Trichogramma and other egg parasitoids
San Antonio (Tx, USA), September 23-27, 1990
Ed. INRA, Paris 1991 (Les Colloques n°56)

Interspecific competition between three species of the genus *Trichogramma (Hym., Trichogrammatidae)*

J. TAVARES*, J. VOEGELE**

* *Universidade dos Açores, Departemento de Biologia, 9502, Ponta Delgada, Portugal*

** *INRA, Laboratoire de Biologie des Invertébrés, Unité de Lutte Biologique 37, Bd du Cap, 06600 Antibes, France*

Summary

For this study, three species of *Trichogramma* were submitted to competition in such a way that each competed with only one of the two other species simultaneously. The species were *T.embryophagum* **Hartig**, *T.maidis* **Pintureau & Voegelé** and *T.buesi* **Voegelé**.

The host eggs *Ephestia kuehniella* **Zeller** (Lep., Pyralidae) were first parasitized by one of the species and when the first occupant was in a prenymphal instar (free living embryo, L_1, L_2 and L_3), adults of the second species were allowed to parasitize the eggs containing the living instar of the first species.

Unider these conditions, *T.embryophagum* eliminated the two other species, *T.maidis* just eliminated *T.buesi* but only in two situations (L_2 and L_3) and *T.buesi* was inactive in all situations. When host eggs are available in sufficient number, all three *Trichogramma* species show a high intra and interspecific discrimination for host eggs recently parasitized.

Introduction

In biological control, it frequently happens that the inundative introduction of a new species, like *T.evanescens*, tends to eliminate, at the time of introduction, local species like *T.buesi* (**Voegelé *et al*, 1975**). Various studies were made concerning the interspecific competition of *Trichogramma* for only one host (**Fisher**, 1961 ; **Sasaba**, 1966 ; **Vinson**, 1972 ; **Godwin & Odell**, 1979 ; **Vinson & Ables**, 1980 ; **Pintureau**, 1981).

In the continuity of these studies, our objective was the comparison of three *Trichogramma* species that are being used in Portugal for the biological control of agricultural pests : *T.buesi*, *T.maidis* and *T.embryophagum*, using isolated host eggs. In this situation, both competition and egg pressure are associated.

Materials and methods

The host eggs used were less than 24 hours old and have previously been radiated by U.V. light. The eggs were then introduced each in one different glass tube (1x5cm). The preimago development after the parasitism of the first occupant happened at 22 ± 1°C, 70 % RH and L:D 16:8, except for a few minutes during the parasitism of the second occupant. The time between the parasitism of the two antagonist species was determined by the dissection of some parasitized eggs of *Ephestia Kuehniella* **Zeller** (Lep., Pyralidae) for determination of the stage of development. The average duration, in hours, between the parasitism of the two species is presented in table 1.

The process of parasitism for the *Trichogramma* females was observed with a dissec-

Stages of development	*T.maidis*	*T.buesi*	*T.embryophagum*
Free living embryo	24	--	--
L_1	28	24	24
L_2	40	48	48
L_3	68	72	96

Table 1 : Duration, in hours, of the development stages for three Trichogramma species, at 22 ± 1 °C.

ting microscope. 24 to 48 hours old females were used. The females were under the effect of egg pressure and each was allowed to penetrate only once the host-egg chorion. This act has a time duration bellow 1 minute. After the eclosion of the adults, the species that survived from the interspecific competition was determined.

Results

Superparasitism and monoparasitism. In previous works, **Tavares** (1985) demonstrated that, when hosts are not abundant, the discrimination capability of the *Trichogramma* females for parasitized eggs disappears almost completely under the effect of egg pressure, this effect being stronger when the *Trichogramma* hasn't good feeding conditions. Having in consideration the future of the eggs parasitized with only one sting, we verify that the development takes place in all cases. Sometimes females lay two eggs in only one sting (superparasitism), but, in the majority of the cases, the host eggs are monoparasitized.

For the study of interspecific competition, only monoparasitized eggs were considered. A minimum of 30 females were observed and, for each stage of development of the first species, we never found a species that could eliminated the other in 100 % of the cases. Thus, two case are possible : (1) the first occupant eliminated the second and (2) the second occupant eliminated the first.

The first occupant eliminates the second. We can verify in Fig.1 that, for all cases, there is a dominance of *T.embryophagum* over *T.maidis* and *T.buesi*, and of *T.maidis* over *T.buesi*, except when the first occupant of the host is in the beginning of the first larval stage. For this particular case, and whatever the species, this stage eliminates the second occupant. *T.buesi* is always dominated, *T.maidis* dominates only *T.buesi* and *T.embryophagum* is always dominant.

