Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(3): 24-27

Received: 05-03-2017
Accepted: 06-04-2017

Rohit Rana
Department of Entomology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Gaje Singh
Department of Entomology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Aditya Kumar Tanwar
Division of Entomology, Indian Agriculture Research Institute, New Delhi, India

Rakesh Kumar
Division of Entomology, Indian Agriculture Research Institute, New Delhi, India

Correspondence
Rohit Rana
Department of Entomology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Effect of weather parameters on the infestation of yellow stem borer, *Scirpophaga incertulas* Walker in basmati rice

Rohit Rana, Gaje Singh, Aditya Kumar Tanwar and Rakesh Kumar

Abstract
The present investigation was conducted to study the effect of weather parameters on the infestation of yellow stem borer, *Scirpophaga incertulas* Walker in basmati rice. Results revealed that the peak period of pooled maximum dead hearts (9.46%) of both cropping seasons was recorded in 35th standard week. Thereafter, infestation declined gradually, but again increased at reproductive stage of crop and the pooled maximum white ears (8.48%) infestation was recorded during both the seasons at 40th standard week. Regression analysis of dead heart formation explained 60.20-61.60 per cent variability due to all tested environmental factors combined while in case of white ears the variability ranged from 63.90-73.50 per cent. Stepwise regression of pooled data of both the years revealed that incidence of YSB was depended on rainfall.

Keywords: Basmati Rice, *Scirpophaga incertulas* and Population dynamics, correlation, stepwise regression.

1. Introduction
Rice (*Oryza sativa* L.) is one of the major staple food crops for more than half of the world's population and being grown worldwide [2]. Rice is grown under diverse growing conditions. India is the largest rice growing country, while China is the largest producer of rice [4].
Warm and humid environment is essential for rice cultivation, also conducive to the survival and proliferation of insects. More than 100 different species of insects are known as rice pests; out of which about 15 are major economic significance [16]. These pests occur regularly and ravage the crop from seedling stage to maturity and few acts as vectors of virus diseases also [14]. Among the different insects associated with rice, the yellow stem borer, *Scirpophaga incertulas* Walker is one of the most destructive insect and is widely distributed monophagous insect in Indian subcontinent and has assumed the number one pest status and attacks the rice crop at all growth stages [5]. The extent of rice yield losses due to YSB has been estimated as 20–70% [6]. Insect larvae bore into the plant and feed on leaf-sheath tissue, on tassel buds, and on the stem. Damaged plants wither and their tassels die or become infertile leading to decreased grain production [17]. In general, yellow stem borer is multivoltine, but abiotic factors play crucial role which affects the incidence of this pest and models based on abiotic factors are very useful for prediction of pest incidence. So forecasting the occurrence of rice yellow stem borer may help the farmers to adopt management practices well in advance thereby minimising the pest damage [3].
Therefore, it is necessary to gain a thorough knowledge on relation of weather parameters to insects (Entomo-climatology) which will be very useful to farmers in all areas where major insect pests are appearing year after year and causing serious damage to crops.
Keeping in view, the severity of damage by yellow stem borer in rice growing area of western Uttar Pradesh and the influence of weather factors on their growth, multiplication and distribution. For developing any pest management programme, specific agro-ecosystem information on abundance and distribution of pest in relation to weather parameters is a basic requirement.

2. Materials and Methods
2.1 Seasonal incidence of rice yellow stem borer
The field experiments were carried out during June to October 2014 and 2015 at Crop

