

BIOLOGICAL STUDIES AND MASS-REARING OF THE
ECTOPARASITOID, *GONIOZUS LEGNERI* GORDH
(HYM. BETHYLIDAE)

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Abstract

The ecto-parasitoid, *G.legneri*, was reared in the laboratory on larvae of the navel orangeworm, *Amyelois transitella* (Walker). At $27\pm 1^{\circ}\text{C}$ and 50-55% R.H., the egg-incubation period was 24 hrs, the larval stage lasted 3.1 days, the pre-pupa lasted 26 hrs and the pupa lasted 6.7 days. The total developmental period of the parasitoid averaged 11.3 days. *G.legneri* females did not deposit eggs daily and the number of egg-deposition averaged 21.5 times during her life-span which averaged 69.4 days. The number of eggs deposited each time averaged 13.4/female and the total number of eggs deposited/female averaged 260.8.

Two trials of rearing were tested for mass production of the parasitoid with the aim of utilizing it as a biocontrol agent in the field.

INTRODUCTION

Goniozus legneri Gordh was recorded for the first time by Gordh (1982) who proposed it as a new species according to description from adult males and females. He mentioned that the parasitoid was collected from Uruguay and sent to California in 1977 to be released as a biocontrol agent against the navel orange-worm, *Amyelois transitella* (Walker) on almond. Legner and Warkentin (1988) reported that the release of *G.legneri* on almond resulted in significant reduction of navel orange-worm density in more than half of the orchards checked in 1987. *G.legneri* was reported also as a parasitoid of the pyralid, *Spectrobates ceratoniae* and the pink boll-worm, *Pectinophora gossypiella* in USA (Gordh et al., 1983; Butler and Schmidt, 1985; Sarhan, 1989). In Egypt, *Perisierola (Goniozus)* sp. was recorded as an external parasitoid of *P.gossypiella* (Hekal, 1974, Farrag, 1976).

The present investigation deals with some biological aspects of *G.legneri*. Two trials of rearing the parasitoid are given in an attempt for mass production of such a parasitoid to be used in Egypt as a biocontrol agent against *P.gossypiella*.

MATERIALS AND METHODS

G. legneri and its host *A. transitella* were obtained from FAR Incorporation, California, USA. The parasitoid was reared in the laboratory on larvae of its host. Rearing took place in plastic vials, 4cm high and 1.5 cm diameter covered with plastic lids. The host, *A. transitella* was reared by the method reported by Gordh et al., (1983).

Durations of the immature stages of the parasitoid

Five females, 5 days old, were confined, individually, in the plastic vials and provided with full-grown host larvae. The introduced larvae were examined, at 2 hr intervals for parasitoid's eggs. The larvae harboured eggs were removed, kept in Petri-dishes and checked every two hrs for egg-hatching. The hatched larvae were left to feed on the host till maturity, spinning the cocoons and developing to pre-pupae and pupae. The durations of egg-stage, larva, pre-pupa and pupa were estimated.

Oviposition

Ten newly emerged females were confined, individually, in the plastic vials with droplets of honey on the inner surface of the vials'lids. Each female was provided with a full-grown host larva which was replaced daily by another one. The removed larvae were checked for parasitoid's eggs and kept until emergence of adult parasitoids. The deposited eggs of each parasitoid female were counted daily till the death of wasps. The pre-oviposition, oviposition and post-oviposition periods were estimated. Sex ratio and longevity of females were calculated.

Mass production

Two trials were tested for mass production of *G. legneri*. In the 1st. method only one female 5 days old was confined in a plastic vials; 1.5 cm diameter and 4 cm high, with a droplet of honey on the inner surface of a plastic lid. A full-grown larva of *A. transitella* was introduced to the female and left for 7 days until the parasitoid's cocoons were formed. The female was then removed to similar vial containing another host larva. The procedure continued until the death of the wasp. 100 females were used and the numbers of cocoons were counted and calculated for each female.

In the 2nd trial, plastic container of 8 cm diameter and 5 cm high were used. 10 full-grown host larvae were confined in each container and droplets of honey

were scattered on the inner surface of the plastic lid. Eight *Goniozus* females 5 days old were introduced to each container and left until the parasitoids' cocoons were formed. The females, in each container, were then transferred to similar container with 10 host larvae inside and droplets of honey on the inner surface of the lid. 25 replicates were used and the numbers of cocoons were counted and calculated for each female.

