INCIDENCE OF WHITE BACKED PLANT HOPPER, *SOGATELLA FURCIFERA* (HORVATH), ZIGZAG LEAF HOPPER, *RECILIA DORSALIS* AND WHITE LEAF HOPPER, *COFANA* SPP. UNDER UPLAND RICE ECOSYSTEM AND THEIR CORRELATION WITH WEATHER PARAMETERS

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Abstract: Rice occupies the prominent place in Indian agriculture. Field experiment was conducted at research farm of Indira Gandhi Krishi Vishwa Vidyalaya, Raipur during *kharif* season 2013-14 using two upland direct seeded rice ecosystems (UDS) and upland transplanted rice ecosystems (UTP). The results of field experiments revealed that the maximum incidence of white backed plant hopper, *Sogatella furcifera* and zigzag leaf hopper, *Recilia dorsalis* observed in UTP with (1.38) and (1.46) as compare to UDS with (0.20) and (0.32) nymph/adult/25 sweeps (seasonal mean), respectively. White backed plant hopper showed significant positive correlation with sun shine hours in UDS only. Zigzag leaf hopper showed significant positive correlation with sun shine hours and significant negative correlation with minimum temperature, average temperature, evening relative humidity, average relative humidity in UTP. The maximum population of white leaf hopper, *Cofana* spp. was observed in UDS as compare to UTP and showed non-significant correlation with weather parameters.

Keywords: Ecosystem, Leaf hopper, Plant hopper, Rice, Upland

INTRODUCTION

Rice occupies the prominent place in Indian agriculture. It is the most important staple food crop of the developing world of more than 3 billion people. 'Rice is life'! This has become a worldwide mantra since the International Year of Rice in 2004 (Uphoff, 2011). About 90 percent of world rice is produced and consumed in Asia (Anonymous, 2004). Rice fields are very important because they are environmental buffers, they are a dynamic ecosystem that helps balance temperature and wind, and it provides a moderating effect on the surroundings (Rogel, 2004). A rice field undergoes three major ecological phases; aquatic, semi-aquatic and a terrestrial dry phase, during a single paddy cultivation cycle (Fernanado, 1995). Globaly rice agro ecosystems is categorized into five major types: (i) Irrigated rice fields (ii) rainfed rice fields (iii) Deep water rice fields, (iv) Upland rice fields, (v) Tidal water rice fields. In Chhattisgarh there are 5 agro-ecosystems in which rice is cultivated with different practices (Annonymous, 2009). Upland rice is usually grown in unfavourable soil and weather conditions and needs regular attention for obtaining good productivity. Insect pests menace is one among the many hurdles in reaching comprehensive rice grain productivity. The diversity of upland rice environments gives rise to a more heterogeneous insect fauna compared with the more homogeneous lowlands. Over 100 species of insect pests attack rice crop at various stages of its growth in India (Kalode and Pasalu, 1986). Rice plant hoppers are major pests across the country especially in irrigated rice. White backed plant hopper (WBPH), *Sogatella furcifera* Horvath (Hemiptera: Delphacidae) is economic importance because direct damage to crop by nymphs and adults sucking phloem sap and leading to hopper burn. White backed plant hopper, *Sogatella furcifera* Horvath is one of the most important rice pests (Watanabe, 1992). With the widespread introduction during the green revolution in the sixties and seventies of fertilizers, of improved varieties and of pesticides to rice crops, plant hoppers became important pests, most notably the white backed planthopper, *Sogatella furcifera* Horvath. White leaf hopper, *Cofana spectra* Distant (Hemiptera: Cicadellidae) damaged rice, sugarcane, wheat, sorghum, barley, grasses, etc. as a minor pest but some time serious pests. Zigzag leaf hopper, *Recilia. dorsalis* (Hemiptera: Cicadellidae) nymphs and adults excrete honeydew while feeding. Honeydew is attractive to ants because of its sugar content and may later be infected with sooty moulds. *R. dorsalis* can transmit rice tungro bacilliform virus, rice tungro spherical virus, rice dwarf virus and rice orange leaf virus. The aim of this study was to determine the incidence of Delphacidae and Cicadellidae in rice field between the developments stages of rice and it is relation with the weather factors. It is hoped that the findings from the study can contribute to the more ecological precise ways in dealing with outbreaks and control of insect pests of rice.

