Azalea Research

What's New in Integrated Pest Management for Azaleas?—Biological Control Update

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Insect Pest Management

Several methods of pest control are available to managers and growers of azaleas and landscape plants to help them reduce damage from insect and mite pests. Traditionally, great reliance has been placed on the use of chemical pesticides. Recently, however, social and economic factors have made this approach less attractive, with the result that interest has increased in the development and implementation of different approaches. The integration of multiple methods of pest control accompanied by regular monitoring, decision-making, and evaluation is commonly referred to as Integrated Pest Management (IPM). One of the most promising alternatives to the use of conventional insecticides is **biological control.** Biological control can be defined as the use of predators, parasites (or parasitoids), and pathogens to reduce pest populations below damaging levels. *Predators* are animals that find and kill a series of prey to complete their growth and development. A ladybird beetle that kills aphids each day to feed itself is a good example. Many insects, spiders, and mites are predaceous in both immature and adult stages. *Parasitoids* are generally species that complete their growth and development on or in a single host. Consequently, parasites are usually smaller than their hosts. Many parasitoids require hosts only for immature stages of development. *Pathogens* are agents that cause disease such as fungi, bacteria, and viruses.

The goals of biological control are to lower pest densities to innocuous levels and keep them there. Biological control practices must be sustained over an extended period of time. This contrasts with the notion of eradication that implies the complete elimination of all pests at a site. Eradication is rarely achieved by any method of pest control, including the use of pesticides. Furthermore, pest control through eradication is unstable even when it can be achieved because pests from other locations often rapidly re-colonize the landscape. In the absence of natural enemies, pests quickly increase and reach damaging levels.

Biological control is achieved in three general ways:

1) **Conservation**—Existing natural enemies may be protected through management practices that favor their survival and reproduction.
2) **Augmentation**—If existing natural enemies are too scarce or appear too late to prevent damage, extra parasites or predators, purchased from a commercial insectary or collected elsewhere, can be released at the site. Augmentation may also rely on the application of a formulated biological control agent such as nematodes. Formulation is sometimes considered a separate category of biological control.
3) **Importation**—If a pest is an introduced species that lacks effective natural enemies, new biological control agents may be introduced from other locations.

There is no new progress to report concerning the importation of biological control agents for pests of azaleas at the time of this writing. Therefore, in this brief review only progress in conservation and augmentation will be discussed in reference to azaleas.

Conservation

With respect to azaleas, two approaches have proven effective in conserving natural enemies in residential landscapes. The first approach relies on the relationship between habitat complexity and natural enemy abundance and activity. Several studies have established a link between the vegetational texture of a landscape; that is, the number of species and their representation as trees, shrubs, bedding plants, and ground covers, and the number and activity of predators and parasitoids in the landscape. In general, landscapes with many kinds of plants and amounts of shade, and several strata of plants (overstory trees, understory trees, shrubs, bedding plants, and ground covers) are home to more natural enemies than landscapes comprised of few types and strata of plants with high levels of light exposure. Diverse landscapes provide vital resources for natural enemies, such as a diverse array of food including prey like azalea lace bugs and nectar and pollen for those natural enemies that require both plants and animals to eat. Perhaps favorable regimes of temperature, humidity, incident light, and refuges from their own predators favor natural enemies in complex landscapes. The lesson here is to diversify your landscape to the greatest extent possible with plants that flower and occupy different strata. Plant different species of trees that will mature to be large or small, and mix shrubs, bed-

Lace bug damage. *(Photo by Mike Raupp)*

ding plants, and ground covers into the design.

The second approach for conserving natural enemies is to select insecticides with short periods of residual activity. We all know that even under the best of circumstances pest populations may become intolerable and insecticides may be the only option for saving the aesthetic value or life of a plant. We have found that insecticides with long periods of residual activity such as organophosphates often reduce the abundance of predators and parasitoids in landscapes. Contact materials such as insecticidal oil and soap have short periods of residual activity and may help conserve natural enemies in landscapes. For pests such as azalea lace bug, we recommend the use of short residual, contact insecticides whenever it is feasible. Some newer insecticides such as those containing the active ingredient imidacloprid can be applied to the soil. The insecticide is taken into the azalea through the roots and distributed throughout the plant systemically. Imidacloprid provides spectacular and long-lasting control of several species of lace bugs on shrubs. The use of systemic insecticides applied through the soil is an attractive alternative to the application of wet sprays to the leaves of shrubs because it reduces the exposure of natural enemies that might be found on the plant at the time of application.

