Host age selection behaviour of *Trichogramma aurosum* Sugonjaev & Sorokina (Hymenoptera: Trichogrammatidae)

Selektion nach Wirtsalter durch *Trichogramma aurosum* Sugonjaev & Sorokina (Hymenoptera: Trichogrammatidae)

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Abstract

Host age selection in several German strains of *Trichogramma aurosum* Sugonjaev & Sorokina was examined in laboratory choice tests under direct observation for 90 min., in order to select candidate strains for attempts at controlling the codling moth, *Cydia pomonella* L. (Lepidoptera: Tortricidae). Experiments were conducted at room temperature by exposing combinations of two host ages (zero vs. 4 and 1 vs. 5-day old) to a single female wasp. Host age did not appear to affect the wasps parasitization behaviour, although they spent longer time drilling on old eggs (4 and 5 days old) compared with fresh ones (0 and 1 day old). This not necessarily means that they preferred fresh eggs over old ones, since both type of hosts were parasitized in the choice test. Possibly an increased mechanical resistance of the chorion of older eggs was responsible for the prolonged drilling time. Mean drumming time was independent of host age. Mean duration of drilling and drumming was in general longest in the first and last egg attacked by all *T. aurosum* strains tested and for all host ages. Drilling time consumed more than 80% of the mean handling time of all strains tested for all host ages, followed by resting and walking.

Keywords: *Trichogramma aurosum*, egg parasitoids, host age, choice test, host selection, parasitization behaviour, *Cydia pomonella*, codling moth.

Introduction

The use of natural enemies like predators, parasitoids and microorganisms to suppress populations of insect pests is the major aim of biological control. The most widely used beneficial organisms worldwide belong to the genus *Trichogramma* (Hymenoptera: Trichogrammatidae) (Smith, 1996). This genus comprises more than 200 nominal species that are primary egg parasitoids (Pinto, 1999). Cosmopolitan in distribution, *Trichogramma* spp. occupy habitats that range from aquatic to high arboreal. Although these extremely tiny wasps (*ca*. 500 µm) attack mainly eggs of lepidopterous species, they have been collected from well over 200 species belonging to > 70 families and eight orders. Attempts at controlling insect pests using *Trichogramma* spp. started in the beginning of the last century in the USA and in the former Sowjetunion.

Trichogramma aurosum was described in 1975 by Sugonjaev & Sorokina. However, only studies on its distribution have been carried out in the USA and Russia. *Trichogramma aurosum* was found in Germany for the first time in 2000 (Monje & Zebitz, 2003). According to preliminary host preference experiments it was shown that this species prefers eggs of the codling moth, *Cydia pomonella* L. (Lepidoptera: Tortricidae), over other host eggs. In 2001 - 2002, a wide collection of this species was carried out in the German Federal Republic from eggs of *Nematus tibialis* (Hymenoptera: Ten-

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thredinidae) on *Robinia pseudoacacia*. Pilot experiments revealed that *T. aurosum* may be a potential candidate antagonist for attempts to control *C. pomonella* in apple orchards. This study aims to investigate whether *T. aurosum* discriminates between different host ages.

Material and Methods

Field trips and collection from the field were done during summer 2002 and 2003 by collecting parasitized (black) eggs of *Nematus tibialis* on leaves of *Robinia* trees in several locations in the German Republic and its neighbouring countries. The collected strains of *T. aurosum* are maintained for the laboratory experiments at present. Stock cultures of the apple codling moth, *Cydia pomonella* L., and the Mediterranean flour moth, *Ephestia kuehniella* Zeller, were established under laboratory conditions for the experiments. Stock cultures of the beneficial wasps *T. aurosum* were maintained in the laboratory for the research. About 21 strains of the wasps were reared in large numbers for the different experiments planned.

