Israel Journal of Entomology Vol. V, 1970

A CONTRIBUTION TO THE BIONOMICS OF HYLEMYA PLATURA MG. (= H. cilicrura Rond.) (Anthomyiidae) in Israel3

Shoshana Yathom

ABSTRACT

In individual rearing of H. piatura Mg. (= H. cilicrura, Rond.) at various constant temperatures the development period of each stage was assessed and the threshold of development and the thermal constants were established. The immature stages have a threshold of development at about 6 - 7 C, whereas that for preovipostion is about 4°C. Temperatures close to the threshold, cause a long development period during which heavy mortality occurs at all stages. The egg stage is also very susceptible to low relative humidity (below 80%), especially when combined with temperatures exceeding 30 C, which are lethal to all the immature stage's.

Introduction

Laboratory studies have been carried out on the bionomics of Hylemya pLatura Mg. (= H. cilicrura Rond.) in Israel, based on mass breeding of the fly throughout the year (3). In those studies no separate records were made for the separate stages, with the exception of the preoviposition period, but this too was based on mass populations. The present study was undertaken to fill in the gaps in our knowledge on the bionomics of this pest in Israel.

Methods

A mass breeding of flies served as the source of material for the tests.
In the spring of 1963 large numbers of adult flies were kept on a sugar and milk solution. The females oviposited freely in plates where beans were sown in moist sand covered with fish-meal, in order to attract them; oviposition was very heavy. The hatching larvae, after feeding on the fish meal, developed in the

* Contribution from The Volcani Institute of Agricultural Research, Bet Dagan, Israel. 1970 Series, No. 1765-E.

bean seeds, pupated in the sand and subsequently emerged as adult flies.

Eggs for observation and tests were collected within 12 hours after oviposition and removed to petri dishes; high relative humidity was maintained for the eggs by means of a moist cotton wick. A total of 17,200 eggs were thus reared in the laboratory at constant temperatures ranging from 8 to 34°C. Hatching was recorded twice daily by a count of empty egg shells, as the maggots sometimes disappeared. The incubation period at each temperature was calculated as the arithmetic mean of all the eggs that hatched.

To test the influence of various degrees of relative humidity on egg development, 4000 eggs were reared over saturated solutions of different salts, producing different levels of relative humidity. The effects were assessed according to the number of eggs which developed, again based on the number of empty egg shells.

In order to obtain larvae for trials under standard conditions, masses of eggs, numbering thousands, were removed to petri dishes under optimal conditions of relative humidity and temperature. On hatching, the larvae were removed, in groups of 100, and placed on ten germinating bean seeds, sown in moist sand. The larvae were reared at various temperatures from 10 to 28°C. Puparia were sought every day and removed. The development period at each temperature was calculated as the mean for all the larvae that succeeded in pupating.

Pupae for trials were obtained from mass breeding of larvae. Mature larvae were taken and placed over slightly wet sand, into which they entered and pupated. The puparia were kept at various temperatures from 8 to 34°C. Emergence was examined every day. The mean pupal period at each temperature was calculated from the pupae that gave rise to flies.

For oviposition studies, female flies were reared separately in lamp chimneys covered with cheese cloth, over a dish of moist sand. Drinking water and food were supplied by means of cotton wicks. Eggs were laid on the sand. Three diets were compared: a sugar solution, a sugar and milk solution, and yeast hydrolysate. Mortality and oviposition were recorded daily. In addition, groups of female flies were kept separately throughout the year at average temperatures of 15.5 to 27.5°C, on a standard diet of milk and sugar, and the preovipostion period was recorded.

Results

A. Development

Eggs: From the incubation periods of eggs that were kept under optimal conditions of relative humidity at constant temperatures, the corresponding mean rates of development were calculated as percentage per day (i.e., 100 times the reciprocals of incubation periods in days). The results are shown in Fig. 1.

