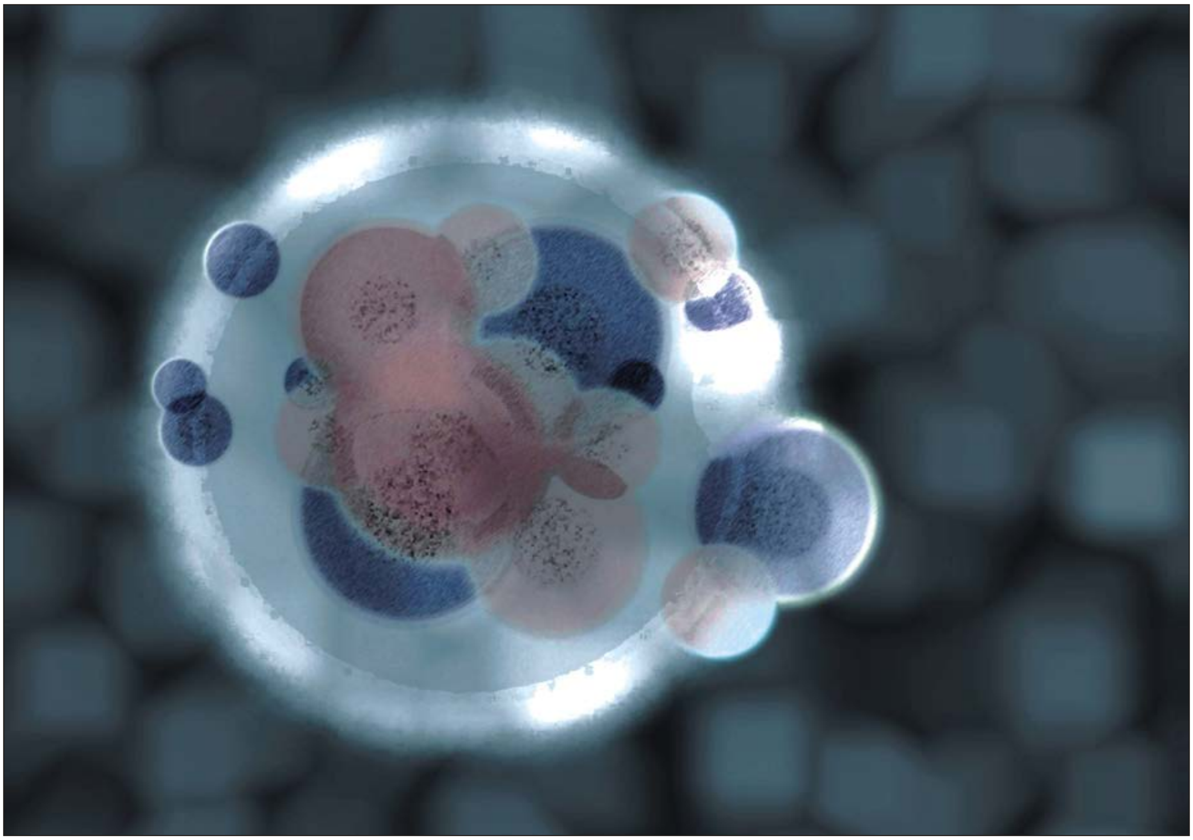

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Augmentation of *Chrysoperla* spp. for Control of Citrus Thrips in Mangos

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Abstract: The predatory effect of two species of *Chrysoperla* [*Chrysoperla carnea* (Stephens) and *C. rufilabris* (Burmeister)] was evaluated against citrus thrips, Scritothrips citric (Moulton), at the Three Flags Mango Ranch near Salton City, California, U.S.A. For both species the early release of 50 larvae/tree failed to cause any reduction in thrips number but treatment of 100 and 200 larvae/tree for both species and 1,000 eggs of *C. rufilabris* resulted in significantly lower thrips numbers for 1-2 post release samples.

