RUTGERS COOPERATIVE RESEARCH & EXTENSION AT THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION

# PLANT & PEST ADVISORY

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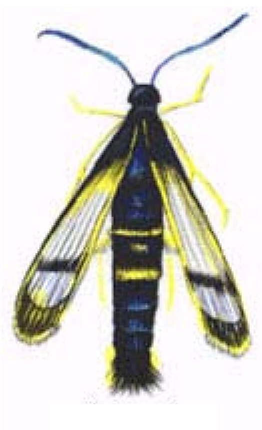

## Early Season Issue



## Questioning the Plant Stress Hypothesis

*Steven K. Rettke, Ornamental IPM Program Associate*

### Definition

The Plant Stress Hypothesis generally states that plants subjected to stressful conditions become more susceptible to attack by insects and diseases. This is due to the plant's increased suitability as a food or due to the reduced ability of the stressed plant to defend itself. It is commonly believed that when a plant is stressed it becomes better food for "bugs." Is it therefore correct to state that plant stress leads to pest outbreaks, or is the statement too simplistic?

### The Experiments

A publication written in 1998 *(Koricheva et. al.)* summarized approximately 70 controlled experiments that were performed to study how different types of plant stresses affected insect/mite attacks. Various types of environmental stresses were included in these studies (e.g., drought stress, water-logged roots, ozone exposure, excess shade, as well as many others). Nutrient stress was also studied, but will not be considered in this article.

Insects were classified by the way they consumed plants in order to organize the research data (e.g., chewers, suckers, miners, gallers and borers). In fact, organizing the insect herbivores into these *guilds* was the only way the data made sense (a guild is a collection of things that do something the same way).

The researchers analyzed four attributes that are important to the well being of insects and mites (as well as all living organisms) and they included (1) growth, (2) reproduction, (3) survival and (4) colonization.

### Overview of the Results

For **chewing insects** (e.g., **caterpillars**, **sawflies**, **leaf-feeding beetles**), the study of the various stresses placed upon plants did not indicate any consistent increase or decrease in insect growth, survival, or colonization rates. However, there was a consistent decrease in reproduction when chewing insects fed upon stressed plants. In other words, plants became poorer food when chewing insects fed on stressed plants and then attempted to reproduce.

For **sucking type insects/mites** (e.g., **aphids**, **scales**, **adelgids**, and **mites**), plants under stress proved to provide better food for their abilities to grow (i.e., improved rate of development) and for the improved ability

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to reproduce by laying eggs. Therefore, stressed plants are a benefit to this particular guild of insects/mites (suckers).

The **leafminers** (e.g., **birch, holly, and boxwood leafminers**) were shown to be unaffected by stressed plants. No differences with rates of growth, reproduction, survival or colonization were observed where leafminers fed upon stressed plants.

**Galling type insects/mites** that produce abnormal growth on leaves and stems (e.g., **spruce galls**, **oak galls**, various **leaf galls**, etc.) were negatively affected when they fed upon stressed plants. Both survival and colonization rates decreased where gallers fed upon stressed plants.

Along with the suckers, the other big winners within the plant stress hypothesis study were the **borers**. Observations showed that the colonization rate of boring type insects (e.g., **bronze birch borer**, **chestnut borer**, **bark beetle**, **clearwing moth**, etc.) increased when plants were stressed. This result is very consistent with general practical landscape experiences.

The included chart consisting of (+), (-), (0), and (x) symbols, represents a simplification of a fairly complex statistical analysis of how insect guilds and well-being traits interact when stressed plants are fed upon.

## Specific Plant and Stress Type Results

The general results of the research were broken down further and divided into coniferous and deciduous plants. With conifers, the studies indicated that both the sucker and borer guilds increased their reproduction and colonization rates on stressed plants. Stressed deciduous plants showed that borers only increased their colonization rates.

Various types of environmental stresses were also found to impact the insect guilds in different ways. The research showed that shading benefited chewing insects in terms of their growth rates. Gypsy moths and tent caterpillars, for example, will benefit from plants under shade stress. Alternatively, pollution will negatively affect chewers, whereas suckers will be positively affected. Furthermore, when plants are under water stress, the chewers' reproductive abilities were negatively affected, but the suckers' reproduction rates increased. Hence, these research examples have indicated that the plant stress hypothesis can be complex, and simple answers are usually not appropriate. The various possible interactions can become complicated and confusing.