MATERIAL AND METHOD

The populations of rice white backed plant hopper, *Sogatella furcifera* (Horvath), Zigzag leaf hopper,

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Recilia dorsalis and white leaf hopper, *Cofana* spp. were recorded through sweeping net in both upland transplanted rice ecosystem (UTP) and upland direct seeded rice ecosystem (UDS. A specification of sweep net is 30 cm diameter and 65cm depth. Sampling was done randomly four places by 25 sweep of rice field in morning at weekly interval. The observations on occurrence of plant and leaf hopper were recorded by taking total 4 samples from 4 locations in both ecosystems. All samples were collected near the center of the ecosystem at least 5 meter from the edge in order to reduce edge effects. Weekly collections were calculated for determining the population dynamics of plant and leaf hopper. Correlation analysis was carried out between field incidence of plant hopper, leaf hopper and weather parameters during *kharif* season 2013-14. Regression analysis was worked out as per method given by Gomez and Gomez, (1985).

RESULT AND DISCUSSION

Population dynamics of White backed plant hopper, *Sogatella furcifera* (Horvath)

White backed plant hopper, *Sogatella furcifera* was initiated on the rice crop during 2nd week of September with 1.00 adult/25 sweeps and reached to maximum with 1.25 adult/25 sweeps during 3rd week of October in upland direct seeded rice ecosystem (UDS while in the upland transplanted rice ecosystem (UTP) pests first noticed on rice crop during 2nd week of September with 0.50 adult/25 sweeps and maximum during 4th week of October with 8.75 adult/25 sweeps. In this experiment maximum incidence (based on seasonal mean) of white backed plant hopper, *Sogatella furcifera* observed in UTP with 1.38 nymph/adult/25 sweeps as compare to UDS with 0.20 nymph/adult/25 sweeps (Table 1 and fig1). These finding are in conformity with Reddy *et al.,* (1983), Rajendra (2009) and Garg (2012) reported that the *S. furcifera* appeared 2nd fortnight of September and highest during October to November. Ngoan (1972) reported that the sudden decline of WBPH at the later part of the growth stage may be attributed to the loss of succulence in the plant as crop moved towards senescence. On the contrary, Rajendra (2009) reported that the *S. furcifera* incidence highest in drill sown as compared to upghat transplanted rainfed paddy ecosystem.

Population dynamics of Zigzag leaf hopper, *Recilia dorsalis*

First appearance of zigzag leaf hopper, *Recilia dorsalis* was observed 37 SMW in month of September with 0.25 nymph/adult/25 sweeps and maximum during 43 SMW in month of October with of 2.25 nymph/adult/25 sweeps in upland direct seeded rice ecosystem (UDS) whereas in the upland transplanted rice ecosystem (UTP) pests appeared during 1st week (36 SMW) of September with 0.25 nymph/adult/25 sweeps and remain up to crop harvesting. There was an increase in population in subsequent weeks and the maximum *R. dorsalis* population was recorded in last week (44 SMW) of October with 12.75 nymph/adult/25 sweeps. Incidence of zigzag leaf hopper, *Recilia dorsalis* was highest in UTP (1.46 seasonal mean) as compare to UDS (0.32 seasonal mean) during *kharif* season (Table 1and fig1). The present finding corroborates with Pathak and Khan (1994) who reported the seasonal occurrence varies distinctly in rice fields between areas where the insects undergo dormancy and diapause on the one hand, and where they remain active year-round on the other and *Nilaparvata lugens* and *Recilia dorsalis* become more prevalent during later stages. On the contrary, Nath and Bhagabati (1998) reported that the first appearance of zigzag leafhopper, *R. dorsalis* was slightly delayed in rice fields. The maximum numbers were recorded on 9th September during 1998 and 12th August during 1999 in Jorhat (India). The early disappearance of the zigzag leafhopper population might be due to maturity of the rice plant during October -November and the population might migrate to some other preferred hosts other than rice.

Population dynamics of white leaf hopper, *Cofana* spp.

