

**Final Report to the North American Strawberry Growers Association
(NASGA)**

Project:

Integrating Biological Control of Twospotted Spider Mites into Pest Management Practices

Silvia I. Rondon¹

James F. Price²

Daniel J. Cantliffe²

University of Florida, Institute of Food and Agricultural Sciences

¹Horticultural Sciences Department, ²Entomology and Nematology Department

P.O. Box 110690, Gainesville, FL 32611

Contact: srondon@mail.ifas.ufl.edu

Introduction

Tetranychus urticae Koch, the twospotted spider mite (TSM), is the key pest affecting commercial strawberry production in Florida. Control strategies for TSM relied on several applications of pesticides during the strawberry production season which resulted in high control costs and the development of resistance (Price et al. 2001; Price and Kring 1990; Howard et al. 1985). Biological control, which involves the use of beneficial arthropods to control pests, is a viable alternative for a sustainable strawberry production system. In the strawberry agroecosystem, the use of predatory mites provides a feasible option to conventional broad-spectrum pesticides. *Phytoseiulus persimilis* Athias-Henriot and *Neoseiulus californicus* McGregor have been the main predatory mites released in Florida and other strawberry production areas (Decou 1994, Wood et al. 1994). Their establishment has been relatively successful; however, in 2002, Florida growers had an estimated 40% adoption of a predatory mite biological control program; however, in 2003, the usage dropped to 27%. This figure indicates that in certain economic environments, growers still prefer chemical alternatives opposed to biological approaches. Thus, in order to protect the crop in the long term through a reduction in arthropod resistance, a combination of biological and chemical approaches through selection of low-risk pesticides to better sustain a strawberry crop must be tested.

The objective of this proposal of research is to determine any comparative advantages between the beneficial predatory mites, *Phytoseiulus persimilis* and *Neoseiulus californicus* for control of the TSM in strawberry. Results from this research could increase the geographic range over which biological control of spider mites could be successful.

Materials and Methods

Large farm field plots were established from October through April at three farms: (1) Ferris Farms (P.O. Box 909, Floral City, FL 34436); (2) Hinton Farms Produce (1839 North Bend Road, Dover, FL 33527); and (3) Golf Coast Research and Education Center (5007 60th Street East, Bradenton, FL 34203-9324). On all the locations, planting started the last week of September and continued through mid-October. Plastic mulch was placed on raised beds after methyl bromide and drip tape was applied. Fertilizer was applied along with the irrigation. Methyl bromide was applied in combination with chloropicrin approximately two weeks prior to transplanting for managing soil borne diseases, nematodes, and weeds. Row middles were not treated. During the growing season, workers cut runners, and harvested fruits. At harvesting time, fruits were picked by hand and unmarketable fruits were left on plants or discarded in row middles.

In each farm, treatments included two predatory mite species and a chemical miticide control. Treatments were arranged from east to west as followed: (1) *Phytoseiulus persimilis*; (2) standard grower program (conventional miticides); and (3) *Neoseiulus californicus*. The grower standard program acted as a control for comparisons with predatory mite treated areas. Each single plot on growers' strawberry farms were 5-12 acres.

Scouting started after four fully develop leaflets was found. One hundred leaves per treatment (collected randomly) were sampled weekly. Sample sites run evenly distributed in a diagonal from one corner to the other, excluding influencing factors such as field edges. The undersurface of leaves was examined carefully for the presence of TSM by using a hand lens (5X and 14X).

Predatory mites were released at a rate of 1 predatory mite per strawberry plant when 5-10% of the leaves were infested with adult TSM. If populations of TSM exceed 10 %, compatible miticides (Acramite or Vendex) were sprayed at the recommended rate before predators were released. Predatory mites were provided by the Koppert Biological Systems, USA subsidiary, and were applied manually by farm workers previously trained.

All data collected on TSM and predatory mites was transformed ($\sqrt{}$) to stabilize variances and then subjected to an Analysis of Variance (ANOVA) or Poisson distribution followed by mean separation using Least Significant Difference (LSD) tests (SAS Institute, 2001). Farming practices also will be collected and a cost / return comparison between biological and chemical control will be made.

