ENTOMOPHAGA, 33 (2), 1988, 245-248

LABORATORY REARING OF *ANAPHES SORDIDATUS* [*HYM. : MYMARIDAE*] ON CARROT WEEVIL EGGS [*COL. : CURCULIONIDAE*]

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A technique for rearing *Anaphes sordidatus* (Girault) on eggs of laboratory-reared carrot weevil, *Listronotus oregonensis* (Le Conte), is described. Individual rearing was possible by using polyethylene embedding capsules that enabled easy manipulation of parasitized carrot weevil eggs for use in subsequent experimental procedures. The technique described resulted in 65 % parasitization of carrot weevil eggs and 90 mn per day were sufficient to obtain *ca.* 200 parasites daily.

KEY-WORDS : *Mymaridae, Curculionidae,* parasite, *Listronotus oregonensis, Anaphes sordidatus.*

The carrot weevil (CW), *Listronotus oregonensis* (Le Conte), attacks umbelliferous crops, especially carrots, in northeastern North America (**Boivin,** 1985a ; **Stevenson,** 1985 ; **Grafius & Collins,** 1986). The control of this insect relies exclusively on chemical insecticides although and Integrated Pest Management (IPM) program in southwestern Québec has considerably reduced pesticides use through a better management of the pest (**Boivin,** 1985b).

Biological control of the CW could also reduce the use of chemical insecticides. Several species of entomophagous nematodes were found to kill CW larvae, pupae and adults (**Bélair & Boivin,** 1985), and an egg parasite, *Anaphes sordidatus* (Girault), was recorded in Michigan (**Collins & Grafius,** 1986b) and Québec (**Boivin,** 1986). In an unsprayed carrot field in southwestern Québec, 52 % of the CW eggs were parasitized by *A. sordidatus* (**Boivin,** 1986) indicating that this parasite could be of advantage in an IPM program. **Collins & Grafius** (1986a,b) reared *A. sordidatus* on CW eggs in plastic containers. However, this technique involves tedious manipulation of both parasites and CW eggs. A rearing technique is described, which eases manipulation of CW eggs.

REARING METHOD

The rearing originated from CW eggs extracted from carrot plants sampled in an unsprayed carrot field at the Agriculture Canada experimental farm at Sainte-Clotilde, Québec.

At emergence, adult *A. sordidatus* were placed on a filter paper deposited on an inverted Petri dish (PD), 9.5 cm in diameter. A maximum of 25 ♂ and 25 ♀ were placed in each PD along with *ca.* 10 CW eggs per female parasite. The CW eggs were extracted from carrot pieces obtained as described by **Martel *et al.*** (1975) and were less than 48 h old. As food source for the adult parasites, 50 mg of a dry mixture of yeast hydrolysate enzymatic (33 % volume), brewer's yeast (50 % volume), and soya flour (17 % volume) was placed on the filter paper. Distilled water (0.2 ml) was then added onto the filter paper with a syringe. A 2nd inverted PD was then placed over the parasites and sealed with Parafilm® to avoid loss of moisture or parasites.

The PD was placed in an incubator at 24 ± 1 °C and a photoperiod of 16L : 8D. After 3-4 days, which represent the average lifespan of the parasite at that temperature (**Collins & Grafius,** 1986b), each CW egg was individually placed in a size 3 (*ca.* 300 µl) Beem™ polyethylene embedding capsule (Pelco Electron Microscopy Supplies, Ted Pella Co., Tustin, CA) using a fine moistened brush. These capsules were placed on a moistened filter paper in a sealed PD. The air inside the PD was saturated with humidity and some condensation occurred inside the PD but not in the capsules. The PD containing the capsules was placed in an incubator under the conditions described earlier. The capsules were then examined daily for emergence of CW larvae or adult parasites.

The use of these embedding capsules allowed easy manipulation of individual CW eggs without danger of mechanically damaging them or accidentally losing recently emerged parasites. All eggs from a single oviposition PD could be kept together or randomized according to an experimental design. As these capsules are translucent, emergence data from individual eggs can be recorded.

The eggs were classified as non-parasitized (CW larvae emerged), parasitized (adult parasite emerged), mechanically damaged (egg collapsed with recognizable mechanical damage) or aborted eggs (no emergence but normal appearance). Most mechanical damage occurred when the eggs were removed from the carrots before exposure to parasites. Damaged eggs collapsed rapidly and were not used. Aborted eggs comprised natural abortion of CW larval development, abortion caused by adult parasite penetration but without oviposition and incomplete development of a parasite larvae. Sterile CW eggs, which can be recognized by their pale color (**Baudoin & Boivin,** 1985) were not transferred into capsules. Both mechanically damaged and aborted eggs represented less than 2 % of the eggs.

Using this technique, *A. sordidatus* has been laboratory-reared for 18 months. During this period, 65 % of the CW eggs were successfully parasitized and a mean number of 1.84 parasites emerged from each CW egg, i.e. slightly more than for field collected CW eggs (1.6 parasites/CW egg ; **Boivin,** 1986). The sex ratio obtained for these individuals was 1 ♂ : 1.19 ♀.

An evaluation of the time needed to process 200 parasites daily was made. The rearing procedure was divided into 1) extraction of CW eggs from carrots and placement in the PD (40 min), 2) removal of adult parasites from capsules and placement into PD (30 min), 3) placement of parasitized CW eggs into the capsules (10 min), and 4) examination of PD containing parasitized CW eggs (10 min). Removing CW eggs from carrots is the most time consuming step ; although eggs are easy to find on carrots, they are very fragile when less than 48 h old. Adult parasites can be easily removed from the capsules in which they emerged, using a fine moistened brush to place them onto filter paper. Handling CW eggs from the PD to the capsules is much easier as the CW eggs are older and harder. Examination of the capsules can be made without removing them from the PD. Most parasites emerge within a few days which simplifies the manipulation of the PD.

In conclusion, the rearing of *A. sordidatus* on CW eggs is well adapted to a small scale laboratory rearing. With 0.2 person/year (roughly 90 mn per working day) a steady production of *ca.* 200 parasites/day was reached. While this production level would be unsatisfactory for mass release, it permits the establishment of a colony large enough for most biological studies.

ACKNOWLEDGEMENTS

I thank Miss **Danielle Thibodeau** for her technical assistance.

RÉSUMÉ

Technique d'élevage en laboratoire d'*Anaphes sordidatus* [*Hymenoptera : Mymaridae*] sur œufs de charançon de la carotte [*Coleoptera : Curculionidae*].

Une technique d'élevage d'*Anaphes sordidatus* (Girault) sur des œufs de charançon de la carotte, *Listronotus oregonensis* (Le Conte), obtenus d'un élevage en laboratoire est décrite. L'élevage individuel des parasites est rendu possible par l'utilisation de capsules d'enrobage en polyéthylène. Ces capsules permettent la manipulation des œufs parasités du charançon de la carotte destinés à l'élevage ou à des protocoles expérimentaux. Avec l'emploi de cette technique d'élevage, 65 % des œufs de charançon sont parasités et 90 minutes par jour suffisent pour obtenir environ 200 parasites par jour.

MOTS CLÉS : *Mymaridae, Curculionidae,* parasite, *Listronotus oregonensis, Anaphes sordidatus.*

Received : 31 March 1987 ; Accepted : 18 June 1987.

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