

Population Dynamics of Citrus Butterfly, *Papilio* sp. (Papilionidae: Lepidoptera) on Acid Lime

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ABSTRACT: Citrus butterflies, *Papilio demoleus* and *Papilio polytes* are the two economically important butterfly species attacking on citrus crops. The larvae of this pest act as defoliators and found to cause significant loss to citrus production. Acid lime, *Citrus aurantiifolia* Swingle is one of the important citrus crops grown extensively in northern Karnataka. The production of acid lime is under threat due to attack of citrus butterfly under both nursery and field conditions. For the management of these insect pests, it is important to know how pest is behaving under changing weather conditions. A fixed plot survey was carried out at fortnightly interval to study population dynamics of citrus butterfly from November 2020 to June 2022. The observation on incidence of citrus butterfly was recorded on ten randomly selected plants by counting number of larva per plant. The results of the study indicated that, the citrus butterfly incidence was noticed throughout study period with raising and falling trends in population. During the study period, the larval population was ranged from 1.20 to 10.10 larvae per plant. The peak activity was recorded during December and August months. Minimum incidence of citrus butterfly was noticed during first and second fortnight of May month. The data on correlation of larval population with abiotic environmental factors indicated significantly negative correlation with maximum temperature ($r=-0.843$), minimum temperature ($r=-0.577$) and rainfall ($r=-0.353$). A significant positive correlation was observed with morning relative humidity ($r=0.567$) and evening relative humidity ($r=0.481$). Whereas non-significant negative correlation was recorded with wind speed ($r=-0.272^{NS}$) and sunshine hours ($r=-0.220^{NS}$). The multiple linear regression analysis indicated that different weather parameters influenced the population dynamics of citrus butterfly to an extent of 77.50 per cent. The information of nil incidence, low incidence and peak incidence will provide strong basis for initiation of suitable control measures against citrus butterfly.

Keywords: Citrus butterfly, *P. demoleus*, *P. polytes*, population dynamics, correlation.

INTRODUCTION

The citrus fruits represent one of the world's major fruit crops and produced across the globe in tropical and subtropical climates. Citrus crops due to their unique diversity have greater adaptability for cultivation under wide range of climatic conditions (Samson, 1986). Acid lime, *Citrus aurantiifolia* Swingle is one of the

important citrus crops grown in India. The area under cultivation of acid lime is been increasing in recent times because of regular income, market access and export opportunities in domestic and international market (Anon., 2020). Despite a significant increase in area and production of citrus crops, its cultivation is under the severe threat of abiotic and biotic stresses. Among various biotic stresses, the insect-pests

problems are one of the major constraints in hampering the citrus production (Butani, 1979; Pruthi and Mani 1945). As many as 250 species of insect and mite pests have been reported to infest citrus plants in both the nurseries and orchards and inflicting heavy economic losses (Nayar *et al.*, 1976; Shivashankar and Singh, 2005). Among them, citrus butterfly, *Papilio demoleus* L. and *Papilio polytes* L. are the serious pests of citrus whose larval forms cause economic damage to crops by devouring large quantity of foliage during their development (Singh, 1993). The caterpillars are voracious feeders of young seedlings and cause death of the seedling within no time (Resham *et al.*, 1986). The larvae of citrus butterfly are of regular occurrence in nurseries, young plantation and on new flushes of grown up trees. Severe infestation of pest results in complete defoliation of the young tree and decreased photosynthetic activity leading to reduction in vigour, plant growth, and finally fruit yield (Bhutani and Jotwani 1975; Narayanamma *et al.*, 2001). The citrus butterfly population was found active throughout the year with peak infestation from August to November on Khasi mandarin (Kumar *et al.*, 2021). Whereas, Sharma (2021) recorded peak activity of citrus butterfly from February to May months on other citrus crops. However, the information on seasonal abundance of citrus butterfly on acid lime is very meagre. The information on seasonal abundance, fluctuations in build-up of population and interaction with various environmental factors has become imperative for scheduling effective management strategies against insect pests. Hence, there is need for investigations on dynamics of insect pests to find out vulnerable link in developmental cycle of insect pest. So, the present study was investigated to know the population dynamics of citrus butterflies on acid lime.

