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Seasonal incidence of rice stem borer, *Scirpophaga incertulas* (WLK) on different varieties in relation to weather parameters

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Abstract

Transplanting of six varieties (NDR-359, KARMA MAHSURI, CR-3969-24-1-2-1-1, HRI-174, PHI-18104 and CHANDRAHASINI) was done 31st July 2020 during *Kharif* season for investigate the seasonal incidence of rice stem borer, *Scirpophaga incertulas* (Wlk) on different varieties of paddy. Dead heart started from 36th SMW and continued upto 41st SMW, while white ear head was recorded on 41st SMW and reached peak in 42nd SMW. On the basis of peak infestation period, the maximum dead heart was recorded on CR-3969-24-1-2-1-1 (32.59%) while minimum dead heart was found in Karma Mahsuri (10.66%) variety of paddy. The white ear head per cent was ranged from 2.93% to 11.94%. The findings demonstrated that climatic conditions had no statistically significant relationship with the percentage of dead hearts and white ears. Temperature, relative humidity, rainfall, and sunshine hours had little bearing on the stem borer infestation and the manifestation of symptoms such as a dead heart and white ear head.

Keywords: Rice varieties, weather parameters, yellow stem borer, percent dead heart and white ear head

Introduction

Rice is one of the most important staple food crop of India for more than 2/3rd of its population. As this crop plays a vital role in our national food security and is a means of livelihood for millions of rural households, the slogan "Rice is life" can be considered fitting for our country. It is a rich source of nutrition and contains a fair amount of protein (6-10%), carbohydrates (70-80%), minerals (1.2-20%) and vitamins (Riboflavin, Thiamine, Niacin and Vitamin E) (Anonymous, 2014) [1].

After China, India is the second-largest producer and consumer of rice. In India, the total area covered by rice is 42.95 million hectares, with 111.01 million tonnes of production and 2494 kg ha⁻¹ of productivity. (Anonymous, 2018) [2].

Chhattisgarh is known traditionally as an Indian rice bowl. There were more than 23,250 varieties of rice registered in the state. Rice is grown in Chhattisgarh in an area of 3.79 million hectare (mha) and covers 8.58% of India, with an average yield of 6.91 million tonne. (Anonymous, 2018) [3].

Rice stem borer is a main category of insect pests due to widespread adaptation, varying in species and numbers. However, most of these economically valuable species belong to the Lepidopteran, Pyralidae and Noctuidae families. The Pyralid is the family of most important insect pests, with 35 of the 50 known stem borer species, widespread species, extending from Aisa and Oceania into the Middle East and Europe. The most prevalent species in Asia are *Scirpophaga incertulas* (Walker), *Chilo suppressalis*, *Scirpophaga innotata* (Walker), and *Sesamia inferens* (Walker). (Ghose *et al.*, 1960) [6].

Stem borer in rice is considered as the most harmful pest which is mono phagous-pest of rice, its presence is almost throughout entire country. It causes the damage which is known as dead-heart in which pest attack the crop in nursery or transplanting stage while white ear head or silver shoot is referred to the damage which is caused at flowering stage in which pest is present at node of peduncle. (Anusha *et al.*, 2015) [4].

Most susceptible stage of paddy for stem-borer pest is flowering as well as tillering stage so this problem can be only managed by developing resistant cultivar of paddy.

There has been significant yield-loss in production of rice for stem-borer, plant-hopper, gall-midge, leaf-folder and others are 30%, 20%, 15%, 10%, 25% (Krishnaiah, *et al.*, 2015) [7].

Over all seasonal-abundance knowledge & population trend was of greater importance to cop-up with various problem & reduce losses of yield (Das *et al.*, 2008) ^[5]

Material and Method

Study of seasonal incidence of yellow stem borer under plain region of Chhattisgarh were carried out Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur, a constituent college of Indira Gandhi Krishi Vishwavidyalaya, Raipur during *Kharif* season 2020. Transplanting of Six paddy varieties (NDR-359, KARMA MAHSURI, CR 3969-24-1-2-1-1, HRI -174, PHI-18104, Chandrahasini) was done on 31st July 2020 during *Kharif* season to determine their potential against yellow stem borer of paddy under field condition. The weekly meteorological data recorded from the meteorological observatory of the Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur. 10 plants were randomly selected in each plot of four replication and tagged as to record observation, which row to row and plant to plant distance of 20 and 15 cm. respectively maintained in RBD.

