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Seasonal incidence of key insect-pests and natural enemies on rice *Oryza sativa* (L.) in Northern hills of Chhattisgarh

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Abstract

A field study on seasonal incidence of key insect-pests and natural enemies in rice *Oryza sativa* (L.) was undertaken at Raj Mohini Devi College of Agriculture and Research Station, Ambikapur (C.G.) during *Kharif* 2023. The result revealed that the gall midge, stem borer as DH, leaf folder, whorl maggot incidence were recorded from 1st fortnight of September, and the peak incidence of gall midge (6.59% SS) and stem borer (9.71% DH) observed during 1st fortnight of October, while leaf folder (8.92% LD) and whorl maggot (4.48% LD) were recorded in 2nd fortnight of September and 1st fortnight of October, respectively. The stem borer as white ear head, panicle mite incidence and gundhi bug population were observed from 2nd fortnight of October to 1st fortnight of November and the peak activity reach during the 2nd fortnight of October to stem borer (12.40% WE) and 1st fortnight of November to panicle mite (9.68% Head Damage) and gundhi bug (12.92/hill), respectively.

Keywords: Seasonal incidence, key insect-pests, natural enemies, rice, Surguja

Introduction

Rice (*Oryza sativa* L.) belonging to the Poaceae family, Sub-family Oryzoideae, tribe Oryzae is the staple food crop for more than 60% of the world population and is particularly important in Southeast Asian countries. Grown for more than 6000 years, rice is economically, socially and culturally important to a large number of people across the globe (Pathak *et al.*, 1994) [10].

Chhattisgarh is known as “rice bowl of India” and about 82% population of the state is dependent on agriculture for their livelihood the total rice grown area was 3.79 million hectares with the production of 7.16 million tonnes per hectares (Anonymous, 2019) [2].

The rice crop is subjected to damage by many numbers of insect pests, among them the yellow stem borer, *Scirpophaga incertulas* (Walker) is the major insect pest causing dead hearts and white ears (Satpathi *et al.*, 2012) [15]. The rice leaf folder, *Cnaphalocrocis medinalis* (Guenee) is considered as a minor pest, (Nanda *et al.*, 2000) [8].

Abiotic factors regulate seasonal incidence, population count and development rates of the pest and natural enemies. As the cultivation of rice crop have expanded around the world, crop become susceptible to different environmental and biotic stress which has increased the pest infestation. Among the abiotic parameters; temperature and relative humidity play key role that regulates population dynamics, developmental rates and seasonal incidence of the insects and their natural enemies. Such information are essential in developing pest management programmes with economical and ecological balance.

Materials and Methods

The experiment was conducted at Research-cum-Instructional Farm of R.M.D College of Agriculture and Research Station, Ambikapur (C.G.) during *Kharif* season 2023. The crop (Var. MTU 1010) was raised by adopting standard agronomic practices. Observation on incidence of key insect-pests and natural enemies were recorded from randomly selected 10 hills per plot at fortnightly interval. The samples had kept free from any insecticidal treatment during the study.

The incidence of gall midge *Orseolia oryzae* had estimated by counting the total tillers and affected tillers as silver shoot per 10 hills selected at random per three spots.

$$\text{Silver shoot (\%)} = \frac{\text{Number of silver shoot}}{\text{Total number of productive tillers}} \times 100$$

The population count on yellow stem borer *Scirpophaga incertulas* counting the total tillers and affected tillers as dead heart at random selected per 10 hills per three spots.

$$\text{Dead heart (\%)} = \frac{\text{Number of dead heart}}{\text{Total number of tiller}} \times 100$$

$$\text{White ear head (\%)} = \frac{\text{Number of white ears}}{\text{Total number of productive panicle}} \times 100$$

The incidence of rice leaf folder *Cnaphalocrocis medinalis* had estimated by counting the total leaves and affected leaves per 10 hills selected at random per three spots.

$$\text{Leaf folder (\%)} = \frac{\text{Number of infested leaves}}{\text{Total number of total leaves}} \times 100$$

The incidence of whorl maggot had estimated by counting the total leaves and affected leaves per 10 hills selected at random per three spots.

$$\text{Whorl maggot (\%)} = \frac{\text{Number of infested leaves}}{\text{Total number of total leaves}} \times 100$$

The incidence of panicle mites the grain infestation percentage was recorded by counting the total (infested and uninfested) number of grain and the number of infested grain per panicle were recorded at fortnightly intervals. Percentage of infested grain was counted by using following formula:-

$$\text{Panicle mite (\%)} = \frac{\text{Total Number of infested Grains}}{\text{Total number of Grains}} \times 100$$

The number of adult stages of gundhi bug, dragonfly, damselfly, spider and lady bird beetle were recorded on 10 hills per spot.

