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

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Abstract
Transplanting of eight paddy varieties (PR-113,HKR-47,NDR-359, Sarju-52,PS-4,PS-5,PS-15 and PS-21) was done on 11th july 2016 during *Kharif* season for investigate the seasonal incidence of rice stem borer, *Scirpophaga incertulas* (Walker) on different varieties of paddy. Dead heart started from 32th standard week and continued upto 38th standard week, while white ear head was recorded on 35th standard week and it reached peak in 45th standard week .On the basis of peak infestation period, the maximum dead heart was recorded on PS-15(30.3%) while, minimum dead heart was found in HKR-47(14.6%) variety of paddy. The white ear head percent was ranged from 27% to 44.9%. Varietal reaction did not play a prominent role for the high or low stem borer incidence. Relationship of weather parameters indicated that they play a major role in creating the variation in *S. incertulas* prevalence. Temperature and relative humidity conducive during the cropping season, wide variation was recorded in the amount of rainfall and its distribution in along with the variation in sunshine hour. High rainfall during, August with low sunshine hours in September, followed by gradual decrease of rainfall with increase in sunshine hours towards October resulted in more *S. incertulas* incidence.

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

1. Introduction
Rice (*Oryza sativa* L.) is the world's second most important cereal crop feeding about 50% of the world population and provides 19% of the global calories intake [7]. Rice is the world's second most important cereal crop, feeding about 50% of the world population and provides single largest food source for the poor throughout Asia. It is the agricultural commodity with the third-highest worldwide production (740.9 million metric tons), after sugarcane and maize [5]. Change in a region's climate due to temperature increase could induce changes in the occurrence patterns of insect pests [9].

Rice crop is attacked by several insect pests from nursery to harvest, which cause severe yield loss in one region of the country or another. It is occupied by various kinds of invertebrates that inhabit soil, water and vegetation area of rice ecosystems. Land-dwelling arthropod community largely comprises of insects and spiders. Terrestrial arthropods include rice pests, their natural enemies and non-rice pest insects that visit rice ecosystems for other concerns [16]. The most important and widely distributed pest species are stem borers (*Scirpophaga incertulas*), leaf folders (*Cnaphalocrocis medinalis*), planthoppers, and gall midge (*Orseolia oryzae*). Stem borers are chronic pests, found in every field in every season, but generally at low numbers. Planthoppers and gall midge usually create localized outbreaks, causing high yield losses in relatively small areas. In India the major constraints of rice production is the occurrence of insect pests at various stages of crop growth. *Scirpophaga incertulas* (Walker) is a monophagous pest of paddy which is the most destructive pest and found almost all region of world. Symptoms of this pest is characterised by 'dead heart' in hill at vegetative stage and 'white ear' in panicle at reproductive stage.

The yellow stem borer is an important pest of irrigated rice in south and Southeast Asia. the rice variety *Oryza sativa* is attacked by Yellow stem borer (*Scirpophaga incertulas*) causing dead hearts in younger plants [2].

Climate change, especially temperature increase, will affect insect physiology, behaviour, and development as well as species distribution and abundance, evidenced by changes in the number of generations a year, increasing survival rates in winter, and the earlier appearance of some insects [10].

Knowledge of the seasonal abundance and population build up trend is essential to ensure timely preparedness to tackle impending pest problems and prevent crop losses [4]. In this regard, the present investigation was carried out with the following objectives of population dynamics of rice stem borer, *Scirpophaga incertulas* on different varieties of rice in relation to weather parameters.

2. Material and method

Study of seasonal incidence and effect of the weather parameters on population of yellow stem borer under tarai region of Uttarakhand were carried out at Norman E. Borlaug Centre, G.B. Pant University of Agriculture and Technology, Pantnagar during *Kharif* season 2016. Transplanting of eight paddy varieties (PR-113, HKR-47, NDR-359, Sarju-52, PS-4, PS-5, PS-15 and PS-21) was done on 11th july2016 during *Kharif* season to determine their potential against yellow stem borer of paddy under field condition at crop research centre. The weekly meteorological data recorded from the meterological observatory of the university at NEB-CRC. Five plants were randomly selected in each plot of three replication and tagged as to record observations, with row to row and plant to plant distance of 20 and 15 cm, respectively maintained in randomized block design (RBD).

2.1 Method of observation

For dead heart –Number of dead heart in vegetative stage and total number of tillers were recorded from 5 hills in each plot and percent damage was calculated by using following formula-

$$\% \text{ Dead heart} = \frac{No.of\ dead\ hearts/5\ hills}{Total\ No.of\ panicles/5\ hills} X\ 100$$

For white ear head- Number of white ears plants in ear heading stage and total number of panicles were recorded from 5 hills in each plot and percent damage was calculated by using following formula-

% White earhead

$$= \frac{No.of\ white\ ears/5\ hills}{Total\ No.of\ panicles/5\ hills} x100$$

2.3 Statistical analysis

The data were subjected to the analysis of variance using simple Randomized block design (R.B.D.) program. The simple correlation was worked out between stem borer population and weather parameters.

