MAGAZINE - SINCE 1937
GROWERTALKS

Pest Management

Building a Better Banker Plant

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>> Published Date: 6/29/2015

Aphids are common pests of greenhouse ornamental and vegetable crops. Peppers, tomatoes, cucumbers, annuals, perennials, herbs—they all get aphids. Aphids damage plants by removing energy and by causing leaves to become stunted and distorted. They also produce a lot of honeydew that grows sooty mold and transmits plant viruses.

Pictured: A banker plant to provide hosts for aphid parasitoids in a greenhouse.

There are many aphid species, but green peach aphids (*Myzus persicae*) and melon aphids (*Aphis gossypii*) are the most common. More growers are turning to biological control to manage these pests and there are quite a few biological control agents available to help. Biological control works best when natural enemies are present in your greenhouse all the time. Unfortunately, most natural enemies, like the aphid parasitoid *Aphidius colemani*, don't survive or reproduce in greenhouses without pests. *Aphidius colemani* are tiny (less than 1/8 in.) wasps that kill aphids by laying eggs inside them, then the wasp larvae feed on the aphid innards. After several days, the adult parasitoid emerges from within the (now dead) aphid to parasitize more aphids. So clearly *A. colemani* can't reproduce without aphids. This means purchasing and releasing *A. colemani* "whether you need them or not."

Banker plants were developed to address the problem that *A. colemani* cannot reproduce without aphids. Banker plants provide resources, such as food or hosts to sustain natural enemies within greenhouses. There are many different types of banker plants that support many types of natural enemies, but the most common is the aphid banker plant system. This consists of grain plants infested with bird cherry-oat aphids, *Rhopalosiphum padi*, which are good hosts for *A. colemani*, but are not greenhouse pests. Thus, if you're lucky enough not to have pest aphids, *A. colemani* can reproduce and sustain their population on bird cherry-oat aphids instead. Then when aphids come in on transplants, worker clothing or a gentle breeze, you have an army of parasitoids ready to attack them.

The promise of "free" parasitoids has made a lot of people interested in banker plant systems. There are obviously some logistics and expenses involved in growing grains and maintaining the banker plants in your greenhouse. The trouble is, even if you're willing to do this, we still don't know the optimal banker plant system. It seems simple enough: grow some grain (easy), grow some aphids (easy?) and let the parasitoids go nuts. However, within these three simple components is a lot of variation and ways we could move from good banker plants to great banker plants.

We have focused our research on the grains. The reason is that some plants are high-quality hosts for aphids and some plants are not. You probably notice that some crop species and even cultivars of the same species just always have more pests than others. Plant quality for aphids affects aphid reproduction, size and nutritional value for parasitoids. All these things matter. Aphids need to reproduce fast enough to keep the parasitoids supplied with hosts. Just like most animals, if aphids have nutritious food, they'll grow larger than if they have less nutritious food. Large aphids often yield larger parasitoids that are more likely to be female (only females parasitize aphids), have more eggs, can fly farther and can parasitize larger aphids. All of these qualities should improve biological control.

Dozens of different plant species and cultivars have been used for banker plants in research and in practice. To find the best banker plant, we studied the most commonly used species: barley, oats, rye and wheat. Over the past couple of years, we've conducted many experiments to figure out how these species affect parasitoids and perform as banker plants. (By the way, when I say "we" I mean several graduate students, undergraduates and postdoctoral researchers who have counted more aphids than any of them care to remember.)

Knowing that plants affect aphids and aphids affect parasitoids, we started simply by growing three cultivars of each of our four plant species in the greenhouse. When the plants were a few inches tall, we infested them with bird cherry-oat aphids collected from farms around Raleigh, North Carolina. The goal of this experiment was to see which plant produced the most aphids and, thus, the most hosts for *A. colemani*.

After several weeks and a lot of counting, we found that oats were actually the worst host for bird-cherry oat aphids. More aphids died when we put them on oats and those that lived had fewer babies. After a couple of weeks, this meant that the aphid populations on oats could be 60% smaller than on other plants. In some cases, slow aphid population growth could be a benefit if it meant that banker plants lasted longer and weren't decimated by aphid feeding. Unfortunately, other experiments showed that oats don't last longer than other plant species and, in fact, they actually grew taller and had longer leaves that could flop and block light from surrounding crop plants.

So what did work? Aphids survived longest and had the most babies on wheat. Aphids on barley developed the fastest. Thus, in terms of aphid production wheat and barley seemed like the best banker plants. However, we really need to grow parasitoids. Since oats were poor quality hosts for aphids, this hinted that aphids on oats could be poor quality hosts for A. colemani. We released *A. colemani* in cages with bird cherry-oat aphids growing on a single leaf of all our plant species. Aphids on all the species and cultivars were parasitized and became mummies. However, parasitoids never emerged from about half the mummies on oats. Oats also had the least mummies—about 50% less—when we released *A. colemani* in larger cages with hundreds of aphids.

Less parasitoids often means less biological control, but the reverse may not be true. In cages with rye plants, we had as many mummies and parasitoids as in our top performers: barley and wheat. However, only 26% of the parasitoids from rye were female. This means three quarters of the parasitoids from rye plants are useless males that don't parasitize anything. So it seems like wheat and barley are the best bet for producing the most female parasitoids per plant.

We tested three cultivars of each grain species in our experiments. Luckily, all the cultivars within a species were pretty similar in terms of the number of aphids and mummies they produced and the percentage of *A. colemani* that were female. This is good because not all grain cultivars are readily available in all areas. Seed stores stock what local farmers plant. We suspect that most wheat and barley cultivars will perform similarly to the ones we tested, but you should keep an eye on them to be sure. If you notice the aphids aren't growing well or that they're not being parasitized, you might try a different cultivar to see if it helps.

As a bonus, we've often found that the parasitoids from banker plants are better than those from commercial insectaries. We generally get a higher percentage of females from banker plants and they are often bigger and live longer. We don't know if this is because banker plants produce fresh parasitoids that haven't been shipped or if they're just growing on better hosts.

Parasitoids from banker plants aren't free by any means. But, hopefully, our research will help make your banker plants the best they can be. **GT**

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