## Mature vs. Younger Trees

Studies also showed differences in insect/mite effects when plants under stress are in various growth stages (e.g., mature plants, saplings and seedlings). Research showed the chewers' reproductive rates were reduced more on stressed mature trees compared to saplings or seedlings under stress. Therefore, when mature trees were stressed, they generally became poorer quality food for chewing insects than were saplings or seedlings that were under stress. As a result, stressed younger trees have greater vulnerabilities to chewing insects than stressed mature trees. Furthermore, the sucker guild reproduction rates were shown to increase on stressed saplings, but not on stressed mature tress. Again, the research results indicate that stressed mature trees can better withstand an assault from suckers than can younger trees. The scenario changes when boring insects and stressed mature trees are considered. Colonization was enhanced on stressed mature trees, but was not enhanced on younger saplings.

## Growth Rates

Insects/mites were also affected differently when stressed plants have various growth rates (i.e., rapid growing vs. slow growing plants). Basically, survival rates were reduced on slow-growing plants under stress, but enhanced on fast-growing plants under stress. In other words, plants growing slowly will be able to withstand stress from insects/mites better than plants that are growing quickly.

## Conclusions

With the complexity and the variety of insect types, stress types, plant growth types and insect well-being traits, it becomes impossible to generalize and state that stressed plants are better food for "bugs" and cause them to increase. Such a simple generalization is incorrect and therefore, more variables need to be included.

The study, however, does allow for some specific generalizations to be stated. The insect guilds (e.g., chewers, suckers, miners, gallers, and borers) are affected in numerous ways when they feed on stressed plants. For example, stressed conifers will have a more difficult time dealing with insects and mites than deciduous plants. Mature trees under stress will withstand insect attack better than younger trees under stress, with the exception of borers.

Who are the big winners and losers? Suckers and borers usually benefit when plants are stressed. Chewers and miners show no consistent response when plants are stressed. For example, it is not correct to state that gypsy moths will do better when oaks are under drought stress. Gallers generally suffer when plants are stressed.

*Reference: Adapted from a presentation by Dr. M. Raupp, ASCA Conference, @ Newport, RI, 12-5-2000.*

### Effects of Stress on Life History Traits

| GUILDS ▸ / TRAITS ▾ | Chewers | Suckers | Miners | Gallers | Borers |
|---|---|---|---|---|---|
| Growth | 0 | + | x | x | x |
| Fecundity | - | + | 0 | x | x |
| Survival | 0 | 0 | 0 | - | x |
| Attraction | 0 | 0 | 0 | - | + |

