International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 21-23

Received: 06-07-2019
Accepted: 10-08-2019

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Population dynamics of insect-pests of paddy and its correlation with weather parameters

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Abstract
The research experiment discusses the population dynamics of paddy and its correlation with weather parameters in Zonal Agricultural Research Station, Sindewahi, Chandrapur district of Maharashtra. Occurrence and abundance of insect pests of paddy was monitored on rice variety PKV HMT during the season Kharif, 2014 with the spacing of 20 cm x 15 cm following the recommended package of practices. this investigation revealed that, the pest activity commenced from 29th Standard Meteorological Week and continued to 44th SMW. Highest dead hearts (6.77%) of yellow stem borer, *Scirpophaga incertulas* was found in the 44th SMW. The maximum population of armyworm (3.43 hill^{-1}) was recorded in the 36th SMW, the peak population of cutworm (1.71 hill^{-1}) was estimated in the 36th SMW. The highest per cent leaf damage due to leaf folder (15.63%) was found in the 40th SMW. The maximum population of Brown plant hopper (7.43 hill^{-1}), WBPH (9.14 hill^{-1}) were found in 44th SMW while green leaf hopper (3.86 hill^{-1}) in 43rd SMW. The incidence of gall midge was not noticed. Yellow stem borer, BPH, WBPH, GLH and leaf folder positively correlated with maximum and minimum temperature, morning relative humidity while armyworm and cutworm positively correlated with rainy days, rainfall, Morning and evening relative humidity. Evening relative humidity, rainfall and rainy days discourages the population of yellow stem borer, brown plant hopper, WBPH, green leaf hopper and leaf folder but encourage armyworm and cutworm.

Keywords: Population, dynamics, weather, parameters, pests, correlation, paddy

Introduction
Rice (*Oryza sativa* L.) is an important staple food crop for more than half of the world population and accounts for more than 50 per cent of the daily calories intake (Khush, 2005) [9]. Rice is grown in many regions across India. In India, rice occupies one quarter of the total cropped area, contributing about 40 to 43 per cent of total food grain production and continues to play a vital role in the National food and livelihood security system. India is the world's second largest rice producer and consumer next to China. Total area under rice in India is 43.95 million ha. with annual production of 106.54 million tones. (Directorate of Economics and Statistics, Department of Agriculture and Cooperation, 2016). But its yield is greatly affected every year by various insect pests (Barwal *et al.* 1994, Dutta and Hazarika, 1994). Among the various insect pests of paddy, yellow stem borer, brown plant hopper, WBPH, green leaf hopper, leaf folder, gall midge, armyworm, cutworm are reported regularly during entire crop season.

In the development of pest management strategies a detailed knowledge of the influence of abiotic factors on insect pests is essential. Weather and climatic conditions are known to significantly affect the population dynamics of insect pests (Kennedy and Storer, 2000) [7]. Knowledge of abiotic conditions such as temperature, day length, rainfall and relative humidity can be used as important components in forecasting and predicting the severity of insect pest population. (Milford and Dugdale, 1990) [10]. Knowledge of insect pests population dynamics is essential for developing sustainable crop protection strategies and for interpreting and forecasting the response of taxonomic groups to weather patterns varying on a daily basis, seasonally or as a long term consequence of global climate change (Denholm *et al*. 2001) [3]. Information on population dynamics of insect-pests complex in relation to weather parameters under Sindewahi, Chandrapur district condition is lacking. Hence, considering the importance of insect-pests of rice an attempt has been made to study the population dynamics and its correlation with weather parameters.

Materials and Methods

For recording the population of insect-pests, the research experiment was conducted at Zonal Agricultural Research Station, Sindewahi, District-Chandrapur, Maharashtra during Kharif, 2014. Total experimental plot size measured 20m x 20m. The seedlings were transplanted in the non-replicated experimental plots with spacing 20 cm between plant to plant and 15 cm row to row. 21 days old seedlings of PKV HMT rice variety were transplanted in first week of July from the nursery sown 21 days ago in the experimental year. The normal cultural practices were performed throughout the growing season of the crop.

Method of data collection: data collection was started after ten days of transplanting and subsequent at weekly intervals, using also standard/ sweeping method as per need. For insect-pests population, visual counts of the number of insects 10 hill^{-1} in each plot were taken. Observations on incidence of insects were taken on hill^{-1} basis. Ten Plants (hill) were randomly selected from plot planted with PKV HMT for recording incidence of insect-pests. The observations continued till harvest of the crop. The observations were recorded at morning hours.

Correlation analysis is drawn between data recorded on pest population and weather parameters. Base on this statistical data, the results of the investigation have been interpreted and conclusions have been drawn.

Results and Discussion

Population dynamics of insect-pests of paddy crop (Table 1)

The results indicated that, the percentages of dead hearts were found initially low (4.95%) during 42nd SMW which gradually increased during successive standard weeks and reached at the maximum level (6.77%) during 44th SMW. Similar observations were recorded by Devendra Singh *et al.* (2018) [4] and Rai *et al.* (1990) [12]. Kakde and Patel (2014) [6] reported that, yellow stem borer infestation reached its peak during first week of September and first week of October. The armyworm and cutworm hill^{-1} varied from 0.28-3.43 and 1.0-4.0 respectively in field based observations recorded from 29th to 44th SMW at weekly interval during Kharif, 2014. Weather conditions prevailed during crop season showed that the incidence of armyworm and cutworm was not favoured much by the prevailing weather conditions. The incidence of brown plant hopper, WBPH and green leaf hopper hill^{-1} was observed from 39th to 44th SMW ranging from 2.57-7.43, 2.43-9.14, 1.29-6.00 hill^{-1} respectively. the incidence of leaf folder revealed that, the per cent damaged leaves was highest at 40th SMW with 1563 per cent followed by 44th SMW (10.88%) and 38th SMW (10.87%) and lowest population was recorded at 36th SMW with 1.28 per cent during Kharif, 2014. Similar results were observed by Khan and Ramamurthy (2004) [8], Prasad and Prasad (2006) [11] and Devendra Singh *et al.* (2018) [4] which supports present findings. The abiotic parameters are having direct impact on insect population dynamics through modulation of developmental rates, survival, fecundity, voltism and dispersal. The incidence or population of gall midge was not reported during entire crop season of paddy.

