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Effect of Environmental Factors on Incidence of Yellow Stem Borer (*Scirpophaga incertulas* Walker) in Rice (*O. sativa* L.) Ecosystem of Varanasi Region

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A B S T R A C T

The present investigation was conducted on submergence rice variety Swarna sub-1 to study the effect of environmental factors on the incidence of yellow stem borer, *Scirpophaga incertulas* (Walker) during *Kharif* season of 2016 and 2017 at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The infestation of yellow stem borer was noticed in the field from 2nd week of July to 4th week of October during both *Kharif* season of 2016 and 2017. The maximum dead hearts (DH) and white ear head (WEH) were recorded in 40th Standard meteorological week (SMW) (8.48% DH) and 44th Standard meteorological week (SMW) (8.10% WEH) during both *Kharif* seasons of 2016 and 2017. These studies revealed that per cent dead heart was a significant positive correlation with maximum, minimum and average temperature, evening and average relative humidity while white ear head showed a significant positive correlation with maximum and minimum temperature and evening and average relative humidity. Other parameters showed a negative relationship with the dead heart and white ear head of yellow stem borer.

Introduction

Rice is one of the major food crops in the world, providing food for fifty per cent of the world population (Anonymous, 2004). About 90 per cent of rice is grown and consumed in Asian countries (Khush and Brar, 2002). Severe use of fertilizers particularly nitrogenous fertilizers, high yielding varieties, sequential cropping and arbitrary use of insecticides have resulted in the development of insect pests (Gupta *et al.*, 2002). In India, approximately 100 insect species have been reported on rice and out of the 20 species causing 30 per cent yield loss from seedling to maturity (Atwal and Dhaliwal, 2005). Among them, yellow stem borer is distributed throughout India and regarded as most dominating and destructive pest species causing about 25-30 per cent loss in yield and it causes27.34 per cent losses annually (Pasulu *et al.*, 2002 and Cattling *et al.*, 1987). Larvae of yellow stem borer bore into the stem and feed inside. As results of central

shoot withers and produces dead heart at vegetative stage and white ear heads at maturity stage. This can lead to the complete failure of the crop (Karthikeyan and Purushothaman, 2000). It is the most destructive insect pests of the rice crop and responsible for an annual yield loss of 10 to 15 per cent with local catastrophic outbreaks causing up to 60 per cent damage (Daryaei, 2005). The yellow stem borer *Scirpophaga incertulas* (Walker) solely causes 2-20 per cent damage and for increase in every per cent of white ears there was 1.3 per cent yield loss observed (Satpathi *et al.,* 2012) and also caused 1 to 19 per cent yield loss in early planted rice crops and 38 to 80 per cent in late planted rice (Catinding and Heong, 2003). Yield loss is found positively correlated with the dead heart and white ear head infestations of vegetative and reproductive phase of the crop, respectively (Rahman *et al.,* 2004).

Environmental factors play an important role in crop growth as well as development of pest and diseases. Environmental factors *viz.*, temperature, moisture, light etc. have a direct influence on the development of insect pests. Wind and rainfall are important not only for survival but also for disposal of insect population (Saxena and Murty, 2014). Keeping these points in view, an experiment was conducted to assess the effect of environmental factors on the yellow stem borer population during *Kharif* 2016 and 2017.

Materials and Methods

Experimental site of Agriculture Research Farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India lies between 24° 56' N to 25° 35' N Latitude and 82° 14' E to 83° 24' E Longitude and the elevation is 82 m above the mean sea level, almost in the centre of Indo-Gangetic belt. It possesses sub-tropical climate and annual rainfall ranges from 1.5 mm to 175.6 mm and 1.0 mm to 139.8 mm received during *Kharif* 2016-17 and *Kharif* 2017-18. A bulk plot of 100 m^2 was raised adjacent to the main experiment plot so as to study the population build up of the pest under the study. The pest population was recorded in this unprotected plot at the weekly interval from the occurrence or initiation of pest infestation and was continued up to crop maturity. The incidence of the pest was recorded at 10 randomly selected hills. Weather data were recorded simultaneously from the meteorological observatory available at Department of Agronomy, Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. Meteorological observations viz., temperature (Maximum and Minimum), relative humidity (Maximum and Minimum), rainfall and these observations were correlated with the occurrence of the pest population. A correlation coefficient method was adopted to work out the relationship between the occurrence of the pest and weather parameters correlation method was adopted. The per cent incidence (dead hearts/ white ears) was calculated as follows:

$$\text{Per cent Incidence} = \frac{\text{Number of dead hearts/white ears}}{\text{Total number of tillers/panicles}} \times 100$$

