5.9
32	0.67	0.00	0.10	0.20	0.00	0.00	26.2	32.2	85.9	125	3.4
33	4.65	0.00	0.21	0.28	0.00	0.00	26.2	33.8	80.8	18.8	5.4
34	6.25	0.00	0.35	1.36	0.15	0.00	25.5	32.2	87.8	24.6	2.6
35	10.25	0.00	0.68	0.28	0.25	0.00	26.1	32.7	81.2	1.0	5.5
36	12.97	0.00	1.35	0.57	0.66	0.00	26.2	33.7	79.4	42.4	3.9
37	8.91	0.00	3.80	0.87	2.33	0.00	25.5	32.1	78.8	206.0	5.6
38	8.95	0.00	2.15	1.75	2.86	0.00	25.0	31.1	85.8	41.0	6.7
39	10.63	0.00	3.25	1.85	4.33	0.00	25.1	32.2	84.5	63.0	7.3
40	9.53	0.00	5.40	2.35	4.70	0.20	24.5	32.7	82.8	18.0	8.1
41	7.57	0.00	6.75	2.78	5.65	0.30	24.0	34.0	84.5	00	9.0
42	8.16	0.00	4.85	2.85	7.46	0.15	23.6	31.8	81.3	24	6.9
43	0.00	5.48	2.68	3.25	8.50	0.23	18.2	31.1	68.0	00	6.5
44	0.00	7.41	1.7	2.13	9.84	0.75	15.0	27.7	68.3	00	6.6
45	0.00	3.66	0.5	1.13	4.68	1.37	13.7	29.7	69.4	00	6.5

Table 2: Correlation between incidences of major insect pest with abiotic factors.

Major Insect-Pest of Rice crop		Abiotic factor				
		Temprature(^{o}C)		Relative humidity (%)	Rainfall (mm)	Sun Shine (hrs)
		Min (^{o}C)	Max. (^{o}C)			
Yellow stem borer	DH%	NS(0.325)	NS(0.120)	0.560	NS(0.226)	NS(0.204)
	WE%	-0.894	-0.785	-0.799	NS(-0.298)	NS(0.195)
Leaf folder % damage		NS(-0.124)	NS(-0.098)	NS(-0.185)	NS(0.088)	0.720
Green leaf hopper (No./hill)		-0.513	-0.482	NS(-0.094)	NS(-0.205)	0.627
Brownplant hopper (No./hill)		-0.760	-0.696	NS(-0.451)	NS(-0.225)	0.633
Gundhi bug (No./hill)		-0.906	-0.668	-0.608	NS(-0.313)	NS(0.321)

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