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Impact of Weather Parameters on Incidence of Green Leaf Hopper in Rice

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ABSTRACT: The experiment was carried out on impact of weather parameters on incidence of green leaf hopper in rice at Main Rice Research Station, Anand Agricultural University, Nawagam during *Kharif*, 2021 and 2022. The incidence of green leaf hopper initiated at stem elongation stage of the crop (0.28 hopper/ hill) *i.e.,* 37th SMW; (2nd week of September and 28 DAT). Subsequently, the population oscillated and reached peak (2.96 hoppers/ hill) at milky grain stage of the crop *i.e.,* 42nd SMW (2nd week of October and 63 DAT) following gradually decreased and reaching minimum at mature grain stage. The data on correlation between population of green leaf hopper incidence and weather parameters showed negative correlation between green leaf hopper incidence with minimum temperature (MinT, r=-0.215), morning relative humidity (RH_1, r=-0.119), evening relative humidity (RH_2, r=-0.305), rainfall (r=-259) and rainy days (r=-0.309) while, positive association with maximum temperature (MaxT, r=0.248) and bright sunshine hours (BSS, r=0.425).

Keywords: Correlation, Green Leaf Hopper, Growth stages, Rice and Weather data.

INTRODUCTION

Rice, *Oryza sativa* (L.) is one of the important cereal crops, being the staple food for more than 65 per cent of the world population (Mathur *et al.,* 1999). Among the rice growing countries in the world, India has the largest area under rice crop *i.e.,* 47.83 million ha and ranked second in production, next to China *i.e.,* 135.67 million tonnes with productivity of 2838 kg per hectare during 2022-23 (Anonymous, 2024a). However, in Gujarat state the area under rice cultivation is about 0.95million ha with a production of 2.39 million tonnes, whereas the productivity is 2529.56 kg/ha during 2022-23 (Anonymous, 2024b). The warm and humid environment is essential for rice cultivation, simultaneously it is also favourable for the survival and development of insect-pests. More than 100 different species of insects are known as rice pests, out of which about 15 are major and economically important (Teng *et al.,* 1993).

Amongst the sucking insect-pests infesting rice, plant hoppers especially the brown plant hopper, white backed plant hopper and green leaf hopper are of economic concern in India (Atwal *et al*., 1967). The green leaf hopper population are more sporadic in Gujarat region. Both the nymphs and adults suck on the stem as well as leaf sheath and remove plant sap, resulting in leaf yellowing. Under high hopper population, excessive removal of plant sap causes the plant turn brown. The average yield loss 10 to 90 per cent in rice has been accounted due to plant hoppers (Krishnaiah and Varma 2015).

Seasonal dynamics studies help in planning need based application of insecticides as it clearly reveals the insect-pests peak activity as well as its free periods during the crop growth. Each insect-pests requires certain set of weather conditions for its survival and multiplication. In addition to this, climate change will have an impact on insect-pests behaviour, distribution and abundance, as indicated by an increase in the number of generations per year, higher winter survival rates and the earlier appearance of the majority of insects (Singh *et al.,* 2012; Patel and Singh 2017). Knowledge of seasonal dynamics of green leaf hopper and different crop growth phases as well as weather parameters are essential for developing sustainable crop protection strategies.

MATERIALS AND METHODS

The study on impact of weather parameters on incidence of green leaf hopper in rice was carried out at Main Rice Research Station, Anand Agricultural University, Nawagam during *Kharif*, 2021 and 2022. The seeds of rice variety, GR 11 were sown on the well-prepared nursery bed and raised by adopting the recommended agronomical practices. The seedlings of 30 days old were transplanted in the field with 20 × 15 cm spacing. The transplanting dates of experiments was 20th August, 2021 and 19th August 2022, respectively during both the year. The experimental plot size was 10.0 × 45.0 m and it was kept free from any plant protection measures. The observations were recorded from randomly selected 5 quadrates each of 1 × 1 m

area in the experimental plot. The observations on green leaf hopper incidence were recorded from five randomly selected hills from each quadrate at weekly interval starting from immediately after transplanting to harvest of the crop. The observations of different growth stages of crop were also noted during experimental period. The observations on population of green leaf hopper were recorded by counting number per hill on sheath area on stem region.

Data on weather parameters *viz*., maximum temperature (MaxT), minimum temperature (MinT), morning relative humidity (RH_1), evening relative humidity (RH_2), bright sunshine hours (BSS), rainfall (RF) and rainy days for the year 2021 and 2022 were collected from Meteorological laboratory, Main Rice Research Station, Anand Agricultural University, Nawagam. The observations of incidence of GLH in rice and different weather parameters were correlated.

RESULTS AND DISCUSSION

A. Seasonal dynamics of green leaf hopper in rice

The data on the incidence of green leaf hopper (Table 1) exhibited that the population initiated at stem elongation stage of the crop (0.48 hopper/hill) *i.e.,* 37th SMW (second week of September and 28 DAT) during *Kharif,* 2021. Subsequently, the population oscillated and reached peak (5.84 hoppers/hill) at milky grain stage of the crop *i.e.,* 42nd SMW (second week of October and 63 DAT) following gradually decreased and reaching minimum (0.04 hopper/hill) at mature grain stage *i.e.,* 45th SMW (first week of November and 84 DAT).

