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PLANT DISEASES

The Pathogens Are Knocking

For well over 40 years, public and private researchers have been trying to trick plants into protecting themselves by making them "think" they are being attacked by a pathogen. This may sound a little crazy until you think about how the human body reacts to immunization shots. Of course, this analogy only goes so far; plants do NOT have an immune system at all like ours. However, plants do have an amazing capacity to produce some interesting chemical and physical responses to infection by a pathogen. In this article, I'll explain and examine several commercially available compounds that are being used to induce something called systemic acquired resistance (SAR) in plants.

What exactly is SAR? Systemic acquired resistance is a broad-spectrum, systemic, plant defense response that is triggered by exposing a plant to certain natural or synthetic chemical compounds or to a weak (hypovirulent) strain of a specific pathogen. These inducers or elicitors do not have a direct effect on pathogens. Rather, they are more like an intruder setting off the house alarm. Depending on the plant species and its genetic makeup, the response to a perceived intruder might include one or more of the following: signal the distant plant cells (for example, salicylic acid), chemical warfare (for example, enzymes), build stronger barriers (for example, lignin), or localized suicide (hypersensitive reaction). Depending on the plant, the environment, and the inducer, peak SAR activity may take several days or weeks to develop and may last for several weeks or even months. For a much more thorough explanation of SAR, consider reading the selected references listed at the end of this article.

Many SAR compounds are being researched around the world. However, only a few have been commercialized. Although not are labeled for the turf and ornamental market at this time, I'll include several that you may hear more about.

Harpin. This protein is marketed by Eden Biosciences Corp. as Messenger. The harpin protein in this formulation is identical to the protein that was initially discovered and naturally produced by *Erwinia amylovora* (the fire blight pathogen). The label states that this is "A biochemical pesticide used for plant disease management, insect suppression, and plant growth enhancement." Although the label states generally that Messenger will "aid in the management of diseases," several viral, bacterial, and fungal pathogens are specifically mentioned. Messenger is labeled for application on a wide range of vegetable, fruit, field, tree, and vine crops. However, it is not labeled for turfgrass (except seed production) or ornamentals. A cursory review of several recent experimental turf-disease trials revealed that Messenger did not protect against infection by *Pythium* or *Rhizoctonia*. However, I encourage researchers and practitioners alike to recognize the importance of the following statement found on the Messenger label: "Plants require 5–7 days to fully induce resistance."

Acibenzolar-S-methyl (ASM). This compound is marketed by Syngenta as Actigard. The proposed common name of acibenzolar-S-methyl has many variants, most notably benzothiadiazole (BTH). The label states that Actigard "is a selective, systemic compound used for the control of downy mildew of cole crops and leafy vegetables, bacterial leaf spots of tomato, and blue mold of tobacco." This product is not labeled for turfgrass or ornamentals. A cursory review of several recent experimental turf and ornamental disease trials revealed that Actigard offered no protection against Entomosporium leaf spot of photinia or Rhizoctonia brown patch of turfgrass and less than acceptable protection against Phytophthora root rot of snapdragon and dollar spot of turfgrass. Once again, I encourage researchers and practitioners to recognize the importance of the following statement found on the Actigard label: "Maximum disease control is normally obtained 4 days after an Actigard application."

Phosphonates. Following the Fungicide Resistance Action Committee's (FRAC) lead, I have combined the fosetyl-aluminum (marketed by Bayer as Aliette and Signature and by Lesco as Prodigy) and phosphorous acid (marketed by Cleary's as Alude; Arbor-Systems as Whippet; and JH Biotech as Fosphite) compounds into the phosphonate group. From the literature, it appears that the debate continues as to

whether or not phosphonates technically fit the SAR definition (they are plant nutrients, and they are slightly but directly toxic to certain fungi). Nevertheless, and for practical purposes, I feel that their inclusion in this article is warranted. As you read labels, literature, and research reports, it is important to note that fosetyl-aluminum is commonly listed as "aluminum tris(ethyl phosphonate)," which is the chemical name. Similarly, phosphorous acid has several common synonyms, such as potassium phosphite and mono- and di-potassium salts of phosphorous acid. The phosphonate compounds are widely available in many markets, including turf and ornamentals. Their protection against *Pythium*, *Phytophthora*, and downy mildew diseases is well documented.

Although the SAR phenomenon has been studied for quite some time, many basic questions remain unanswered. As research explains more about molecular plant—microbe interactions, we will learn how to manipulate these and future SAR compounds like the relative precision instruments that they are.

Selected references.

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(Bruce Paulsrud)

Oak Problems

Many oak problems have been reported in Illinois. Phone calls, plant samples, and e-mail messages report problems on oaks, especially white oaks. I would like to provide one concrete diagnosis, but the situations vary almost as much as the callers. Oddly, most inquiries are about white oaks. If you think you know the cause of the problem, feel free to voice your concern to me at n-pataky@uiuc.edu, with "oaks" in the subject line. Here are a few of the problems that we have been able to confirm on oaks so far this season.

