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Authors: Van Driesche, R. G., and Lyon, S.

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COMMERCIAL ADOPTION OF BIOLOGICAL CONTROL-BASED IPM FOR WHITEFLIES IN POINSETTIA

R. G. VAN DRIESCHE AND S. LYON
Department of Entomology, University of Massachusetts, Amherst, MA 01003

The whiteflies *Bemisia argentifolii* Bellows and Perring and *Trialeurodes vaporariorum* Westwood continue to be the most important insect pests in commercial poinsettia (*Euphorbia pulcherrrima* Willd. ex Koltz) production in the northeastern United States. Most crops are chemically treated to suppress whiteflies, either preventatively with pot applications at planting of the systemic insecticide imidacloprid (Marathon®) or, later in the crop cycle, with foliage applications of various other insecticides. In the fall of 2000, a survey of 22 Massachusetts poinsettia growers found they used an average of 8.3 pesticide applications for this pest, at a cost of \$0.14 ± \$0.02 (SE) per plant (Van Driesche et al. 2002). Significantly, only 7 of 22 growers were able to achieve full season whitefly suppression with only the use of Marathon® at planting; the other 15 growers all needed to apply additional foliar pesticides later.

As an alternative approach, the use of parasitoids for suppression of whiteflies in poinsettia crops has been developed over the past decade (Hoddle and Van Driesche 1996, 1999a,b; Hoddle et al. 1996a,b, 1997a,b,c,d, 1998, 1999, 2001; Van Driesche et al. 1999a,b, 2001a,b, 2002). Unlike most implementation of augmentative biological control, the release pattern and rate was not based on testimonials but rather replicated controlled research trials in experimental and commercial greenhouses. This research considered three initial parasiotids (*Encarsia formosa* Gahan, *E. formosa* Beltsville strain, and *Eretmocercus eremicus* Rose and Zolnerowich), three release patterns (constant, front end loaded and back end loaded) and three release rates (3, 1 and 0.5 females per plant per week), as well as in combination with insect growth regulators. Cost of use, while at first uneconomical (\$2.70 per plant per season) was reduced steadily through research and changes in product price, reaching \$0.25 per plant (including the cost of shipping) (Van Driesche et al. 2002), a 93% reduction in cost.

Here, we report results of the first large scale commercial adoption of this biological control program, which was implemented by one of the largest Massachusetts poinsettia growers in 2002 on the grower's initiative. A single large greenhouse with 15,408 potted plants (wholesale value, \$77,737) was managed through releases of *E. eremicus* (purchased from Syngenta) released at 0.5 females per stem. Whitefly populations were monitored in alternate weeks by staff of our laboratory and an employee of the producer, using the same protocol as employed in Van Driesche et al. (2002). The grower purchased, received, and released his own parasitoids. Here we report on the degree of suppression obtained and the degree of grower satisfaction with the outcome in terms of crop quality and production cost. We also discuss management errors that occurred and how they affected the ease of maintaining biological control.

The greenhouse range under biological control management was divided into east and west blocks that were separated by an internal space for movement of machinery. Both sections were physically inside one very large greenhouse ($23{,}520\ ft^2 = 2219\ m^2$). The trial began 9 September, 2002 when the range was filled with untreated plants (potted in mid-August in another greenhouse), which were immediately sampled to measure whitefly density. The trial ended 4 December, once the majority of plants had been removed for sale. A total of 14,625 plants were initially placed under biological control, 7894 in the east and 6731 in the west blocks. Approximately 16 October, the grower introduced an additional 783 "Winter Rose" poinsettia plants from a different greenhouse, for a final total of 15,408 plants in the test area. This variety has crumpled bracts, creating a false rose appearance. These plants had not been treated with Marathon® prior to their introduction into the biological control area and were highly infested with whiteflies (4.2 ± 1.1 SE live nymphs and pupae per leaf when introduced). These plants were placed as a group on the far west side and acted as an undesired source of adult whiteflies for the remainder of the plants in the test greenhouse, especially those in the west block.

In the east block, 6 parasitoid releases were made, in weeks 3, 6, 7, 8, 9, 10 (on 25 September; 16, 23 and 30 October; and 6 and 13 November, respectively) and three insect growth regulator applications (using Enstar II® because Precision®, the material used in our previous tests, was no longer available) were made in weeks 4, 5, and 9 (2 and 10 October and 5 November). These applications were timed to suppress whiteflies at midcrop but before bract coloration. (We did not recommend the third treatment, which was only applied by the grower because the other half of the greenhouse was being treated). Whiteflies were suppressed below the at-harvest target threshold of 2.0 live nymphs and pupae per leaf for the entire cropping period and at harvest had 1.1 ± 0.1 SE live nymphs and pupae per leaf (Fig. 1).

