

Final Project Report to the NYS IPM Program, Agricultural IPM 2000 – 2001

Title: Biological mite control in Hudson and Champlain Valley Apple Orchards Through the Distribution and Conservation of *Typhlodromus pyri*

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Abstract:

In contrast to western New York where the mite predator *Typhlodromus pyri* is widespread and conserved to provide biological mite control, biological mite control has not been actively pursued in eastern New York orchards, at least in part because of the real or assumed absence of *T. pyri*. Previous research has shown that *T. pyri* can provide complete biological mite control in eastern New York orchards. During 2001 we began a project to demonstrate this on a large scale. We found that:

- Of 11 Hudson valley (HV) and 8 Champlain valley (CV) orchards where *T. pyri* were released, the predator was also present in approximately 80% of the plots in these orchards where it was not released.
- Release of *T. pyri* increased densities of the predator 2 to 3 fold compared to densities in plots where no releases were made.
- Densities of European red mite (*Panonychus ulmi*) remained low in release plots even though miticides were not used.
- These results indicate the strong potential for using *T. pyri* in HV and CV orchards to control European red mite.

Background and justification:

Although efficacious miticides continue to be developed and made available, the costs of control using these materials are escalating during a period when many orchardists are attempting to remain viable by minimizing expenses. Furthermore, chemically-based mite control programs may be environmentally harmful and the potential for resistance to miticides by the pest mites is a concern. Biological control of mites is an economically and technologically feasible alternative to pesticides. Two species of predaceous mites predominate in commercial orchards in New York, *Amblyseius fallacis* and *Typhlodromus pyri*. While these two phytoseiid mites look very similar, they have very different biologies and it is *T. pyri* that is the most effective biological control agent (Nyrop et al. 1998). In fact, when *T. pyri* is conserved in commercial apple orchards, it can eliminate the need for miticides (Walde et al 1992, Hardman et al 1991, Blommers 1994). Primary among the differences that lead to *T. pyri* being a more effective biological control agent are that it survives in apples trees year round and can achieve quite high densities on a variety of alternative food sources including pollen and fungal spores (Breadth et al. 1998, Nyrop et al. 1998). *Typhlodromus pyri* is common in western New York apple orchards, and was thought to be relegated to this geographic area. However, recent research has demonstrated that *T. pyri* can provide effective biological control in both the Champlain and Hudson valley apple growing regions. This research also suggested that *T. pyri* was indigenous to at least a few orchards in these areas. These results indicate that a mite biological control program based on conserving *T. pyri* could be very effective in these apple growing regions.

Objectives:

The overall goal of this project is to implement a reliable and effective mite biological control system in eastern New York apple orchards. To accomplish this goal two objectives are being pursued:

1. Establish and evaluate the effectiveness of *T. pyri* in Champlain and Hudson valley orchards and simultaneously determine the extent to which this predator is indigenous to these areas.
2. Educate growers on how to conserve *T. pyri*, how to distribute the predator throughout orchard plantings, and how to monitor pest mites to verify the effectiveness of biological control.

Procedures:

Typhlodromus pyri were released in 8 and 11 orchards in the Champlain (CV) and Hudson valley (HV) growing regions, respectively. In each orchard, two blocks of approximately 1-5 ha were identified and treated with insecticides and fungicides that are not toxic to *T. pyri*. Within each block, single plots of 20 trees (4 rows, 5 trees per row) were marked and *T. pyri* were released into one of these blocks with the other serving as a control. In the CV predators were released by affixing banding material¹ that harbored predators to each of the 6 interior trees in the release plot. Approximately 100 predators were released per tree. In the HV approximately half of the orchards were inoculated using banding material. In the remaining orchards, flower clusters with *T. pyri* were used to inoculate predators with approximately 50 predators being released per tree. Mite dynamics were monitored by collecting 25 leaves per tree from each of the 6 interior trees of the plots. Mites on these leaves were brushed onto a glass plate and counted. Adult phytoseiids were mounted on glass slides and identified. In the HV mite densities were estimated 4 times from early June through August whereas in the CV 6 estimates were made.

¹ Banding material consists of burlap glued to Tree-wrap™ banding. These bands are placed around trees in late summer or early fall and *T. pyri* move into them to overwinter.

