

BIOLOGICAL CONTROL OF INSECTS AND MITES IN GREENHOUSE CROPS

CAROL S. GLENISTER

*IPM Laboratories, Inc.
Locke, New York 13092-0099*

INTRODUCTION

Biological control is the use of beneficial organisms to keep pest organisms under control. In the context of the greenhouse and nursery, such beneficial organisms include beneficial bacteria, beneficial fungi, beneficial nematodes, beneficial insects, and beneficial mites (1, 2). Beneficial insects and mites are used extensively throughout European glasshouse vegetables for control of greenhouse whiteflies and spider mites (4, 6) and are seeing increased use in interior landscapes (5).

This paper describes a demonstration project using beneficial insects and mites for control of greenhouse pests in Arthur H. Steffen's clematis in Rochester, New York. Steffen's, the largest propagator of clematis worldwide, first experimented with biological controls in 1977 (3). They see innovation toward biological controls as one of the answers to public and worker concerns with chemical pesticides.

The project was originally intended to be a demonstration of biological control of spider mites, but after we carefully set up the trial, no spider mites appeared anywhere in any of the greenhouses all season. However, we faced infestations of whiteflies, thrips, cyclamen mites, and aphids with biological and least toxic solutions. This paper describes the preparations and season-long controls undertaken in the demonstration greenhouse and compares it to treatments in an adjacent, conventionally managed greenhouse.

PROJECT SETUP

Steffen's dedicated one 2000 sq ft greenhouse of clematis to the biological control project and an adjacent identical greenhouse to serve as a comparison under conventional control. To ensure pest levels as low as possible, all plants were removed and all weeds eradicated from the biological control house by late February. The house stood completely empty for nine weeks, ensuring cleanup of any pests by starvation and unfavorable temperatures.

Next we set up a pest monitoring and record-keeping system to ensure early detection of pests and early introduction of beneficial insects and mites. A Steffen's grower was responsible for daily monitoring of plants during watering and weekly counts of pests

on four 3 in. x 5 in. yellow sticky cards placed at canopy level throughout each house. In addition, records of pest levels were kept in map form on a grid outline of the greenhouse with different colors and symbols designating different pests and density levels.

A third precaution prior to starting this program was to determine which pesticides would be compatible with biological controls in case some pests should require pesticide treatment. Published and unpublished research shows that Safer's Soap, Vendex, and Avid are all relatively permissive to survival of beneficials (5, Sanderson, personal comm., see acknowledgements). Steffen's tested these three pesticides on several cultivars of clematis with no adverse effects.

BIOLOGICAL CONTROL APPLICATION

Releases of the whitefly parasite, *Encarsia formosa* began soon after the plants were placed in the greenhouse, as we knew that a small number of whiteflies came in on the plants. Sticky card catches averaged about 3.7 adult whiteflies per card per week (a very low catch). We released 1000 wasps at each of the first three releases (Table 1), and 2000 in the June releases (increased numbers due only to extras being available). Since these tiny, beneficial wasps have a generation time of 25 days at 70 °F, multiple releases are necessary to quickly create overlapping generations of the whitefly parasites and get constant whitefly parasitization.

Table 1 summarizes the biological control releases.

Table 1. Biological control treatments 1989.

Beneficial	Release dates
Thrips predators, 50T (<i>Amblyseius barkeri</i>)	7/12
Aphid lions, 2T (<i>Chrysoperla rufilabris</i>)	7/7, 8/2, 8/26
Whitefly parasites (<i>Encarsia formosa</i>)	5/11, 5/18, 5/26, 6/2, 6/8, 8/12, 8/17, 9/6

With the transfer of a small number of whitefly-infested plants into the biocontrol house in late July, whiteflies once more threatened, so we resumed *Encarsia* releases. We released 2000 on the first day and 1000 on each of two subsequent days.

Thrips first appeared on yellow sticky cards near the intake vent in mid-June, and per card catches had doubled by mid-July from 7 to 14. Cyclamen mites were of concern elsewhere in the complex.

Fifty thousand predacious mites, *Amblyseius barkeri*, were released on July 12 to contain both these pests. Suspended in wheat bran, they were sprinkled throughout the house and concentrated near the intake vent.

Patches of aphids began to threaten in early July and were controlled with spot treatments of Safer's Soap (2.5 oz/gal water) on the worst areas, and releases of 2000 lacewing immatures (*Chrysoperla rufilabris*) throughout the aphid infestation. Lacewings eat aphids only while immature over a period of about 2 weeks, so multiple releases are also important for prolonged control. The July 20 Safer's treatment was repeated on July 30 because a substitute applicator apparently did not get adequate coverage, resulting in negligible control on July 20.

RESULTS AND DISCUSSION

When the spider mites did not appear by August 24, we ceased formal observations except to do a final pest map on October 31. Pesticide treatments in the biocontrol and conventional houses are summarized in Table 2. All treatments in the conventional house were whole-house treatments, whereas the Safer's treatments in the biological control house were spot treatments. The conventional Kelthane treatments were for cyclamen mites, while the Orthene and Diazinon were directed against whiteflies and thrips.