Host age: Experiments were conducted at room temperature by exposing combinations of two host ages (0 vs. 4 and 1 vs. 5 old day) to a single female wasp in a choice tests. Each test was conducted in a plastic petri-dish (5.3 cm diam.) carrying a piece of graph-paper (2 x 2 cm). Eight eggs of each age were arranged in an grid square shape alternatively, and 4 mm apart. Then the *Trichogramma* females were released and allowed to parasitize the hosts. Every behavioural event was recorded using the Observer® software for 90 min. after the first contact with one egg: Walking, cleaning, resting (handling time), contact, drumming (touching the host egg with the antennae), acceptance (by starting drilling), or rejection (by leaving the host and walking away), drilling, and oviposition (movement of the abdomen can be clearly seen). Each treatment was repeated 20 times.

Parasitization behaviour and learning ability: These experiments addressed to the question whether the female wasps can learn and whether prior experience plays a role in subsequent behaviour. They were conducted by offering only fresh eggs to newly hatched female wasps (> 24 h old). Experimental conditions were the same as for the experiments described above.

Results & Discussion

Females of *T. aurosum* spent longer time drilling on old eggs (4 and 5 days old) compared with fresh ones (0 and 1 day old) (Fig. 1). This not necessarily means that they prefer fresh eggs over old ones, since both type of hosts were parasitized in the choice test. Similar results were obtained by both Brand *et. al.* (1984) and Godin & Boivin (1994) with *T. evanescens* and *T. pretiosum* respectively. Host age generally does not appear to affect contact or acceptance of eggs of different host species, but duration of the oviposition behaviour is sometimes influenced by host age (Pak *et. al*., 1986). Furthermore, Reznik *et al.* (1997) found that host acceptance depends not only on current host age, but also on the age of the previously offered host. Possibly an increased mechanical resistance of the chorion of older eggs was responsible for the prolonged drilling time. Mean drumming time was independent of host age (Fig. 2), where females spent about the same time drumming on fresh and old eggs. In general, mean duration of drilling was highest in the first and last attacked egg (Fig. 3). It was shorter for the second up to the sixth attacked host. On the contrary, drumming time was always higher for the first host and lower for the subsequent attacked hosts (Fig. 4). Results suggest that learning takes place on the first host encountered, thus reducing han-

dling time on the subsequent hosts. A more detailed analysis of the behaviour events (especially walking and resting) between the host encounters may help to explain the longer duration of drilling time on the last host attacked. The wasps consumed about 75, 80, 85, and 95% of the handling time on drilling the 0, 1, 4 and 5 day old eggs, respectively, 5% for drumming and 10% for resting. Future studies will focus on determining host acceptance and preference between different hosts.

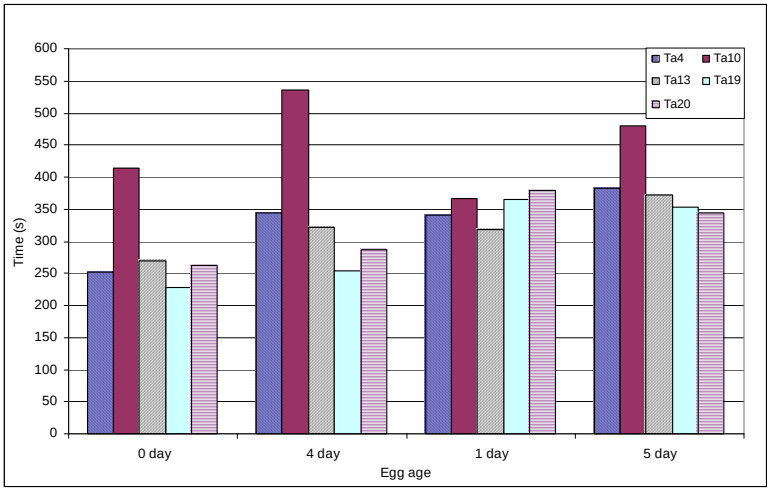

Fig. 1: Mean duration of drilling by five *T. aurosum* strains in parasitising 0 vs. 4 day and 1 vs. 5 day old eggs of *C. pomonella* at room temperature.

