



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(7): 3227-3231
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www.thepharmajournal.com
Received: 20-04-2022
Accepted: 08-06-2022

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A study on seasonal incidence of rice stem borer and rice leaf folder in relation to weather factors in basmati rice

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Abstract

The experiment was carried out in randomized block design with three replications during *Kharif*, 2019 at Crop Research Centre of Sardar Vallabh Bhai Patel University of Agri. & Tech., Meerut. The first incidence of rice stem borer was recorded on fourth week of June and reached its peak (9.11 per cent dead hearts) during fourth week of August when average temperature and relative humidity were 32°C and 65.6 per cent, respectively. The first incidence of rice leaf folder was recorded on first week of July and reached a maximum level at the third week of September when mean temperature and relative humidity were 28.4°C and 87 per cent, respectively. There was positive correlation of dead hearts with evening RH, morning RH, minimum and maximum temperature. The correlation relationship of relative humidity, minimum temperature and maximum temperature is negative with per cent white ears. The correlation of rice leaf folder was positive with minimum temperature, RH and rainfall and negative with maximum temperature.

Keywords: Rice stem borer, rice leaf folder, dead hearts, white eardead, basmati rice

Introduction

Rice (*Oryza sativa* L.) is the second most important cereal crop after wheat which feeds about 45% of the world population and provides 15% of the global calories intake (Anonymous, 2018) [1]. India is the largest rice growing country, while China is the largest producing rice country in the world. Year 2004 was declared as "International Year of Rice". Almost 85% of the rice is grown and consumed in Asia (Kakde and Patel, 2015) [8]. Rice is a healthy cereal as it does not contain fat and cholesterol. Rice is an excellent food to include in a balanced diet. It is a good source of carbohydrates, protein, vitamins and minerals such as thiamine, niacin, iron, riboflavin, calcium and fiber. It has low sugar. Rice is gluten free, making rice the essential choice for people with gluten free dietary requirements and diabetic patients (Laskowski *et al.*, 2019) [9]. In India the total area under rice is 43.86 million ha, production is about 115.60 million tonnes and productivity is 2390 kg/ha. Rice cultivated in India is about 21.81% of total rice produced in the world. Uttar Pradesh is the second largest producer of rice after West Bengal occupying 5.87 million ha area under rice with annual production of 12.17 million tonnes and average productivity of 2072 kg/ha. (Anonymous, 2018) [1]. In India, basmati rice is mainly known for its aroma, fragrance, taste and super fine grains and grown mainly in the western part of Uttar Pradesh, Uttarakhand, Punjab and Haryana which accounts for 90% of the total basmati production. Basmati rice cultivation is gaining popularity in western Uttar Pradesh due to higher returns and best climatic condition which is favorable for export quality production. Realizing the importance of crop and availability of irrigation water, the Government of India has identified western Uttar Pradesh as one of the potential basmati rice export zones (Siddiq *et al.*, 2012) [11]. There are some abiotic and biotic factors which cause low production and productivity of rice. Abiotic stresses include high and low temperatures, salinity, submergence, drought and oxygen stress which significantly contribute in decreasing crop yield. More than 45% crop damage has been reported due to these factors. Under biotic stress the most important and widely distributed insect pest species are stem borers, leaf folders, plant hoppers, and gall midge. Stem borers are found in every field in every season. (Bray *et al.*, 2000) [3]. Both biotic and abiotic factors are believed to be responsible for pest population dynamics. Temperature causes the direct effects like growth, survival, reproduction, development and dispersal (Karuppaiah and Sujayanad, 2012).

Materials and Methods

The experiment was carried out during *Kharif* 2019 at CRC of Sardar Vallabh Bhai Patel University of Agriculture and Technology Modipuram, Meerut, which is located at the distance of about 10Km from Meerut city on Delhi - Dehradun highway. It lies between 77° 15' E and 70° 30' E longitude and 28° 43' N and 29° 17' N latitude at an altitude of 237 meters above the mean sea level. The total geographical area of Meerut district is 2564 Km². The climate of Meerut is semi-arid, sub-tropical characterized by very hot summer and severe cold winters. In summer the temperature often goes upto 45°C in the month of May and June. The winters are severe with a minimum temperature of about 3°C with occasional ground frost. The average annual rainfall is about 800 mm and usually occur from July to September. Few showers of cyclonic rains are also received during December to January or late spring. The meteorological information of Modipuram, Meerut was obtained from meteorological laboratory of Soil Science Department of Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut. The meteorological data pertaining to temperature, relative humidity and rainfall during experimental period.