Table 2. Pesticide treatments 1989

Conventional control house		Biological control house	
Date	Pesticide	Date	Pesticide
7/13	Kelthane	7/13	Safer's soap
7/20	Kelthane	7/20	Safer's soap
8/10	Orthene	7/30	Safer's soap
8/16	Diazinon	9/7	Benlate drench
8/23	Benlate drench		

Average whitefly and thrip populations detected on the sticky cards through the season are shown in Figures 1 and 2, respectively. Since sticky cards lure whiteflies from a distance, a catch of 3 per week represents a situation where the whiteflies can barely be detected during a prolonged search of many plants. The late-season whitefly outbreak highlighted the pest management tenet about cleaning up new stock before introducing it into a clean house. Between August 24 and October 31, whitefly numbers in the biocontrol house jumped to considerably more than 14 per square foot in some infested locales, but these whiteflies became heavily

parasitized and were not considered a problem. Thrips levels in the biocontrol house closely tracked those in the conventional house. Aphid numbers remained spotty and light throughout August, and then disappeared.

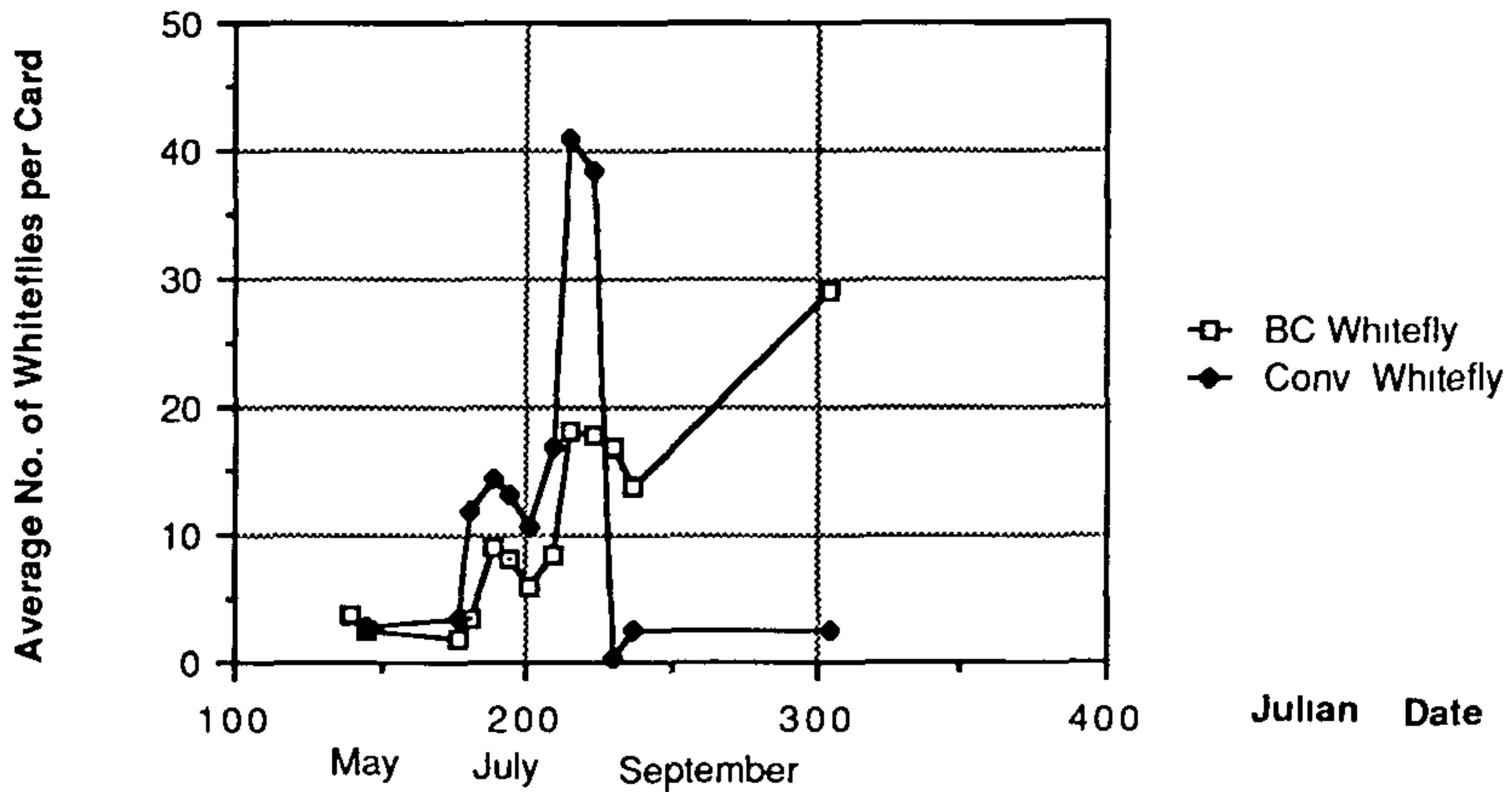


Figure 1. Weekly sticky card counts of whiteflies.

