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Influence of weather parameters on the population dynamics of insect-pests of mango in West Bengal

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ABSTRACT

The insect-pests infestation in mango leads to severe injury to its' shoots, flowers and fruits by hopper, leaf cutting weevil, shoot borer, grey weevil and fruit flies. The present investigation was taken up during 2006 and 2007 to study the population dynamics of prevailing five insect-pests of mango in relation to weather parameters. The correlation worked out between various pests and weather parameters of previous week and previous fortnight revealed highly significant correlation in most of the cases. Except shoot borer, which was significantly influenced by rainfall, all the other pests were significantly influenced by temperature related indices. Among all the weather parameters heat sum showed highest degree of correlation with fruit fly population.

Key words: Mango pests, population dynamics, weather parameters, correlation

Mango, the king of fruits having a great nutritional, medicinal or industrial utility to humanity and is grown in as many as 63 countries all over the world. India is at the top being the highest producer of this fruit and it constitutes an important horticultural asset of the country. In West Bengal, it is grown in almost all the districts and occupies an area of 88.137 thousand hectare with the production of 578 thousand tonnes (Anonymous, 2011). The popular varieties grown in West Bengal are Langra, Fazli and Himsagar. The export trend of mango is increasing day by day and is largely dependent upon the quality of fruits, which is affected by biotic and abiotic factors. The crop is attacked by more than 400 pests in the world (Tandon and Verghese, 1985), of these about 260 insect and mite pests have been reported from Indian subcontinent, of which nearly 30 pests are serious and capable of causing major losses to crop growth and yield (Pena and Mohyuddin, 1997; Kapadia, 2003). The status of the pest changes rapidly because of their dynamic nature and is affected in general by the abiotic factors.

This study was undertaken to establish the complex relationships between weather parameters on the population build up of different insect-pests of mango.

MATERIALS AND METHODS

In order to study the population dynamics of different insect- pests of mango prevalent in West Bengal, the population/ damage of mango hopper and fruit fly were recorded at fortnightly interval, whereas, the same for grey weevil, shoot borer and leaf cutting weevil were recorded at monthly interval in the orchards and at nursery of the Regional Research Sub-Station, Uttar Banga Krishi Viswavidyalaya, Mathurapur, Malda, West Bengal during 2006 and 2007. Five trees and fifteen saplings were selected randomly from mango orchard and nursery (Cv. Himsagar), respectively. To evaluate the influence of predisposing weather parameters, weather data preceding the population count at each interval were divided into three phases, viz, the immediate week prior to population count, the immediate fortnight prior to population count and the week before the immediate preceding week of the population count. Weather data during these periods were used to study their comparative influence on the population dynamics of major pests.

For this study daily rainfall, maximum temperature and minimum temperature data were collected from the Agro-meteorological Centre of District Seed Farm, Malda, Government of West Bengal. Using meteorological data derived indices like day temperature (DT), night temperature (NT), diurnal variation (DV) and heat sum (HS) were calculated following Venkataraman and Krishnan (1992) as given below-

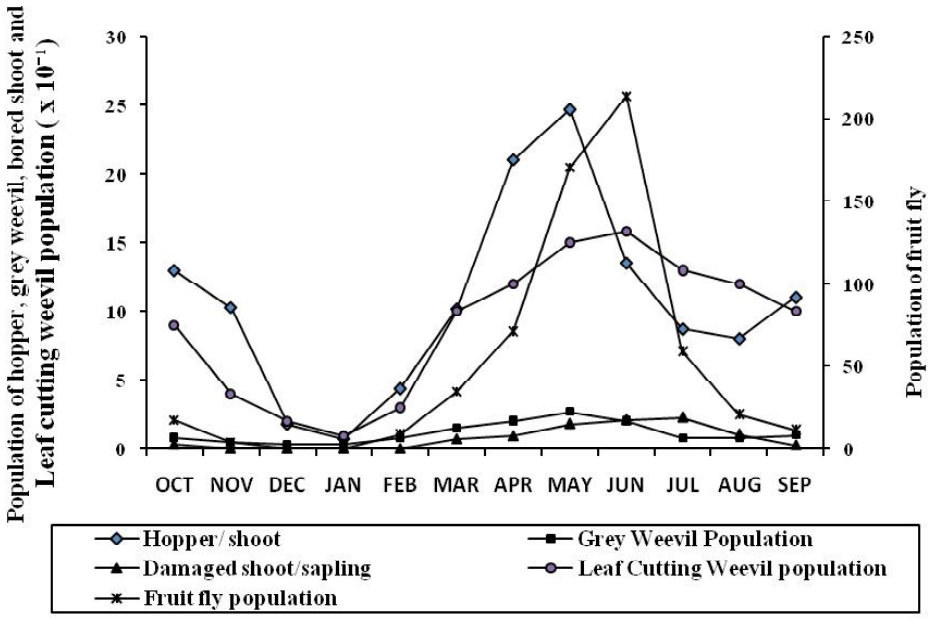

Fig. 1: Population dynamics of important insect-pests of mango in West Bengal during 2006-07

$$DT = Tmax - 0.4\,(Tmax - Tmin)$$

$$NT = Tmin + 0.4\,(Tmax - Tmin)$$

$$DV = DT - NT$$

$$HS = \sum \frac{Tmax + Tmin}{2} - \text{base temperature}$$

Summarized information on different meteorological parameters pertaining to three different periods as mentioned earlier were correlated with the insect population. Correlation studies between weather parameters and insect population were made i) using round the year data and ii) using dry season data (October-May). This segregation was also done to assess whether expected heavy rainfall during rainy season can influence the relationship between insect population and other weather parameters. Scattered diagrams as well as trend line were also drawn to study the degree of correlation between the insect population and most significant weather parameter.

