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Editor: Susan Barton, Extension Specialist, University of Delaware  
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**ASSOCIATION NEWS**  
**Valann Budischak**  
**Executive Director, D.N.L.A.**

It's spring! Almost. The hustle and bustle of the green industry has begun. In some cases, it never slowed. However, most companies have been impacted by our sluggish economy. Many limped out of 2007, and have made some tough adjustments. All are hoping for a better 2008.

The DNLA, in its ongoing commitment to schedule top notch speakers and meet the industry's needs, had two business speakers at its recent Delaware Horticulture Industry Expo. More than 440 people attended the event that was held January 16<sup>th</sup> & 17<sup>th</sup> at the Modern Maturity Center in Dover. George Koziarz, the Certified Business Appraisal Consultant of the ANLA, walked attendees through the process of collecting and using your numbers in your business. Gary Simon, of the DE Small Business Development Center dove into a necessary and complicated topic that many companies try to avoid – the business plan. Attendees of the two-day event were wowed by Rick Darke's discussion of *Grasses, Sedges, Rushes for Livable Delaware Landscapes*. Adam Kindl of Grassroot Organics addressed the ABC's of organic land care and the growing public interest in organics. John Frett and Bob Lyons, both of the University of Delaware and affiliated with the UD Botanic Gardens, challenged our woody plant identification skills and gave us spring fever with the highlights of the annuals at the UDBG trial gardens.

The 2007 DNLA Landscape Award winners were recognized at the DHIE. Winners received a plaque and a check for \$325. Award recipients are: Tom Taylor, University of Delaware – Institutional; Rick Hollender, Garden Design Group – Large Project; Susan Waeber, Garden Design Group – Medium Project.

**Reminder: Please keep our 2008 Landscape Awards program in mind throughout the upcoming season.** We encourage any member to submit an entry. We had many outstanding entries in 2007, and we'd like to receive even more in 2008. More information will follow later in the summer.

You should soon be receiving the 2008 DNLA Membership Directory. When renewing your membership, many companies take the opportunity to make a donation to our Research and Education Fund. This fund allows the DNLA to subsidize research and educational projects that are of interest and benefit to the horticulture industry in the state of Delaware. It also allowed us to support ANLA's Lighthouse Fund. I'd like to offer a special thanks to our many members that consistently support this worthwhile fund.

Mark your calendars! August 20<sup>th</sup> is the date that has been set for the Summer Expo. As you know, the DNLA board has made the decision to move this event between the three counties. This year's Expo will be held in NCC at the University of Delaware Botanic Gardens – a true gem of a garden. The UDBG has many beautiful specimens in a landscape setting. Attendees will be able to see firsthand the trial gardens that Bob Lyons discussed at January's DHIE. The annuals should be at their peak. Stay tuned. More information will follow.

## Welcome New Members:

Atlantic Tractor  
2688 Pulaski Highway  
Newark, DE 19702  
(302) 834-0114

Big Dog Landscaping  
242 Rushes Drive  
Bear, DE 19701  
(302) 420-7930

Delaware Park Racing LLC  
777 Delaware Park Blvd.  
Wilmington, DE 19804  
(302) 994-2521, Ext.7396

Delmarva Property Maintenance  
P.O. Box 155  
Houston, DE 19954  
(302) 242-5266

DeVilbiss Landscape Architects  
P.O. Box 398  
Lewes, DE 19958  
(302) 645-0500

McIlvain Lawn Mowing & More  
26564 Carpenter Road  
Milton, DE 19968  
(302) 684-4213

Murray Sod  
53 Lighthouse Road  
Selbyville, DE 19975  
(410) 352-5660

R & J's General Contractors  
1679 S. State Street, Lot 68  
Dover, DE 19901  
(302) 270-5415

Second Nature Landscape Management  
756 Taylor Road  
Downingtown, PA 19335  
(610) 873-9565

Sports Field Services, LLC  
P.O. Box 426  
Hockessin, DE 19707  
(610) 268-8566

Sporting Valley Turf Farms  
1527 S. Colebrook Road  
Manheim, PA 17545  
(717) 898-5000

Stonegates  
4031 Kennett Pike  
Greenville, DE 19807  
(302) 658-6200

On February 27<sup>th</sup>, seven individuals sat for the Certified Nursery Professional core and/or specialty exams. Congratulations are in order for the following individual:

### **New CNP:**

Lisa McHugh  
*Wilmington State Park*

## U of D NEWS

### Susan Barton, Extension Specialist

We are in the thick of “spring training” for the nursery and landscape industry. The Ornamentals Short Courses are going on right now and have been well attended. At this writing, there are still a few left (see below). Also, remember our offer to come to you. Several organizations have taken contacted us and we are doing special workshops at Hagley Museum and Gardens as well as at the New Castle County Extension Office for a few groups.