The second occupant eliminates the first. We found again the dominance indicated earlier, but only if the first occupant is in the third larval stage. Like we said before, the second

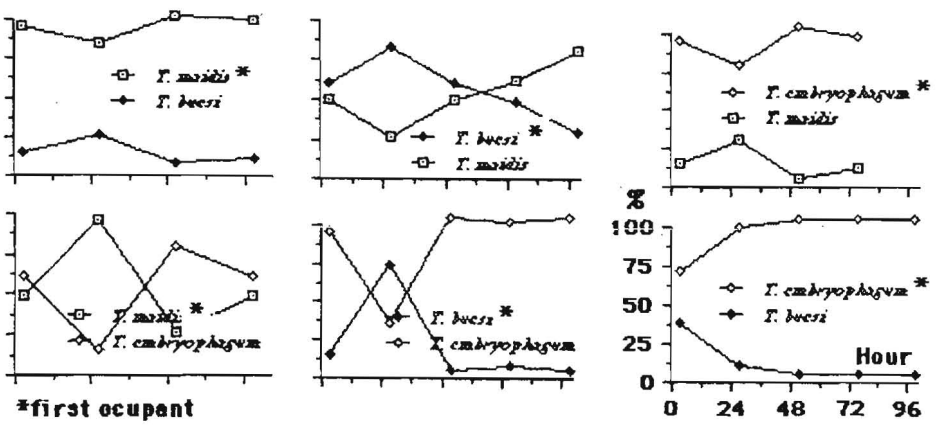

Figure 1 : Interspecific competition between three species of Trichogramma, studied two by two, in function of the time of occupation of the first species. the data are expressed in % of emergence for each species.

species is always incapable of dominating.

All the process works as if the first larval stage is that of the higher competitive capability. This larval stage is capable of movement, particularely well provided with sharp mandibles and salivary glands and having also a very fast growth rate.

There is a very low number of commensalism cases between two species in the same host egg until the adult stage is reached. These cases occur more frequently for shorter periods of time between the parasitism of the two antagonist species. The commensalism is still rather important until the end of the embryonic development. *T.embryopahgum* was found to be the most tolerant of the three species. It was also verified that *T.maidis* and *T.buesi* refuse to parasitize eggs already attacked by other species when the first species has reached the third larval stage and has, in part, produced its nymphal envolope.

Discussion and conclusion

In contrast to the Proctotrupids, the Trichogrammatids show a very high discrimination capability for eggs previously parasitized by another female of the same species. This capability, in the case of *T.maidis*, which parasitizes egg-clusters with a majority of overlapping eggs, tends to reduce its egg laying capacity. The process works like if they would try to avoid overlapping of their egg laying territory over that of their neighbour.

The same case happens with the interspecific competition, although, in case of egg pressure, the *Trichogramma* act as hyperparasites. *T.buesi* is a low level hyperparasites. With *T.maidis*, this phenomenon is much stronger. Such fact was also reported by **Pintureau** (1981) for *T.nubilale* and *T.lutea*. *T.maidis* is eliminated by *T.embryophagum* that acts as a larval and nymphal hyperparasite.

Trichogramma have also the general character of the Hymenoptera for occupying eggs parasitized by another species if they are in the embryological stage like it was demonstrated by **Pintureau** (1981) with *T.dendrolimi* **Matsumura**. This last species, like *T.embryophagum*, known to colonize preferably the arborical plants, eliminates *T.maidis* in all situations. It is necessary to notice that such competitive situations should be relatively rare in natural conditions, existing only when there is a strong numerical out of balance between the species in competition and the number of host eggs, which is a frequent situation after an inundative release.

There is a sequence of situations from monoparasitism to interspecific commensalism, followed by a stage of superparasitism without commensalism accompanied with a total or partial elimination of the individuals in interspecific competition and ending in a situation of hyperparasitism.

References

Fisher R. 1961. Effects of temperatures fo rearing and reproduction of *Aptesis basizona* **Grav.** (Hym., Ichneumonidae). *Ann. Entomol.* **93** : 799-801.

Godwin P. & T. Odell 1979. A laboratory study of the interaction of two parasites of *Lymantria dispar* (Lep., Lymantriidae) : *Blepharipa pratensis* (Dipt., Tachinidae) and *Brachymeria intermedia* (Hym., Chalcididae). *Entomophaga.* **24** : 185-190.

Pintureau B. 1981. Compétition interspécifique entre espèces de Trichogrammatidae (Hyménoptères) : vérification du phénomène d'élimination. *Bull.Soc.Ent. Mulhouse.* 49-58.

Sasaba T. 1966. Interspecific competition between two species of *Trichogramma*. III. The analytical study on the competition. *Res.Popul. Ecol.* **8** : 102-106.

Tavares J. 1985. Etude comparée de trois espèces de Trichogrammes : *T.maidis* **Pintureau** et **Voegelé**, *T.buesi* **Voegelé** et *T.embryophagum* **Hartig** (Hym., Trichogrammatidae). *Thèse de Docteur-Ingénieur. Université d'Aix-Marseille.* 122pp.

Vinson S.B. 1972. Competition and host discrimination between two species of tobacco budworm parasitoids. *Ann. Entomol. Soc. Amer.* **65** : 229-236.

Vinson S.B. & **J. Ables** 1980. Interspecific competition among endoparasitoids of tobacco budworm larvae (Lep., Noctuidae). *Entomophaga*. **25** : 357-362.

Voegelé J., S. Poitout, J. Daumal, R. Bues & **J. Pizzol**. 1979. Premiers essais de lâchers de Trichogrammes du groupe *evanescens* **Westw.** (Hym., Trichogrammatidae) contre la Noctuelle du chou *Barathra brassicae* L. (Lep., Noctuidae) dans la région d'Hyères (Var). *VII Reuinion Nac. Contol Biologico. Mexico*. 148-154.