BIOLOGY OF THE PREDACIOUS MITE *Amblyseius brazilli* (Phytoseiidae: Mesostigmata) UNDER DIFFERENT PHOTOPERIOD, LIGHT INTENSITY AND TEMPERATURE REGIMES[1]

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ABSTRACT

In the present paper, the different aspects of the life cycle of *Amblyseius brazilii* El-Banhawy were studied under different photoperiods, light intensities and temperatures. Light had no effect on the incubation period. Under darkeness and different illumination conditions, the process of hatching was completed. Light intensity had a negligeable effect. Higher temperature shortened the incubation period; it was 1.8±0.4 days under 25±1C° while 2.4±0.3 days under 21±2.0C°. The developmental period was more sensitive to photoperiod and temperature changes. It was 3.3±1.6, 3.2±0.6, 3.8±0.8 and 5.3±0.6 under 24, 16, 8 and 0 hr of lighting/day and 3.2±0.6 and 5.4±0.5 days under 25±1C° and 21±2.0C° respectively. Light intensity had no profound effect on the developmental period. The preoviposition period correlated negatively with the three different factors with the exception that the predator did not oviposit in the absence of light. The average number of eggs/ /day under the different conditions was 1.9, 1.1, 0.9 and 0.1 under 24, 16, 8 and 0 hr of lighting/day, 0.8, 0.8 and 0.6 under 390, 223 and 112 ft-c and 1.1 and 0.9 under 25±1C° and 21±2.0C° respectively.

INTRODUCTION

Phytoseiid mites as small arthropods are effected by two major groups of factors: biotic and abiotic or physical factors. The biotic factors were suggested to be prey density, predator density and characteristics of the predators and prey (LEOPOLD, 1933; HOLLING, 1961). These components were subject to several studies among which were those of McMURTRY & SCRIVEN, 1966; MORI & CHANT, 1966; EL-BADRY & EL-BANHAWY, 1968; MORI, 1969; SANDNESS & McMURTRY, 1972. On the other hand, predators may react differently under different physical factors. *Phytoseiulus persimilis* Athias-Henriot ate more prey at low humidity and less prey at high humidity (MORI & CHANT, 1965) and laid more eggs at 26C° than at 20C° (McCLANAHAN, 1968). *Amblyseius hibisci* Chant in the egg stage responded to humidities below 40%, while this level was not suita

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eggs, while long-day photoperiod induced more eggs. Fig. 1 shows the resulting regression line indicating the strong correlation between photoperiod and reproduction.

The exposure of the females to 390, 223 and 112 ft-c slightly changed the egg laying magnitude (Table 2). Temperature showed a clear effect; the average number of eggs/day was 1.1 at 25C° while 0.9 at 21C°.

TABLE 1 - Effect of different photoperiods, light intensities and temperatures on the duration of *A. brazilli*.

Factors	Duration (days)												
Photoperiod (hr)	Incubation period				Developmental period				Preoviposition period				Percent of individuals lost
	Max.	Min.	Avg.	S.D.	Max.	Min.	Avg.	S.D.	Max.	Min.	Avg.	S.D.	
24	2.0	1.0	1.3	0.3	4.0	3.0	3.3	1.5	2.0	1.0	1.8	0.5	20%
16	2.0	1.0	1.8	0.4	4.0	3.0	3.2	0.6	2.0	1.0	1.7	0.2	15%
8	2.0	1.0	1.6	0.4	4.0	3.5	3.8	0.8	3.0	-	3.0	0	38%
0	2.5	1.5	2.0	0.3	6.0	5.0	5.3	0.6	-	-	a	-	85.7%
r.	-0.731	-	-	-	-0.882	-	-	-	-0.735	-	-	-	-
b.	-0.024	-	-	-	-0.083	-	-	-	-0.048	-	-	-	-
Light intensity (ft-c)													
390	2.0	1.0	1.4	0.5	4.0	3.0	3.8	0.6	3.0	1.0	2.0	1.0	0%
223	3.1	1.0	2.0	0.7	5.0	4.0	4.8	0.4	3.0	2.0	2.5	0.6	0%
112	2.0	1.5	1.9	0.7	4.0	3.0	3.7	0.9	4.0	2.0	3.5	0.8	0%
r.	-0.835	-	-	-	-0.643	-	-	-	-0.936	-	-	-	-
b.	-0.0002	-	-	-	-0.003	-	-	-	-0.0005	-	-	-	-
Temp. (C°)													
25±1.0	2.0	1.0	1.8	0.4	4.0	3.0	3.2	0.6	2.0	1.0	1.7	0.2	15%
21±2.0	3.0	2.0	2.4	0.3	6.0	5.0	5.4	0.5	3.0	2.0	2.8	0.6	0%