During *Kharif,* 2022, GLH population was observed very less as compared to earlier year. The pest incidence began at stem elongation stage (0.08 hopper/ hill) *i.e.,* 37th SMW (second week of September and 28 DAT) continued till maturity of the crop. Which gained its highest level (0.16 hopper/hill) during flowering stage of the crop *i.e.,* 40th SMW (fifth week of September and 49 DAT). Eventually, the population declined and reached the lowest (0.08 hopper/hill) during milky stage *i.e.,* 42nd SMW (Second week of October and 63 DAT). The population of GLH also followed more or less similar the pattern of WBPH and disappeared completely from the dough grain stage *i.e.,* 43rd SMW till the harvesting.

The data on pooled over years revealed that the incidence of green leaf hopper was observed from 37th SMW (0.28 hopper/ hill) to 45th SMW (0.02 hopper/ hill) exhibiting the highest incidence (2.96 hoppers/ hill) during milky grain stage *i.e.,* 42nd SMW (second week of October and 63 DAT). The data on green leaf hopper incidence during both of the years and pooled over years determined that GLH preferred the milky grain stage of the crop. Green leaf hopper appeared in rice crop from August to October and the population gradually decreased as the crop reached the harvesting stage. Similar and supporting results with present findings were reported by Sreelatha *et al.* (2022).

Table 1: Seasonal dynamic of green leaf hopper in rice (*Kharif*, 2021 and 2022).

Month	SMW	DAT	Crop growth stage	Green leaf hopper (No./hill)		
				2021	2022	Pooled
August	34	7	Tillering	0.00	0.00	0.00
	35	14	Tillering	0.00	0.00	0.00
September	36	21	Stem elongation	0.00	0.00	0.00
	37	28	Stem elongation	0.48	0.08	0.28
	38	35	Booting	0.56	0.04	0.30
	39	42	Heading	2.28	0.00	1.14
	40	49	Flowering	0.56	0.16	0.36
October	41	56	Flowering	4.44	0.12	2.28
	42	63	Milky grain	5.84	0.08	2.96
	43	70	Dough grain	1.36	0.00	0.68
	44	77	Dough grain	1.92	0.00	0.96
November	45	84	Mature grain	0.04	0.00	0.02

Note: SMW- Standard Meteorological Week; DAT- Days after transplanting

B. Correlation matrix of the relationship between incidence of green leaf hopper with weather parameters

The data on correlation between population of green leaf hopper incidence and weather parameters during *Kharif,* 2021 showed that minimum temperature (MinT, r=-0.099), morning relative humidity (RH_2, r=-0.034), evening relative humidity (RH_2, r=-0.300), rainfall (r=-0.285) and rainy days (r=-0.315) exhibited negative correlation while, maximum temperature (MaxT, r=0.392) and bright sunshine hours (BSS, r=0.498) exhibited positive association.

During *Kharif,* 2022, maximum temperature (MaxT, r=-0.349) and bright sunshine hours (BSS, r=-0.554) found negative association with GLH population while, rest of the weather factors *viz.,* minimum temperature (MinT, r=0.255), morning relative humidity (RH_1, r=0.436), evening relative humidity (RH_2, r=0.313), rainfall (r=0.387) and rainy days (r=0.542) exhibited positive association.

The correlation data on pooled over years registered negative correlation between green leaf hopper incidence with minimum temperature (MinT, r=-0.215), morning relative humidity (RH_1, r=-0.119), evening relative humidity (RH_2, r=-0.305), rainfall (r=-259) and rainy days (r=-0.309) while, positive association with maximum temperature (MaxT, r=0.248) and bright sunshine hours (BSS, r=0.425).

The correlation of brown plant hopper shows non-significant negative correlation with rainfall, maximum as well as minimum temperature and average

temperature (Kumar *et al.*, 2020). BPH population showed positive and non-significant correlation with maximum temperature and rainfall. Whereas, negative and non-significant correlation with sunshine (Yadav *et al.*, 2023). These reports of brown plant hopper population correlation are somewhat aligning with the current results of green leaf hopper correlation with weather parameter.

Table 2: Correlation of green leaf hopper incidence with weather parameters in rice (*Kharif*, 2021 and 2022).

Weather parameters		Green leaf hopper		
Year		2021	2022	Pooled
Temperature (°C)	Max.	0.392	-0.349	0.248
	Min.	-0.099	0.255	-0.215
Relative Humidity (%)	Mor.	-0.034	0.436	-0.119
	Even.	-0.300	0.313	-0.305
Bright sunshine (hr)		0.498	-0.554	0.425
Rainfall (mm)		-0.285	0.387	-0.259
Rainy days		-0.315	0.542	-0.309

Note: There was a total of 9 observations recorded during the experimental periods; Max.-Maximum; Min.-Minimum; Mor.-Morning; Even. – Evening

CONCLUSION

The study conducted that, the incidence of green leaf hopper commenced at the stem elongation stage and peaked at the milky grain stage and its declining at the mature grain stage. Correlation analysis revealed that GLH incidence had a negative relationship with minimum temperature, morning and evening relative humidity, rainfall and rainy days. Conversely, it showed a positive association with maximum temperature and bright sunshine hours. These findings highlight the influence of specific weather parameters on GLH dynamics in rice crops.

FUTURE SCOPE

The findings of this study provide a foundation for future research and practical applications to manage green leaf hopper (GLH) infestations in rice crops. Potential future scopes include, development of predictive models by utilizing the identified correlations between weather parameters and GLH incidence. The study's insights can guide the development of weather-based IPM strategies to optimize pesticide use and minimize environmental impact. Incorporating the results into decision-support tools for farmers can improve pest management practices and boost crop productivity.

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Conflict of Interest. None.

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