A correlation coefficient method was used to find out the relationship, between the occurrence of the pest population and the weather parameters.

Results and Discussion

In the present study, the result revealed that the gall midge, *Orseolia oryzae* infestation as percent silver shoot first appeared from 1st fortnight of September (1.12%SS) to 2nd fortnight of October (2.13% SS) and their peak activity (6.59% SS) was observed during 1st fortnight of October (Table.1). The gall midge infestation showed non-significant yet positive correlation with minimum temperature ($r=0.069$). In a similar vein, Laxmi *et al.* (2018) [18] also reported gall midge peak occurrence in the initial week of October.

Yellow stem borer as percent dead heart appeared in rice crop during 1st fortnight of September (6.19%) and the pest population reached its peak of (9.71%) during the 1st

fortnight of October. The correlation analysis revealed that, the yellow stem borer incidence (% DH) showed a negative significant correlation with relative humidity-I ($r=-0.901$) and relative humidity-II ($r=-0.893$) (Table 3). These results are similar to the findings of Sulagitti *et al.* (2017) [16].

The incidence of leaf folder infestation as percent leaf damage begins during 1st fortnight of September (7.70%) (Table 1 and Fig. 1) and the pest infestation reached its highest level during 2nd fortnight of September (8.92%), after that the infestation gradually decreased. The correlation analysis revealed a no significant positive correlations with any of the abiotic parameter. These findings are similar to the results of Ahmed *et al.* (2010) [11] and Bhumi Reddy *et al.* (2018) [14].

Whorl maggot was first appeared as well as the maximum incidence of 4.48% leaf damage during 1st fortnight of September as (4.48% leaf damage), (which is presented in Table 1 and Fig. 1). The pest infestation had showed positive significant correlation with minimum temperature ($r=0.976$), which is presented in Table 3. Similar result was found by Kantesh *et al.* (2021) [15].

Panicle mite *Stenotarsonemus spinki* was first appeared during 2nd fortnight of October as (8.60% panicle damage), where the maximum infestation (9.68% panicle damage) was observed during 1st fortnight of November. Thus, the major activity period of pest was observed from October and November.

The population of rice earhead bug/gundhi bug was noticed during 2nd fortnight of October 12.34/hill and attained its highest level (12.92/hill) was observed during 1st fortnight of November. The present results are in close association with the findings of Sulagitti *et al.* (2017) [16].

Dragonfly commenced from the 1st fortnight of September (0.35/hill) to 1st fortnight of November (0.25/hill). The major activity period of dragonflies was noted from October to November, which is presented in Table 2. A statistically significant positive correlation was identified with the relative humidity-I ($r=0.920$) and relative humidity-II ($r=0.881$), while positive non-significant correlations were found with the maximum temperature ($r=0.615$). In a similar vein Mondal and Chakravorty (2017) reported no significant variations in dragonfly populations across different growth stages of *Kharif* rice.

Damselfly activity initiated during the 1st fortnight of September (0.37/hill). The peak population of damselflies reaching (0.97/hill) was documented during the first fortnight of October. Damselfly showcased statistically non-significant positive correlations with minimum temperature ($r=0.149$) (Table.3&4). Similarly, Mondal and Chakravorty (2017) [7] recorded damselfly population during the tillering stage (12.55 individuals per 5 hills).

Spiders initial appearance of 1.24/hill during the 1st fortnight of September. The peak population of spiders at 3.04/hill was observed in the first fortnight of October. A study found a statistically positive yet non-significant correlation with relative humidity-I ($r=0.151$) and relative humidity-II ($r=0.135$) as indicated in Table 2 and Table 4.

Initial population of ladybird beetle on rice crops was observed from 1.46/hill during the 1st fortnight of September and the peaking was at 3.32/hill during the 2nd fortnight of the September. The beetle population was showed significant negative correlation with rainfall ($r=-0.977$) (Table 2 & 4). Prakash (2021) [13] also noted similar results, indicating that the ladybird beetle exhibited its peak activity during the final week of September with a population of 5.30 per hill.

