RESEARCH ARTICLE

SEASONAL INCIDENCE OF CITRUS BUTTERFLY, *PAPILIO DEMOLEUS* LINNAEUS (LEPIDOPTERA: PAPILIONIDAE) IN ACID LIME

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ABSTRACT

The studies on seasonal incidence of citrus butterfly, *Papilio demoleus* L. on acid lime revealed that maximum temperature (-0.385) showed negative significant association and evening relative humidity (0.497) showed positive significant association with butterfly larval population in citrus during 2015-16. Regression analysis of the citrus butterfly incidence during April 2015-March 2016 indicated that all the weather parameters i.e., maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rainfall, rainy days, sunshine hours and wind speed together influenced citrus butterfly incidence to the extent of 48.5 per cent (R^2=0.485) and regression equation models developed were $Y = -41.152 - (1.068)$ Max Temp $-(0.688)$ Min Temp $+ (0.002)$ Mor RH $+ (0.381)$ Eve RH $+ (0.030)$ Rf $+ (1.227)$ Rd $- (0.347)$ Ssh $+ (0.585)$ Ws respectively.

Key words: Seasonal incidence, Citrus butterfly, *Papilio demoleus* L, Acid lime

INTRODUCTION

Citrus is one of the important fruit crops and is grown in more than 52 countries around the world. Citrus industry is the third largest, in the world after mango and banana. Citrus crop is being infested by around 165 species of economically important insect pests in India causing up to 30 per cent yield loss (Pruthi and Mani, 1945). In India about 250 species of insects have been found attacking and spoiling various citrus species (Nayar *et al*., 1976). About 55 insect and mite species were recorded from Rayalaseema region (Ramasubba *et al*, 1989). Among various insects citrus butterfly, *Papilio demoleus* Linnaeus commonly known as the lime or citrus swallowtail, has a successful dispersal and becoming a major pest of citrus plants throughout Asia *P. demoleus* feeds on the foliage of citrus trees and is regarded as a major citrus pest especially in nurseries the larval forms cause serious damage to citrus family by devouring large quantity of foliage during the later stages of their development, particularly in Southern and Southeast Asia. Narayanamma *et al*. (2001) observed 83 per cent defoliation in sweet oranges grown in Southern zone of Andhra Pradesh.

MATERIALS AND METHODS

Studies were carried out on Balaji acid lime trees grown at AICRP on Fruits (Citrus), Tirupati from April 2015 to

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March 2016. Observations were recorded on 10 unprotected randomly tagged trees @ 8 twigs of approximately 15 cm length at four directions of the tree to know the population fluctuations during the period of study and also to correlate the population with climatic variations. From each tree, the data on larval population of citrus butterfly were taken at fortnightly interval. These studies also provide information about the favourable periods for pest build up that help in the management of the pest. The weather parameters *viz.,* maximum temperature and minimum temperature, morning relative humidity, evening relative humidity, rainfall, rainy days, sunshine hours and wind speed were recorded on daily basis from April, 2015 to March, 2016 and compiled the data as standard week.

RESULTS AND DISCUSSION

The larval population of *P. demoleus* was recorded at fortnightly intervals starting from the appearance of the pest. The data regarding larval population, and their correlation with temperature (maximum and minimum), relative humidity (morning and evening), rainfall, rainy days, sunshine hours and wind velocity were presented in table 1. The incidence of pest infestation started from first fortnight of June 2015 (2.3 larvae/tree). The population increased gradually from second fortnight of July 2015 (5.95 larvae/tree) to second fortnight of October 2015 (9.75 larvae/tree) and again incidence was declined during first fortnight of November may be due to heavy rainfall (212.07mm) and again incidence was increased from second fortnight of November 2015 to second fortnight

Table 1. Seasonal abundance of citrus butterfly, *Papilio demoleus* L. on acid lime during April, 2015 to March, 2016