The experiment was laid out in randomized block design with three replications. There were total eight treatments including control. The plot size for each treatment was kept 4 x 3 m². The provision was made to irrigate small plots separately with the help of irrigation channels provided in the experimental area. The seeds of rice variety Pusa Basmati - 1509 were sown in 5 x 8 m² plot size on 22nd June, 2019. Before sowing seed, treatment was done with *Trichoderma viridae* for the protection against fungal diseases. An intensive survey was conducted to record the seasonal incidence of rice stem borer and rice leaf folder in basmati rice. The random sampling was carried out. Ten hills were tagged randomly from each untreated plot of the trial. These plants were observed regularly at weekly interval. Dead hearts and white ear heads formation due to rice stem borer attack were counted and larval populations of rice leaf folder were counted per hill starting after one week at transplanting till the harvest of the crop at weekly interval. The meteorological data was collected of the crop season from the Indian Institute of Farming System Research (IIFSR) observatory. The data on the pest population was correlated with the prevailing temperature, relative humidity and rainfall.

The influence of key meteorological parameters on the pest incidence was worked out with simple correlation. (Gomez and Gomez, 1984) [6].

Where,

$$r = \frac{S_{xy}}{[(S_x^2) (S_y^2)]^{1/2}}$$

r = Simple correlation coefficient

Sx² = Correlated sum of squares for meteorological parameter

Sy² = Correlation sum of squares of pest incidence

Sxy = Correlation sum of cross products.

Result and Discussion

Rice stem borer

The data presented in Table 4.1 and Fig 4.1 revealed that the infestation of rice stem borer initiated from 25th standard

week with 0.8 per cent dead hearts. The peak infestation of vegetative stage was observed with 9.11 per cent dead hearts at 34th standard week. The peak infestation at ear head stage was occurred during 45th standard week with 8.88 per cent white ear heads. During the peak infestation of dead hearts (25th standard week) the temperature ranged from 26.9°C to 37.1°C, relative humidity ranged 53 per cent in evening to 78 per cent in the morning. The rainfall was recorded 0.0 mm. During the peak infestation of white ears (45th standard week) the temperature ranged from 13.8°C to 29°C, relative humidity ranged 42 per cent in evening to 77 per cent in the morning. The rainfall was recorded 0.0 mm. The correlation results revealed from table 4.2 showed that there is significant positive correlation of dead hearts with morning RH (r = 0.447) and evening RH (r = 0.561) and a positive correlation with maximum temperature (r = 0.064) and significant positive correlation with minimum temperature (r = 0.480). The relationship between the per cent white ears and relative humidity is negative with evening RH (r = -0.230) and morning RH (r = -0.166). There is negative non-significant correlation of white ears with maximum temperature (r = -0.488) minimum temperature (r = -0.498).