Research Centre, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut Uttar Pradesh. The experiment was conducted in Randomized Block Design (RBD) with rice cv. Pusa 1121. The spacing adopted was 20 × 10 cm and all the cultural operations except plant protection were followed as per the recommendations. The observations of *S. incertulas* infestation were recorded at weekly interval, 15 days after transplanting till harvesting. The borer infestation was assessed by counting number of dead hearts (DH) in the initial stage of damage and number of white ear heads (WEH) at later stage from five randomly selected spots consisting of 5 hills each. Both the dead hearts and white ear heads were removed from the infested tillers so that only fresh infestation of the pest can be realized every time. To the study instantaneous effect of major abiotic factors *viz.*, maximum temperature, minimum temperature, average temperature, morning relative humidity, evening relative humidity, average relative humidity, rainfall on the population of *S. incertulas*, correlation coefficient was worked out. Finally data so obtained were worked out and converted into percentage of dead heart [Per cent dead hearts = Total number of dead hearts / Total number of tillers X 100] and percentage white ear [Per cent white ears = Total number of white ears / Total number of tillers X 100] [8]. The weekly meteorological data recorded at ICAR-Indian Institute of Farming System Research, Modipuram (Meerut) during the *kharif* 2014 and 2015 from July to October period were utilized for this purpose.

2.2 Statistical analysis

The influence of weather parameters on damage done by *S. incertulas* (Dead Hearts and White Ears) was analyzed by regression and correlation analysis for a period of two years. The data was analyzed by using statistical software SPSS 16.0.

3. Results and Discussion

The impact of major abiotic factors on the incidence of per cent dead hearts (DH) at vegetative stage and per cent white ear heads (WE) at reproductive stage at weekly interval during *kharif* 2014 and 2015 according to standard weeks.

3.1 During *Kharif* season 2014

The data are depicted in Fig 1 and 2 revealed that the infestation of *S. incertulas* initiated from 31st standard week with 4.12 per cent dead hearts. The peak infestation was observed with 9.68 per cent dead hearts at 35th SW during *kharif* 2014. Furthermore, the fluctuations in the infestation were recorded, which again reach second peak during first week of October (40th SW) with 8.34 per cent white ears. The infestation of yellow stem borer was observed till 42nd SW (3.45% WE) similar pattern of seasonal incidence was reported by [1, 9, 10, 13].

The correlation co-efficient between stem borer infestation and weather parameters (minimum and average temperature) had significant results. The results revealed from table 2 showed that the morning relative humidity had negative correlation (r= -0.18), while maximum temperature (r= 0.45), minimum temperature (r= 0.58), evening relative humidity (r= 0.48) and rainfall (r= 0.49) had positive correlation with *S. incertulas* incidence *i.e* dead hearts at vegetative stage during the *Kharif* season 2014.

As far as the formation of white ears at reproductive stage is concerned, the minimum temperature (r= -0.28), evening relative humidity (r= -0.62) and rainfall (r=-0.35) had negative correlation while all the other weather parameters *viz*; maximum temperature (r= 0.09) and morning relative humidity (0.13), had positive correlation with *S. incertulas* infestation for the formation of while ear during the *Kharif* season 2014, [11] corroborates our findings.

3.2 During *Kharif* season 2015

The data presented in Table 2 and depicted in Fig. 2 revealed that the dead heart (5.38% DH) was recorded first time at 31st SW and declined (0% DH) in 38th SW. The peak infestation was recorded with 9.23 per cent dead hearts at 35th SW. On the other hand, the formation of white ears started from 38th SW (6.95% WE) and recorded its peak during 40th SW with 8.61 per cent white ears. The incidence of *S. incertulas* was observed till 42nd SW (4.25% WE).

The results of the study indicated that the stem borer damage maintained a significant positive correlation with different weather parameters (minimum and average temperature) which are presented in Table 2. Results revealed that the *S. incertulas* infestation (DH) and weather parameters had positive correlation with maximum temperature (r= 0.06), minimum temperature (r= 0.65), morning relative humidity (r= 0.37), evening relative humidity (r= 0.49), and rainfall (r= 0.32) at vegetative stage during *Kharif* 2015.

At reproductive stage the correlation co-efficient between white ears formation and weather factors found positive with Maximum temperature (r=0.22). However, it was negatively correlated with minimum temperature (r=−0.43), morning relative humidity (r=−0.33), evening relative humidity (r=−0.40) and rainfall (r=−0.14) during *Kharif*, 2015 (Table 2). Similar findings were also reported by [7, 12, 15].