3. Result and discussion

3.1 Dead heart

The first appearance of dead heart was recorded on 32nd standard week, i.e., August 2nd week with the initial appearance on 4 varieties with maximum dead heart,1.7% in PS-4 and NDR-359,While no dead heart was observed in HKR-47,Sarju-52, PS-15 and PS-21.Fluctuation in stem borer's population is evident from table which shows that on 1st and 2nd week of September, PS-4 and Sarju-52 were least affected, respectively while PR-113 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 2nd week of August and attained its peak during 4th week of September with maximum dead heart in PS-15(30.3%) followed by PR-113(26.7%) and minimum 14.6% in HKR-47. [17] Had similar finding and reported that more damage of yellow stem borer was found during September and October. It is clear from table that all varieties, except Sarju-52 show significant negative correlation with minimum temperature. Varieties PR-113, NDR-359 and PS-21 show significant negative correlation -0.72, -0.72 and -0.74, respectively with minimum relative humidity. Significant negative correlation with rainfall is shown by dead heart damage in varieties, PR-113, HKR-47,NDR-359, Sarju-52,PS-15 and PS-21. Similar results were also obtained by [3] who, observed that rainfall (0.521) and sunshine hours (0.609) had significant positive correlation with the population and they also found that minimum temperature (-0.807) and minimum relative humidity (-0.782) had significant negative correlation with the population.

3.2 White earhead

The first appearance of white ear head was recorded on 35th standard week, i.e., September 1st week with the initial appearance on 3 varieties with maximum white ears, 3.3% in PR-113, 1.9% In PS-4 and 1.1% in PS-15, while no dead heart was observed in HKR-47, NDR-359, PS-5, Sarju-52 and PS-21. From 42nd week onwards, damage keep increasing, which reaches on its peak level on 45th standard week. The data obtained on the population dynamics of yellow stem borer on different rice varieties revealed that the white ear head started from the1st week of September and attained its peak during 2nd week of November with maximum white ears in NDR-359(44.9%) followed by PR-113 (44.3%) and minimum 27% in variety PS-5. white ear head symptom and weather parameters, shows that varieties, PR-113, HKR-47 and PS-15 show significant negative correlation with maximum temperature. Significant negative correlation values -0.96,-0.92,-0.90,-0.93,-0.94 and-0.93 were recorded in varieties, PR-113, HKR-47, PS-4, NDR-359, Sarju-52 and PS-21, respectively with minimum temperature. Varieties PR-113, NDR-359 and Sarju-52 show significant negative correlation with minimum relative humidity.

4. Conclusion

Based on the results of the present investigation it can concluded that rice varieties are prone to insect attack. During 2016, with transplanting towards the second week of July, dead heart and white earhead caused by *S. incertulas* on different varieties of paddy infestation started from the 2nd week of august and 1st week of September, respectively. Similar observations were also reported by [11] as yellow stem borer moth exhibiting their peak activity in the month of September. However, [18] reported three peak periods viz., July, August and September of *Scirpophaga incertulas* moth activity during Kharif season. HKR-47 had minimum percent dead heart followed by Sarju-52, while it was higher in PS-15 and PR113. But depending upon the weather conditions, particularly the amount of rainfall during the cropping period starting from June to October could influence the pest incidence to a great extent. The sunshine hour is also a major factor, which along with rainfall, influences the severity of yellow stem borer on rice.

However, [15] found that low temperature, high relative humidity and rainfall resulted in YSB outbreak. [13] Reported that YSB moth population had no effect of temperature while it was positively correlated to maximum relative humidity and sunshine but negatively correlated with rainfall. [12] investigated that maximum temperature, rainfall and relative humidity were negatively correlated while minimum temperature, evaporation and sunshine were positively correlated to YSB moth population but [14] reported that YSB

moth population had positive correlation with temperature, rainfall and relative humidity. The findings of the present study are in close agreement with [1], reported a negative correlation of dead heart % with temperature. Present findings are in line with the results of [8], who reported the occurrence of the pest, peaked during September to October [6]. Reported that infestation of yellow stem borer had a negative correlation with maximum temperature in kharif rice.

5. Acknowledgment

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Table 1: Percent dead heart cause by yellow stem borer *S. incertulas* during *kharif*, 2016.

