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Status of stem borer *Scirpophaga incertulas* Walker in different direct seeded rice cultivation system and correlation with maximum and minimum temperature

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Abstract
The present investigation was conducted to study the status of yellow stem borer, *Scirpophaga incertulas* Walker infesting different direct seeded rice cultivation system and its correlation with maximum and minimum temperature at Mahasamund district during Kharif 2020. Results revealed that the initiation of yellow stem borer dead heart infestation was observed with (0.33%/hill) and (0.67%/hill) in wet seeded rice (WSR) and BIASI system respectively during 1st fortnight of July. Maximum peak of dead heart infestation was recorded at 1st fortnight of September in all the cultivation system with (12.33%/hill), (12.67%/hill) and (10.33%/hill) in DSR (dry seeded rice), WSR (wet seeded rice) and BIASI respectively. White ear head infestation was recorded first at 1st fortnight of October in all the studied cultivation system with (6.00%/hill), (6.33%/hill) and (7.00%/hill) in DSR, WSR and BIASI respectively. The maximum white ear head infestation was recorded at 1st fortnight of November with (13.33%/hill), (12.67%/hill) and (10.67%/hill) in DSR, WSR and BIASI. Yellow stem borer dead heart expressed non-significant negative correlation with maximum temperature and non-significant positive correlation with minimum temperature in all cultivation system. Whereas white ear head showed non-significant negative correlation with maximum temperature and minimum temperature in DSR, WSR and BIASI system of rice cultivation.

Keywords: Yellow stem borer, *Scirpophaga incertulas,* direct seeded rice cultivation

Introduction
For a large portion of the world's population, rice (*Oryza sativa* L.) serves as a staple food (Devendra *et al*. 2018) [2]. It is the second most important cereal crop. Various farming techniques and meteorological conditions are used to raise rice in many different parts of the world. In terms of global rice production and consumption, China is first, followed by India (Sawai and Kothikar, 2019) [7]. In India, there are approximately 43.774 million ha of total rice-growing land, with an annual yield of 112.757 million tonnes and a productivity of 2576 kg/ha (Anonymous, 2018). North to south and east to west, rice is grown in practically every region of the nation. In Chhattisgarh, rice occupies average of 3.6 million ha. with the productivity of the state ranging between 1.2 to 1.6 t/ha depending upon the rainfall. The state is comprised with three agro-ecological zones i.e., Chhattisgarh plain. Bastar plateau and northern hill region of Surguja. The most common rice cultivation systems are adopted by farmers of Mahasamund district as per the conditions and situation required. These cultivation systems are categorized as DSR (dry seeded rice), WSR (wet seeded rice), BIASI (biasi system of cultivation). Rice Insect pests in the Chhattisgarh region are responsible for losses of up to 20% per year. More than one hundred (100) insect species, of which fifteen are of significant economic importance which attacks the rice crop. From region to region and season to season, the severity of losses brought on by various insect pests varies substantially. According to Satpathi *et al*. (2012) [6], the yellow stem borer, *Scirpophaga incertulas* Walker (Pyralidae: Lepidoptera), is the most destructive pest of rice and is monophagous. It results in the damage-causing symptoms "Dead heart" at the vegetative stage and "White ear" at the reproductive stage (Kakde and Patel, 2014) [3]. According to Krishnaiah and Varma (2012) [5], yield loss due to dead heart and white ears, respectively, ranged from 11.2 to 40.1% and 27.6 to 71.7%. According to Chatterjee and Mondal (2014) [1], the yellow stem borer is responsible for a 10–60% yield loss. According to Karthikeyan and Purushothaman (2000) [4], a severe yellow stem borer attack on rice results in crop failure.

Material and Methods

Status of yellow stem borer infestation was study is carried out in three different rice cultivation systems i.e., dry seeded rice (DSR), wet seeded Rice (WSR) and biasi system of rice cultivation in district Mahasamund, during Kharif season 2020. The data on rice stem borer damage symptoms are recorded fortnightly on randomly selected 10 plants to work out the percent infestation. Correlation studies of stem borer infestation with maximum and minimum temperature is carried out for all the cultivation system.

Methodology

Stem Borer

The incidence of stem borer was taken on number of dead hearts/white ears from10 randomly selected hills in each rice cultivation systems. The percent incidence (dead heart/white ears) was calculated as follows.

$$\text{Percent dead heart/hill} = \frac{\text{Number of dead heart}}{\text{Total number of tillers}} \text{ X } 100$$

$$\text{White ear head percent/ hill} \frac{\text{Number of white ear heads}}{\text{Total number of panicles}} \text{ X } 100$$

Results and Discussion

The data presented (Table 1) on the incidence of yellow stem borer revealed that the percent dead heart incidence in dry seeded rice cultivation was first appeared at 2nd fortnight of July with 0.33% dead heart/hill. The peak of 12.33% incidence of dead heart were recorded at 1st fortnight of September. Overall seasonal mean population is 2.37% dead heart/hill of Correlation data with maximum and minimum temperature revealed that there was non-significant negative correlation between maximum temperature r= -0.535 and non-significant positive correlation between minimum temperature r= 0.253. Percent white ear head infestation was first appeared at 1st fortnight of October with 6.00% white ear head/hill. The peak of 13.33% infestation of white ear head were recorded during 1st fortnight of November. Correlation data revealed that there was non-significant negative correlation between maximum temperature and minimum temperature r= -0.046 and r= -0.618 respectively (Table 2).

