Original Research Article

Impact of climate variables on occurrence of rice earhead bug, *Leptocorisaoratorius*(F.) (Hemiptera: Alydidae)

Abstract

Rice earhead bug, *Leptocorisa*oratorius (F.) (Hemiptera: Alydidae) is one of the major sucking pests of rice, causing significant yield losses worldwide. The population fluctuation and infestation of earhead bug is influenced by different meteorological parameters. A field experiment was conducted at the ICR (Instructional Cum Research) Farm, Assam Agricultural University, Jorhat with a view to study the occurrence of rice earhead bug, *L. oratorius*on rice crop during *Ahu* (Autumn rice) season, 2018 and 2019. The population of *L. oratorius*was first observed in the field during the month of May and attained its peak population (2.66 and 1.56 adult per hill) on second and third week of June in 2018 and 2019, respectively. The occurrence of *L. oratorius* was also correlated with the different climate variables *viz.,* temperature, relative humidity, rainfall and bright sunshine hour (BSSH). The correlation analysis revealed no significant impact of climatic variables on the occurrence of *L. oratorius* population during 2018, while all the variables except rainfall showed significant correlation with the occurrence of *L. oratorius* population during 2019. In 2019, a significant best fit multiple regression model was developed for *L. oratorius* to predict their seasonal occurrence under agro-climatic condition of Jorhat, Assam. The percent grain infestation was also recorded during 2018 and 2019, which was found to be 39.34 and 37.11 per cent, respectively.

Keywords: Occurrence, earhead bug, climate variables, correlation, per cent grain infestation

1. Introduction

Rice is the major diet for over half of the world's population. It is the second largest cereal grown in the world after maize and is grown in an area of about 160.9 million hectares, with a total production of 487 million metric tons and productivity of 4.44 metric tons per hectares in 2014

(USDA, 2015). In India, rice production is estimated 116.42 million ton over an area of 43.79 million ha with a productivity of 2659 kg/ha, which accounts for around 22.1% of global production (US$ 1.6 billion) (Anonymous, 2019; Das *et al*., 2020). In Assam, rice is grown on 2.46 million ha of land, yielding 5.14 million ton, with a productivity of 2086 kg/ha (Anonymous, 2019; Das *et al*., 2020). Based on geoclimatic variations and rainfall status of Assam the rice growing seasonsare mainly classified as winter or *Sali* rice (June-July to November- December), autumn or *Ahu* rice (March-April to June-July) and summer or *Boro* rice (November-December to May-June).

Besides the abiotic factors, rice production system is also threatened by different biotic factors and among these, insect pest are the major contributor. Approximately 300 species of insect pests have been identified on rice crop at various growth phases of the crop, and out of these, 23 species can cause significant losses (Das *et al*., 2021). In India, insect infestation can reduce rice yield by 25% (Mondal *et al*., 2017; Das *et al*., 2021). After transplanting of rice crop significant yield losses caused by some borers, epidermal feeders and sucking pests. The rice earhead bug, *L. oratorius* is one of the major sucking pests of rice, whose infestation can lower the production by 15-30% (Baharally& Simon, 2014; Tiwari *et al*.,2014; Gupta *et al*., 2018; Das *et al*., 2021). The earhead bug attack rice crop at reproductive stage particularly at milky stage of the crop. Both the nymphs and adults puncture the grains and suck the sap from milky grains and turn them chaffy. Under severe infestation, the colour of whole panicle becomes white. However, the application of insecticides to this reproductive phage is quite challengeable. The population fluctuations and infestation of earhead bug are also influenced by different weather parameters *viz.*, temperature, relative humidity, bright sunshine hour and rainfall etc. Till now, no study has been conducted on occurrence of rice ear head bug and their correlation with different meteorological parameters during *Ahu* season. Hence, the present investigation was carried out to observe the effect of climate variables on the population of rice earhead bug during *Ahu* (Autumn) season, 2018-2019 and established a relationship between them so that the farmers can predict the upcoming pest problem and minimize the crop losses by formulating an effective pest management strategy which ultimately reduces the use of insecticides. Moreover, the infestation of earhead bug on rice was also studied.