Flooding has caused injury in some areas. Such injury can occur from actual flooding or from less obvious situations, such as water-saturated soils or poor drainage of clay sites. Although you would expect all the oaks in a flooded area to be affected equally, species differ in their tolerance to flooded soils. According to Sinclair, Lyon, and Johnson in *Diseases of Trees and Shrubs,* bur and pin oak have intermediate tolerance to flooding, while red and white oaks are intolerant. Injury symptoms might include downward bending of the petioles, wilting, chlorosis, leaf margin necrosis, leaf drop, twig dieback, root death, and possibly death of the tree. Any sort of root injury could mimic these symptoms.

Phytophthora collar rot is a disease that is closely associated with flooding. The fungal pathogen *(Phytophthora)* lives in the soil and invades the tree at the root collar. A wound increases chances of infection, but the fungus can enter unwounded, young roots to get to the collar. Wet conditions are a necessity for infection. The disease causes the collar and some roots to rot, inhibiting movement of water and nutrients. Wood at the collar is brown and watersoaked. Aboveground symptoms include stunted, sparse, chlorotic foliage, much like flooding damage.

Oak wilt, discussed in issue no. 9 of this newsletter, may account for some of the oak decline in Illinois. The Plant Clinic has confirmed this disease on only five oaks in 2004. Species information is not always available, but at least one is known to be a white oak. Three samples were in DuPage County, one in Madison County, and one in Winnebago County. Others are still incubating. Oaks in the red oak group die suddenly from this disease, usually in one growing season. The white oak group shows a slower decline from oak wilt, sometimes taking several years for tree death to occur. Oak wilt causes a discoloration of the vascular tissue in affected branches. This diagnostic clue should help distinguish it from other problems.

Bacterial leaf scorch (BLS) is another possible player in oak decline. That disease was discussed in issue no. 12 of this newsletter. The bacterium *(Xylella fastidiosa)* that causes BLS causes slow decline and death of the tree. It has been confirmed on red, pin, bur, shingle, and white oaks in Illinois. Usually this disease causes marginal leaf necrosis (browning), often bordered by a band separating the necrotic and green tissues. These symptoms recur each year, spreading a bit further in the tree with each passing year. BLS usually takes 4 to 6 years to kill a tree.

We have also had reports of oaks infected with **Armillaria root rot**. The disease is caused by a fungus that invades below ground. Armillaria can continue to live as long as it has organic matter on which to survive. Often it remains in the on roots of a tree that has died and has been cut down. Interestingly, this fungus attacks plants predisposed by drought, flooding, poor drainage, frost, repeated insect attacks,

mechanical injury, and the like. You can see that the oak decline problem may involve many factors. For more on Armillaria root rot, consult *Report on Plant Disease*, no. 602, "Armillaria Root Rot of Trees and Shrubs." This report can be found on the Web at http://www.ag.uiuc.edu/%7Evista/horticul.htm. The diagnostic signs provided by this disease are mushrooms at the base of the tree or shoestringlike rhizomorphs growing just under the bark at the base of the tree.

The final problem we have seen on oaks is **oak tatters**, a problem discussed in issue no. 5 of this newsletter. Leaves retain only major veins and a bit of blade tissue around those veins when this condition occurs. Leaves look like something has eaten them and left the major veins. Insects are not involved. White oak is the common oak species affected. Many of the trees with oak tatters are affected early in the season but produce normal leaves later in the season. There has been some concern that a tree repeatedly attached by oak tatters might decline and even die. No evidence exists to confirm this theory, but the question merits investigation.

It is likely that other problems could be involved in oak decline. The frequency of oak concerns of 2003 and 2004 suggests that environmental stress may be a large part of the problem. The possibilities listed here show that the decline may be caused by different reasons in different locales. *(Nancy Pataky)*

INSECTS

All Miticides Are Not Created Equal

When it comes to selecting a miticide to control spider mites, or "mites" in landscapes and nurseries, there is sometimes confusion that all miticides are similar in terms of their use and the range of mites that they control. However, miticides are not all created equal because miticides may vary in where they can be used and the target mites on the label. Below are detailed descriptions of six miticides that are generally recommended for controlling mites both indoors and/or outdoors. In a later issue of this newsletter, an additional five miticides will be addressed.

