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Study on Seasonal Incidence of Insect Pests in Rice (*Oryza sativa* L.) Ecological Engineering Field

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ABSTRACT: The present experiment was carried out at Ecological Engineering Research Field, NIPHM, Rajendranagar, Hyderabad to study the seasonal incidence of insect pests of rice crop, during *kharif* 2020-21. The yellow stem borer incidence was started from 2nd week of July and the pest population reached its highest level during the 4th week of September. The leaf folder and gundhi bug infestation reached its highest level during 4th week of August and 4th week of September, respectively. Brown plant hopper and green leaf hopper appeared in rice crop from August to October and the population gradually decreased as the crop reached the harvesting stage. Grass hopper observed in rice crop during 2nd week of August and gained highest level during 1st week of October. Rice butterfly was first observed during 4th week of July and reached its highest level during 4th week of September. These findings will be helpful for proper and timely management of insect pests in rice ecosystem.

Keywords: Yellow stem borer, Leaf folder, Gundhi bug, Brown plant hopper, Seasonal incidence, Abiotic factors, Ecological Engineering.

INTRODUCTION

Rice (*Oryza sativa* L.) is an important cereal crop in the world, serving as staple diet for millions of peoples and stands second in the world after wheat in area and production. In Asia almost 90% of the rice is grown and consumed (Anonymous, 2006). In India it is cultivated on an area of 44.00 million hectares with a production of 104.80 million tonnes and productivity of 2177 kg/ha. In Telangana state of India annually rice is grown on 44.00 lakh acres and produces 7.34 million tonnes. Worldwide upto 37% rice crop is damaged by many insects species. An average loss of 25-30% in paddy production due to the damage of insect pests was recorded in India (Dhaliwal and Arora 2010) where as in the state of Telangana about 40-50 % loss is observed (Anonymous, 2017).

The rice crop is subjected to damage by many number of insect pests, among them the yellow stem borer, *Scirpophaga incertulas* (Walker) is the major insect pest causing dead hearts and white ears leading to major economic damage (Satpathi *et al.,* 2012). The rice leaf folder, *Cnaphalocrocis medinalis* (Guenee), which was considered as a minor pest, during last decades has assumed a major pest status (Nanda *et al.,* 2000). The larvae fold the leaves and scrape the green tissues showing scorching and drying symptoms. The yield loss, to the extent of 5 to 25% was reported due to the damage caused by leaf folder (Kulgagod *et al.,* 2011).

The sucking pests like Brown plant hopper (BPH), *Nilaparvata lugens* (Stal); Green leaf hopper (GLH), *Nephotettix virescens* and Rice gundhi bug, *Leptocorisa acuta* (Thunberg) causes damage by sucking plant cell sap. The brown plant hopper (BPH) and green leaf hopper (GLH) are economically important pests as they oviposit in plant tissues and suck sap that leads to plant wilting and hopper burn symptoms (Turner *et al.,* 1999). They cause direct damage to rice crop by feeding on the phloem sap and indirectly by transmitting viral diseases like grassy stunt virus and tungro virus (Sogawa, 1992). Gundhi bug sucks the sap from individual grains in milky stage and make them chaffy.

Recently, ecological based pest management strategies in rice crop are gaining importance. In above point of view, the main component of any pest management programme is to regular monitoring of field, study the incidence period of pest and its distribution on crop. Seasonal incidence study helps, in planning need based plant protection strategies which shows exact peak activity and free periods of insect pests on crop. The insect pest population may vary due to various abiotic (environmental factors) and biotic (biological control) factors of an area. The present study was conducted, to know the effect of abiotic factors on the incidence of

pest population on rice crop grown at NIPHM ecological engineering field during *kharif* 2020-2021.

MATERIALS AND METHODS

The experiment was conducted during the *kharif* 2021, at Ecological Engineering Research Farm, NIPHM, Rajendranagar, Hyderabad, India. In the experiment, the rice variety RNR-15048 was sown on 28th June 2021. The seedlings of sufficient age were transplanted to the main field during last week of July with a spacing of 20 × 15 cm^2 in hills and all the agronomical practices *viz.*, irrigation, intercultural operations and bioinput applications were followed as recommended by ecological engineering principles to raise the rice crop. No pesticides application was followed throughout the crop period, to get a natural pest incidence on the crop.

