TREE FRUIT CROPS

Insect Identification
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CORNELL COOPERATIVE EXTENSION

Predatory Mites

Typhlodromus pyri (Scheuten), *Amblyseius fallacis* (Garman), *Typhlodromus occidentalis* (Nesbitt) (Acari:Phytoseiidae), and *Zetzellia mali* (Ewing) (Acari:Stigmaeidae)

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Predatory mites can provide consistent biological control of pest mites such as the European red mite (*Panonychus ulmi*), (ERM), and two-spotted spider mite (*Tetranuchus urticae*), (TSSM). Pure or mixed populations of several predatory mites occur in New York tree and small fruit plantings. The most important of these predators are the phytoseiids *Typhlodromus pyri* and *Amblyseius fallacis* (fig. 1). *Metaseiulus occidentalis*, another phytoseiid, is capable of controlling pest mites, but it occurs only sporadically in New York orchards. Its behavior as a predator is similar to *A. fallacis*. *Zetzellia mali*, a Stigmaeid or yellow mite, can be found in almost any orchard in the state, but provides biological control by itself only when ERM numbers are relatively low.

Photographs Figures 2, 3, and 4 by J. Ogrodnick

Figure 1. Phytoseiid, feeding on ERM

Description and Biology

The predaceous mites discussed here pass through five stages: egg, larva, protonymph, deutonymph, and adult. Larvae are six-legged; nymphal stages and adults are eight-legged (fig. 2). When on leaves, these mites are typically found on the underside near the midrib. Eggs are usually laid along or under the midrib or other large veins, and quiescent forms are most often found there.

Typhlodromus pyri (TP) is common in commercial apple orchards in New York. Found primarily on trees, it overwinters as a mated adult female in crevices on the trunk, branches, and spurs. Adult females emerge from overwintering sites on warm, early spring days, sometimes before bud break. They can survive and reproduce on a diet of pollen, fungi, and plant fluids during the early season when animal prey are absent. Adults are pear-shaped, minute (slightly smaller than an ERM adult), and generally a creamy white color (fig. 2), but because their guts take on color from prey, they may appear red or brown (fig. 3). TP move actively over plant surfaces in search of prey.

TP females live approximately 20 days and lay an average of 20-30 eggs. Eggs are pear-shaped, almost transparent and slightly larger than ERM eggs (fig. 5). TP may begin laying eggs in or on flower buds, or inside unopened flowers, as early as tight cluster or pink through bloom. After flowers open, TP eggs are laid on the undersides of leaves, hatching in 1-3 days, depending on temperature. Larvae are nearly transparent and almost impossible to find without the aid of a microscope. As they molt into nymphs, their appearance becomes milky.

There are three to four generations of TP per year in New York. Numbers are typically low early in the season because of winter mortality, but increase as summer progresses.

Amblyseius fallacis (AF) is virtually identical to TP, so a compound microscope is needed to distinguish between them.

Figure 2. Phytoseiid, larva, nymph, and adult

Figure 3. Phytoseiid, after feeding on ERM

Figure 4. Z. mali adult, before and after feeding

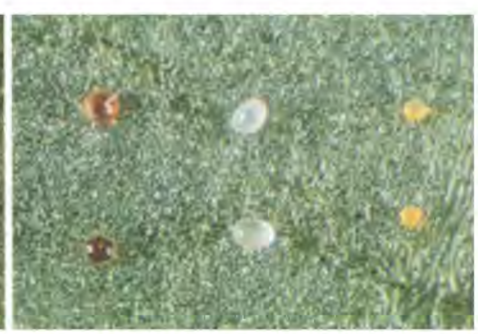

Figure 5. ERM, phytoseiid, Z. mali eggs

AF overwinters in trees if prey are available in the fall. It can be found in trees as early as bloom, but numbers are often very low until July or August because of high winter mortality (greater than TP). AF is also found in orchard ground cover (especially broadleaves), but during a single growing season this population has little effect on numbers in the trees.

AF live nearly as long as TP, but lay twice as many eggs, which are indistinguishable from those of TP. Immatures develop in one-third of the time required by TP. AF populations can increase rapidly and may overtake and deplete prey populations. In such cases it readily migrates to sites with more prey. It completes 4–6 generations per year in New York.

Zetzellia mali (ZM) overwinters as a mated female in crevices and under bark. It prefers to feed on rust mites, but will prey on eggs and immature stages of ERM and TSSM. It also feeds on phytoseiid eggs and is cannibalistic. ZM can survive on pollen, sap, and fungal spores, but will not reproduce on this diet. It is slow to explore a tree in search of new prey, so as pest mites such as ERM move from older leaves to new feeding sites on younger leaves, they often escape ZM predation.