Period of observation	Avg. No. of caterpillars/ tree	Maximum Temperature (^{0}c)	Minimum temperature (^{0}c)	Relative humidity morning (%)	Relative humidity evening (%)	Rainfall (mm)	Rainy days (days)	Sunshine hours (h)	Wind speed (kmph)
I FN April, 2015	0.00	33.71	22.20	87.40	48.14	40.20	2	7.31	3.53
II FN April, 2015	0.00	35.90	22.60	89.10	40.40	24.00	2	6.13	5.37
I FN, May, 2015	0.00	38.10	25.80	53.00	38.40	0.00	0	5.96	4.50
II FN, May, 2015	0.00	41.60	26.10	51.70	27.40	0.00	0	4.52	9.00
I FN, June, 2015	2.30	37.70	25.10	65.90	42.00	0.00	0	4.51	4.80
II FN, June, 2015	2.75	37.00	26.40	65.30	37.90	29.7	1	7.24	9.30
I FN, July, 2015	4.52	38.00	26.50	74.60	36.90	7.00	1	4.49	11.43
II FN, July, 2015	5.95	36.60	25.20	77.10	41.70	14.20	2	4.69	8.70
I FN, August, 2015	7.52	35.70	26.50	71.40	45.60	0.00	0	6.77	10.10
II FN, August, 2015	8.17	35.00	21.00	82.30	46.30	49.20	1	4.07	7.50
I FN, September,2015	9.92	31.60	22.80	89.30	62.43	0.00	0	5.8	6.41
II FN, September,2015	10.42	33.30	20.70	84.00	51.71	73.00	3	5.06	4.10
I FN, October, 2015	8.92	33.10	20.90	87.10	55.60	114.20	3	8.23	3.10
II FN,October, 2015	9.75	32.00	21.00	81.90	64.70	0.00	0	4.83	4.80
I FN, November, 2015	3.82	28.70	23.00	88.90	79.00	212.07	3	0.79	3.20
II FN, November, 2015	5	28.10	22.00	95.40	80.40	170.00	3	3.41	7.90
I FN, December, 2015	6.5	30.40	20.60	91.90	63.90	0.00	0	6.56	2.80
II FN, December,2015	5.2	29.70	18.10	88.00	60.60	0.00	0	7.93	2.20
I FN, January, 2016	4.1	29.86	18.40	87.43	61.29	0.00	0	7.74	4.70
II FN, January, 2016	3.2	29.80	16.77	92.00	59.29	0.00	0	6.01	3.00
I FN, February, 2016	2.5	32.89	17.10	85.57	33.86	0.00	0	8.84	3.00
II FN, February, 2016	1.25	32.69	18.97	88.86	43.43	0.00	0	8.67	4.00
I FN, March 2016	0.27	36.06	24.63	80.86	41.00	0.00	0	6.1	3.75
II FN, March, 2016	0.05	36.56	23.50	78.43	32.14	0.00	0	8.14	3.90

*Significant at 5 % probability

Table 2. Relationship between *Papilio demoleus* L. larval population on balaji acid lime and weather factors

S.No	Weather parameter	Correlation coefficient
1	Maximum temperature	-0.385*
2	Minimum temperature	-0.189 NS
3	Relative humidity-mor	0.321 NS
4	Relative humidity-eve	0.497*
5	Rainfall	0.198 NS
6	Rainy days	0.233 NS
7	Sunshine hours	-0.184 NS
8	Wind speed	0.113 NS

NS Non significant; *Significant at 5 % probability

Table 3. Regression analysis of citrus butterfly in relation to weather parameters during 2015-2016 at AICRP, Tirupati.

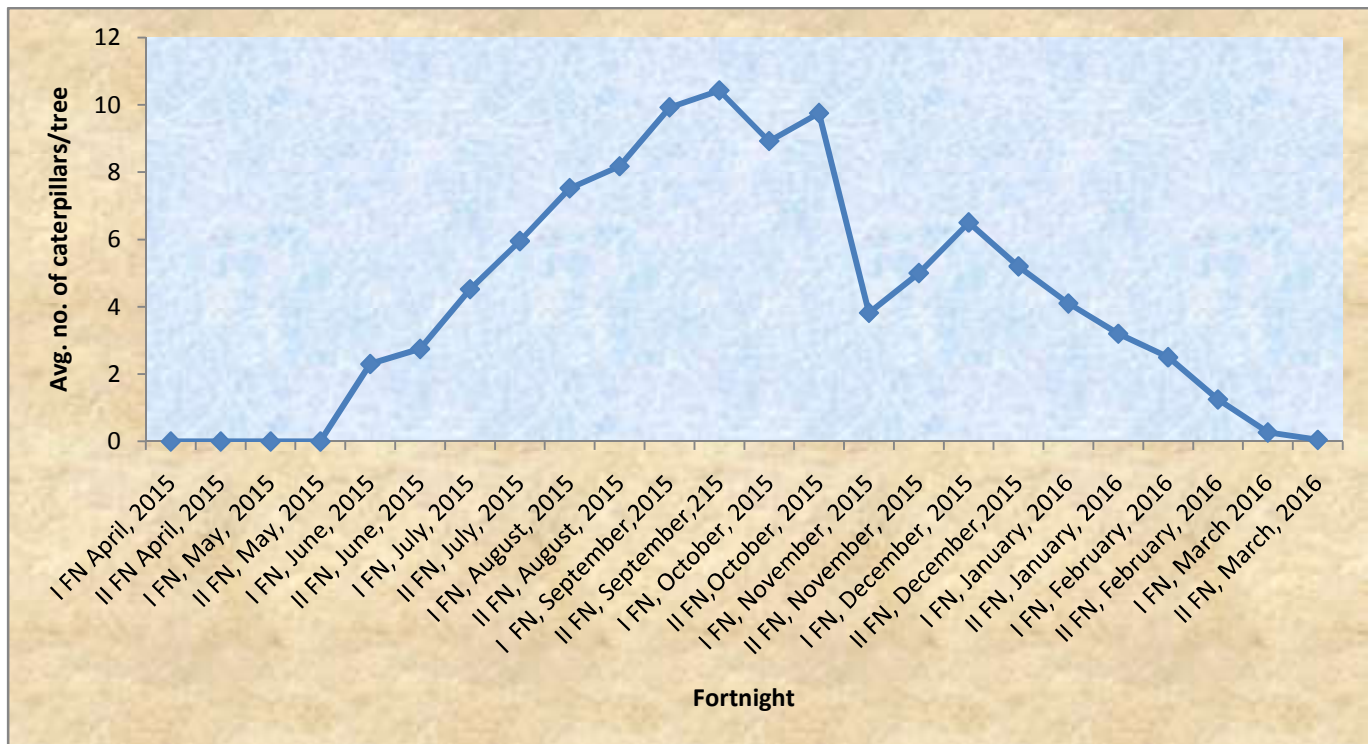| Regression model	Regression equation	R^2 value
Citrus butterfly	Y = -41.152 - (1.068) Max Temp - (0.688)Min Temp +(0.002)Mor RH + (0.381)Eve RH + (0.030)Rf +(1.227)Rd - (0.347)Ssh + (0.585)Ws	0.485

