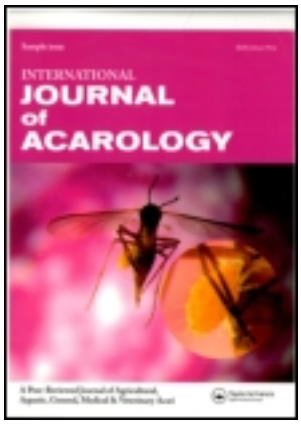


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# EFFECT OF INFESTATION WITH *COCCIPOLIPUS EPILACHNAE* SMILEY (ACARINA: PODAPOLIPIDAE) ON FECUNDITY AND LONGEVITY OF THE MEXICAN BEAN BEETLE

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ABSTRACT—In laboratory tests, infestation of adult Mexican bean beetles, *Epilachna varivestis* Mulsant, with the introduced ectoparasitic mite *Coccipolipus epilachnae* Smiley reduced total oviposition by an average of 66.2% and increased mortality by an average of 40%. These results indicate that *C. epilachnae* has good potential for use as a biological control agent against the Mexican bean beetle.



## INTRODUCTION

The Mexican bean beetle, *Epilachna varivestis* Mulsant (Coleoptera: Coccinellidae), is the major pest of soybeans in the eastern United States. Soybean growers have increased the use of pesticides to control the Mexican bean beetle (MBB) because native biotic agents are incapable of suppressing populations of the pest to below economic injury levels. Therefore, a search was conducted for suitable biological control agents. The parasitic wasp *Pediobius foveolatus* (Crawford) (Hymenoptera: Eulophidae) was first introduced into the United States in the 1960's from India and introduced again in 1973 (Schroder 1981). The wasp reduced MBB populations to below economic injury levels but did not survive the winter seasons (Stevens et al., 1975). Despite the inability of the wasp to overwinter, it remains a useful biological control agent through annual inoculative releases.

The only other known biological control agent that appears to have potential in reducing MBB populations is an ectoparasitic mite introduced in 1974 from Central America (Smiley, 1974). This mite, *Coccipolipus epilachnae* Smiley, was the first parasite of the adult MBB introduced into the United States. The mite is specific to coccinellid beetles of the subfamily Epilachninae, all of which are phytophagous (Schroder 1979). Basic biological studies have been conducted on the biology and reproductive behavior of the mite (Schroder, 1981). The effect of the mite on fecundity and longevity of the MBB is reported here.

## MATERIALS AND METHODS

Mexican bean beetles utilized in this study were the progeny of adult beetles collected from soybean fields on the Eastern Shore of Maryland in the fall of 1978. Beetles were stored in pint (0.56 l.) cartons at 15 ° C and provided with a 2% sugar-water solution in a vial plugged with a wick. Beetles of the first subsequent generation were sexed several days after emergence, and males and females were placed in separate containers for 5 days, at which time infested beetles of the same sex infested with female mites in the larval (dispersal) stage were added to each container. Beetles that became infested within 3 days were set up in 20 male-female pairs, placed in plastic containers (Schroder et al. 1976), and given fresh lima bean foliage 3 times per week. An additional 20 pairs of noninfested MBB were set up as controls. The 40 containers were then placed in a growth chamber maintained at 22 °C with a 16 L:8 D photoperiod. Surplus MBB were held under the same conditions as above in 4 separate containers, each holding infested or noninfested male or female beetles. These MBB were used as replacements for those that died during the first 7 days of the test. The containers and contents were examined 3 times per week. The number of beetle egg masses, dead adult beetles, and the presence or absence of mites at the time of death of the host was recorded. The study was terminated at the death of the last beetle.

Student's t-tests were performed on 10 different days between the 8th and 29th days, on days during which egg mass data were recorded. Calculations were not performed during the first 7 days of the test because it was assumed that differences in the number of egg masses per female could not yet be attributed to infestation with the mite. A t-test was also performed to compare the accumulated number of egg masses produced by infested and non-infested beetles.