Table 1: Seasonal incidence of key insect-pests of rice and weather parameter during *Kharif* 2023

Month	Fortnight	Gall midge (% SS)	Stem borer (% DH)	Stem borer (% WE)	Leaf folder (% LD)	Whorl maggot (% LD)	Panicle mite (%ED)	Earhead bug (per plant)	Temperature (°C)		Rainfall (mm)	Relative humidity (%)	
									Max.	Min.		RH-I	RH-II
Sep	1 st	1.12	6.19	0.00	7.70	4.48	0.00	0.00	30.8	22.2	167.0	89.30	72.20
	2 nd	5.72	8.44	0.00	8.92	3.13	0.00	0.00	31.1	21.6	70.8	88.70	70.50
Oct	1 st	6.59	9.71	0.00	8.79	2.00	0.00	0.00	27.9	21.4	67.8	88.70	69.60
	2 nd	2.13	7.50	12.40	6.81	1.24	8.60	12.34	31.4	21.2	101.6	93.70	75.60
Nov	1 st	0.00	5.44	11.68	4.56	0.00	9.68	12.92	30.6	21.0	128.0	88.70	68.00
Mean		3.11	7.46	7.68	7.46	2.17	3.66	5.05	30.4	21.5	107.0	89.82	71.18

Note: SS – Silver shoot, LD- Leaf damage, DH- Dead heart, WE- White earhead, ED- Earhead damage

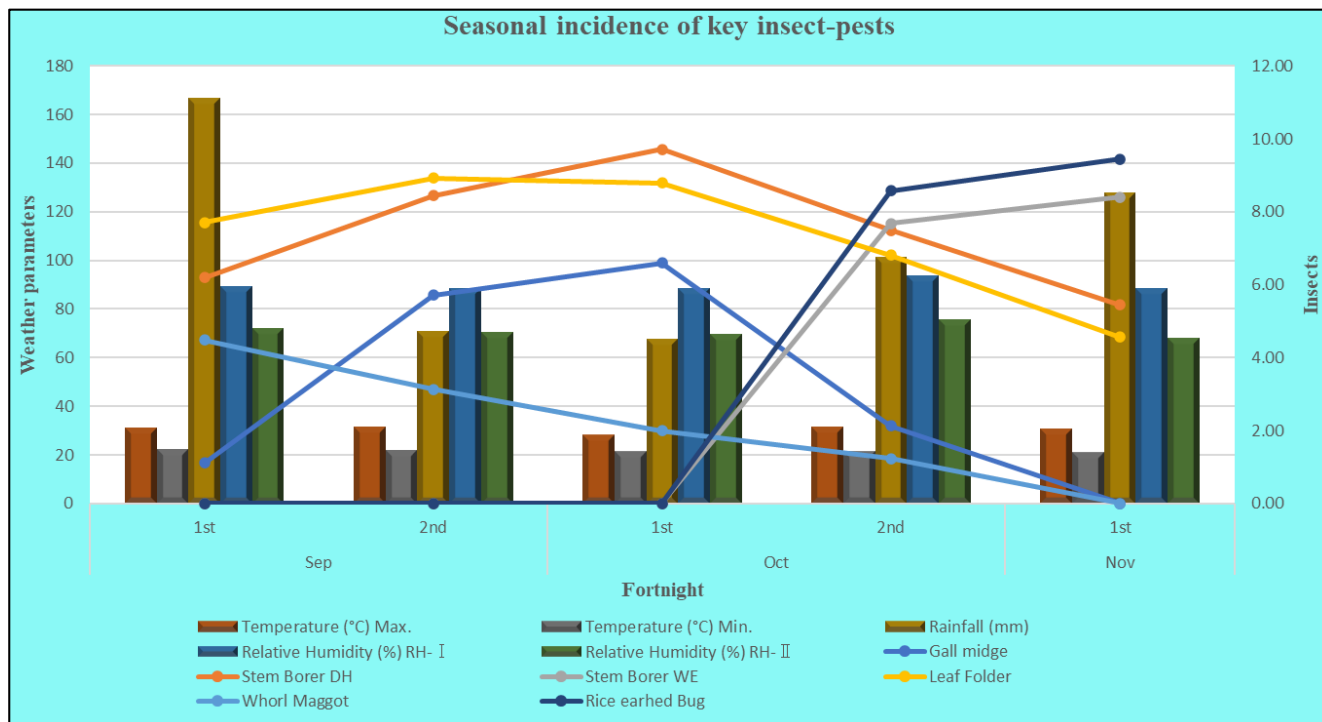


Fig 1: Correlation of insect-pest’s infestation (%) and weather parameters during the crop growth period of *Kharif* -2023

Table 2: Seasonal incidence of natural enemies with weather parameters during *Kharif* 2023

Month	Fortnight	Dragonfly	Damsel fly	Spider	Lady bird beetle	Temperature (°C)		Rainfall (mm)	Relative humidity (%)	
						Max.	Min.		RH-I	RH-II
Sep	1 st	0.35	0.37	1.24	1.46	30.8	22.2	167.0	89.30	72.20
	2 nd	0.53	0.90	2.08	3.32	31.1	21.6	70.8	88.70	70.50
Oct	1 st	0.22	0.97	3.04	3.07	27.9	21.4	67.8	88.70	69.60
	2 nd	0.99	0.36	2.25	2.42	31.4	21.2	101.6	93.70	75.60
Nov	1 st	0.25	0.21	1.19	1.88	30.6	21.0	128.0	88.70	68.00
Mean		0.46	0.56	1.96	2.43	30.36	21.48	107.04	89.82	71.18

