



ISSN (E): 2277-7695

ISSN (P): 2349-8242

TPI 2024; 13(1): 18-21

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www.thepharmajournal.com

Received: 25-10-2023

Accepted: 28-11-2023

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Seasonal incidence of lemon butterfly (*Papilio demoleus* Linnaeus) in relation to weather parameters on acid lime

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Abstract

The present investigation entitled “Seasonal incidence and management of lemon butterfly *Papilio demoleus* Linnaeus on acid lime (*Citrus aurantifolia* Swingle)” was undertaken at AICRP on Fruits, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri during 2022-2023. The studies on seasonal incidence of lemon butterfly on acid lime indicated that the pest occurs throughout the year except summer months. From the data it was observed that lemon butterfly incidence started increasing from June and attended its peak at 37th Standard Meteorological Week (first fortnight of September). The data on correlation studies of lemon butterfly incidence with weather parameters indicated that there was significant negative correlation between larval population of lemon butterfly with maximum temperature ($r = -0.698^{**}$). However, lemon butterfly incidence showed positive correlation with morning relative humidity ($r = 0.808^{**}$), evening relative humidity ($r = 0.885^{**}$) and wind velocity ($r = 0.608^{**}$), whereas, negative and non-significant negative correlation was found with minimum temperature ($r = -0.035$) and rainfall ($r = -0.104$).

Keywords: Seasonal incidence, acid lime, *Papilio demoleus*, weather parameters, correlation

Introduction

Citrus is one of the important commercial fruit crops of the world and is native of tropical and sub-tropical regions of south-east Asia (Webber, 1967) [16]. Citrus industry is the third largest industry in the world after mango and banana, demonstrating its significant economic impact. China ranks first with 22.9 million tonnes followed by Brazil with 22.7 million tonnes and USA with 10.4 million tonnes.

While, India stands in 4th position with 10.48 million tonnes (Kumar *et al.*, 2022) [9]. Acid lime in India is the most valuable fruit crop, which is valued for its nutritional and medicinal benefits. It is a good source of Vitamin- C (62.90 mg/100 ml), Vitamin- B1, Vitamin -B2 and minerals like Calcium (90 mg /100 ml), Phosphorus (20 mg/100 ml) and Iron (0.3 mg/100 ml) (Abhilash *et al.*, 2018) [11]. In India, citrus fruit covers 10.91 lakh hectares of area and 14150 thousand metric tonnes production and acid lime is the second largest citrus crop according to area and production. Among citrus fruits, acid lime covers about 322 thousand hectares area and about 3517 thousand metric tonnes production. While, Maharashtra covers 33.30 thousand hectares of land under lime cultivation and 324.7 thousand metric tonnes of total fruit production (Anonymous, 2022) [2]. As many as 250 species of insect and mite pests have been reported to infest citrus plants in both the nurseries and orchards and causing heavy economic losses (Nayar *et al.*, 1976; Shivashankar and Singh, 2005) [12, 15]. Among these pests, citrus butterfly, *Papilio demoleus* Linnaeus commonly known as swallowtail, (Lepidoptera: Papilionidae), is one of the economically important pest of citrus plant worldwide (Homziak *et al.* 2006 and Rajanikumar *et al.* 2014) [7, 13]. Lemon butterfly infestation results in complete defoliation of the young tree leaving only midribs and decreased photosynthetic activity causing reduction in vigour, plant growth, and finally fruit yield (Bhutani and Jotwani 1975; Narayanamma *et al.*, 2001) [3, 11]. Keeping in view the losses caused by this pest, the present study was designed to estimate the population density of lemon butterfly and its correlation with climatic parameters.

