Pome Fruits—Biological Control

The Potential of Earwigs as Pear Psylla Natural Enemies

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Four investigations were conducted to answer the following questions: 1) Do earwigs consume pear psylla? 2) Can earwigs impact psylla population development in the field? 3) Can a small-scale release of earwigs augment the indigenous population? 4) Do earwigs disperse and forage in the pear tree canopy? These studies are briefly summarized below.

The functional response of earwigs to pear psylla eggs was determined under controlled laboratory conditions. Although the best-fit curve did not precisely fit the typical Type II model, it indicates that earwigs consume pear psylla eggs under the experimental conditions.

Earwig impact on psylla was estimated by comparing the seasonal dynamics of pear psylla among small trees of differing earwig density. Earwig numbers/tree were 1) enhanced by placing an earwig shelter at the base of each of 12 trees, 2) excluded by continually removing earwigs from the shelters, and 3) left unmodified on four trees. Psylla immatures were monitored on both terminal and spur leaves and earwigs were counted weekly from late June until mid-August. Psylla egg densities were highest in trees where earwigs were excluded, lower in trees receiving shelters, and intermediate in unmodified trees.

To monitor within-orchard movement and estimate orchard population size, a mark/recapture study was conducted at a commercial pear orchard under a program of "soft" chemical control. A single earwig shelter was placed on each of 113 adjacent trees aligned within a quadrangular grid. Earwigs were collected from another orchard and, to provide a replicated release, were separated into three populations of 280 earwigs each. Members of each population were marked on the nota with one of three colors and then released onto three separate trees near the center of the grid. To provide another estimate of the size of the resident earwig population, an additional 231 earwigs marked with two different colors were released in sets of three/tree at a later date. To account for mortality among marked earwigs, marked earwigs were enclosed and maintained in the orchard as controls. Shelters were monitored at least weekly. Most observations were terminated in early September, when all earwigs were removed from all shelters as they were sampled, deriving a third population estimate.

In general, marked earwigs released from a point source had dispersed throughout the study grid in under a month. The mean dispersal rate gradually increased during the first month, but later declined to a consistent rate. After the first few weeks, a consistent and precedented pattern of insect dispersal emerged. Numbers of unmarked earwigs, however, increased sevenfold during the study, suggesting that earwigs aggregate to areas of high earwig density. If so, augmentation of indigenous populations could enhance earwig immigration. The three estimates of the indigenous earwig population size were similar and showed that the resident

earwig population was small enough to be substantially enhanced by the addition of 850 earwigs.

The vertical distribution study consisted of 18 shelters placed among 12 trees according to two treatments: 1) shelter height (ground level vs mid-canopy vs upper canopy), and 2) number of shelters/tree (one vs three). Each combination of shelter height and number was replicated three times. Earwigs were counted and returned to each shelter at least twice weekly. Neither number of shelters/tree nor shelter height significantly affected numbers of earwigs. Accordingly, further analysis of treatment means is not formally required. However, among the trees with only a single shelter/tree, the high shelters held significantly more earwigs than those at the other two heights. Although earwig density in the canopy was not greater in trees with three shelters compared to trees with one, relatively higher numbers at mid-height may indicate greater movement among the three traps.