Date of observation	SW	% Dead Heart							
		PR-113	HKR-47	PS-4	NDR-359	PS-5	Sarju-52	PS-15	PS-21
11-08-16	32	0.9	0	1.7	1.7	1.5	0	0	0
18-08-16	33	3.3	0.5	4.3	1.9	2	0	1.2	1.8
25-08-16	34	6.2	1.5	4.7	5.4	3.5	2.5	6.9	6.1
01-09-16	35	15.7	8.5	7.9	10.7	10.8	9.3	11.6	12.2
08-09-16	36	20.8	11.5	11	14.6	17.1	10.5	18.8	18
15-09-16	37	24.3	12.5	15.1	16	24.4	15.8	29.4	21.1
22-09-16	38	26.7	14.6	16	17.1	24.4	16.1	30.3	22.0
SEm±		2.07	2.06	1.58	1.29	3.26	1.67	2.77	2.93
C.D. at 5%		6.39	6.35	4.87	3.98	10.0	5.15	8.53	9.04

SW – Standard week, SE (m) = Sum of error due to mean, C.D. = Critical Difference, Temp = Temperature (^{0}C), RH = Relative humidity (%), RF = Rainfall (mm)

Table 2: Percent White ear head caused by yellow stem borer *S. incertulas* during *kharif*, 2016.

Date of observation	SW	% White Ear Head							
		PR-113	HKR-47	PS-4	NDR-359	PS-5	Sarju-52	PS-15	PS-21
01-09-16	35	3.3	0	1.9	0	0	0	1.13	0
08-09-16	36	7.1	4.5	4.6	4.3	3.7	0.9	3.06	3.4
15-09-16	37	7.3	7.1	7	7.1	5	4	5.83	8.3
22-09-16	38	8.2	7.6	10.3	9.5	11.9	6.8	10.1	11.5
29-09-16	39	8.3	7.8	12.5	10.3	13	7.6	10.7	13
06-10-16	40	10.9	10.1	17.3	12.5	14.6	14.4	12.3	15.4
13-10-16	41	16.8	16.8	27.1	23.2	15.7	18.8	25.4	19.8
20-10-16	42	22	20.1	27.6	34.9	19.8	23.5	31.5	24.2
27-10-16	43	33.3	22.4	29.2	38.9	20.2	27.8	36	26.5
03-11-16	44	36.8	26.7	34.8	40.7	24.2	28	38.5	34.1
10-11-16	45	44.3	30.3	36.2	44.9	27	31.9	40.2	36.7
SEm±		3.42	1.57	2.55	2.42	1.95	2.0	5.75	1.6
C.D. at 5%		10.10	4.64	7.54	7.14	5.78	5.90	16.98	4.77

SW – Standard week, SE (m) = Sum of error due to mean, C.D. = Critical Difference, Temp = Temperature (^{0}C), RH = Relative humidity (%), RF = Rainfall (mm)

Table 3: Correlation relationship between Dead heart caused by YSB population and weather parameters of Pantnagar during kharif 2016.

Variety	Temperature (^{0}C)		Relative Humidity (%)		Rainfall(mm)	Wind Velocity (wv)	Sun Shine (ss)
	Max.	Min.	Max.	Min.			
PR-113	-0.195	-0.758*	-0.190	-0.722*	-0.763*	-0.063	0.625
HKR-47	-0.157	-0.746*	-0.157	-0.689	-0.729*	-0.037	0.622
PS-4	-0.187	-0.773*	-0.310	-0.683	-0.695	-0.212	0.526
NDR-359	-0.215	-0.741*	-0.193	-0.722*	-0.794*	-0.048	0.683
PS-5	-0.100	-0.753*	-0.345	-0.639	-0.672	-0.229	0.592
Sarju-52	-0.096	-0.691	-0.277	-0.673	-0.742*	-0.080	0.616
PS-15	-0.179	-0.716*	-0.394	-0.641	-0.718*	-0.232	0.573
PS-21	-0.230	-0.765*	-0.219	-0.737*	-0.791*	-0.092	0.664

*Significant at 0.05 level, Max- Maximum temperature, Min- Minimum temperature

Table 4: Correlation relationship between White ear head caused by YSB population and weather parameters of Pantnagar during kharif 2016.

Variety	Temperature (^{0}C)		Relative Humidity (%)		Rainfall(mm)	Wind Velocity (wv)	Sun Shine (ss)
	Max.	Min.	Max.	Min.			
PR-113	-0.911*	-0.962*	0.304	-0.931*	-0.231	-0.444	-0.206
HKR-47	-0.919*	-0.927*	0.236	-0.888	-0.214	-0.597	-0.302
PS-4	-0.891	-0.903*	0.154	-0.858	-0.229	-0.617	-0.346
NDR-359	-0.895	-0.931*	0.269	-0.907*	-0.223	-0.546	-0.320
PS-5	-0.867	-0.893	0.062	-0.804	-0.085	-0.679	-0.310
Sarju-52	-0.853	-0.940*	0.140	-0.909*	-0.234	-0.551	-0.285
PS-15	-0.902*	-0.897	0.250	-0.860	-0.206	-0.566	-0.397
PS-21	-0.889	-0.931*	0.159	-0.872	-0.168	-0.634	-0.275

*Significant at 0.05 level, Max- Maximum temperature, Min- Minimum temperature

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