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Observation of the impact of environmental parameters on brown plant hopper, *Nilaparvata lugens* (Stal.) and its natural enemies

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Abstract
A field experiment was conducted during *kharif* season of 2018 at Agriculture Research Station, Sakoli, Dist. Bhandara (MS) under Dr. Panjabrao Krishi Vidyapeeth, Akola to study the observation of impact of environmental parameters onbrown plant hopper and its natural enemies. The result revealed that abundance of brown plant hopper was initiated from 36th MW and continued to 47th MW and its peak incidence during 44th MW (12.6 nos./hill). Incidence of brown plant hopper had significant negative correlation Rainfall (r= -0.617) and rainy days (r= -671) and maximum temperature (r= 0.597) had significant positive correlation at 5% significant level. Minimum temperature (r= -0.798) showed significant negative significant correlation with population of brown plant hopper at 1% significant level. Similarly, impact of green mirid bug (r= 0.953) and brown mirid bug (r= 0.898) on population of brown plant hopper showed significant positive correlation at 1% significant level.

Keywords: Brown plant hopper, environmental parameters and natural enemies

Introduction
Rice (*Oryza sativa* L.) is the world's second most important cereal crop and known with different names in India as Dangar (Gujarat), Bhatt (Maharashtra), Chawal (U.P., Bihar), Voldu (A.P.), Dhan (W.B.), Chaul (Punjab), Shali (J & K), Nellu (Tamil Nadu, Kerala). It is one of the oldest and second most intensively grown cereal crops next to wheat and ranks third in grain production. Rice is life and princess among the cereals.India is the world's second largest rice producer and consumer next to china. Rice has unique position in Indian economy. In 2017 rice cultivated on area 43.57 million hectares with an annual production 104.32 million tonnes and productivity about 2.98 tonnes/ha (Anonymous, 2017) [1]. Total Indian output of rice at an all-time high of 166.5 MT (111.0 MT, milled basis). This level would stand 1.2 per cent above the final estimate for the 2016 season and some 2.3 million tonnes above previous FAO expectations, (Anonymous, 2018) [2]. Rice is the most important food all over world. Rice is a high energy or high calories food and of high biological value of the proteins. These days, several types of rice and their products are used in different nations of the world *viz.*, USA. China, Indonesia, Japan, Srilanka, Africa and India etc.

The brown plant hopper, *Nilaparvata lugens* (Stal.) belong to the order Homoptera, family Delphacidae with piercing and sucking mouth parts. The plant hoppers suck the plant sap from the phloem vessels through their proboscis, due to this plant starts wilting with outer most leaves drying first and then the entire plant dries up. Under severe cases field gives a burnt appearance in concentric circles known as "hopper burn". The yield losses caused by insect pest in rice have been reported to the tune of 25 per cent (Dhaliwal *et al*. 2010) [6]. The average yield loss in rice have been accounted for 20% loss in plant hoppers (Krishnaiah and Varma, 2015) [11].

Change in a region's climate due to changes in temperature, humidity, rainfall could induce changes in the occurrence pattern of insect pests. Climate change, especially temperature increase will affect insect physiology, behaviour and development as well as species distribution and abundance, evidenced by changes in the number of generations a year, increasing survival rates in winter and the earlier appearance of some insects. Studies of the seasonal abundance and population build up trend is essential to ensure timely preparedness to tackle impending pest problems and prevent crop losses (Patel and Singh, 2017).

Material and method
The present investigation on study the seasonal incidence of brown plant hopper of paddy was carried at Agriculture Research Station, Sakoli, Dist. Bhandara (MS) under Dr. Panjabrao

Deshmukh Krishi Vidyapeeth, Akola, during *kharif* 2018. PKV HMT, a popular variety of rice was used for the experiment. The soil was puddle before planting. Experiment plot was filled with water for one to two days to allow the water to sink properly into the soil and to make the soil soft for easy puddling. The puddling was done by tractor. Before transplanting, the layout was made in the field in accordance with experimental design by using of measuring tape, nylon string and wooden pegs. 2-3 seedling of PKV HMT were transplanted per hill at the spacing of 20 x 15 cm in puddled soil. The recommended fertilizers dose for paddy crop were applied @ 100:50:50 kg NPK/ha. Half dose of N (50 kg) and full dose of P_2O_5 (50 kg) and K_2O (50 kg) was applied before transplanting and half dose of N (50 kg) was applied at 30 days after transplanting.

