The Pharma Innovation

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Effect of weather parameters on incidence of blue beetle, 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 blue beetle incidence and weather parameters.

Results revealed that morning relative humidity in S_1V_1 (r=0.702), S_1V_2 (r=0.661), S_1V_3 (r=0.739), S_1V_4 (r=0.684), S_1V_5 (r=0.746), S_1V_6 (r=0.762), S_1V_7 (r=0.705), evening relative humidity in S_1V_1 (r=0.597), S_1V_3 (r=0.638), S_1V_4 (r=0.572), S_1V_5 (r=0.612), S_1V_6 (r=0.638), S_1V_7 (r=0.605) was found to be positively significant. While, maximum temperature in S_1V_1 (r=-0.704), S_1V_2 (r=-0.622), S_1V_3 (r=-0.711), S_1V_4 (r=-0.650), S_1V_5 (r=-0.684), S_1V_6 (r=-0.708), S_1V_7 (r=-0.677), S_1V_8 (r=-0.579), S_2V_5 (r=-0.618), S_2V_6 (r=-0.616), S_2V_8 (r=-0.582) and bright sunshine hours S_1V_1 (r=-0.585), S_1V_2 (r=-0.591), S_1V_3 (r=-0.670), S_1V_4 (r=-0.601), S_1V_5 (r=-0.666), S_1V_6(r=-0.687), S_1V_7 (r=-0.638) was found to be negatively significant. Remaining all of the weather parameters were found to be non-significant.

Keywords: Blue beetle, 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].

Rice blue beetle, *Leptispa pygmaea* (Baly.) is mainly found in southern parts of Karnataka, Maharashtra, Tamil Nadu, Kerala [6]. Rice blue beetle occupying major status at some hot spot areas. The grub and adult stage of this pest is feeding on upper surface of leaves, causing longitudinal white streaks. In sever incidence, the leaves fold longitudinally and dry up.

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 blue beetle, *Leptispa pygmaea* incidence on rice.

Material and Method

The experiment was conducted to know correlation between blue beetle 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.*, S_1-23rd Met. Week, S_2-24th Met. Week and S_3-25th Met. Week. The sub plot treatments comprised nine varieties *viz.*, 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 and V_9-Jaya. Thus there were 27 treatment combinations.

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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 - 23rd Meteorological week (4th to 10th June). S_2 - 24th Meteorological week (11th to 17th June). S_3 - 25th Meteorological week (18th to 24th 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
For rice blue beetle, total number of leaves per hill and infested leaves per hill from five randomly selected hills were recorded. The per cent infestation of rice blue beetle was calculated by using formula given below.

$$\text{Per cent infestation of blue beetle} = \frac{\text{Total number of infested leaves}}{\text{Total number of leaves per hill}} \times 100$$

The observations were recorded at weekly interval. The data thus obtained was converted into arc sine transformation and subjected to statistical analysis.

Result and Discussion
Kharif **2018-2019**
The data on correlation between blue beetle infesting rice at different sowing time and different meteorological parameters during 2018-2019 are presented in Table 1 revealed that, the weather parameters like maximum temperature (r= -0.618) was found to be negatively significant with blue beetle infestation in S_1 (23rd SMW, 4th to 10th June). Remaining all of the weather parameters were found to be non-significant.

During 2018-2019 the data on correlation between blue beetle infesting rice at different varieties and different meteorological parameters revealed that, the weather parameters like maximum temperature had found to be negatively significant in V_3 (r=-0.586), V_5 (r=-0.579), V_6 (r=-0.577) and V_9 (r=-0.600). Remaining all of the weather parameters were found to be non-significant.