Collection of Insect pests and their observation. In rice crop the seasonal incidence of insect pests was studied on an area of 100 m^2. The nursery was raised beside to the main experiment plot, in order to study the population build up of insect pests. The pest population was recorded in this unprotected area at 7 days interval from the occurrence of pest, both from nursery and main field and was continued upto maturity. The incidence of insect pests were observed and recorded on 10 plants selected randomly. The population count on yellow stem borer was taken on number of dead hearts/white ears and total number of tillers/panicles from 10 randomly selected plants. The per cent incidence (dead heart/white ears) was calculated as follows

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

In case of leaf folder number of damaged leaves and total leaves from 10 randomly selected plants were observed. The percentage of leaf damage was calculated as follows

$$\text{Percent incidence} = \frac{\text{Number of damaged leaves by leaf folder}}{\text{Total number of leaves}} \times 100$$

In case of rice butterfly number of damaged leaves and total leaves from 10 randomly selected plants were observed. The percentage of leaf damage was calculated as follows

$$\text{Percent incidence} = \frac{\text{Number of damaged leaves by rice butterfly}}{\text{Total number of leaves}} \times 100$$

In case of leaf folder and rice butterfly the number of larvae observed per 10 hills were counted.

The number of nymph and adult stages of brown plant hopper, green leaf hopper, gundhi bug and grasshopper on all the 10 hills were recorded.

Simultaneously, weather data was recorded from the meteorological observatory of Agricultural Research Institute, Professor Jayashanker Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India and was correlated with the pest population occurrence. A correlation coefficient method was used to find out the relationship, between the occurrence of the pest population and the weather parameters.

The correlation coefficient (r) analysis was carried out by using OP STAT.

Statistical analysis. Weekly data of pest population was correlated with the prevailing climatic factors such as maximum, minimum and average temperature, morning, evening and average relative humidity and rainfall.

RESULTS AND DISCUSSION

In the present study, yellow stem borer appeared in rice crop during 2nd week of July *i.e.* 29th S.W. (0.3%) and the pest population reached its peak of (6.6%) during the 4th week of September *i.e.* 39th S.W. (Table 1, Fig 1). But the actual action was started from 3rd week of August *i.e.* 34th S.W. Therefore, the maximum activity of pest is observed from August-September. In case of white ears there was a gradual increase, and reached its highest level during 3rd week of October *i.e.* 43rd S.W. (4.0%). The correlation analysis revealed that, the yellow stem borer incidence (% dead heart) showed a positive non-significant correlation, with morning, evening, average relative humidity and minimum temperature (r = 0.189, 0.412, 0.375 & 0.220) and a negative non-significant correlation observed with rainfall, maximum and average temperature (r = -0.036, -0.460 & 0.194) (Table 2). The per cent white ears, was found to be negative significant correlation with morning, evening, average relative humidity and minimum temperature (r = -0.682, -0.754, -0.762 & -0.735) and a negative non-significant correlation was observed with rainfall and average temperature (r = -0.225 & -0.262) and maximum temperature showed a positive non-significant correlation (r = 0.246). In the vegetative stage, the incidence of borers was higher as compared to reproductive stage. This results are similar to the findings of Sulagitti *et al.* (2017); Sharma *et al.*, (2018) who reported that the maximum activity of yellow stem borer was observed during September-October. The present findings correlating abiotic factors with rice yellow stem borer are in line with the results of Pathak (1994); Pujari *et al.* (2007); Sulagitti *et al.* (2017) revealed that the peak activity of the stem borer is observed during the vegetative stage of the crop. Swetha and Chandra Pal (2017), reported that relationship of weather parameters, indicated that they play major role in creating the variation in rice yellow stem borer prevalence.

