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Population dynamics of whitebacked plant hopper, *Sogatella furcifera* on basmati rice in relation to biotic and weather parameters

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Abstract
The objective of study was to examine the population of WBPH and its natural enemies under agro-climatic condition of Haryana, India during Kharif-2012. The WBPH population varied from 0.4 to 403.4/10 hills and 4.6 to 224.4/10 hills during 2011 and 2012, respectively. The maximum population was recorded 38th week during both the years. The population started declining from 39th week and was negligible by the end of October i.e. 42nd and 43rd week during 2011 and 2012, respectively. The population of spiders (39.2/10 hills) and mirid bugs (64.2/10 hills) was maximum in 39th SMW during 2011while in 2012 the population of spiders was maximum (23.6/10 hills) in 37th SMW and that of mirid bugs 66.8 /10 hills in 40th SMW. The correlation of WBPH with abiotic and biotic factors did not show any significant relationship.

Keywords: Population, *Sogatella furcifera*, Rice, biotic, abiotic

1. Introduction
Rice (*Oryza sativa* L.) is the world's most important crop and a staple food for more than 50% of the world's population [6]. The warm and humid climate in which rice is grown is highly conducive to insect proliferation.
More than 100 species of insects are known to attack this crop [8]. Of these, about 20 species are of major economic significance and the overall yield losses due to insect pests vary between 21-51% [14]. Annual yield loss to rice caused by planthoppers alone was one million tonne during 1970-1990 [4]. Amongst the sucking insect pests infesting rice, planthoppers especially the brown planthopper, *Nilaparvata lugens* (Stal), whitebacked planthopper, *Sogatella furcifera* (Horvath) and leaf hoppers are of economic concern in India [1]. Both the nymphs and adults feed on the stem and leaf sheath and remove plant sap, resulting in leaf yellowing, reduced tillering and plant height, and unfilled grains. Under high insect population, excessive removal of plant sap causes the plant to wilt, die and turn brown, a condition known as hopper burn [5].
The whitebacked planthopper was first reported to cause very heavy damage in Kapurthala, Ludhiana, Karnal, Gurgaon, Sangrur and Ambala district of joint Punjab in 1966 [1]. The yield losses ranging from 54.4 to 79.8 per cent were reported on different varieties in Haryana [7]. One of the major factors contributing to the increase in severity of this pest is the indiscriminate use of insecticides, which also kill many natural enemies [2]. Further, insecticides residues in *Basmati* are a big issue at national and international levels now-a-days. Climate change, especially temperature will affect insect physiology, development, behavior, distribution and abundance evidenced by changes in the number of generations a year, increasing survival rates, and insect appearance [10]. Therefore, to avoid catastrophe, it is essential to adopt a more sophisticated level of pesticide management as part of an integrated pest management approach. So knowledge of the seasonal abundance and population build up trend is essential to ensure timely preparedness to manage pest problems and prevent crop losses [4]. In this regard, the present investigation was carried out to estimate population dynamics of *Sogatella furcifera* on rice in relation to weather parameters.

2. Material and Methods
2.1 Experimental Site
The experiment was conducted in farm area of Chaudhary Charan Singh Haryana Agricultural University, Rice Research Station, Kaul (29°51' N latitude, 76°41' E longitude) Haryana,

India. To study the population dynamics of whitebacked planthopper, 30 days old seedlings of variety, *Taraori Basmati* were transplanted at 20x15 cm spacing in the field of 2000 square meter (m^2). The field was transplanted on 7th and 10th July during *Kharif* 2011 and 2012, respectively. The recommended agronomic practices were followed to raise the crop. However, no pesticide was applied in crop till harvesting. The whole area was divided into 5 equal blocks of 36x10 m^2 each.

2.2 Observations

The number of different post embryonic development stages of whitebacked planthopper were collected from 10 hills, selected randomly from each block, at 7 days intervals. The observation were started 7 days after transplanting (DAT) and continued until harvesting. The population of WBPH along with predators was recorded in the forenoon by tapping the plant by hand from the base of the plant to the top into a white enamel tray containing a little water. The tray was cleaned every time before next observation. The metrological data were recorded daily to correlate the nature of relationship of WBPH with abiotic factors.

2.3 Statistical Analysis

The data were subjected to the analysis of variance using simple Randomized Block Design (RBD) program. A simple correlation was calculated to know the relationship between biotic and abiotic and the population of WBPH.