#### **Delaware Cooperative Extension is willing to come to you!**

If you have 10 people or more, we will conduct a workshop at your site on insects, diseases, weeds, cultural problems, sustainable landscapes, business skills or any other nursery or landscape industry topic that interests you and your employees. The cost will be \$10 per person and scheduling is based on the availability of the instructor with expertise in the topic you choose. Please contact your county extension agent (New Castle – Carrie at 831-2506; Kent – Gordon at 730-4000; Sussex – Tracy at 856-7303) or Sue Barton at 831-2531 to schedule a special workshop.

**Turf Workshop<sup>+</sup> \***– This one-day program will focus on turfgrass installation, maintenance and management for the home and commercial landscape. It will include pesticide and nutrient management topics. The workshop will be held at the Research and Education Center in Georgetown from 8 AM until 12 PM on March 14.

**Plant Material Uses Series** –Plants will be presented in the context of how they are used in the landscape. The goal of this series is to introduce landscapers to a wider plant palette and show them how to use those plants. This

series will be offered in New Castle County and the County Extension Office on Wyoming Road from 7-9 PM. (Cost is \$35 or \$10 for each session)

#### **Session 3: Plants in Groups or Masses** – Susan Barton, Extension Specialist, Ornamentals, Thursday, 3/13

In this session, learn which plants work best in combination with one another. Learn how groups of perennials, shrubs and trees can be used to perform specific functions in the landscape and enhance landscape aesthetics.

#### **Session 4: Drought Tolerant Plants** – Carrie Murphy, Extension Specialist, Ornamentals, Tuesday, 3/18

As we deal with droughts more frequently in Delaware, water conservation has become an integral part of landscape management. In this short course we will discuss how plants respond to drought, how to manage drought conditions, and the importance of selecting low maintenance, drought tolerant plants for the landscape.

#### **Session 5: Problem-Free Plants\*** –Bob Mulrooney, Extension Pathologist, Tuesday, 4/1

This session will cover a list of deciduous and evergreen trees and shrubs that I have not seen in the diagnostic lab at all or rarely in 33 years of diagnosing plant problems. Expect a rather subjective list but take home some ideas of pest-free or almost pest-free plants for the landscape.

#### **Deciduous Tree Series**

This series will focus on one important type of landscape plant—deciduous trees. We will cover culture, insects and diseases in 4 sessions throughout the month of March at the Research and Education Center in Georgetown. Sessions will be conducted from 4 to 6 PM. (Cost is \$25

or \$10 for each session).

**Cultural Concerns<sup>+</sup>** - Susan Barton, Extension Specialist, Ornamentals, Tuesday, 3/11

This session will address planting and management issues related to deciduous trees. We will cover plant selection, soil modification, planting technique, pruning, fertilization, mulching and cultural problems associated with trees in the landscape.

**Insects\*** – Brian Kunkel, IPM Specialist, Thursday, 3/27

Participants will learn about insects attacking deciduous trees. Options for controlling borers, scales and defoliating insects will be covered.

**Diseases\*** – Bob Mulrooney, Extension Pathologist, Thursday, 3/20.

Participants will learn about the identification and control of common diseases of leaves, stems and roots that infect our common deciduous trees.

### **UDBG Events**

The University of Delaware Botanic Gardens sponsors events for gardeners and commercial landscapers. The UDBG is a wonderful resource for the nursery and landscape industry. The Spring UDBG plant sale is a great place to buy unusual plants with limited availability in the nursery and landscape trade. The sale benefits student internships as well as growth and development of the UDBG.

**Plant Sale Preview Talk** – Tuesday, March 18 from 7-9 PM in the Girl Scout Building on the College of Agriculture and Natural Resources campus in Newark. This talk is free and open to the public. It will include a small, select plant silent auction.

**Guided Plant Walk** – Thursday, March 27 from 4- 5:30 PM departing from Fischer Greenhouse. This plant walk is free with a reservation (302-831-2531). Dr. John Frett will lead this tour of plant sale items so buyers can see plants established in the landscape in larger or mature sizes.

**UDBG Plant Sale** – Saturday, April 26 from 9:30 AM to 4 PM. The UDBG spring plant sale is held on Ag Day each year. Plants include perennials, tender perennials, shrubs, small flowering trees, evergreens and shade trees. Plant sizes range from quarts to 5 gallons.