The incidence of leaf folder infestation begin during 3rdweek of July *i.e.* 30th S.W. (1 larvae/10 hills) and the larval population increased gradually till 2nd week of August *i.e.* 33rd S.W. with (5 larvae/10 hills) (Table 1, Fig. 1) and the pest population reached its highest level during 4th week of August *i.e.* 35th S.W. (6 larvae/ 10 hills). Later the population started decreasing, when the crop attained maturity. The correlation analysis revealed a positive non-significant relation with morning, evening, average relative humidity, minimum and average temperature (r = 0.282, 0.353, 0.348, 0.371 & 0.040) and showed negative non-significant with rainfall and maximum temperature (r = -0.159 & -0.255).

Table 1: Seasonal incidence of insect pests on rice during *Kharif*, 2020-2021.

Standard week	Respective Month and Dates	*S. incertulas* (Percent incidence/10 hills)		*C. medinalis* (No. of larvae/10 hills	*L. acuta* (No. of insects/10 hills)	*N. lugens* (No. of insects/10 hills)	*N. virescens* (No. of insects /10 hills)	*H. banian* (No. of insects/10 hills)	*M. leda* (No. of larvae/10 hills)	Temperature (°C)			Relative Humidity (%)			Rainfall (mm)
		% DH	% WE							Max.	Min.	Avrg.	Morng.	Evng.	Avrg.	
27	June 28- July 4	0	0	0	0	0	0	0	0	32.4	23.7	28.05	94.9	60.7	77.8	3.6
28	July 5-11	0	0	0	0	0	0	0	0	32.6	23.5	28.05	94.9	73.6	84.25	6.1
29	July 12-18	0.3	0	0	0	0	0	0	0	28.6	23.1	25.85	97.7	85.7	91.7	23.6
30	July 19-25	0.8	0	1	0	0	0	0	0	27.8	22.3	25.05	98.9	87.4	93.15	11.4
31	July 26-1	1.3	0	2	0	0	0	0	1	30.5	23.3	26.9	95.8	75.5	85.65	0.3
32	Aug 2-8	2.3	0	3	0	1	0	0	2	31.0	23.1	27.05	96.6	76.6	86.6	0.0
33	Aug 9-15	2.5	0	5	0	1	0	1	3	32.8	24.1	28.45	93.4	65.6	79.5	0.3
34	Aug 16-22	3.6	0	5	1	2	1	1	5	28.3	22.6	25.45	94.4	80.0	87.2	7.7
35	Aug 23-29	4.2	0	6	2	3	2	2	7	30.9	22.9	26.9	96.0	71.1	83.55	3.4
36	Aug 30 to Sep 5	4.6	0	5	2	5	4	2	8	28.6	22.5	25.55	99.0	77.0	88	6.8
37	Sep 6-12	5.4	0	4	4	7	4	3	10	27.4	22.2	24.8	93.4	80.1	86.75	8.6
38	Sep 13-19	6.0	0	4	4	8	5	5	12	29.7	22.9	26.3	90.7	69.3	80	0.9
39	Sep 20-26	6.6	2.5	3	5	9	7	7	13	29.7	22.4	26.05	95.3	74.7	85	6.8
40	Sep 27 to Oct 3	0	3.2	2	6	12	9	9	16	31.3	22.8	27.05	94.0	60.0	77	0.2
41	Oct 4-10	0	3.6	1	4	13	5	12	12	31.9	22.3	27.1	92.4	60.4	76.4	13.0
42	Oct 11-17	0	3.8	0	3	9	3	6	8	31.2	21.0	26.1	91.4	63.4	77.4	0.2
43	Oct 18-24	0	4.0	0	2	5	1	3	5	30.6	20.4	25.5	87.7	49.0	68.35	1.1
44	Oct 25-31	0	4.2	0	1	1	1	1	1	30.4	18.1	24.25	88.3	47.1	67.7	0.0

These findings, are similar to the results of Ahmed *et al.* (2010); Sharma *et al.* (2018) who reported that maximum, minimum and average temperature had no impact on leaf infestation by leaf folder. These results are also almost similar to the results of Bhumireddy *et al.* (2018); Khan *et al.* (2004) reported that minimum temperature, temperature gradient had a negative influence on leaf folder population.