Data were summarized several ways. The number of release and control plots in which *T. pyri* were found was determined. This provided a measure of the extent to which *T. pyri* were indigenous to the study orchards. The proportion of phytoseiids identified that were *T. pyri* was calculated for each plot in each orchard provided that at least 10 phytoseiids were identified from the plot during the course of the study. Average proportions for release and control plots within each region were calculated. The average seasonal density of all phytoseiids and of *T. pyri* were calculated for each plot in each orchard and means for release and control plots within each region were determined. Average seasonal phytoseiid densities was calculated as the average of the sample means across time where each sample mean was based on six 25 leaf samples. The average seasonal density of *T. pyri* was estimated by multiplying the average phytoseiid density by the proportion of *T. pyri* identified from the site provided that at least 10 phytoseiids were identified. If this criterion was not met, the estimate of average seasonal *T. pyri* density was considered missing. Average seasonal density of European red mite across all sample dates and the maximum of these sample estimates were determined for each plot in each orchard. Means of these averages were determined for the release and control plots in each region.

One hundred leaf samples were collected from 17 additional orchards and examined for phytoseiids. Phytoseiids that were found were mounted on glass slides and identified to species.

We met with participating growers several times during the season to communicate results of the work to them. At the end of the growing season we held meetings to review the outcome of the program, review mite biological control principles and identify potential problems with the program.

Results and discussion:

Of the 11 orchards located in HV, 7 harbored *T. pyri* in both release and control plots, in two orchards *T. pyri* were found only in the release plots, in one orchard *T. pyri* was found only in the control plot, and in the remaining orchard no *T. pyri* were found. Of the 8 orchards in CV, *T. pyri* were found in all the release plots, but also in 7 of the control plots. These results show that *T. pyri* were indigenous to approximately 75% of the orchards that we worked in. However, samples from an additional 17 orchards revealed 9 with phytoseiids, but only in two of these orchards were *T. pyri* found. Clearly, *T. pyri* are indigenous to these apple growing regions and hence, offers the potential for controlling European red mite. However, this predator is either lacking or at very low densities in many orchards.

During the course of the study we identified 1694 phytoseiid mites of which approximately 60% were *T. pyri*. The remaining 40% of identified phytoseiids were, aside from 3 specimens, all *Amblyseius fallacis*. From release plots we identified 1143 phytoseiids, of which 75% were *T. pyri*. Corresponding numbers from the control plots were 548 phytoseiids, 28% of which were *T. pyri*. These data are broken down by region and treatment in Fig. 1. *Typhlodromus pyri* constituted approximately twice the proportion of identified phytoseiids in release plots compared to control plots in both regions. There was one orchard in HV where nearly all the phytoseiids identified from the control plot (45) were *T. pyri*.

Densities of *T. pyri* were 2 to 3 fold higher in release plots compared to plots where the predators were not released (Fig. 2). The higher numbers of phytoseiids in the release plot can be attributed to greater abundance of *T. pyri* because in release plots, abundance of *T. pyri*

frequently was close to the abundance of all phytoseiids; however, this was not the case in the control plots (Fig. 2).

Average and maximum densities of European red mite (Figs. 3 and 4) were generally equivalent in release and control plots in both regions. For all but one site, densities of pest mites in release plots remained below a treatment threshold of 7-10 mites per leaf, even though miticides were not applied to these plots. While we can not be certain that these acceptable pest levels can be fully attributed to *T. pyri* in these plots, the results are very encouraging.

During the course of meetings with participant orchardists we identified limitations to using *T. pyri* as a biological control for European red mite. One important limitation is the lack of a control tactic for tarnished plant bug that is benign to *T. pyri*. During 2002 we will address this questions.

Through this work we found that *T. pyri* were indigenous to many orchards in the Champlain and Hudson valleys. Despite the existing presence of these predators, releases of *T. pyri* resulted in increased numbers and proportions of the phytoseiid. Acceptable numbers of European red mite in the plots where predators were released and in the absence of miticides provides additional evidence for the biological control of European red mite that this predator can provided.