Methods of observation

For dead heart – Number of dead heart in vegetative stage and total number of tillers were recorded from 10 hills in each plot and per cent damage was calculated by using formula given (Patel *et al.*, 2017) ^[8] following formula –

$$\% \text{ Dead heart} = \frac{\text{No. of dead hearts}}{\text{Total No. of tillers}} \times 100$$

For white ear head – Number of white ears plants in ear heading stage and total number of productive tillers were recorded from 10 hills in each plot and per cent damage was calculated by using following formula –

$$\% \text{ white ear head} = \frac{\text{No. of white ears}}{\text{Total No. of productive tillers}} \times 100$$

Statistical analysis

The data were subjected to the analysis of variance using simple Randomized block design program. The simple correlation was worked out between stem borer population.

Result and Discussion

Dead heart: The first appearance of dead heart was recorded on 36th standard week, first week of September with maximum dead heart was in 16.26% in CR-3969-24-1-2-1-1. Fluctuation in stem borer’s population is evident from table which shows that on September 1st week to 2nd week of October, Karma Mahsuri was least affected, while CR-3969-24-1-2-1-1 was highly affected from dead heart on above weeks. The data obtained on the population dynamics of yellow stem borer on different rice varieties revealed that the dead heart started from 1st week of September and attained its peak during 4th week of September with maximum dead heart in CR-3969-24-1-2-1-1 (32.59%) followed by Chandrahasini (29.83%) and minimum 10.66% in Karma mahsuri. The per cent dead heart and the weather factors *viz.* temperature (maximum and minimum), relative humidity (morning and evening), rainfall and sunshine hours. The result revealed that the per cent dead heart of var. NDR 359, Karma Mahsuri (ZC), CR 3969-24-1-2-1-1, HRI 174, PHI-18104 and Chandrahasini were positively correlated with maximum and minimum temperature, morning, evening and average RH and were negatively correlated with rainfall and sunshine hours.

White ear head

The per cent white ear was observed from 41st standard week (second week of October) and lasted till 43rd standard week (fourth week of October). The per cent white ear among different varieties varying in different varieties. The maximum per cent white ear of 7.89% was noticed in the variety CR 3969-24-1-2-1-1 which was ranging from 3.78% to 11.94%. The least per cent white ear was noticed in the variety Karma Mahsuri, which was ranging from 2.93 to 5.98% during standard meteorological week. The varieties PHI-18104 (Hybrid), HRI 174, NDR 359 and Chandrahasini recorded the mean per cent white ear of 5.53%, 5.71%, 6.37% and 6.92% respectively

Table 1: Per cent dead heart cause by yellow stem borer *S. incertulas* during *Kharif*, 2020

SMW	Date	Karma Mahsuri	PHI-18104	HRI 174	CR 3969-24-1-2-1-1	NDR 359	Chandrahasini
36	03/09/2020	12.21	13.29	4.75	16.26	13.30	10.07
37	10/09/2020	22.95	20.18	27.55	30.17	24.21	27.93
38	17/09/2020	14.55	18.16	4.43	25.03	14.56	22.26
39	24/09/2020	10.66	13.58	20.18	32.59	16.98	29.83
40	01/10/2020	3.15	9.85	14.51	22.26	13.13	15.71
41	08/10/2020	2.99	6.50	6.79	9.74	6.50	7.28
	Max	22.95	20.18	27.55	32.59	24.21	29.83
	Min	2.99	6.50	4.43	9.74	6.50	7.28
	Mean	11.09	13.59	13.04	22.68	14.78	18.85