The incidence of gundhi bug was noticed during 3rd week of August *i.e.* 34th S.W. (1/10 hills) and attained its highest level during 4th week of September *i.e.* 40th S.W. (6/ 10 hills). Correlation analysis revealed that negative significant correlation was observed with rainfall, morning, evening, average relative humidity, minimum, maximum and average temperature (r = -0.102, -0.300, -0.233, -0.256, -0.106, -0.168 &-0.174). The present results are in close association with the findings of Sulagitti *et al.*, (2017) reported that highest number of rice gundhi bugs were recorded during the 4th week of October.

Brown plant hopper, appeared in rice crop during 1st week of August *i.e.* 32nd S.W. (1/ 10 hills) and its activity gained actual shootout during the 1st week of September *i.e.* 36th S.W. (5/10 hills) and reached highest level during 1st week of October *i.e.* 41st S.W. (13/ 10 hills) (Table 1). Later on the population of brown plant hopper decreased as the crop reached the maturity. The correlation analysis revealed a positive non-significant correlation with maximum temperature (r = 0.026) and showed a negative non-significant correlation with rainfall, morning, evening, average relative humidity, minimum and average temperature (r = -0.064, -0.326, -0.294, -0.311, -0.153 & -0.072). A similar results of, incidence of brown plant hopper are in line with the finding of Patil *et al.* (2020); Anil Kumar *et al.* (2020).

Green leaf hopper was observed during 3rdweek of August *i.e.* 34th S.W. (1/10 hills) and its activity gained momentum during 3rd week of September i.e. 38th S.W. (5 / 10 hills) and reached highest level during 4th week of September 40th S.W. (9/10 hills). Later on the green leaf hopper population has decreased as the crop reached the maturity. The correlation analysis revealed a negative non-significant correlation with rainfall, morning, evening, average relative humidity, maximum, minimum and average temperature with the population (r = -0.078, -0.132, -0.159, -0.158, -0.090, -0.063 & -0.101) (Table 2, Fig. 1). Shamim *et al.* (2009); Begum *et al.* (2014) also found the highest number of green leaf hopper activity during October and November. Results of Shamim *et al.* (2009); Anuj and Saxena (1999) reported that green leaf hopper had a negative non-significant correlation with temperature, evening relative humidity and rainfall.

In rice crop, grass hopper appeared during 2nd week of August i.e. 33rd S.W. (1/10 hills) and its action gained during 3rd week of September *i.e.* 38th S.W. (5/10 hills) and gained highest level at 1st week of October (12/10 hills). Gradually, the population decreased as the crop reached the harvesting stage and the correlation analysis revealed a positive non-significant correlation with maximum and average temperature (r = 0.162 & 0.034) while the remaining weather parameters rainfall, morning, evening, average relative humidity and minimum temperature are negative and non-significantly correlated with the population (r = -0.008, -0.327, -0.350, -0.356 & -0.135).

Rice butterfly was first observed during 4th week of July *i.e.* 31st S.W. (1 larvae/10 hill) and its activity, gained actual shootout during 4th week of August *i.e.* 35th S.W. (7 larvae/10 hills) and reached its highest level during 4th week of September *i.e.* 40th S.W. (16/10 hills) and gradually decreased as the crop reached the harvesting stage around 2nd week of October. The correlation analysis of rice butterfly revealed a negative non-significant correlation with rainfall, morning, evening, average relative humidity, maximum, minimum and average temperature (r = -0.124, -0.214, -0.164, -0.181, -0.082, -0.029 & -0.075) while other weather parameters found negative non-significant correlation with the population (Table 2, Fig. 1). Similar to the present findings, Muchhala (2014) reported three distinct peaks during 38th, 42nd and 44th S.W. respectively. Major activity periods was observed from August to December.

