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Effect of abiotic factors on the population dynamics of paddy earhead bug, *Leptocorisa oratorius* F

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Abstract
The present investigation was carried out to monitor the population dynamics and their correlation with weather parameters. The experiment result revealed that the population of bug appearance coincided with the flowering stage of the rice whereas the peak population (1.81 bugs/hill) was recorded only one week after its 1st appearance and then after the decrease in its population gradually took place which came down to zero on the last date of observation 11 November, 2020 which clearly depicted that the gundhi bug population was absent from 22 July 2020 to 23 September 2020. The correlation matrix indicated that the Relative humidity was only having positive impact on the gundhi bug population whereas the rest of the weather parameters shown negative impacts on the gundhi bug population. Warm weather with humid condition during the flowering and dough stage of rice increases the gundhi bug population. At these stages proper management strategies must be taken to reduce the yield loss.

Keywords: paddy earhead bug, *Leptocorisa oratorius* F, population and correlation

Introduction
Rice is the most important staple food crop with more than half of the world's population relying on it as the major daily source of calories and protein [12]. But, insect pests are among the most important biological constraints limiting rice yield potential and reflect large scale reduction both in quality and quantity [2, 3]. The crop is attacked by more than 100 species of insects; 20 of them can cause economic damage. Among them, rice gundhi bug is the most destructive insect pest of rice. The pest appears on rice just before the flowering stage and continues until panicles ripen. In Aisa mainly four species of genus *Leptocorisa* are reported to infest the rice crop *viz. L. acuta, L. varicornis, L. oratorius, L. chinensis,* etc [1, 4, 5, 9, 11, 14, 15, 22, 23]. Among them, *L. acuta* (Thunb.) (Hemiptera: Alydidae) has been reported earlier in many tropical countries including India [16]. Where as in Bihar *L. oratorious* found to aggregate on non-rice weeds (*Echinocola* spp. *Paniculum* spp. *Cyperus* spp. etc.) grown in and around rice fields before the flowering of rice [13]. Both nymphs and adults suck the juice from grains in milky stage, also from peduncle, leaves and stem causing shrivelled and chaffy grains and the feeding site favour the development of sooty mould which cause considerable loss in the yield which sometimes rich up to 30% [21]. A heavy infestation can result in 80% (Maharashtra) or total (Malaysia) loss of the crop [17]. Control methods in current use against the pest are primarily based on chemical insecticides; however substantial use delivers a natural lop-sidedness by killing non-target beneficial insects and accumulation of poisonous build-ups in the earth. Also the use of resistant rice varieties and natural enemies like predators and parasites in the management of rice bug population have not been promising [15]. Today, the population dynamics along with limiting factors of this pest are very essential for the timely adoption of different management practices. So, the present experiment was carried out to detect the occurrence, identification and estimation of the actual field population density of this pest

Materials and Methods
Study was conducted during *Kharif,* 2020 at the farm of Krishi Vigyan Kendra, Khodawandpur, Begusarai, Bihar.

Data on the occurrence of paddy earhead bug and its population dynamics were recorded on rice variety Rajendra Sweta. Untreated plots of the experiment on field efficacy of insecticides and seed production plots were used for observations. The observations were also taken on the stage of the crop attacked by the insect pests. Weekly observations of gundhi bug were taken before the emergence of panicle till the harvesting of the crop using five random quadrates of an area of one meter square. The mean values of gundhi bug populations at weekly interval were worked out form the collected data. Weekly weather data *viz*., temperature (maximum and minimum), relative humidity (morning and evening), and rainfall were obtained from Meteorological Observatory, Department of Agronomy, Bihar Agricultural University, Sabour. The data on population dynamics were subjected to correlation coefficient analysis.

Results and Discussions

Through understanding the insect ecology forms a basis for effective pest management and conservation of natural enemies. A major part of insect ecology can be understood if the factors influencing its population are thoroughly investigated. Among these factors, weather parameters are the important and there is a need to understand their influences, keeping this in view, the investigation was carried out to study the population dynamics of paddy earhead bug, *Leptocorisa oratorius* F. on rice variety Rajendra sweta in the year 2020.

