Studies on the Spread of Rice Hoppers in Relation to the Weather Conditions to Decide Their Effective Management

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ABSTRACT
A survey for occurrence and spread of leaf and plant hoppers in rice crop during entire growing season was made in farmer's field and Government Farms of Rewa district of Madhya Pradesh for two consecutive years. Frequency of out break and population build up of white backed plant hoppers (WBPH) and green leaf hoppers (GLH) were recorded and their correlations were worked out with the prevailing weather conditions. Results revealed that WBPH and GLH were the regular pests in rice, but infestation of former was more serious than later. Though infestation of both hoppers was seen during entire growth span of rice, former was severe pest during early growth phase of crop and later at mid-growth phase. Both pests had shown their strong negative relationships with maximum and minimum temperature and sunshine hours. Thus, forecasting modules are also suggested in this paper to decide timely and effective management of these pests in rice.

Introduction:
Rice (*Oryza sativa* L.) is a predominant crop in Rewa region, which comprises with Rewa, Satna, Sidhi, Shahdol, Umariya and Anooppur Districts of Madhya Pradesh. Rice is extensively growth by direct seeding in both up and lowlands under rain-fed conditions with very low productivity (9.87 q/ha). High yielding crop varieties have been introduced since the late seventies to enhance the productivity level. But these varieties require high level of management including use of costly fertilizers and insecticides for good growth and effective pest management, respectively. The use of insufficient agro-inputs and indiscriminate control of insect-pests by the farmers may be the cause of low productivity of the crop.

Among numerous insect-pests damaging rice, leaf and plant hoppers are most serious during entire growing season of crop. These pests cause severe yield losses and the severity of their infestation mostly depends on the prevailing weather conditions, besides the effect of crop varieties, sowing time and methods, manuring and weed-management etc. (Atwal, 1986; and Kenmore, 1991). Therefore, the knowledge pertaining to out break and then population buildup of these insect pests in relation to weather conditions and cultural practices of crop-cultivation have much concern to develop the effective pest management. Such desired information are meager, which could be generated through a site-specific regular surveillance and monitoring of insect damage (Lowe, 1980). Hence, the present investigations have been under taken.

Methodology:
Survey on out break and spread of leaf and plant hoppers of rice viz., white backed plant hoppers (WBPH), brown plant hoppers (BPH) and green leaf hoppers (GLH) was made in rice crops grown on the farmer's fields and Government Farms in Rewa District of Madhya Pradesh during rainy season (July to October) for two consecutive years. For surveillance in farmer's fields, 5 villages were selected neighbouring to approachable road-sides in each of the 8 blocks of the district. Afterthis, 5 fields were marked in each selected village for recording the data pertaining to incidence of rice hoppers. One round of survey in all selected villages of each block was completed in 8 days and again it was repeated at fortnightly intervals. Meanwhile, the information pertaining to crop parameters viz., variety, sowing time, sowing method, manure and fertilizer application and weed management etc. as well as weather parameters viz., temperature, rainfall, relative humidity and sunshine etc. were also documented. The weather parameters were recorded from the offices of each block of the district. The regression equations were worked out as per suggestions of Chattarjee (1997) for predicting the spread of pest to develop the timely and effective

pest management.

Results and Discussion:
Out of the 3 major hoppers infesting rice, the presence of BLH was almost nil, hence remaining two hoppers included here.

Infestation of WBPH (*Sogatella furcifera* Hovarth):
The infestation of this pest was seen from early stage of crop and continued till the reproductive phase with the peak intensity in one month old crop mostly in all high yielding varieties at all locations during both years (**Table 1**). Thus, it was a regular serious pest in the district. Direct seeded crop grown with the use of manures and fertilizers favored more for infestation of this pest than unmannered one agreeing with the findings of Dash *et al*. (1996). Different varieties had shown variable degree of susceptibility to this pest. Kranti variety offered the highest infestation followed by IR-36. Other high yielding dwarf varieties (IR-64 and Kalinga-3) had lesser infestation than the former. However, local variety had significantly the lowest infestation. Its infestation was not homogenous in all blocks of the district mainly due to change in local weather conditions and cultural practices of crop cultivation. The succulent growth of plants at early growth phase i.e. 30 days after sowing (DAS) was much favorable for severe infestation than other growth stages. The infestation of this pest was maximum in Teonthar block at 60 DAS, respectively mainly due to late sowing of crop. These results also corroborated the earlier findings of Rath and Misra (1997) from Orissa and Sharma *et al*. (1998) from Uttar Pradesh.

Infestation of GLH (*Nephotettix verescens* Dist.):
The infestation of this pest started slightly later than WBPH. Its intensity was relatively lesser during early growth phase (30 DAS) than during grand growth phase (60 DAS) in all crop varieties except local one in different blocks of the district. Thus, the time of severity for its infestation was almost reverse when compared with infestation of WBPH. Earlier, Pophaly and Gupta (1995) have also emphasized that infestation of GLH became much serious at grand vegetative growth stage particularly in well manured conditions. The degree of infestation of this pest also varied among different blocks mainly due to varying local weather conditions and cultural practices followed for cultivation of crop. Typically, the presence of this pest was nil in Naigarhi block of the district mainly due cultivation of local varieties with the use of less or no fertilizers.