It is evident from the data (Table 1 and fig1) the adult population of white leaf hopper, *Cofana* spp. initiated during 34 SMW in month of August with 0.25 adult/25 sweeps and disappears after 37 SMW in month of September. The maximum population of *Cofana* spp. was observed on 36 SMW in month September with 0.75 adult/25 sweeps in upland direct seeded rice ecosystem (UDS) while in the upland transplanted rice ecosystem (UTP) pests papered from 2nd week (33 SMW) of August with 0.25 adult/25 sweeps and highest during 1st week (36 SMW) of September with a population of 0.50 adult/25 sweeps. The maximum seasonal mean population of white leaf hopper, *Cofana* spp. was observed in UDS as compare to UTP during *kharif* season 2013-14. These findings are in agreement with Oyediran and Heinrichs (1999) reported that the peak populations occur at 6 WAT (late tillering phase of crop growth) and the populations of *Cofana* species were higher in lowland than in upland fields. Gangurde (2004) reported that the higher *Cofona spectra* (Cicadellidae) was recorded during the tillering stage and milk stage of the crop in both insecticides treated and untreated irrigated rice production systems of the Philippines in a single season. Singh and Singh (2010) reported that the white rice leafhopper, *C. spectra* occurs in all rice fields but is most common in rainfed rice and it is minor pest.

Correlation co-efficient between rice hopper and weather factors in upland rice ecosystem

It was evident from the data (Table 2and fig 1) that the zigzag leaf hopper showed significant positive correlation with sun shine hours and significant negative correlation with minimum temperature, average temperature, evening relative humidity, average relative humidity except this showed non-significant negative correlation with maximum temperature and morning relative humidity in UPT while non significant correlation with all weather factors in UDS at 5 and 1 per cent level of significance. Except sun shine hours WBPH showed non- significant positive and negative correlation with weather parameter in both UDS and UTP. WBPH showed significant positive correlation with sun shine hours in UDS only. Population of white leaf hopper, *Cofona* spp. showed non-significant positive and negative correlation with weather factors in both ecosystems at 5 and 1 per cent level of significance. These findings are in agreement with Rajendra (2009) reported that the white backed plant hopper population showed negative relationship with maximum temperature and minimum temperature, whereas positive relationship with morning relative humidity in Upghat transplanted paddy ecosystem in Sirsi tulak, Karnataka. Narayansamy *et al.* (1979) reported that positive correlation with relative humidity.

CONCLUSION

From the above study it can be concluded that the highest incidence of white backed plant hopper and zigzag leaf hopper was observed in upland transplanted rice ecosystem (UPT) as compare to upland direct seeded rice ecosystem (UDS) during October month but highest incidence of white leaf hopper observed in UDS as compare to UTP. This is probably due to the effects of biotic and abiotic factors. White backed plant hopper and Zigzag leaf hopper showed significant correlation with weather factors while white leaf hopper showed non-significant correlation with weather factors.