Correlation between weather parameters and paddy insect-pests (Table 2)

The correlation coefficient determined between the insect-pets of paddy and abiotic factors revealed that, the incidence of yellow stem borer, brown plant hopper, WBPH, green leaf hopper and leaf folder were positively correlated with maximum temperature, minimum temperature and morning relative humidity while evening relative humidity, rainfall and rainy days had a negative impact. Devendra Singh *et al.* (2018) [4] reported that, the incidence of yellow stem borer was negatively correlated with maximum temperature, minimum temperature, relative humidity and rainfall. The results partially supported by the findings of Bhattacharya *et al.* (2006) [2], Kaul *et al.* (1999) [5], Bhadauria and Singh (2009) [1]. the incidence of armyworm and cutworm positively correlated with morning and evening relative humidity, rainfall and rainy days while maximum temperature and minimum temperature showed negative impact. these information's can be utilized in formulating appropriate management strategies for the major insect-pets of paddy crop through location specific IPM strategy.

Table 1: Incidence of insect-pests of paddy during Kharif, 2014.

Sr. No.	Date	SMW	Yellow Stem Borer (% DH/WEH)	Hoppers No. Hill^{-1}			Leaf folder (% Damaged Leaves)	Gall Midge No. Hill^{-1}	Armyworm No. Hill^{-1}	Cutworm No. Hill^{-1}	Rainfall (mm)	Rainy Days	Temperature (^{0}C)		Relative Humidity (%)	
				BPH	WBPH	GLH							Maximum	Minimum	Morning	Evening
1	16-22 July 2014	29	-	-	-	-	-	-	2.00	-	135.5	4.0	26.0	15.5	89	79
2	23-29 July 2014	30	-	-	-	-	-	-	1.70	-	73.9	3.0	28.2	14.2	91	77
3	30-05 Aug 2014	31	-	-	-	-	-	-	1.50	-	29.0	3.0	29.7	16.6	91	71
4	06-12 Aug 2014	32	-	-	-	-	-	-	0.29	-	25.0	3.0	31.2	16.2	87	65
5	13-19 Aug 2014	33	-	-	-	-	-	-	0.30	-	03.0	1.0	32.1	16.3	86	60
6	20-26 Aug 2014	34	-	-	-	-	-	-	1.29	-	0.2	0.0	31.4	15.9	93	69
7	27-02 Sept 2014	35	-	-	-	-	-	-	3.14	-	151.1	5.0	29.1	14.8	95	78
8	03-09 Sept 2014	36	-	-	-	-	1.28	-	3.43	1.71	186.0	4.0	27.4	14.8	90	81
9	10-16 Sept 2014	37	-	-	-	-	1.50	-	0.57	4.0	15.2	2.0	30.2	14.8	94	74
10	17-23 Sept 2014	38	-	-	-	-	10.87	-	-	-	7.2	1.0	31.2	15.6	93	70
11	24-30 Sept 2014	39	-	2.57	2.43	1.29	8.33	-	-	-	0.0	0.0	32.6	18.9	90	50
12	01-07 Oct 2014	40	-	3.86	4.29	3.00	15.63	-	-	-	0.0	0.0	33.8	23.9	89	55
13	08-14 Oct 2014	41	-	5.57	5.86	3.57	10.00	-	0.71	-	0.0	0.0	29.5	21.6	91	67
14	15-21 Oct 2014	42	4.95	6.71	5.29	1.86	7.69	-	-	1.0	0.0	0.0	32.2	21.8	92	57
15	22-28 Oct 2014	43	5.01	6.00	9.00	3.86	7.02	-	-	2.0	5.5	0.0	29.0	18.6	89	47
16	29-04 Nov 2014	44	6.77	7.43	9.14	6.00	10.88	-	0.28	-	0.0	0.0	30.7	15.6	93	41

Table 2: Correlation of insect-pests of paddy with weather parameters.

Sr. No.	Pests	Weather parameters					
		Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)	Rainy Days
		Maximum	Minimum	Morning	Evening		
1	Yellow stem borer	0.088	0.190	0.137	-0.702	-0.297	-0.446
2	Brown plant hopper	0.270	0.652	0.050	-0.773	-0.460	-0.678
3	WBPH	0.184	0.549	0.010	-0.799	-0.436	-0.649
4	Green leaf hopper	0.209	0.511	0.036	-0.783	-0.425	-0.628
5	Leaf folder	0.512	0.713	0.073	-0.640	-0.504	-0.700
6	Armyworm	-0.711	-0.526	0.242	0.753	0.921	0.816
7	Cutworm	-0.167	-0.126	0.212	0.091	0.044	0.023

Conclusion

For recording the population of insect-pests, the study was undertaken at Zonal Agricultural research Station, Sindewahi, Chandrapur district of Maharashtra during Kharif, 2014. It can be concluded that, yellow stem borer, brown plant hopper, WBPH, green leaf hopper, leaf folder, armyworm cutworm reported during entire crop season of paddy and occurred in more or less population. The weather parameters greatly influenced the population of these insect-pests. Incidence of gall midge was not reported.

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