All studies were carried out at $27\pm 1^{\circ}\text{C}$ and 50-55% R.H.

RESULTS

Durations of the immature stages

As presented in Table 1, the incubation period of *G.legneri* eggs averaged 24 hrs, the larval stage lasted 3.1 days, the prepupa lasted 26 hrs and the pupal stage lasted 6.7 days. The total developmental period of the parasitoid averaged 11.3 days.

Table 1. Durations of immature stages of *G.legneri* at $27\pm 1^{\circ}\text{C}$ and 50-55% R.H.

Immature stage	Duration
Egg	24 ± 1.3 (21-26) hrs
Larva	3.1 ± 0.21 (3-4) days
Pre-pupa	26.0 ± 1.42 (22-29) hrs
Pupa	6.7 ± 0.60 (6-8) days
Total developmental period	11.3 ± 0.13 (10-12) days

Oviposition behaviour

G.legneri female attacks and stings the host larva soon after exposure. The larva becomes partially paralyzed within a few minutes then the female feeds on its body-fluids. Oviposition starts, however, 1-8 days after paralysis (average 2.7 ± 1.2 days). *G.legneri* female did not lay eggs daily and the period between two ovipositions averaged 2.9 ± 1.33 days (1-8).

Ovipositional periods, fecundity and longevity, Table 2

The pre-oviposition, oviposition and post-oviposition periods in *G.legneri* averaged 4.4, 65.6 and 5.8 days, respectively. The female deposited eggs 21.5 times (13-26) during her life. The number of eggs deposited each time averaged 13.4 (4-

24)/female. The total number of eggs deposited/female averaged 260.8 (131-365) during her life-time which averaged 69.4 days (39-91).

Table 2. Ovipositional periods, no. of eggs/female and longevity of female *G.legneri* at $27\pm 1^\circ\text{C}$ and 50-55% R.H.

Preoviposition period (days)	Oviposition period (days)	Postoviposition period (days)	Fecundity			Longevity (days)
			No. of ovipositions/female	No. of eggs/oviposition	Total no. of eggs/female	
4.4 \pm 1.22 (3-7)	65.6 \pm 13.52 (32-80)	5.8 \pm 4.87 (2-19)	21.5 \pm 4.0 (13-26)	13.4 \pm 1.27 (4-24)	260 \pm 83.11 (131-365)	69.4 \pm 19.39 (39-91)

Mass production

In the first trial, Table 3, when *G.legneri* female was allowed to parasitize one host larva weekly till her death, the progeny produced averaged 98.5/female. Sex ratio was 88.1% females.

Table 3. Progeny produced by 100 females *G.legneri* in 13 successive exposure to *A.transitella* larvae (1 female/larva) at $27\pm 1^\circ\text{C}$ and 50-55% R.H.

Exposure	Average Progeny/female	No. of survive females	Sex ratio % females
1st exposure	9.2 \pm 1.53	100	91.1
2nd	13.5 \pm 1.94	100	88.7
3rd	11.7 \pm 1.13	100	93.3
4th	12.4 \pm 2.11	100	91.5
5th	11.4 \pm 1.91	100	85.1
6th	12.1 \pm 2.32	96	89.2
7th	10.8 \pm 2.19	80	92.2
8th	11.4 \pm 1.73	60	87.5
9th	9.1 \pm 1.66	48	88.8
10th	10.3 \pm 1.17	40	83.7
11th	10.9 \pm 2.16	32	89.5
12th	8.1 \pm 1.12	18	81.1
13th	3.2 \pm 0.65	6	84.7
Average of total progeny/female 98.5 \pm 4.61.			

In the second trial, Table 4, when the parasitoids were allowed to parasitize *A.transitella* larvae at a rate of 8 female/10 larvae, the number of progeny produced/container averaged 96.7, 108.5 and 105 in three successive exposures. The respective numbers of progeny/female averaged 12.1, 13.5 and 13.1, while the numbers of progeny/host larva averaged 9.7, 10.8 and 10.5. The total progeny/female averaged 38.7. Sex ratios were 90.2%, 88.8 and 89.3% females in the three successive exposures, respectively.

