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Parasitism of *Spalangia cameroni* (Hymenoptera, Pteromalidae), an idiobiont parasitoid on pupae of *Ceratitis capitata* (Diptera, Tephritidae)

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Abstract: *Spalangia cameroni* Perkins, 1910 is a pteromalid hymenopteran, well known as a pupal parasitoid of flies belonging to different taxonomic families in the order Diptera, as Muscidae, Sarcophagidae and Anthomyiidae. This species is being used as a biological control agent against the housefly (*Musca domestica*) and the stable fly (*Stomoxys calcitrans*). In the family Tephritidae it was known as a parasitoid of *Anastrepha suspensa*, *Dacus cucurbitae* and *D. passiflorae*, but recently it has been described as a parasitoid of the Mediterranean Fruit Fly, *Ceratitis capitata*, in the Valencian Community (Spain). Due to the importance of that fruit fly species as a serious pest on citrus and fruit trees, it has been started the rearing and the biological study of *S. cameroni* in laboratory conditions, in order to know its ability to be used in the biological control of the medfly. Biological and parasitic parameters of the insect, as adult longevity, female fecundity and fertility, influence of host age and temperature on parasitism and female ability in searching the host buried in the ground, are being analysed.

Key words: *Ceratitis capitata*, pupal ecto-parasitoid, *Spalangia cameroni*, parasitic activity

Introduction

In the year 2003, a population of the parasitoid *Spalangia cameroni* Perkins, 1910 (Hymenoptera, Pteromalidae) was found parasitizing pupae of *Ceratitis capitata* (Wiedemann) in field: adults of the insect were obtained in the laboratory emerging from pupae of the medfly found in the field (Falcó et al., 2004; 2006). This was the first record in the world of *S. cameroni* as a parasitoid of *C. capitata*. It is a generalist pupal ectoparasitoid of several taxonomic families in the order Diptera, including Tephritidae: *Anastrepha suspensa* (Loew), *Dacus* sp., *D. cucurbitae* Coquillett and *D. passiflorae* Froggatt (Noyes, 2005), and also now *C. capitata*.

S. cameroni is being used in the biological control of some dipteran species as *Musca domestica* L. (the house fly) and *Stomoxys calcitrans* (L.) (the stable fly), which are a serious problem in animal farms in several countries like Denmark, USA, Australia, Costa Rica and Colombia (Steenberg *et al*., 2001; Geden y Hogsette, 2006). In our laboratory, in the last years, we have studied the biological parameters of *S. cameroni* on pupae of *C. capitata* in order to know possibilities in using this species as a biological control agent of the Medfly.

Material and methods

Laboratory rearing of S. cameroni

To keep a rearing of *S. cameroni* in laboratory conditions (Figure 1), we have developed a very simple method consisting in offering, twice a week, pupae of *C. capitata* (from our laboratory rearing) to adults of the parasitoid confined in a plastic cage (30x20x20 cm) with

ventilation and a supply of water and honey to adults, in a climatic chamber (Light 16 h - 24±1ºC, 60-70% RH and Dark 8 h – 21±1ºC, 70-80% RH).

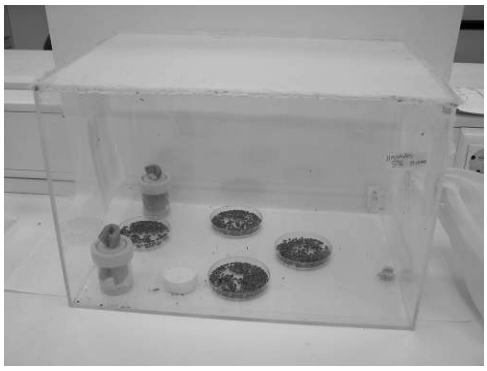

Figure 1. Laboratory rearing cage of *S. cameroni*

Parasitized pupae in plastic Petri dishes were kept in the same climatic chamber to evolve until parasitoid adult emergence.

