EFFECT OF A PARASITIC MITE, *COCCIPOLIPUS EPILACHNAE*, ON FECUNDITY, FOOD CONSUMPTION AND LONGEVITY OF THE MEXICAN BEAN BEETLE[1]

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ABSTRACT

Comparisons were made between uninfested adult Mexican bean beetles and those infested with the ectoparasitic mite *Coccipolipus epilachnae* Smiley. No significant differences were found based on longevity, fecundity, or food consumption of beetles fed lima beans and held at 22°C on a 16 hr light - 8 hr dark day.

Key Words: Mexican bean beetle, *Coccipolipus epilachnae* mite, longevity, fecundity, food consumption.

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INTRODUCTION

Mexican bean beetles (*Epilachna varivestis* Mulsant) (MBB) were brought from El Salvador to Beltsville, MD, in 1972 for use in genetic studies. Examination of these adults revealed numerous small mites on the under surfaces of the elytra. These ectoparasitic mites, described by Smiley (1974) as a new species, *Coccipolipus epilachnae,* were thought to be responsible for lack of vigor in the host beetle colony.

The larviform female mites congregate on the underside and near the tip of the host elytra where they are in position to move over the bridge formed by extension of the male abdomen making contact with the female beetle during mating. These mites feed by sucking hemolymph from the underside of the elytra or abdomen of adult hosts.

Information on the effect of ectoparasitic mites on their hosts is scarce in the literature. Schroder (1982) reported *C. epilachnae* mite infestations on the MBB reduced beetle fecundity by 55% in 30 days and resulted in 22% mortality to infested beetles during the 30 day test period. In contrast to these results, Hochmuth (1981) showed no significant difference at the 5% level in feeding, fecundity, or longevity of the Mexican bean beetle due to *C. epilachnae* infestation. Because of these conflicting results and the importance of the MBB as a pest, further studies were conducted to determine the effect of *C. epilachnae* on the feeding, fecundity, and longevity of adult Mexican bean beetles. Results supporting Schroder's findings would encourage further study and application of the beetle-mite system, whereas confirmation of Hochmuth's results would discourage such efforts.

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MATERIALS AND METHODS

Adult MBB were reared on lima beans, *Phaseolus lunatus,* cv. 'Henderson'. Adult beetles of the same age were selected for the test and divided equally according to sex. Within 24 hours after eclosion, equal numbers of beetles were placed in containers with mite infested beetles facilitating the transfer of mites to the uninfested adults. After a period of 10 days, these beetles were examined to confirm mite transfer. An equal number of beetles were kept uninfested.

The test rearing unit consisted of a 1 pint cardboard cylinder with a screen lid. Each rearing unit contained an equal number of male and female adult beetles (either 2 or 3 pairs). The beetles were held at 22°C and a 16 hr light - 8 hr dark day. Each unit was provided with a lima bean leaf kept turgid by holding its petiole with a cotton plug in a plastic vial that contained water. New foliage was provided at almost daily intervals. Surface area of each leaf was measured by a Li-Cor-3100® area meter prior to feeding and at the time of replacement. Foliage area consumption and numbers of eggs were recorded from mite infested and uninfested beetles for a period of 28 days. The experiment was repeated four times from 1982 - 1984 at Beltsville, MD, with 12 replicates in the first test, 14 in the 2nd, and 8 in the 3rd and 4th.

The variances of the data were analyzed to determine if significant differences existed in fecundity, food consumption, and longevity between mite infested and uninfested beetles. Total eggs produced and foliage consumed in the infested beetles was compared among tests with those of the uninfested beetles. In one of the four tests, beetles were placed on test with either a light infestation (av. 5.4 mites) or a heavy infestation (av. 29.2 mites) per adult. At the end of this test, total numbers of mites per replicate were recorded, the variances of the data analyzed, and Duncan's multiple range test applied to determine if differences in fecundity and food consumption occurred among infestation levels and controls.

RESULTS AND DISCUSSION

Fecundity: The average number of eggs produced per female MBB ranged in treated or control groups between 155 and 465 over the four tests with a mean of 348.5 ± 80.6 per uninfested females compared to 282.6 ± 86.4 per mite infested females. At the same temperature of 22°C, Hochmuth (1981) reports that infested females and uninfested females laid an average of 294 and 335 eggs, respectively, over a 42 day period when fed on soybean leaves.

In three of four tests, uninfested females out-produced infested females (Table 1); however, in only one of the tests was there a significant difference between treatments. No significant difference existed in fecundity between infested and uninfested females from combined data ($P > 0.05$).

Schroder (1982) who counted egg masses rather than individual eggs found a highly significant reduction in numbers of egg masses laid by infested females. Since our data do not include egg mass counts, a direct comparison with our data cannot be made.