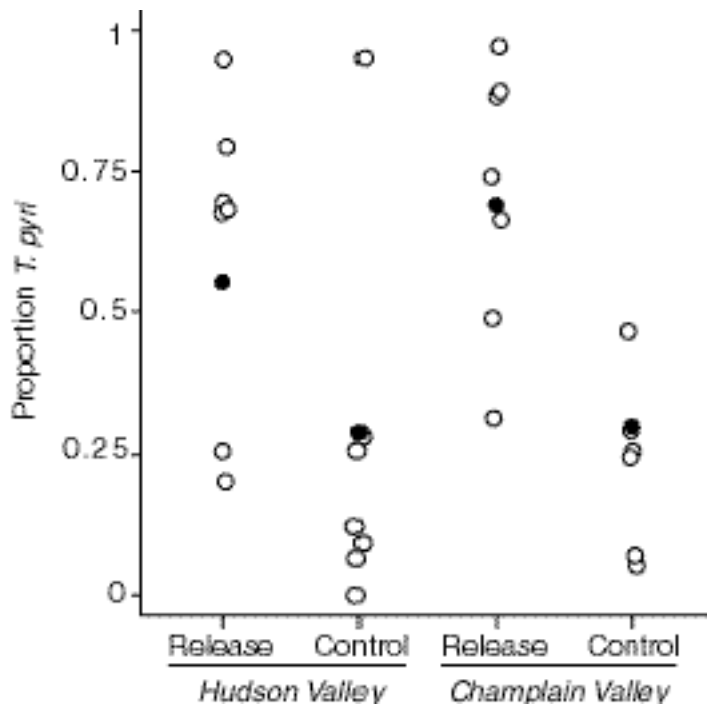


Figure 1. Proportions of collected phytoseiids identified as *T. pyri* in plots where *T. pyri* were released and were not released in the Hudson and Champlain valleys. Proportions were only calculated for sites from which at least 10 phytoseiids were identified. Data points were randomly moved on the plot by up to 2% of the plotting surface so that data points would not overlap. Solid symbols are means.

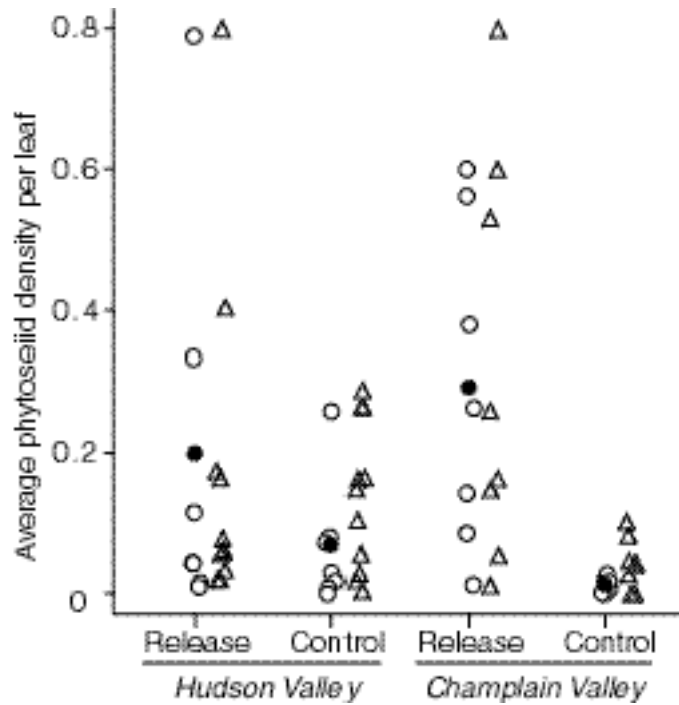


Figure 2. Average seasonal densities per leaf of *T. pyri* (circles) and all phytoseiids (triangles) in plots where *T. pyri* were and were not released in the Hudson and Champlain valleys. Average densities of *T. pyri* were estimated by multiplying the average densities of all phytoseiids by the proportion of *T. pyri* identified from the site. Densities of *T. pyri* were only estimated if at least 10 phytoseiids were identified. Solid circles are means of average seasonal *T. pyri* densities for release and control plots in the two regions..

