REARING OF *PHYLLOCNITIS CITRELLA* STAINTON (LEPIDOPTERA: GRACILLARIIDAE) IN ORDER TO MULTIPLY THE PARASITOID *SEMIELACHER PETIOLATUS* GIRault

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**ABSTRACT**

The present work has shown that a citrus leaf can support the nutritive needs of 5 individual *P. citrella*. Beyond this number of feeding larvae leaf mortality results as larval densities increase. An increasing number of female *P. citrella* (> 6 females per suitable leaf) adversely affects rearing due to competition for oviposition sites and resource limitation for developing larvae. To maximize efficient production of *P. citrella*, a quantitative relationship between ovipositing females, larval densities, and leaf quality needs to be determined. Our results indicate that one ovipositing female should have access to six leaves under rearing conditions.

**INTRODUCTION**

To control exotic pests, classical biological control attempts to seek in the pest’s original country its natural enemies (e.g., the case of *Aleurothrixus floccosus*) for release in the invaded territory. Classical biological control has been used for citrus leafminer in different countries that have been recently invaded over the period 1993-1995 (Heppner, 1993; Beattie and Smith 1993; Garijo and Garcia, 1994; Anagnou-veroniki, 1995; Berkani, 1995; Ortu and al., 1995; Argov and Rossler, 1996; Aytas and al., 1996; Jerraya et al., 1996). One major difficulty has been the mass rearing of leafminers to supply to parasitoids being used in the biological control program. To maximise rearing efficiency we have investigated the precise conditions needed for maximum leafminer multiplication to mass rear parasitoids for of augmentative releases.

**MATERIALS AND METHODS**

One hundred two year old plants (*Poncirus trifoliata*), maintained in greenhouses were selected for rearing studies, pinched, and isolated in one of three cages (A, B, and C). These plants were carefully looked after and subjected to fertigation and pinching to promote healthy continuous growth. Seventeen days after pinching, grown leaves become suitable for oviposition by *P. citrella*. When *P. citrella* was released into cages with plants there were approximately 500 leaves/cage for females. We introduced 40, 80 and 160 couples respectively in cages A, B and C on June 11, 2002. These cages were kept inside an experimental greenhouse where temperature and humidity were controlled (average temperature 30°C and RH 80-90 %) (after Smith and Hoy, 1995). One week after inoculation the first batch of oviposition occurred and we focused on % of mortality, rate of infestation, rate of eclosion, number of eggs, of larvae and of pupae in each cage. This was followed a second set of observations done one week later (i.e., 15 days post-inoculation on June 25 2002). Statistical analyses were done using (SAS, 2000).

**RESULTS AND DISCUSSION**

*P. citrella* offspring 7 days after inoculation – Table 1

We found that:

1) The rate of *P. citrella* eclosion was the same whatever the cage density. This means that the activity of laying starts almost in a simultaneous manner for all the females and that the duration of incubation was comparable across the three cages stocked with different densities of ovipositing females.

2) The absence of the third instar larva in the three cages shows either there is a delay in oviposition or that the conditions of the cages were not favourable for rearing as under optimal conditions, the duration of the egg stage and first instar larva (*L*₁) are 2 days and 1 day, respectively.

3) If the density of initial inoculation affects the rate of female oviposition in cages, we can say that this capacity is about 97 % in the cage A, 73% in the cage B, and declines to 59 % in the cage C. This suggests that increasing the density of ovipositing females in cages adversely affects oviposition rates.

4) Numbers of eggs laid per leaf were 5, 9, 18 in the cages A, B and C, respectively. Consequently survivorship rates of first and second instar larvae were affected, most likely a result of overpopulation and resource depletion which resulted in mortality rates of 6%, 65% and 79% for cages A, B and C, respectively. Oviposition deterring pheromones applied to leaves on which have freshly deposited eggs do not deter further oviposition by females under crowded conditions.

5) *P. citrella* has a male:female sex ratio of 1:1. Therefore, we can estimate that the number of females produced per cages was 40 in cage A, 80 in cage B and 160 in cage C. These female populations, laid 2470 eggs (494 x 500), 4720 (944 x 500) and 8975 eggs (1795 x 500) in cages A, B, and C, respectively. In this way, we calculated the fecundity per female per cage as 61 for cage A, 59 for cage B, and 56 for the cage C. The differences between the fecundity values were not significant and were similar to values considered as being around the average fecundity for female *P. citrella*. 

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We deduce from this study that:
   i) In the cages we used and the temperature and humidity conditions, females laid all their eggs within a week.
   ii) Females are not capable restraining oviposition to prevent overpopulation in cages.

Consequently from this experiment we can conclude that:
   i) Female \textit{P. citrella} are capable of over exploiting oviposition resources, they show a great capacity for discovery, being able to distribute eggs on almost all suitable leaves. This may maximize opportunities for larval survival.
   ii) Oviposition is complete with 7 days of female emergence.

\textit{P. citrella} offspring 15 days post-inoculation – Table 2

We can conclude from the Table 2 that:
   i) New batches of eggs were not laid which means that oviposition was complete within 7 days of inoculation at 30°C.
   ii) Populations of \textit{P. citrella} in cages were composed of mixed stages and smallest instar development was slow.
   iii) Mortality was observed for all larval instars, but not pupae, and larval mortality was greatest when caged populations were highest.
   iv) Percentage survival was 94%, 30% and 10% for cages A, B, and C, respectively.

A larval density of approximately 5 (4.94 ± 12) larvae per leaf results in around 3% mortality. This suggests that a citrus leaf can provide 5 larval \textit{P. citrella} with their nutritive needs.

REFERENCES