Participation in field days and grower meetings was conducted simultaneously with the on-farm demonstration trials.

Results

(1) Northern Florida: Floral City (Ferris Farm, Citrus County)

Transplants from most nurseries arrived with less than usual TSM problems at the farm. Better than expected results were observed for TSM control on young transplants by applying Brigade® (bifenthrin) pyrethroid plus Diazinon® (organophosphate) immediately after the transplant establishment period (October 22) (Fig. 1). This application was made before the grower was enrolled on the on-farm trial. The effectiveness of Brigade and Diazinon plus the

cold temperatures resulted into a low density of TSM from November through early February. However, during the week of February 10, TSM population increased (Fig. 1).

Both predators were released on February 26 at a rate of one predatory mite per plant. Predatory mites established in the crop approximately three weeks after released. Since the releases were made near the end of the season, the grower did not spray any miticide in the control area. Strawberry prices by the end of February dropped from \$ 33 dollars per flat, at the top of the season, to \$ 7 dollars a flat at the end of the season, making the miticide application uneconomic. Harvest continued until the first week of April. By the end of March, *P. persimilis* had already established, reducing approximately 10% of the TSM population. There was a 1-week delay in *N. californicus* establishment; however, by the time *N. californicus* was established, the crop was terminated. A 5 % reduction of the TSM population was observed due to *N. californicus*. Both predators performed well; however, the initial population of TSM was beyond the 10% thresholds at the time of application and it should have been sprayed with a compatible miticide before the actual day the predators were released.

(2) Balm (Hinton Farm, Hillsborough County)

Due to the spotty infestation of TSM throughout the farm, *Phytoseiulus persimilis* was released on December 16th, while *N. californicus* was released on February 26th. Twospotted spider mite developed moderate densities very early in the area to be treated with *P. persimilis* (18%) in spite of an early application of Brigade (binfenthrin) on November 9th and potassium salts of fatty acids on November 18th. The area to be treated with *N. californicus* reached 5% infestation of leaflets only at the end of the season. Vendex 50WP was applied to the *Persimilis*

plot on November 27 to reduce TSM until the *Neoseiulus* area had enough mites to perform the predatory releases at the same time. Since we did not want to expose the grower to any economic loss, the decision of releasing *P. persimilis* was made. As a result, there was no means to compare the effectiveness of the two predator species. Control of TSM by *P. persimilis* was unusually slow (about 10 weeks), perhaps a result of the high number of cool and cold days (Fig. 2).

3) Dover (Hillsborough County)

Twospotted spider mite densities remained at a very unusual low level the entire season, perhaps in response to a winter with a more than usual number of cool and cold days. The low densities of TSM resulted in unsatisfactory ecological conditions to make sound inferences about predator effectiveness. *Phytoseiulus persimilis* was released on December 9 (at about 13% average spider mite infestation) and *N. californicus* were released on December 23 (at about 5% level of spider mite infestation). TSM were reduced to about 5% level of infestation in the areas of both predator species by 25 February (Fig. 3). Agrimek and Savey was sprayed November 21, while Vended was sprayed December 19.

Summary

N. californicus predatory mite seems to survive well but develop populations slowly in the area of this evaluation. The level of tolerance of this species to some pesticides important in strawberry culture is different from that of *P. persimilis*. For instance, *N. californicus* is much

more tolerant to Brigade than is *P. persimilis*. Given that low rates of a compatible, relatively inexpensive miticide such as Vendex can be applied to TSM populations being adjusted by *N. californicus*, it may be practical for a farmer to elect the use of *N. californicus* and gain the benefits of pesticides less tolerated by *P. persimilis*.

Additionally, although these experiments were not designed to compare the effects of the two predators on the tumid spider mite (*Tetranychus tumidus*), that occasional, minor, early-season pest was present in these experiments. Data indicate that *N. californicus* may develop more favorably on this species than does *P. persimilis*. If this is so, then schemes could be developed to use tumid spider mite infestations as an in-field “nursery” for *N. californicus* to develop and be present when TSM begin to emerge as a problem. Additional investigations are required to determine the course of these dynamics however.