The results of data during 2018-2019 on correlation between blue beetle infesting rice at combine effect of different sowing time and varieties with different meteorological parameters revealed that rainfall in S_1V_4 (r=0.590), S_1V_6 (r=0.587) and S_1V_9 (r=0.580) was found to be positively significant. While, maximum temperature in S_1V_1 (r=-0.591), S_1V_2 (r=-0.645), S_1V_3 (r=-0.639), S_1V_5 (r=-0.628), S_1V_6 (r=-0.591), S_1V_7 (r=-0.620), S_1V_9 (r=-0.580), S_2V_3 (r=-0.601), S_2V_5 (r=-0.589), S_2V_6 (r=-0.616) and bright sunshine hours in S_1V_5 (r=-0.577), S_1V_7 (r=-0.618), S_1V_8 (r=-0.577) was found to be negatively significant. Remaining all of the weather parameters were found to be non-significant.

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

Treatments	Weather Parameter					
	TMax	**TMin**	**RH-I**	**RH-II**	**Rain**	**BSS**
Main Plot: Sowing Time						
S_1	-0.618*	0.403	0.452	0.542	0.555	-0.566
S_2	-0.550	-0.058	0.105	0.386	0.405	-0.213
S_3	-0.408	-0.323	-0.101	0.209	0.213	0.060
Sub Plot: Varieties						
V_1	-0.499	-0.107	0.109	0.331	0.354	-0.164
V_2	-0.539	-0.059	0.161	0.371	0.421	-0.215
V_3	-0.586*	0.008	0.194	0.420	0.454	-0.275
V_4	-0.505	-0.066	0.144	0.337	0.394	-0.191
V_5	-0.579*	-0.030	0.102	0.416	0.365	-0.223
V_6	-0.577*	0.066	0.247	0.436	0.476	-0.318
V_7	-0.483	-0.081	0.047	0.330	0.334	-0.160
V_8	-0.575	0.066	0.188	0.444	0.447	-0.300
V_9	-0.600*	0.009	0.153	0.444	0.400	-0.241
Interaction- Main plot x Sub plot						
S_1V_1	-0.591*	0.205	0.291	0.490	0.485	-0.450

S_1V_2	-0.645*	0.275	0.250	0.546	0.458	-0.490
S_1V_3	-0.639*	0.394	0.414	0.559	0.522	-0.551
S_1V_4	-0.559	0.392	0.535	0.479	0.590*	-0.543
S_1V_5	-0.628*	0.433	0.467	0.553	0.555	-0.577*
S_1V_6	-0.591*	0.395	0.461	0.521	0.587*	-0.570
S_1V_7	-0.620*	0.490	0.485	0.565	0.533	-0.618*
S_1V_8	-0.559	0.496	0.365	0.556	0.467	-0.577*
S_1V_9	-0.580*	0.432	0.564	0.504	0.580*	-0.562
S_2V_1	-0.497	-0.006	0.248	0.348	0.431	-0.258
S_2V_2	-0.509	0.055	0.353	0.364	0.572	-0.321
S_2V_3	-0.601*	0.056	0.333	0.449	0.546	-0.328
S_2V_4	-0.461	-0.173	-0.027	0.297	0.266	-0.100
S_2V_5	-0.589*	-0.090	-0.042	0.428	0.292	-0.154
S_2V_6	-0.616*	0.197	0.336	0.489	0.546	-0.429
S_2V_7	-0.125	-0.376	-0.302	-0.014	0.083	0.135
S_2V_8	-0.563	0.039	0.143	0.404	0.414	-0.242
S_2V_9	-0.470	-0.175	-0.240	0.335	0.127	-0.052
S_3V_1	-0.400	-0.336	-0.136	0.201	0.163	0.085
S_3V_2	-0.414	-0.307	-0.057	0.221	0.220	0.052
S_3V_3	-0.185	-0.488	-0.285	-0.035	0.094	0.201
S_3V_4	-0.339	-0.424	-0.194	0.125	0.172	0.145
S_3V_5	-0.357	-0.356	-0.136	0.157	0.157	0.081
S_3V_6	-0.383	-0.365	-0.129	0.185	0.169	0.117
S_3V_7	-0.459	-0.272	-0.072	0.269	0.236	0.036
S_3V_8	-0.440	-0.191	0.035	0.275	0.330	-0.086
S_3V_9	-0.517	-0.205	0.017	0.331	0.294	-0.031

Table 'r' value = 0.708 at 1% level of significance.
Table 'r' value = 0.576 at 5% level of significance (N = 12 i.e. N-2 d.f.).
*Significant at 5% level of significance.
**Significant at 1% level of significance.