To understand YSB incident on rice with respect to the environmental factors, linear regression analysis was done with single and multiple environmental factors. It was clear that R^2 value kept increasing when more environmental factors were added in the regression models for both dead hearts and white ears in both the years which mean a single environmental factor is not reliable to predict the incidence of the YSB on rice. In case of dead heart formation regression analysis explained 60.20-61.60 per cent variability due to all tested environmental factors combined while in case of white ears the variability ranged from 63.90-73.50 per cent (Table 1). Furthermore, the step wise regression analysis revealed that the incidence of YSB was only depended on minimum temperature in both 2014, 2015 with the variability of 34 to 42 per cent. Interestingly, stepwise regression of pooled data of both the years revealed that the rainfall is the factor on which incidence of YSB depended the most.

Table 1: Multivariate regression model of weather parameters and damage done by *S. incertulas* in basmati rice.

Year	Linear Regression equation	R^2	100 R^2
2014	**Dead hearts**		
	Y= 1.159 X1-35.48	0.205	20.50
	Y= -0.006 X1+0.669 X2-11.86	0.339	33.90
	Y=-0.32 X1+0.82 X2-0.35 X3+27.09	0.417	41.70
	Y=2.025 X1-0.865 X2-0.514 X3+0.451 X4-25.60	0.502	50.20
	Y=2.359*X1-1.015 X2-0.484 X3+0.405 X4+0.711 X5-33.99	0.616	61.60
	White Ears		
	Z= 0.199 X1-4.4	0.008	0.80
	Z= 1.775 X1-0.905 X2-36.34	0.326	32.60
	Z=2.088 X1-1.061 X2+0.344 X3-74.67	0.424	42.40
	Z=-1.85 X1+1.777 X2+0.619 X3-0.756 X4+13.676	0.732	73.20
	Z=-1.894 X1+1.796 X2+0.615 X3-0.75 X4-0.93 X5+14.77	0.735	73.50
2015	**Dead hearts**		
	Y= 0.201 X1-3.104	0.004	0.40
	Y= -0.137 X1+0.810 X2-10.492	0.422	42.20
	Y=-0.035 X1+0.739 X2+0.497 X3-59.125	0.473	47.30
	Y=-2.223 X1+2.175 X2-+1.082 X3-0.411 X4-48.48	0.600	60.00
	Y=-2.251 X1+2.182 X2+1.103 X3-0.402 X4-0.154 X5-50.111	0.602	60.20
	White Ears		
	Z= 0.620 X1-18.424	0.047	4.70
	Z= 0.838 X1-0.524 X2-13.643	0.270	27.00
	Z=0.759 X1-0.469 X2-0.389 X3-24.001	0.310	31.00
	Z=3.581 X1-2.321 X2-1.139 X3+0.531 X4+10.272	0.579	57.90
	Z=3.711 X1-2.355 X2-1.236 X3+0.485 X4+0.72 X5+17.890	0.639	63.90
	Stepwise Regression equations		
	Dead Hearts		
2014	Y= -12.01+.667X2	0.34	34.00
2015	Y= -14.892+.80X2	0.42	42.00
Pooled	Y=1.325+2.04X4	0.405	40.5

