The Effect of Prey Diet on Predation Efficiency of the Coccinellid, *Cryptolaemus montrouzieri* (Mulsant).

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Introduction

The physical conditions in greenhouses approach an optimum environment for the uncontrolled increase in populations of phytophagous insects. Once the insect is introduced, the greenhouse structure affords warm temperatures, high humidity and a physical barrier isolating the pest from the naturally occuring predators and parasites present in nature.

Effective chemical control of insects in greenhouse conditions when plant diversity is high is difficult. Compact growth habit, certain structural plant forms such as leaf sheaths, and dense foliage all prevent adequate application of the chemical to the entire plant. Failure to treat all surfaces, along with sub-lethal dosages due to improper application rates and pest diversity contribute to a serious problem encountered by greenhouses today—that of resistance and resurgence. The phenomenon of pesticide resistance followed by a rapid resurgence of the surviving insects can cause an actual increase in the pest population following chemical application as discussed by Doutt (1951).

Biological control of greenhouse pests through introduction of natural enemies offers a viable alternative to chemical controls.

This study began with the introduction of a predaceous coccinellid, *Cryptolaemus montrouzieri* (Mulsant) into a greenhouse to control a common species of mealybug *Planococcus citri* (Risso). The coccinellid was successfully introduced by Koebele into California from Australia in 1891 to control mealybugs in citrus orchards. Subsequent references in the literature also credit the beetle with successful population regulation. Immature soft scales ("crawlers") have also been shown to be prey items (Hagen, personal communication).

During observations of the *Cryptolaemus* we discovered that both the adult and larval stages feed not only on the immature stages of the soft scales *Coccus hesperidum* L. and *Saissetia coffeae* (Walker) but were also found to be feeding on adults of both species. In addition both adults and larvae were observed feeding on an aphid *Aphis nerii* (Fonscolombe).

Experiments, using various prey items as a food source were devised to determine what effects, if any, a dietary change had on the life cycle, larval development and fecundity of the coccinellid.

Materials and Methods

Adult *Cryptolaemus* beetles, newly emerged from pupation were sexed (sexual dimorphism permits easy identification) and adults were placed in standard-sized glass petri dishes. The dishes were examined daily in all experiments. Fresh food sources and plant materials obtained from the campus greenhouse were supplied daily. Room temperatures of the laboratory averaged 76°F during most of the study.

Summary of Experiments

The initial experiment was designed to establish the egg production potential of the adult beetle. Females were given a diet of mealybugs on *Coleus* leaves, a preferred food source, and daily egg laying rates were recorded for each female. Eggs produced were removed and transferred to separate petri dishes. These were later examined in an attempt to determine % viability of eggs produced on the diet.

Females began laying viable eggs within 24 hours of insemination. The eggs are laid singly, in and around the mealybug egg mass, on plant parts and in the cracks and crevices of bark and stems. Egg laying initially appears to be triggered by a suitable substrate having a roughened texture, possibly perceived by the tarsi. The female then begins a searching pattern looking for both a food source and oviposition site. This latter behavior involves the use of the mandibles, antennae and ovipositor.

Given ample food *and* optimum substrate, the egg laying potential for these beetles is as high as 50 eggs per day, with the normal range 20-30.

A subsequent study dealt with rearing the beetle from egg to adult to determine dietary effects on the length of larval instars and the prepupal and pupal stagaes. The various instar stages were verified by the presence of the exuviae. The prepupal period is signaled by attachment of the fourth instar insect exuviae intact, to the substrate by means of a fluid secreted by an anterior abdominal segment. The actual pupal stage was considered to begin when larval segments could no longer be distinguished on the ventral portions of the body.

Three groups of insects were used in this study and each given a different diet. The results showed that the larval-pupal development in number of days was 8% less on a mealybug—*Coleus* diet as compared to a mealybug—oleander diet and 10% less than on an aphid—oleander diet.As the preceeding adults emerged from pupation, they were mated and again divided into three groups. This time we analyzed the effect of prey species on the mean number of days until production of the first egg by the *Cryptolaemus* female. Results of the three diets presented, showed that the mealybug—*Coleus* diet stimulated first egg production in 7 days; mealybug—oleander in 10 days and aphid—oleander in 25 days.

Simultaneously the eggs produced by each group of females were counted, recorded and removed from the various dishes. The results of this study showed that the mean number of eggs per day as the result of a mealybug—*Coleus* diet was approximately three times greater than the production based on a mealybug—oleander diet and fourteen times greater than that derived from an aphid—oleander diet.

Conclusion

One of the difficulties encountered in use of a predatory insect as an agent of pest control, is that near eradication of the host, in this case mealybugs, is followed by the disappearance of the predator. This necessitates reintroduction of the natural enemy. The significance of the results our experiments show is that during periods of time when the predatory beetle has reduced the population of mealybugs to very low levels, an alternate food source of aphids would sustain the predator until levels of mealybugs again increased.