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Alka Kumari
M.Sc. Scholar, Department of Agril. Entomology, Birsa Agricultural University, Kanke Ranchi, Jharkhand, India

Rabindra Prasad
Senior Scientist Cum Associate Professor, Department of Agril. Entomology, Birsa Agricultural University, Kanke Ranchi, Jharkhand, India

Devendra Prasad
University Professor and Chairman, Department of Agril. Entomology, Birsa Agricultural University, Kanke Ranchi, Jharkhand, India

Correspondence
Alka Kumari
M.Sc. Scholar, Department of Agril. Entomology, Birsa Agricultural University, Kanke Ranchi, Jharkhand, India

Effect of weather parameters on incidence and abundance of gall midge (*O. oryzae*) in rice (var TN-I) grown in Ranchi, Jharkhand

Alka Kumari, Rabindra Prasad and Devendra Prasad

Abstract
A field trial was conducted at Rice Research Farm of Birsa Agricultural University, RAC (Ranchi Agriculture College) Kanke, Ranchi during *Kharif* season of 2017 on rice variety TN-1 to monitor the incidence and abundance of rice gall midge in terms of percentage of silver shoot (SS%) caused by gall midge. silver shoot percent count was made at weekly interval starting from 14th days after sowing. The result revealed that the peak incidence attained its peak (39% SS) with hill (plant) infestation in 39th SMW (i.e. 24th Sep to 30th Sep). Silver shoot percent had significantly positive correlation with temperature (both minimum and maximum) while significantly negative correlation with sunshine hrs but RH (%), wind speed, rainfall, and no. of rainy days had non-significant correlation. The climate factors together able to explain the variation in SS% to the extent of 66.56% and coefficient of determination (R^2) found to be significant i.e. 0.6656.

Keywords: Rice, *Orseolia oryzae*, gall midge, weather

1. Introduction
Rice (*Oryza sativa* L.) is one of the important cereal crop of the world and forms the staple food for more than 65% of staple of the world's population and known as king of cereals, nearly 90 percent of area, production and consumption of rice are confined to South East Asian countries [5]. It holds the key to our country's ability to produce enough food for our people. It is primarily a high energy or high calorific food. Out of one dozen insect pests species prevailing in rice agro- ecosystem in the state of Jharkhand, half of a dozen of them are considered as major insect pests which are responsible for causing loss in yield ranging from 20-35 percent in general (Prasad and Prasad, 2006) [8]. Among these major insect pest species, gall midge (*Orseolia oryzae* Wood Mason*)* is one of the most important pest which is capable of causing considerable loss in Jharkhand in general and gall midge endemic areas of the state in particular. The pest could be able to cause loss in yield ranging from 10-25% (Prasad and Prasad, 2006) [8] in the state of Jharkhand under the favourable agro -climatic conditions. The incidence and abundance of rice gall midge depends on both abiotic and biotic factors. Abiotic factors are weather parameters likes temperature (both maximum and minimum), RH (%), Wind speed, rainfall, no of rainy days and sunshine hrs etc. and biotic factors includes predators, parasite and parasitoids. In wet season, *O. oryzae* activity increased (91.3% infestation) in mid- September and high relative humidity played a crucial role in triggering and regulating *O. oryzae* density (Patnaik) [7]. It was also obtained that optimum conditions for this pest were found to be maximum temperatures in the range of 30.1-32.1 ^{0}C, minimum temperatures in the range of 20.8-24 ^{0}C and 90% RH [3]. Major active period of rice gall midge in the field was 36th to 43rd week (Standard meteorological week) [10]. The experiment was conducted to study the incidence and abundance of rice gall midge in terms of percentage of silver shoot (SS%) caused by gall midge in relation to abiotic factors.

2. Material and Method
The experiment was conducted at research farm of Birsa Agricultural University, RAC (Ranchi Agriculture College) Kanke, Ranchi during *Kharif* season of 2017 with rice variety TN-1 (common variety grown by farmers of Jharkhand) transplanted from nursery to main field and the crop was grown without application of insecticide either in soil or as seed treatment. This was done to allow the natural population of gall midge on crop.

