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IMPACT OF WEATHER PARAMETERSON YELLOW STEM BORER

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ABSTRACT: A study on the influence of different weather parameters on fluctuations of Yellow stem borer was carried in Purulia, West Bengal. Yellow stem borer showed that rainfall has significant positive impact, change in rainfall has significant negative impact, temperature difference has significant negative impact, rate of change of temperature difference has significant positive impact, limited difference of relative humidity has significant positive impact, wind speed has significant negative impact at 5% level of significance and duration of sunshine has significant negative impact at 10% level of significance.

KEYWORDS: Yellow stem borer, weather parameter, fluctuations, impact**.**

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1. INTRODUCTION

Rice is the world's most important food crop and is the staple food for 50% of the global population [1,2,3] .The paddy plant is attacked by more than 100 species of insects; some of them can cause significant yield loss in one part of the country to another. Yellow stem borer has emerged as one of the most important pests of rice during post green revolution years throughout the country [4, 5, 6, 7, 8]. The extent of rice yield losses due to Yellow stem borer has been estimated as 20-70% [9, 10, 11]. Both biotic and abiotic factors are believed to be responsible for pest population dynamics [12, 13, 14, 15]. Climatic factors such as temperature, rainfall, and relative humidity greatly influence the outbreak of insect population [16, 17, 18, 19, 20]. Population dynamics of Yellow stem borer like any other species are thus liable to

fluctuate according to the dynamic condition of its environment [21, 22, 23]. 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. There have been many attempts to develop weather based forewarning models for rice stem borer [24, 25, 26, 27, 28]. The attraction of Yellow stem borer by light traps at Cuttack, India has shown positive correlation with maximum temperature, relative humidity, rainfall and wind speed, while showing negative correlation to minimum temperature and daily sunshine hours [29, 30, 31]. However, another study conducted at Jagdalpur, India showed that the attraction of moths by light traps was negatively correlated with minimum temperature, evening relative humidity and rainfall [32]. Maximum temperature and evening relative humidity were negatively correlated, whereas minimum temperature and morning relative humidity were positively correlated with the light trap catches of Yellow stem borer at Raichur, India [33, 34]. Above studies show that the relation between the weather parameters and the fluctuations of Yellow stem borer exhibit site specific variability throughout the India. Hence, the relationship of meteorological parameters and severity of Yellow stem borer damage need to be studied separately for various regions. Keeping this in mind, the present investigation was carried out to study the pest-weather relations at Purulia, West Bengal, India.

2. MATERIALS AND METHODS

2.1. Study area

Gengara village, Purulia Block –II, West Bengal.

2.2. Data collection

Data were collected on Yellow stem borer damage in the paddy field during June 2013 to Oct 2013 and June 2014 to Oct 2014 by visual counting of dead hearts (DHs) and white ear heads (WEHs).The meteorological data was collected from Zonal Drought Resistant Paddy Research Station, Hathwara, Purulia, and West Bengal.

2.3. Data analysis

The pooled regression analysis was adopted to study the impact using appropriate Econometric Methodology by Panel Least Square Technique. Microsoft Excel was also used along with Econometric Views Software to run the regression.

To study the impact of weather parameters on Yellow stem borer damage the author applied the following regression model:

$$\text{Plant-A} = \beta_0 + \beta_1 RF + \beta_2 RF\text{^}2 + \beta_3 T\_DIFF + \beta_4 T\_DIFF\text{^}2 + \beta_5 RH\_LDIFF + \beta_6 WS + \beta_7 DUSUN + U$$

Where,

Plant-A: Plant affected

RF: Rainfall

RF^2: Rate of change of rainfall

T_DIFF: Temperature difference

T_DIFF^2: Rate of change of temperature difference

RH_LDIFF: Limited difference of relative humidity

WS: Wind speed

DUSUN: Duration of sunshine

U: Error term

3. RESULTS AND DISCUSSION

3.1. Descriptive Statistics

In this study the descriptive statistics of used variables have been presented inTable-1

Table 1: Descriptive statistics of the sample studied

	PLANT_A	RF	T_MAX	T_MIN	T_DIFF	RH_MAX	RH_MIN	RH_DIFF	RH_LDIFF	WS	DUSUN
Mean	1.52	6.51	30.94	24.61	6.45	81.58	58.19	23.42	0.55	3.24	5.05
Median	0.23	5.88	31.71	24.58	6.65	84.57	62.5	19.01	1	3.35	5
Maximum	6.16	13.2	36.1	33.1	9.23	98	78	52.16	1	4.5	8
Minimum	0	0.6	24	17	1.99	52	30.7	10	0	1.15	3.42
Std. Dev.	1.94	3.07	2.75	3.53	1.79	10.89	14.81	13.21	0.50	0.81	1.16
Skewness	0.85	0.37	-0.81	0.41	-0.59	-1.43	-0.62	0.98	-0.18	-0.60	0.58
Kurtosis	2.27	2.84	3.54	3.73	2.84	4.74	2.003	2.62	1.03	2.69	2.73
Jarque-Bera	6.31	1.06	5.38	2.18	2.64	20.64	4.68	7.29	7.33	2.83	2.64
Probability	0.04	0.59	0.07	0.33	0.27	0.00	0.10	0.026	0.02	0.24	0.27
Sum	66.88	286.33	1361.63	1082.99	283.64	3589.86	2560.4	1030.46	24	142.61	222.21
Sum Sq. Dev.	161.47	404.71	324.44	535.61	137.21	5107.69	9433.92	7502.59	10.90	28.59	57.74
Observations	44	44	44	44	44	44	44	44	44	44	44

