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E: ISSN NO.: 2455-0817 *Remarking An Analisation*

Influence of Temperature on Developmental Stages of Lemon Butterfly, Papilio Demoleous (Linn.) *(Papilionidae ; Lepidoptera)*

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Abstract

The temperature have direct influence on the rate of development and survival of an insect. The activity and movement of insects caused by fluctuation of temperature often led to their survival. The laboratory studies made on the effect of different level of temperature (5°C, 10c, 15c, 20c, 25c, 30c, 35c, 40c, 45c, and 50c)on the incubation, larval, and pupal period of Papilio demolious (Linn.), a serious pest of citrus plant. It revealed that eggs were failed to hatched into larvae at extremely low (5c, and 10c) and high temperature(50c). The larval period as well as pupal period were also affected by the exposure of different intensity of temperature. Larval and pupal period increased with decreasing the temperature level and larvae goes into hibernation at extreme low temperature with 96- 120days larval period. Only IVth and Vth instar larvae were capable to tolerate 5c temperature with maximum days of larval period and moulted into pupae. Similar results were found for pupal development. The optimal or moderate temperature were 25c to 40c for the development of experimented insect. Controlled experiment was conducted at level of 30c temp. and 60±5 relative humidity.

Keywords: Survivality, Papilio demolious, papilionidae, Lepidoptera, Abiotic, pupae

Introduction

Lemon butterfly, Papilio demoleous (linn.) belongs to the genus Papilio which has been placed in the family Papilionidae of order Lepidoptera, firstly reported by Linneus (1758), Pruthi & Mani (1945), Butani (1975), and Ram P, Pal R K, Singh J (2000), as a voracious feeder of lemon leaf. After a major survey Bell T.R. (1957) was found the serious infestation of larvae of lemon butter fly from Kashmir to Cylon east word to Burma , west word to Percia, also in China & Formosa region which cause great loss to citrus plants. Ayyer T.V.R. (1919), Mishra C.S.(1919), Desh Pandey & Karnadikar (1948) were discovered some other host plants of this pest like Beal, Ber, Glycosism etc. Saljioqi, N and M.A. Rafi (2006) also studied the biology and host preferences of lemon caterpillars.

The incubation period was 2.7 – 5.5 days, varies from March to November with 83.70% - 93.20% viability (Brar, 1959). Maheshra babu (1988), Resham et.al.(1986), Singh & Gangwar (1989), Radke & Kandelkar (1989) studied the larval forms and identified the 5 instars and 4 moults with 13 – 16 days larval period but Atwal (1964), Brar & Rathor (1973) Ashoken (1997) stated that larval period was vary from 8.5 -28.8 days depending upon temperature and relative humidity. They also observed that prepupal & pupal period as well as viability was also affected by the climatic conditions, ranges from 8.2 days during June and 128 days in November to March called hibernation period, named by Brar & Rathor (1973). The workers like , Tripathi et al. (19998), Ather, Rafi. (2000) and Tiatula Jameer et al. (2012) also worked on the biology of citrus butterfly. Sharifi and Zavea (1970) worked on the effect of Abiotic factors in field conditions from June to September. Hays (1957) was observed the effect of temperature on hatchability of papilio eggs. The effect of constant temperature on the rate of development on 4th instar larvae ,prepupae, and pupae of citrus butterfly observed by Atwal 919710, Patil et al. (1984), Gautam R.D. (1986), Mustafa, T S (1988) and Garg J R et al. (1992)

found that the fluctuation of Abiotic factors directly affect the development, percentage of hatching and mortality rate of developmental stages of insects. It has been established in case many sps. Of insects. In the present investigation was undertaken to study the influence of different intensity of temperature on the survival and development of various immature stages of P. demoleous which was not well established, there for a detailed study was conducted.