Acknowledgements

We extend our sincere gratitude to the North American Strawberry Growers Association for partial funding of this research and to Koppert BV who provided us with the predatory mites. We would like to thank Al Herndon (Ferris Farm) and Cammy Hinton and Wiley (Hinton’s Farm) for their collaboration.

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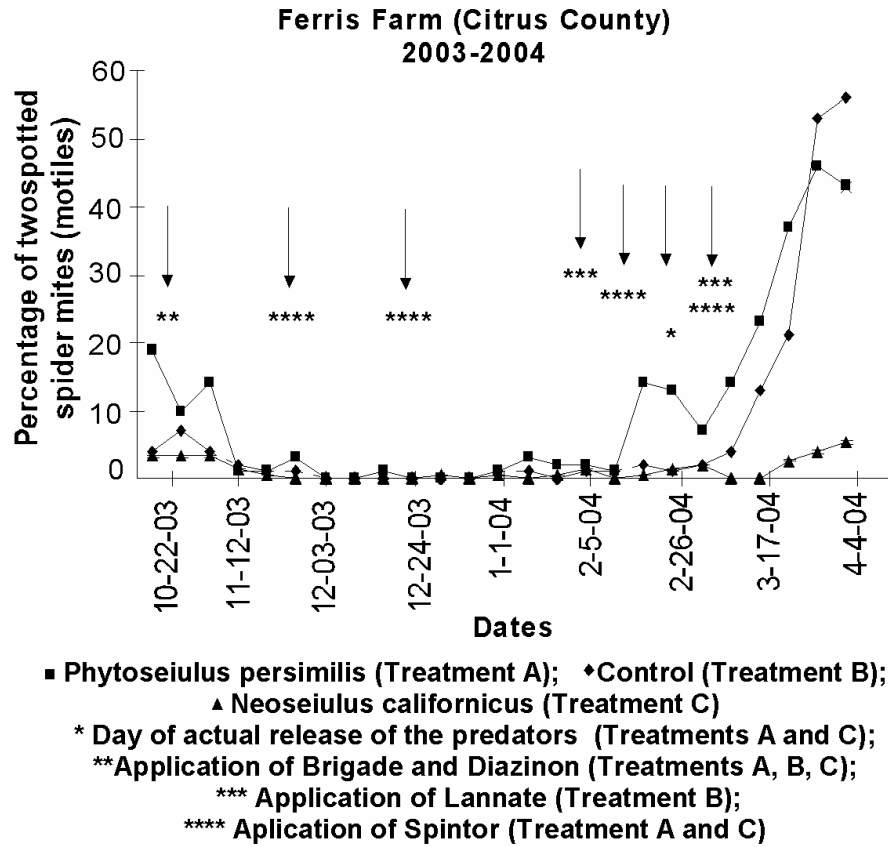


Fig. 1 Population dynamics of the twospotted spider mite, *Tetranychus urticae* Koch, on an on-farm predatory mite trial in Citrus County, 2003-2004.