2. Materials and Methods

The experiment was conducted during *Ahu* (Autumn) season of rice crop, 2018 and 2019 at the ICR (Instructional Cum Research) Farm, Assam Agricultural University, Jorhat with a view to study the occurrence of rice earhead bug, *L. oratorius*. The experiment was conducted with a net area of 65 sq.m. The net area was divided into three equal plots measuring 16 sq.m (4 m X 4m) each where, each plot served as a replication. In the experiment, the variety 'Luit' was taken under supervision. Luit is a short duration variety and takes about 90 to 100 days to mature and suitable for rainfed low land conditions. The seedlings were transplanted to the main field on 13th of March, 2018 and 11th of March, 2019, with spacing of 20 cm between rows and 10 cm between plants. The crop was regularly monitored and observed for the presence of *L. oratorius*at weekly interval from 10 randomly selected hills in each plot starting from panicle initiation to till harvesting of the crop. The results obtained from the present investigation were then correlated with meteorological parameters (Kalita *et al*., 2015; Das *et al*., 2021).

The entire experimental area was divided into three plots to estimate the grain infestation percentage. Three numbers of panicles were taken from each of the five hills that were collected from each plot. Each plot was considered as a replication. The total number of grains (infested and uninfested) and the number of infested grains per panicle were counted in order to determine the per cent grain infestation. Infested grain percentage was calculated using the formula as mentioned below (Aktar *et al*., 2020; Das *et al*., 2021):

$$\text{Per cent grain infestation} = \frac{\text{Total no. of infested grain}}{\text{Total no. of grain (Infested + uninfested)}} \times 100$$

3. Results and Discussion

3.1 Seasonal occurrence of *L. oratorius*

3.1.1 Occurrence of *L. oratorius*during *Ahu* season, 2018 & 2019

The population of *L. oratorius* was first observed during the initiation of reproductive phase (third week of May) with 0.33 and 0.30 adults per hill in the year 2018 & 2019, respectively. However the maximum number of adult (2.66 and 1.56 adults per hill) were observed during second and third week of June *i.e.* 24th week for both the years (Table 1 and Table 2, Fig. 1 and 2). The results of the present investigation were found to be similar with the findings of Girish *et al*. (2012) and Das *et al*. (2021) who reported earhead bug population was mainly confined during reproductive phase of the crop. During the reproductive phase, flowering can occur which favours the maximum population of gundhi bug coupled with high temperature and humidity (Khare *et al*., 2020).

Table 1. Seasonal occurrence ofriceearheadbug(*Leptocorisaoratorius*)during*Ahu* season,2018

Weeks	Number of adult /hill	Temp. (ºC)		Relative Humidity (%)		Rainfall (mm.)	Bright Sun Shine Hours (BSSH)
		Max.	Min.	Mor.	Eve.		
18	0	28.6	20.5	93	72	39.7	3.1
19	0	28.1	21.2	96	77	25.5	2.8
20	0.33	32.0	22.1	90	64	73.4	7.1
21	0.56	33.2	24.1	91	72	86.3	3.7
22	1.13	31.1	24.1	94	73	17.2	4.1
23	1.76	34.5	25.1	92	65	72.2	6.7
24	2.66	31.7	25.0	97	82	99.4	1.0
25	1.66	32.5	25.3	95	83	35.2	3.1
26	0.90	33.3	24.8	94	74	25.5	3.5
27	0.43	32.3	25.6	93	80	110.6	2.4
28	0.20	34.3	25.8	92	71	46.3	5.2

Table 2. Seasonal occurrence ofriceearhead bug(*Leptocorisaoratorius*)during*Ahu* season,2019

Weeks	Number of adult/hill	Temp. (ºC)		Relative Humidity (%)		Rainfall (mm.)	Bright Sun Shine Hour (BSSH)
		Max.	Min.	Mor.	Eve.		
18	0	25.9	21.1	98	83	192.2	1.7
19	0	26.1	20.6	96	84	51.6	1.5
20	0.30	28.3	21.2	95	79	52.9	1.9
21	0.63	28.4	22.5	93	80	75.9	1.4
22	0.93	31.2	23.7	90	67	14.0	4.8
23	1.30	32.2	24.9	93	74	48.8	2.6
24	1.56	33.7	25.9	86	71	55.9	3.6
25	1.20	32.8	25.6	90	76	149.5	4.5
26	0.76	32.7	25.4	90	76	65.4	3.8
27	0.50	33.8	25.7	95	76	194.9	3.9
28	0.26	29.3	25.1	93	90	65.4	0.0