The per hill population of gundhi bug has been presented in table 1 which is supported by different weather parameters like maximum temperature (^{0}C), minimum temperature (^{0}C), Relative humidity (%, 7 AM), Relative humidity (%, 2 PM), and Rainfall (mm). The population found on different dates of observation starting from 22nd July, 2020 to 11th November, 2020 at 7 days interval has also been represented in bar diagram (Fig. 1). The table and the figure both depicted that the gundhi bug population was absent from 22 July 2020 to 23 Sep. 2020. The infestation of gundhi bug was started form 39th Standard meteorological i.e., last week of September and continued up to 44th SMW (first week of November), ranged from 0.06-1.81 bugs/hill. The observation of the bug population indicated that its appearance almost coincided with the flowering phase or dough stage (Table 2). The present finding is in conformity with Ghule *et al*. [6] who observed that the population of earhead bugs in *Kharif* was in the range of 1.15 to 12.05 bugs per five net sweeps from second week of September (37th SMW) to first week of November (45th SMW). The slight variations observed here might be due to difference in sowing time and different geographical locations. Girish *et al*. [7] observed gundhi bug population appeared during reproductive phase of the crop. Singh *et al*. [20] recorded that the gundhi bug population was found from 39th to 48th standard week. In their studies the population of gundhi bug ranged from 5.00 to 21.90 per five sweeps.

The observation on the bug population also indicated that its appearance coincided with the flowering stage of the rice and the peak population was recorded only one week after its 1st appearance and then after decrease in its population gradually took place which came down to zero on the last date of observation 11 Nov.2020. Similar results were also found by Sharma *et al*. [18], who observed *Leptocorisa acuta* Thunberg (Alydidae, Hemiptera) had maximum population in the second and third weeks of October during the aforesaid period. Singh *et al*. [20] found that the maximum population of gundhi bud was recorded in the 43rd SMW and 48th SMW.

In present studies, the highest population of gundhi bug were recorded on 7th October comes under 40th SMW and least population have been found on 4th of November which comes under 45th SMW. Shitiri *et al*. [19] reported the incidence of ear head bug was observed from 60 days after transplanting till harvest. Peak incidence was observed at 120 days after transplanting. Kalita *et al*. [10] observed gundhi bug population was found maximum when the crop attained the milky stage in the first fortnight of October. Similar results were also obtained by Singh *et al*. [20] which corroborates the present findings with very slight different which might be due to difference in sowing time and different geographical locations.

The correlation matrix of different weather parameters with the population of gundhi bug has represented in tabular form in Table 3. The correlation matrix table indicated that the relative humidity (both 7 AM and 2 PM) was only having a positive impact on the gundhi bug population whereas the rest of the weather parameters shown negative impacts on the gundhi bug population. Similar results were observed by Gupta *et al*. [8], which found that the Rainfall and maximum and minimum temperature were negatively correlated with the population *L. acuta.*

Table 1: Population of gundhi bug at weekly interval along with different weather parameters

Observation Dates	Maximum temperature (°C)	Minimum temperature (°C)	Relative Humidity (%, 7 AM)	Relative Humidity (%, 2 PM)	Rainfall (mm)	Gundhi bug population (per hill)
22-07-2020	32.40	24.40	90.00	79.00	0.00	0.00
29-07-2020	34.20	27.00	88.00	75.00	0.00	0.00
05-08-2020	33.10	25.00	95.00	66.00	0.50	0.00
12-08-2020	32.80	25.00	97.00	88.00	10.00	0.00
19-08-2020	32.30	26.50	88.00	71.00	0.00	0.00
26-08-2020	33.00	26.80	88.00	78.00	8.80	0.00
02-09-2020	32.00	27.00	91.00	85.00	58.60	0.00
09-09-2020	33.50	27.00	88.00	78.00	0.00	0.00
16-09-2020	32.50	26.20	91.00	64.00	0.00	0.00
23-09-2020	33.70	25.00	91.00	74.00	0.00	0.00
30-09-2020	33.20	25.00	90.00	85.00	2.20	0.71
07-10-2020	35.00	24.40	92.00	70.00	0.80	1.81
14-10-2020	33.60	24.00	95.00	69.00	0.00	1.74
21-10-2020	27.40	23.50	89.00	87.00	6.00	1.68
28-10-2020	30.20	19.00	93.00	66.00	0.00	0.52
04-11-2020	30.30	16.50	86.00	64.00	0.00	0.06
11-11-2020	30.00	16.00	84.00	52.00	0.00	0.00