3. Results and Discussion

3.1 Seasonal population of whitebacked planthopper (WBPH)

The data presented in Table 1 and 2 reveals that the population of WBPH in the field started increasing from 32nd standard meteorological week (SMW) during 2011 and 33rd standard week during 2012. The highest number 403.4 and 224.4 /10 hills were recorded in 38th standard week during *Kharif* 2011 and 2012, respectively by the end of September. Thereafter a sudden and steep decline, which was about four time less (9.6/10 hills) of the peak population in 39th week during *Kharif*, 2011 and about 50 per cent of 121 WBPH/10 hills) during *Kharif* 2012. Further no other peak was observed till the harvest of the crop from 42nd to 43rd SMW during 2011 and 2012, respectively. A similar trend of decrease in population was also observed by [11]. The high incidence of WBPH during mid September when the crop was at panicle emergence stage observed by [9] and [1] who reported a decline in the population in the last week of September and much reduced population in the first half of October support the present findings.

The WBPH population was also recorded in the field, which gradually increased from 32nd and 33rd weeks onwards. A significantly higher (403.4 and 224.4 WBPH/10 hills) population was recorded during 38th week during 2011 and 2012. Thereafter, due to sudden and steep decline WBPH population reached to 9.6 WBPH/10 hills during 39th week 2011 than 2012 population slow decrease (121 WBPH/10 hills) and again increased (8 and 82.8 WBPH/10 hills) during 42nd and 41st week, respectively.

The present findings are also in conformity with [3] who have reported a peak level of 77 and 133/10 hills in 2nd week of September during 1987 and 1988, respectively. Similar trend of population was also observed by [7].

3.2 Effect of abiotic and biotic factors on seasonal population of whitebacked planthopper

3.2.1 Abiotic factors (weather parameters)

During the present studies there was no abrupt change in the averages of temperature and relative humidity and sunshine hours and these weather parameters were in favourable range of growth and development. The average maximum and minimum temperature varied from 31.1°C-34.1°C and 14.5-27.0°C during *Kharif* 2011 and 29.2-33.6°C and 12.6-26.6°C during *Kharif* 2012. The correlation with different abiotic factors did not show any significant relations with any of the weather parameters (Fig 1). These findings are in agreement with the findings of [3]. The growth stage or volatile chemicals released by plant might have affected the stay of the WBPH on crop and insect started emigrating from the crop to the other safer places, abiotic factors played a major role in population fluctuation of whitebacked planthopper. In the present finding pest appeared from August and continued up to October with peak in September and these finding are in concurrence with others [7, 3].

The abundance of WBPH population density with maximum temperature, minimum temperature, relative humidity, sunshine hours and rainfall showed non-significant positive correlation, these finding are in conformity with [12].

3.2.2 Biotic factors (spiders and mirids)

The population of different species of spiders ranged from 6.8-12.8 spiders/10 hills in August (31st to 34th week). The population of spiders started increasing in September and varied from 6.2-18.8 spiders/10 hills from 35th standard week to 38th week. In October, the population of spiders varied from 17.4-39.2 spider/10 hills from 39th to 42nd weeks. The maximum spiders 39.2/10 hills were recorded in 39th standard week. No mirid bug was found during sampling from 31st standard week to 35th standard week and remained low up to 38th week (0.8-9.2/10 hills). The maximum (64.2/10 hills) mirid bugs recorded in 39th week as the population of predators i.e. spiders and mirids peaked in this week (Table 1). While in 2012 the population of different species of spider remained low from 32nd standard week to 36th week and ranged from 5.4 to 7.4 spider/10 hills The maximum number of spiders (23.6/10 hills) were recorded in 37th standard week. No mirid bug was found from the beginning of the observation till 37th standard week. The peak population (66.8/10 hills) mirid bugs was recorded in 40th standard week (Table 2).

In present finding, spider and mirid bug were the dominant predators of WBPH. Spiders, *Lycosa* spp. were observed to prey upon nymphs and adults of WBPH (Fig.1). Increased population of spiders (*Lycosa pseudoannulata*, *Oxyopes javanus*), microvelia and mirid bug (*Cyrtorhinus lividipennis*) etc.by [13]. These might be responsible for reduced WBPH population. The relationship existed between WBPH and population of mirid bug was also reported by [2].

Table 1: Population of whitebacked planthopper (WBPH) and its natural enemies on rice cv. *Taraori Basmati*, in relation to different weather parameters during *Kharif* 2011

Standard weeks	Average No per 10 hills				Weather parameters					
	WBPH Nymph and adult	Spiders	Mirids	Nymphal and adult parasitoids	Temperature (°C)		Relative humidity (%)		Sunshine hours (SSH)	Rainfall (mm)
					Max.	Min.	Morn.	Even.		
31	0.4	12.8	0.0	0.0	34.1	27	91.8	71.7	6.8	0.0
32	8.2	8.0	0.0	0.0	32.9	26.1	89.4	76.7	7.1	0.0
33	58.8	7.6	0.0	0.2	31.1	24.4	94.5	76	5.8	32.7
34	10.4	6.8	0.0	0.2	32.8	25.4	95.4	82.2	5.4	35.0
35	21.4	6.2	0.0	1.2	34.1	25.4	90.8	74.8	7.4	40.9
36	61.8	16.6	0.8	1.2	32.1	25	92.5	81.7	3.2	8.7
37	64.8	18.8	2.4	1.4	33	24.4	95.2	76.2	8.8	291.9
38	403.4	15.4	9.2	3.0	31.6	22.2	95.4	69.2	9.2	0.0
39	9.6	39.2	64.2	0.2	31.5	21.7	92.1	70.2	10.4	0.0
40	4.8	17.8	36	0.6	32.7	20.7	91.4	59.7	9.1	0.0
41	5.2	17.4	24.8	3.2	33.1	17.85	91.2	43.6	8.4	0.0
42	8.0	18.8	50.2	3.2	32.3	14.5	93.2	47.5	7.3	0.0

