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Effect of weather parameters on incidence of yellow stem borer, *Scirpophaga incertulas* (Walker) in rice ecosystem

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Abstract

The present experiment was conducted during *Kharif* season 2018-19 and 2019-2020 at Agronomy farm, Department of Agronomy, College of Agriculture, Dapoli to study the correlation between yellow stem borer incidence and weather parameters. Results revealed that morning relative humidity in S_1V_1 ($r=0.723$), S_1V_2 ($r=0.636$), S_1V_3 ($r=0.880$), S_1V_5 ($r=0.674$) and evening relative humidity in S_1V_3 ($r=0.646$), S_1V_5 ($r=0.620$) and S_1V_6 ($r=0.626$) was found to be positively significant. While, maximum temperature in S_1V_3 ($r=-0.708$), S_1V_4 ($r=-0.704$), S_1V_5 ($r=-0.760$), S_1V_6 ($r=-0.786$), S_1V_7 ($r=-0.721$), S_1V_8 ($r=-0.721$), S_1V_9 ($r=-0.617$) and bright sunshine hours S_1V_2 ($r=-0.606$) and S_1V_3 ($r=-0.747$) was found to be negatively significant. Remaining all of the weather parameters were found to be non-significant.

Keywords: yellow stem borer, weather parameters, Dapoli

Introduction

Rice is the seed of monocot plant *Oryza sativa* (Asian rice) or *Oryza glaberrima* (African rice) belongs to family Graminae is originated from China. It is a staple food for more than two billion people. Insect pests constitute the major yield limiting biotic stresses throughout the rice growing countries. About 300 species of insects have been reported to attack rice crop in India, out of which 20 have been found to be the major pests^[1].

Yellow rice stem borer, *Scirpophaga incertulas* (Walker) is a monophagous pest of paddy that belongs to order Lepidoptera and family *Pyralidae*. It is a key pest as it infests the plant right from seedling to maturity and it has worldwide distribution. Symptoms of this pest are characterized by “dead heart” in hill at vegetative stage and “white ear” in panicle at reproductive stage. The larva creates a hole, get inside, feed on inner content and pupate in silken cocoon inside the larval tunnel in the base of plant^[9]. When infestation occurs at flowering stage, the ear head become chaffy^[4]. In India yellow stem borer, *Scirpophaga incertulas* has assumed the number one status as national pest^[7]. The extent of damage caused by the yellow stem borer in rice ranged from 3 to 95 per cent^[3].

Climate change affects 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. Information about seasonal abundance and population build up trend is essential to ensure timely preparedness to tackle impending pest problems and prevent crop losses. In this regard, the present investigation was carried out with the following objectives of effect of weather parameters on yellow stem borer, *Scirpophaga incertulas* incidence on rice

Materials and Methods

The experiment was conducted to know correlation between yellow stem borer incidence and weather parameters. Data on weather parameters like, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rainfall and sunshine hours for the years 2018-2019 and 2019-2020 were collected from meteorological laboratory, Department of Agronomy, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli.

Experiment Layout: The experiment was conducted during *Kharif* season 2018-2019 and 2019-2020 was laid out in split plot design with three replications. The main plot treatments

were three sowing windows, viz., S₁-23rd Met. Week, S₂- 24th Met. Week and S₃-25th Met. Week. The sub plot treatments comprised nine varieties viz., V₁- Karjat-5, V₂- Karjat-7, V₃- Ratnagiri-24, V₄- Karjat-2, V₅- Palghar-1, V₆- Karjat-3, V₇- Swarna, V₈- Sahyadri-4 and V₉- Jaya. Thus there were 27 treatment combinations.

Details of Experiments

Location	:	Agronomy farm, Dr. B.S.K.K.V., Dapoli.
Season	:	Kharif 2018-2019 and 2019-2020
Crop	:	Rice
Treatment details	:	A] Main plot (Sowing time) S ₁ - 23 rd Meteorological week (4 th to 10 th June). S ₂ - 24 th Meteorological week (11 th to 17 th June) S ₃ - 25 th Meteorological week (18 th to 24 th June) B] Sub plot (Varieties): V ₁ - Karjat-5 V ₂ - Karjat-7 V ₃ - Ratnagiri-24 V ₄ - Karjat-2 V ₅ - Palghar-1 V ₆ - Karjat-3 V ₇ - Swarna V ₈ - Sahyadri-4 V ₉ - Jaya
Plot Size (Gross Plot)	:	Gross: 7.2 x 2.1 m Net plot: 6.8 x 1.8 m
Design	:	Split plot design
Number of replications	:	Three
Spacing	:	20 cm x 15 cm