RESULTS AND DISCUSSION

Mango hopper

Population fluctuations of mango hopper on shoot region averaged over two years of experimentation (Fig.1) revealed that the peak population of hopper was in the month of May. While, during wet months hopper population was lower in the shoot region due to the fact that adult hopper during inactive stages of plant growth remained alive without feeding in the cracks and crevices of the trunk (Patel *et al*.,1984) as well as since heavy shower of monsoon greater than 100 mm in a fortnight had a washing out effect on hopper population (Pandey *et al.,* 2003). Among all the weather parameters and periodicity, average maximum temperature (Tmax) pertaining to previous fortnight and heat sum (HS) pertaining to previous week showed higher correlation (r = 0.87*) with the hopper population (Table 1). It was also observed that weather parameter other than diurnal variation (DV) was almost positively and significantly correlated with mango hopper population at shoot region. Though day temperature regime showed better correlation with hopper population than night temperature regime, however, these two derived indices did not show any better degree of association than the recorded Tmax values. Scattered diagram as well as trend line was made to analyze the degree of relationship between hopper population and maximum temperature (Fig. 2a), which also indicated the strong positive correlation between the two variables. This might be due to the fact that the rate of development of pests will enable a more rapid response to a change in temperature (Karuppaiah and Sujayanad, 2012).

Grey weevil

Fig.1 shows that grey weevil population were very low mostly during winter months. Seasonal correlation of grey weevil population with selected weather parameters i.e., Tmax and Taverage were mostly influenced by their exposure except during November – January. Maximum correlation of grey weevil population was found with Tmax

Table 1: Correlation studies between incidence of insect-pests of mango and weather parameters in West Bengal (Seasonal).

Weather parameter	Hopper population / shoot		Grey weevil population / shoot		Shoot borer / sapling		Population of leaf cutting weevil / shoot		Population of fruit fly / trap	
	Fortnight	Previous week	Fortnight	Previous week	Fortnight	Previous week	Fortnight	Previous week	Fortnight week	Previous
Rainfall	0.63**	0.60*	0.50	0.67	0.65*	0.73**	0.72*	0.77*	0.20	0.45
Tmax.	0.87**	0.85**	0.92**	0.93**	0.46	0.41	0.94**	0.91**	0.63**	0.57*
Tmin.	0.80**	0.81**	0.90**	0.94**	0.58*	0.59*	0.94**	0.95**	0.66**	0.64**
Taverage	0.84**	0.84**	0.92**	0.95**	0.54	0.53	0.96**	0.95**	0.68**	0.63**
DT	0.85**	0.85**	0.92**	0.95**	0.53	0.52	0.96**	0.95**	0.67**	0.62**
NT	0.83**	0.84**	0.92**	0.95**	0.55	0.55	0.95**	0.95**	0.68**	0.64**
DV	-0.23	-0.40	-0.54	-0.69	-0.54	-0.63*	-0.50	-0.66	-0.13	-0.17
HS	0.86**	0.87**	0.89**	0.92**	0.55	0.55	0.96**	0.96**	0.69**	-0.10

*Significant at 5% level ** Significant at 1% level

Mango hopper df= 14, Grey weevil df= 6, Shoot borer df= 10, Leaf cutting weevil df= 6 and Fruit fly df= 6

(Table 1) which was also reflected from the scattered diagram (Fig. 2b). Exposure to higher ambient temperature might have helped the insect to reduce the time required to complete its life cycle and thereby increasing population level quickly.

Shoot borer

There was very low infestation of shoot borer during September to February due to lack of new shoots (Fig. 1). In case of correlation studies, among all the weather parameters and periodicity, rainfall, minimum temperature and diurnal variation pertaining to previous week showed maximum value (r = 0.73*, 0.59* and – 0.63*, respectively). It was revealed from the Table 1 that rainfall had some significant effect on the damage of shoot borer due to the fact that rainfall induces the development of more new shoots. It was found from the Fig. 2c that rainfall had some positive relation with the shoot borer damage and similar observation was also seen in the correlation calculation study.

Leaf cutting weevil

The population of the leaf cutting weevil prevailed throughout the year except during winter months (Fig. 1). Correlation studies of population of leaf cutting weevil with different weather parameters and periodicity showed maximum correlation with rainfall and heat sum pertaining to previous week i.e., r = 0.77* and 0.96*. From the scatter diagram (Fig. 2d) it was seen that there was strong positive relation between the weevil population and temperature related indices which also confirmed the result of correlation study. It is also revealed from the Table 1 that among all the meteorological parameters, rainfall had some significant and positive correlation on the population dynamics of leaf cutting weevil. Similar observation on the influence of rainfall on the population development of leaf cutting weevil was also noted by Rafiquzzaman and Maiti (1997).

