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Comparative study of stem borer *Scirpophaga incertulas* Walker in different transplanted 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 type of transplanted rice cultivation system and its correlation with maximum and minimum temperature at Mahasamund district during Kharif 2020. The findings showed that, during the first week of August, the yellow stem borer dead heart infestation started with (0.67%/hill), (0.33%/hill), and (1.33%/hill), respectively, in normal transplantation (NTP), transplanting with hybrid (TPH), and system of rice intensification (SRI). The first week of September had the highest peak of dead heart infestation in all cultivation systems, with infestation rates of 7.67% per hill, (9.00% per hill), and (4.00% per hill) in NTP, TPH, and SRI, respectively. White ear head infestation was first noted in all cultivation systems during the first two weeks of October, with infestation rates of (4.33%/hill), (5.67%/hill), and (3.00%/hill) in NTP, TPH, and SRI, respectively. The maximum white ear head infestation was recorded at 1st fortnight of November with (9.67% / hill), (11.33% / hill) and (7.00%/hill) in NTP, TPH and SRI. According to correlation studies with stem borer dead heart and white ear head percent infestation, there was a non-significant positive correlation with dead heart and a non-significant negative correlation with white ear head per cent infestation in every rice cultivation system.

Keywords: Yellow stem borer, *Scirpophaga incertulas*, transplanted rice cultivation, SRI

Introduction
India is the world's second-largest producer of rice, and the largest exporter of rice in the world Production increased from 53.6 million tons in financial year 1980 to 186.50 million tons in financial year 2020-21. In some states like West Bengal, Assam, Chhattisgarh and Orissa two crops of rice are raised in a year. The overall rice-growing area in India is estimated to be 43.774 million ha, with a productivity of 2576 kg/ha and an annual production of 112.757 million tonnes (Anonymous, 2018) [1]. Nearly all of the country's regions, from north to south and east to west, are home to rice farms. Rice is grown on an average of 3.6 million ha in Chhattisgarh, with the state's productivity varying from 1.2 to 1.6 t/ha depending on rainfall. The most common rice transplanting cultivation systems are NTP (normal transplanting), TPH (transplanted with hybrid) and SRI (system of rice intensification).
In Chhattisgarh Numerous insect pest target paddy crop in the field, although few of them result in considerable losses. According to Krishnaiah and Varma (2012) [6], 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) [2], 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. According to Satpathi *et al*. (2012) [8], 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].

Material and Methods
Status of yellow stem borer infestation was study is carried out in three different transplanted rice cultivation systems namely (NTP) normal transplanting, (TPH) transplanted with hybrid and (SRI) system of rice intensification Mahasamund district of Chhattisgarh during Kharif season 2020.

The data on damage symptoms caused by rice stem borer are recorded fortnightly on randomly selected 10 plants to work out the per cent infestation. Correlation studies of stem borer infestation with maximum and minimum temperature is carried out for all three transplanting method.

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 per cent 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 per cent dead heart incidence in normal transplanted rice cultivation was first appeared at 1st fortnight of August with 0.67% dead heart/ hill. The peak of 7.67% incidence of dead heart were recorded at 1st fortnight of September. Overall seasonal mean population is 1.33% dead heart/ hill. Correlation data with maximum and minimum temperature revealed that there was non-significant negative correlation between maximum temperature r= -0.420 and non-significant positive correlation between minimum temperature r= 0.238. Per cent white ear head infestation was first appeared at 1st fortnight of October with 4.33% white ear head/ hill. The peak of 9.67% 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= -0.012 and r= -0.580 respectively (Table 2).

The population of stem borer dead heart infestation initiated with 0.33% dead heart in transplanted hybrid rice during 1st fortnight of August. While white ear head initiated with 5.67% white ear head/ hill during 1st fortnight of October. The peak infestation of 9.00% dead heart/ hill and 11.33% white ear head/ hill at found at 1st fortnight of September and 1st fortnight of November respectively (Table 1). Correlation studies with stem borer dead heart and white ear head per cent infestation (Table 2) revealed that there was a non-significant negative correlation between maximum temperature (r= -0.557 and r= -0.006) respectively and non-significant positive correlation with value r= 0.212 in dead heart and non-significant negative correlation between minimum temperature with value r= -0.614 in white ear head.