Key words: *Scritothrips citric*, *Chrysoperla carnea*, *Chrysoperla rufilabris*, predator

Introduction

Release programs using chrysopid species have received considerable attention on a wide range of crops. *Chrysoperla carnea* has been the subject of the bulk of the published research related to chrysopid field releases. Research has tended to focus on *C. carnea* due to (a) its tolerance to the wide ranges of ecological factors found in different agricultural habitats (Zelany, 1984), (b) the high relative frequency of its occurrence in agricultural systems (New, 1984), © its broad prey range and effective searching abilities (Ridgway and Murphy, 1984), (d) a generally high tolerance to many widely used pesticides (Bigler, 1984), (e) the development of rearing techniques which enable the production of the large numbers of eggs and larvae needed for inundative releases (Tulisalo, 1984) and its widespread distribution throughout most of the temperate holarctic region (New, 1984).

Initial field cage release of *C. carnea* in Texas cotton fields resulted in 74-99.5% reduction in *Heliothis zea* (Boddie) and *H. virescens* (Fabricus) populations (Lingren *et al*., 1968, Ridgway and Jones, 1968a) and work quickly expanded to successful open field tests (Ridgway and Jones, 1968b).

Doutt and Hagen (1949, 1950) were the first to attempt augmentative releases with chrysopids and they used *C. carnea* (=C. californica) eggs. They obtained excellent control of the grape mealybug, *Pseudococcus martitimus* (Ehrhorn), on pears with three well-timed releases, each consisting of 250 *C. carnea* eggs per tree. The tolerance of *C. carnea* larvae to DDT and the inability of DDT to control mealybugs were key factors in this study. They found an unexpected residual control the following year.

Breen *et al*. (1992) released first and second instar larvae of *C. rufilabris* against Bemesia argentifolii Bellows and Perring on *Hibiscus rosa- sinensis* L. in the greenhouse and found that releases of 25 or 50 larvae per plant at 2 week intervals maintained the plants at a marketable condition.

Daane *et al*. (1993) compared the effectiveness of different lacewing release methods against the variegated grape leafhopper, *Erythroneura variabilis* Beamer, in experimental plots and commercial vineyards. They found that release rates of 3,000 and 8,000 per acre (costing $9 to $24 per acre, respectively), for each leafhopper brood, reduced pest densities by 35%. Control was variable, with some release plots showing no difference compared with controls and the effectiveness of releases was related to the method of release and degree of synchronization with pest phenology.

Feeding of *C. rufilabris* on citrus thrips, *Scirtothrips citric* (Moulton), was investigated in a laboratory experiment by Khan (1997) and Khan and Morse (1999a). During its 2nd instar, the predator consumed 324 second instar or 277 adult citrus thrips. Similarly, in a field augmentation study, Khan and Morse (1999b) found that six of the 11 chrysopid treatments in citrus orchards resulted in thrips remaining below economic levels. Based on these findings, field studies was initiated on mangos in the Coachella Valley of southern California where citrus thrips populations normally reach quite high levels.

Materials and Methods

1996 Mango Augmentation Study: The predatory effect of *C. carnea* and *C. rfilabris* was evaluated in an augmentation study against citrus thrips populations during spring, 1996 at the Three Flags Mango Ranch (Kitt vriety, *Mangifera indica* L.) Near Salton City in the Coachella Valley, California. The experiment was conducted in two adjacent blocks of trees and evaluated 11 treatments. Each treatment was applied to 8 randomly assigned data trees, 4 in each block. All branches between trees that allowed trees to touch were pruned away. *Chrysoperla carnea* were obtained from the Rincon Vitova Insectary (Ventura, CA) and *C. rufilbaris* from the Beneficial Insectary) Oak Run, CA). Larvae were release at 3 different times. The first release R1) of 50 larvae per tree of *C. carnea* was made on February 23 and of *C. rufilabris* on February 28, 1996. The second release (R2) of 100 larvae per tree for both species was done on March 28 (the week of petal fall) and the third release (R3) of 200 larvae per tree and two rates of eggs (1000 and 5000 eggs/tree) were done on April 24. Larvae were placed individually on outside leaves with a camel-hair brush and cards containing 250 eggs were attached to the tree branches with tape.