Table 2: Population of whitebacked planthopper (WBPH) and its natural enemies on rice cv. *Taraori Basmati*, in relation to different weather parameters during *Kharif* 2012

Standard weeks	Average No per 10 hills				Weather parameters					
	WBPH (nymphal and adult)	Spiders	Mirids	Nymphal and adult parasitoids	Temperature (°C)		Relative humidity (%)		Sunshine hours (SSH)	Rainfall (mm)
					Max.	Min.	Morn.	Even.		
32	4.6	6.4	0.0	0.0	33.4	25.4	90.1	75.4	5.6	20.3
33	8.0	6.2	0.0	0.0	33.1	26.6	90.1	72.6	8.3	0.0
34	8.6	6.6	0.0	0.0	31.6	25.2	95.1	82.1	3.1	22.5
35	75.8	5.4	0.0	0.8	32.2	24.9	94.9	80.6	5.5	168.5
36	118.6	7.4	0.0	0.0	32.6	24.9	88.3	73.3	8.4	9.2
37	99.6	23.6	0.0	1.4	33.6	24.7	95.7	80.6	6.3	51.4
38	224.4	22.4	2.2	1.4	31.1	22.3	94.6	81.1	8.1	35.3
39	121	18.8	4.6	3.2	31.9	20.4	91.6	62.6	10.6	0.0
40	39.4	16	66.8	4.2	33.1	18.4	93.1	48	10.3	0.0
41	82.8	17.4	52.4	6.6	32.8	16.3	87.6	40.7	9.0	0.0
42	6.6	16	48.8	3.2	31.2	15.4	90.1	44	7.0	0.0
43	4.6	20.2	15.6	3.4	29.2	12.6	85.7	45.6	6.4	0.0

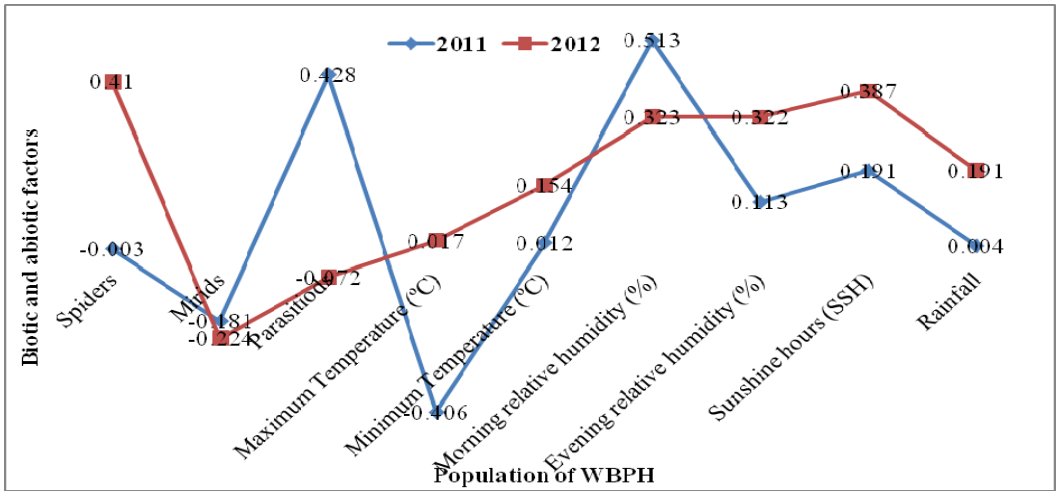

Fig 1: Correlation of whitebacked planthopper (WBPH) with abiotic and biotic factors during *Khraif* 2011and 2012.

4. Conclusion

The population of WBPH was maximum during 38th SMW (4th week of September) during 2011 and 2012. The population of spiders and mirid bugs were maximum in 39th SMW during 2011while in 2012 the population of spiders were maximum (23.6/10 hills) in 37th SMW and that of mirid bugs 66.8 /10 hills in 40th SMW. When WBPH population was correlated with biotic and abiotic factors, the relationship was found non significant. So knowledge of the seasonal abundance and population build up trend is essential to ensure timely preparedness to manage pest problems and prevent crop losses.

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