EFFECTS OF DIFFERENT BIOLOGICAL FACTORS ON LONGEVITY AND FECUNDITY OF *Trichogramma platneri* NAGARKATTI (HYMENOPTERA: TRICHOGRAMMATIDAE) [1]

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RESUMO

Efeitos de diferentes fatores biológicos na longevidade e fecundidade de *Trichogramma platneri* Nagarkatti (Hymenoptera: Trichogrammatidae)

Os efeitos de diferentes fatores na longevidade de *Trichogramma platneri* Nagarkatti foram estudados utilizando ovos de *Trichoplusia ni* (Hübner) como hospedeiro. A alimentação, seguida pelo hospedeiro e o tamanho do parasitóide foram os fatores que mais influenciaram na longevidade das fêmeas de *T. platneri*. Fêmeas mantidas sem alimento apresentaram uma longevidade média de 1,5 dias enquanto que, fêmeas alimentadas com mel, viveram cerca de 10 dias. A mesma tendência foi observada em relação aos machos. A interação alimento/hospedeiro foi altamente significativa. Fêmeas fecundadas e não fecundadas, na ausência do hospedeiro, viveram 5 vezes mais que as que ovipositaram. As fêmeas maiores que se alimentaram tiveram uma longevidade 4,3 vezes maior que fêmeas pequenas nas mesmas condições.

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Apesar de existir correlação entre o tamanho do parasitóide e longevidade, a oviposição aparentemente foi o fator que mais influenciou na longevidade das fêmeas.

Entre os fatores estudados, o acasalamento foi o menos importante. A fecundidade média de fêmeas fecundadas, alimentadas com mel por 24 horas e mantidas com hospedeiros por 5 dias foi maior, porém não diferiu significativamente daquela obtida com fêmeas sem alimento, sob as mesmas condições. Fêmeas não alimentadas parasitaram um número maior de ovos de *T. ni* e produziram consequentemente um número maior de progênie no primeiro dia de oviposição que fêmeas que receberam mel como alimento.

ABSTRACT

The effects of different factors on longevity of *Trichogramma platneri* Nagarkatti were studied, using eggs of *Trichoplusia ni* (Hübner) as host. Food, followed by host egg and parasitoid size were the major factors influencing the longevity of female parasitoids. Starved females had an average life span of 1.5 days whereas, females which fed on honey, lived for about 10 days. The same trend was observed for males. The interaction of food/host was highly significant. Both mated and unmated females, deprived of host eggs, lived 5 days longer than ovipositing females. Large females which fed on honey lived 4.3 days longer than small ones under the same conditions. Despite the correlation between parasitoid size/longevity, oviposition apparently was the main factor influencing longevity of females. Among the factors studied, mating apparently was the less important. The mean fecundity of mated females, fed on honey for 24 hours and then allowed to oviposit during five days, was higher but not significantly different than unfed females under the same conditions. Females without food parasitized more *T. ni* eggs and produced a slightly higher number of progeny in the first day of oviposition than females provided with honey.

INTRODUCTION

Many studies have demonstrated the influence of environmental factors on the fitness of parasitic Hymenoptera. SALT (1940) was one of the first to consider the influence of the host on longevity and fecundity of *Trichogramma*. The need of adult parasites for supplementary food has been emphasized by many researchers. HAGEN (1964) noted that the need for a carbohydrate source by adult parasitoids is often obligatory for egg maturation, oviposition, and longevity. Scarcity

of water or food for adult parasitoids due to lack of pollen, honeydew, or nectar is one of the adverse environmental factors affecting natural enemy effectiveness (De BACH & HAGEN, 1964). Although mating and oviposition influence fecundity and longevity of *Trichogramma*, the results reported have been inconsistent in this regard. To obtain information on the effects of different factors and their interactions on longevity and fecundity of *Trichogramma platneri* Nagarkatti, a series of experiments were conducted, using eggs of *Trichoplusia ni* (Hübner) as host.

MATERIAL AND METHODS

Eggs of the cabbage looper, *Trichoplusia ni* (Hübner) were used as hosts. To obtain *T. ni* eggs, a culture was established and maintained as described by PAK & OATMAN (1982).