This trial emphasizes the different schedules used by biocontrol and conventional pesticide programs. The first biological control for whiteflies was applied May 11 when whiteflies were barely detectable on sticky cards. In contrast, the first pesticide control for whiteflies and thrips was not applied until August 10 when sticky card catches reached about 40 whiteflies per week. Figure 1 illustrates 40 per week to be twice the level that was being maintained in the biological control house before new plants with whiteflies were introduced. A similar situation occurred with thrips. The thrips predator was applied on July 12, one month before the first thrips spray.

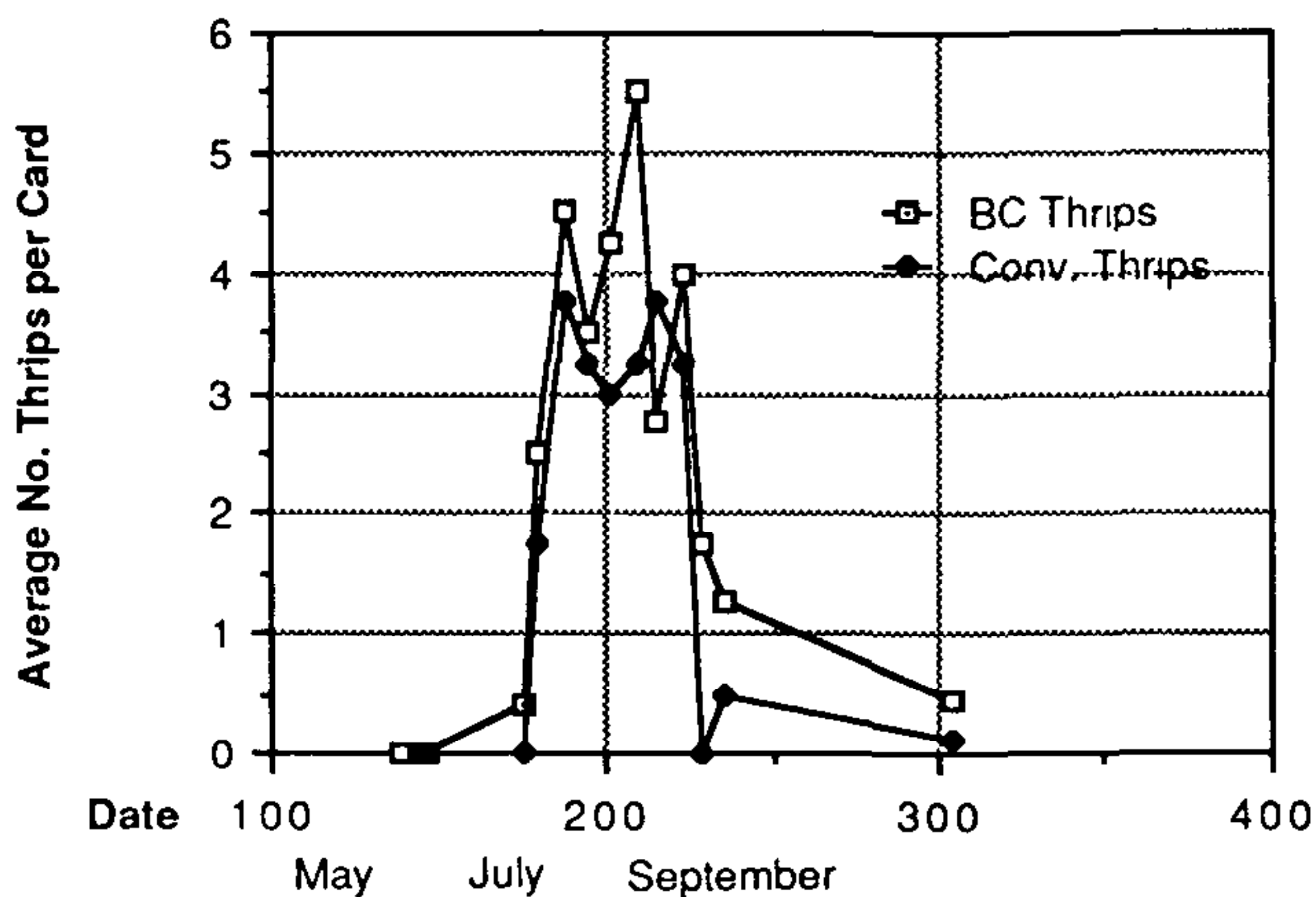


Figure 2. Weekly sticky card counts of thrips.

The total cost of the beneficials for the season was \$271 plus freight (*Encarsia*, \$135; lacewings, \$36; *Amblyseius barkeri*, \$100). As the numbers of beneficials purchased was relatively small, this cost is representative only of low-volume purchases.

The Steffen's growers felt that the control in the biological control house had yielded plants that were equivalent in quality to the conventionally controlled house.

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