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Pest Management

How Plants and Practices Affect Parasitoids

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Most people realize that insecticides can ruin your biological control program, but did you know that many other cultivation practices could increase pest abundance and reduce biological control?

Fertilizer can make plants more nutritious for pests. Warm temperatures make pests develop faster. Plant traits like bushiness and pubescence can make it hard for parasitoids to find hosts. Thus, when your biological control program isn't working as well as usual, a seemingly benign aspect of your plants or plant culture could be to blame.

In this article, we'll consider how some of these hidden factors affect the parasitoid *Aphidius colemani.* Most of these hidden factors won't make your biological control program fail, but could help explain why the same program works great in one season or crop but not as good in another.

Aphidius colemani is the most common parasitoid species on the market for aphid biological control. They parasitize green peach aphids and melon aphids, among others. If you purchase *A. colemani,* you'll receive vials of mummies (pupae) to place within the crop. In a day or so, adult wasps will emerge from the mummies and fly around the greenhouse looking for aphids. Female wasps insert eggs into aphids. The wasp larva develops within the aphid host, then emerges as an adult ready to parasitize more aphids.

The efficacy of *A. colemani* will depend on the percentage of the wasps that are female (only females parasitize aphids), the number of eggs they have and how easily they can find aphids. All these factors can be affected by plant species, temperature and other aspects of your operation.

Leaf traits have been shown to affect parasitoid preference and host location in many ornamental and vegetable crops. Each plant species is different and even different cultivars of the same species can have vastly different leaf size and shape, leaf surface texture, and number and arrangement of leaves. It doesn't seem like these things should matter, but they do.

Pictured: Aphids and a brown aphid mummy on a tomato leaf.

Consider leaf texture. The hairs on pubescent plants look small to us, but it's like walking through knee-high grass for *Aphidius colemani.* It's even worse if instead of simple hairs the leaves have sharp, toxin-filled tricombs. This is like walking through nettles.

A. colemani can "smell" aphid-infested plants from far away. Once on the plant, though, they have to walk around to search for aphids and get close enough to parasitize them. On hairy leaves, walking is harder and searching takes longer, so *A. colemani* will parasitize fewer aphids. In some cases, they may just avoid hairy or tricomb-laden plants in favor of better hunting conditions on other plants. Thus, some species or cultivars in your greenhouse may be less protected than others.

Plant shape and density, or bushiness, can also affect *A. colemani* searching and parasitism rate. We know from other crops that natural enemies are less effective on plants with complex architecture than on plants with simpler architecture. For example, predators like lady beetles take longer to find prey on plants with compound leaves than simple leaves, even if leaf area is the same. It just takes longer to search all those leaflets. It's also easier for pests to hide on densely foliated plants with lots of tight leaves or other nooks and crannies.

This brings us to plant growth regulators. Most ornamental plant growers use plant growth regulators to make plants bushier and fuller. So the desired effects of many plant growth regulator applications—increased branching, more leaves and compact structure—may make it harder for natural enemies to control pests. Of course, as scientists, we just had to figure out if it mattered.

We treated Black Pearl Pepper plants with the common plant growth regulator paclobutrazol. After four weeks, paclobutrazol-treated plants were shorter, bushier and had shorter intermodal distances than untreated plants. Treated plants also had groups of small leaves and short branches growing from each node on the stem. Untreated plants were tall with a few large leaves at each node.

At this point, we infested each treated and untreated plant with green peach aphids and placed each plant in an individual cage with a female *A. colemani* or without a parasitoid. After three weeks, we counted all the aphids and aphid mummies on each plant. Parasitoids on untreated plants reduced aphid abundance by over 90% compared to untreated plants without parasitoids. However, on the bushy, treated plants, parasitoids only reduced aphid abundance by 50% compared to treated plants without parasitoids.

The bottom line is that paclobutrazol-treated plants had nearly three times as many aphids as untreated plants when parasitoids were present. This is a big difference in the efficacy of *A. colemani* as a biological control agent. So what happened? Most aphids on untreated plants were feeding in the open on stems or on the bottom of leaves. On treated plants, most aphids were concealed underneath the small leaves growing on plant stems. In addition, we found three times as many aphid mummies (parasitized aphids) on untreated plants than treated plants. This confirms that fewer aphids were parasitized on the treated plants.

Temperature is also a critical factor in how well your parasitoids function and in how well they can keep up with aphid population growth. *A. colemani* development from egg to adult is fastest—about 10 days—at around 82F (27C). Once the temperature exceeds 86F (30C), *A. colemani* development actually slows down or stops. In contrast, green peach and melon aphids continue reproducing at these higher temperatures and develop to adults in three to four days.

In addition, high temperatures can reduce *A. colemani* attack rate, survival and the proportion of wasps that emerge as females. This is why you could have great biological control in a winter crop when the greenhouse is cool, but poor biological control using the same program in summer. If this happens, an additional biological control agent may be necessary for part of the year when *A. colemani* becomes less effective.

Fertilizer can have a similar effect as temperature on aphid population growth. Nitrogen fertilizer makes plants grow, but it also makes them more nutritious for aphids. On highly fertilized plants, aphid development gets faster and they produce more babies. At some point, though, increasing fertilizer has no benefit for plants—they can only grow so fast. At this point, increasing fertilizer doesn't improve plant appearance or growth rate; it just wastes money and helps aphids outgrow parasitoids. Consult fertilizer manufacturer and Extension Service recommendations to find the lowest fertilizer rate for each crop to maximize plant growth without unnecessarily increasing nutrition for aphids and other pests.

No aspects of greenhouse production, like temperature or fertilization, are "set it and forget it;" biological control is no different. To be sure your biological control program is working, monitor pest and natural enemy abundance so you can increase parasitoid release rates or add a new natural enemy species if pests become abundant. If pests do flare, think about the hidden practices that may have negatively affected *A. colemani* efficacy or positively affected aphids. **GT**

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