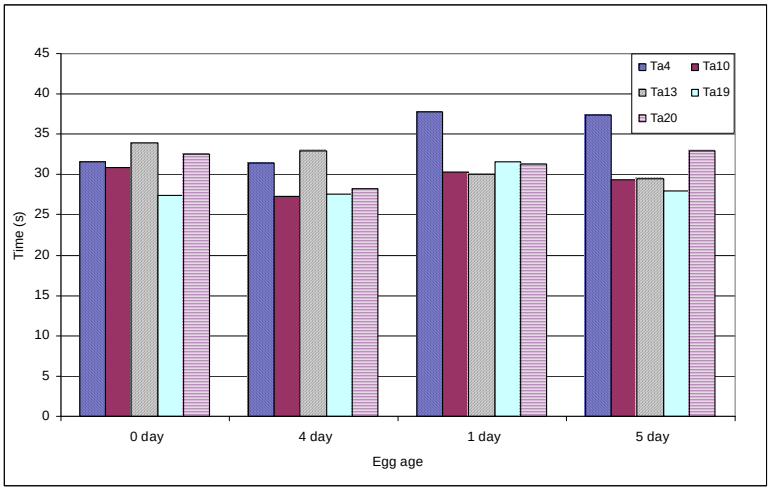

Fig. 2: Mean duration of drumming by five *T. aurosum* strains in parasitising 0 vs. 4 day and 1 vs. 5 day old eggs of *C. pomonella* at room temperature

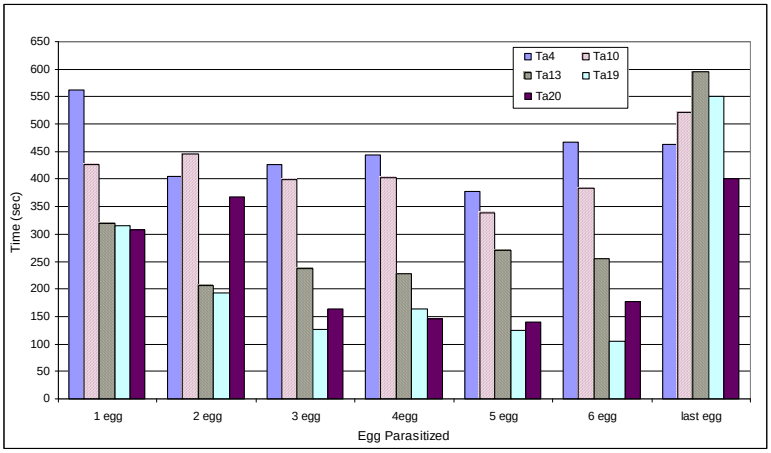

Fig. 3: Mean duration of drilling by five *T. aurosum* strains in parasitising fresh eggs of *C. pomonella* at room temperature.

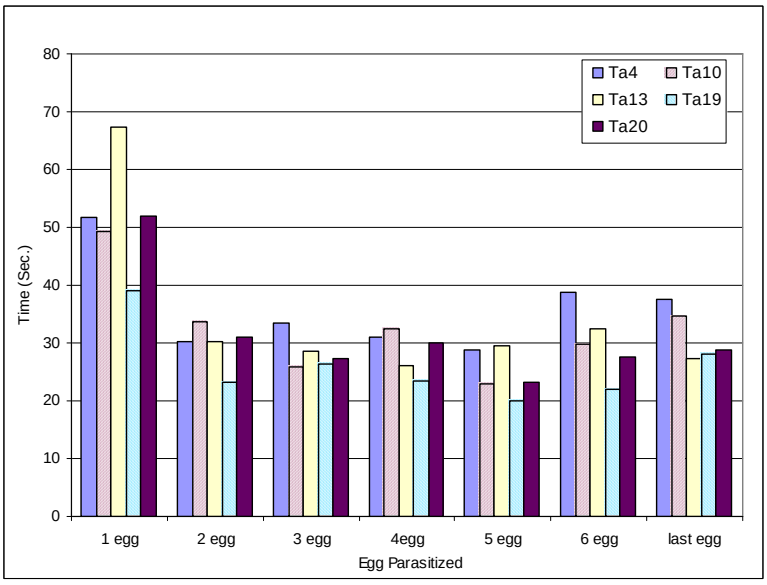

Fig. 4: Mean duration of drumming by five *T. aurosum* strains in parasitising fresh eggs of *C. pomonella* at room temperature.

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