Rice leaf folder

The data presented in Table 4.1 and Fig 4.2 revealed that the infestation of rice leaf folder initiated from 26th standard week with 1 larvae per 10 hills. The corresponding maximum and minimum temperatures were 32.3°C and 26.4 °C while the morning and evening RH were 87 and 72 per cent, respectively. The pest population reached maximum i.e., 15 larvae per 10 hills during 37th standard week. The corresponding maximum and minimum temperatures were 31.2°C and 25.6°C, while the morning and evening RH were 92 and 82 per cent, respectively. The correlation analysis (Table- 4.2) revealed that the leaf folder population showed positive correlation with evening RH (r = 0.385), rainfall (r = 0.079), morning RH (r = 0.364) and minimum temperature (r = 0.087). However, a negative correlation of leaf folder with maximum temperature (r = -0.375) was observed. The incidence of rice stem borer initiated during the month of June and the insect pest population reached peak during the first week of September. In case of white ears, the increase was gradual pointing that the insect pest activity persisted till maturity. Insect pest incidence was high during vegetative phase when the atmosphere is full of clouds with slight rains. These results are in accordance with Rana *et al.*, (2017) [10]. The correlation results showed that there is positive correlation of dead hearts with evening RH, morning RH, minimum temperature and maximum temperature. The relationship between the per cent white ears and relative humidity, minimum temperature and maximum temperature is negative. These results were in close accordance with Justin *et al.*, (2013) [7] who reported that the decrease in the mean temperature along with rain was favorable for the insect pest growth. Further, Chavan *et al.*, (2013) [5] also found a negative significant correlation of rice stem borer with relative humidity during the reproductive stage of the crop. The incidence of rice leaf folder was initiated during first week of July and the insect pest population reached its peak during third week of September. The population started decreasing gradually from first week of October to one larva per 10 hills at the maturity of the crop during third week of November. However, the activity of leaf folder attains rapid growth during second week of September reaching to its peak

during last week of September and this trend lasted till first week of October. These results were in close proximity with the studies of Alvi *et al.*, (2003) [2]. The correlation analysis revealed a positive correlation with minimum temperature and rainfall. A negative correlation was obtained with maximum

temperature. These results are in close association with Chakraborty and Deb (2011) [4] who reported that evening relative humidity and relative humidity had a negative correlation between rainfall and rice leaf folder.

Table 1: Seasonal incidence of rice stem borer and leaf folder in relation to weather factors during *Kharif*, 2019

Stem borer				Leaf folder		Meteorological parameters					
S.W.	Date	% DH	%WE	Larvae/10 hills	Temperature (°C)		Relative Humidity (%)			Rainfall	
					Max.	Min.	Mean	Morning	Evening	Mean	mm
24	June,17-23	0	0	0	33.2	25.6	29.4	76	64	70	93
25	June, 24-30	0.8	0	0	37.1	26.9	32	78	53	65.5	0
26	July,1-7	1.33	0	1	32.3	26.4	29.35	87	72	79.5	176.2
27	July,8-14	2.52	0	3	33.4	26.7	30.05	91	69	80	46.6
28	July,15-21	3.88	0	3	31.1	26.1	28.6	95	82	88.5	158.4
29	July,22-28	4.38	0	4	32.4	26	29.2	90	72	81	49.2
30	July,29- Aug, 04	5.52	0	5	31.2	24.9	28.05	93	76	84.5	60.4
31	Aug,05-11	6.1	0	6	31	25.8	28.4	92	79	85.5	110
32	Aug, 12-18	6.92	0	7	30.4	24.7	27.55	93	86	89.5	175.6
33	Aug, 19-25	8.11	0	8	31.5	24.8	28.15	85	77	81	98.6
34	Aug, 26 – Sep,01	9.11	0	10	34	26	30	83	69	76	1.4
35	Sep, 02- 08	4.3	0	11	31.6	26.2	28.9	90	80	85	31.1
36	Sep, 09-15	2.3	0	13	31.4	26.4	28.9	91	80	85.5	2.6
37	Sep,16-22	2.26	0	15	31.2	25.6	28.4	92	82	87	64.8
38	Sep,23-29	0	3.21	14	28.6	24	26.3	95	88	91.5	115.8
39	Sep,30 – Oct, 06	0	4.08	11	32.4	26.3	29.35	88	74	81	2.6
40	Oct, 07-13	0	5.34	9	32	23.4	27.7	87	61	74	1.5
41	Oct, 14-20	0	7.63	7	32.4	18.4	25.4	74	43	58.5	0
42	Oct, 21-27	0	7.95	5	32.4	17.9	25.15	74	43	58.5	0
43	Oct,28 – Nov, 03	0	8.43	4	31.4	16.6	24	77	43	60	0
44	Nov, 04-10	0	8.52	3	29.2	15.3	22.25	80	45	62.5	0
45	Nov, 11-17	0	8.88	1	29	13.8	21.4	77	42	59.5	0

Table 2: Correlation between per cent seasonal incidence of rice stem borer and leaf folder