On lima bean plants, F. F. Smith (personal communication) found that uninfested females produced an average of 219 eggs over a 37 day span whereas infested females produced 254 eggs in 33 days at 26.7°C. The above data, which are summarized in Table 2, indicate that *C. epilachnae* infestations of MBB did

Table 1. Comparison of fecundity, foliage consumption and longevity between uninfested Mexican bean beetles and those infested with the ectoparasitic mite *Coccipolipus epilachnae*.

	$\overline{X}$ # eggs/ female	p-level	$\overline{X}$ area (cm^2) eaten/adult	p-level	Survival time beetle days on test	p-level
Test #1						
uninfested	280.9	0.0001	131.7	0.85	27.03	0.793
infested	154.8		130.7		27.20	
Test #2						
uninfested	465.5	0.18	166.2	0.61	28.00	0.489
infested	341.2		155.0		27.44	
Test #3						
uninfested	324.2	0.97	156.5	0.45	28.00	0.017
infested	327.9		146.8		25.56	
Test #4						
uninfested	323.5	0.89	103.0	0.83	25.62	0.774
infested	306.4		96.7		24.94	
$\overline{X}$ of 4 tests						
uninfested	318.4	0.63	138.3	0.42	27.16	0.599
infested	276.7		134.5		26.29	

Table 2. Comparison of average numbers of eggs produced by Mexican bean beetle uninfested or infested with the ectoparasitic mite, *Coccipolipus epilachnae*.

Mite presence	Cantwell et al. @ 28 days Food/Temp (lima bean/22°C)	Hochmuth @ 42 days Food/Temp (soybean/22°C)	Smith @ 33 days* Food/Temp (lima bean/26.7°C)
uninfested	376 ns	335 ns	219
infested	356 ns	294 ns	254

* Statistical analysis unavailable for these data.

not result in reduced fecundity. This could possibly be explained by the fact that the MBB is a reflexive bleeder and therefore may have the ability to tolerate a great loss of hemolymph. This ability may make it possible for the beetles to tolerate a loss of hemolymph, whether from hemorrhage during reflexive bleeding, or from mite feeding.

Food Consumption: The average amount of lima bean leaf area consumed by uninfested beetles over the test period was 132.3 ± 25.8 sq. cm. compared to 139.4 ± 28.2 sq. cm. for mite infested beetles. On a daily basis, uninfested and infested beetles consumed approximately 4.9 and 4.8 sq. cm. respectively. In all four tests, uninfested beetles consumed slightly more than infested ones ($P > 0.05$);

however, in each of the four tests differences in food consumption were not significant ($P > 0.05$). This rate of consumption is in general agreement with the findings of Hochmuth (1982), and Ivey and Palmer (1979). At 22°C Hochmuth reported average daily feeding of 6.1 sq. cm. of soybean leaves by uninfested adults. Ivey and Palmer reported surface area feeding on soybeans of 3.8 sq. cm. at 26°C by uninfested adults.

Longevity: Uninfested beetles taken collectively in the four tests lived an average of 27.2 days compared to 26.3 days for the infested beetles. These differences were not significant ($P > 0.05$). Survival times, (Table 1) for uninfested beetles were slightly greater in three of the four tests, however in Test #1 the infested beetles lived slightly longer than the uninfested. In only one test (#3) was there a significant difference between treatments within the tests. Taken collectively there was no significant difference in longevity between infested and uninfested adults. These results are in agreement with those reported by Hochmuth (1981) who found no significant effect of mite infestations on the longevity of the MBB fed on soybeans at 22°C.

Mite infestation level: Beetles which began the test with a light infestation of ca. 5 mites per adult, averaged 100.0 mites after 28 days, whereas those beetles that began the test infested with nearly 30 mites per adults ended with 424.3 mites per adult. The levels of differences in the final counts were highly significant (Table 3). However there were no significant differences in either numbers of eggs produced per female beetle or food consumed per beetle between those with low or high infestations. There were not significant differences in food consumption or fecundity between either infestations levels and controls.

Table 3. Comparison of fecundity and food consumption between Mexican bean beetles with no, low, or high infestations of the ectoparasitic mite *Coccipolipus epilachnae.**

	No infestation	Low infestation	Significance level between low and high	High infestation
$\bar{X}$ # mites at end of 28 day test	0.0 a	100.0 b	0.003	424.3 c
$\bar{X}$ # eggs laid fecundity	465.5 a	375.3 a	0.42	316.9 a
$\bar{X}$ area food consumed-cm^2	166.2	155.1 a	0.99	154.4 a

* Measurements followed by the same letter in the row indicate non-significance.

Parasitic mites commonly become established in insect colonies and have an adverse effect on the insect population. The restriction in movement of the host insect is probably responsible for the high infestation rate and subsequent injury, but in nature host and mites come in contact much more rarely. As a result the influence of mites on insect populations is much less. Although Schroder (1982) observed the mite to be harmful to the MBB under his test conditions and we noted a similar but non-significant tendency, we believe that the mite levels in our tests would exceed those levels that could be widely established in the field. Thus, we conclude that *C. epilachnae* has little or no potential as an agent for suppressing Mexican bean beetle populations.

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