SMW – Standard meteorological week, Max – Maximum, Min – Minimum

Table 2: Per cent White ear head caused by yellow stem borer *S. incertulas* during *Kharif*, 2020

SMW	Date	Karma Mahsuri	PHI-18104	HRI 174	CR 3969-24-1-2-1-1	NDR 359	Chandrahasini
41	08/10/2020	5.98	6.79	0.00	11.94	6.50	0.00
42	15/10/2020	5.86	6.57	10.70	7.96	6.34	10.70
43	22/10/2020	2.93	3.23	6.43	3.78	6.27	10.07
	Mean	4.92	5.53	5.71	7.89	6.37	6.92
	Max	5.98	6.79	10.7	11.94	6.5	10.7
	Min	2.93	3.23	0.00	3.78	6.27	0.00

Table 3: Correlation Matrix of dead heart of different varieties with climatic factors

Varieties	Temperature (°C)			Relative Humidity (%)			Rainfall (mm)	Sunshine (Hours)
	Max.	Min.	Average	Morning	Evening	Average		
Karma Mahsuri	0.694	0.492	0.574	0.194	0.31	0.257	-0.22	-0.237
PHI-18104	0.743	0.55	0.634	0.256	0.364	0.308	-0.224	-0.348
HRI 174	0.583	0.429	0.496	0.136	0.29	0.186	-0.153	-0.131
CR 3969-24-1-2-1-1	0.722	0.523	0.606	0.236	0.372	0.273	-0.22	-0.332
NDR 359	0.727	0.537	0.619	0.233	0.354	0.282	-0.214	-0.295
Chandahasini	0.702	0.494	0.577	0.202	0.36	0.247	-0.217	-0.295

Table 4: Correlation Matrix of white ear head of different varieties with climatic factors

Varieties	Temperature (°C)			Relative Humidity (%)			Rainfall (mm)	Sunshine (Hours)
	Max.	Min.	Average	Morning	Evening	Average		
Karma Mahsuri	0.151	0.129	0.144	0.058	-0.072	-0.019	-0.184	0.097
PHI-18104	0.15	0.131	0.146	0.06	-0.069	-0.016	-0.182	0.097
HRI 174	0.158	-0.012	0.023	-0.111	-0.219	-0.188	-0.266	0.084
CR 3969-24-1-2-1-1	0.134	0.153	0.161	0.101	-0.027	0.028	-0.141	0.091
NDR 359	0.172	0.061	0.09	0.037	-0.184	-0.111	-0.218	0.112
Chandahasini	0.167	-0.054	-0.011	-0.107	-0.287	-0.239	-0.275	0.095

Conclusion

Based on the result of the present investigation it can be concluded that rice varieties are prone to insect attack. During 2020, with transplanting towards the fourth week of July, dead heart and white ear head caused by *S. incertulas* on different varieties of paddy the per cent dead heart infestation was noticed from 36th SMW to 41st SMW. The range of dead heart infestation was significantly higher during October. The per cent white ear was noticed from 41st SMW to 43rd SMW and the higher per cent of infestation was noticed during third week of October. The correlation of per cent dead and per cent white ear was run with the climatic parameters such as temperature, relative humidity, sunshine hours and rainfall. The result revealed that the climatic factors were non-significantly related with per cent dead heart and per cent white ear. The variation with temperature, RH, rainfall and sunshine hours had nothing to do with the stem borer infestation and expressing of its symptoms such as dead heart and white ear.

The per cent dead heart was recorded for different varieties, which reveals that the first appearance of dead heart was recorded on 36th standard week to 41st standard week, i.e. from September first week to October second week. The highest per cent dead heart was recorded in the variety CR 3969-24-1-2-1-1 and the least per cent dead heart was recorded in the variety Karma Mahsuri. The per cent of white ear was observed from 41st standard week (Second week of October) and lasted till 43rd standard week (fourth week of October). The maximum per cent white ear was noticed in the variety CR 3969-24-1-2-1-1 and the least per cent white ear was noticed in the variety Karma Mahsuri during standard meteorological week.

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