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Effect of temperature on preimaginal development of *Phyllocnistis Citrella Stainton* on Kagzilime

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ABSTRACT

An increase in temperature above 10 °C showed significant effect in reducing the duration of egg, larval, pupal stages and life span of *P. citrella* on Kagzilime. Significantly higher percentage of larvae could be pupated at 20 and 25 °C temperatures in comparison to lower (10 and 15 °C) or higher (30 and 35 °C) temperatures. Male and female moths lived longer at lower temperature than at the higher. The female moth that emerged from the larvae reared at 25 °C showed highest (52 eggs per female) fecundity, whereas at 35 °C, 17 eggs per female was observad. *Phyllocnistis citrella Stainton* had very congenial condition at 25 °C for its development and reproduction. There was negative association of temperature with duration of diffrent life stages of *P. citrella*.

Key Words : Temperature, Citrus leaf minor, Kagzilime

Citrus leaf miner, *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) is one of the most serious pests of citrus spp. in India and particularly in the Gujarat state. It is principally a nursery pest and attacks the tender leaves where the larvae feed on the epidermal tissues, creating serpentine mines, generally in the lower epidermis. As a result, the leaves get distroted and crumpled. The growth of the seedling is also checked considerably. Various workers (Pruthi and Mani, 1945 ; Atwal, 1964 ; Sandhu, 1964; Pandey and Pandey, 1964) studied the biology of the pest on rough lemon, but detailed information under nursery condition is not available. Efforts have been made here to understand the role of temperature on the biology of citrus leaf miner on Kagzi lime. The aim was to identify a base temperature and day degree (DD) requirement of different life stages of *P. citrella*.

MATERIALS AND METHODS

A laboratory experiment was conducted at six different temperatures viz., 10, 15, 20, 25, 30 and 35 ± 1 °C in BOD incubator containing citrus seedlings to evolve an optimum temperature for the development of *P. citrella*. At each temperature, 50 leaves containing eggs were

given a dot of red marker on their axils. The oviposited leaves were examined daily in the morning for the duration of different life stages of the *P. citrella*. The leaves containing pupae of *P. citrella* were collected and kept in a petridish (70 x 1.50 cm) containing moist blotting paper. The emerged moths from the pupae were paired and one pair was introduced in each glass chimney (21 x 26 cm), containing citrus seedling. Five per cent honey solution in fresh cotton swab was provided twice in a day to serve as food for moths kept in the incubator till their survival.

Determination of base temperature

The development rates for different stages at different temperatures were measured from the observations. For each stage, temperature verses development rate were regressed and best fit equations were obtained. Three temperature values 5, 7 and 9 °C have been used and egg, larval, pupal, adult and total life cycle were considered for the regression. The time intersect on the origin on the temperature axis was considered to be a base temperature for each stage as per the procedure described by Narwal *et al.* (1986). The base or critical temperatures were also obtained by correlating the actual time (days) taken by the various stages viz., egg, larval, pupal, adult and accumulated growing degree days (GDD) by using 5 °C, 7 °C and 9 °C base temperature for the corresponding stages. The pair which gives highest significant value is considered as the final base temperature which worked out to be at 5 °C.

Day degree requirement

By using the base temperature obtained by the preceding method, day degrees were computed for each stage by using following formula.

$DD = \sum$ Tav-Tb

Where, Tav = Mean daily temperature, Tb = Base temperature, $\sum$ = Duration of development in days (i = 1,2,3,.....n)

The growth index (GI) was computed for *P. citrella* using following formula

GI = Per cent larval survival / Larval duration (Days).

RESULTS AND DUSCUSSION

The date on duration of different stages of P. citrella (Table 1) revealed that egg, larval and pupal duration of *P. citrella* were significantly affected with increase in temperature above 10 °C. The longest (7.36 days) incubation period for the eggs of P. citrella was found at 10 °C which was significantly longer as compared to the rest of the temperatures. The incubation period at 35 °C (3.09 days), 30 °C (3.87 days) and 25 °C (4.19 days) took significantly shorter time as compared to 20 °C (5.56 days) and 15 °C (6.12 days). The highest (86.00%) egg hatching was at 25 °C compared to the lowest (76.00%) at 10 °C.