### **Coming in the SUMMER !**

**Pest Walks\*** –Join Brian Kunkel and Bob Mulrooney for a pest walk at Goodstay Center in Wilmington on June 17 from 4-5:30. (Cost is \$10)

\*Pesticide credits will be awarded for attendance at these sessions.

+Nutrient management credits will be awarded for attendance at these sessions.

### **UDBG PLANT SALE**

Be sure to attend the UDBG Plant Sale this year if you can possibly squeeze it in to your busy spring schedule. This plant sale is designed to introduce the gardening public to new and underused landscape plants. Held in conjunction with Ag Day, which attracts lots of Delawareans, there is usually a good crowd of interested gardeners. As professionals, you can get a sense of what gardeners are interested in and also find unique plants that you might want to include in new projects or on your retail benches to keep your business on the cutting edge. The UDBG Plant Sale proceeds go toward funding student internships.

## CORN GLUTEN MEAL

### **What is it?**

Corn gluten meal has been available since the mid 1980's for pre-emergence weed control. Pre-emergence products formulated from corn meal contain primarily gluten, which has several related amino acid derivatives that are potentially suppressive to weed germination and seedling growth. Corn gluten meal is a byproduct of the corn milling industry, and poses no risk to humans or other animals. Products containing corn gluten meal are also high in organic nitrogen, and can typically be used as a supplemental fertilizer for landscape use, particularly in turfgrass or garden soils. These products must be applied before weed emergence because they are not effective on already established weed infestations, and are applied to the top ¼ inch of soil. Corn gluten meal was discovered during research performed at Iowa State University by Nick Christians on turf pathogens.

### **How does it work?**

Corn gluten meal reportedly suppresses weed growth due to the presence of growth inhibitory compounds. However, the nitrogen supplied by the product appears to be the primary reason for weed suppression because of its stimulation of growth of turfgrass and ornamentals, allowing them to out-compete weeds for limiting resources (space, water, etc.). Unfortunately, the growth of established weeds may also be enhanced by the additional nitrogen, worsening weed problems. At recommended rates of 20 lbs/1000 sq ft applied twice per year, corn gluten meal will add about 4 lbs of total N per 1000 square feet. The products should be applied in spring before annual weeds germinate so weed seed germination can be inhibited. Corn gluten meal will also control winter annual weeds before they germinate in the fall, so a late summer application is necessary for control of these weeds. The product should be applied

uniformly at the recommended times (early May and mid-August), and watered in lightly for activation.

### **What does it control?**

Corn gluten meal is a pre-emergent inhibitor of weed seed germination. It inhibits germination of seeds of many problem annual weeds in turf and gardens, including crabgrass and foxtail, and broadleaf weeds such as purslane, dandelion, and prostrate pigweed. It does not control already established weeds. Application of corn gluten meal to an established turf may help reduce annual weeds by providing nitrogen that enhances growth of turfgrass and its ability to compete successfully with weeds.

### **Where can corn gluten meal be used?**

Corn gluten meal is generally applied in home landscape settings such as turfgrass, ornamental gardens, and vegetable gardens. One should apply the product to the soil surface or turf before the presence of established weeds, or after cultivation or clean-up or in the spring before weeds emerge. Moderate rainfall after application will help to activate the product. When applying corn gluten meal to vegetable gardens that are direct seeded, wait until the vegetable or flower seedlings are up and growing well before applying gluten meal to the garden.

### **What products are available?**

Corn gluten meal is available in a variety of products and formulations. The products are generally sold as a yellow or light brown powder, the consistency of flour, or as pellets. After application, the product will be visible on the turf or soil surface until it breaks down. These products are available in home or retail garden centers as well as on the web. The products tend to be relatively expensive as compared to inorganic sources of N; for example, corn gluten meal is typically 4 to 5 times more expensive than ammonium nitrate.

For additional information on corn gluten meal:  
<http://attra.ncat.org/attra-pub/nursery.html>  
<http://www.extension.umn.edu/yardandgarden/vgbriefs/h531corn gluten.html>  
Nick Christian's website at Iowa State University:  
<http://www.gluten.iastate.edu.html>

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### WHY RHODODENDRON LEAVES CURL IN THE WINTER

When the temperature drops below 35 degrees F, rhododendron leaves begin to cup and curl at the edges. At 24 degrees F, the leaves have curled so tight that half the leaf surface has disappeared and the leaves droop. When temperatures hit the teens, leaves shrivel even tighter turn brownish-green and dangle like stiff string beans. This response to temperature changes is the rhododendrons' method of preventing loss of moisture through their leaves. The upper side of a rhododendron leaf is leathery. The bottom side is dappled with tiny air valves that control the flow of air in and out of a leaf. Cold air contains less moisture than warm air. So when low temperatures and high winds arrive, the leaf valves close. By looking out a window on a wintry day one can determine roughly how cold it is by the degree the rhododendron leaves have curled and dropped. When temperatures rise, the leaves open again. The rhododendron has the same response in summer when temperatures become excessive; the leaves curl to prevent undue moisture loss.