Thirty hills from seasonal incidence plot were taken for recording observations of seasonal incidence of leaf folder. A separate plot of 500 m^2 area was sown and observations were recorded from nursery at weekly interval till the harvest of crop.

Results and Discussion:

Periodical observations on the incidence of brown plant hopper were recorded at weekly interval according to standard weeks. The data presented in table revealed that the brown plant hopper population was initiated from 36th MW and remain continued till harvesting 47th MW. The population of brown plant hopper was very low (0.13 nos./hill) at initiation in the first week of September (36th MW) and then it gradually increases and attained peak during last week of October (44th MW) with population of 12.6 nos./hill. Further, population of brown plant hopper (4.93 nos./hill) was declined in the 1st week of November (45th MW). Thereafter, again increase from second week of November (46th MW) and observed till harvesting *i.e.* 3rd week of November **(**47th MW) with population of 9.10 nos./hill.

Correlation of brown plant hopper with weather parameters and natural enemies

The correlation co-efficient analysis data revealed that, the relative humidity (r=-0.221) had non-significant negative correlation and spider (r= 0.025) and lady bird beetle (r= 0.074) had non-significant positive correlation with population of brown plant hopper. However, rainfall (r= -0.617) and rainy days (r= -671) had significant negative correlation and maximum temperature (r= 0.597) had significant positive correlation with population of brown plant hopper at 5% significant level. Similarly, impact of green mirid bug (r= 0.953) and brown mirid bug (r= 0.898) on population of brown plant hopper was showed significant positive correlation at 1% significant level. Minimum temperature (r= -0.798) showed significant negative significant correlation with population of brown plant hopper at 1% significant level.

The present findings are in accordance with the Choudhary *et al.* (2014) [4] who recorded the incidence of brown plant hopper in the beginning was very low, as soon as the rain stopped in last week of September then the population increased with the vegetative stage of crop and reached highest in week of October and severe in the last week of September to last week of October. The population of brown plant hopper had positive correlation with temperature and relative humidity, whereas negative correlation was found to rainfall. Kharat (2006) [10] reported that population of brown plant hopper had significant positive correlation with maximum temperature, significant negative correlation with evening relative humidity, average humidity and rainy days, however, non-significant negative correlation with relative morning humidity, rainfall and minimum temperature. Desai (2008) [5] found that the population of brown plant hopper had significant positive correlation with maximum temperature and significant negative correlation with minimum temperature.

The data presented in Table revealed that the population of spiders and lady bird beetle were observed from second week of August *i.e.* 32nd MW (0.30 nos./hill) and continued up to the harvest of the crop *i.e.* 47th MW (0.67 nos./hill). The population of green mirid bug was observed from last week of September *i.e.* 39th MW (0.40 nos./hill) and continued up to the harvest of the crop i.e. 47th MW (2.70 nos./hill) and attained the peak at 44th MW (4.20 nos./hill). The population of brown mirid bug was observed from last week of September *i.e.* 39th MW (0.23 nos./hill) and continued up to the harvest of the crop *i.e.* 47th MW (6.37 nos./hill) and attained the peak at 44th MW (7.23 nos./hill).

The present study is in agreement with Barrion and Litsinger, (1980) [3] and Pantua and Litsinger (1980) [13]. They reported that spiders are large part of the predatory arthropod fauna of rice ecosystem and prey upon brown plant hopper. Lua (1985) [12] reported that the density of spiders in the field was positively correlated with that of brown plant hopperpopulation and also the population of mirid but showed positive significant relationship with brown plant hopper. Similarly, Holt *et al.* (1987) [7] reported that spider in rice field can play important role an

important role as predators in reducing the densities of plant hoppers. Rai and Chandrasekar (1979) [14] observed increased mirid bugs with the increasing population of the brown plant hopper and decreased with the declined population of the pest in Karnataka.

