Special Research Report #204: Insect Management

When and How to Optimally Release Natural Enemies To Achieve Effective Biological Pest Control

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BACKGROUND

Biological control has been proposed as a method for controlling insect pests of floricultural crops for many years. Although effective across many pest-crop systems, the 3-10 fold increase in the monetary costs, typically associated with biological control, prevents some growers from embracing it as a regular practice.

Currently, approximately 50 species of parasitoids, predators, and pathogens are available from commercial insectaries for use to control arthropod pests of greenhouse and nursery crops. Two questions are central to their efficient and economical use. They are: (1) When should biological control be initiated and (2) How should natural enemies be optimally released to maximize their efficacy. Answers to these questions are needed not only to make biological controls effective in the specific systems utilized, but also for the general practice of biological control in greenhouse and nursery crops.

When Optimally To Release Natural Enemies For Mites!

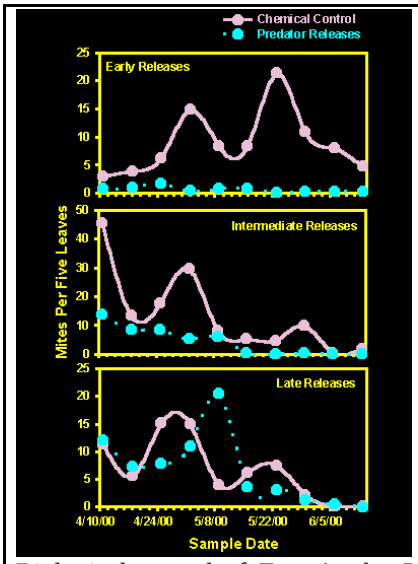
In a commercial greenhouse, plants infested with two-spotted spider mites (*Tetranychus urticae*) were arranged into three groups based on their planting date. Within each age group, plants were allocated to one of two treatment groups: (1) biological control or (2) the grower derived chemical control program. Each age-by-treatment group was replicated four times. Two *Phytoseiulus persimilis* were released weekly per pot for the biological control treatments; while the grower applied insecticides as perceived in the chemical control treatments.

Diffenbachia range with plants of various ages. Control of two spotted spider mite (left inset) may be controlled by properly timed releases of the predatory mite *Phytoseiulus persimilis.*

In all three treatments (recently potted plants, plants in mid production, and plants near harvest), releases of *P. persimilis* provided biological control of *T. urticae*. However, plants in mid-production and near harvest harbored moderate to high densities of pest mites prior to achieving successful biological control. Thus they had significant crop damage. In contrast, releases initiated at the beginning of the crop cycle yielded damage free plants. Also insect control was significantly greater than the chemical control program.

Cost for the biological control program was almost 10% less and the level of control was greater than the weekly spray program used by the grower. Southwest greenhouse growers are now using regular releases of *P. persimilis* to control mite problems on foliage plants and

miniature roses.



Biological control of *T. urtica* by *P. persimilis* (solid line) relative to a grower derived chemical control program (dashed line). Biological control was most effective when initiated early. Thus, *Diffenbachia* plants relatively free of spider mite damage can be produced.

How Optimally To Release Natural Enemies For Aphids!

Aphids are serious pests of floricultural crops worldwide. Because outbreaks can occur rapidly, aphid control requires not only sufficient numbers of natural enemies to be released, but also these natural enemies must rapidly locate patches of infestation.

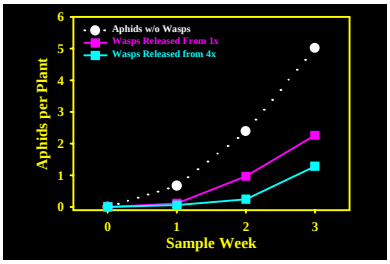
Greenhouse studies documented the ability of green peach aphids to spread over an area of 120 ft^2 per day after infesting a single potted chrysanthemum. Natural enemies must be capable of spreading at least this rapidly to prevent local infestations from becoming problematic.

In greenhouse studies, green lacewing larvae, used as model predators, were incapable of navigating among potted chrysanthemums placed on solid benches. Although lacewing larvae voraciously consume aphids once discovered, successful biological control requires placement of lacewing larvae onto each individual plant infested with aphids.

By comparison, studies with the parasitoid wasp *A. colemani* demonstrated that it could spread over an area of 147 ft^2 per day. From these results, we determined that the most effective biological aphid control could be obtained by releasing *A. colemani* from points no greater than 12 feet apart within a potted chrysanthemum greenhouse.

Movement capabilities of *Aphidius colemani* (top with adjoining aphid mummy) and *Chrysoperla rufilabris* larva (bottom) influence their ability to bring about biological control.

The release technology developed was evaluated in commercial chrysanthemum greenhouses in terms of pest control, economic feasibility, and grower acceptance. The effectiveness of natural enemy releases were determined by comparing aphid populations in grower treated ranges with aphid populations in experimental ranges receiving natural enemy releases using a haphazard release method or an optimal distance (12-ft apart) release method. Each treatment was replicated 3 times. Natural enemies were released weekly into each of the ranges at a rate of one wasp per plant.



Use of the optimal release distances (4x) resulted in significantly greater aphid biological control than the haphazard method (1x) and in comparison to plots not receiving any wasps. Use of the optimal release rate cost the grower 1.2-1.3 times the cost of insecticide applications. In contrast, haphazard releases cost the grower 2-3 times the cost of insecticide applications. The quality of plants harvested from the optimal release distance plots were equivalent to those harvested from the insecticide check plots, and significantly greater than plants harvested from the haphazard and no release plots.

Adaptation of this approach to other biological control programs should improve efficacy and reduce costs.