Results and Discussion

Kharif 2016-17

The data pertaining to mean per cent incidence of *S. incertulas* (Walker) has been illustrated in figure 1. The data recorded on the seasonal incidence of yellow stem borer, *S. incertulas* was taken in two phases first from tillering to panicle initiation as per cent dead hearts during the vegetative stage and the second phase from panicle initiation till

harvest as per cent white ears during the reproductive stage. The damage symptoms were observed for the first time during 30th standard meteorological week *i.e.,* three weeks after transplanting. It was evident from the figure that the dead hearts (DH) and white ear heads incidence of yellow stem borer ranged from 0.51 to 8.48 per cent and 7.21 to 8.10 per cent during the course of study.

The maximum dead hearts (8.48 %) incidence noticed in the 40th standard meteorological week (SMW) followed by 7.41 and 6.72 per cent noticed in the 39th and 38th standard meteorological week, respectively. Whereas, minimum dead hearts (0.51 %) incidence was recorded in the 30th standard meteorological week (SMW).

The maximum white ear head (8.10 %) incidence was noticed in the 44th standard meteorological week (SMW) followed by 7.72 and 7.52 per cent during 43rd and 42nd standard meteorological week (SMW) whereas, minimum white ear head (7.21 %) incidence was recorded in the 41st standard meteorological week (SMW). It clearly indicates that the dead hearts and white ear head incidence gradually increased from 30th to 40th and 41st to 44th standard meteorological week (SMW), thereafter declined trend was recorded during the course of the investigation. A correlation was worked out to find out the relationship between the per cent dead hearts and white ear head and weather parameters.

The results showed a significant positive correlation with minimum temperature (r= 0.492*), evening RH (r= 0.545*) and average relative humidity (r= 0.494*), positive non-significant correlation with other parameters (Table 1). However, the relationship between the per cent white ear heads and major weather parameters showed that there is a highly significant positive correlation with morning (r= 0.659**), evening (r= 0.668**) and average relative humidity (r= 0.675**) and significant positive correlation with maximum temperature (r= 0.544*) (Table 1).

Kharif 2017-18

The incidence was observed for the first time during the 29th standard meteorological week. It was evident from the figure 2 that the dead hearts (DH) and white ear head incidence of yellow stem borer ranged from 0.28 to 8.34 per cent and 6.55 to 8.88 per cent during the course of study.

The maximum dead hearts (8.34 %) was noticed in the 39th standard meteorological week (SMW) followed by 7.18 and 6.20 per cent noticed in the 38th and 37th standard meteorological week, respectively. Whereas, minimum dead hearts (0.28 %) was recorded in the 29th standard meteorological week (SMW). The maximum white ear head (8.88 %) was noticed in the 44th standard meteorological week (SMW) followed by 8.64 and 8.10 per cent during 43rd and 42nd standard meteorological week (SMW).

Whereas, minimum white ear head (6.55 %) was recorded in 10th standard meteorological week (SMW). It clearly indicates that the dead hearts and white ear head incidence gradually increased from 29th to 40th and 41st to 44th standard meteorological week (SMW), thereafter declined trend was recorded during the course of an investigation.

A correlation was worked out to find out the relationship between the per cent dead hearts and white ear head and weather parameters. The results showed a significant positive correlation with maximum, minimum and average temperature with r= 0.525, 0.511 and 0.577 (Table 2). Non-significant negative correlation with evening (r= -0.469) and average RH (r= -0.490), respectively.

