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Pradeep Kumar Verma
Department of Entomology, SVPUA&T, Meerut, Uttar Pradesh, India

Hem Singh
Department of Entomology, SVPUA&T, Meerut, Uttar Pradesh, India

Bhupendra Singh
Department of Entomology, SVPUA&T, Meerut, Uttar Pradesh, India

Reetesh Pratap Singh
Department of Entomology, SVPUA&T, Meerut, Uttar Pradesh, India

Avinash Varma
Quantum University, Roorkee, Uttarakhand, India

Corresponding Author
Pradeep Kumar Verma
Department of Entomology, SVPUA&T, Meerut, Uttar Pradesh, India

Population dynamics of brown plant hopper, *Nilaparvata lugens* (Stal.) in basmati rice and its correlation with abiotic factors in western plain zone of Uttar Pradesh

Pradeep Kumar Verma, Hem Singh, Bhupendra Singh, Reetesh Pratap Singh and Avinash Varma

Abstract
An experiment was conducted in Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology Meerut, (U.P.) India during the *Kharif* 2019. The data showed that the BPH incidence was started from 33th standard week (third week of August) and continued till 44th standard week (first week of November). And it attends its peak level during the 38th standard week (third week of September) with 15.17 BPH/hill when temperature max., min, maximum, minimum relative humidity and rainfall 33.5 ^{0}C, 23.2 ^{0}C, 93.7, 62.2 per cent and rainfall 2.3 mm were recorded. However, minimum Rice Brown plant hopper population 1.23BPH/hill recorded that at 33th standard week (third week of August). Correlation studies between mean populations of Brown plant hopper and weather factor exhibited non significance positive correlations with maximum, minimum temperature and maximum, minimum relative humidity with, (r = +0.0186), (r = +0.175), (r = +0.417), and (r = +0.301), respectively. While rainfall had non significance negative correlations (r = -0.427) Brown plant hoppers populations during *Kharif*, 2019**.**

Keywords: BPH, basmati rice, temperature, correlation. rainfall

Introduction
Rice (*Oryza sativa* Linn.) belongs to the family-Graminae, and it is one of the world largest cereal crops fulfil the caloric need for millions of people. Rice is considered appropriate crop for our country and play a significant role in our national food security. The total area under rice cultivation is 44 million ha with Production 117.94 million tonnes. Uttar Pradesh is the second largest producer of rice after West Bengal occupying 5.5 million ha area under rice with annual production of 15.3 million tonnes. (Anonymous, 2019-20) [1]. The major basmati rice producing states are Haryana, Punjab, Uttar Pradesh, Jammu & Kashmir, Uttarakhand, and Himachal Pradesh. Haryana is the major basmati rice cultivating state, producing more than 60 per cent of the total basmati rice produced in India, total area of basmati rice cultivation in India was 1555 million ha, and in U.P. is occupied 256.2 million ha (Anonymous 2017) [2].

Rice is the staple food in developing countries. It is an important crop because it contains high nutritive value per 100 gm of rice is energy 1,527 KJ (365 Kcal), carbohydrate 76.7 gm., fibre 0.6 gm., fat 1.0 gm., protein 7.5 gm., water 13.3 gm., vitamin B_1 0.070 mg, vitamin B_2 0.049 mg, vitamin B_3 1.6 mg, vitamin B_5 1.014 mg, calcium 10 mg, phosphorous 190 mg and iron 3.3 mg. Other edible use includes rice flakes, puffed rice, rice wafers and canned rice. It is also used in starch sand beverage industries (Salim *et al.* 2003 and FAO 2011) [9]. Rice environment attacked by 800 species of different insects around the world. Out of that, 20 insects' pest considered as rice major pest, cause economic damage crop such as stem borer, plant hopper, grass hopper, defoliators and gall midge in China and South Asia having measure pest of rice like yellow stem borer, leaf folder, plant hopper and gall midge, and brown plant hopper (Noor and Hussain, 2015) [3]. The Brown plant hopper is a monophagus insect and it measure about small (2.0-3.5 mm in body length) brownish in colour and sucking insect, belonging to the suborder Homoptera and order hemiptera and it belong to family Delphacidae (Tamrakar, 2010) [14]. Both nymph and adult of Rice brown plant hopper suck the cell sap of the plant directly and it is also a vector transmitting viral disease like grassy stunt