Fig 1. Seasonal incidence of citrus butterfly, *Papilio demoleus* L. during 2015-2016 at AICRP on Citrus, Tirupati

of December 2015 and again pest decreased slowly from first fortnight of January 2016 (4.1 larvae/tree) and least incidence was observed from second fortnight of February 2016 (2.5 larvae/tree) to second fortnight of March 2016 (0.05 larvae/plant). Highest larval population of 10.42 larvae/tree was recorded during second fortnight of September 2015 which coincided with the emergence of new flush during which period maximum temperature (33^0C), minimum temperature (20.7^0C), morning relative humidity (84%) and evening relative humidity (51.71%) were recorded (Fig. 1). Correlation between butterfly larval population and weather parameters *viz.,* maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rainfall, rainy days, sunshine hours and wind velocity were worked out and co-efficient values are presented in table 2. The values of correlation coefficients (r) were then tested for their statistical significance.

Correlation studies of citrus butterfly incidence in relation to weather parameters at All India Co-ordinated Research Project on Fruits (Citrus), Tirupati: Correlation analysis between avg. no. of caterpillars/tree with weather parameters indicated that maximum temperature (-0.385), showed negative significance and positive significance with evening relative humidity (0.497).

Regression analysis of citrus butterfly incidence in relation to weather parameters at All India Co-ordinated Research Project on Fruits (Citrus), Tirupati: Regression analysis of data showed influence of weather parameters on citrus butterfly incidence in citrus at All India Co-ordinated Research Project on Fruits (Citrus), Tirupati.

The full model regression equations developed were

Y = -41.152 -(1.068) Max Temp -(0.688)Min Temp + (0.002)Mor RH + (0.381) Eve RH + (0.030)Rf + (1.227)Rd - (0.347)Ssh + (0.585)Ws

Regression analysis of the citrus butterfly incidence during April 2015-March 2016 indicated that all the weather parameters i.e., maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rainfall, rainy days, sunshine hours and wind speed together influenced citrus butterfly incidence to the extent of 48.5 per cent (R^2=0.485) Table 3. The findings of the present investigation were comparable with the studies of Ganguli and Ghosh (1967) who reported that the occurrence of citrus butterflies in the months of February, April, June, August and November when there were low temperature and high relative humidity. Sahu *et al.* (2015) observed maximum population of citrus butterfly during the month of September. Ramakrishna rao *et al.* (2015) revealed that the highest larval population of citrus butterfly was recorded during second fortnight of December. However, according to Hayes (1957) and Resham *et al.* (1986) the population was negligible in winter months. According to Maheswara babu (1988) pest population declined during October and there was no population from second fortnight of November to the end of December. According to Lakshmi narayanamma (2000) pest population declined from March and negligible incidence of the pest was observed from April to July. The difference in the occurrence of pest activity might be due to the major variations in the weather factors from one region to another region where wide variations exists in the climatic conditions.

Conclusion

Studies were made on the seasonal incidence of citrus butterfly on acid lime during April 2015-March 2016. The incidence of pest infestation started from first fortnight of June 2015 (2.3 larvae/tree). The population increased gradually from second fortnight of July 2015 (5.95 larvae/tree) to second fortnight of October 2015 (9.75 larvae/tree) and again incidence was declined during first fortnight of November may be due to heavy rainfall (212.07mm) and again incidence was increased from second fortnight of November 2015 to second fortnight

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