Average values, Standard Deviation, maximum and minimum values provide important insights discussed below:

Plant Affected

Average plant affected (Picture-1) per week during study period was 1·52%.Maximum affected plant was 6·16%.Minimum affected plant was 0% and the standard deviation 1·9.

Picture 1: Photograph showing affected paddy field

Rain fall

Average rainfall per week during study period was 6·5mm.Maximum rainfall was 13·2mm.Minimum rainfall was 0·6mm and the variability of rainfall was quite high indicating a standard deviation 3·06.Total number of observation was 44.

Maximum Temperature

Average maximum temperature per week was $30·9^0$C.Maximum of the maximum temperature was $36·1^0$C.Minimum of the maximum temperature was 24^0C and the difference of maximum temperature was moderately high indicating a standard deviation 2·74.

Minimum Temperature

Average minimum temperature per week was $24·6^0$C. Maximum of the minimum temperature $33·1^0$C. Minimum of the minimum temperature 17^0C and the difference of the minimum temperature were quite high indicating a standard deviation 3·5.

Temperature Difference

Average temperature difference per week during study period was $6·44^0$C. Maximum temperature difference was $9·23^0$C. Minimum temperature difference was $1·99^0$C and the variability of temperature difference was moderate indicating a standard deviation 1·78.

Maximum Relative Humidity

Average maximum relative humidity per week during study period was 81·5.Maximum of the maximum relative humidity was 98. Minimum of the maximum relative humidity was 52 and the difference of maximum relative humidity was very high indicating a standard deviation 10·8.

Minimum Relative Humidity

Average minimum relative humidity per week during study period was 58·1.Maximum of minimum relative humidity was 78.Minimum of the minimum relative humidity 30·7 and the difference of minimum relative humidity was very high indicating a standard deviation 14·8.

Difference of Relative Humidity

Average difference of relative humidity per week during study period was 23·4.Maximum difference of relative humidity was 52·16.Minimum difference of relative humidity was 10 and the variability of difference of relative humidity was quite high indicating a standard deviation 13·2.

Limited Difference of Relative Humidity

It has been found in 24 cases out of 44 making it 54% incidence.

Wind Speed

Average wind speed per week during study period was 3·24 Km/Hr. Maximum wind speed was 4·5 Km/Hr. Minimum wind speed was 1·15 and the variability of wind speed was low indicating a standard deviation 0·8.

Duration of Sunshine

Average duration of sunshine per week during study period was 5 hours. Maximum duration of sunshine was 8 hours. Minimum duration of sunshine was 3·4 hours and the difference duration of sunshine was moderate indicating a standard deviation 1·15.

Impact of percentage of plant affected in 2013 and 2014 is started around the month of August and continued up to the month of October. In 2013, the pest attack was maximum around the month of September where as in 2014 it started earlier from mid August. The variability was higher in 2013. But in 2014 the field experienced a steady attack from August onwards.