Material and Methods

In order to record seasonal incidence of lemon butterfly, *Papilio demoleus* Linnaeus, the observation were recorded from acid lime orchard Var. Sai Sharbati plants located at AICRP

on Fruits, Department of Horticulture, MPKV, Rahuri. Ten acid lime plants were randomly selected and tagged and observations were recorded at weekly interval by counting the number of larval population on plants during the July 2022 to June 2023. The selected plants were kept free from application of any insecticide throughout study period of recording observations. All other recommended agronomical practices were adopted. The larval population was then correlated with the prevailing meteorological weather parameters viz., maximum temperature (°C), minimum temperature (°C), rainfall (mm), relative humidity (%) and wind velocity (km/hr) using standard statistical procedure to find out the specific impact of weather parameters on lemon butterfly *Papilio demoleus* Linnaeus on acid lime plant.

Results and Discussion

The data on seasonal incidence of lemon butterfly, *Papilio demoleus* L. during July 2022 to June 2023 is presented in Table 1.

Seasonal incidence of lemon butterfly *Papilio demoleus* L. on acid lime

The results revealed that the activity of lemon butterfly *Papilio demoleus*, on acid lime was observed from the first fortnight of July 2022 and thereafter its population started increasing upto the month of September 2022 and gradually decreasing afterwards upto April and May. Peak larval population were recorded in the month of September (37th SMW) i.e. 8.6 larvae/plant followed by 8.2 larvae/plant in 38th SMW and minimum population was observed in month of April and May (14th SMW – 22th SMW).

Almost similar observations were reported by Devi *et al.*, (2018) [4] that the peak activity of larval population was in 39th Standard Meteorological Week and the lowest average population of caterpillar i.e. 0 larva/5 replicates of kinnow was recorded in 18th, 20th, 21st and 24th to 28th SMW. In close

proximity to current findings, Jahnavi *et al.*, (2018) [8] recorded high density of citrus butterfly larvae (8.17 larvae/plant) during August month and nil incidences during April and May months. Similarly, Sahu *et al.*, (2015) [14], Maheswarababu (1988) [10] observed maximum population of citrus butterfly during the month of September which are in conformity with the current findings.

Correlation Coefficient between weather parameters and incidence of lemon butterfly on acid lime during July 2022 to June 2023

The data pertaining to correlation coefficient between weather parameters and incidence of lemon butterfly, *Papilio demoleus* is presented in Table 2. The data indicated that there was significant negative correlation between lemon butterfly larval population and maximum temperature ($r = -0.698^{**}$). However, lemon butterfly incidence showed positive correlation with morning relative humidity ($r = 0.808^{**}$), evening relative humidity ($r = 0.885^{**}$) and wind velocity ($r = 0.608^{**}$), whereas negative and non-significant correlation was found with minimum temperature ($r = -0.035$) and rainfall ($r = -0.104$).

The results of present study is in line with findings of Haldhar *et al.*, (2010) [6] where the egg and larval population of citrus butterfly had positive correlation with morning and evening relative humidity, and negative correlation with maximum temperature, and rainfall. Similarly, Devi *et al.*, (2018) [4] reported significant positive correlation with morning and evening relative humidity, wind velocity and significant negative correlation with maximum temperature. The results of present investigation are in agreement with Janhavi *et al.*, (2018) [8], Dileep Kumar *et al.*, (2022) [5] and Sahu *et al.*, (2015) [14] who found significant negative correlation with maximum temperature and significant positive correlation with evening and morning relative humidity.

Table 1: Seasonal incidence of lemon butterfly *P. demoleus* on acid lime during July 2022 to June 2023