Aim of Study

Present Study try to find out the possible effects of different level of temperature on the biology of Papilio Demolous which will be useful to study the impact of Abiotic factors on the development of Insects

Material and Methods

To study the effect of temperature on immature stages of P. demolious, various possible levels of temperature ie. 5C, 10C, 15C, 20C, 25C, 30C, 35C, 40C, 45C, and 50C were maintained in the incubators. The 60+5 % relative humidity was provided at all the level of temperatures in incubators. All the stages of lemon butterfly namely, eggs, I, II, III, IV, and Vth instar larvae, pre pupae and pupae were selected from laboratory reared insects and kept in to various rearing jars having fresh citrus leaves which are utilized by caterpillars as food. At least 50 eggs , 30 larvae, pre pupae and pupae were taken in each replicate. The experiments were repeated three times. The control was also running in another incubator.

The observations were recorded after six hours of intervals. When the eggs were hatched and caterpillars moulted in to next instar as well as pre pupae changed into pupae and adult emerged from pupae. Carefully collected the data during experiment conducted. The same data also noted from controlled experiments.

Result and Discussion

The experimental data were collected and placed in tables 01, 02, and 03. And results were analysed statistically as follows.

On Incubation Period

The data related to temperature impact on egg development are placed in table 01. The tabulated data indicated that the incubation period of eggs depend upon the fluctuation of temperature. The eggs which kept at 5C temperature, failed to hatch, while some results were obtained at 10C. It was the minimum temperature at which 18% of eggs were hatched with maximum incubation period of 12.19 days. It was further observed that at 15C temperature eggs were hatched after a long time, 9.08 days of incubation period with 40% hatching and 59.18% of mortality. At 20C and 25C incubation period was 5.77 and 4.08 days with 58% & 74% hatching. Furthermore, at 30C and 35C incubation period was further reduced to 3.62 and 3.20 days which minimum and moderate with highest percentage of hatching i. e. 94% and 98% respectively. The results reveals that at 40C the incubation period was 2.59 days and 82% eggs were hatched. But at high temperature, i. e. 45C, the recoded incubation period was shortest, 2.27 days with 40% hatching. No hatching was recorded at 50C , because all the eggs were dried. These findings were in agreement with the study of Timberlin et. al. (2002) and Mahesh Pathak (2003). In the controlled experiment the 98% eggs were hatched with moderate incubation period (3.37days).

On Different Instar Larvae

The observations of influences of different temperature levels on all larval forms are placed in table 02.

A – On First Instar Larvae

The aforesaid table revealed that just hatched larvae kept at 5C tem. Failed to keep alive like the eggs. But at 10C temp. 23.33% larvae were survive to moult with highest level of mortality (75%) and larval period (4.86days). At 15C, survivability increased as 33.33% with larval period of 3.99days. The larval period reduced to 3.15 days with 50% and 46% of mortality. Whyle 10.71% mortality, 83.33% survival and 2.57 days larval period were reported at 25C temperature. The moderate larval period, 2.29 and 1.99 days and 93.33% & 90.00% survival rate was recorded at 30C % 35C temp. respectively. The findings indicating that at 45C temp. the larval period gradually decreased up to 1.99 days by increasing the mortality rate, 32.33% No moult was observed at 50C . The observations were in conformity with Balo, J S & S A L Haywards (2010).

B – On Second Instar Larvae

The tabulated data indicate that no survival of 2nd larvae at 5^{0}C temp. but at 10^{0}C the larval period were 5.13 & 4.43 days having 30.00% & 46.66% rate of survival, respectively. The mortality rate decreased up to 41.38% and 24.48% with decreasing the larval period of 4.01 and 3.53 days at 20^{0}C and 25^{0}C temp, respectively. The maximum survivability 93.33%, and 83.33% . as well as 2.89 & 2.41 days larval period were reported at temp. level of 30^{0}C & 35^{0}C . At 40^{0}C & 45^{0}C temperature the larval period were further reduced as 2.01 & 1.72 days with 34.14% & 68.14% rate of mortality. No survival at 50^{0}C temp. Similar data were recorded by Regniere, J. et. al. (2012). The controlled result showing the 2.62 days larval period and 3.34% mortality.

C – On Third Instar Larvae

The calculated data were indicated that all third instar larvae died at 5C temp. but some larvae survived at 10^{0}C & 15^{0}C temperature with mortality rate of 62.07% & 48.27%, showing 5.06 & 4.76 days larval period. At 20^{0}C, 25^{0}C, 30^{0}C & 35^{0}C temperature, the larval period gradually decreased as larval period 4.15, 3.723.38 and 2.68 days with highest level of survivability rate (up to 96.00%). But at 40^{0}C & 45^{0}C temp. mortality again increased (20.69% & 44.83%) with larval period of 2.01 & 1.76 days. Tomasz Jawsoki & Jack Hilszezaski (2013). All the larvae died at 50^{0}C temperature.