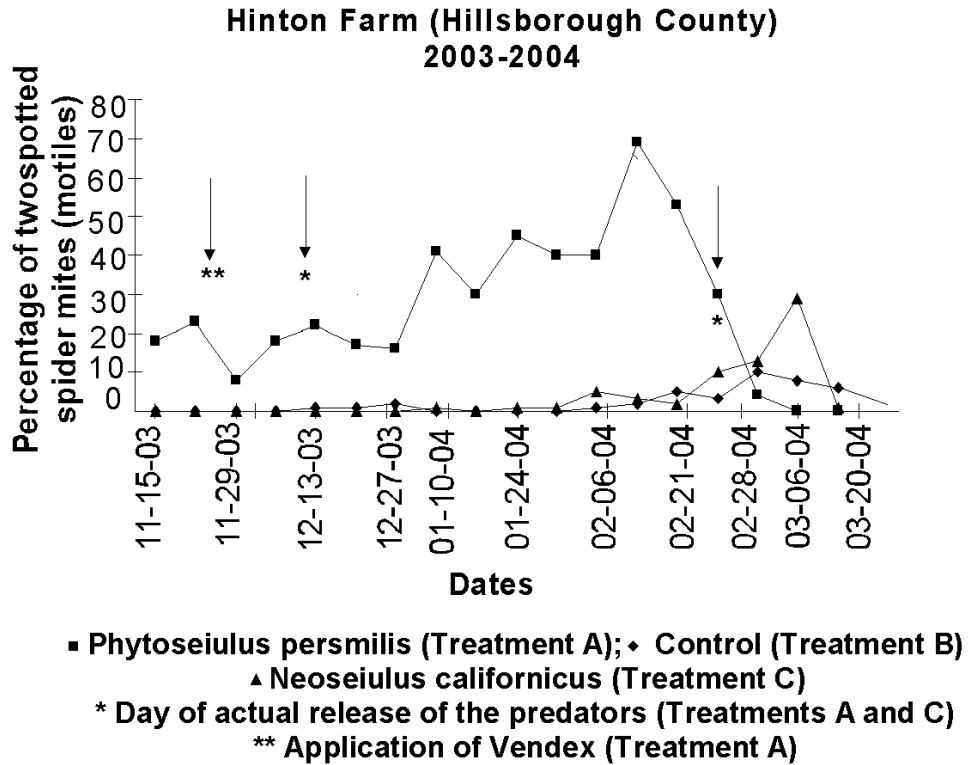


Fig. 2 Population dynamics of the twospotted spider mite, *Tetranychus urticae* Koch, on an on farm predatory mite trial in Hillsborough County, 2003-2004.

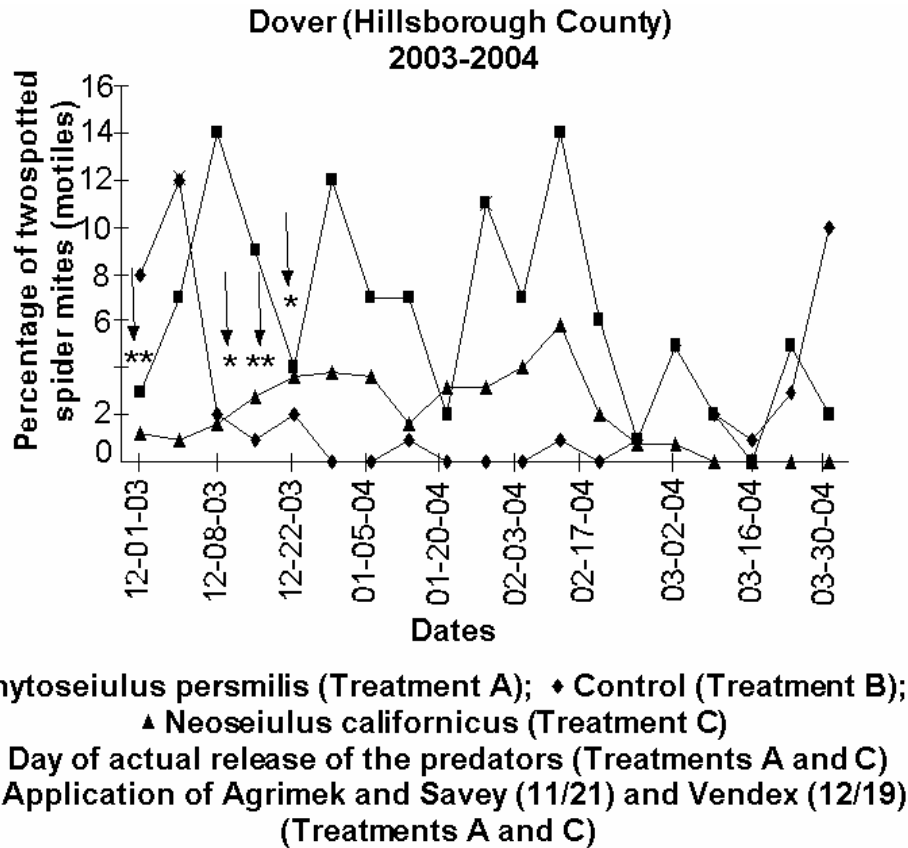


Fig. 3 Population dynamics of the twospotted spider mite, *Tetranychus urticae* Koch, on an on-farm predatory mite trial in Hillsborough County, 2003-2004.