Correlation coefficient			
Weather Parameters	Stem borer		Leaf folder
	Dead Hearts	White ear heads	
Max. Temp (°C)	0.064	-0.488*	-0.375
Min. Temp (°C)	0.480*	-0.498*	0.087
Morning Relative Humidity (%)	0.447*	-0.166	0.364
Evening Relative Humidity (%)	0.561**	-0.230	0.385
Rainfall	0.307	-0.327	0.079

*-Significant (p<0.01),

** - Significant (p<0.05)

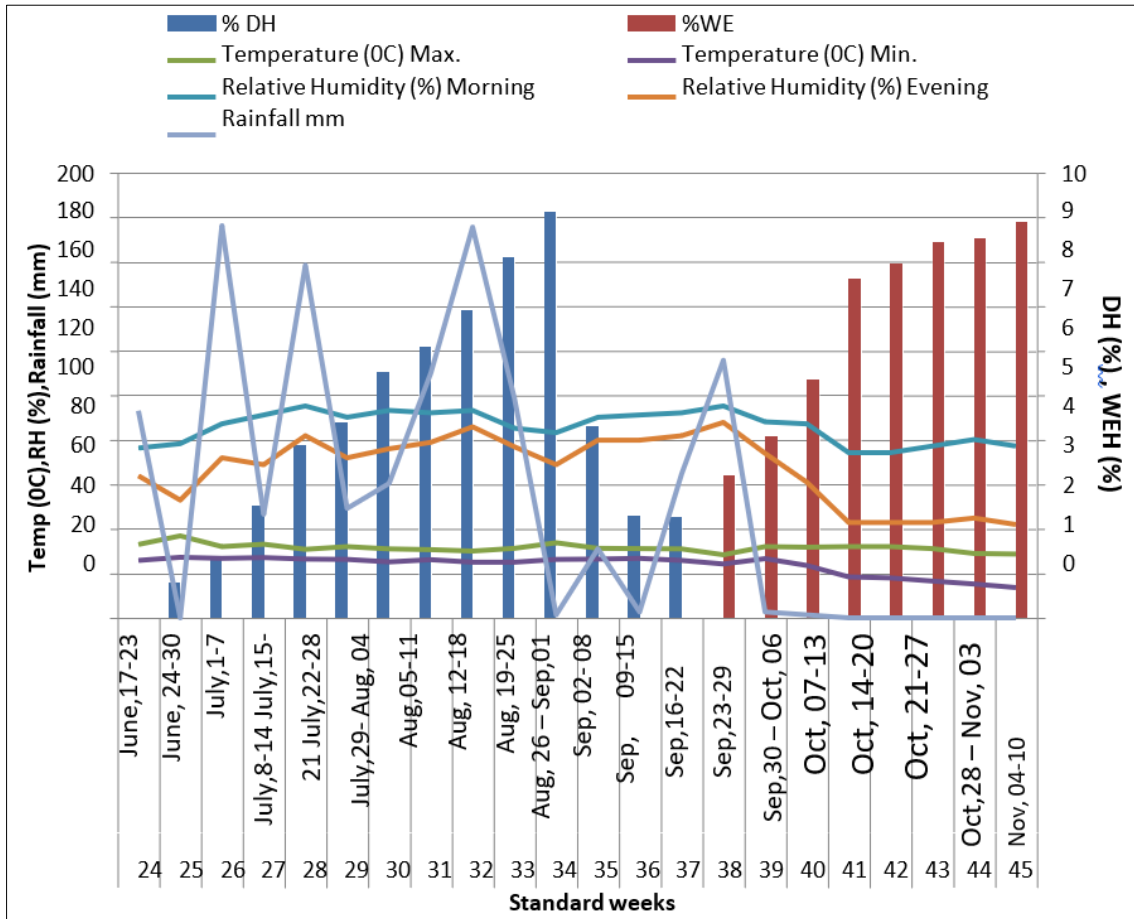


Fig 1: Seasonal incidence of rice stem borer in relation to weather factors during *Kharif*, 2019