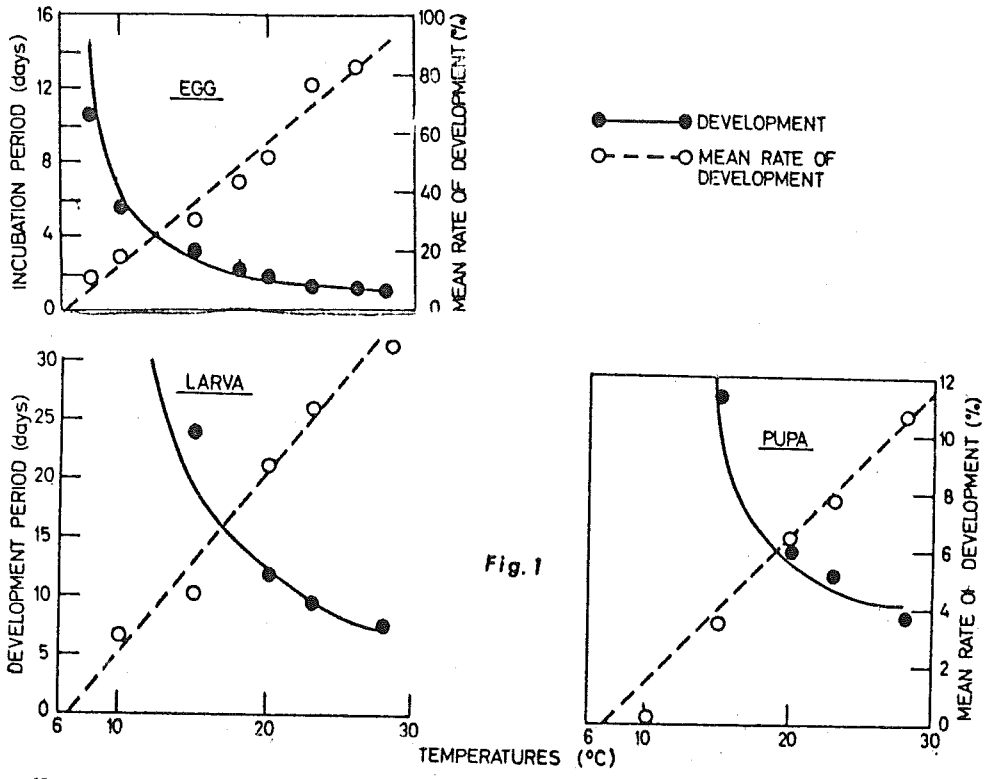

Fig. 1

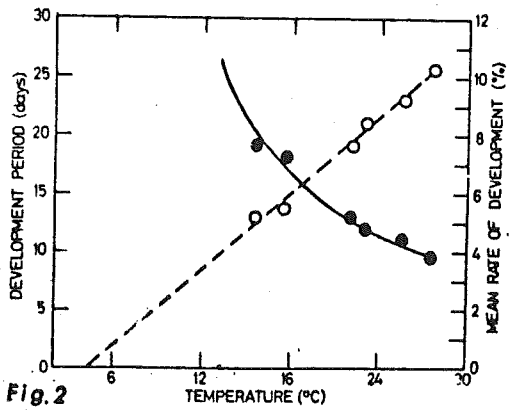

Fig. 2

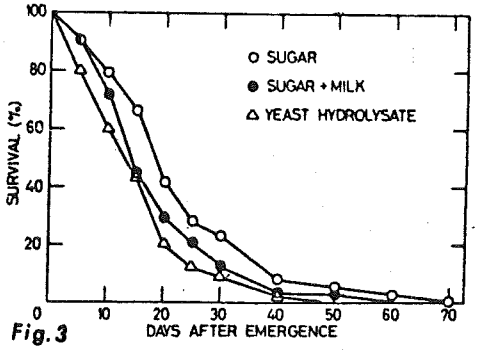

Fig. 3

Fig. 1. Length of development periods and mean rate of development of egg, larva and pupa at different temperatures.
Fig. 2. Length of the preoviposition period and mean rate of its development.
Fig. 3. Percentage of survival (life span) of flies fed on different diets.

Larvae: From the development period of maggots reared in bean sprouts at constant temperatures, the corresponding mean rates of development were calculated as percentage per day.

Pupae: By rearing pupae at various constant temperatures it was observed that emergence usually started with the female flies. When the duration of the pupal period was calculated separately for males and for females, it was found that the mean development period at all temperatures was somewhat shorter for females, the difference being 2 days at 10°C, decreasing gradually to 0.2 days at 28°C. However, the mean rates of development at constant temperatures presented herewith were calculated using the entire population including males and females.

Preoviposition: The mean rates of the preoviposition periods obtained by rearing flies on a standard diet of a sugar and milk solution, at various average temperatures, were calculated as percent per day; the resulting data are shown in Fig. 2.

Since the regression of development rate on temperature was approximately linear, the threshold temperature for development for each stage was found by extrapolation (Fig. 1 and 2). These and the thermal constants are shown in Table 1.

Table 1

Threshold temperatures for development and thermal constants of all stages of H. platura Mg.

Stage	Number of individuals	Threshold temp. (°C)	Thermal constant (day-degrees)
egg	12,827	6.2	25
larva	942	6.5	163
pupa	1,046	7.0	198
preoviposition	75	4.0	230

B. Survival

Immature stages: Results obtained from rearing 4000 eggs at various combinations of temperature and relative humidity showed that the percentage of hatching increased with the increase in relative humidity, being about 80% at relative humidities exceeding 85% at all temperatures except 34°C (see Table 2).