MATERIALS AND METHODS

The fixed plot survey was carried out to record the seasonal fluctuation of citrus butterfly, *Papilio demoleus* L. and *Papilio polytes* L. infesting acid lime on variety Kagzi lime at College of Agriculture, Vijayapura. The population of citrus butterflies were recorded at fortnightly intervals from November 2020 to June 2022 to assess the seasonal fluctuation in population. The observations on incidence of citrus butterflies were recorded on ten randomly selected plants in the field. The number of larvae per plant was recorded on selected plants and average number of larvae per plant was worked out. The plant protection measures were completely abandoned during the experimental period to observe how pest behave with respect to changing weather conditions.

Later, the observation on larval population of citrus butterfly was correlated with abiotic factors such as maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, wind

speed, sunshine hours and rainfall using SPSS statistical software. The multiple regression analysis was also worked out to see what extent the weather parameters influence on seasonal incidences of citrus butterfly on acid lime.

RESULTS AND DISCUSSION

The regular monitoring was made to study fluctuations in population of citrus butterflies, *P. demoleus* and *P. polytes* on acid lime from November 2020 to June 2022 at fortnight intervals. Observations on activity of pest were recorded on six year old acid lime orchard (Var. Kagzi lime). The data on dynamics of pests with abiotic factors are presented in Table 1.

The season abundance of citrus butterfly was studied by counting number of larvae present per acid lime plant. The data on larval population showed that, the activity of citrus butterfly, *Papilio* sp. was recorded throughout year. During the study period, the larval population was ranged from 1.20 to 10.10 larvae per plant. The trends in rising and falling of larval population were observed two times in a year. The peak activity was recorded during December and August months. The first peak population of 9.95 and 10.10 larvae per plant was recorded during second fortnight of December 2020 and 2021, respectively. Similarly, the peak larval population was observed during first fortnight of December with 9.50 and 9.55 larvae per plant, respectively during 2020 and 2021. The second peak population of 8.60 larvae per plant was recorded during first fortnight of August 2021. Minimum incidence of citrus butterfly was noticed during first and second fortnight of May 2021 with 1.25 and 1.20 larvae per plant, respectively (Table 1). The present findings are in accordance with Kumari (2006) wherein peak population of *P. demoleus* was observed during November to December and negligible incidence during March and April. In close proximity to current findings, Jahnvi *et al.* (2018) recorded high density of citrus butterfly larvae (8.17 larvae/plant) during August month and nil incidences during April and May months. Similarly, Arya (2019) revealed that larval population of citrus butterfly were maximum during August month on Kagzi lime. Kumar *et al.* (2021) also reported the peak activity of citrus butterfly from August to November on mandarins. Contrary to present findings, Sharma (2021) recorded peak incidence of citrus butterfly from February to May months. Since pest is known to feed on several species of citrus plants, the change in host plant and emergence of fresh growth of plant may also influence on incidence of citrus butterfly.

The data on correlation of larval population with abiotic environmental factors indicated that, significantly negative correlation with maximum temperature ($r=-0.843$), minimum temperature ($r=-0.577$) (Fig. 1) and rainfall ($r=-0.353$). A significant positive correlation

was observed with morning relative humidity ($r=0.567$) and evening relative humidity ($r=0.481$) (Fig. 2). Whereas non-significant negative correlation was recorded with wind speed ($r=-0.272^{NS}$) and sunshine hours ($r=-0.220^{NS}$). The multiple linear regression analysis indicated that different weather parameters influenced the population dynamics of citrus butterfly to an extent of 77.50 per cent (Table 1). The present study is in line with findings of Haldhar *et al.* (2010) where the egg and larval population citrus butterfly had positive correlation with morning and evening relative humidity, and negative correlation with maximum temperature, minimum temperature and rainfall. Similarly, Devi *et al.* (2018) reported significant positive correlation with morning and evening relative humidity, and significant negative correlation with maximum temperature, minimum temperature. On