and ragged stunt. *Nilaparvata lugence* (Stal.), caused economic damage by sucking phloem sap which leads the circular patches in the field is termed as hopper burn symptoms and cause several yield losses (Rao *et al.*, 2003) [8]. The estimated loss of rice crop yield due to brown plant hopper is about 10 to 30 per cent (Dale, 1994) [4]. About 50 per cent of Indian farmer use insecticides ranging from one to six application per crop season on leaf folder, brown plant hopper and white backed plant hopper (Lakshmi *et al.*, 2010) [6].

The major insect pests of Basmati rice crop encountered in North Eastern part of the Uttar Pradesh are yellow stem borer (*Scirpophaga incertulas* Walker.), brown plant hopper (*Nilaparvata lugens* Stal.),white backed plant hopper (*Sogatella furacifera* Distant.), leaf hopper (*Pyrilla perpusilla* Walker.), green leaf hopper (*Nephotettixni gropictus* Stal,.), rice grass hopper (*Hieroglyphus banian* Fabr.), rice gundhi bug (*Leptocorisa varicornis* Thunberg.), rice gall midge (*Orseolia oryzae* Wood Masan.), rice leaf folder (*Cnaphalocrocis medinalis*), rice hispa (*Dicladispa armigera* oliver.), rice thrips (*Stenchaetothrips biformis* Bagnall.), rice case worm (*Nymphula depunctalis* Guenee.), zig zag leaf hopper (*Recilia dorsalis* Motschulsky.) and common cut worm (*Spodoptera litura* Fabricius.) (Singh and Singh, 2014) [11].

Methods and Material

The geographic situation of Meerut district lies between 28° 57, to 29° 02 North Latitude and 77° 40 to 77° 45 East latitude in the Indo-Gangetic Plains of India. Meerut district comes under the north-western plain sub-region of upper Gangetic zone in western U.P. Meerut district cover the total area of 2,522 Km sq. It possesses humid sub-tropical climate and experiences mean annual rainfall ranging 0.0 to 150 mm (approx.), most of which is received during *Kharif*, 2019. Mean maximum temperature experienced during the experiment was 36.4 ^{0}C during 2nd week of July and the mean minimum temperature was 14.2 ^{0}C during 2nd week of November. The maximum rainfall experienced was 150 mm during 2nd week of July.

The present investigation was carried out during *Kharif*, 2019 in randomized block design with replicated thrice and have a plot size of 4x3 m^2. The seedlings transplanted in main field July 22th, 2019 and the variety, Pusa Basmati-1 was selected for present investigation for population dynamics of BPH population and the normal agronomic practices were follow in the crop grown under the prevailing condition at Crop Research Centre of Sardar Vallabhbhai Patel university of Agriculture and Technology Meerut, (U.P.) and approximately same agricultural practices farmers were also adopted observations were taken by direct visual counting method. In this method, the random samplings of ten hills were carried out for the purpose of population fluctuation of the BPH in basmati rice field. Hills were tagged out from each plot of untreated control. These plants were observed regularly at weekly interval. The nymphal and adult population of BPH were recorded per hill starting from the transplanting till the harvest of the crop. The meteorological data was also recorded throughout the crop season.