X1=Max. Temperature; X2= Min. Temperature; X3=RH; X4=Rainfall Significant

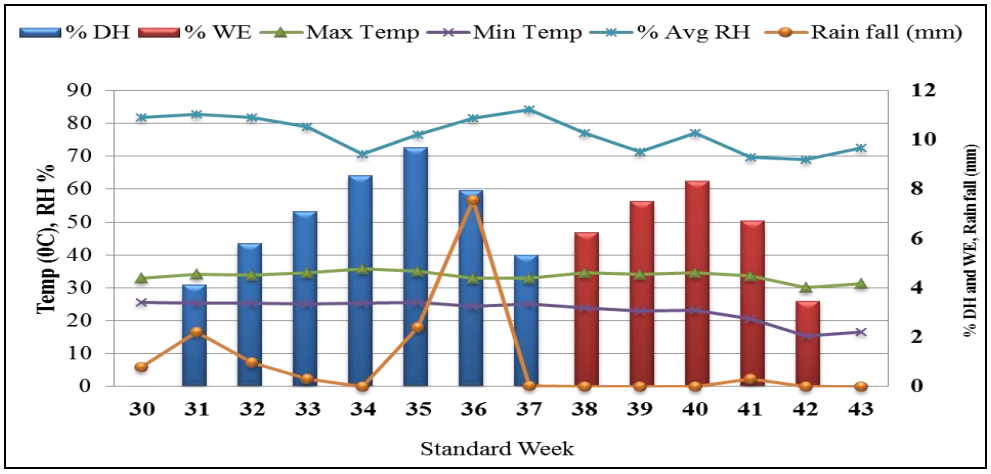

Fig 1: Seasonal incidence of yellow stem borer in relation to weather factors during *Kharif*, 2014

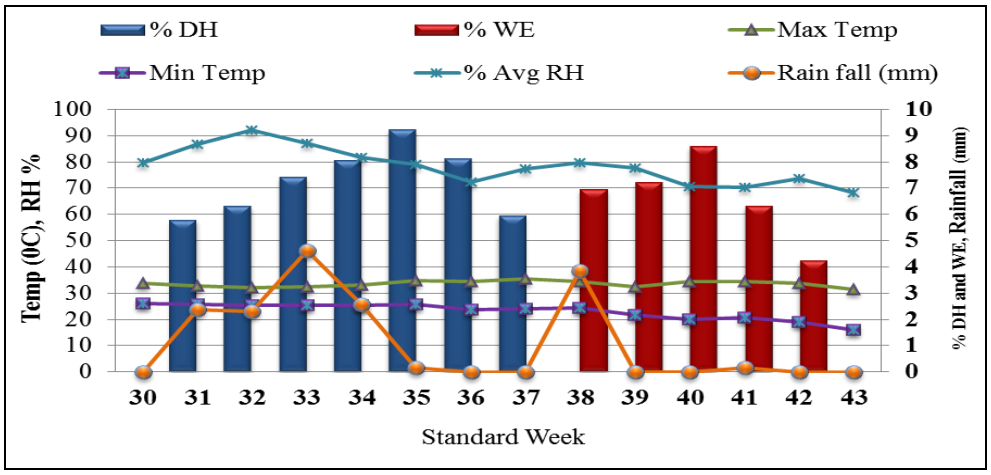

Fig 2: Seasonal incidence of yellow stem borer in relation to weather factors during *Kharif*, 2015

Table 2: Correlation between per cent seasonal incidence of *Scirpophaga incertulas* and weather parameters

Weather Parameters	Correlation coefficient (r)			
	Dead Heart		White Ear Heads	
	2014	2015	2014	2015
Max. Temp. (0C)	0.45#	0.06#	0.09#	0.22#
Min. Temp. (0C)	0.58**	0.65*	-0.28#	-0.43#
Average	0.57**	0.60**	-0.18#	-0.31#
Morn. Relative Humidity (%)	-0.18#	0.37#	0.13#	-0.33#
Eve. Relative Humidity (%)	0.48#	0.49#	-0.62*	-0.40#
Average	0.35#	0.51#	-0.48#	-0.42#
Rainfall (mm)	0.49#	0.32#	-0.35#	-0.14#

*-Significant (p<0.01), **-Significant (p< 0.05), #-Non significant

4. Conclusion

The peak period of *S. incertulas* was recorded in last week of August to first week of September (35th standard week) at vegetative stage and at reproductive stage the *S. incertulas* arrived at peak in 1st week of October (40th standard week) during *Kharif*, 2014 and 2015. The seasonal incidence of *S. incertulas* delineated the YSB population build up and interaction with weather parameters, which can be utilized for decision making. Regression analysis of environmental factors for YSB incident varied from 60.20-61.60 and 63.90-73.50 percent in case of dead heart and white ears, respectively so these regression models can help to predict the incidence of YSB on rice.