Table 3: Correlation of key insect-pests with weather parameters during *Kharif* – 2023

Pests	Temperature (°C)		Rainfall (mm)	Relative humidity (%)	
	Max.	Min.		RH-I	RH-II
Gall midge	-0.569	0.069	-0.852	-0.241	-0.211
Yellow stem borer DH	-0.498	-0.064	-0.433	-0.901*	-0.893*
Yellow stem borer WE	-0.498	-0.043	-0.913*	-0.144	-0.058
Leaf folder	-0.344	0.552	-0.498	-0.162	0.169
Whorl maggot	0.068	0.976**	0.244	-0.217	0.238
Panicle mite	0.398	-0.763	0.187	0.513	0.124
Earhead bug	0.409	-0.758	0.177	0.552	0.168

* 5% level of significance, **1% level of significance

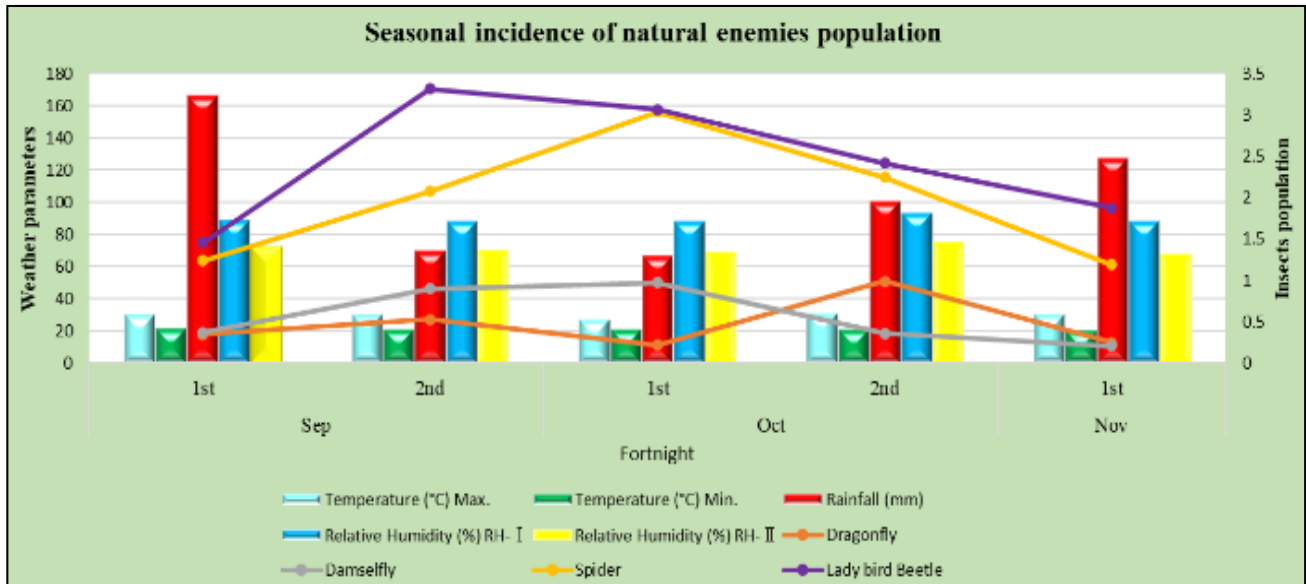


Fig 2: Correlation of insect-pests population & natural enemies with weather parameters during the crop growth period of *Kharif*-2023

Table 4: Correlation of natural enemy population with weather parameters during *Kharif*– 2023

Pests and natural enemies	Temperature (°C)		Rainfall (mm)	Relative humidity (%)	
	Max.	Min.		RH-I	RH-II
Dragonfly	0.615	-0.17	-0.133	0.920*	0.881*
Damselfly	-0.579	0.149	-0.797	-0.371	-0.209
Spider	-0.638	-0.213	-0.839	0.151	0.135
Lady bird beetle	-0.337	-0.261	-0.977**	-0.093	-0.099

* 5% level of significance, **1% level of significance

Conclusion

The present research study seasonal incidence of key insect-pests and natural enemies on rice revealed that, during vegetative phase of plant the incidence of gall midge on the percent silver shoot, whorl maggot percent infestation, yellow stem borer on the percent dead hearts were observed highest and percent white ears were highest during reproductive phase of the crop. Therefore, control measures to be taken stages to avoid loss in reproductive phase. For proper and timely management of the insect pests of ecological engineering rice field, these findings could be helpful.

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