The sowing was done on 14th June, transplanting on 2nd August and harvesting on 27th December, 2017. Meteorological data on temperature, rainfall, no of rainy days, relative humidity, wind speed and sun shine hours were obtained weekly from the meteorological observatory maintained in the Department of Agricultural Physics and Climatology, Birsa Agricultural University, Ranchi. Observations were taken periodically at weekly intervals starting from 14th days after sowing. Twenty rice plants (hills) were randomly selected for the observation to be recorded for the presence of silver shoot (SS) by counting total number of tillers (TT) and no. of SS.

- Percentage of silver shoot (SS) was calculated by employing the following formula:

$$SS\ (\%) = \frac{\text{Total no. of Silver Shoot (SS) in 20 hills}}{\text{Total no. of tillers (SS + healthy tillers) in 20 hills}} \text{ X } 100$$

2.1 Statistical Analysis

2.2 Co-relation & Regression studies

Weekly data on percentage S.S. variety-wise were co-related with weekly meteorological parameters *viz*. temperature (max & min), relative humidity, rainfall, no. of rainy days, sunshine hours etc. The regression co-efficients (b' s) were also worked out for drawing the conclusion.

3. Result and discussion

The data presented in Table-1 revealed that the incidence of silver shoot percent (SS%) caused by gall midge started from 33 SMW (standard meteorological week) i.e. 13th Aug-19th Aug,2017 with very low level of incidence in terms of percentage of silver shoot, SS (17%). The pest incidence attained its peak (39%SS) with hill (plant) infestation in 39 SMW (i.e.24th Sep-30th Sep) with advancement of vegetative growth and age of plants almost upto the points of time of maximum tillering stage and before initiation of panicle emergence in crop plants and then the pest incidence began to decline from 22% SS in 40th SMW (i.e.1st Oct- 07 Oct) to the minimum level of 2% SS in 43th.

Table 1: Dynamics of gall midge, *Orseolia oryzae* on rice (var-TN1) in terms of SS (%) during crop season in relation to abiotic factors

SMW	Period 2017	Temperature		R.H. (%)	Wind speed (km/hr)	Rainfall (mm)	No of rainy days	SS%
		Max	Min					TN-I
30	23rd Jul-29th Jul	25.90	18.00	78.10	3.94	524.60	5.00	0
31	30th Jul-5th Aug	31.20	18.30	78.10	1.99	57.70	3.00	0
32	6th Aug- 12th Aug	31.10	20.40	79.00	3.56	94.30	4.00	0
33	13th Aug- 19th Aug	29.50	20.70	78.35	3.47	10.50	1.00	17
34	20th Aug- 26th Aug	31.50	21.60	78.00	3.79	67.30	2.00	22
35	27th Aug-2nd Sep	30.10	21.00	79.40	3.16	103.80	3.00	30
36	3rd Sep- 9th Sep	30.50	21.20	76.50	2.69	0.00	0.00	34
37	10th Sep-16th Sep	30.80	22.60	75.70	2.04	2.00	0.00	35
38	17th sep-23rd Sep	30.30	21.20	76.40	1.93	14.20	1.00	37
39	24th Sep- 30th Sep	30.60	22.60	76.35	2.01	43.80	3.00	39
40	1st Oct-07th Oct	29.90	21.50	77.75	1.56	53.00	5.00	22
41	8th Oct-14th Oct	29.50	21.60	77.00	2.30	2.00	0.00	12
42	15th Oct- 21st Oct	28.50	16.70	78.00	1.49	27.60	3.00	7
43	22nd Oct- 28th Oct	29.60	15.30	76.80	1.60	0.00	0.00	2
44	29th Oct- 4th Nov	27.10	13.10	74.80	2.09	0.00	0.00	0
45	5th Nov- 11th Nov	26.40	11.50	75.80	1.54	0.00	0.00	0
46	12th Nov- 18th Nov	24.90	12.80	76.15	1.71	2.00	0.00	0
47	19th Nov- 25th Nov	25.00	9.20	77.45	2.63	0.00	0.00	0
48	26th Nov - 2nd Dec	24.20	5.40	76.65	2.91	0.00	0.00	0

SMW (i.e.22nd Oct- 28th Oct) in the present experimentation. The impact of weather factors in regulation of activities in incidence of gall midge in terms of incidence of silver shoot (SS%) was also studied through correlation and regression analysis.