The larvae reared at 10 °C took significantly longer duration (17.95 days) as compared to that of other temperatures. The shortest (6.43 days) pupal period was found at higher (35 °C) temperature followed by longer duration with temperature

Table 1 : Effect of temprature on development of *P. citrella*

Temperature (°C)	Duration (days)							Fecundity (Av. no. of eggs/ female)	Growth	Egg hatch (%)
	Egg	Larval	Pupal	Longevity						
				Male	Female	Male	Female			
10	7.36	17.95	16.77	4.27	5.88	46.10	47.83	22.7	4.10	76
15	6.12	15.16	13.96	74.20	5.14	39.54	40.35	26.3	5.11	80
20	5.56	13.78	12.15	3.43	4.86	34.50	36.66	41.1	5.99	80
25	4.19	11.97	10.77	3.41	4.58	30.50	31.52	52.4	6.99	86
30	3.87	9.42	8.37	2.82	4.07	23.63	26.46	31.9	8.16	78
35	3.09	7.24	6.43	2.55	3.50	19.33	20.25	16.5	9.57	78
S.Em. +	0.19	0.22	0.23	0.19	0.24	0.54	0.53	1.84	-----	2.61
C.D. (0.05)	0.54	0.63	0.65	0.53	0.66	1.54	1.49	5.22	-----	NS
C.V. (%)	19.05	8.84	10.16	28.15	21.47	5.57	5.80	18.27	-----	9.72

Table 2 : Regression analysis of effect of temprature on duration and rate of development of different life stages of *P.citrella*.

Stage	Duration and temperture					Rate and Temperature				
	constant	coeffici ent	r	R^2	S.Em	consta nt	coeffi cient	r	R^2	S.Em
Egg	11.8273	-0.2273	-0.9498	89.27	0.6887	0.0501	0.0048	0.9824	96.51	0.0080
Larval	24.3109	-0.4538	-0.9869	97.38	0.6505	0.0209	0.0024	0.9943	98.87	0.0022
Pupal	23.3591	-0.4291	-0.9817	96.37	0.7280	0.0244	0.0023	0.9927	98.55	0.0025
Adult	8.4536	-0.1131	-0.8497	72.20	0.6134	0.1083	0.0029	0.8435	71.14	0.0162
Total life	67.9509	-1.2233	-0.9726	94.59	2.5571	0.2037	0.0124	0.9827	96.58	0.0205

Table 3 : Thermal time (degree) requirement for different stages of P. citrella with base temperature of 5 °C.

State	Base temp. (°C)	Thermal time (degree °C days) for rearing temperature (°C)						D.D	CV (%)
		10	15	20	25	30	35		
Egg	5	55	80	105	100	125	120	98	21
Larval	5	80	120	150	160	150	120	130	20
Pupal	5	80	130	150	180	175	150	144	19
Adult	5	35	60	75	100	125	120	86	34
Total life	5	175	280	360	420	300	210	291	31

temperature decreasc. The highest (83.72%) larvae were pupated at 25 °C, whereas the lowest (69.23%) were observad at 35 °C.

The life span of both male and female *P. citrella* adult moths was significantly shortest at 35 °C into relatively longer duration at 10 °C. The female moth emerged from the larvae reared at 25 °C showed highest (52 eggs per female) fecundity, whereas at 35 °C fecundity was lowest. The highest growth index (9.57) was observed at 35 °C.

The duration of different stages of the *P. citrella* were regressed linearly over temperature and yielded high (> - 0.84) and significant correlation (Table 2). An increase in temperature by one degree decreased the duration of egg, larval, pupal, adult and total life span by 0.23, 0.45, 0.43, 0.11 and 1.22 days, respectively.

The correlation co-efficient between developmental rate (l/t) and temperature (Tabel 3) was greater than 0.84 for different stages of *P. citrella* indicated highly significant positive correlation between these two variables.

The base temperature for egg, larval, pupal, adult duration and total life span worked out from the line of best fit of linear equation was 5 °C Using this, the degree day requirement (thermal time) for different life stages of *P. citrella* was estimated. These values differ from those of Liu (1993)

The highest variation was observed (Table 3) in adult stage (CV = 34.24%), whereas the egg, larval and pupal stages yield more or less, CV around 20 per cent. Ujiye (1990) from Japan, reported the lowest threshold temperature for flight.

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