Fruit fly

The seasonal population of fruit fly was maximum during May –June due to availability of suitable stage of the fruits (Fig. 1). Among all the weather parameters and periodicity, heat sum pertaining to previous fortnight showed maximum correlation (r = 0.69*) with mango fruit fly population (Table 1) and from scatter diagram similarly positive relation was obtained between the insect incidence with heat sum (Fig. 2e), may be among the various abiotic factors, temperature cause the direct effect on the growth and development of the insect. While, studying across the

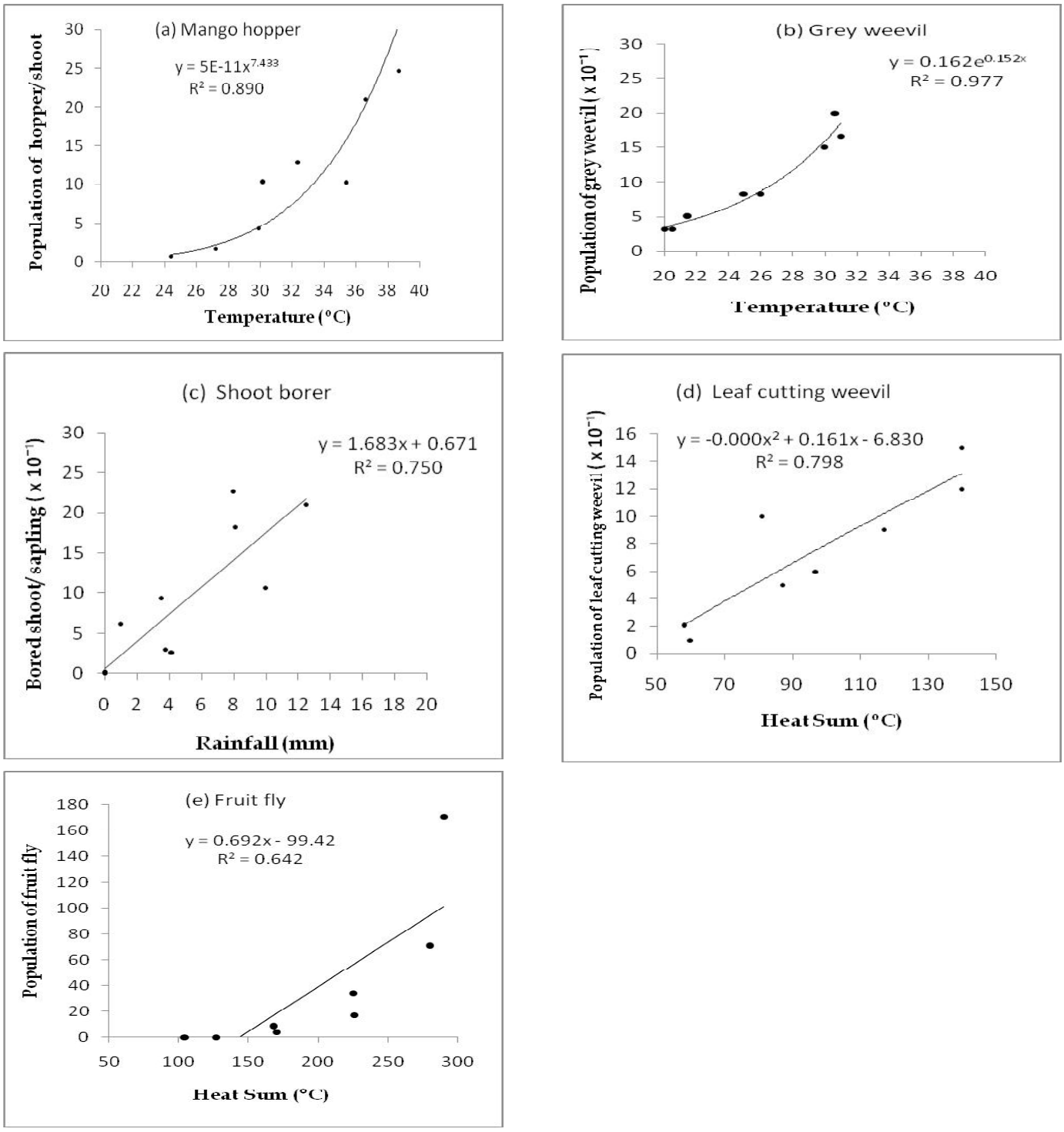

Fig. 2(a-e) : Scattered diagram and regression line showing the relation between population of insect pests of mango and significant weather parameters

weather parameters and periodicity, it was pointed out that weather parameters other than diurnal variation were almost positively and significantly correlated with fruit fly population.

CONCLUSION

Shoot borer was significantly influenced by rainfall while all the other pests of mango were significantly influenced by temperature related indices.

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