Table 2

Percentages of hatching of H. platura eggs at various combinations of temperature and relative humidity

Temperature (°C)	Relative humidity (%)				
	33	53	75	87	95
10	5	20	41	79	87
15	16	28	44	88	87
20	23	32	57	70	82
22	25	31	47	87	78
24	4	22	41	78	87
26	8	23	44	78	83
30	5	17	45	87	78
34	1	8	30	57	58

Eggs reared under optimal conditions of relative humidity and at constant temperatures showed a high percent of hatching, as shown in Table 3.

Table 3

Survival of the immature stages of H. platura Mg. at various temperatures.

Temp. (°C)	Eggs		Larvae		Pupae	
	Number	% hatching	Number	% pupating	Number	% emerging
8	2,000	70.2			200	0.5
10	2,000	88,4	300	57.3*	200	30.0
15	1,800	91.6	300	41.3	200	87.5
18.5	500	91.0			200	78.5
20	1,400	85.6	300	44.7	200	65.5
22	1,400	80.5	300	62.0	200	63.0
24	1,800	85.1	300	55.0	400	61.5
26	1,500	83.5				
28	800	74.5	300	53.6	200	72.0
30	1,900	83.0				
34	2,100	29.0	200	0	200	0

The pupae formed from larvae reared at 10°C and removed on pupation to to 24°C, gave rise to very few flies (about 17% of the pupae emerging as adults).

The percentage of larval survival, as expressed by those that succeeded in pupation, is shown in Table 3. It was about 50% at all temperatures except 34°C where it was zero.

Percentage of emergence varied very much at the temperatures tested. At constant temperatures of 15 - 28°C it was quite high, but dropped to 30% at 10°C, almost nil at 8°C, and zero at 34°C. Pupae that did not give rise to flies were examined and found to be desiccated and dead. Keeping the pupae at 8°C did not halt development, which proceeded at a very slow rate, but high mortality ensued. When pupae kept at 8°C for 56 days were removed to 24°C, emergence occurred after 3-9 days. If the prepupal period was included in the 8°C treatment, mortality was even higher.

Adults: Adult diet greatly affected the life span of H. platura flies, which was longest on sugar, as shown in Fig. 3. Though the life span was longer on sugar, no oviposition occurred with flies feeding on sugar alone. Flies on a milk or yeast hydrolysate diet did oviposit, with yeast somewhat shortening the preoviposition period; however, total oviposition was the same on both diets.

Table 4

Effects of diet on oviposition and life span of H. platura Mg.

Diet	Number of ♀♀	Median life span (days) ♀♀	♂♂	Previpo-sition period (days)	Ovipositing (%)	Eggs per ♀ Mean	Range
Sugar	10	30	17	-	0	-	-
Sugar+milk	63	20	13	16 ± 6.7	20	112	38-245
Yeast hydrolysate	53	17	10	14 ± 5.4	17	106	49-213

Discussion

Results obtained by the individual rearing of the various stages of H. platura Mg. (H. cilicrura Rond.) supplement and confirm the findings from mass breedings published earlier (3). They are also in accord with results obtained elsewhere (1, 2).

The preoviposition period in mass population was shorter than in individual breedings. There was also a tendency toward more oviposition in mass population, which might possibly be attributed to some unknown overcrowding effect.

The fly is active in Israel during the winter, when temperatures are well above the threshold for its development. Limiting climatic factors exist in Israel during the summer, when daily temperatures often rise above 30°C, combined with very low relative humidity.

Temperatures of 28°C, when combined with high relative humidity, gave a high percentage of emergence, and also allowed larval development. At higher temeratures the larvae failed to develop and the pupae were killed; however, the latter did not enter any form of aestivation, as was pointed out earlier and by others (2, 3). However, since this species while not having a diapause somehow survives the summer, it can only be surmised that, during the summer, the species retreats to some favourable microclimatic habitats where high relative humidity and temperatures, lower than in the macroclimate, prevail throughout the long summer.

References

1. Harris, C.R., Svec, H.J. & Begg, J.A. (1966). Mass rearing of root maggots under controlled environmental conditions: Seed-corn maggot, Hylemya cilicrura; bean seed fly, H. liturata; Euxesta notata: and Chaetopsis sp. J. econ. Ent. 59 : 407-410.

2. McLeod, D.G.R. (1964). Nutrition and reproductive behavior of the seed-corn maggot, Hylemyia cilicrura (Rond.) (Diptera: Anthomyiidae). Ent. exp. appl. 7 (4) : 329-334.

3. Yathom, S. (1961). Laboratory studies on the bionomics of Hylemyia cilicrura Rond. in Israel. Israel J. agric. Res. 11 (1) : 51-56.