The population of stem borer dead heart infestation initiated with 0.33% dead heart in wet seeded rice (WSR) during 1st fortnight of July. While white ear head initiated with 6.33% white ear head/hill during 1st fortnight of October. The peak infestation of 12.67% dead heart/hill and 12.67% white ear head/hill at 1st fortnight of September and November respectively (Table 1). Correlation studies with stem borer dead heart and white ear head percent infestation (Table 2) revealed that there was a non-significant negative correlation between maximum temperature (r= -0.488 and r= -0.030) respectively and non-significant positive correlation with value r= 0.309 and non-significant negative correlation between minimum temperature with value r= -0.566.

Periodical observations (Table 1) of stem borer in biasi cultivation system of rice crop revealed that the percent dead heart infestation was first appeared at 1st fortnight of July with 0.67% dead heart/hill with peak of 10.33% of dead heart/hill were recorded at 1st fortnight of September. White ear head infestation was first appeared at 1st fortnight of October with 7.00% white ear head/hill. The peak of 10.67% infestation of white ear head/hill were recorded at 1st fortnight of November. Findings on correlation studies with dead heart percent infestation (Table 2) shown a non-significant negative correlation between maximum r= -0.411 and non-significant positive correlation with minimum temperature r= 0.273. In case of white ear head there is a non-significant negative correlation with maximum and minimum temperature r= -0.034 and r= -0.565 respectively.

Table 1: Status of Stem borer *Scirpophaga incertulas* Walker in different direct Seeded rice cultivation system

	DSR		WSR		BIASI		Temperature (°C)	
Month	Dead Heart	WEH	Dead Heart	WEH	Dead Heart	WEH	Max.	Min.
July - I	0.00	0.00	0.33	0	0.67	0.00	33.5	25.5
July - II	0.33	0.00	1.33	0	1.00	0.00	32.3	25.6
August - I	2.00	0.00	3.00	0	1.33	0.00	33.0	26.0
August - II	6.33	0.00	7.00	0	3.67	0.00	29.3	25.2
September - I	12.33	0.00	12.67	0	10.33	0.00	30.8	25.1
September - II	2.67	0.00	4.00	0	2.67	0.00	33.5	26.1
October - I	0.00	6.00	0.00	6.33	0.00	7.00	32.2	25.3
October - II	0.00	11.33	0.00	11.00	0.00	9.33	31.9	25.0
November - I	0.00	13.33	0.00	12.67	0.00	10.67	32.5	20.9
November - II	0.00	9.33	0.00	8	0.00	7.33	31.0	15.3
OM	2.37	4.00	2.83	3.8	1.97	3.43		

Table 2: Correlation between mean infestation (%) of Yellow stem borer with Temperature

	Dead Heart		White Ear Head	
Cultivation System	Maximum Temperature	Minimum Temperature	Maximum Temperature	Minimum Temperature
DSR	-0.535	0.253	-0.046	-0.618
WSR	-0.488	0.309	-0.030	-0.566
BIASI	-0.411	0.273	-0.034	-0.565

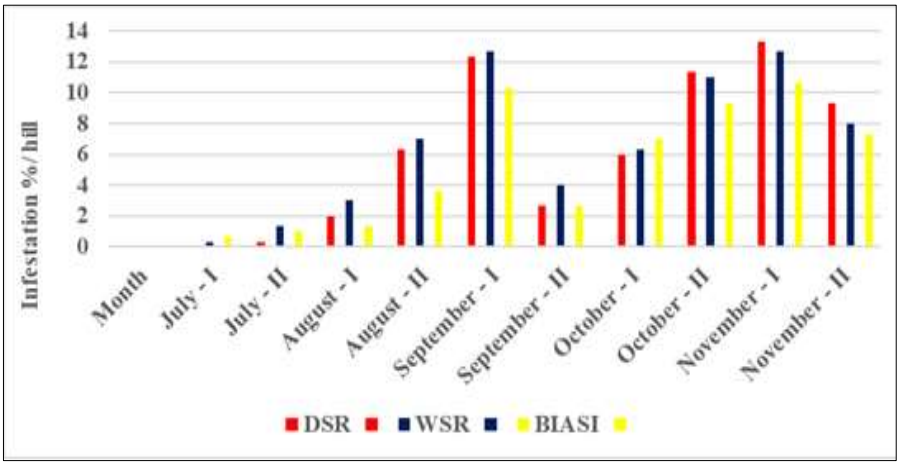

Fig 1: Status of Stem borer *Scirpophaga incertulas* Walker in different direct seeded rice cultivation system

Conclusion

Maximum dead heart infestation was found from 2nd fortnight of August to first fortnight of September month. Among all the three rice cultivation system, overall highest mean dead heart infestation was recorded in (WSR) wet seeded rice (2.83% dead heart/hill) followed by (DSR) dry seeded rice (2.37% dead heart/hill) and lowest infestation found in Biasi (1.97% dead heart/hill). maximum white ear head infestation was found from 1st fortnight of October to 2nd fortnight of November month. Among all rice cultivation system highest white ear head infestation was recorded in (DSR) dry seeded rice (4.00% white ear head/hill) followed by ((WSR) wet seeded rice (3.80% white ear head/hill) and lowest in Biasi (3.4% white ear head/hill). There no significant correlation with stem borer population and Temperature (maximum and minimum). These findings could be helpful for decision making and timely management of yellow stem borer in rice crop.

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