Title: **Biological Control of Spider Mites and Armyworms on Strawberries Grown Under Row Covers for Fall and Winter Production**

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Objective: To develop a sound and effective pest management system using biological control in strawberries under row covers.

Justification:

Although forcing strawberry production during the winter months using row covers may be viable, almost nothing is known about controlling pests with biological agents in the row cover environment. Spider mites (*Tetranychus urticae),* and armyworms are major constraints to strawberry production systems during the winter months as well during the spring production. It is becoming increasingly clear that the strategy of unilateral reliance on chemical control will not be the final solution to the problem of TSSM control (Osborne et al. 1999). Three major problems are inherent to chemical control: 1) development of resistance in target pest species and TSSM has a long history of insecticide resistance development (Osborne et al. 1999), 2) the dwindling supply of useful registered insecticides and acaricides, 3) the detrimental effects of these chemicals on non target species resulting in resurgence in the target pest and/or secondary

pests outbreaks. On the other hand biological control alone does not always give adequate protection. Thus an integrated pest management strategy might be most appropriate in this case. There is a critical need for integrating biological control agents with existing cultural and chemical control methods.

Within the past 15 years there has been a growing interest on the part of the growers and public in general, to move away from chemical pesticides in favor of biological control methods. However, it is only in the last 5 years that we had been able to secure dependable suppliers of good quality natural enemies of a number of common pests including the TSSM. The biological control of TSSM using predatory mites has been effective in open field and greenhouse situations (Osborne et al. 1999). This research proposes to use three biological control agents (two TSSM predators and *Bacillus thuringiensis* for armyworms), to develop a management system for this pest complex on strawberries grown under row covers.

Production during the "off season" will not only provide additional income to producers but will provide consumers with a source of fresh, locally-grown strawberries that are insecticide free. Because of the increased consumer demand, the price of strawberries grown during the winter months can be as much as four times higher that of strawberries grown during the regular spring/summer season. Information generated from this research should help strawberry growers move toward a more sustainable and cost-effective management system for spider mite and armyworm control on off-season strawberries. In addition, this approach should greatly diminish problems associated with the use of insecticides/miticides such as impacts on non-target species and pesticide residues on strawberries and in ground water.

Methodology

'Sweet Charlie' variety strawberries were used for the test. After light treatment conditioning strawberries were planted on September 18/2003. All plots have been weekly fertilized with 15-5-15 at 2.5 lbs/acre rate. Also, all plots are being treated weekly with Captan® for Botrytis fungus control. Underground irrigation has been applied in all plots when needed. Row covers were placed on plots on November 17th /2003. Each plot was covered with a tunnel formed from clear plastic that is hold at about 30-40 inches above the plants with a wire frame. The plastic is hold on the sides with wire holders. Plastic covers are opened early in the mornings during days with mild temperatures by lifting the plastic on one side of the plot and rolling it

over to the other side and then rolled over back in place late in the afternoon to leave it covered during the evenings. Plots were 2 m wide and approximately 7.5-8 m long with two rows per plot. Strawberries on each plot were planted at 25 plants per row for a total of 50 strawberry plants per plot. There were 5 replicates per treatment for a total of 20 plots for the three treatments and the control. Treatments were arranged as a complete randomized block design. Treatments consisted of releases of the predatory mite (*Phytoseiulus persimilis*) at three different densities. *P. persimilis* release densities per treatment were 33, 66 and 100 predatory mites per row-meter respectively for the three treatments.

Beginning in October TSSM populations had been monitored twice weekly by randomly removing and examining 6 leaflets per plot for TSSM eggs, immature forms and adults as well as predators. The first week of December 2003 TSSM densities reached a 10-15 % leaves infestation level per plot and this was almost double (5-10%) the density that Van de Vrie and Price (1994) found to be the adequate for predator release without yield loss. Therefore, in order to reduce spider mite pressure, Vendex 50WP® was applied at the lowest rate of 1.5 lb/ acre and 10 days later *P. persimilis* predators were released at the three different rates mentioned above. Control of lepidopteran pests such as the yellow-striped armyworm, *Spodoptera ornithogalli*, and the southern armyworm, *S. eridania*, will be carried out by applying the microbial agent, *Bacillus thuringiensis,* when populations of these caterpillars are observed during routine sampling. Strawberry yields has been assessed twice weekly through continuous harvest, grading and weighing ripe berries.

Harvest (2 times per week) began on December 1st/2003. During the first harvest all the ripe berries were collected from 6 plants chosen at random per plot and those plants were numbered and flagged in order to keep sampling the same plants and obtain a cumulative yield per plant per plot at the end of the season. The weight of marketable fruit per plot of 50 plants has been slowly but steadily increasing beginning on December 1st/2003 with approximately 1527.5 g per plot of 50 plants per week to about 1596.5 g per plot on December 29/2003.

The TSSM population is currently low and sampling is continuing to assess the action of the predators against TSSM.