D- On Fourth Instar Larvae

The findings reveals that longer larval period i.e. 11.84 & 09.94 days, higher mortality i.e. 83.34% & 60.00% at 5^{0}C & 10^{0}C temperature. The time to moult the 4th instar in to 5th instar larvae at 15^{0}C, 20^{0}C, 25^{0}C & 30^{0}C was 8.43, 6.58, 4.62 & 3.41 days with 60.00%, 73.33%, 80.00% & 1000.00% of survivality. The larval period was again reduced as 2.77, 2.09 and 1.78 days having 90.00%, 80.00% and 66.66% mortality at

the level of 35^0C, 40^0C and 45^0C temperature. Mahesh Pathak and co workers (2003) also found similar results during his course of work.

E – On Fifth Instar Larvae

The calculated observations were indicated that as the temp. ranges increase as 5^0C, 10^0C, 15^0C and 20^0C, the larval period were gradually decreased as 16.22, 12.85, 9.52 and 7.07 days with increasing the rate of survival as 33.33%, 50.00%, 63.33% and 80.00%, respectively. The highest survivability were at 25^0C, 30^0C which were 90.00%, 100.00% and 100.00% having 5.13, 3.75 and 3.28 days larval period. The larval period recorded as 2.610 and 2.21 days at 40^0C and 45^0C temp .with 86.00% and 80.00% survivability. Timberlin, Alder, Myers (2009) observed similar trends in the development of Black soldier fly in relation to temperature. The fifth instar larvae were also unable to tolerate the 50^0C temperature.

On Papal Stages

The study on the impact of the temperature on the survival and development of pupal stage was carried out the findings were placed in table – 03.

The similar effects were found on the survival and pupal period like incubation and larval period of experimental insect, P. demoleous Linn. No pupae were emerged into adults at extremely low temperature (5^0C). The low temperature prolonging the pupal period and it was significant below 20^0C. The pupae reached in the hibernation stage and required 95.26±20.19 days with 76.66% mortality at 10^0C temperature, these findings were in agreement with the result of Balo & Haywards (2010). The pupal period was gradually decreased with increasing the temperature. The exposure of 15^0C and 20^0C temperature were required 59.03 & 24.85 days and 53.34% & 76.66% pupae were emerged. In the present investigation the 93.33%, 100%, & 100% pupae were emerged into adult in 11.01, 9.38 and 8.17 days at the level of 25^0C, 30^0C and 35^0C temperature. As the temperature increased the emergence rate decreased with decreasing pupal period their for at 40^0C & 45^0C the 80.00% and 50.00% emergence rate with 7.62 & 6.69 days pupal period was reported. The 100% mortality was recorded at 50^0C temperature, Atwal (1955) and Thomas G. et.al. (1993). But no mortality was found in controlled experiment with 8.64 days pupal period.

Concludingly, below or above ascertain temperature, no eggs were hatched as well as the larvae of different instar and pupae were failed to moult into the pupae and emerged into adult, respectively. During the course of laboratory work, it was proven that as temperature increased from 10^0C to 45^0C,the developmental period and mortality rate gradually decreased. The temperature intensity between 25^0C to 35^0C at 65±5% R.H. were found as moderate developmental period and maximum rate of survival. Hence it has been established that temperature is a main factor which directly influence the developmental activities of an insect.

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Table - 01.
Effect of temperature on the incubation period of P. demoleous at 60±5% R. H.