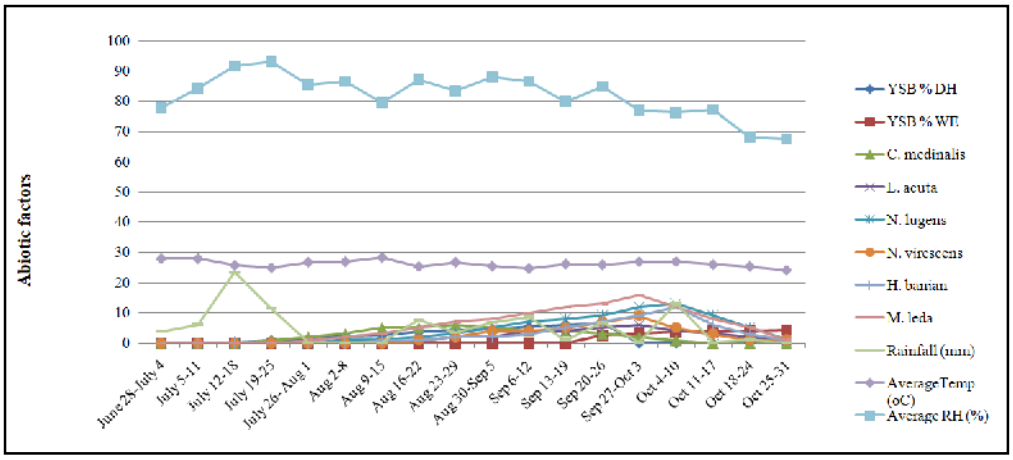

Fig. 1. Influence of abiotic factors on the abundance of various insect pests of rice.

Table 2: Correlation coefficient (r) of insect pest population on rice with prevailing weather parameters during *kharif*, 2020-21.

Insect Pests		Rainfall	Weather parameters					
			Relative Humidity			Temperature		
			Morning	Evening	Average	Maximum	Minimum	Average
S. incertulas	**%DH**	-0.036^{NS}	0.189^{NS}	0.412^{NS}	0.375^{NS}	-0.460^{NS}	0.220^{NS}	-0.194^{NS}
	%WH	-0.225^{NS}	-0.682**	-0.754**	-0.762**	0.246^{NS}	-0.735**	-0.262^{NS}
C. medinalis		-0.159^{NS}	0.282^{NS}	0.353^{NS}	0.348^{NS}	-0.255^{NS}	0.371^{NS}	0.040^{NS}
L. acuta		-0.102^{NS}	-0.300^{NS}	-0.233^{NS}	-0.256^{NS}	-0.106^{NS}	-0.168^{NS}	-0.174^{NS}
N. lugens		-0.064^{NS}	-0.326^{NS}	-0.294^{NS}	-0.311^{NS}	0.026^{NS}	-0.153^{NS}	-0.072^{NS}
N. virescens		-0.078^{NS}	-0.132^{NS}	-0.159^{NS}	-0.158^{NS}	-0.090^{NS}	-0.063^{NS}	-0.101^{NS}
H. banian		-0.008^{NS}	-0.327^{NS}	-0.350^{NS}	-0.356^{NS}	0.162^{NS}	-0.135^{NS}	0.034^{NS}
M. leda		-0.124^{NS}	-0.214^{NS}	-0.164^{NS}	-0.181^{NS}	-0.082^{NS}	-0.029^{NS}	-0.075^{NS}

** Correlation is significant at the 0.01 level

CONCLUSION

The present research study on insect pests of rice revealed that, during vegetative phase of plant the incidence of yellow stem borer on the per cent dead hearts were observed highest and per cent white ears were highest during reproductive phase of the crop. Therefore, control measures to be taken in early stages to avoid loss in reproductive phase. The leaf folder infestation started during 2nd week of July and recorded its peak population during 2nd week of September. The rainfall and average temperature didn't get any affect on leaf folder population as so, it was better to take preventive measures from July month to October month. Gundhi bug attacked the crop during grain filling to milking stage of crop and causes greater loss by producing chaffy grains and they can be easily controlled by collecting sweep nets in observed period. The seasonal incidence revealed that the population of brown plant hopper was appeared in rice crop during 1st week of September *i.e*. the population increased with decreased in rainfall as negative correlation was observed with rainfall. The population of green leaf hopper was observed during 2nd week of September and population decreased when the crop attained maturity. As the field being maintained without use of pesticides and fertilizers following ecological engineering principles, the insect pests population were recorded below ETL level. For proper and timely management of the insect pests of ecological engineering rice field, these findings could be helpful.

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Conflict of Interest. None.

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