In the findings of regarding occurrence of natural enemies population occurrence, similar type findings were reported by Khan and Mishra (2003) [9] and Vijaykumar and Patil (2004) [15], wherein they found that the spider population was directly related to growth stages of the rice plants. Kharat (2006) [10] revealed that the population of spiders increased from 32nd standard week. Khan (2006) [8] stated that abundance of natural enemies is very reliable to suppress pest population. These reports support the present finding.

Conclusion

On the basis of present investigation, it was concluded that peak activity of brown plant hopper was observed in last week of October. Furthermore, the fluctuations in the incidence were recorded, which again reached second peak during week of November. Then damage of brown plant hopper was gradually declined and continued upto maturity of crop. Incidence of brown plant hopper had significant positive correlation with maximum temperature and significant negative correlation with rainfall and rainy days.

Table 1: Seasonal incidence of brown plant hoper and natural enemies of paddy in fixed plot survey during *kharif* 2018.

Date	MW	Brown plant hoper (No./hill)	Natural enemies (No./hill)				Rainfall (mm) (In MW)	Rainy days	Temperature		Relative morning humidity (%)
			Mirid Bug		Spider	Lady bird beetles			Max (^{O}C)	Min (^{O}C)	
			Green mirid bug	Brown mirid bug							
	26						132.2	2	32	24	83.71
6.7.2018	27	0.00	0.00	0.00	0.00	0.00	106.6	5	31	23	97.14
12.7.2018	28	0.00	0.00	0.00	0.00	0.00	92.2	6	29	24	89.00
19.7.2018	29	0.00	0.00	0.00	0.00	0.00	123.6	4	29	24	79.14
25.7.2018	30	0.00	0.00	0.00	0.00	0.00	49.6	2	29	23	81.28
3.8.2018	31	0.00	0.00	0.00	0.00	0.00	0.0	0	33	23	74.57
8.8.2018	32	0.00	0.00	0.00	0.30	0.30	42.4	3	32	24	70.85
17.8.2018	33	0.00	0.00	0.00	0.30	0.00	134.0	4	31	24	91.28
23.8.2018	34	0.00	0.00	0.00	0.70	0.30	102.4	2	30	23	87.28
29.8.2018	35	0.00	0.00	0.00	0.00	0.00	68.8	3	28	23	90.14
3.9.2018	36	0.13	0.00	0.00	0.17	0.00	25.4	2	29	22	94.57
12.9.2018	37	0.10	0.00	0.00	0.33	0.10	0.0	0	34	21	94.28
18.9.2018	38	0.63	0.00	0.00	0.17	0.07	47.0	2	32	23	90.28
24.9.2018	39	2.33	0.40	0.23	0.60	0.16	0.0	0	34	22	64.00
1.10.2018	40	5.33	0.73	0.47	0.50	0.23	0.0	0	35	21	94.71
8.10.2018	41	5.70	1.50	1.26	0.33	0.17	0.0	0	34	19	78.71
15.10.2018	42	9.47	4.03	3.57	0.30	0.23	0.0	0	35	19	84.00
22.10.2018	43	8.03	2.93	2.70	0.16	0.10	0.0	0	35	17	73.57
31.10.2018	44	12.6	4.20	7.23	0.16	0.13	0.0	0	32	17	80.71
5.11.2018	45	4.93	0.93	1.23	0.30	0.27	0.0	0	32	15	91.42
13.11.2018	46	5.73	1.50	2.23	0.20	0.20	0.0	0	33	13	89.28
19.11.2018	47	9.10	2.70	6.37	0.67	0.67	0.0	0	32	15	77.42

Table 2: Correlation of brown plant hoper of paddy with weather parameter and natural enemies

Pest	Weather parameters					Natural enemies (No./hill)			
	Rainfall (mm)	Rainy days	Temperature		RH Morn. (%)	Green mirid bug	Brown mirid bug	Spider	Lady bird beetles
			Max (^{O}C)	Min (^{O}C)					
Brown plant hoper (No./hill)	-0.617*	-0.671*	0.597*	-0.798**	-0.221	0.953**	0.898**	0.025	0.454

Table 'r' value at 1% significance level: 0.708
Table 'r' value at 5% significance level: 0.576
**Significant Correlation at 1% significance level, *Significant Correlation at 5% significance level

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