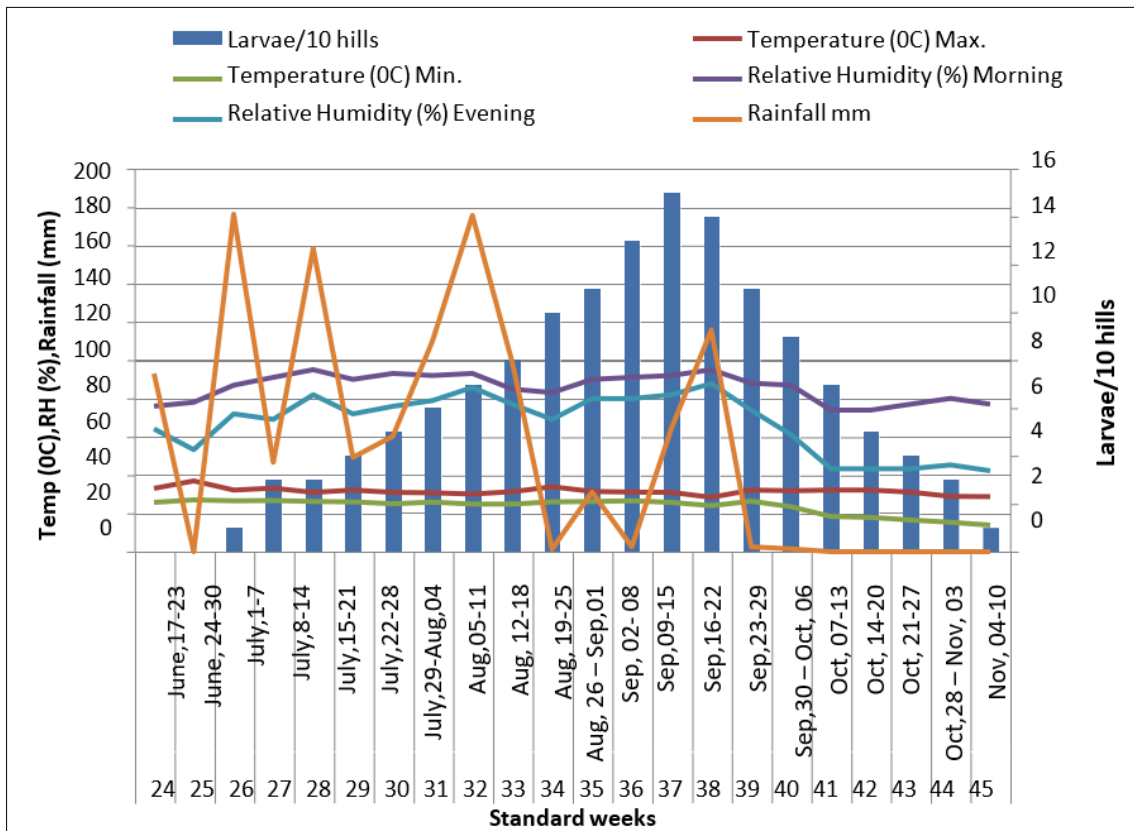


Fig 2: Seasonal incidence of rice leaf folder in relation to weather factors during *Kharif*, 2019

Conclusion

Studies on the incidence of rice stem borer showed that the per cent dead hearts were observed highest during 34th standard week during vegetative growth phase and per cent white ears were highest during 45th standard week during reproductive growth phase of the crop. The incidence of leaf folder was found highest on 37th standard week when turgidity of the leaf was high. The correlation between the incidence of rice stem borer and weather parameters revealed that per cent dead hearts showed a non-significant positive correlation with maximum temperature and rainfall. The per cent white ears had significant negative correlation with maximum temperature and a non-significant negative correlation with rainfall and average RH. The correlation studies between the incidence of rice leaf folder and weather parameters showed a non-significant negative correlation with maximum temperature. A positive non-significant correlation is found in case of rainfall and minimum temperature.

Acknowledgement

The authors thankful to the Hon'ble Vice-Chancellor, Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipuram, Meerut (UP), India, for providing the financial and logistics support for conducting this research work and authors express special gratitude to the advisor (Dr. Gaje Singh).

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