Talstar is a pyrethroid-based insecticide/miticide with the active ingredient bifenthrin. The product is labeled for control of the following mites: twospotted spider mite, broad mite, clover mite, and European red mite. There are a number of different formulations, and each has certain use requirements. However, in general, Talstar is registered for use on indoor and outdoor ornamentals. This includes greenhouses, lathhouses, shadehouses, outdoor nurseries, and ornamental trees. Talstar is a contact insecticide/miticide, so it is important to cover thoroughly all plant parts during application. The product provides between 7 and 21 days of residual activity. Talstar is a restricted-use pesticide, and rates vary depending on the formulation. So be sure to read the label prior to use. This insecticide/miticide has the same mode of action as lambda-cyhalothrin (Scimitar; see next), so avoid using these two products in succession in a rotation program.

Scimitar is a pyrethroid-based insecticide/miticide with the active ingredient lambda-cyhalothrin. This product has a very general label stating control of "mites" and broad mites. It can be used to control mites on ornamentals in greenhouses, shadehouses, nurseries, and outdoor landscapes. Scimitar is a contact and stomach poison (when ingested) insecticide/miticide providing up to 14 days of residual activity. The label rate for control of mites is 1.5 to 5.0 fl oz per 100 gal. Scimitar has the same mode of action as bifenthrin (Talstar; see previous), so avoid using these two products in succession in a rotation program. Scimitar, like many pyrethroids, is a restricted-use pesticide.

Hexygon contains the active ingredient hexythiazox and is labeled for control of twospotted spider mite, arborvitae spider mite, European red mite, honey locust spider mite, Pacific spider mite, Southern red mite, spruce spider mite, strawberry spider mite, and Willamette mite. Hexygon is registered for use on ornamental plants grown in nurseries, greenhouses, shadehouses, and Christmas tree plantations. In addition, it may be used on established ornamental landscape plantings, interiorscapes, residential areas, public areas, and commercial areas. Hexygon is a contact and stomach poison miticide, so thorough coverage of all plant parts is recommended. The product can provide 30 to 45 days of residual activity. The label rate is 1 to 2 oz per 100 gal. Hexygon is active on mite eggs and the immature stages. In fact, eggs deposited by adult females that contact treated surfaces are not viable. The product has no activity on adult mites. Hexygon has the same mode of action as clofentezine (Ovation; see next), so it is important to avoid using these two miticides in succession in a rotation program.

Ovation contains the active ingredient clofentezine and is labeled for control of twospotted spider mite, Pacific spider mite, McDaniel spider mite, European red mite, and yellow spider mite. The product is registered for use in greenhouses, saranhouses, shadehouses, outdoor containers, and field-grown nursery stock. Ovation is a contact miticide, so thorough coverage of all plant parts is critical during application. It is active on mite eggs and the immature stages. The product has no activity on adult mites. Although Ovation is slow-acting, it may provide up to 45 days

of residual activity. The label rate is 2 fl oz per 100 gal. Ovation has the same mode of action as hexythiazox (Hexygon; see previous), which means that the two miticides should not be used in succession in a rotation program. Ovation is toxic to fish.

Sanmite, which contains the active ingredient pyridaben, is labeled for control of twospotted spider mite, broad mite, European red mite, Southern red mite, and tumid mite. The material is registered for use on ornamental plants grown in greenhouses or outdoors. Sanmite is a contact miticide so thorough coverage of all plant parts is important. It has activity on all mite life stages, including eggs, nymphs, larvae, and adults. Sanmite is fast-acting on the mobile stages and provides up to 45 days of residual activity. The label rate is 4 oz per 100 gal. Sanmite has the same mode of action as fenpyroximate (Akari; see next), so these two miticides should not be used in succession in a rotation program.

Akari contains the active ingredient fenpyroximate. The product has a very general label stating control of "spider mites." Akari is labeled for use on greenhouse ornamental crops and indoor ornamental plantings and plantscapes. This miticide is a contact and stomach poison, so thorough coverage of all plant parts is essential during application. The product is effective on all spider mite life stages including eggs. Akari works very fast, with rapid knockdown. In fact, treated mites immediately stop feeding, and females fail to lay eggs. This miticide provides up to 21 days of residual activity. The label rate is 16 to 24 fl oz per 100 gal. Akari has the same mode of action as pyridaben (Sanmite; see previous), so these two miticides should not be used in succession in a rotation program.

For more information on the products mentioned, be sure to consult the label or the manufacturer. *(Raymond A. Cloyd)*

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Major authors are Phil Nixon, (217)333-6650, Fredric Miller, (708)352-0109, and Raymond Cloyd, (217)244-7218, entomologists; Nancy Pataky, (217)333-0519, plant pathologist; Bruce Paulsrud, (217)244-9646, pesticide applicator training; and Tom Voigt and David Williams, (217)333-0350, and Michelle Weisbrook, (217)244-4397, horticulturists. Phil Nixon is the executive editor of the *Home, Yard, and Garden Pest Newsletter*. This newsletter is written by faculty in the Department of Natural Resources and Environmental Sciences and the Department of Crop Sciences. It is edited by Mary Overmier and typeset by Virginia Cuppernell, Information Technology and Communication Services.

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