a - mated females failing to oviposit

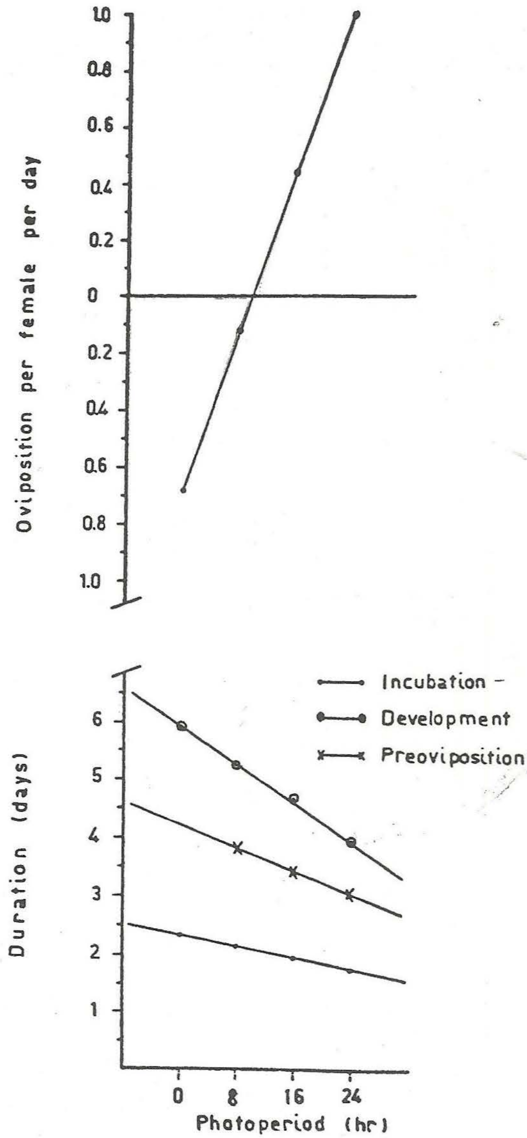

FIGURE 1 - Relation between photoperiod, and durations and oviposition/day.

TABLE 2 - Effect of different photoperiods, light intensities and temperatures on the daily oviposition per female.

Factors	Nº of eggs/female on days								
Photoperiod (hr)	1	2	3	4	5	6	7	8	Avg.
24	0.6	2.0	2.0	1.8	2.8	2.0	2.0	-	1.9
16	0.5	1.0	1.0	1.0	-	1.0	2.0	-	1.1
8	1.1	0.7	0.5	1.1	0.9	0.7	1.1	0.8	0.9
0	0.1	0.3	0	0.1	0	0.1	0	0	0.1
r.	+0.953	-	-	-	-	-	-	-	-
b.	+0.07	-	-	-	-	-	-	-	-
Light intensity (ft-c)									
390	0	1.4	0.6	0.4	1.1	0.8	1.0	0.7	0.8
223	0.3	0.6	1.3	0.6	0.6	1.0	1.2	0.6	0.8
112	0.3	0.3	0.5	0.3	0.3	0.8	1.0	1.5	0.6
r.	+0.771	-	-	-	-	-	-	-	-
b.	+0.0001	-	-	-	-	-	-	-	-
Temp. (C^o)									
25 ± 1.0	0.5	1.1	1.0	1.0	-	1.0	2.0	-	1.1
21 ± 2.0	0.4	0.6	1.4	1.0	-	-	0.6	1.2	0.9

- Uncounted data

RESULTS

Incubation period

The average incubation period was 1.3 ± 0.3, 1.8 ± 0.4, 1.6 ± 0.4 and 2.0 ± 0.3 days under 24, 16, 8 and 0 hr of lighting/day respectively (Table 1). As shown in Figure 1, the incubation period correlated negatively with the photoperiod. It was almost the same under 223 and 112 ft-c and considerably shorter under 390 ft-c (Table 1). At the two temperatures tested, the average period was 1.8 ± 0.4 days at the higher temperature and 2.4 ± 0.3 days at the lower one. The results gave an indication that although the incubation period showed a negative correlation with photoperiod and light intensity, it was more sensitive to temperature change.