5. Acknowledge

Authors are highly thankful to Head, Department of Entomology, and the Director Research, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, for the necessary facilities and encouragement during course of present investigation and also thankful to ICAR-Indian Institute of Farming System Research, Modipuram (Meerut) for providing weather data.

6. Reference

1. Adiroubane D, Raja K. Influence of weather parameters on the occurrence of rice yellow stem borer, *Scirpophaga incertulus* (Walker). Journal of Rice Research. 2010; 3:5-9.
2. Aggarwal PK, Ladha JK, Singh RK, Devakumar C, Hardy B. Science, technology, and trade for peace and prosperity. Proceedings of the 26th International Rice Research Conference, 9-12 October 2006, New Delhi, India. Los Baños (Philippines) and New Delhi (India): International Rice Research Institute, Indian Council of Agricultural Research, and National Academy of Agricultural Sciences. Printed by Macmillan India Ltd. 2006, 782.
3. Agrawal R, Mehta SC. Weather-based forecasting of crop yields, pests and diseases-IASRI models. Journal of Indian Society of Agricultural Statistics. 2007; 61:255-245.
4. Anonymous. Directorate of Economics and Statistics, Department of Agri. And Cooperation, Ministry of Agri., Govt. of India. All India area, production and yield of rice, 2012.
5. Atwal AS, Dhaliwal GS. Agricultural Pest of South Asia and Their Management. Kalyani Publishers, New Delhi. 2008, 242.
6. Chelliah A, Benthur JS, Prakasa RPS. Approaches to rice management-achievements and opportunities. Oryza, 1989; 26:12-26.
7. David PK. Studies on the seasonal incidence of rice stem borer and leaf folder in Tambirabarani delta. *M.Sc., (Agri.) Thesis*, Tamil Nadu Agric. Univ., Killikulam, Tamil Nadu (India), 1995.
8. Heinrichs EA, Medrano FG, Rapusas HR. Genetic evaluation for insect resistance in rice. IRRI, Los Banos, Lagna, Philippines, 1985, 356.
9. Kakde AM, Patel KG. Seasonal incidence of rice yellow stem borer, *Scirpophaga incertulas* (Walker) in relation to conventional and SRI Methods of planting and its correlation with weather parameters. Journal of Agricultural and Veterinary Science. 2014; 7:5-10.
10. Kumar S, Patil CB, Bhatt RI, Rai AB. Influence of abiotic factors on the infestation by the yellow stem borer, *Scirpophaga incertulas* (Walker). Gujarat Agriculture University Research Journal. 1995; 20(2):175-178.
11. Leo JCG, Preetha G. Seasonal incidence of rice yellow stem borer, *Scirpophaga incertulas* (walker) in Tamil Nadu. Indian Journal Entomology. 2013; 75:109-112.
12. Mishra AK, Singh SPN, Parwez A. Incidence of yellow stem borer, *Scirpophaga incertulas* (Walker) in different cultivars of boro rice (*Oryza sativa* L.) at different crop stage. Oryza. 2005; 42(4):329-332.
13. Mishra MK, Sharma RC, Singh RB, Singh RP. Monitoring of yellow stem borer, *Scirpophaga incertulas* (Walker) in rice through light and pheromone traps. Agricultural and Biology Research. 2012; 28(2):135-139.
14. Pradhan S. In tropics, protection research more needed than production research. Indian Journal of Entomology.1971; 33:233-259.
15. Prasanna kumar NR, Chander S, Kumar LV. Development of weather based rice yellow stem borer prediction model for the Cauvery command rice areas, Karnataka, India. Cogent Food & Agriculture. 2015; 1:995281.
16. Teng PS, Heong KL, Keith M. Advances in tropical rice pest management research. In: New frontiers in rice research (Eds.: K. Muralidharan and E. A. Siddiq). Directorate of Rice Research, Hyderabad, India, 1993, 255.
17. Yang Z, Chen H, Tang W, Hua HX, Lin YJ. Development and characterization of transgenic rice expressing two *Bacillus thuringiensisgenes*. Pest Management Science. 2011; 67(**4**):414-422.