Results and Discussion

The population of BPH, in the basmati rice crop along with meteorological during *Kharif*-2019 has been presented in Table-1 and Figure - 1. The data showed that. The observation on Brown plant hoppers in rice recorded from 29th to 45th standard week. The population of BPH was first reported at 33th (fourth week of August) standard week with 1.23 BPH/hill with temperature maximum., minimum, maximum, minimum relative humidity and rainfall were recorded 32 ℃, 24.4 ℃, 95, 86.7 per cent, and 64 mm, respectively (Table-1 Figure-1). The population of BPH increased during the vegetative growth stage of crop. The rice BPH increased gradually and reached to a peak level (15.17 BPH/hill) during 38th standard week (third week of September) when temperature max., min, maximum, minimum relative humidity and rainfall were recorded 33.5^{0}C, 23.2^{0}C, 93.7, 62.2 per cent and 2.3 mm respectively. These observations are in agreement with the earlier findings of Win *et al.*, (2011) [15] who concluded that hoppers population maximum (in mid-September) associated with high humidity, high temperature and high rainfall. The BPH population was lowest (in mid-week of October) suggesting that low rainfall and low humidity were at least partially responsible for the decrease population of Brown Plant Hoppers. Narayanasamy *et al.*, (2015) [7] reported that the temperature increase above 34°C is detrimental to the development of Brown plant hopper. The present findings are supported by the findings Sarkar *et al*., (2018) [13] the incidence of BPH in the beginning was very low and the population increased along with the growth of the crop. The population was more during the vegetative growth stage of crop. The present findings are supported by the findings Kumar *et al.*, (2019) [5] who reported that the Brown plant hopper population was low from July to August where, as maximum population was recorded in mid-September.

Correlation between brown plant hoppers in relation to abiotic factors

The mean BPH population and their correlation with abiotic factors are presented in Table- 2. It is revealed that the infestation of Brown plant hoppers population was correlated Non significant positive with abiotic factors *viz*., Temperature maximum, minimum, R.H. max, R.H. min, (r = +0.0186), (r = +0.175), (r = +0.417), (r = +0.301), whereas were negatively correlated with rainfall (-0.427**).** The present findings are similar to the finding of Chaudhary *et al.*, (2014) [10] also reported that the population of BPH was positively correlated to temperature and relative humidity where as a negative correlation was found to rainfall. The present findings are supported by the findings Sharma *et al.*, (2018) [12] also investigated that the Brown plant hopper population has significantly positive correlation with morning RH, evening RH and average RH. Further non-significant positive correlation with minimum temperature, maximum temperature, average temperature and a non-significant negative correlation with rainfall was observed. The results are agreement by findings of Kumar *et al*., (2019) [5] also reported that positive correlation of BPH with temperature and also negative correlation with rainfall.

Table 1: Population dynamics of Rice Brown Plant Hopper in relation to abiotic factors during *Kharif*, 2019

29	July	16-22	0	36.4	23.9	87.3	50.6	8.4
30		23-29	0	35.3	24.5	93.7	68.0	150.0
31		30-5(Aug.)	0	35.9	25.2	90.0	46.6	48.0
32	August	6-12	0	34.0	25.2	94.8	67.6	92.0
33		13-19	1.23	32.0	24.4	95.0	86.7	64.0
34		20-26	4.86	33.7	24.5	94.8	71.3	3.2
35		27-2(Sept.)	6.1	34.8	25.2	93.3	70.7	88.0
36	September	3-9	9.7	34.4	25.4	95.8	76.0	0.0
37		10-16	12.6	34.5	25.0	94.8	71.4	0.0
38		17-23	15.17	33.5	23.2	93.7	62.4	2.3
39		24-30	10.86	31.4	22.6	94.8	72.3	14.4
40	October	1-7	7.67	31.2	20.6	95.2	60.7	22.9
41		8-14	6.3	31.9	18.9	93.5	57.0	0.0
42		15-21	5.43	32.0	18.5	94.7	61.0	0.0
43		22-28	3.73	30.1	15.9	94.2	50.9	0.0
44		29-4(Nov.)	1.73	29.8	15.8	93.7	53.7	0.0
45	November	11	0	28.1	14.2	93.7	56.8	0.0