ZM is smaller and less active than the phytoseiids. It is bright yellow, although its gut can take on a reddish hue after feeding (fig. 4). ZM eggs are round, bright yellow, and about half the size of ERM eggs (fig. 5). ZM usually completes four generations per year. It cannot build up as rapidly as the phytoseiids, but its persistence allows it to eventually reach high numbers.

In general, an "effective" predator (1) prefers to feed on the pest species, (2) actively searches for its preferred prey, (3) has the reproductive potential to increase its numbers more quickly than its prey, and (4) has the ability to persist when prey numbers are low. A predator's effectiveness is determined by which traits it exhibits either alone or in combination with another species.

Both phytoseiid species prefer to feed on tetranychid mites and actively search for them. Short-term, AF can better control a large pest mite population than TP. It is voracious and its population increases quickly in relation to its prey. When the pest mite population is high, AF numbers can overtake the pest population. If it reduces its prey to very low numbers, AF will leave in search of more prey. TP does not reproduce as quickly as AF and cannot overtake and control an expanding pest mite population, but it can thrive at low prey density. It remains in trees, surviving on a variety of alternative foods. Once the pest mite population has been reduced to a low density, TP will prevent its buildup unless disrupted by the use of a pesticide to which it is susceptible. A mixed population of AF and TP is desirable, but alone TP provides more consistent pest mite control for a longer time.

ZM by itself is the least likely mite to provide effective biological control. Its preferred prey is the apple rust mite and when it does feed on tetranychids, it does not consume many prey. ZM does not have AF's potential for rapid population growth and may compete with TP and AF by consuming their eggs and competing for common prey. However, ZM has many attributes that contribute to biological mite control. It can survive on a variety of alternative foods, so while not as efficient a predator as the phytoseiids, ZM can persist for long periods without prey and eventually reach densities capable of controlling pest mites. ZM can also complement biological control by phytoseiids by feeding on stationary forms of pest mites (phytoseiids prefer motile forms), such as overwintering eggs and quiescent immature mites. They can also serve as another source of prey.

Predator Use and Conservation

Pesticide selection. The best way to establish a predator mite population in an orchard is to conserve and promote those that exist naturally. This cannot be achieved unless pesticides are selected on the basis of their toxicity to predators. One application of a chemical considered highly toxic to a predator species, at any time during the season, will significantly decrease populations. Pesticides only moderately toxic to predators may have little or no long-term effect on overall populations when applied sparingly. If applied too often, these same materials may have a very negative impact. Refer to the most recent Cornell Cooperative Extension *Pest Management Recommendations for Commercial Tree Fruit Production* for up-to-date information on pesticide toxicity to predatory mites.

It can take up to three years of judicious pesticide use to establish a population of predators high enough to control pest mites. To maintain the population, a long-term pesticide program using the least toxic materials must be adopted.

Effect of horticultural oils. Oil should be applied prebloom to suppress pest mites early in the season. Prebloom application of oil has little or no effect on overwintered phytoseiid mites because of their habit of seeking protected sites, but it can greatly reduce overwintering ERM eggs, allowing predator populations to grow in relation to the pest's numbers.

Recent research indicates that a single application of highly refined petroleum oil sprayed after petal fall ("summer oil"), at rates of 1% or less, has little impact on predators. Research is under way to determine the effect of multiple applications.

Effect of cultural practices. Although AF are found in orchard ground cover, recent research indicates that ground cover management has no effect on AF abundance in trees during a single season. Ground cover, however, may play a role in keeping AF in the orchard, by serving as a refuge for AF dispersed from the trees.

Orchards with established predator mite populations can be used to introduce predators to other orchards through a procedure known as "seeding." Limbs pruned from trees infested with predatory mites are placed into uninfested trees. Bloom is probably the best time to seed because predator mites are concentrated on flowers where they feed on pollen until petal fall. Or, seeding can be part of summer pruning operations. Seeding can also be undertaken during late summer, before predators begin entering overwintering sites, or in early spring before they leave overwintering sites.

Importance of apple rust mite. The apple rust mite (*Aculus schlechtendali*) can be an important food source for phytoseiid mites when ERM or TSSM populations are low, especially in the early season. It is the preferred prey of *Zetzellia mali*. Rust mites feed on foliage, but their numbers must be extremely high to damage plants. Controlling them before they reach a damaging level is not economically justified and may have a negative impact on predator mites.

Monitoring predator effectiveness. Under least toxic pesticide practices, the population of one or more species of predator mites will increase. They can be detected, using a 10x hand lens, by monitoring the same leaves sampled for ERM. In evaluating the potential of predators to control ERM, it is not necessary, or practical, to determine their numbers. The best way to tell if biological mite control is successful is to monitor the ERM population to determine whether it is below or above threshold guidelines according to Cornell Cooperative Extension's *Pest Management Recommendations for Tree Fruit Production.*

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