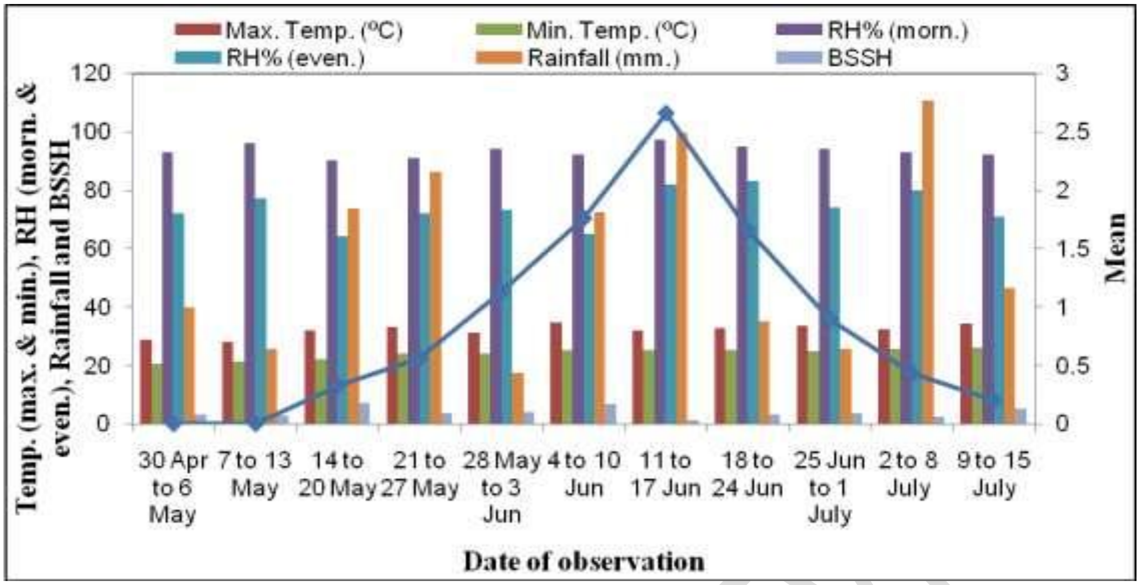

Fig. 1. Occurrence of rice earhead bug, *Leptocorisaoratorius*during *Ahu*, 2018

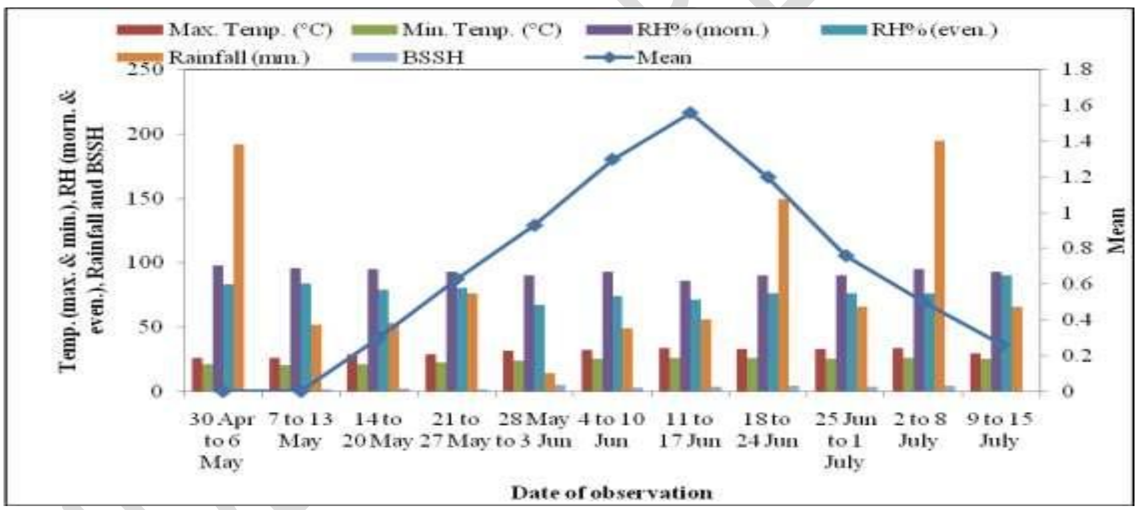

Fig. 2. Occurrence of rice earhead bug, *Leptocorisaoratorius*during *Ahu*, 2019

3.2Correlation of *L. oratorius*incidence with meteorological parameters during *Ahu*, 2018 & 2019

