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Effect of weather factors on the population of *Chaetocnema* spp.,*Monolepta signata* Oliver and *Aulacophora foveicollis* (Lucas) on paddy under rainfed lowland conditions in Mizoram, India

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ABSTRACT

The present study was undertaken during kharif 2013 and 2014 to know the relationship between weather parameters and chrysomelids (Coleoptera: Chrysomelidae)*viz*., *Chaetocnema* spp., *Monolepta signata* Oliverand *Aulacophora foveicollis* (Lucas)in rice agro-ecosystem in Mizoram, India.*Chaetocnema* spp., and *M. signata* were found to first invade the crop during last week of August, whereas *A. foveicollis* was recorded during third week of September. The highest populations of *Chaetocnema* spp. and *M. signata* were during September. However, the highest population of *A. foveicollis* was during October. Morning relative humidity (RH) had significant correlation with populations of *Chaetocnema* spp., *M. signata* and *A. foveicollis*. When there was abrupt fall in minimum temperature and coupled with increase in morning RH, rainfall and rainy days a build-up in *Chaetocnema* spp. population was recorded during the pooled year. These studies clearly indicate that weather factors play an important role in *Chaetocnema* spp., *M. signata* and *A. foveicollis* incidence.

Key words : Seasonal abundance, seasons, weather parameters, interaction, Eastern Himalayas, population build-up

Rice, the staple food of over half of the world's population, is grown in more than 110 countries. Most of the world's rice production is from irrigated and rainfed lowland rice fields where insect pests are constraints (Pathak and Khan, 1994). Rice is grown in the warm and humid environment which is also conducive to the proliferation of insects. Modern varieties, high tillering, heavily fertilized and the practice of multi-cropping rice throughout the year favors the buildup of pest populations. Average rice yield loss due to various insect pests was estimated to be 31.5% inAsia (excluding China) and 21 % in North and Central America.The rice plant is subject to attack by more than 100 species of insects (Arora and Dhaliwal, 1996); 20 of them can cause economic damage. Together they infest all parts of the plant at all growth stages, and a few transmit viral diseases.

Climatic conditions largely influence the insect pests number and activity as well as several parasites and predators either directly or indirectly (Arif *et al*., 2006; Kumar and Gupta, 2016; Saha *et al.* 2016).Boopathi *et al*., (2012) have shown that besides the availability of new leaves and shoots, weather factors also play an important role in *Chaetocnema* spp., *M. signata* and *A. foveicollis* incidence.The pest status does not remain static throughout the year but changes accordingly based on weather factors. Therefore, a thorough understanding of interaction between weather parameters and pest dynamics is pre-requisite for weather-based pest forecasting model. Hence, the present study was undertaken to know the relationship between weather factors and chewing pests in rice agro-ecosystem in Mizoram, India.

MATERIALS AND METHODS

Field experiment

The present study was carried out at the research farm, ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib, Mizoram, India during *kharif* season in both 2013 and 2014 with rice cultivar Gomati. Around 2000 m^2 area was taken to study the population buildup of *Chaetocnema* spp., *M. signata* and *A. foveicollis* in lowland rice. The total area was divided into ten equal segments and

Table 1: Effect of weather factors on the population of *Chaetocnema* spp., *Monolepta signata* and *Aulacophora foveicollis* on paddy under rainfed lowland condition during two seasons (Pooled data of 2013 and 2014)

SMW	No./10plants±standar error*			Weather factors						
	Chaetocnema spp.	*Monolepta signata*	*Aulacophora foveicollis*	Temperature (°C)		Relative humidity (%)		Rainfall	Rainy	Total
				Maximum	Minimum	Morning	Evening	(mm)	days	EP
35	14.5a ± 1.2	1.0d ± 0.8	-	30.3	22.0	85.9	51.4	21.8	5.0	3.6
36	16.3a ± 3.1	10.0a ± 2.8	-	30.2	21.6	89.8	50.1	26.5	5.5	3.8
37	14.8a ± 1.7	5.0bcd ± 1.5	-	29.9	22.3	87.8	54.1	20.8	4.0	2.8
38	6.0bc ± 2.3	7.2ab ± 0.6	0.2b ± 0.2	29.7	22.9	86.5	55.1	14.1	3.5	3.8
39	9.3b ± 3.1	10.3a ± 1.3	1.2a ± 0.3	30.2	22.7	85.2	56.0	16.2	4.5	3.4
40	9.0b ± 1.0	6.5ab ± 0.8	1.0a ± 0.3	30.6	23.1	79.4	52.5	2.9	2.5	3.1
41	0.2d ± 0.2	3.7bcd ± 1.5	1.3a ± 0.2	30.5	23.0	72.1	49.4	6.7	2.5	3.9
42	2.3cd ± 1.3	2.3cd ± 0.2	1.5a ± 0.5	29.6	22.5	79.7	45.3	0.6	0.5	3.5

SMW: Standard meteorological week *Data in interaction analyzed with Least Squares Means and means separated with standard error of the mean at $P<0.01$. in a column, means followed by a common letter(s) are not significantly different by Tukey's at $P < 0.01$.

considered each one as a replication. The rice crop was established by manual transplanting of 25 days old seedlings with spacing of 20×10 cm row to row and plant to plant, respectively. All the recommended agricultural practices were followed in raising the crop. No plant protection measure was taken throughout the crop season.