Kharif 2019-2020

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

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

Treatments	Weather Parameter					
	TMax	TMin	RH-I	RH-II	Rain	BSS
Main Plot: Sowing Time						
S_1	-0.370	-0.114	0.335	0.207	0.147	-0.266
S_2	-0.302	-0.210	0.321	0.107	0.006	-0.147
S_3	-0.334	-0.123	0.372	0.124	-0.010	-0.189
Sub Plot: Varieties						
V_1	-0.307	-0.092	0.335	0.114	0.002	-0.191
V_2	-0.299	-0.182	0.289	0.082	-0.022	-0.158
V_3	-0.327	-0.139	0.303	0.132	0.020	-0.206
V_4	-0.338	-0.107	0.320	0.138	0.005	-0.220
V_5	-0.445	-0.114	0.437	0.249	0.122	-0.306
V_6	-0.388	-0.249	0.362	0.176	0.144	-0.225
V_7	-0.421	-0.212	0.417	0.206	0.112	-0.247
V_8	-0.368	-0.251	0.380	0.161	0.122	-0.197
V_9	-0.429	-0.231	0.439	0.204	0.150	-0.251
Interaction-Main plot x Sub plot						
S_1V_1	-0.446	-0.113	0.395	0.252	0.206	-0.315
S_1V_2	-0.406	-0.181	0.390	0.218	0.213	-0.274
S_1V_3	-0.336	-0.115	0.255	0.167	0.113	-0.246
S_1V_4	-0.244	-0.106	0.135	0.104	0.029	-0.195
S_1V_5	-0.422	-0.095	0.315	0.281	0.233	-0.352
S_1V_6	-0.366	-0.239	0.268	0.207	0.209	-0.258
S_1V_7	-0.465	-0.035	0.350	0.332	0.294	-0.403
S_1V_8	-0.448	-0.068	0.365	0.306	0.319	-0.369
S_1V_9	-0.345	-0.202	0.252	0.201	0.175	-0.259

S_2V_1	-0.113	-0.111	0.168	-0.038	-0.141	-0.034
S_2V_2	-0.155	-0.304	0.122	-0.047	-0.128	-0.010
S_2V_3	-0.172	-0.199	0.157	0.016	-0.113	-0.068
S_2V_4	-0.329	-0.097	0.343	0.149	0.005	-0.199
S_2V_5	-0.386	-0.107	0.428	0.216	0.055	-0.241
S_2V_6	-0.395	-0.168	0.334	0.189	0.153	-0.254
S_2V_7	-0.270	-0.411	0.336	0.068	0.026	-0.037
S_2V_8	-0.370	-0.181	0.360	0.186	0.069	-0.230
S_2V_9	-0.403	-0.217	0.472	0.164	0.175	-0.196
S_3V_1	-0.345	-0.051	0.381	0.144	-0.003	-0.225
S_3V_2	-0.290	-0.055	0.305	0.084	-0.088	-0.174
S_3V_3	-0.325	-0.098	0.342	0.088	-0.018	-0.186
S_3V_4	-0.281	-0.070	0.322	0.070	-0.084	-0.157
S_3V_5	-0.394	-0.089	0.422	0.189	0.049	-0.251
S_3V_6	-0.282	-0.204	0.351	0.098	-0.014	-0.124
S_3V_7	-0.401	-0.067	0.412	0.196	0.029	-0.268
S_3V_8	-0.257	-0.333	0.331	0.041	0.016	-0.053
$_3V_9$	-0.351	-0.160	0.404	0.153	0.018	-0.192

Table 'r' value = 0.708 at 1% level of significance.
Table 'r' value = 0.576 at 5% level of significance (N = 12 i.e. N-2 d.f.).
* Significant at 5% level of significance.
**Significant at 1% level of significance.