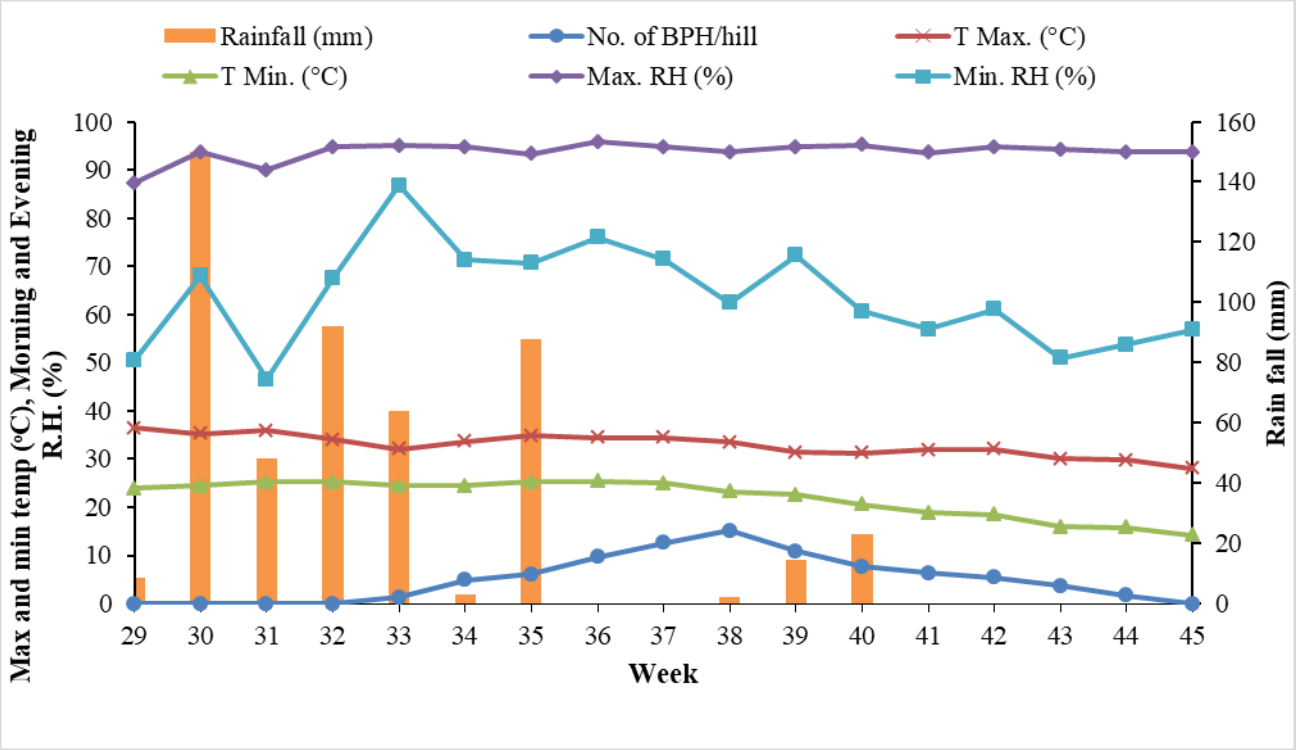

Fig 1: Population dynamics of Rice Brown Plant Hopper in relation to abiotic factors du ring *Kharif*, 201

Table 2: Correlations between Rice Brown Plant Hopper infestations with abiotic factors during *Kharif*, 2019

Season	Name of pest	Meteorological parameter				
Kharif-2019	Brown plant hopper	Max. Temperature ºC	Min. Temperature ºC	Max. Relative humidity (%)	Min. Relative humidity (%)	Rainfall (mm)
Correlation coefficient (r=)		0.0186	0.175	0.417	0.301	-0.427

Conclusion

It may be concluded that brown plant hopper population attend its peak level during the 38th standard week (third week of September) with 15.17 BPH/hill when maximum and minimum temperatures were 33.5 ºC and 23.2 ºC, maximum and minimum relative humidity 93.7 and 62.2 per cent and rainfall 2.3 mm were recorded. However, minimum rice brown plant hopper population 1.23BPH/hill recorded that at 33th standard week (third week of August). Correlation studies between mean populations of brown plant hopper and weather factor exhibited non significance positive correlations with maximum, minimum temperature, and maximum, minimum relative humidity with, (r = +0.0186), (r = +0.175), (r = +0.417), and (r = +0.301), respectively. While rainfall had non significance negative correlations (r = -0.427) brown plant hoppers populations during *Kharif*, 2019.

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