The results of the correlation analysis showed that in 2018, the adult population of rice earhead bug (*L. oratorius*) correlated positively but non-significantly with maximum temperature (r = 0.353), minimum temperature (r = 0.536), morning relative humidity (r = 0.469), evening relative humidity (r = 0.333), and rainfall (r = 0.251) whereas, non significant negative correlation was found with BSSH (r = -0.227) (Table 3). These findings closely align with those of Das *et al*. (2021) who observed a non significant positive correlation between gundhi bug(rice earhead bug) and maximum temperature.

However, in 2019, there was a significant positive correlation between the adult population of earhead bug and the maximum temperature (r = 0.802), minimum temperature (r = 0.711) and BSSH (r = 0.631) while, a significant negative correlation with morning relative humidity (r = -0.849), evening relative humidity (r = -0.750) and non significant negative correlation with rainfall (r = -0.255) were found (Table 3). Similarly, Kalita *et al.* (2015) also found a non-significant negative correlation between the total rainfall (r= -0.018) and gundhi bug population during 2007. Sulagitti*et al*. (2017) also recorded a non significant negative correlation between rainfall (r= - 0.087) and gundhi bug population. According to Gupta *et al*. (2018) the gundhi bug incidence had significant positive correlation with BSH (r= 0.556) and non significant negative correlation with rainfall (r= -0.356).

Table3.Correlation between the population of*L.oratorius*andmeteorological parametersduring*Ahu* season, 2018 &2019

Meteorological parameters	**Year**	
	2018	**2019**
Maximum temperature	0.353	0.802*
Minimum temperature	0.536	0.711*
Morning relative humidity	0.469	-0.849*
Evening relative humidity	0.333	-0.750*
BSSH	-0.227	0.631*
Rainfall (mm)	0.251	-0.255

***=Significantat5%**

The correlation analysis helps to predict the forthcoming infestation of rice earhead bug in *Ahu* season so that the farmers can escape the crop damage by formulating an effective pest management strategy which ultimately reduces the use of pesticides. The non significant correlation between the population of earhead bugs and climatic variables in 2018 may be a result of the effect of other (biotic) factors, which might lead to an increase in population.

Because table 1 shows that even though there were more rainfall and lower temperatures in the 24th week of 2018 than in the same week in 2019, there were still a large number of riceearhead bugs (2.66 adults/hill).

The best fit multiple regression equation was established to forecast the population of *L. oratorius*with meteorological parameters during *Ahu* season, 2019 as it showed the significant result. The multiple regression analysis is between population of *L. oratorius*as dependent variables and all the parameters under the study as independent variables. The results revealed that only morning relative humidity determined the occurrence of rice earhead bug [R^2 =0.721 (72.10%) and adjusted R^2= 0.691 (69.10 %)] (Table 4). The multiple regression equation Y= 12.82531-0.13115*Mor. RH (%) expressed the magnitude of the relationship during *Ahu* season, 2019. This "best fit model" predicts the seasonal occurrence of *L. oratorius* on rice crop under Jorhat agro-climatic condition.

Table4. Multipleregressionequationof *Leptocorisaoratorius*occurrencewith meteorologicalparameters during*Ahu* season, 2019

Multipleregressionequation	R^2	AdjustedR^2
12.82531-0.13115*Mor. RH(%)	0.721	0.691

3.3 Damage Percentage

There is a direct relation between the earhead bug population and infested grain percentage. The population of earhead bug was more in 2018 as compared to the 2019. The percent of grain infestation was reported to be 39.34 in 2018 and 37.11 in 2019 during *Ahu* season (Table 5).

Table5.Per centgraininfestationofriceearhead bugduring*Ahu* season,2018 &2019

Year	Mean±SE (%)	Pooled (2018& 2019)

2018	39.34±2.64 (34.11-42.64)	38.22±3.05
2019	37.11±3.84 (32.03-44.63)	**(33.07-43.63)**

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