Augmentation

Augmentation can be practiced in two general ways, inoculation and inundation. Inoculation means releasing a relatively small number of natural enemies in an area where pests are present in the hope that they will become established, reproduce, increase in number, and provide continuing control. Inoculative releases may be made periodically. The application of milky spore bacteria to control Japanese beetle grubs in turf is an example of an inoculative release. Inundation means that large numbers of natural enemies are released with a goal of rapid reductions of pest populations. In this case, the natural enemy is used like a biotic insecticide and the expectation is not necessarily one of persistence of the natural enemy in the habitat. The application of thousands of entomopathogenic nematodes to the trunk of a rhododendron to kill the larvae of rhododendron borer is an example of an inundative release.

One promising approach to managing lace bugs on azaleas is the augmentative release of green lacewing larvae. Green lacewing larvae are voracious predators of many types of pests including lace bugs. In a nursery setting we found that commercially purchased green lacewing larvae released at the rate of 10 larvae per plant provided almost 90% control of azalea lace bug.

We have also used augmentative releases of deadly nematodes to manage another common landscape pest—the black vine weevil. In this case we applied the nematode *Heterorhabditis bacteriophora* to containers of the perennials *Bergenia, Heuchera,* and *Epimedium.* In all three studies the nematodes provided levels of control comparable or superior to those found with conventional insecticides. The promising results of these trials on small herbaceous perennials await confirmation for woody plants such as azaleas in landscapes.

Success or failure of augmentation will depend on many things. You must know the identity of your pest and determine if it is in a life stage susceptible to control by biological control agents. For example, small nymphs of lace bugs may be vulnerable to attack by larvae of lacewings purchased commercially. Lace bug eggs and adults are relatively invulnerable to lacewing larvae. Releases timed for control of lace bug nymphs may succeed while releases timed to the presence of adults may fail. Your attempts to manage pests will be most successful if you release your natural enemies when the pest population is comprised of vulnerable stages.

This is an azalea lace bug being attacked by a green lacewing larva. *(Photo by Miles Lepping)*

Once you have identified the target pest and sampled to determine its life stage, select and purchase an

appropriate biological control agent. Today, more than 100 kinds of biological control agents are available on the market. This selection increases the possibilities for control. However, not every pest has a biological control agent. At present there is no effective biological control agent for Japanese beetle adults. By contrast, for some pests such as aphids you will have many possible candidates to select from, including predators such as lady beetles and lacewings, parasitoids such as tiny wasps, and fungal pathogens. Boring caterpillars such as iris, dogwood, sycamore, banded-ash clearwing, and peach tree borer have been controlled with nematodes in the family *Steinernematidae,* whereas beetle larvae including grubs of black vine weevil and oriental beetle appear more susceptible to attack by nematodes in the family *Heterorhabditidae.* Learn which agent is right for the target pest and choose the right one.

This is damage from a black vine weevil.
(Photo by John Davidson)

There are several reference books that can assist in your selection of natural enemies. A few of these are listed below. An excellent aid in the selection process is the catalog of suppliers of biological control agents developed by the California Environmental Protection Agency. It can be perused and obtained electronically at www.cdpr.ca.gov/docs/ipminov/bensuppl.htm. This reference lists common target pest such as aphids, scales, and spider mites, and suggests several potential biological control agents for each. Contact information including corporate names, addresses, phone and fax numbers, e-mails and Web addresses is provided. Most suppliers will provide information concerning the storage, handling, and release of control agents.

We offer the following advice when selecting suppliers of biological control agents. Dependability rather than price should be your primary consideration. Augmentative biological control will generally be more expensive than the application of conventional insecticides. This is a given. If you are committed to releasing biological control agents, then be sure that the agent you order arrives when you need it and in good condition. We have experienced problems with agents arriving late or dead, sometimes both. Suppliers occasionally ship species different from those listed in the catalog. All of these problems complicate the situation and reduce the chances of successful biological control. Shop around, find reliable suppliers, and stick with them.

General References on Biological Control in Landscapes and Urban Forests

Flint, M.L. and S.H. Dreistadt. 1998. *Natural Enemies Handbook: The Illustrated Guide to Biological Pest Control.* Berkeley, California: University of California.

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Raupp has more than 100 publications and has delivered over 100 invitational seminars or symposium presentations on these topics. He has received five regional or national awards for excellence, including the US Secretary of Agriculture's Award for Environmental Protection. His work has been featured in Good Housekeeping, Fine Gardening, *and* Organic Gardening *magazines, and he has appeared on National Public Radio and CNN. He works closely with arborists and citizens to develop effective and environmentally acceptable methods of pest control.*

A black vine weevil adult and larva.
(Photo by John Davidson)