Experiments on parasitism

Several bioassays have been carried out, in the same climatic chamber mentioned above, in order to know: adult longevity, female fecundity and fertility, killing activity on pupae of *C. capitata* and sex-ratio. Couples of *S. cameroni* were isolated on plastic cages (Figure 2) with a supply of water and honey and ten host pupae per day until female death.

Figure 2. Cages used in bioassays with couples of *S. cameroni*.

Other bioassays were developed to know the effect of temperature on the parasitic activity of the parasitoid. In a climatic chamber, with 60-70% RH and a photoperiod of 16:8 (L:D), several constant temperatures were studied: 15, 20, 25, 30, 35 and 40 ºC. Couples of *S. cameroni* (eight days-old) were confined in plastic cages (the same as in the previous experiments) and females allowed to oviposit during a period of 5 days. Two different experiments were performed: one to know fecundity of females and the other to detect fertility (emergence of adults).

The influence of host age on the parasitism of *S. cameroni* was also examined. A bioassay was performed comparing the effect of old and young pupae of *C. capitata* on parasitism. Experiments of choice and no-choice for the two types of host pupae were developed, using isolated couples of *S. cameroni* in plastic cages (Figure 2) and counting the fecundity and fertility of females, during a period of 5 days, on pupae of 1-3 days-old (young pupae) and pupae of 6-8 days-old (old pupae).

Finally, we have studied the ability of the females of *S. cameroni* in finding and parasitizing buried pupae of *C. capitata*, as it will be the real situation for the parasitoid in the field. For that, several bioassays have been developed with isolated couples in plastic cages (Figure 2) and putting pupae of *C. capitata* in plastic Petri dishes but buried 4 cm in soil.

Results and discussion

The rearing system described above has allowed us to keep a laboratory population of the parasitoid for more than 40 generations.

In Table 1, results on the parasitic activity of *S. cameroni* are shown. It has to be pointed out that the action of females of the parasitoid in killing pupae of the medfly is as important as the female fertility, as it had previously been described by Gerling & Legner (1968) on *Musca domestica*, and this is an interesting characteristic of the parasitoid to be considered in the control of the pest. And another important aspect is the sex ratio in the progeny, which is favourable to females.

Table 1. Data on parasitism of *S. cameroni* on pupae of *C. capitata*.

Adult longevity	18-20 days
α Fecundity	22-24 eggs/α
α Fertility	13-15 individuals/α
Killed pupae	12-15 pupae/α
Sex ratio	70% α

Results on parasitic activity (fecundity and fertility) of *S. cameroni* at different constant temperatures are shown in Table 2. At 20, 25 and 30 ºC females are able of put eggs on pupae of *C. capitata* and there is a complete immature development and emergence of adults of the parasitoid. However, at 15 and 35 ºC we found egg-laying on pupae but no adult emergence was detected. And finally, there was neither egg-laying nor adult emergence at 40 ºC. So these results indicates that *S cameroni* could parasitize *C. capitata* in our Mediterranean climatic conditions.

Table 2. Results on parasitism of *S. cameroni* at different constant temperatures.

Temperature	**Parasitic Activity**
20, 25 & 30 ºC	Egg-laying & adult emergence
15 & 35 ºC	Egg-laying & no adult emergence
40 ºC	Nothing

The bioassay on the effect of host age on parasitism showed that there was a slight preference for old-host pupae (choice test) but no significant differences were found and *S. cameroni* females parasitize old-host pupae as well young-host pupae in non-choice test.

Finally, in bioassays on parasitic activity on buried pupae, we found that females can find and parasitize the pupae buried in soil, but more experiments must be done in order to compare parasitic activity of *S. cameroni* on buried and not buried pupae. Nowadays more research is being developed on the parasitism of *S. cameroni* on *C. capitata* to know real possibilities in using this parasitoid as a biological control agent of medfly populations in our country.

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