Observations on the incidence of *Chaetocnema* spp., *M. signata* and *A. foveicollis* were recorded starting from initial appearance to up to harvest. Sampling was done at weekly interval accountinga dults of *Chaetocnema* spp., *M. signata* and *A. foveicollis* by counting number of beetles/ plant/hill from 10 randomly selected plants in 10 hills. The daily weather data for study period was obtained from the Meteorological Unit, ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib, Mizoram, India.

Data analysis

The weekly data on chrysomelids incidences were subjected to correlation analyses with average weekly weather factors with pooled data of two years (2013 and 2014) to find out the influence of abiotic factors on insects infestation. Data were analyzed using two-way ANOVA for seasonal incidence of *Chaetocnema* spp., *M. signata* and *A. foveicollis* during two seasons.

RESULTS AND DISCUSSION

Chaetocnema spp.

The seasonal fluctuation of *Chaetocnema* spp. varied from 0.2±0.2 to 16.3±3.1 per 10 plants in the pooled data (average of 2013 and 2014) (Table 1). The population increased reaching a peak on 36thstandard meteorological week (SMW) i.e. first week of September(16.3±3.1 per 10plants).There was not significant difference in its population due to season/year, where as its population significantly varied due to weekly distribution (Table 2).

Correlation coefficient between *Chaetocnema* spp. population and weather factors revealed that *Chaetocnema* spp. population had positive significant correlation with morning RH ($r = 0.831$), rainfall ($r = 0.832$) and rainy days ($r = 0.809$) in the pooled data (Table 3), while minimum temperature ($r = -0.723$) had negative significant correlation with *Chaetocnema* spp. population. Maximum temperature, evening RH and total EP showed non-significant correlation with *Chaetocnema* spp. population. Earlier, Boopathi *et al*. (2012) reported that *Chaetocnema* spp. had positive significant correlation with morning relative humidity.

Table 2: Analysis of variance (ANOVA)

Source	df	*Chaetocnema* spp.		*M. signata*		*A. foveicollis*	
		F value	*P* value	*F* value	*P* value	*F* value	*P* value
Season (S)	1, 30	0.056	0.815ns	1.171	0.288ns	0.042	0.839
Week (W)	7, 30	11.676	<0.001	6.754	<0.001	5.354	<0.001
Interaction (S × W)	7, 30	0.770	0.616ns	0.469	0.849ns	0.912	0.511ns

ns, non-significant.

Table 3: Correlation between weather parameters and population of *Chaetocnema* spp., *Monolepta signata* and *Aulacophora foveicollis*on paddy under rainfed lowland condition (Pooled data of 2013 and 2014)

Weather parameters	*Chaetocnema* spp.	*M. signata*	*A. foveicollis*
Maximum temperature	0.104ns	0.066ns	0.119ns
Minimum temperature	-0.723*	-0.007ns	0.608ns
Morning relative humidity	0.831*	0.720*	-0.793*
Evening relative humidity	0.377ns	0.537ns	-0.397ns
Rainfall (mm)	0.832*	0.328ns	0.840**
Rainy days (d)	0.809*	0.444ns	-0.750*
Total EP	-0.351ns	0.031ns	0.034ns

ns,*,** non-significant or significant at P≤0.01 or P≤0.05

Monolepta signata

The seasonal fluctuation of *M. signata* varied from 1.0±0.8 to 10.3±1.3 (Table 1). There was two peaks in its population first peak during 36thSMW (10.0±2.8 per 10plants) and second during 39thSMW (10.3±1.3 per 10plants), there after it decreased. Boopathi *et al*. (2012) reported that *M. signata* population was found more during September (16.25 per 10 plants).As observed in case of *Chaetocnema spp.,* the population of *M. signata*also did not vary between the years, however, within the season, weekly variation was significant (Table 2). *M. signata* population had positive significant correlation with morning RH (r = 0.720) (Table 3). However, other weather parameters showed non-significant correlation with *M. signata* population.

Aulacophora foveicollis

The seasonal fluctuation of *A. foveicollis* varied less in comparison to others pests (Table 1). The activity of pumpkin beetle started from third week of September and the population reached a peak on second week of October i.e. 42 SMW(1.5±0.5 per 10plants). In contrast to other two pests, the population of *A. foveicollis* varied significantly between the season/years as well as during the weeks (Table 2).

Correlation coefficient between *A. foveicollis* and weather factors revealed that *A. foveicollis* population had positive significant correlation with rainfall (r = 0.840) (Table 3), while morning RH (r = -0.793) and rainy days (r = -0.750) had negative significant correlation with pumpkin beetle population. However, other weather parameters showed non-significant correlation with pumpkin beetle population.

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