contrarily, Gaur *et al.* (2018) recorded significant positive correlation with morning relative humidity and non-significant positive correlation with maximum temperature, minimum temperature, evening relative humidity and rainfall. Sharma (2021) also reported positive influence of temperature on incidence of citrus butterfly.

The information on population dynamics of citrus butterfly *viz.*, nil incidence, low incidence, moderate incidence and peak incidence provide strong basis for initiation of suitable control measure against citrus butterfly on acid lime. The same information can be made use to develop pest outbreak prediction model based on prevailing weather condition, so it help to forewarn the farmers to initiate appropriate management practices.

Table 1: Population dynamics of citrus butterfly, *Papilio demoleus* L. and *Papilio polytes* L. on acid lime during 2020-2022.

Months		Larvae/plant	Months		Larvae/plant
November 2020	I FN	7.30	September 2021	I FN	5.40
	II FN	7.85		II FN	5.10
December 2020	I FN	9.50	October 2021	I FN	4.40
	II FN	9.95		II FN	4.85
January 2021	I FN	5.75	November 2021	I FN	7.15
	II FN	5.30		II FN	8.00
February 2021	I FN	4.20	December 2021	I FN	9.55
	II FN	3.10		II FN	10.10
March 2021	I FN	2.60	January 2022	I FN	6.30
	II FN	2.10		II FN	5.35
April 2021	I FN	1.60	February 2022	I FN	4.50
	II FN	1.65		II FN	3.30
May 2021	I FN	1.25	March 2022	I FN	2.75
	II FN	1.20		II FN	2.35
June 2021	I FN	3.50	April 2022	I FN	1.70
	II FN	3.80		II FN	1.75
July 2021	I FN	6.35	May 2022	I FN	1.40
	II FN	7.55		II FN	1.45
August 2021	I FN	8.60	June 2022	I FN	3.75
	II FN	8.20		II FN	4.00
Correlation of larval population of citrus butterfly with weather parameters					
Maximum temperature			-0.843**		
Minimum temperature			-0.577**		
Morning relative humidity			0.567**		
Evening relative humidity			0.481**		
Wind speed			-0.272 ^{NS}		
Sunshine hours			-0.220 ^{NS}		
Rainfall			-0.353*		
Multiple linear regression equation			Coefficient of determination (R²)		
Y=14.05-0.09X ₁ -0.45X ₂ +0.08X ₃ -0.01X ₄ -0.03X ₅ -0.47X ₆ -0.06X ₇			0.775		

*Correlation is significant at 0.05 level **Correlation is significant at 0.01 level