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### THE EFFECT OF LANDSCAPE PLANTS ON PERCEIVED HOME VALUE

Alex X. Niemiera, Extension Horticulturist,  
Department of Horticulture, Virginia Tech

The value of an attractive landscape to a home's perceived value has often been stated at 15 percent. Is this figure reliable, and what landscape features contribute to the value of a home? How does a landscape contractor convince his/her client to spend a significant portion of a home's construction budget on landscaping, and is this a wise investment? How can a homeowner feel justified by spending thousands of dollars to landscape a newly constructed house? Will thousands of dollars worth of landscaping, significantly increase the "curb appeal" of a home for sale? To answer these questions, researchers conducted a seven-state survey of attendees at consumer home and garden shows to determine consumer perspective on how plant size, type, and design sophistication in a landscape affect the perceived value of a home (Behe *et al.*, 2005).

#### The Survey

In 1999, survey respondents viewed a photo of a newly built suburban house with only a lawn and concrete pathway. They were then shown 16 photographs of this house with **different plant sizes and types, and levels of design sophistication**. Plant sizes were small, medium, or large based on available sizes of plant types (perennial, shrub, or tree). Design sophistication levels (see Figures 1, 2, 3) were: 1) foundation planting only, 2) foundation planting with one large, oblong island planting and one or two single specimen trees in the lawn, or 3) a foundation planting with adjoining beds and two or three large island plantings, all incorporating curved bed lines. Plant types were:

- evergreen only
- evergreen and deciduous plants
- evergreen and deciduous plants with 20 percent of the visual area of the landscape beds planted in annual or perennial color
- evergreen and deciduous plants, 20 percent annual or perennial color, and the addition of a colored brick sidewalk entrance.

## Survey Results

**What factor was most important?** Survey respondents ranked design sophistication as most important, plant size as next important, and diversity of plant type as least important.

<i>Importance rank</i>	<i>Landscape aspect</i>	<i>% of value added to home</i>
<b>1</b>	<b>Design sophistication</b>	<b>42</b>
<b>2</b>	<b>Plant size</b>	<b>36</b>
<b>3</b>	<b>Diversity of plant material type</b>	<b>22</b>

Table 1. Survey results with the ranking of landscape aspects and the percent value that these aspects added to the home value.

The preferred landscape included a sophisticated design with large deciduous, evergreen, and annual color plants and colored hardscape. These results differ slightly compared to a 1999 Michigan study with an identical methodology (Hardy *et al.*, 2000). In that study, plant size was the factor that most added to a home's value (40.2 percent) and design sophistication was a close second (36.5 percent). As in the previous study, plant type was placed third (23.3 percent). The authors of the seven-state 1999 study hypothesized that the difference between the two studies may relate to survey respondents--flower show venue (Michigan) vs. home and garden show (seven-state survey). Another potential difference was that Michigan respondents may value plant size more because plants grow more slowly in Michigan compared to the areas of the multi-state survey (Delaware, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, and Texas).

### **What was the increase in perceived value?**

The change in value (from no landscape to well-landscaped) ranged from 5.5 percent (Louisiana) to 11.4 percent (South Carolina). The increase

in home value from the least valued landscape to the most valued landscape in the Michigan study was 12.7 percent.

Thus, a home valued at \$150,000 with no landscape (lawn only) could be worth \$8,250 to \$19,050 more with a sophisticated landscape with color and large plants. Interestingly, the multi-state study found that very minimal landscapes (simple design with small plants) detracted from the value of a landscape.

Data from research conducted from 1996-97 in Greenville, S.C., showed home price premiums increased 6 percent to 7 percent for home landscapes that were upgraded from good to excellent and 4 percent to 5 percent for an upgrade from average to good (Henry, 2000). By combining these data, the value added by an upgrade from average to excellent increases a home value by 10 percent to 12 percent. Thus, this finding is consistent with the survey results of Behe *et al.* (2005) and Hardy *et al.* (2000).

**Conclusion.** Survey results showed that relatively large landscape expenditures significantly increase perceived home value and will result in a higher selling price than homes with a minimal landscape. Design sophistication and plant size were the landscape factors that most affected value. The resulting increase in “curb appeal” of the property may also help differentiate a home in a subdivision where house styles are similar and thereby attract potential buyers into a home; especially important in a competitive housing market.

