EFFECTS OF COOL TEMPERATURES ON OVIPOSITION AND DEVELOPMENT OF *COTESIA MARGINIVENTRIS* (HYMENOPTERA: BRACONIDAE)

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C. marginiventris, an abundant parasitoid of noctuids in summer, practically disappears from fall to spring in northern Florida, when the cabbage looper (*Trichoplusia ni* (Hübner)) can become a serious problem in crucifers. Temperature might be a limiting factor for the efficiency of *C. marginiventris*. In the present study we attempted to evaluate the oviposition performance of *C. marginiventris* and its development at different temperatures. We used cabbage looper and beet armyworm (*Spodoptera exigua* (Hübner)) as hosts to determine if the time of parasitoid development differs in hosts with different growth rates.

C. marginiventris used in this study were obtained from the Mississippi State University rearing facility. Both host species were from 1.5 year-old colonies maintained on pinto bean-based diet (Guy et al. 1985) at USDA-ARS, Gainesville, Florida. First- and second-instar larvae of either beet armyworm or cabbage looper were offered in clusters of 100 to *C. marginiventris* females. The larvae on individual leaves of pigweed (*Amaranthus* sp.) were placed in transparent 400 ml plastic containers, with a top of nylon screen. Females of *C. marginiventris* were chilled to 10°C and a single female was then placed into each container and supplied with a streak of honey and a moist cotton ball (placed on the nylon top). The containers were placed in temperature-controlled environmental chambers (Forma Scientific Diurnal Growth Chambers with a 16 h light : 8 h dark photoperiod) at 10, 15, 20, and 25°C. After 24 h, the wasps were removed, and feeding cups with artificial diet were added to each container. Some containers were held in their respective environmental chambers to determine time of parasitoid development at different temperatures. Other containers were transferred to the 25°C chamber to maximize the rearing of progeny. A total of 60 *C. marginiventris* females were tested. Containers were checked daily for parasitoid cocoons. Cocoons and larvae with a parasitoid-produced exit hole were removed and counted to assess parasitism. The statistical analyses (ANOVA and t-test) were performed using "JMP" at $\alpha = 0.05$ (SAS Institute Inc., ©1989- 95).

At 10°C, no parasitism occurred. Apparently, the wasps remained completely inactive at this temperature. When oviposition occurred at 15°C, 20°C, and 25°C, a mean (±SE) of 28.4 ± 5.3 (n = 5), 40.2 ± 7.4 (n = 9), and 39.6 ± 8.8 (n = 7) percent of host larvae were parasitised, respectively. The fecundity of *C. marginiventris* varied greatly and no significant ($P > 0.05$) differences in mean number of progeny/female were observed.

At 15°C, cabbage looper larvae develop faster than beet armyworm larvae. However, the difference in development time of *C. marginiventris* larvae was non-significant ($P > 0.05$) when reared in beet armyworm (47.3 ± 1.5 days SE) and in cabbage looper (45.4 ± 2.6), ranging from 37 to 62 days (n = 23). Eighteen *C. marginiventris*' cocoons were transferred from 15 to 25°C: 6 took 6 days to eclose; 6 emerged with a two-week delay; and the rest never eclosed. Five cocoons that were left at 15°C never eclosed as well.

At 20°C, mean development time was 17.6 ± 0.3 days in beet armyworm larvae (n = 69, wasp progeny were from six different females). No significant difference was found ($P > 0.05$) when first instar (17.4 ± 0.3 days (n = 19)) vs. second instar host larvae (17.7 ± 0.3 days (n = 50)) were parasitised. In cabbage looper, mean development time was more rapid (16.1 ± 0.3 days (n = 53, six different females)) than in beet armyworm, and this difference was significant ($P < 0.0001$). The development time at this temperature ranged from 14 to 21 days. Duration of the pupal stage was 6.6 ± 0.1 days (n = 28), ranging from five to eight days.

At 25°C, development took 8.4 ± 0.1 days in beet armyworm larvae (n = 152, progeny of six different females). Unlike 20°C, at 25°C the parasitoids developed more slowly in cabbage looper (9.7 ± 0.1 days (n = 48, progeny of five different females)) ($P < 0.0001$). Duration of the pupal stage at this temperature was 4 days.

Maximum life-time fecundity of *C. marginiventris* was previously found to be 111 ± 16 (Jalali et al. 1987). Here, we report data on maximum 24-h fecundity and how it changes with time. At 22°C, we supplied single *C. marginiventris* females with ca. 150 one-day-old beet armyworm larvae on young collard leaves in tightly sealed 15 cm Petri dishes. A streak of honey was placed on the inside of the lid. After 24 hours, the wasps were removed and offered a new group of larvae. The old larvae were fed collard leaves for two more days and then dissected for parasitoids. Mean fecundity was 85.8 ± 1.7 eggs on the first day, and 16.3 ± 6.8 eggs on the second day.

Twenty *C. marginiventris* were reared outdoors in November-December, using beet armyworm larvae as hosts. Larvae on cabbage leaves were placed in a 30 × 30 × 30 cm plexiglass cage with two netting sides for ventilation. Thus, the light cycle and temperature inside the cage were ambient. We monitored the cage daily for *C. marginiventris* cocoons and later, for adults. During the test period, temperatures fluctuated between 15-25°C during the day and –2-5°C at night. The average monthly temperature in the region in November and December is 14°C and 16°C, respectively, equal to our coldest rearing setting in the laboratory. Nevertheless, the parasitoids pupated in only 14.2 ± 0.3 days; the duration of the pupal stage was 11.4 ± 0.2 days. During November-January, we also placed ca. 200 beet armyworm larvae on cabbage plants in several cabbage fields in northeastern Florida to determine the presence of naturally-occurring *C. marginiventris.* A mixture of two-to-five day-old larvae were used, which fed on collard leaves prior to release. Larvae were collected after three-four days and dissected for parasitoids. They yielded eggs and larvae of *C. marginiventris* of all instars, which indicated that *C. marginiventris* was successfully developing through.

SUMMARY

Host species had no or small effect on the time of *C. marginiventris* development at different temperatures, while temperature at the time of oviposition had no effect on the numbers of resulting progeny. In the laboratory, most eggs (85/female) were laid by wasps during the first 24-hours. In winter, *C. marginiventris* reproduced more rapidly outdoors than at controlled constant temperatures with the same average, and attacked sentinel host larvae in cabbage fields.

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