## RESULTS

*Effect on fecundity*—A comparison is shown in Fig. 1 of the number of egg masses (converted to the mean number of egg masses per female per day) produced by infested and noninfested MBB during the first 30 days.

The overall difference in fecundity between infested and noninfested MBB was highly significant ($p \leq .01$), indication of a definite reduction in fecundity of the MBB attributable to infestation with the mite. The t tests were then computed from egg mass data collected during 3 intervals (Fig. 1). The difference in fecundity for interval A (days 8-13) was significant ($p \leq .05$), and differences were highly significant (p VI .01) for interval B (days 14-22) and interval C (days 23-29).

The total number of egg masses produced during the first 60 days was determined at 10-day intervals (Table 1). The mean percentage reduction in oviposition in infested MBB was 66.2%. Again the differences in fecundity for the 60-day period were highly significant ($p \leq .01$), indication that the reduction in oviposition was attributable to infestation with the mite.

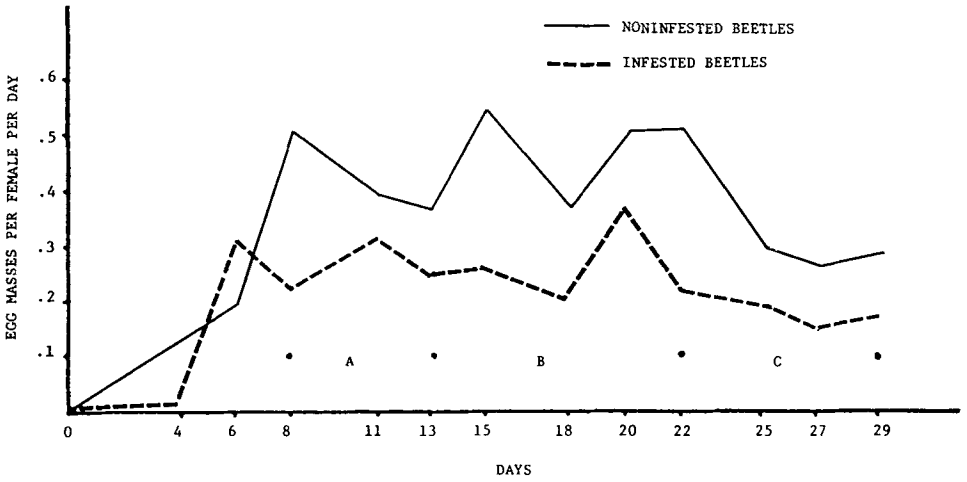


Fig. 1. Number of egg masses oviposited by female Mexican bean beetles infested or not infested with the mite *Coccipolipus epilachnae*. A, B, and C represent the intervals from which t tests were computed.

*Effect on longevity*—Infestation of MBB with the ectoparasitic mite was shown to reduce the longevity of adult Mexican bean beetles (Fig. 2). Differences were not significant between A, B, C, and D until the 16th day. Test results indicated that 54% of the mite-infested beetles died within 30 days, whereas 40 days had elapsed before 50% of the noninfested beetles had died. Approximately 90% of the mite-infested beetles had died by day 40, a 40% increase in mortality in the mite-infested beetles over that in the noninfested beetles. The approximate day of the last surviving mite-free male and female beetle was 67 and 87 days, respectively, compared to 42 and 58 days, respectively, for the last mite-infested male and female, a reduction in longevity of 37.3% and 33.3%, respectively.