Table 4. Progeny produced by *G.legneri* females in three successive exposures to *A.transitella* larvae at a rate of 8 females/10 larvae.

Exposures	Progeny/ container	Progeny/ female	Progeny/ larva	Sex ratio % females
1st exposure	96.7±22.51	12.1±1.53	9.7±0.88	90.2
2nd*	108.5±19.36	13.5±2.11	10.8±2.23	88.7
3rd*	105.0±24.33	13.1±1.88	10.5±1.66	82.3
Average of total progeny/female 38.7 ± 2.78.				

DISCUSSION

G.legneri was reared in the laboratory on larvae of the navel orange-worm *A.transitella*. At 27±1°C and 50-55% R.H., the total developmental period of the parasitoid averaged 11.3 days. Butler and Schmidt (1985) found that the parasitoid's developmental period averaged 15.6 days at 25°C and 9.2 days at 30°C when reared on the pink bollworm *P.gossypiella*. Sarhan (1989), on the other hand, reported this period to be 20 and 11.1 days, at 25 and 30°C, respectively, when the parasitoid was reared on *Ephesia kuehniella*.

G.legneri females did not deposit eggs daily, it deposited the eggs 21.5 times (13-26) during its life-time which lasted an average of 69.4 days. The number of eggs deposited each time averaged 13.4, whereas the total number of eggs deposited/female averaged 260.8. Butler and Schmidt (1985) found that *G.legneri* female, reared on *P.gossypiella*, produced 67.7 cocoons during its life time which lasted 30.1 days at 30°C. Sarhan (1989) mentioned that the female, reared on *E.kuehniella* produced 33 cocoons at 25°C and 41 cocoons at 30°C during its life-time which lasted 21.6 and 18.2 days, respectively.

For mass-production of *G.legneri* for commercial use, two trials were tested

in order to minimize labour and costs. In the first trial the parasitoid females were reared individually and a host larva was introduced to each female weekly. The progeny produced averaged 98.5/female and the sex ratio was 88.1% females. In the second trial, the parasitoid was reared at a rate of 8 females/10 larvae. The females were left until the cocoons were formed, then they were removed and introduced to another 10 larvae. The progeny produced averaged 38.7/female in three successive exposures. Sex ratio was 89.1% females.

Legner and Warkentin (1988) studied the effects of variable host-parasite densities on parasitization rates, progeny and sex ratio in *G.legneri*. They found that the number of progenies produced averaged 66.2, 74.1 and 84.1 when 9 females were introduced to 10, 15 and 25 *A.transitella* larvae (in Petri-dishes), respectively. The respective numbers of cocoons/host were 6.6, 4.9 and 3.4 while the numbers of progeny/female were 8.3, 9.3 and 10.5.

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دراسة بيولوجية والاكثار الكمي للطفيل *Goniozus legneri*

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تم تربية الطفيل *G.legneri* فى المعمل على يرقات *Amyelois transitella* على درجة حرارة ٢٧° م ورطوبة نسبية ٥٠ - ٥٥٪ وتحت هذه الظروف كانت فترة حضانة بيض الطفيل ٢٤ ساعة، وكانت فترة الطور اليرقى ٣,١ يوما، وطور ما قبل العذراء ٢٦ ساعة، وطور العذراء ٦,٧ يوما. كما استغرقت دورة حياة الطفيل (من البيضة حتى خروج الحشرة الكاملة) ١١,٣ يوما.

وقد وجد أن أنثى الطفيل لاتضع البيض يوميا وأن عدد المرات التى وضعت فيها الأنثى البيض كانت ٢١,٥ مرة طوال فترة حياتها التى بلغت ٦٩,٤ يوما. كان متوسط عدد البيض الذى تضعه الأنثى فى كل مرة ١٣,٤ بيضة وكان متوسط عدد البيض الكلى الذى وضعت الأنثى طوال فترة حياتها ٢٦٠,٨ بيضة.

وقد تم تجريب طريقتين للاكثار الكمي للطفيل فى المعمل بهدف استخدام هذا الطفيل كوسيلة للمكافحة الحيوية لدودة اللوز القرنفلية فى مصر.