Method of recording observations

Five hills per plot were selected randomly to record the observations on the incidence of yellow stem borer infesting rice. The total number of tillers per hill and infested tillers per hill were recorded from five randomly selected hills for stem borer. The per cent stem borer infestation was worked out by using formula given below;

$$\text{Per cent infestation of stem borer} = \frac{\text{No. of dead hearts /white ear heads}}{\text{Total no. of tillers/panicles per hill}} \times 100$$

Results and Discussion

Kharif 2018

The data on correlation between yellow stem borer infesting rice at different sowing time and different meteorological parameters during 2018-2019 presented in Table 1 revealed that, rainfall ($r = 0.908$) was found to be positively significant with yellow stem borer infestation in S₁ (23rd SMW, 4th to 10th June). Remaining all other weather parameters were found to be non-significant.

During 2018-2019 the data on correlation between yellow stem borer infesting rice at different varieties and different meteorological parameters presented in Table 1 revealed that, rainfall was found to be positively significant with yellow stem borer infestation in V₁ ($r=0.662$), V₂ ($r=0.626$), V₃ ($r=0.730$), V₄ ($r=0.622$), V₅ ($r=0.745$), V₆ ($r=0.603$) and V₉ ($r=0.662$). While, maximum temperature had found to be negatively significant in V₃ ($r=-0.633$) and V₅ ($r=-0.608$). Remaining all of the weather parameters were found to be non-significant.

The correlation between yellow stem borer infesting rice during 2018-2019 on combine effect of different sowing time and varieties with different meteorological parameters presented in Table 1 revealed that rainfall in S₁V₁ ($r=0.894$), S₁V₂ ($r=0.840$), S₁V₃ ($r=0.889$), S₁V₄ ($r=0.926$), S₁V₅ ($r=0.898$), S₁V₆ ($r=0.867$), S₁V₇ ($r=0.888$), S₁V₈ ($r=0.819$), S₁V₉ ($r=0.885$) S₂V₅ ($r=0.661$) and morning relative humidity in S₁V₆ ($r=0.629$), S₁V₇ ($r=0.621$) and S₁V₈ ($r=0.611$) were found to be positively significant. While, maximum temperature was found to be negatively significant in S₁V₁ ($r=-0.605$), S₁V₃ ($r=-0.604$), S₁V₄ ($r=-0.631$), S₁V₉ ($r=-0.631$) and S₂V₅ ($r=-0.605$). Remaining all of the weather parameters were found to be non-significant.

Kharif 2019-2020

The data on correlation between yellow stem borer infesting rice at different sowing time, varieties and combine effect of different sowing time and varieties and different meteorological parameters during 2019-2020 are presented in Table 2 revealed that, all the weather parameters were found to be non-significant.

Pooled Data

The data on correlation between yellow stem borer infesting rice at different sowing time and different meteorological parameters during 2018-2019 and 2019-2020 are presented in Table 3 revealed that, all the weather parameters were found to be non-significant.

During 2018-2019 and 2019-2020 the data on correlation between yellow stem borer infesting rice at different varieties and different meteorological parameters are presented in Table 3 revealed that, all the weather parameters were found to be non-significant.

The results of data during 2018-2019 and 2019-2020 are presented in Table 3 on correlation between the yellow stem borer infesting rice at combine effect of different sowing time and varieties with different meteorological parameters like morning relative humidity in S₁V₁ ($r=0.723$), S₁V₂ ($r=0.636$), S₁V₃ ($r=0.880$), S₁V₅ ($r=0.674$) and evening relative humidity in S₁V₃ ($r=0.646$), S₁V₅ ($r=0.620$) and S₁V₆ ($r=0.626$) was found to be positively significant. While, maximum temperature in S₁V₃ ($r=-0.708$), S₁V₄ ($r=-0.704$), S₁V₅ ($r=-0.760$), S₁V₆ ($r=-0.786$), S₁V₇ ($r=-0.721$), S₁V₈ ($r=-0.721$), S₁V₉ ($r=-0.617$) and bright sunshine hours S₁V₂ ($r=-0.606$) and S₁V₃ ($r=-0.747$) was found to be negatively significant. Remaining all of the weather parameters were found to be non-significant.

