Introducing Ants (Hymenoptera: Formicidae) Into Pear Orchards for the Control of Pear Psylla, *Cacopsylla pyricola* (Foerster) (Homoptera: Psyllidae)[1]

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ABSTRACT Nesting boxes were used to transplant *Formica neoclara* (Emery) into pear orchards to act as biological control agents of pear psylla, *Cacopsylla pyricola* (Foerster) in an integrated psylla management system. Transplant success was ca. 80%. *F. neoclara* began contributing to pear psylla control 2 yr after introduction into an orchard. One colony of *F. neoclara* spread over ca. 2 ha of orchard within 2 yr.

KEY WORDS Insecta, biological control, IPM, beneficial insect introduction, *Formica neoclara, Cacopsylla pyricola,* Psyllidae, Formicidae, Hymenoptera, Homoptera.

Ants are effective predators against a variety of insect pests (Liu 1939, Brown 1959, Leston 1973, Finnegan 1974, Gotwald 1986), especially in long-term relatively undisturbed habitats, such as orchards and forests. Recent studies (Paulson 1990) have found that predatory ants can significantly reduce population densities of pear psylla, *Cacopsylla pyricola* (Foerster), the most damaging pests of pears in Washington state. Currently pear psylla control is attained through extensive use of pesticides. However, rapid development of resistance by pear psylla to many widely used pesticides has diminished effectiveness of chemical programs and necessitated development of alternative methods for pear psylla control. One promising method is the deployment of predaceous ants.

Ants can perform an important role in pear orchard management, both by preying upon psylla and by collecting honeydew. However, beneficial ants are not found in many pear orchards. This paper outlines a successful method for transplanting ant colonies into pear orchards where they can be incorporated into modified psylla management programs.

This study focused on developing techniques for transplanting *Formica neoclara* (Emery) into pear orchards. However, the techniques outlined here can be utilized with many ant species. Although other species of ants could potentially be used as biological control agents of pear psylla, *F. neoclara* was chosen primarily because it was native to the pear growing areas of Washington and had been implicated as an important predator of pear psylla. It also has several other qualities which facilitated its use in this study. *F. neoclara* is polygynous; colonies may contain hundreds of queens. This virtually guarantees that transplanted colonies will contain a viable queen. The presence of multiple queens also increases the reproductive potential of the colony and decreases the time for ants to reach

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beneficial population densities. *F. neoclara* nests in the soil, forming low mounds. Nest structure simplifies its collection and does not interfere with orchard equipment. Lastly, *F. neoclara* is relatively inoffensive to humans since it cannot sting and is too small to inflict a painful bite.

Materials and Methods

Wooden nesting boxes were constructed for collecting, transporting, and transplanting ant colonies. The size of boxes varied with ant colony size. A box 40 by 60 by 30 cm high was sufficient for most colonies. Boxes were constructed from low grade white pine. Treated lumber and wood products, such as particle board and plywood, were not used as construction materials because they may contain compounds which are potentially harmful to ants. Since nesting boxes in our study were used only once, emphasis was placed on simplicity and ease of construction. Planks (2.54 cm × 30.48 cm) were nailed together with butt joints at the corners with an internal frame of 5.08 cm × 5.08 cm studs added for strength. To prevent ants from escaping during transportation, care was taken to assure that joints of the boxes fit tightly. Duct tape was used as a final sealant.

Ant colonies were carefully collected into nesting boxes using shovels. During collection, uninhabited nesting material was separated from material containing brood and workers. Methods were similar to those utilized by Bradley (1972) for relocating *Formica obsuripes* Forel and *Dolichodereus taschenbergi* (Mayr), except that colonies were collected into bags instead of wooden boxes. Colonies were collected during periods when ants were relatively inactive (early morning), and soil was moist.

Before the boxes were sealed, cotton saturated with honey and water was placed inside with each ant colony. If the nesting material was very dry, 100-200 ml of water was misted on the colony inside the box using a hand-held squirt bottle. Sealed nesting boxes were disturbed as little as possible. Boxed colonies were held for 1-2 d in a cool (< 27°C), dry, shady place prior to introduction into an orchard.

In the orchard a hole large enough to accommodate a nesting box was dug in the soil in an area where the box would not be disturbed or inundated by irrigation. Several exit holes (2.5 cm diam) were drilled through each side of each box before it was placed into the hole. Boxes were then buried under 12 cm of soil. The location and movement of each nest was carefully monitored and recorded on a map of the orchard.

A total of 27 *F. neoclara* colonies were introduced into two pear orchards under organic management located near Wenatchee, Washington during the summers of 1987-1988.

Results and Discussion

Transplantation success was approximately 80%; 22 of 27 transplanted colonies were accounted for in 1989. Within 2 wk of introduction, ant colonies vacated the nesting boxes and established new nests usually within 3-4 m of the nesting boxes. The farthest that a colony moved from its nesting box was 19 m. The colonies relocated to areas with full morning exposure to the sun which were shaded during the afternoon. Although the ants did not remain in the boxes, the boxes protected

the ants during transportation and the initial period of introduction into the orchard. Ant mortality was negligible in properly handled boxes.

After ant colonies have been introduced into an orchard, efforts must be made to conserve the ant population and to allow them to reproduce and spread throughout the orchard. With proper care ant population densities can reach beneficial levels very quickly. In our study, *F. neoclara* began to contribute to pear psylla management 2 yr after introduction. At one site, pear psylla population densities at the end of the second season after ant introduction were one-fifth those of psylla densities before ant introduction (Paulson 1990, Paulson and Akre 1990, 1991). Significantly higher population densities of pear psylla were also found in trees from which ants were excluded from foraging (Akre and Paulson 1988, 1989, Paulson 1989, Paulson and Akre 1990). In 2 yr, one colony of *F. neoclara* established new nests and foraged over a 2 ha area (Paulson 1990).

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