**+ = Increase  - = Decrease  0 = No Difference  x = Data Insufficient**

# Diseases of Christmas Trees

*Ann B. Gould, Ph.D., Specialist in Plant Pathology*

| HOST | DISEASE | MANAGEMENT | CHEMICAL CONTROL* |
|---|---|---|---|
| All Christmas Trees | Canker (*Cytospora*, Atropellis) | Maintain plant vigor and avoid wounding and moisture stress. Prune affected branches during dry weather at least 6 to 8 inches below affected tissue with surface-disinfested pruning tools. | None. |
| | Armillaria root rot (shoe string root rot) | Avoid establishing plantations in areas where previous stands of trees were affected by this disease. Avoid nutrient and moisture stress. Remove and destroy stumps and roots of diseased trees. | None. |
| | Root rot | Examine stock before planting; avoid excessive moisture and planting beds with poor drainage. | Non-water molds (e.g., *Rhizoctonia*, *Fusarium*): azoxystrobin, Banrot, fludioxonil, flutolanil (Douglas-fir), *Gliocladium virens*, iprodione, Mycostop (not for landscape use), *Streptomyces griseoviridis*, SoilGard, SysStar, thiophanate-methyl, or triflumizole.<br>Water molds (e.g., *Pythium*, *Phytophthora*): drench plants with Banrot, etridiazole (red, southern, western pine), fosetyl-Al (foliar spray or dip treatment at transplant), *Gliocladium virens*, mefenoxam, phosphite (dip or foliar treatment, nurseries only), or SoilGard and repeat as specified on label. |
| Douglas-fir | Rhabdocline needle cast | Remove old and severely diseased (more than 30%) trees prior to budbreak. Prune branches on lightly affected trees (less than 30%) prior to budbreak with surface-disinfested pruning tools. Remove clippings and culled trees from block. Improve air circulation through proper spacing and weed control. | Spray chlorothalonil when 10% of buds have broken (are 1/2 inch long) in block. Spray twice more, one and three weeks after the first spray. A fourth spray may be necessary if weather remains cool and wet. Other compounds labeled for control include copper hydroxide, copper salts, mancozeb, Spectro, or Stature. |
| | Swiss needle cast | Improve air circulation through proper spacing and weed control. | When candles are 1/2 inch long, apply azoxystrobin, chlorothalonil(1 application), mancozeb (2-wk. intervals through infection period), Manhandle, Spectro or thiophanate-methyl. |
| Pine | Brown spot | Maintain plant vigor and improve air circulation through proper spacing and weed control. | Apply chlorothalonil, (new growth is 1/2 inch and repeat at 3- to 4-week intervals), mancozeb (every 2 weeks through infec tion period), Junction, Manhandle, Spectro or Stature according to label timing and rates. |
| | Needle cast (*Cyclaneusma*, *Lophodermium*) | Minimize prolonged periods of leaf wetness and reduce humidity through proper spacing and weed control. Avoid moisture stress. | In spring, apply chlorothalonil (early spring and repeat at 6- to 8-wk. intervals through fall), copper, ferbam, Junction, mancozeb, (every 2 weeks through infection period), Manhandle, Spectro, or triadimefon according to label directions. Sprays must continue through fall during periods suitable for infection. |
| | Dothistroma (red band) needle blight | Improve air circulation through proper spacing and weed control. Rake up and remove fallen needles. | In spring, apply copper salts of fatty and rosin acids, copper sulfate, or Junction according to label directions. |

***Table continued on page 4***

# Diseases of Turfgrass

*Bruce B. Clarke, Ph.D., Specialist in Turfgrass Pathology*

## Pink Snow Mold/Fusarium Patch

**Pink snow mold,** caused by the fungus *Microdochium nivale* (= Fusarium nivale), is present on greens, tees, and home lawns at this time. This disease was quite severe in many locations in New Jersey again this year. Current infections can be controlled with Banner, Chipco 26GT, chlorothalonil, Compass, ConSyst, Eagle, Heritage, Insignia, Medallion, Spectro, thiophanate-methyl, or vinclozolin. For best results next fall, apply any of these fungicides (or PCNB) on a preventive basis in early to mid-November and then repeat in late-January if the snow cover recedes. Do not reapply PCNB after January 15 due to the possibility of phytotoxicity during warm weather.

## Yellow Patch

This disease, often referred to as **cool season brown patch,** is apparent on greens and tees at this time. Unlike brown patch which occurs in the summer, **yellow patch** (*Rhizoctonia cerealis*) thrives during cool, wet weather between October and May. We often see a lot of this disease in late-March and early April as the turf is emerging from dormancy. Patches are chlorotic and typically range from several inches to three feet in diameter. Patch centers are frequently green, resulting in a “frog-eye” or yellowish ring effect. Although Banner, chlorothalonil, Cleary 3336, Heritage, Medallion, or Prostar are currently the only turf fungicides labeled for the control of this disease, Chipco 26GT has also provided good control of yellow patch when applied for snow mold in tests at Rutgers University. Even without the use of fungicides, however, symptoms generally disappear with a return to regular mowing and warm weather. ❑

*Table continued from page 3*

| HOST | DISEASE | MANAGEMENT | CHEMICAL CONTROL* |
|---|---|---|---|
| | Pine gall rust | Remove galls from trees. Inspect incoming stock and destroy affected seedlings. Do not plant pines close to plantings of red oak. | Apply azoxystrobin, ferbam (seedling nurseries only), flutolanil, mancozeb, (every 2 weeks through infection period), Manhandle, myclobutanil (nursery use only), sulfur (dusting), triadimefon, or ziram (seedlings) in spring and repeat according to label recommendations. |
| | Sphaeropsis (Diplodia) shoot blight and canker | Improve plant vigor, prune affected branches during dry weather, and consider planting tolerant species. | Apply azoxystrobin, copper salts, Junction, propiconazole, (every 14 days prior to major period of infection), Spectro, Stature, SysStar, thiophanate-methyl, or triamefon at budbreak according to label directions. |
| Spruce | Rhizosphaera needle cast | Minimize leaf wetness through proper spacing and weed control. Where the disease is present, avoid shearing trees when wet. | In early June (when new growth is 1/2 to 2 inches long), apply chlorothalonil, copper, mancozeb, Spectro, or Stature and repeat at intervals on label. |