The present observations are more or less support the findings of Chattopadhyay and Samui^[2] who stated that drop in mean temperature in association with continuous rainfall was found to be the most congenial weather condition for the incidence of the yellow stem borer. Mishra *et al.*^[5] reported that the relative humidity and rainfall had significant positive correlation in respect to white ear head. Sankpal^[8] reported that the maximum temperature as well as bright sunshine hours had negative correlation with yellow stem borer incidence at pre-harvest, while minimum temperature, morning relative humidity, evening relative humidity and rainfall had positive correlation with yellow stem borer. Mondal and Chakraborty^[6] revealed that temperature recorded significant negative correlation with the incidence of DH and WH. Sulagitti *et al.*^[10] showed a positive significant correlation with evening and average humidity and a positive non-significant correlation with morning humidity and rainfall.

Table 1: Correlation between sowing time, varieties and interaction (sowing time and varieties) and weather parameters on per cent yellow stem borer infestation during *Kharif* 2018-2019

Treatments	Weather Parameter					
	TMax	TMin	RH-I	RH-II	Rain	BSS
Main Plot: Sowing Time						
S ₁	-0.589	0.086	0.589	0.519	908**	-0.480
S ₂	-0.538	-0.371	0.017	0.371	0.561	-0.042
S ₃	-0.442	-0.430	-0.186	0.257	0.222	0.124
Sub Plot:- Varieties						
V ₁	-0.573	-0.243	0.224	0.428	0.662*	-0.160
V ₂	-0.575	-0.219	0.161	0.443	0.626*	-0.209
V ₃	-0.633*	-0.134	0.288	0.501	0.730*	-0.289
V ₄	-0.571	-0.229	0.174	0.435	0.622*	-0.157
V ₅	-0.608*	-0.159	0.293	0.484	0.745**	-0.273
V ₆	-0.535	-0.234	0.194	0.377	0.603*	-0.161
V ₇	-0.542	-0.311	0.107	0.366	0.561	-0.091
V ₈	-0.536	-0.233	0.192	0.377	-0.570	-0.138
V ₉	-0.561	-0.183	0.231	0.434	0.662*	-0.203
Interaction- Main plot x Sub plot						
S ₁ V ₁	-0.605*	0.068	0.571	0.529	0.894**	-0.472
S ₁ V ₂	-0.559	0.014	0.439	0.512	0.840**	-0.429
S ₁ V ₃	-0.604*	0.082	0.595	0.521	0.889**	-0.478
S ₁ V ₄	-0.631*	0.109	0.583	0.556	0.926**	-0.501
S ₁ V ₅	-0.551	0.086	0.584	0.491	0.898**	-0.462
S ₁ V ₆	-0.533	0.125	0.629*	0.465	0.867**	-0.469
S ₁ V ₇	-0.557	0.117	0.621*	0.486	0.888**	-0.478
S ₁ V ₈	-0.523	0.125	0.611*	0.453	0.819**	-0.460
S ₁ V ₉	-0.631*	0.127	0.536	0.564	0.885**	-0.495
S ₂ V ₁	-0.459	-0.370	0.113	0.295	0.566	0.012
S ₂ V ₂	-0.510	-0.406	-0.040	0.342	0.519	-0.015
S ₂ V ₃	-0.559	-0.295	0.048	0.400	0.593	-0.112
S ₂ V ₄	-0.485	-0.391	0.095	0.312	0.588	0.011
S ₂ V ₅	-0.605*	-0.237	0.143	0.461	0.661*	-0.193
S ₂ V ₆	-0.481	-0.363	0.009	0.320	0.482	-0.019
S ₂ V ₇	-0.467	-0.467	-0.127	0.288	0.421	0.0930
S ₂ V ₈	-0.484	-0.434	-0.083	0.321	0.433	0.078
S ₂ V ₉	-0.412	-0.400	-0.036	0.265	0.467	0.0237
S ₃ V ₁	-0.364	-0.528	-0.341	0.184	0.072	0.278
S ₃ V ₂	-0.548	-0.245	-0.032	0.400	0.328	-0.094
S ₃ V ₃	-0.594	-0.296	-0.116	0.446	0.330	-0.034
S ₃ V ₄	-0.326	-0.417	-0.281	0.192	0.055	0.192
S ₃ V ₅	-0.471	-0.351	-0.041	0.307	0.329	0.0160
S ₃ V ₆	-0.371	-0.429	-0.199	0.165	0.172	0.143
S ₃ V ₇	-0.306	-0.489	-0.283	0.103	0.070	0.234
S ₃ V ₈	-0.340	-0.443	-0.212	0.138	0.117	0.198
S ₃ V ₉	-0.408	-0.456	-0.066	0.244	0.339	0.150

Table 'r' value = 0.735 at 1% level of significance and

Table 'r' value = 0.602 at 5% level of significance (N = 11 i.e. N-2 d.f.)