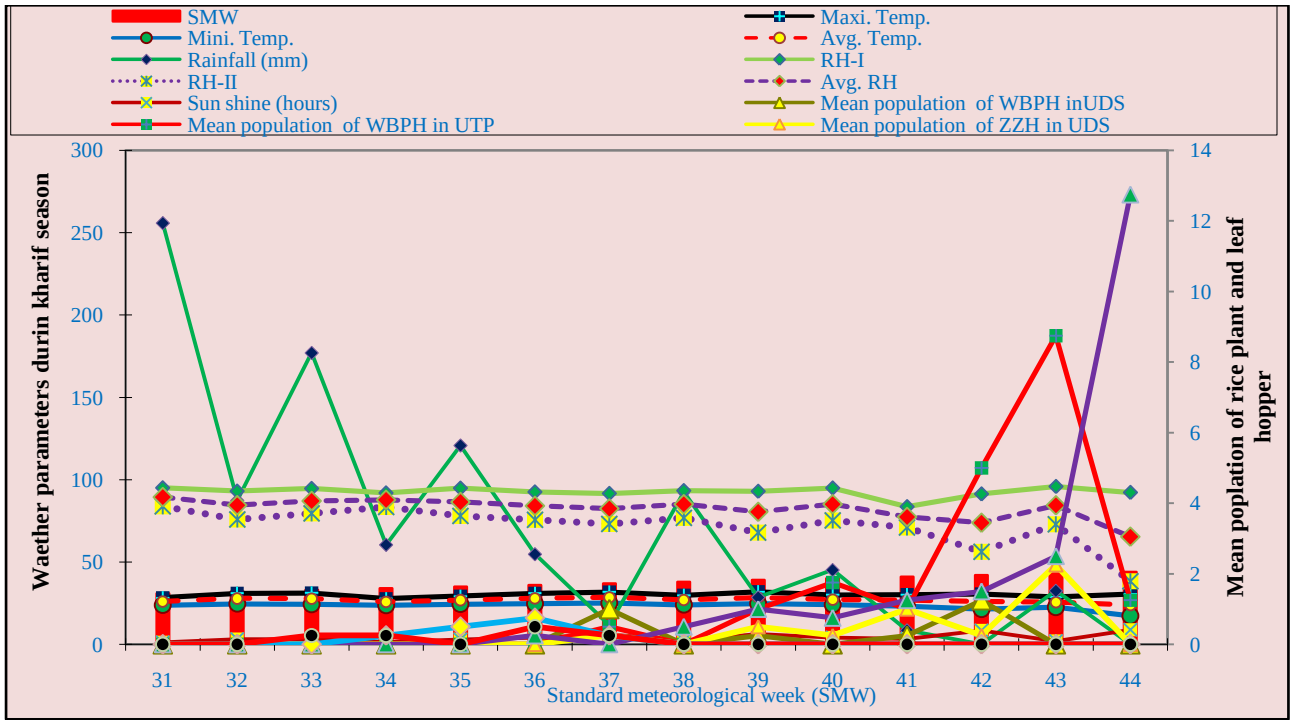

Fig: 1. Population fluctuation of rice white backed plant hopper, zigzag leaf hopper and white leaf hopper with Weather parameters.

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Table 1. Mean population of white backed plant hopper, zigzag leaf hopper and white leaf hopper in upland direct seeded and transplanted rice ecosystem

*SMW	Upland direct seeded rice ecosystem			Upland transplanted rice ecosystem			Weather parameters							
							Temperature (^{0}C)			Rainfall (mm)	Relative humidity (%)			Sun shine (hours)
	WBPH	ZZLH	WLH	WBPH	ZZLH	WLH	Maxi. Temp.	Mini. Temp.	Avg. Temp.		Morn.	Even.	Avg.	
31	0	0	0	0	0	0	28.30	23.90	26.10	255.80	95.10	83.90	89.50	1.30
32	0	0	0	0	0	0	31.10	24.70	27.90	87.40	93.10	76.00	84.55	3.30
33	0	0	0	0	0	0.25	31.30	24.40	27.85	177.00	94.70	79.60	87.15	3.30
34	0	0	0.25	0	0	0.25	27.80	23.80	25.80	60.50	92.00	83.60	87.80	1.50
35	0	0	0.5	0	0	0	29.30	24.50	26.90	120.80	94.90	78.10	86.50	3.10
36	0	0	0.75	0	0.25	0.5	31.10	24.80	27.95	54.80	92.60	75.70	84.15	4.20
37	1	0.25	0.25	0.5	0	0.25	31.90	25.20	28.55	11.60	91.70	73.30	82.50	6.20
38	0	0	0	0	0.5	0	29.90	24.10	27.00	92.60	93.40	76.90	85.15	2.50
39	0.25	0.5	0	1	1	0	32.00	24.90	28.45	28.60	93.00	68.00	80.50	6.30
40	0	0.25	0	1.75	0.75	0	30.10	24.20	27.15	45.20	95.00	75.30	85.15	4.20
41	0.25	1	0	1	1.25	0	30.20	23.30	26.75	8.60	83.70	71.10	77.40	3.50
42	1.25	0.25	0	5	1.5	0	30.70	21.40	26.05	0.00	91.40	56.30	73.85	8.60
43	0	2.25	0	8.75	2.5	0	28.80	22.60	25.70	32.60	95.90	73.10	84.50	2.10
44	0	0	0	1.25	12.75	0	30.50	17.30	23.90	0.00	92.30	38.40	65.35	8.90
**S.M.	0.20	0.32	0.13	1.38	1.46	0.09								

*SMW= Standard meteorological week, **S.M. = Seasonal Mean, WBPH= white backed plant hopper, ZZLH= Zigzag leaf hopper, WLH = white leaf hopper.