Note: FN-Fortnight

X₁- Maximum temperature; X₂- Minimum temperature; X₃- Morning relative humidity

X₄- Evening relative humidity; X₅- Wind speed; X₆- Sunshine hours; X₇- Rainfall

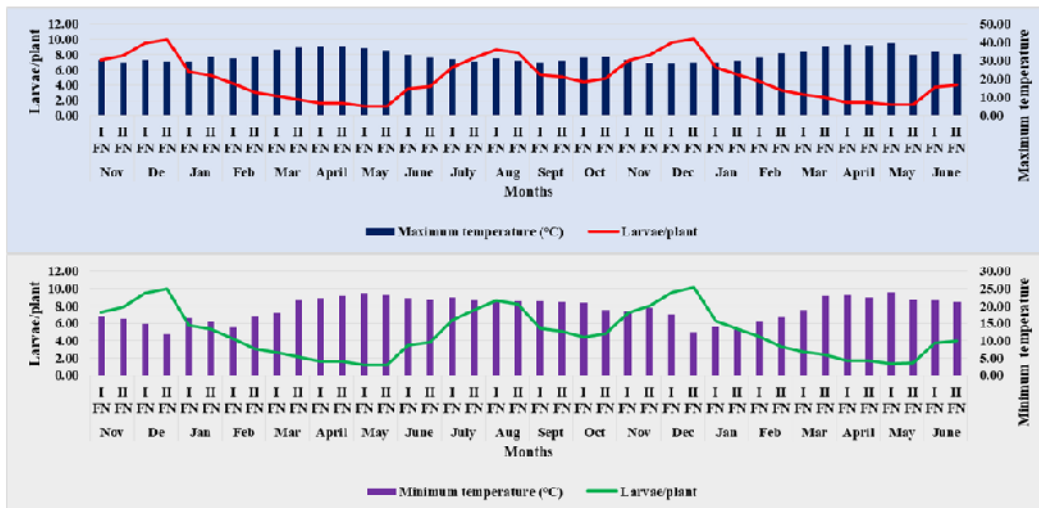


Fig. 1. The influence of maximum and minimum temperature on larval population of citrus butterfly.

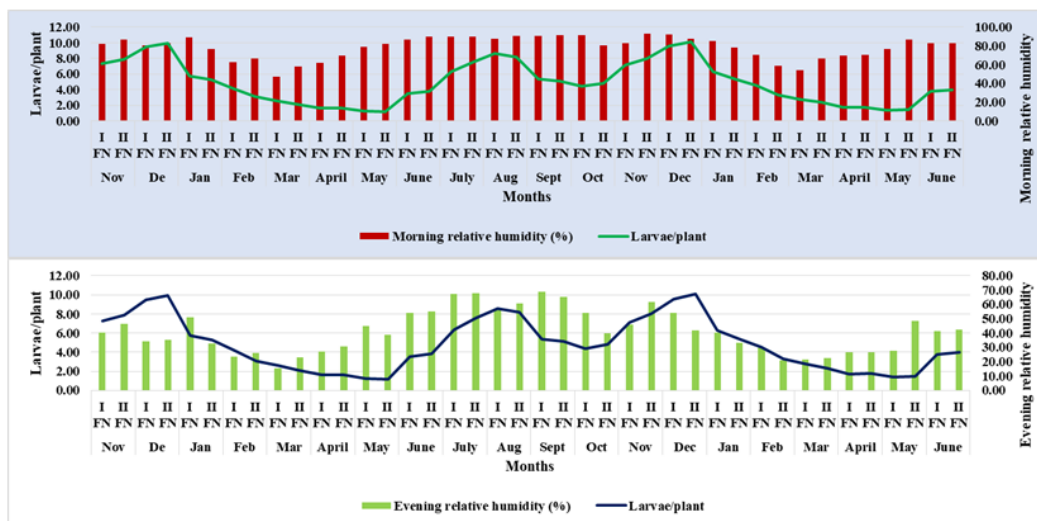


Fig. 2. The influence of morning and evening relative humidity on larval population of citrus butterfly.

CONCLUSION

The outcome of present study clearly indicated that citrus butterfly activity was noticed throughout the year with two peak population during August and December months. The correlation data indicated that temperature and relative humidity are the two important factors that significantly affect the seasonal abundance of citrus butterfly on acid lime. This information can be very much useful in order to initiate control measures, and it helps to develop prediction model about outbreak of pests based on data on abiotic factors.

FUTURE SCOPE

The citrus butterfly is one of the severe pests of acid lime. The management of pest greatly demands information on incidences of pest at various phenological stages of the crop. The information

generated on incidence and correlation with weather factors during present study forms valuable asset to develop crop-pest ecological model to predict the incidence of pest well in advance and it help to forewarn farmers to initiate necessary measures against pest.

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Conflict of Interest. None.

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