These finding of the present studies were found in corroboration with the reports of Shrivastava *et al.* (1987) [10] showed that major active period of rice gall midge in the field was 36th to 43rd week (Standard meteorological week). Sain *et al.* (1992) [9] also reported that the pest appeared in late August, its incidence reached a peak in October and declined by December. Hegdekatti (1927) [2] reported that incidence of gall midge in the rice seed bed is seen in July, whereas in the field the pest appears in August. He also stated that when rainfall was more than 6" even in May the infestation was more serious, if the rice crop is available in the field in any case. Yen *et al.* (1941) [12] found that adults were first observed in flight in late March and were most numerous in early August. Vajssiere and Galland (1951) [11] revealed that *Pachydioplosis oryzae* infests rice plants during June-September. In India, Khan and Murthy (1955) [4] and Patel *et al*. (1957) reported that *Orseolia oryzae* usually appeared on the monsoon crop in the first or second week of July. They noted two peaks of appearance of galls one in mid- August and the other some 14-20 days later. Injury caused by the past is occurring mainly in the monsoon season with maximum incidence between the 3rd week in August and the 2nd week in September. Descamps (1956) [1] observed that infestation begins towards the end of July and increases until October, when rice fields begins to dry up. Murthy (1957) [6] reported that infestation increases with lateness of sowing and transplanting of rice.

The correlation analysis between weather parameters and silver shoot percent has been represented in Table-2. The data revealed that silver shoot percent (SS%) had significantly positive correlation with temperature (both maximum (r =0.618**) and minimum (r= 0.716**)) at 1% level of significant. A significantly negative relationship at 1% level was between SS (%) and sunshine hrs (-0.629 **). Other correlation coefficients between SS (%) and RH%, wind

speed, rainfall, no. of rainy days were found to be non - significant at 5% level of significance. The co-efficient of determination (R^2) for SS (%) was found to be significant. It showed that the climatic factors together were able to explain the variation in SS(%) during peak active period of gall midge to the extent of 66.56%.

Table 2: Simple correlation coefficients and regression equation between weather parameters(X) and mean SS% (Y) caused by *Orseolia oryzae* in rice (var-TN1)

Weather parameters	Correlation coefficient (r)	Regression coefficient (b)
X_1 -Maximum Temperature (ºC)	0.618^{**}	-2.002
X_2- Minimum Temperature (ºC)	0.716^{**}	2.439
X_3- Relative Humidity (%)	-0.045^{NS}	-3.801
X_4- Wind Speed (km h^{-1})	-0.011^{NS}	2.697
X_5 – Rainfall	-0.157^{NS}	-0.056
X_6 – No. of Rainy days	0.060^{NS}	0.725
X_7 -- Sunshine Hour (hrs)	-0.629^{**}	-0.171

SC -Susceptible rice variety
RC -Resistant rice variety
** Significant at P 1%
* Significant at P 5%
Multiple regression equation:
$Y = 320.214+2.002\ (X_1) +2.439\ (X_2) -3.801\ (X_3) + 2.697\ (X_4)-0.056\ (X_5) +0.725\ (X_6)-0.171X_7$
Coefficient of determination (R^2) = 0.6656
Multiple R-value: 0.8158

These finding of the present studies were found in corroboration with the reports of Patnaik *et al*. (1985) [7] who obtained that in wet season, *O. oryzae* activity increased (91.3% infestation) in mid- September and high relative humidity played a crucial role in triggering and regulating the activity of the insect (*O. oryzae)*. Kalidas *et al*. (1986) [3] obtained that optimum conditions for this pest were found to be maximum temperatures in the range of 30.1-32.1 ^{0}C, minimum temperatures in the range of 20.8-24 ^{0}C and 90% RH.

4. Conclusion

The most active period of gall midge was found in 39th SMW i.e. 24th September to 30th September 2017 in TN-1. Silver shoot percent had significantly positive correlation with temperature (both minimum and maximum) while significantly negative correlation with sunshine hrs but RH (%), wind speed, rainfall, and no. of rainy days had non-significant correlation. The climatic factors together were able to explain the variation in SS (%) during experimental period of gall midge to the extent of 66.56%.

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