Fig.1 Influence of abiotic factors on seasonal incidence of yellow stem borer of rice during *Kharif*- 2016

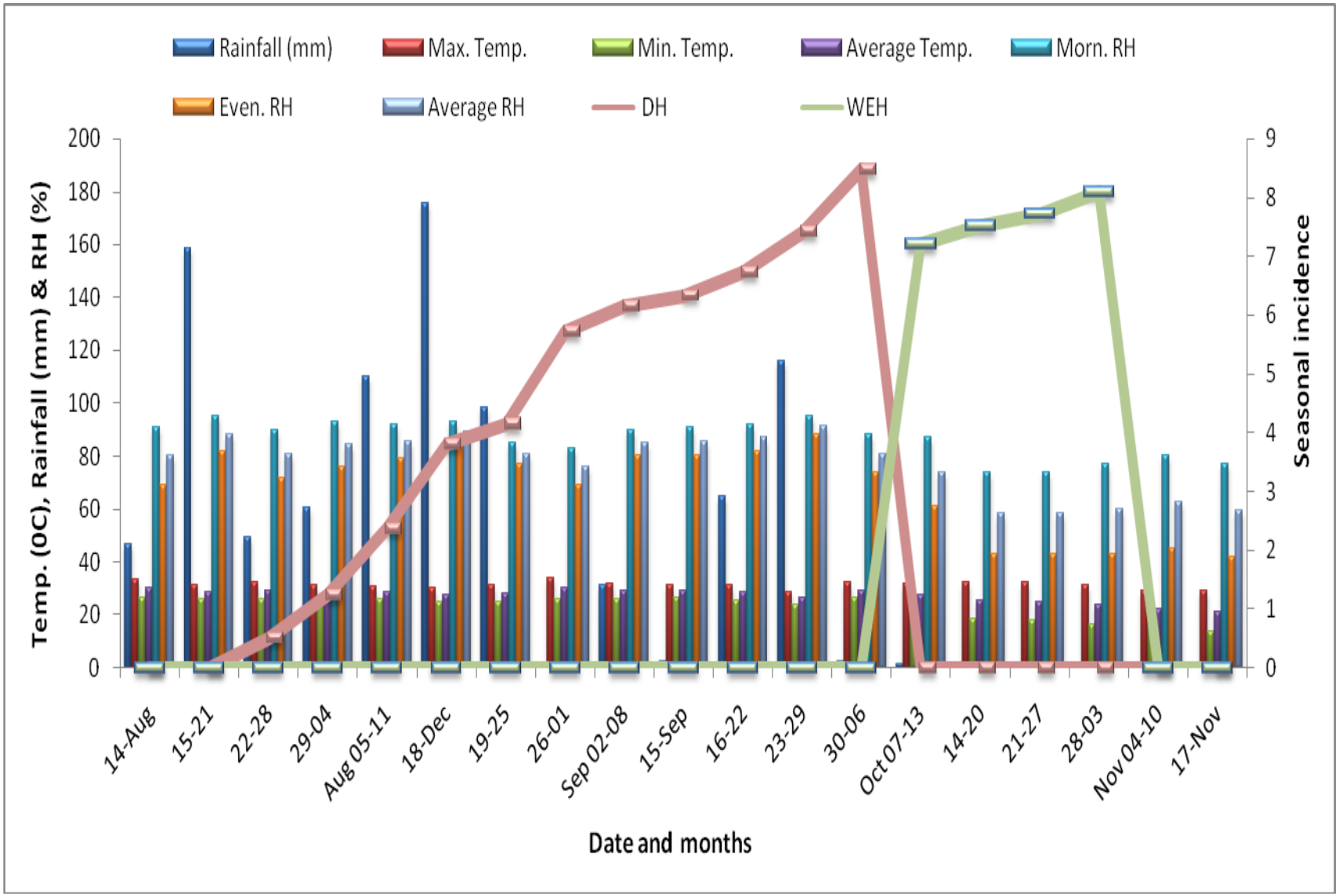

Fig.2 Influence of abiotic factors on seasonal incidence of yellow stem borer of rice during *Kharif*- 2017