## DISCUSSION

Results of these laboratory studies clearly indicate the potential of *C. epilachnae* as a biological control agent for use against the Mexican bean beetle. The ability of this species of mite to successfully overwinter in the climate of the Middle Atlantic states has been previously demonstrated in field cage studies (Schroder 1981). After the mite becomes established and more widely dispersed, the subsequent reduction of

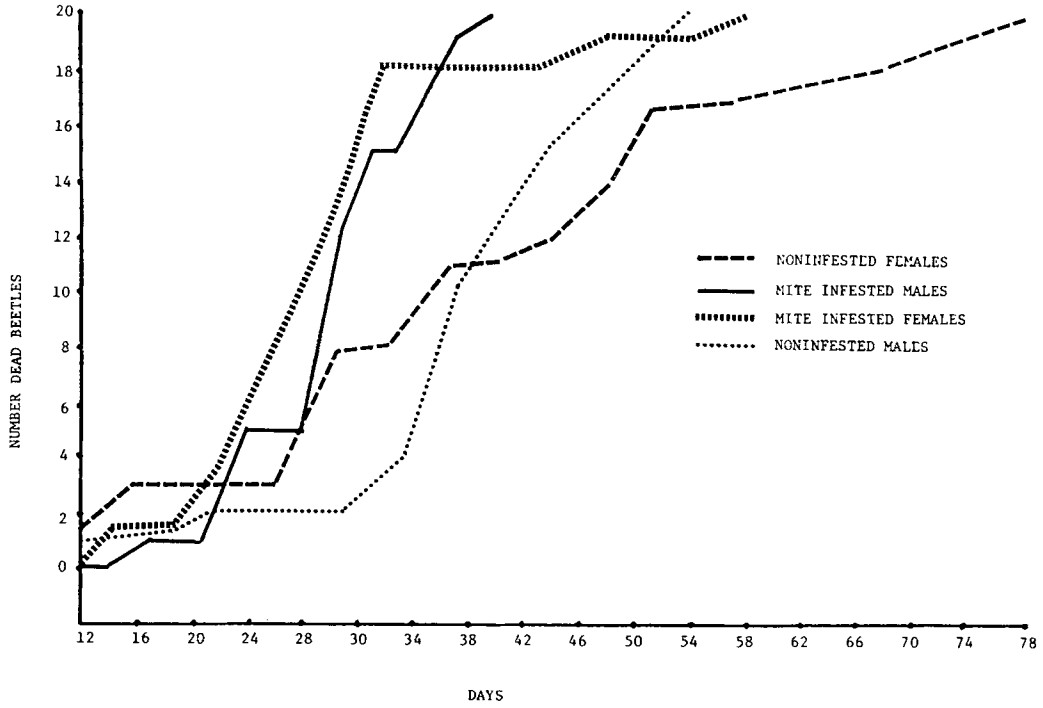


Fig. 2. Mortality of adult Mexican bean beetles infested or not infested with the mite *Coccipolipus epilachnae.*

Table 1. Effect of infestation with *Coccipolipus epilachnae* on fecundity of the Mexican bean beetle.

| Interval (days) | Infested beetles: Number surviving adults female | Infested beetles: Number new egg masses | Infested beetles: Number total accumulated egg masses | Noninfested beetles: Number surviving adults female | Noninfested beetles: Number new egg masses | Noninfested beetles: Number total accumulated egg masses | % reduction in oviposition |
|---|---|---|---|---|---|---|---|
| 1-10 | 20 | 28 | 28 | 20 | 38 | 38 | 26.32 |
| 11-20 | 19 | 58 | 86.5 | 19 | 99 | 137 | 40.9 |
| 21-30 | 14 | 22 | 108.5 | 18 | 49 | 186 | 55.1 |
| 31-40 | 6 | 7 | 115.5 | 13 | 47 | 233 | 85.1 |
| 41-50 | 3 | 2 | 118.0 | 7 | 24 | 257 | 89.6 |
| 51-60 | 1 | 0 | 118.0 | 1 | 10 | 267 | 100.0 |
| Total | | 118.0 | | | 267 | | 66.2 |

Mexican bean beetle populations in the area of release will benefit small farmers, home gardeners, and other growers. The reduction in longevity and fecundity shown here of mite-infested MBB demonstrates for the first time the potential for success in the use of a species of parasitic mite in the biological control of a major insect pest.

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