Development and preoviposition

In this test, newly hatched larva isolated singly on orange leaf discs were observed till maturity under different photoperiods, light intensities and temperatures. The virgin females were allowed to mate by introducing a male to each one of them. After copulation, all the males were picked up. The time elapsing from the termination of copulation till the emergence of the first egg was recorded. Under complete darkness, few individuals reached maturity (14,3%) after a long period and the females failed to oviposit (Table 1), indicating that light was essential for egg formation. Under 8 hr of lighting/day, more individuals reached maturity (62%) and the time of development was shorter. Under 16 hr of lighting/day, all the individuals exhibited uniformly the shortest developmental period (3.2 ± 0.6 days); no more decrease in the time of development was observed under 24 hr of lighting/day (Table 1). Similar results were obtained during the preoviposition period. The statistical analysis of the data showed a strong negative correlation between photoperiod and the time of development or preoviposition (Figure 1).

Individuals kept under different amounts of light gave dissimilar results. While the time required for complete development was short and almost equal under 112 and 390 ft-c, it was long under 223 ft-c (Table 1). This may suggest the lack of response to light intensity or the interference of an indeterminate factor which magnified the error. On the contrary, preoviposition gradually shortened form 3.5 ± 0.8 days under 112 ft-c to 2.5 ± 0.6 days and 2.0 ± 1.0 days under 223 and 390 ft-c respectively (r. -0.936).

Temperature accelerated tha rate of development. The developmental and preovipositional periods were 3.2 ± 0.6 and 1.7 ± 0.2 days under $25\pm1.0C^{o}$ while 5.4 ± 0.5 and 2.8 ± 0.6 days under $21.\pm2.0C^{o}$ respectively (Table 1).

Reproduction

Nine groups of young mated females were isolated singly on orange leaf discs and exposed to different conditions for 8 days. Table 2 shows the number of eggs/female. In complete darkness, very few eggs were deposited; this might have resulted from the short exposure to light during examinations. Short-day photoperiod gave a moderate amount of ble for *A. limonicus* German & Mc Gregor, indicating that it preferred high humidities (McMURTRY & SCRIVEN, 1965). *A. fallacis* (German) laid more eggs at 26C° than at 20C° (McCLANAHAN, 1968) and under 10 hr of lighting/day than under 24, 14 or 0 hr (SMITH & NEWSON, 1970). *Typhlodromus occidentalis* (Nesbitt) laid more eggs and its longevity was shorter when the temperature increased from 18.5C° to 30C° (PRUSZYNSKI & CONE, 1973.

Among phytoseiid mites that exhibit diapause, photoperiod was a major factor controlling the induction of diapause (*T.* (*A.*) *similis* (Koch), SAPOZHNIKOVA, 1964; *T. occidentalis*, HOY & FLAHERTY, 1970; CROFT, 1971; *A. umbraticus* (CHANT), KNISLEY & SWIFT, 1971). The present work studies the biology of *A. brazilli* El-Banhawy under different photoperiod, light intensity and temperature regimes and is the 4th in a series of studies on the predator under investigation (EL-BANHAWY, 1975 a; 1975 b; 1976).