Study on stem borer (Table 1) in normal transplanted cultivation system of rice crop revealed that the per cent dead heart infestation was first appeared at 1st fortnight of August with 1.33% dead heart/ hill with peak of 4.00% of dead heart/ hill was recorded at 1st fortnight of September. White ear head infestation was first appeared at 1st fortnight of October with 3.00% white ear head/ hill. The peak of 7.00% infestation of white ear head/ hill was recorded at 1st fortnight of November. Findings on correlation studies with dead heart per cent infestation (Table 2) shown a non-significant negative correlation between maximum r= -0.476 and non-significant positive correlation with minimum temperature r= 0.302. In case of white ear head there is a non-significant negative correlation with maximum and minimum temperature r= -0.058 and r= -0.651 respectively.

The present findings on the activity of stem borer dead heart are in agreement with the observation made by Ngo (2007) and Karthikeyan (2010) also reported that the lower incidence of stem borer in system of rice intensification (SRI) as compare to normal system of cultivation. Visalakshmi (2014) [9] stated that mean stem borer incidence (dead heart %) was low in SRI method (6.15%) as compared to conventional method (15.65%).

Table 1: Stem borer *Scirpophaga incertulas* Walker in different transplanted rice cultivation system

Month	NTP		TPH		SRI		Temperature	
	Dead Heart	WEH	Dead Heart	WEH	Dead Heart	WEH	Max. Temp. (°C)	Min. Temp (°C)
July - I	0.00	0.00	0.00	0.00	0.00	0.00	33.5	25.5
July - II	0.00	0.00	0.00	0.00	0.00	0.00	32.3	25.6
August - I	0.67	0.00	0.33	0.00	1.33	0.00	33.0	26.0
August - II	2.67	0.00	4.33	0.00	2.33	0.00	29.3	25.2
September - I	7.67	0.00	9.00	0.00	4.00	0.00	30.8	25.1
September - II	2.33	0.00	1.67	0.00	1.33	0.00	33.5	26.1
October - I	0.00	4.33	0.00	5.67	0.00	3.00	32.2	25.3
October - II	0.00	6.67	0.00	6.00	0.00	6.00	31.9	25.0
November - I	0.00	9.67	0.00	11.33	0.00	7.00	32.5	20.9
November - II	0.00	5.33	0.00	6.33	0.00	5.33	31.0	15.3
OM	1.33	2.60	1.53	2.93	0.90	2.13		

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

Cultivation System	Dead Heart		White Ear Head	
	Maximum Temperature	Minimum Temperature	Maximum Temperature	Minimum Temperature
NTP	-0.420	0.238	-0.012	-0.580
TPH	-0.557	0.212	-0.006	-0.614
SRI	-0.476	0.302	-0.058	-0.651

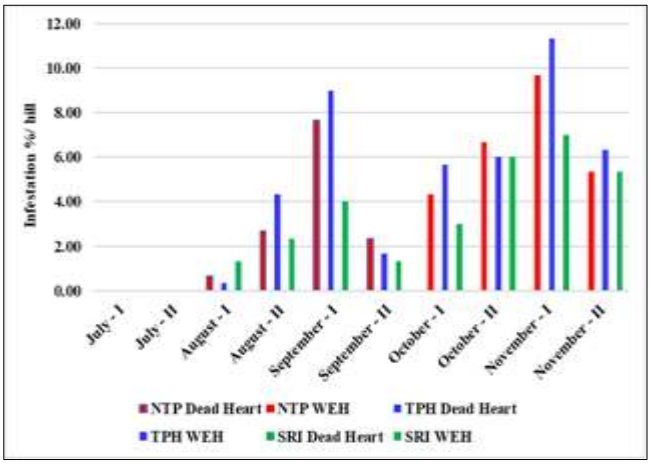

Fig 1: Status of Stem borer *Scirpophaga incertulas* Walker in different transplanted rice cultivation system

Conclusion

Stem borer dead heart infestation was found started from 1st fortnight of August and continue till 2nd fortnight of September month. Among all the three rice cultivation system, overall highest mean dead heart and white ear head

infestation was recorded in (TPH) transplanted with hybrid (1.53% dead heart/ hill and 2.93% white ear head/ hill) followed by (NTP) normal transplanted rice (1.33% dead heart/ hill and 2.60% white ear head/ hill) and lowest infestation found in (SRI) system of rice intensification (0.90% dead heart/ hill and 2.13% white ear head/ hill) respectively. There no significant correlation with stem borer population and Temperature (maximum and minimum).

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