3.2. Empirical Estimates and Discussion

Dependent Variable: PLANT_A

Method: Panel Least Squares

Sample (adjusted): 6/01/2013 to 10/26/2013, 6/01/2014 to 10/26/2014

Periods included: 22

Cross-sections included: 2

Total panel (balanced) observations: 44

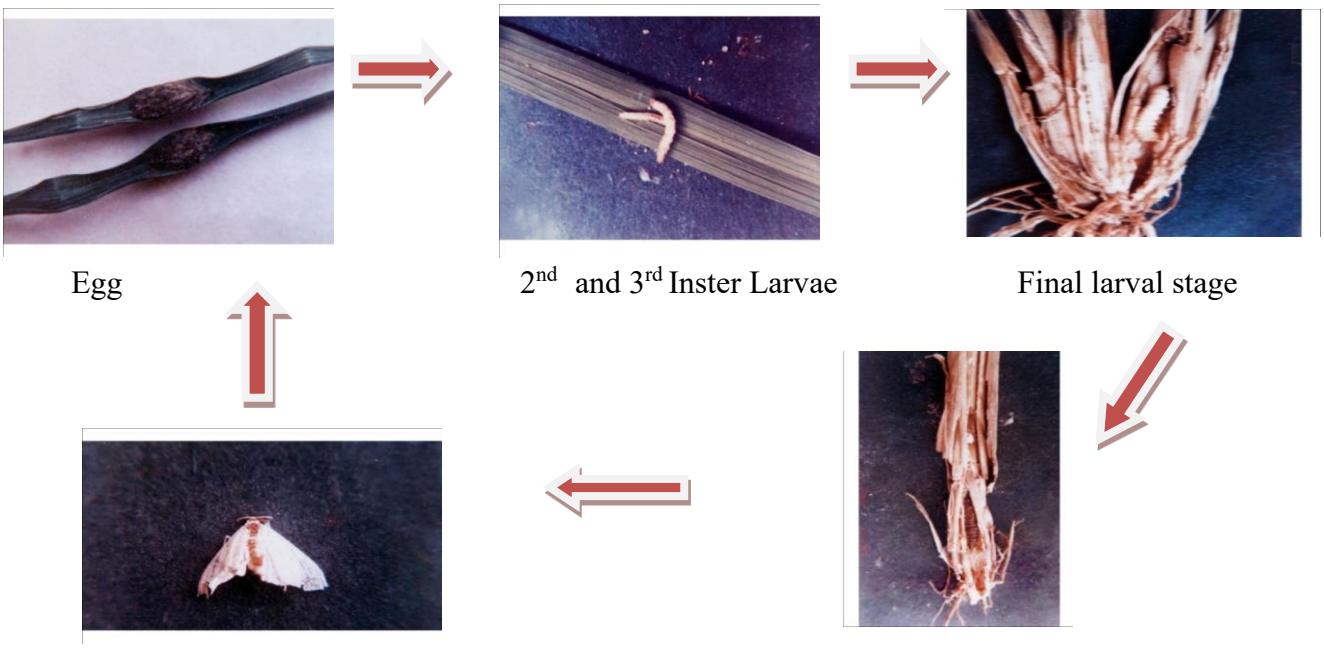
Table 2: Empirical estimates of the regression model used for the study

Variable	Coefficient	Std.Error	t-Statistic	Prob.
RF	0.95666	0.315688	3.030391	0.0045
RF^2	-0.07454	0.02042	-3.650014	0.0008
T_DIFF	-1.05155	0.50636	-2.076689	0.045
T_DIFF^2	0.1039	0.043997	2.361427	0.0237
RH_LDIFF	1.51736	0.541564	2.801804	0.0081
WS	-1.27879	0.415817	-3.075375	0.004
DUSUN	-0.24583	0.140154	-1.754015	0.0879
C	5.83239	2.096682	2.781724	0.0086
R-squared	0.79992	Mean dependent var		1.52
Adjusted R-squared	0.76101	S.D. dependent var		1.937846
S.E. of regression	0.94734	Akaike info criterion		2.892647
Sum squared resid	32.3083	Schwarz criterion		3.217045
Log likelihood	-55.6382	Hannan-Quinn criter.		3.012949
F-statistic	20.561	Durbin-Watson stat		1.396508
Prob(F-statistic)	0			

In the considered model seven regressors are used to study the impact of weather parameters on the incidence of yellow stem borer. Rainfall has positive impact with significant result at 5% level. This implies as rainfall increases % of plant affected by the Yellow stem borer significantly increases if other variables remain constant. Study shows that change of temperature difference and limited difference of relative humidity also have significant positive impact at 5% level. But change in rainfall has significant negative impact at 5% level. This implies that as rate of change of rainfall changes % of plant affected by the Yellow stem borer

significantly decreases. Temperature difference, wind speed and duration of sunshine also have a significant negative impact at 5% and 10% level respectively. A strong wind may have a detrimental effect on Yellow stem borer population because it may physically destruct various developmental stages of the pest. Regarding duration of sunshine, present observation is more or less similar with earlier studies by Sankpal [35].

Picture 2: Dead *Scirpophaga* Population



Picture 3: Different stages of life cycle of *Scirpophaga* sp

4. CONCLUSION

The investigation revealed that rainfall, rate of change of rainfall, temperature difference, rate of change of temperature difference, limited difference of relative humidity, wind speed, duration of sunshine have a remarkable influence on the fluctuations of Yellow stem borer .If the average amount of rainfall is higher but variability of rainfall is lower than the probability of Yellow stem borer damage will be greater. The probability of infestation of rice Yellow stem borer will also be greater if the difference of relative humidity is 10-20% and if the variability

of temperature difference is high. So, in such circumstances cultivators should have take appropriate management strategies against rice Yellow stem borer damage in Purulia. Study on the influence of different weather parameters on the succession of rice Yellow stem borer may predict likely occurrence of the pest in Purulia; therefore developing a plan of timely action for achieving success against Yellow stem borer attack in the region.

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CONFLICT OF INTEREST

There are no conflicts of interest to disclose.

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