Brush transfer mortality of lacewing larvae was determined by taking a random sample of 32 larvae of each species on each release date. Four larvae were placed into individual plastic straws after releases on every second tree. These larvae were confined in a plastic straw with food (eggs of *Ephestia kuehniella* Zeller for *C. rufilabris* and eggs of *Stitotroga cerealella* (Oilvier) for *C. carnea*. In a similar manner, larval survival in the absence of food was tested by confining 32 larvae in individual plastic straws. Mortality was assessed every 24 h. Each test was run for four days. Egg hatchability in the field was determined by counting hatched and unhatched eggs from 5 cards, each with 250 eggs that were brought back to the laboratory after 4 days in the field after each release. Thrips infestation data were taken on a weekly basis by shaking citrus thrips at five random locations on each tree onto a metal try of 28x18 cm size. Monitoring was changed to counts of ten randomly selected fruit per tree for thrips infestation on April 9 when thrips were found mostly on the fruit. For both shake and fruit samples, all larval and adult citrus thrips were counted.

Results

1996 Mango Augmentation Study: Results from the 1996 augmentation study are discussed. For both species, the early release of 50 larvae per tree failed to cause any reduction in thrips numbers but the middle and late treatments of 100 and 200 larvae/tree, respectively, caused significantly lower thrips numbers during one or both of the first two samples taken after release. Similarly, in both of the multiple the multiple release treatments (R1+R2+R3), the first release had little impact on thrips number but the second release resulted in fewer thrips on the second sample after that release and third release resulted in fewer thrips during both of the first 2 samples after release. Release of both 1,000 and 5,000 eggs of *C. rufilabris* per tree also reduced thrips numbers for 1-2 samples post release.

Counts of egg cards resulted in 89.0% (±0.05) hatch on cards sampled after release. Daane *et al*. (1993) reported 38% egg mortality in machine-delivered eggs. No mortality (except 3% in the second release of *C. rufilabris*) in the brush transfer method of larval release was detected. Seventy five to 100% of the larvae died in the starvation test by the end of 96 h.

Discussion

We are not aware of any previous research done on citrus thrips on mangos. The pest control advisor we worked with at the Three Flags Mango Ranch, Joe Barcinas of Entomological Services, Inc., suggested that we compare early versus late chrysopid release timings. Because thrips levels build to such a high level on the fruit later in the season, he was concerned that chrysopid releases might have little impact unless they were made early in the season. We view the results of the 1996 mango augmentation study as being encouraging but not definitive. For unknown reasons, the early release (timing R1) of 50 larvae/ tree was not effective. All remaining releases, however, led to a reduction in citrus thrips levels during one or both of the first two samples taken after release. We suspect that a major problem in this field study was reinvasion of data trees by citrus thrips from surrounding trees. This may partially explain why chrysopid releases failed to provide extended control fo citrus thrips levels.

Future use of chrysopid releases by growers will depend mostly on the cost of releases (economics) and the viability of other control alternatives. Larvae and eggs are available from isnectaries at a cost of US$31 per 1,000 larvae and $32.00 per 10,000 eggs on cards, respectively. Hand release of 50 larvae (5,000 larvae/acre based on a typical 100 trees/acre for citrus) or 500 eggs per tree (50, 000 eggs/acre) would cost about $154 and $160 per acre, respectively. These costs do not include the cost of applying the chrysopids which would be especially high for hand release of larvae.

In competition with currently available pesticides for citrus thrips control, costs that are much higher than typical chemical costs of $80 acre are robably not economical. Recently, however, Beneficial Insectary has been experimenting with machine delivery of green lacewing eggs using a 'BioSprayer' System. Daane *et al*. (1993) released lacewings eggs that were mixed with corn grit as bio-carrier. By adjusting funnel size at the bottom of the container and speed for the tractor, the release rate was adjusted as desired. With a cost for lacewings eggs of US$1.50 per 1,000 eggs in bulk and $12 for 1 gallon fo bio-carrier for delivery of 1000,000 eggs, a more competitive price of $81 per acre is obtained for a release rate of 500 eggs/tree or 50,000 eggs/acre. Evaluation of this level and method of release would be worthwhile

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