* Significant at 5% level of significance

**Significant at 1% level of significance

Table 2: Correlation between sowing time, varieties and interaction (sowing time and varieties) and weather parameters on per cent yellow stem borer infestation during *Kharif* 2019-2020

Treatments	Weather Parameter					
	TMax	TMin	RH-I	RH-II	Rain	BSS
Main Plot: Sowing Time						
S ₁	-0.276	-0.408	0.258	0.072	0.124	-0.052
S ₂	-0.364	-0.172	0.504	0.205	0.108	-0.173
S ₃	-0.364	-0.172	0.504	0.205	0.108	-0.173
Sub Plot:- Varieties						
V ₁	-0.404	-0.133	0.402	0.219	0.066	-0.241
V ₂	-0.471	-0.254	0.494	0.293	0.234	-0.267
V ₃	-0.456	-0.161	0.516	0.302	0.205	-0.274
V ₄	-0.360	-0.287	0.440	0.193	0.149	-0.142
V ₅	-0.215	-0.341	0.369	0.062	0.021	0.013
V ₆	-0.279	-0.411	0.379	0.092	0.042	-0.036
V ₇	-0.241	-0.444	0.345	0.055	0.057	0.012

V ₈	-0.350	-0.239	0.469	0.190	0.138	-0.146
V ₉	-0.424	-0.163	0.524	0.263	0.270	-0.226
Interaction- Main plot x Sub plot						
S ₁ V ₁	-0.372	-0.035	0.206	0.209	0.157	-0.271
S ₁ V ₂	-0.343	-0.275	0.305	0.147	0.189	-0.156
S ₁ V ₃	-0.415	-0.219	0.365	0.214	0.260	-0.237
S ₁ V ₄	-0.368	-0.392	0.406	0.180	0.293	-0.126
S ₁ V ₅	-0.045	-0.519	0.184	-0.125	0.004	0.227
S ₁ V ₆	-0.142	-0.244	0.010	0.024	-0.047	-0.060
S ₁ V ₇	-0.024	-0.535	0.150	-0.147	-0.034	0.244
S ₁ V ₈	-0.198	-0.693	0.179	0.030	0.115	0.049
S ₁ V ₉	-0.579	-0.055	0.470	0.389	0.424	-0.456
S ₂ V ₁	-0.356	-0.184	0.485	0.198	0.078	-0.178
S ₂ V ₂	-0.488	-0.254	0.575	0.317	0.251	-0.277
S ₂ V ₃	-0.325	0.079	0.469	0.250	0.011	-0.232
S ₂ V ₄	-0.305	0.021	0.398	0.204	0.008	-0.199
S ₂ V ₅	-0.309	-0.162	0.440	0.185	0.010	-0.155
S ₂ V ₆	-0.274	-0.328	0.440	0.079	0.118	-0.030
S ₂ V ₇	-0.363	-0.445	0.461	0.162	0.201	-0.102
S ₂ V ₈	-0.331	-0.049	0.502	0.179	0.117	-0.159
S ₂ V ₉	-0.132	-0.177	0.331	0.029	0.010	0.048
S ₃ V ₁	-0.128	0.058	0.118	0.068	-0.251	-0.096
S ₃ V ₂	-0.212	-0.011	0.250	0.216	-0.083	-0.164
S ₃ V ₃	-0.212	-0.124	0.287	0.196	-0.027	-0.114
S ₃ V ₄	0.065	-0.393	0.049	-0.151	-0.254	0.237
S ₃ V ₅	-0.074	-0.158	0.253	0.041	-0.084	0.049
S ₃ V ₆	-0.173	-0.259	0.306	0.087	-0.064	-0.011
S ₃ V ₇	-0.067	-0.179	0.123	0.019	-0.219	0.033
S ₃ V ₈	-0.184	-0.065	0.294	0.141	-0.024	-0.085
S ₃ V ₉	-0.296	-0.060	0.440	0.218	0.107	-0.159

Table 'r' value = 0.735 at 1% level of significance and

Table 'r' value = 0.602 at 5% level of significance (N = 11 i.e. N-2 d.f.)