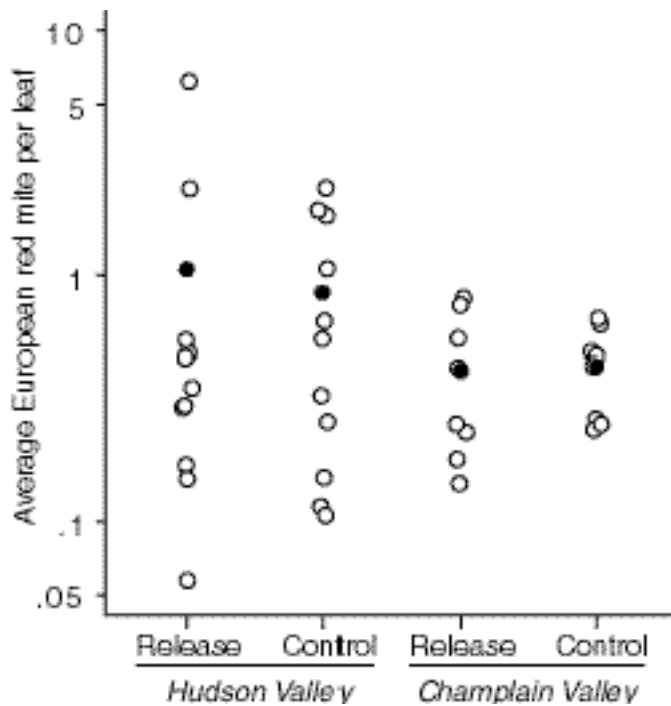


Figure 3. Average seasonal densities per leaf of European red mite in plots where *T. pyri* were and were not released in the Hudson and Champlain valleys. Solid circles are means.

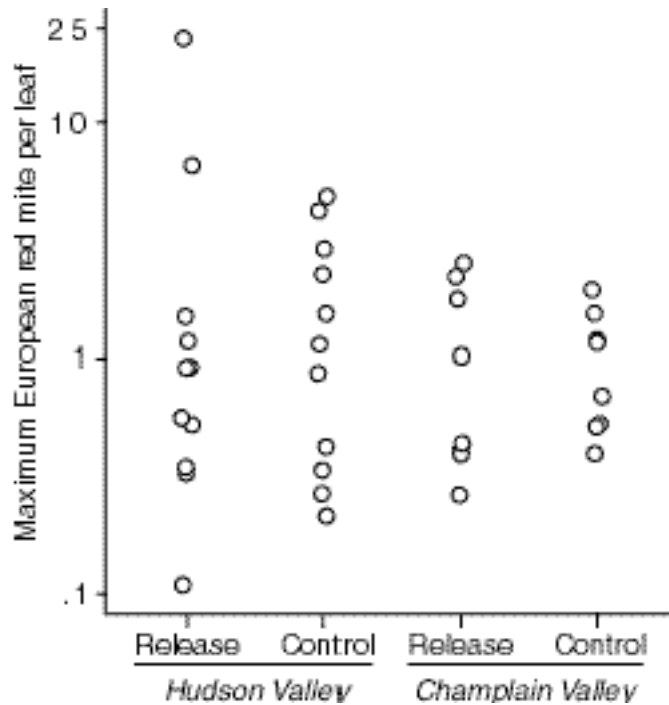


Figure 4. Maximum densities per leaf of European red mite in plots where *T. pyri* were and were not released in the Hudson and Champlain valleys. Maximums are the largest sample mean estimated from 6 25 leaf samples collected during the sampling period.

References:

- Blommers, L. H. 1994. Integrated pest management in European apple orchards. *Ann. Rev. Entomol.* 39:213-241
- Breath, D., J. P. Nyrop and J. Kovach. 1998. A guide for integrated mite control in apples in the northeast. Cornell IPM Publ. #215.
- Hardman, J. M. R. E. L. Rogers, J. P. Nyrop and T. L. Frisch. 1991. Effect of pesticide applications on abundance of European red mite (Acari: Tetranychidae) and *Typhlodromus pyri* (Acari: Phytoseiidae) in Nova Scotian apple orchards. *J. Econ. Entomol.* 84:570-580.
- Nyrop, J. P., G. English-Loeb and A. Roda. 1997. Conservation biological control of spider mites in perennial cropping systems. *In Perspectives on the Conservation of Natural Enemies of Pests.* P. Barbosa [ed]. Academic Press, New York.
- Walde, S. J., J. P. Nyrop, and J. M. Hardman. 1992. Dynamics of *Panonychus ulmi* and *Typhlodromus pyri*: Factors contributing to persistence. *Exp. Appl. Acarol.* 14:261-291.