Effect of weather conditions:
The correlation coefficient values (r) between different weather conditions and population build up/m^2 of WBPH as well as GLH at different growth stages of rice grown in the district are given

in **Table 2**. It is evident from the data that rainfall had positive relationships with the population of these pests, but relationships were not significant. Other weather parameters had shown their inverse relationships with the population of these pests at all growth stages. However, the relationships were significant only with temperature (both maximum and minimum) and sunshine hours/day. It is notable that correlations were much stronger at 30 DAS growth stage in case of WBPH than that of GLH, while the position of relationships reversed at 60 DAS growth stage. The results are in close conformity with the findings of Tripathi *et al.* (1997) and Bhatnagar and Saxena (1999). The regression equations were determined to predict the infestation of serious pests for efficient pest management only when 'r' values had sown their significance. The population of pests/m^2 could be predicted as under with the regression equations: -

1. Population of WBPH/m^2 (y) with reduction in each ^{0}C of mean monthly maximum temperature (x) at different growth stages: -
   (a) At 30 DAS – y = 7.7480 – 0.1562 x
   (b) At 60 DAS – y = 6.7597 – 0.1606 x
2. Population of WBPH/m^2 (y) with reduction in each ^{0}C of mean minimum temperature (x) at different growth stages:-
   (a) At 30 DAS – y = 9.3980 – 0.3082 x
   (b) At 60 DAS – y = 11.2662 – 0.3211 x
3. Population of WBPH/m^2 (y) with reduction in each hour of sunshine/day (x) at different growth stages:-
   (a) At 30 DAS – y = 5.6936 – 0.7955 x
   (b) At 60 DAS – y = 7.6483 – 0.8026 x
4. Population of GLH/m^2 (y) with reduction in each ^{0}C of mean monthly maximum temperature (x) at different growth stages:-
   (a) At 30 DAS – y = 8.6321 – 0.0835 x
   (b) At 60 DAS – y = 9.6387 – 0.1072 x
5. Population of GLH/m^2 (y) with reduction in each ^{0}C of mean minimum temperature (x) at different growth stages:-
   (a) At 30 DAS – y = 7.4386 – 1.0023 x
   (b) At 60 DAS – y = 10.5643 – 0.2130 x
6. Population of GLH/m^2 (y) with reduction in each hour of sunshine/day (x) at different growth stages:-
   (a) At 30 DAS – y = 6.7321 – 1.0985 x
   (b) At 60 DAS – y = 7.1073 – 0.7854 x

Table 1- Mean population/m^2 of WBPH and GLH on different rice cultures at various growth stage in different blocks of Rewa District (MP).

Treatment	WBPH		GLH	
	30 DAS	60 DAS	30 DAS	60 DAS
Rice cultures				
DS IR-36 (F)	76.60	34.23	47.50	73.93
DS IR-36 (UF)	29.20	12.87	34.20	51.53
Lehi IR-36 (F)	67.53	53.50	40.30	72.65

Treatment	WBPH		GLH	
	30 DAS	60 DAS	30 DAS	60 DAS
DS IR-64 (F)	53.23	45.99	39.71	60.10
DS Local (UF)	06.43	08.85	24.9	08.98
DS Kalinga-3 (F)	50.67	42.90	05.28	13.41
TR Kranti (F)	83.11	74.40	58.86	157.16
SEm±	6.50	4.82	3.99	9.0
CD (P=0.05)	18.40	13.10	11.29	25.95
Blocks				
Mauganj	102.12	36.96	29.21	62.63
Hanumana	72.80	34.90	28.37	54.68
Naigarhi	12.87	30.86	0.00	0.00
Raipur,Karchuliyan	21.25	5.52	39.30	58.52
Rewa	74.97	47.25	38.06	92.45
Sirmour	26.16	38.08	0.00	0.00
Jawa	41.78	31.10	45.02	54.43
Teonthar	55.15	48.29	41.97	87.13
SEm±	2.49	1.76	0.31	0.35
CD (P=0.05)	7.05	5.00	0.88	1.05

DS – Direct seeded, TR – Transplanted, F – Fertilized, UF – Unfertilized

Table 2- Correlation coefficient (r) between weather parameters and population of WBPH and GLH at different growth of rice in Rewa District.

Mean monthly weather parameters	WBPH		GLH	
	30 DAS	60 DAS	30 DAS	60 DAS
Rainfall (mm)	0.1601	0.0474	0.0653	0.1721
Rainy days (number)	-0.1150	-0.0208	-0.0356	-0.1130
Maximum temperature (^{0}C)	-0.2002**	-0.1469*	-0.01266*	-0.1875**
Minimum temperature (^{0}C)	-0.2666**	-0.1612*	-0.1835*	-0.2076**
Morning RH (%)	-0.1296	-0.0760	-0.1132	-0.1325*
Evening RH (%)	-0.0077	-0.0395	-0.0911	-0.0124
Sunshine hours/day	-0.2984**	-0.1439*	-0.1715*	-0.3022**

* and ** significant at 5 and 1% level of probability, respectively RH – relative humidity

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