* Significant at 5% level of significance

**Significant at 1% level of significance

Table 3: Pooled correlation between sowing time, varieties and interaction (sowing time and varieties) and weather parameters on per cent yellow stem borer infestation during *Kharif* 2018-2019 and 2019-2020

Treatments	Weather Parameter					
	T Max	T Min	RH-I	RH-II	Rain	BSS
Main Plot: Sowing Time						
S ₁	-0.431	-0.141	0.549	0.304	0.079	-0.195
S ₂	-0.456	-0.379	0.135	0.276	0.077	-0.019
S ₃	-0.381	-0.419	-0.008	0.213	0.097	0.038
Sub Plot:- Varieties						
V ₁	-0.511	-0.292	0.348	0.332	0.099	-0.121
V ₂	-0.569	-0.258	0.410	0.398	0.257	-0.213
V ₃	-0.571	-0.232	0.412	0.400	0.221	-0.217
V ₄	-0.509	-0.356	0.321	0.333	0.213	-0.123
V ₅	-0.426	-0.384	0.257	0.260	0.062	-0.021
V ₆	-0.492	-0.306	0.299	0.309	0.073	-0.097
V ₇	-0.462	-0.386	0.261	0.278	0.106	-0.054
V ₈	-0.446	-0.298	0.195	0.265	0.072	-0.068
V ₉	-0.508	-0.306	0.358	0.347	0.272	-0.158
Interaction- Main plot x Sub plot						
S ₁ V ₁	-0.598	0.302	0.723*	0.516	0.336	-0.557
S ₁ V ₂	-0.546	0.306	0.636*	0.486	0.509	-0.606*
S ₁ V ₃	-0.708*	0.455	0.880**	0.646*	0.523	-0.747**
S ₁ V ₄	-0.705*	-0.013	0.526	0.565	0.333	-0.395
S ₁ V ₅	-0.760*	0.010	0.674*	0.620*	0.444	-0.489
S ₁ V ₆	-0.786*	0.015	0.539	0.626*	0.387	-0.466
S ₁ V ₇	-0.721*	-0.093	0.413	0.543	0.341	-0.370
S ₁ V ₈	-0.721*	-0.051	0.547	0.567	0.331	-0.392
S ₁ V ₉	-0.617*	-0.110	0.510	0.470	0.349	-0.336
S ₂ V ₁	-0.402	-0.438	0.132	0.227	-0.013	0.058
S ₂ V ₂	-0.524	-0.356	0.235	0.344	0.168	-0.095
S ₂ V ₃	-0.469	-0.317	0.102	0.293	0.068	-0.052
S ₂ V ₄	-0.370	-0.405	0.004	0.179	-0.053	0.064
S ₂ V ₅	-0.464	-0.404	0.152	0.276	0.072	-0.015

S ₂ V ₆	-0.401	-0.378	0.118	0.230	0.060	0.010
S ₂ V ₇	-0.483	-0.401	0.215	0.302	0.123	-0.044
S ₂ V ₈	-0.398	-0.333	0.020	0.241	0.011	0.028
S ₂ V ₉	-0.323	-0.412	0.072	0.181	0.080	0.066
S ₃ V ₁	-0.339	-0.406	-0.095	0.174	-0.017	0.088
S ₃ V ₂	-0.513	-0.302	0.168	0.355	0.222	-0.125
S ₃ V ₃	-0.512	-0.357	0.120	0.366	0.203	-0.073
S ₃ V ₄	-0.301	-0.532	-0.036	0.148	0.159	0.105
S ₃ V ₅	-0.321	-0.433	-0.010	0.176	0.077	0.081
S ₃ V ₆	-0.352	-0.429	-0.050	0.174	0.057	0.064
S ₃ V ₇	-0.300	-0.419	-0.085	0.127	0.009	0.092
S ₃ V ₈	-0.304	-0.344	-0.100	0.148	0.056	0.056
S ₃ V ₉	-0.356	-0.479	0.025	0.202	0.118	0.080

Table 'r' value = 0.735 at 1% level of significance and
Table 'r' value = 0.602 at 5% level of significance (N = 11 i.e. N-2 d.f.)

* Significant at 5% level of significance

**Significant at 1% level of significance

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