A laboratory culture of *T. platneri* was obtained from parasitized *Cydia pomonella* (L.) eggs collected from an apple tree in Riverside, California. The parasitoids were cultured on *T. ni* eggs as described by HOHMANN *et al.* (1988). Cultures were started at different days to provide material for the experiments as needed.

Virgin males and females were obtained for the various studies by isolating individual parasitized host egg in gelatin capsule (000 size) streaked with honey.

Glass shell vials (9,5 x 2,5 cm) were used as oviposition units, as described by OATMAN & PLATNER (1973). All experiments were conducted at room conditions (24 ± 1°C, RH 50 ± 15%).

In the experiments in which hosts were available, a large number of *T. ni* eggs (24 hr old) was provided every other day. Observations were made daily in order to determine the mortality of the parasitoids. In the experiment in which size was included as one of the factors studied, male and female parasites were mounted after daeth in Hoyers' medium on glass, microscope slides. The hind tibia lengths were measured, using a micrometer mounted in the eye-piece of compound microscope.

In the fecundity experiment, two groups of twelve mated female parasitoids were used. One group was provided with honey from the time of emergence until the end of the experiment. The second group was kept without food. In the host egg exposure experiment, female parasitoids were exposed to *T. ni* eggs for five days. The females then were removed and the host eggs held for the development of parasitoid progeny.

In all experiments the female parasitoids were 24 hours old.

RESULTS AND DISCUSSION

The effects of food, host egg, and mating on the longevity of *T. platneri* are shown in Table 1. The presence of host eggs influenced longevity, regardless of whether or not mating occurred. Starved females lived about 1.5 days compared to 10.0 days for females that were provided with honey. The same trend was observed for males, 12.2 versus 1.4 days.

The interaction between food and host egg was highly significant ($F = 23.22$, $P < 0.0001$, d.f. = 1. 136). Both mated and unmated females, deprived of host eggs, lived about five days longer than females allowed to oviposit (Table 1).

Longevity of males and females apparently was not affected by mating in any combination tested. However, in a preliminary experiment conducted in gelatin capsules (000 size), using fed parasites in the absence of hosts, unmated females lived significantly longer (26.4 days) than mated females (20.8 days) $t = 4.87$, $P < 0.0001$, d.f. = 90.0). These results suggest that the size of the container used affects the longevity considerably. When the same test was conducted, using larger vials (9. 5x2. 5cm), the longevity was only about one-half that recorded when gelatin capsules were used.

When the size of the females that were provided with honey also was considered, the same pattern was observed in relation to mating and host availability (Table 2). Large females lived longer than smaller ones under the same conditions. The differences, however, were significant only when host eggs were absent ($F = 11.01$, $P < 0.0001$, d.f. = 11. 204). In this case, the larger females lived about 4.3 days longer than the smaller ones.

When hosts were present and oviposition occurred the females lived a shorter period when compared to conspecifics in the same size class hosts. Moreover, small females that were deprived of hosts lived longer than larger ovipositing females (host eggs present). Also, a significant correlation between parasitoid size and longevity was found for mated ($r = 0.47$, $t = 2.97$, $P < 0.005$, d.f. = 31) and unmated males ($r = 0.57$, $t = 4.03$, $P < 0.0005$, d.f. = 34).

Although the availability of honey markedly affected the longevity of *T. platneri*, it did not increase fecundity. The mean fecundity of mated females, provided with honey for twenty-four hours and then allowed to oviposit for five days, was similar to unfed females (Table 3).

TABLE 1 - Effects of honey, host egg, and mating on longetity (in days) of *T. platneri*.

Host egg Presence	Fed (n=18)			Unfed		
	Mean	(Sd)	Range	Mean	(Sd)	Range
			Mated Females			
YES	7.1	± 3.66b*	2-15	1.9	± 0.23c	1-2
NO	12.8	± 5.25a	3-21	1.4	± 0.55c	1-3
			Virgin Females			
YES	8.0	± 5.13b	2-17	1.5	± 0.60c	1-3
NO	13.0	± 5.28a	2-21	1.3	± 0.49c	1-2
			Males**			
NO	12.2	± 5.41a	1-18	1.4	± 0.54c	1-3

* Column means followed by the same letter are not significantly different at 1% level.

** Had mated with females.

TABLE 2 - Effects of host egg mating on longevity (in days) of different sizes* of *T. platneri* that were provided with honey.