Temperature C	No.of eggs treated	Av. Incubation Period (days)	No. of eggs Hatched	Hatching %	Observed Mortality %	Corrected Mortality %
05	50	-	Nil	00.00	100.00	100.00
10	50	12.19±2.88	09	18.00	82.00	81.63
15	50	9.08±2.26	20	40.00	60.00	59.18
20	50	5.77±1.84	29	58.00	42.00	40.12
25	50	4.08±1.33	37	74.00	26.00	24.49
30	50	3.62±1.19	48	96.00	04.00	02.04
35	50	3.20±1.01	49	98.00	02.00	00.00
40	50	2.59±0.72	41	58.00	42.00	40.00
45	50	2.27±0.26	20	40.00	60.00	59.18
50	50	-	Nil	00.00	100.00	100.00
Control	50	3.37±1.03	49	98.00	02.00	00.00

Table - 03
Effect of temperature on pupal period of P. Demoleous at 60±5% R. H.

Temperature C	No.of pupae treated	Av.pupation period (days)	No.of pupae Emerged	%age of Emergence	observed Mortality %	correted Mortality %
05	30	-	00	00.00	00.00	100.00
10	30	95.26±29.19	09	30.00	70.00	76.66
15	30	59.03±11.29	16	53.33	46.67	46.67
20	30	24.85±6.66	23	76.66	23.34	23.34
25	30	11.01±3.81	28	93.34	06.67	06.67
30	30	9.38±2.27	30	100.00	00.00	00.00
35	30	8.17±1.99	30	100.00	00.00	00.00
40	30	7.62±1.66	27	80.00	20.00	20.00
45	30	6.69±1.01	15	50.00	50.00	50.00
50	30	-	00	00.00	100.00	100.00
control	30	8.64±1.83	30	100.00	00.00	00.00

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Table - 02

Summary of the effect of temperature on the developmental period of different instar larvae of P. Demoleous (Linn).C

Temp. C	No. of larvae treated	Ist INSTAR			IInd INSTAR			IIIrd INSTAR			IVth INSTAR			Vth INSTAR		
		Av. larval Period (days)	Survival %	Corr. Mortality %	Av. Larval Period (days)	Surviv. %	Corr. Mort. %	Av. Larval Period (days)	Surviv. %	Corr. Mort. %	Av. Laval Period (days)	Surviv. %	Corr. Mort. %	Av. Larval Period (days)	Surviv. %	Corr. Mort. %
05	30	---	00.00	100.00	--	00.00	100	---	00.00	100	11.84±3.34	16.66	83.33	16.22±6.18	33.33	66.67
10	30	4.86±1.44	23.34	75.00	5.13±2.11	30.00	68.96	5.06±2.51	36.66	62.07	9.94±2.99	40.00	60.00	12.85±5.11	50.00	50.00
15	30	3.99±1.12	33.34	64.29	4.43±1.44	46.66	51.73	4.76±2.01	50.00	48.27	8.43±2.45	60.00	40.00	9.52±3.05	63.33	36.67
20	30	3.15±0.88	50.00	46.43	4.01 ±1.23	56.66	41.38	4.15±1.77	66.66	31.04	6.58±1.99	73.33	26.67	7.07±2.33	80.00	20.00
25	30	2.57±0.82	83.33	10.71	3.53±0.99	73.33	25.48	3.72±1.44	76.66	20.69	4.41±1.23	100	00.00	5.15±0.68	98.00	00.00
30	30	2.29±0.63	93.33	03.81	2.89±0.77	93.34	03.79	3.38±1.21	96.66	00.00	3.41±1.03	100	00.00	3.75±0.59	100	00.00
35	30	1.99±0.19	90.00	06.89	2.41±0.53	83.33	13.44	2.61±0.42	90.00	06.89	2.77±0.69	90.00	06.89	3.28±0.49	100	00.00
40	30	1.81±0.23	63.33	32.14	2.01±0.33	63.34	34.14	2.01±0.22	76.66	20.69	2.09±0.54	80.00	16.34	2.61±0.44	86.66	13.34
45	30	---	00.00	100.00	1.72±0.12	30.00	68.96	1.74±0.17	53.34	44.83	1.78±0.25	66.66	33.34	2.21± 0.62	80.00	20.00
50	30	---	00.00	100.00	---	00.00	100	--	---	100	---	----	100	---	---	100
Cont.	30	2.25±0.83	93.33	06.63	2.61±0.99	96.66	03.34	3.08±1.11	96.66	3.34	2.89±0.88	100	00.00	3.52±1.09treate		00.00

*The experiments were conducted at 60±5 %R. H.