Table 2. Correlation co-efficient (r) and Regression analysis between mean population of plant and leaf hopper with weather parameter in upland direct seeded and transplanted rice ecosystem

Correlation with			**Correlation co-efficient (r)**		**Regression equation value**	
Weather parameter		**Rice pests**	**UDS**	**UTP**	**UDS**	**UTP**
Temperature(^{0}C)	Maxi. Temp.	WBPH	0.402	-0.171	y = 1.274x + 29.96 R^2 = 0.161	y = -0.087x + 30.33 R^2 = 0.029
		ZZH	-0.172	0.046	y = -0.354x + 30.32 R^2 = 0.029	y = 0.017x + 30.18 R^2 = 0.002
		White hopper	0.006	0.201	y = 0.034x + 30.21 R^2 = 4E-05	y = 1.632x + 30.06 R^2 = 0.040
	Mini. Temp.	WBPH	-0.060	-0.344	y = -0.300x + 23.56 R^2 = 0.003	y = -0.280x + 23.89 R^2 = 0.118
		ZZH	-0.089	-0.927**	y = -0.293x + 23.60 R^2 = 0.008	y = -0.569x + 24.34 R^2 = 0.858
		White hopper	0.313	0.324	y = 2.730x + 23.16 R^2 = 0.098	y = 4.191x + 23.13 R^2 = 0.104
	Average Temp.	WBPH	0.155	-0.362	y = 0.486x + 26.76 R^2 = 0.024	y = -0.184x + 27.11 R^2 = 0.130
		ZZH	-0.158	-0.720**	y = -0.323x + 26.96 R^2 = 0.025	y = -0.275x + 27.26 R^2 = 0.518
		White hopper	0.254	0.361	y = 1.382x + 26.68 R^2 = 0.064	y = 2.912x + 26.60 R^2 = 0.130
Rainfall (mm)		WBPH	-0.439	-0.389	y = -79.50x + 85.29 R^2 = 0.192	y = -11.39x + 85.34 R^2 = 0.151
		ZZH	-0.341	-0.381	y = -40.19x + 82.59 R^2 = 0.116	y = -8.400x + 81.97 R^2 = 0.144
		White hopper	-0.011	0.017	y = -3.356x + 70.09 R^2 = 0.000	y = 7.906x + 68.97 R^2 = 0.000
Relative humidity (%)	Morning	WBPH	-0.318	0.149	y = -2.326x + 93.22 R^2 = 0.101	y = 0.176x + 92.52 R^2 = 0.022
		ZZH	-0.082	-0.073	y = -0.390x + 92.89 R^2 = 0.006	y = -0.065x + 92.86 R^2 = 0.005
		White hopper	0.052	-0.010	y = 0.660x + 92.68 R^2 = 0.002	y = -0.197x + 92.78 R^2 = 0.000
	Evening	WBPH	-0.316	-0.287	y = -9.223x + 73.90 R^2 = 0.099	y = -1.355x + 73.95 R^2 = 0.082
		ZZH	-0.038	-0.876**	y = -0.715x + 72.32 R^2 = 0.001	y = -3.117x + 76.65 R^2 = 0.766
		White hopper	0.245	0.281	y = 12.36x + 70.54 R^2 = 0.060	y = 21.04x + 70.21 R^2 = 0.078
	Average	WBPH	-0.365	-0.230	y = -5.775x + 83.56 R^2 = 0.133	y = -0.589x + 83.24 R^2 = 0.052
		ZZH	-0.054	-0.824**	y = -0.553x + 82.61 R^2 = 0.002	y = -1.591x + 84.76 R^2 = 0.679
		White hopper	0.238	0.256	y = 6.513x + 81.61 R^2 = 0.056	y = 10.42x + 81.50 R^2 = 0.065
Sun shine (hours)		WBPH	0.611*	0.147	y = 3.637x + 3.499 R^2 = 0.373	y = 0.141x + 4.019 R^2 = 0.021
		ZZH	-0.145	0.585*	y = -0.561x + 4.394 R^2 = 0.021	y = 0.424x + 3.592 R^2 = 0.342
		White hopper	-0.101	-0.084	y = -1.043x + 4.344 R^2 = 0.010	y = -1.282x + 4.328 R^2 = 0.007

*Significant at 5 % level (2.145), **Significant at 1 % level (2.977), UDS = Upland direct seeded rice ecosystem, UTP = Upland transplanted rice ecosystem

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