Table 2: Populations of gundhi bug with different growth stages of rice

Season	Month	SMW	Growth Stages of the crop	Populations of gundhi bug (bug/hill)
Kharif, 2020	July	29	Tillering	0.00
		30		0.00
	August	31	Vegetative stage	0.00
		32		0.00
		33		0.00
		34		0.00
		35		0.00
	September	36	Milking Stage	0.00
		37		0.00
		38		0.00
		39		0.71
	November	40		1.81
		41	Dough Stage	1.74
		42		1.68
		43		0.52
	December	44	Ripening stage	0.06
		45		0.00

Table 3: Correlation matrix of weather parameters with population of gundhi bug

	X1	X2	X3	X4	X5	Y
X1	1.0000	0.5908	0.3315	0.0741	-0.0750	-0.0832
X2		1.0000	0.3169	0.6073	0.2636	-0.0675
X3			1.0000	0.2877	0.1027	0.2632
X4				1.0000	0.4298	0.1095
X5					1.0000	-0.1313

X1-Maximum temperature (°C); X2-Minimum temperature (°C); X3-Relative humidity(%, 7.00 AM); X4- Relative humidity (%, 2.00 PM); X5-Rainfall (mm); Y-Population of gundhi bug

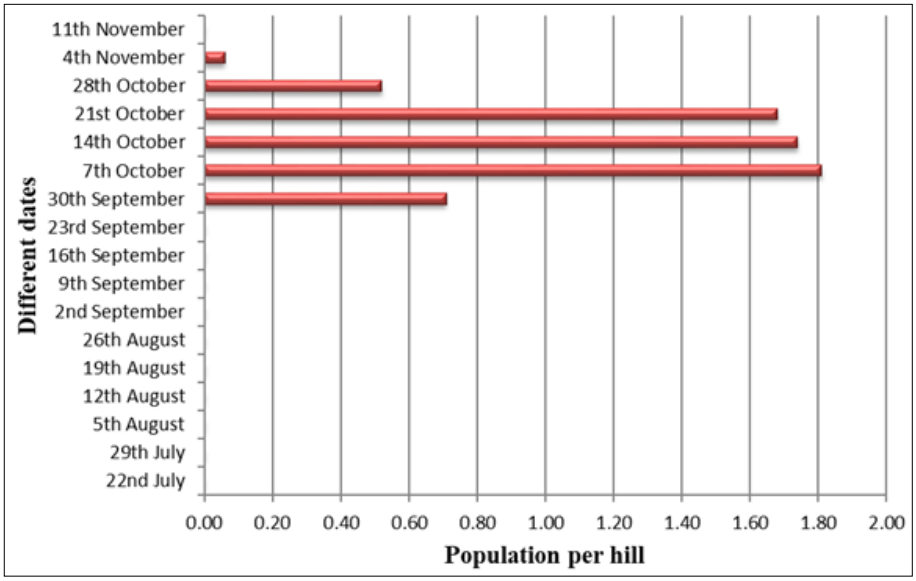

Fig 1: Per hill population of gundhi bug on different dates of observations during 2020

Conclusion

The maximum population of gundhi bugs were recorded at the flowering stage as well as dough stage. Warm weather favoured the build-up of gundhi bug. Its peak time of activity was observed in cooler hours of the day like early morning and late evening hours. The population of paddy earhead bug was absent from July 22 to September 30. The Relative humidity was only having a positive impact on the gundhi bug population whereas the rest of the weather parameters shown negative impacts on the gundhi bug population.

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