MATERIALS AND METHODS

The predators used were obtained from mass cultures maintained on orange leaves placed with their upper surfaces on trays (35 x 12cm) lined with cotton and saturated with water. To avoid drying of the trays and leaves, water was added every 2 days. The excess of water on the leaves' edges confined the mites. Pollen grains of *Ricinus communis* (L.) were added to the leaves every 3 days as a source of food since the species can feed, develop and reproduce on pollen grains (EL-BANHAWY, 1975). The same technique was also used in the different tests with the exception that every individual was placed singly on an orange leaf disc, 3cm in diameter as a uniform rearing substrate. Small amounts of pollen grains were added to each disc and replaced by fresh ones every 3 days. The experiment was worked at 25±1C° and 60±10% relative humidity in a controlled chamber provided with several shelters, each illuminated by 3 fluorescent bulbs (65 watts) which produced 280 ft-c at the level of the shelters. Photoperiod was controlled by an electrical time switch. The effect of darkness was studied in a separate incubator under the same temperature and humidity. During the time of examination which lasted 10-15 minutes/day, the incubator was opened to permit aerification and to remove the accumulated water droplets. Other shelters were supplied with 4, 2 and 1 fluorescent bulbs (65 watts) which produced 390, 223 and 112 ft-c at the level of the shelters. The amount of light was measured by a luxmeter. In this test, the photoperiod was maintained at 16 hr/day. An additional test was conducted at 21±2C° and 16 hr of lighting/day. In the different tests, females were isolated singly on orange leaf discs and left until they laid eggs. They were then picked up and their eggs were observed twice a day till the young reached maturity. Several groups of gravid females obtained from the mass cultures were kept under different conditions. The egg laying was counted every day for 8 successive days. Every test consisted of 15 eggs or 8-12 females.

DISCUSSION

This work is part of a series of studies on the predacious mite *A. brazilli*. The first work described it as a new common species from Brasil; the second showed its ability to develop and reproduce under different food regimes and the third studied the toxicity of various acaricides to the predator. The present work discusses the response of the different aspects of the life cycle of the predator to different physical factors.

Photoperiod and light intensity did not show any real effect on the process of hatching. All the eggs hatched under different amounts of light, different photoperiods and darkness. LORD(1971) found that all the eggs of the predacious insect *Atractotomus mali* (MEYER) incubated under 24, 16 and 0 hr of lighting/day at 23C° hatched, indicating the inconspicuous effect of light during this period. Temperature, however, was an important factor. The time required for hatching under the warm condition was one third less than that required under the colder one.

The developmental period was influenced by photoperiod and temperature change. Under long-day photoperiod or warm conditions, it was shorter and vice versa. PRUSZYNSKI and CONE(1973) observed that *T. occidentalis* responded to temperature increase from 15C° to 35C° by shortening the generation time. During the preoviposition period, all the tested factors had strong effects. In the absence oflight, the females were not able to oviposit. In fact, very little is known about the physiological change that initiates or increase oviposition in mites. Probably, the exposure to light stimulates the hormonal system which may promote ovulation and reproduction. The amount of eggs produced by the predator differed from one species to another and depended on the time of exposure to light. *A. brazilli* gave increasing amounts of eggs with the increase of the time of exposure, while *A. fallacis* gave more eggs under 10 hr of lighting/day than under 0, 14 or 24 hr (SMITH & NEWSON, 1970). The influence of temperature on reproduction showed that the average number of eggs/day was greater under 25±1C° than under 21±2C°. *T. occidentalis* gave different amounts of eggs under different temperatures (LEE & DAVIS, 1968; LAING, 1969; CROFT & McMURTRY, 1972; PRUSZYNSKI & CONE, 1975).

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RESUMO

No presente trabalho, os diferentes aspectos do ciclo de vida de *Amblyseius brazilli* foram estudados sob diferentes fotoperíodos, intensidade luminosa e temperaturas. A luz não teve efeito no período de incubação. Na escuridão e em diferentes intensidade de luz o desenvolvimento do ácaro foi completo.

Altas temperaturas diminuiram o período de incubação, assim, para 25±1°C esse período foi de 1,8±0,4 dias enquanto que para 21±2°C foi de 2,4±0,3 dias. O período de desenvolvimento foi mais sensível ao fotoperíodo e à mudança de temperatura.

A intensidade luminosa não teve efeito significante no período de desenvolvimento.

O período de pré-oviposição teve correlação negativa para os 3 diferentes fatores. Na ausência de luz o ácaro não ovipositou.

O número médio de ovos por dia foi de 1,9; 1,1; 0,9 e 0,1 para 24, 16, 8 e zero horas de luz diária. Para 390, 223 e 112 ft-c a média de ovos por dia foi de 0,8; 0,8 e 0,6, respectivamente enquanto que para 25±1°C e 21±2°C essa média foi de 1,1 para o primeiro e 0,9 para o segundo.