Pooled data
The data on correlation between blue beetle infesting rice at different sowing time and different meteorological parameters during 2018-2019 and 2019-2020 are presented in Table 3 revealed that, morning relative humidity in S_1 (r=0.625) was found to be positively significant. While, maximum temperature in S_1 (r=-0.659) was found to be negatively significant. Remaining all of the weather parameters were found to be non-significant.

During 2018-2019 and 2019-2020 the data on correlation between blue beetle infesting rice at different varieties and different meteorological parameters revealed that, maximum temperature in V_5 (r=-0.628), V_6 (r=-0.595), V_8 (r=-0.585) and V_9 (r=-0.612) was found to be negatively significant. Remaining all of the weather parameters were found to be non-significant.

The results of data during 2018-2019 and 2019-2020 revealed that morning relative humidity in S_1V_1 (r=0.702), S_1V_2 (r=0.661), S_1V_3 (r=0.739), S_1V_4 (r=0.684), S_1V_5 (r=0.746), S_1V_6 (r=0.762), S_1V_7 (r=0.705), evening relative humidity in S_1V_1 (r=0.597), S_1V_3 (r=0.638), S_1V_4 (r=0.572), S_1V_5 (r=0.612), S_1V_6 (r=0.638), S_1V_7 (r=0.605) was found to be positively significant. While, maximum temperature in S_1V_1 (r=-0.704), S_1V_2 (r=-0.622), S_1V_3 (r=-0.711), S_1V_4 (r=-0.650), S_1V_5 (r=-0.684), S_1V_6 (r=-0.708), S_1V_7 (r=-0.677), S_1V_8 (r=-0.579), S_2V_5 (r=-0.618), S_2V_6 (r=-0.616), S_2V_8 (r=-0.582) and bright sunshine hours S_1V_1 (r=-0.585), S_1V_2 (r=-0.591), S_1V_3 (r=-0.670), S_1V_4 (r=-0.601), S_1V_5 (r=-0.666), S_1V_6 (r=-0.687), S_1V_7 (r=-0.638) was found to be negatively significant. Remaining all of the weather parameters were found to be non-significant.

The results of the present findings are in accordance with the results of earlier workers. Kharat [6] revealed that the blue beetle incidence and morning relative humidity and average humidity exhibited positive non- significant correlation. Patel [2] indicated that evening relative humidity (r=0.546) and average relative humidity (r=0.539) had significant positive correlation with the adult population of blue beetle, while maximum temperature (r=-0.566) had significant negative correlation with the adult population of blue beetle. Minimum temperature (r=0.455), morning relative humidity (r=0.464), wind velocity (r=0.323), rainfall (r=0.220) and rainy days (r=0.398) had non-significant positive correlation, while average temperature (r=-0.195), sunshine hours (r=-0.447) and evaporation (r=-0.075) had non-significant negative correlation with the adult population of blue beetle. Karthikeyan and Jacob [3] revealed a negative correlation with maximum temperature and sunshine whereas a positive correlation was observed with minimum temperature and relative humidity with population. Rainfall showed no significant effect. Japur *et al*. [2] revealed that the pest population and per cent leaf damage during 1st and 2nd week of July exhibited a positive correlation with morning and evening RH and rainfall (0.063, 0.603, 0.465 and 0.041, 0.591 and 0.473, respectively) while the correlation was negative with maximum and minimum temperature, whereas during 3rd and 4th week of July and during 1st, 2nd, 3rd and 4th week of August there was a positive correlation with morning and evening relative humidity while the correlation was negative with minimum temperature.