Month	SMW	Average no. of caterpillars/plant	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Wind Velocity (km/hr)
			Maximum	Minimum	Morning	Evening		
July 2022	27	4.1	30.5	23.9	84	63	15.2	4.4
	28	4.5	29.7	23.4	89	80	37.6	2.4
	29	5.3	29.3	24	85	63	7.4	4.5
	30	5.8	29.1	23.5	97	55	68.4	3.4
	31	6.1	30.7	23.5	89	62	120	1.0
August 2022	32	6.6	28.3	24.1	84	71	56.2	3.1
	33	6.9	28.3	24.1	81	70	2.6	5.4
	34	7.2	29.8	24.1	81	64	1.6	4.0
	35	7.6	31.6	23.2	87	54	22.8	1.5
September 2022	36	7.8	30.8	23.5	91	65	150	1.3
	37	8.6	29	23.6	91	74	75.8	1.8
	38	8.2	27.5	22.1	90	70	98	2.7
	39	7.9	29.6	22.7	90	63	32.6	1.0
October 2022	40	7.1	31.4	23	88	58	30.8	2.0
	41	7.0	28.5	22.7	93	69	65.8	1.5
	42	6.9	27.6	21.6	92	71	59	1.2
	43	5.8	28.2	18.7	85	43	3.6	0.6
	44	4.4	29.6	17.3	83	36	0	1.0
November 2022	45	4.3	31	17.2	77	27	0	1.0
	46	3.6	30.1	15.6	85	34	0	1.3
	47	4.3	28	14.7	78	32	0	0.9
	48	3.2	30.5	16.2	81	36	0	0.6
December 2022	49	3.5	30.1	16.3	88	39	0	0.6
	50	3.3	28.9	17.3	87	47	0	1.1
	51	2.9	30.3	16.2	83	34	0	0.8
	52	2.7	31.7	16	81	31	0	0.8

January 2023	1	3.4	28.3	15	91	42	0	0.4
	2	3.7	25.2	14.6	88	54	0	1.5
	3	3.5	26.7	14	89	44	0	0.5
	4	3.6	24.7	12	92	42	0	2.0
	5	2.1	28.7	12.1	82	24	0	0.8
February 2023	6	2.3	27.3	13.2	81	33	0	1.5
	7	1.9	29.2	14.4	80	30	0	0.7
	8	1.2	33	16.1	73	23	0	1.0
	9	0.9	33.1	18.1	55	21	0	0.6
March 2023	10	1.8	32.3	19.7	73	30	0	1.4
	11	1.3	35.7	21.1	59	18	2.4	2.0
	12	1.2	37.6	22.5	55	16	0	2.1
	13	1.1	38.1	22.3	55	14	0	1.8
April 2023	14	0.1	34.7	23.4	52	12	0	1.9
	15	0.0	38.9	24.5	59	17	0	1.2
	16	0.0	38.8	24.9	52	16	0	1.9
	17	0.0	39.4	27.5	45	17	0	2.0
	18	0.0	39.9	26.4	50	17	0	3.2
May 2023	19	0.1	40.9	28.1	50	21	0	3.6
	20	0.3	39.1	27	60	23	1.6	4.9
	21	0.2	37.5	27	61	25	0	5.9
	22	0.6	38.3	26.3	65	25	0	6.0
June 2023	23	1.4	38.1	26	65	31	8.6	3.8
	24	2.2	35.8	26.2	72	39	9	3.4
	25	3.1	33.4	24.4	80	52	96.6	3.5
	26	3.7	31.1	24.3	84	58	58.2	2.3

Table 2: Correlation Coefficient between weather parameters and incidence of lemon butterfly on acid lime during July 2022 to June 2023

Weather parameters	Correlation coefficient value(r)
Maximum temperature (°C)	-0.698**
Minimum temperature (°C)	-0.035
Morning relative humidity (%)	0.808**
Evening relative humidity (%)	0.885**
Wind velocity (km/hr)	0.608**
Rainfall (mm)	-0.104

** Significant at 1% probability

* Significant at 5% probability

Conclusion

The activity of lemon butterfly observed throughout the year except April and May month with peak activity during September (37th SMW). The abiotic factors viz., morning relative humidity, evening relative humidity and wind velocity were found positively correlated indicating that the increase in larval population was synchronized with these factors. However, maximum temperature shows significantly negative correlation.

The remaining factors viz., minimum temperature and rainfall were found to be negative and nonsignificant with larval population, whereas, maximum temperature shows significantly negative correlation.

Acknowledgement

The authors thank the Head, Department of Entomology, PGI, MPKV, Rahuri (MS) for providing necessary help and guidance during the course of investigation. The present study was a part of M.Sc. (Agri.) dissertation submitted by S.A. Meshram to PGI, Mahatma Phule Krishi Vidhyapeeth, Rahuri (MS), India, during year 2023.

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