INTRINSIC COMPETITION BETWEEN *APANTELES MELANOSCELUS* [HYM. : *BRACONIDAE*] and *ROGAS LYMANTRIAIE* [HYM. : *BRACONIDAE*] REARED ON *LYMANTRIA DISPAR* [LEP. : *LYMANTRIIDAE*]

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In the laboratory, competition was determined between *Apanteles melanoscelus* RATZEBURG and *Rogas lymantriae* WATANABE by rearing both in the same gypsy moth, *Lymantria dispar* (L.), hosts. Each parasite attacked larvae previously parasitized by its competitor; neither parasite was excluded by the action of the other, but those that attacked first were more successful. Of 600 competitive interactions tested, only 1 gypsy moth larva yielded both parasite species. Percentage of parasitism was not significantly reduced, which suggests that *A. melanoscelus* and *R. lymantriae* are intrinsically compatible and that establishment of *R. lymantriae* in the United States could provide an additional benefit for gypsy moth control.

After the gypsy moth, *Lymantria dispar* (LINNAEUS), was accidentally introduced into the United States in 1869, parasites were introduced for control (Hoy, 1976). *Apanteles melanoscelus* RATZEBURG is well established throughout the northeastern United States (BURGESS & CROSSMAN, 1929) and is the most effective early larval parasite. Efforts to establish additional parasites continue. The braconid endoparasite, *Rogas lymantriae* WATANABE, collected in 1978 from gypsy moth from Honshu and Hokkaido, Japan, is not yet established in the United States. WESLOH *et al.*, (1979) considered assessment of introduced parasites a requisite to release, especially for a hyperparasite. Assessment in the laboratory cannot fully approximate field conditions, but obvious interactions should be investigated. We believed that this was particular appropriate for *A. melanoscelus* and *R. lymantriae* because of their similarities.

*A. melanoscelus* and *R. lymantriae* are primary gypsy moth parasites, attack 1st to 3rd instars by laying eggs within larvae, are solitary and have approximately the same developmental period (14-20 days). *R. lymantriae* kills the larva in the 4th instar by consuming all internal tissues. It forms a tough cocoon internally; the host remnants and parasite are called a mummy. *A. melanoscelus* exits from live gypsy moth larvae and forms an external cocoon. Parasitized larvae are not killed immediately, and a few may survive.

There are reports of intrinsic competition between parasites of forest lepidoptera (GRIFFITHS, 1976, SCHRODER, 1974) but only one is known for the gypsy moth. GODWIN & ODELL (1979) reported that the chalcid, *Brachymeryia intermedia* (NEES), was not a significant mortality factor for the tachinid, *Blepharipa pratensis* (MEIGEN), which infests gypsy moth pupae. However, LEWIS (1960) demonstrated that in spruce budworm, *Choristoneura fumiferana* (CLEM.) parasitized by both *Apanteles fumiferanae* VIER and *Glypta fumiferanae* (VIER), only 1 parasite could survive. Further, when *A. fumiferanae* parasitized larvae first, it inhibited egg hatch of *G. fumiferanae*; the effect of inhibition increased with time.
We ascertained the compatibility of *R. lymantriae* and *A. melanoscelus* to determine if there was an avoidance of hosts previously parasitized by the other species or if multiple parasitism was detrimental to either or both parasites.

**MATERIALS AND METHODS**

One hundred recently molted 2nd-instar gypsy moth larvae obtained from the F19 and F20 laboratory colony of the Gypsy Moth Methods Development Laboratory, Otis Air Force Base, Massachusetts, U.S.A., were parasitized by *A. melanoscelus* and another 100 larvae by *R. lymantriae*. Second instars are preferred for oviposition by both parasites; oviposition in 3rd or 4th instars is difficult because of the length of larval setae. To ensure parasitization, oviposition was confirmed visually. *A. melanoscelus* was from a laboratory colony established in 1977 from gypsy moth larvae collected in Connecticut; *R. lymantriae* had been under colonization since November 1978 when it was received from the USDA, SEA, Beneficial Insect Research Laboratory. Parasitized larvae were separated into groups of 5, placed into 1/2-litre, unwaxed ice cream cartons with clear plastic lids, and reared on a 30-g cup of artificial diet after Odell & Rollinson (1966).

To determine the effect of age on competition between the 2 parasite species, 25 larvae were parasitized by the reciprocal species at 0, 3, and 6 days after initial parasitism; 25 larvae parasitized by each parasite were held as controls. One of each species was placed into a carton with 5 larvae previously parasitized by its rival. When stinging was observed, the larvae were removed and reared individually on artificial diet in 60 x 15-mm plastic Petri dishes. Because *A. melanoscelus* diapauses at photophases of 16 h or less, larvae were reared under a 20 h photophase. This experiment was repeated 4 times from March to July 1980. We had previously determined that the 20 h photophase shortened development of *R. lymantriae* but did not prevent mummification.

**RESULTS AND DISCUSSION**

There was no consistent evidence that either parasite dominated the other (fig. 1) *R. lymantriae* did not produce mummies in 2 tests and *A. melanoscelus* successfully parasitized hosts in all but 1 test. In all 4 studies, less than 100 % parasitism was caused mainly by unsuccessful parasitization by either or both parasites, and the gypsy moth larvae were discarded upon reaching 5th instar. Other causes were mortality due to pathogenic organisms or ovipositional trauma; these never exceeded 5 % in any study.

Gypsy moth larvae previously parasitized by either *A. melanoscelus* or *R. lymantriae* were attacked by of the reciprocal species at all 3 periods of exposure. We did not offer unparasitized hosts; hence, no solid conclusion can be made on interspecific host discrimination or selectivity. The discriminating capability of *R. lymantriae* is unknown, but *A. melanoscelus* can discriminate between hosts previously parasitized by the same species (Weseloh, 1976). Thus, interspecific discrimination seems possible. Because there was no evidence of rejection of parasitized hosts by either adult parasite, we believe that multiple parasitism in the field is possible.

Both parasites successfully attacked larvae previously parasitized by their competitors, which indicates that inhibition of development by the older parasite was not absolute. However, the parasites that attacked first were more successful. When *R. lymantriae* attacked first, it parasitized 45 % of the larvae and *A. melanoscelus* parasitized 29 %. When *A. melanoscelus* attacked first it parasitized 56 % of the larvae and *R. lymantriae* parasitized 24 %. Because eggs hatch for both species in about 3 days, larvae stung by the 1st species could have developed for 9 days before eggs of the 2nd species eclosed.