Table 3: Pooled correlation between sowing time, varieties and interaction (sowing time and varieties) and weather parameters on per cent blue beetle 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	**-0.659***	0.154	**0.625***	0.505	0.342	-0.544
S_2	-0.558	-0.121	0.330	0.349	0.147	-0.284
S_3	-0.436	-0.302	0.077	0.194	0.041	-0.095
Sub Plot: Varieties						
V_1	-0.525	-0.114	0.295	0.306	0.115	-0.266
V_2	-0.529	-0.131	0.321	0.303	0.120	-0.271
V_3	-0.574	-0.065	0.390	0.364	0.159	-0.337

V₄	-0.533	-0.097	0.321	0.315	0.112	-0.283
V₅	-0.628*	-0.065	0.369	0.417	0.230	-0.367
V₆	-0.595*	-0.075	0.456	0.393	0.267	-0.374
V₇	-0.562	-0.155	0.302	0.346	0.229	-0.294
V₈	-0.585	-0.073	0.395	0.392	0.259	-0.355
V₉	-0.612	-0.113	0.367	0.399	0.261	-0.348
Interaction-Main plot x Sub plot						
S₁V₁	-0.704*	0.228	0.702*	0.597*	0.391	-0.585*
S₁V₂	-0.622*	0.306	0.661*	0.523	0.327	-0.591*
S₁V₃	-0.711**	0.384	0.739**	0.638*	0.411	-0.670*
S₁V₄	-0.650*	0.324	0.684*	0.572*	0.360	-0.601*
S₁V₅	-0.684*	0.371	0.746**	0.612*	0.425	-0.666*
S₁V₆	-0.708**	0.347	0.762**	0.638*	0.489	-0.687*
S₁V₇	-0.677*	0.394	0.705*	0.605*	0.349	-0.638*
S₁V₈	-0.579*	-0.174	0.395	0.375	0.220	-0.297
S₁V₉	-0.565	0.010	0.431	0.402	0.220	-0.371
S₂V₁	-0.466	-0.027	0.340	0.273	0.009	-0.255
S₂V₂	-0.449	-0.107	0.384	0.247	0.021	-0.236
S₂V₃	-0.517	-0.062	0.418	0.331	0.042	-0.278
S₂V₄	-0.525	-0.143	0.248	0.318	0.129	-0.239
S₂V₅	-0.618*	-0.097	0.276	0.424	0.188	-0.306
S₂V₆	-0.616*	0.048	0.527	0.436	0.302	-0.456
S₂V₇	-0.341	-0.399	0.043	0.132	0.104	-0.026
S₂V₈	-0.582*	-0.063	0.344	0.384	0.190	-0.339
S₂V₉	-0.524	-0.202	0.155	0.329	0.312	-0.248
S₃V₁	-0.436	-0.288	0.058	0.195	0.050	-0.103
S₃V₂	-0.413	-0.257	0.067	0.174	-0.016	-0.090
S₃V₃	-0.298	-0.377	-0.068	0.035	-0.031	0.004
S₃V₄	-0.371	-0.332	-0.009	0.122	-0.039	-0.026
S₃V₅	-0.451	-0.284	0.101	0.211	0.078	-0.125
S₃V₆	-0.406	-0.371	0.047	0.175	0.020	-0.030
S₃V₇	-0.494	-0.247	0.121	0.258	0.092	-0.158
S₃V₈	-0.429	-0.328	0.170	0.207	0.091	-0.102
S₃V₉	-0.503	-0.258	0.146	0.273	0.086	-0.150

Table 'r' value = 0.708 at 1% level of significance.
Table 'r' value = 0.576 at 5% level of significance (N = 12 i.e. N-2 d. f.).
* Significant at 5% level of significance.
**Significant at 1% level of significance.

Acknowledgment

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