**Refer to label for timing and rates.*

*Fungicides labelled for use in Christmas trees (plantation, landscape, nursery, or seed bed):***

*Azoxystrobin, chlorothalonil, copper hydroxide, copper salts of fatty and rosin acids, copper sulfate, etridiazole, ferbam, fludioxonil, flutolanil, fosetyl-Al, Gliocladium virens GL-21, mancozeb, Mancozeb + copper hydroxide (Junction), mancozeb + myclobutanil (Manhandle), mefenoxam, myclobutanil, phosphite, propamocarb hydrochloride, propiconazole, Streptomyces griseoviridis K61, thiophanate-methyl, thiophanate-methyl + chlorothalonil (ConSyst, Spectro), thiophanate-methyl + etridiazole (Banrot), thiophanate-methyl + flutolanil (SysStar), triadimefon, triflumizole, ziram*

***This list may not include all fungicides that are sold for disease control in Christmas trees, nor does it imply any preference whatsoever.*

# Shaded Turf Varieties

*James A. Murphy, Ph.D., Specialist in Turf Management*

It is about time for people to start their landscape work, and grass seeding is a common spring ritual, albeit not the best time to do this task. Recall that late-summer and early-fall (mid August to early October) is a much better timing to establish turf from seed. Nevertheless, some insight on seed selection for shaded areas is often helpful in the spring.

Shaded areas in landscapes commonly contain struggling turf each year. And property owners frequently attempt to improve ground cover in those areas with seed in the spring. Fine fescues are well known for adaptation to shaded environments. Tall fescues, while unrecognized for this trait, are also well adapted to shaded environments.

Unfortunately, there isn't extensive data on performance of turf varieties in the shade. Thanks to the tree plantings of Dr. Reed Funk at the Adelphia Plant Science Research and Extension Farm, Dr. William Meyer has been able to initiate some shade trial work. Some of the initial data for this shade work is available on pages 42-43 of the 2003 Rutgers Turfgrass Proceedings (Table 5 of the fine fescues article).

Listed below is a list of those varieties that have good to excellent performance in the heavy shade trial at Adelphia.

The top 13 named cultivars (first statistical group based on the LSD) in Table 5 of the 2003 Proceedings were:

Ambrose - Chewings fescue
Shenandoah II - tall fescue
Plantation - tall fescue
Finelawn Elite - tall fescue
Intrigue - Chewings

Mustang 3 - tall fescue
Oxford - hard fescue
Prospect - tall fescue
Ambassador - Chewings fescue
Rebel Exceda - tall fescue

Bingo - tall fescue
Seven Seas - Chewings fescue
Reliant II - hard fescue
Signia - tall fescue

The next group (good tolerance) was:

Scorpion - tall fescue
Minotaur - hard fescue
Discovery - hard fescue
Rebel Sentry - tall fescue
Aurora - hard fescue

Cindy Lou - strong creeping red fescue
Raptor - tall fescue
SR 3100 - hard fescue
Berkshire - hard fescue
Biltmore - tall fescue

# Plant Diagnostic Laboratory Highlights

*Richard J. Buckley, Laboratory Coordinator*

## General Interest

After a record number of sample submissions in 2004, we are starting off the current season at a slow pace. Several weeks with below average temperatures and regular bouts of snow have kept most plant managers and yard work enthusiasts indoors. Sitting in the laboratory this week was a couple of turf samples – **fairy ring** on seashore paspalum from a golf course in Naples, Florida and **pythium seedling blight** on bentgrass sent to the laboratory from Seattle, Washington. We did have one turfgrass sample from a golf course in Middlesex County, however, with – you guessed it – **anthracnose basal crown rot**! We expect to see more turf as we move forward and golf courses begin to open for the season. As far as ornamental plants were concerned, the disease of the week was **white peach scale**. Two downstate nurseries brought holly samples with **white peach scale** infestations. The insect was active at this time because the plants had been kept at higher temperatures in hoop houses. We have seen an increasing number of plants with this armored scale over the last couple of years from both nursery production and residential landscape plants. It appears holly is a favored host. Last, but not least, a Cumberland County nursery brought a flat of rhododendron cuttings that was diagnosed with **phytophthora crown and root rot**. ❑