Host egg Presence	Large parasites (0.172-0.218mm)				Small parasites (0.124-0.171mm)			
	n	Mean	Sd	Range	n	Mean	Sd	Range
			Mated Females					
YES	23	9.8 ±	4.08cd**	1-16	26	6.7 ±	3.31de	2-14
NO	10	17.3 ±	4.52a	6-22	19	11.8 ±	4.27bc	3-18
			Virgin Females					
YES	30	9.8 ±	4.92cd	2-18	14	4.4 ±	4.01e	2-15
NO	14	14.8 ±	4.48ab	2-21	13	11.6 ±	3.77bc	4-18
			Mated Males					
NO	12	15.4 ±	2.10a	11-18	21	10.8 ±	5.59	1-17
			Virgin Males					
NO	21	14.5 ±	3.50ab	2-22	14	10.8 ±	3.78c	3-17

* Based on hind tibia length.

** Column means followed by the same letter are not significantly different at 1% level.

TABLE 3 - Effects of food on fecundity *T. platneri* females while being exposed to *T. ni* eggs for 5 days.

Female condition	Mean tibia length parental female n	(mm)	Mean No. host eggs parasitized	No. progeny mean	(Sd)	Mean No. parasites/ host egg	Sex ratio (F:M)
Fed**	12	0.169a*	19.7a	27.6 ±	21.1a	1.609a	1:0.22a
Unfed	11	0.163a	16.9a	24.4 ±	17.4a	1.695a	1:0.29a

* Column means followed by the same letter are not significantly different at 5% level.

** Honey provided as food.

The number and sex ratio of progeny emerging from hosts parasitized by either fed or unfed females did no differ significantly. Most of the starved females (82%) died in the second day of oviposition, only one female lived until the fifth day. Of the fed females, only 16.6% died during the five-day ovipositional period.

The results show that food was the limiting factor in the longevity of *T. platneri*. Large individuals provided with honey, lived longer without host eggs than small ones under identical conditions. An increase in longevity also has been reported for other species of *Trichogramma* when food was provided (SCHULZE, 1926; PETERSON, 1930; LUND, 1938; YU, 1984). In relation to host availability, there has been some disagreement about its effects on longevity. In this experiment, an increase in longevity occurred when females were deprived of hosts. Similar results were obtained with an ichneumonid, *Campóplex haywardi* Blanchard, by LEONG & OATMAN (1968). They found that the longevity of ovipositing females was 7.8 days less than that of nonovipositing females. WAAGE & MING (1984) reported that large *Trichogramma evanescens* Westwood females lived longer in the absence of hosts. However, LUND (1938) obtained different results for *T. evanescens*. He noted that virgin females lived longer in the presence of hosts than in their absence. HASE (1925) suggested that the increased longevity in the presence of hosts may be due to host feeding by the female. This apparently was not the case with *T. platneri* as nonovipositing females, in all combinations studied, lived significantly longer than ovipositing females. Host feeding alone apparently has little effect in prolonging the life of female parasitoids in the absence of carbohydrates. Starved females provided with hosts did not live longer than starved females in the absence of host eggs. According to DOTTEN (1911), the host feeding behavior is more important in supplying protein needed for oogenesis.

Mating apparently has no effect on longevity of *T. platneri*. LUND (1928) and PAK & OATMAN (1982) also reported that the longevity of *T. evanescens* and *Trichogramma brevicapillum* Pinto and Platner females, respectively, was not affected by pairing whereas YU (1984) reported that *Trichogramma minutum* Riley females lived longer when they were not mated.

Food did not increase fecundity of *T. platneri*. The fact that starved females had a similar fecundity as fed ones (Table 3) suggests that food apparently is not an important requisite for progeny production in females that either have or that are developing most of their complement of eggs at emergence. The results obtained differ from those recorded for *T. evanescens* and *T. minutum* by LUND (1938) and YU (1984), respectively. They reported that fed females had a significant higher fecundity than unfed females. YU (1984) also reported that the fecundity of fed *T. minutum* in the first day of oviposition was almost twice that of unfed females.

The discrepancy among the results obtained in these experiments and those reported by other researchers probably are due to the methodology, host, and species of *Trichogramma* used.

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