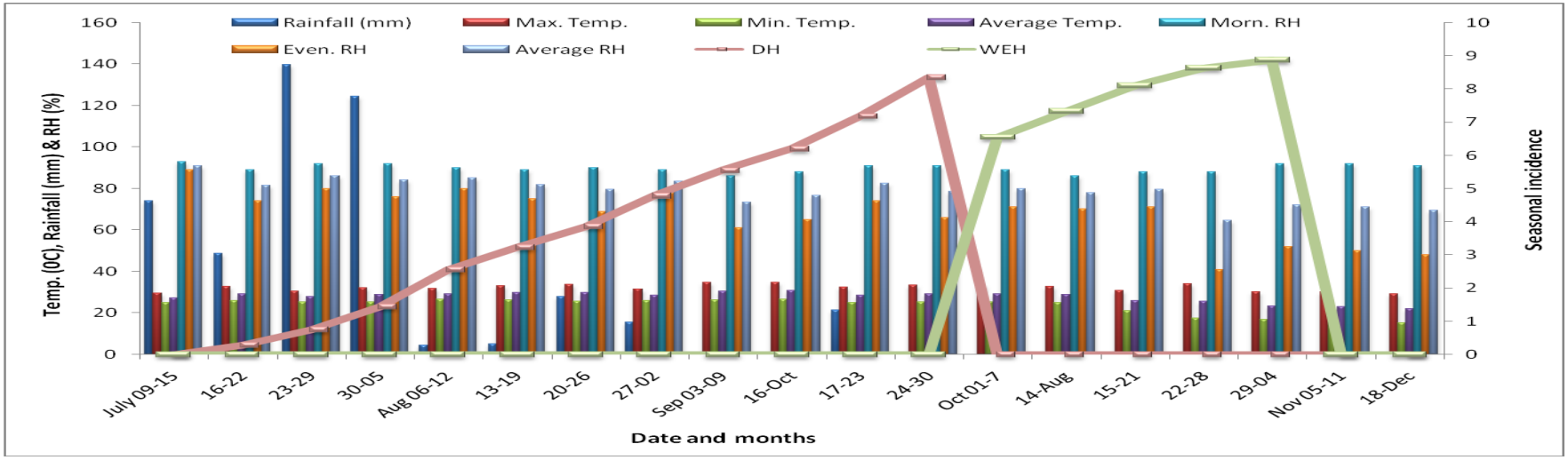

Table.1 Correlation coefficient of insect pest population on rice with prevailing weather parameters during *Kharif*- 2016

Insect pests		Weather parameters						
		Rainfall (mm)	Temperature			Relative Humidity		
			Maximum	Minimum	Average	Morning	Evening	Average
Yellow stem borer	% DH	-0.045	0.034	0.492*	0.429	0.353	0.545*	0.494*
	% WEH	-0.440	0.544*	-0.509*	-0.367	0.659**	0.668**	0.675**

Table.2 Correlation coefficient of yellow stem borer population on rice with prevailing weather parameters during *Kharif*- 2017

Insect pests		Weather parameters						
		Rainfall (mm)	Temperature			Relative Humidity		
			Maximum	Minimum	Average	Morning	Evening	Average
Yellow stem borer	% DH	-0.187	0.525*	0.511*	0.577**	-0.131	0.158	0.131
	% WEH	-0.378	-0.072	0.528*	-0.436	-0.238	-0.469*	-0.490*

The present finding is in close conformity with the report of Bora *et al.,* (1995) who reported that the pest incidence was higher in the vegetative stage with a peak level of damage (9.0-12.5% dead hearts) recorded 6-7 weeks after transplanting, whereas in the reproductive stage damage was low (0.4-0.6% WEH) in the ahu crop.

Maximum pest incidence (8.72% DH) was recorded during the first week of October 1991 in the Sali crop. White ear head damage was greater in the Sali crop than the ahu during both years. Further Kumar and Sudhakar (2001) who reported that the peak activity of yellow stem borer was observed in the second fortnight of October during *Kharif* 1998 and in the second fortnight of March during *rabi* 1998/99. Justin and Preetha (2013) reported that the weather parameters showed a significant positive correlation with relative humidity but negative correlation with minimum temperature and rainfall respectively.

In conclusion, the infestation of yellow stem borer was noticed in the field from 2nd week of July to 4th week of October during both the year of study. The maximum dead hearts (DH) and white ear head (WEH) were recorded in the month of September and October during *Kharif* season of 2016 and 2017.

Population fluctuation was correlated with environmental factors which showed that significant positive correlation with maximum, minimum and average temperature, evening and average relative humidity while white ear head showed a highly significant positive correlation with morning, evening and average relative humidity. Other parameters showed a negative relationship with dead heart and white ear head of yellow stem borer.

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