# Nitrate Leaching from Lawns

*Joseph R. Heckman, Ph.D., Specialist in Soil Fertility*

Various N fertilizer sources are available for lawn turf. Few field studies, however, have determined the losses of nitrate from lawns receiving different formulations of N fertilizers. Guillard and Kopp (p. 1822-1827 J. Environ. Qual., Vol. 33, September-October 2004) report that nitrate leaching from cool-season lawn turf is more likely to occur during late fall through early spring in southern New England than during late spring through summer. Their lysimeter study showed greater nitrate leaching losses with soluble fertilizer formulations than with slow-release or organic fertilizers. Results suggest that soil nitrate N concentrations in northern coastal climates should be minimized before the major leaching periods to reduce the potential for leaching losses. To further reduce the threats of nitrate leaching, lawn turf fertilizers should be formulated with a larger percentage of slow-release N than with soluble N. ❏

# New Jersey School IPM Program

*Patricia D. Hastings, NJinPAS Coordinator/ Assistant Pesticide Safety Education Program Coordinator*

The School IPM Act was signed into law for New Jersey in December 2002. For a Rutgers Cooperative Research &Extension Fact Sheet and the key requirements of the Act, see www.pestmanagement.rutgers.edu/IPM/SchoolIPM/NJAct/nj.htm.

In New Jersey, all public, private, and charter schools are required to adopt an IPM Policy that includes a school-specific IPM Plan. The New Jersey Department of Environmental Protection (NJDEP) in cooperation with the New Jersey School Boards Association, the Commissioner of Education, and Rutgers Cooperative Research & Extension produced a Model School IPM Policy for use by the schools. See www.pestmanagement.rutgers.edu/IPM/SchoolIPM/plan.htm for a template Model Policy.

The Model Policy stipulated that the school would also issue a plan of how School IPM would be implemented by June 12, 2004. Accordingly, Rutgers Cooperative Research & Extension and the New Jersey Department of Environmental Protection have jointly developed a Model School IPM Plan for New Jersey Schools that can be adapted and adopted by individual schools. See www.pestmanagement.rutgers.edu/IPM/SchoolIPM/plan.htm for a template Model Plan. ❏

# Factsheet on Establishing an Ornamental Aquatic Plant Culture Facility

*Gef Flimlin, Ocean County Marine Agent and Don Schnoor, Ornamental Aquatic Consultant*

Incorporating ornamental ponds and containers of aquatic plants into backyard landscaping has become quite popular over the past ten years and many garden centers and home improvement stores are featuring a variety of equipment for homeowners. Pre-formed ponds as well as dug and lined ponds bring together various segments of landscaping with the use of stones, filters, pumps, lights, fish and aquatic plants to provide attractive features. There are many varieties of ornamental aquatic plants and the market for these is growing steadily. Aquatic plants have been imported from Florida for years, but now New Jersey growers are starting to raise them to meet market demands.

Aquatic plants in some instances can be considered weeds and can be fouling organisms that need to be removed. Plants such as water hyacinth produce beautiful flowers, but these same plants may cause problems in some natural bodies of water. However, in a controlled cultured setting they will grow well and propagate themselves with little assistance and serve as a decorative addition to backyard water gardens. Nursery growers in New Jersey have the opportunity to make adjustments to their greenhouses to take advantage of this growing market and add income in the process.

A new Rutgers Cooperative Extension factsheet, Establishing an Ornamental Aquatic Plant Culture Facility outlines the initial steps growers can take to enter into the business of culturing ornamental aquatic plants for use in the landscape. The factsheet, FS535 is available online at: http://www.rcre.rutgers.edu/pubs/publication.asp?pid=FS535 or from your County Rutgers Cooperative Research & Extension office. ❏

# SFMANJ Educational Day

The Sports Field Managers Association of NJ (SFMANJ) is sponsoring an educational day at Hammonton High School in Hammonton, NJ on April 6, 2005 with registration beginning at 8:00 am. Morning educational sessions at Hammonton High School will be followed by a lunch sponsored by Tuckahoe Turf Farm and a tour of the Tuckahoe sod production facility. Two NJ DEP pesticide credits will be awarded to those in attendance. Registration is $10.00 for SFMANJ members and $35.00 for non-members. More information is available at 908-730-7770. ❏

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