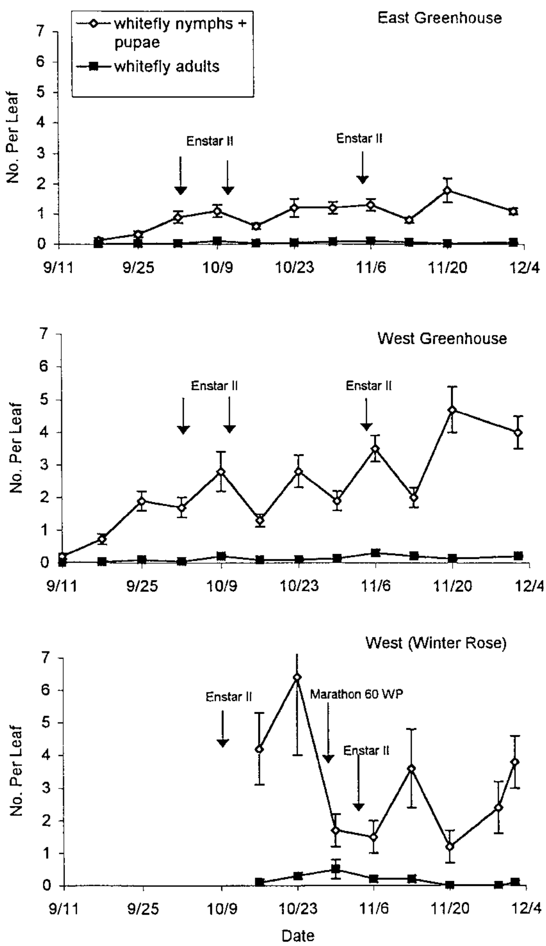

Fig. 1. Densities of live whiteflies per leaf in poinsettia in three parts of a greenhouse managed with releases of the parasitoid *Eretmocerus eremicus* near Boston, Massachusetts in 2002.

West block was filled with plants one week before east block. The grower made 8 parasitoid releases, in weeks 2, 3, 6, 7, 8, 9, 10,11 (on 18 and 25 September; 16, 23, and 30 October; and 6, 13 and 20 November, respectively). Enstar II was applied three times, in weeks 4, 5, and 9 on the same dates as East block. West block whitefly counts exceeded the target threshold (2.0) on two dates each in October and November and had 4.0 ± 0.5 SE live nymphs and pupae per leaf at sale on 4 December (Fig. 1). Higher whitefly densities in West block were caused in large measure by the introduction on 16 October of the "Winter Rose" plants. The edge of the block in contact with the "Winter Rose" plants was the most strongly affected. At harvest, west block plants exceeded our target threshold, but grower assessment of plant quality was favorable and plants were readily sold.

"Winter Rose" plants, which were placed next to the west block plants on 16 October, were also sampled weekly. These plants had 4.2 ± 1.1 SE live nymphs and pupae per leaf when introduced, but this increased to 6.4 ± 2.4 SE within 1 week. We immediately recommended treatment with Marathon®, as removal to another greenhouse was not possible. Marathon® was not applied until 30 October. In addition, this block of plants was treated twice with foliar applications of Enstar II® (10 October and 6 November), even though it was difficult to obtain effective coverage. At harvest, this group of plants had 3.8 ± 0.5 SE live nymphs and pupae per leaf.

Costs of the parasitoid releases (inclusive of shipping) and the IGR applications for the east and west blocks were $0.10 per plant and $0.14, respectively. This was based on the application of two packages of 10,000 *E. eremicus* pupae on each release date. This number of pupae and the numbers of plants in the test greenhouse, together with an assumed 50/50 sex ratio and 70% emergence rate, suggests a parasitoid release rate of ca. 0.45 females per plant was achieved. The price for biological control in this trial is lower than in previous trials because fewer total applications were made, in part because the grower did not start the biological control program until ca 3 weeks after planting, and applied an IGR in 3 weeks (rather than 2 as recommended), thus reducing the number of parasitoid applications in his 15 week crop from an expected 13 to actual 6-8. However, it is noteworthy that even this reduced frequency maintained control, in the absence of a source of whitefly-contaminated plants (i.e., the "Winter Rose" plants).

The per plant cost of whitefly control in this crop ($0.10 to $0.14 for the parasitoids, including shipping, and the IGR applications) compares to $0.14 for chemical control (exclusive of labor) for the same grower in 2001, when he applied Marathon® and nine other pesticides (one or more applications of each) to suppress whiteflies in the same greenhouse.

An exit interview with the grower found a high level of satisfaction with the biological control program. Production of this crop (as part of a Massachusetts extension effort to assist growers interested in implementing biological control measures) has demonstrated that sufficient information exists for northeast poinsettia growers to be successful in use of biological control for whitefly management and produce crops that meet the target threshold for whitefly suppression, with consequent good market acceptance. Costs were also acceptable to the grower relative to his past need for application of ten different pesticide products in a comparable crop in the previous year. This is the first published demonstration of successful implementation of biological in poinsettia in the United States at a price competitive with pesticides, meeting fully all grower concerns.

Summary

Releases of *Eretmocerus eremicus* at the reduced rate of 0.5 females per plant per week, combined with three mid-season applications of the insect growth regulator kinoprene (Enstar II), successfully maintained densities of live nymphs+pupae of pest whiteflies (*Bemisia argentifolii*) at or below threshold (2 per leaf), barring management errors (introduction of highly infested plants). This program had a cost of $0.10-0.14 per plant, including the cost of the pesticide, the parasitoids and their shipping. This price was equal to or lower than the average cost of chemical control ($0.14 per plant) for 22 Massachusetts poinsettia growers whose pesticide application records were examined in a separate survey. This trial demonstrates that effective whitefly biological control on poinsettia can be achieved in the northeastern United States at prices competitive with current pesticide use.

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