Landscape contractors can use the above information to help the homeowner understand the relationship between house landscape and house value. This can add to the marketability of their services and maximize their business potential. In a 1999 focus group approach study conducted in Nebraska, Rodie and Pappozzi (1999) found that improved communication

from the contractor as well as from the homeowner is needed to make the most of the landscape design and customer satisfaction. They also noted the need for client education in terms of understanding and appreciating the design process and the ultimate value of the design and requisite expertise to create and execute it.

The overall survey conclusion was that design sophistication was the highest ranked factor that added to the perceived value of a home. Thus, investing in the services of a landscape design professional will optimize the value of a home. In contrast to many home improvements the value of an investment in a landscape improvement increases over time since the growth and maturity of trees and shrubs enhance aesthetic appeal.

#### Literature Cited

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### GETTING MORE CUSTOMERS THROUGH THE DOOR

**Larry Newlin, Imperial Nurseries  
Territory Manager**

I hadn't realized how slow the garden center world had become in some parts of the country where the drought has taken its toll. The question that is uppermost on everyone's mind is: how do we get customers in the door? So, that's what I've tried to address in the attached article. There's no magic bullet, but if we don't get appreciable rains in the coming months, spring is going to be very tough for wholesale and retailers alike.

Management guru, Peter Drucker, said there are two main priorities for the head of a business – marketing and innovation. This year has been especially challenging for retail owners dealing with an atrocious Easter freeze just as the spring season was entering full stride, a heat wave and prolonged drought through the summer and fall, water restrictions in many areas, and a severe downturn in the housing market. Attracting new customers and getting existing customers to return more often and spend more has become extremely challenging. When customer traffic turns into a trickle due to water restrictions, heat waves, and drought, it points up the fact that marketing needs to become more creative and more cost effective.

A political commentator recently said that the more a myth is repeated in Washington or in the news media the more it becomes accepted fact. Over the years the myth that garden centers should spend three percent of their sales on marketing keeps being perpetrated. The question isn't how much others are spending. Too many garden centers have poor profit performance, so, why ask what is average? Some garden centers have been in business for ages, and at least in theory, do not need to spend as much as younger businesses. Some garden centers are on heavily traveled thoroughfares where capturing passerby attention is not as

difficult as an off-the-beaten-path destination center. Moreover, the question of how much to spend is relatively less important than determining “what is your most effective means of marketing” and doing more of it on a timely basis.

In this challenging environment, it is important to be ruthless in seeking out and destroying parts of your marketing plan that you think are not working. Your newspaper rep, Yellow Pages rep, radio/T.V. rep may be the nicest person in the world, but you need to present them with a 2008 marketing budget that works best for you. If their part of the plan is reduced or eliminated, then, let them down easy but stick to your guns. Nor should you be intimidated by “customer Moms or Dads” seeking a donation for their kids' yearbook or marching band – that's not marketing. If you want to contribute to it as a charitable contribution or as part of your public relations effort – categorize the expense in those terms. Having a charitable contribution budget and procedure for soliciting your business is a good way to get these incidental but constant requests under control.

Traditionally, garden centers have spent a good share of their marketing budget on newspaper advertising and Yellow Pages. Two things you won't find your home center competition doing is advertising in the newspaper or in the Yellow Pages. From time to time they may insert circulars, but I would be shocked if you have seen a line ad in the sports section or home and garden section. These folks employ very sophisticated marketing firms, and they know that newspaper readership is declining and that it is increasingly difficult to make an impression in that medium that will result in the reader taking action – i.e. coming into the store to buy. Similarly, home centers do not rely on Yellow Page advertising to attract new customers. Smaller businesses may find that there are much more economical and effective ways to attract

new customers through new homeowner programs, direct mail to new homeowners, or door hangers in new neighborhoods.

On the other hand, two things you won't see your home center competitors do are a) develop a "wreck-a-day" color bed in front of their store and b) have a marquee that is changed very frequently with short, catchy messages. If you have any traffic on the street, road, or avenue, where you do business, develop long linear color beds – not display gardens but high impact color. Make this a top priority (it may be your most important means of bringing in new customers) and plan on planting it at least twice a year – use high impact flowers with primary colors and plant in mass. As importantly, make sure that the color bed is well-weeded, dead-headed, edged, and maintained as an estate planting. Similarly, a readable marquee with a pithy, preferably humorous message that is changed no less than every other day will pay great dividends. If passersby are flying by at 60 miles plus per hour – don't count on them reading much – stick to very few words. Announce events, sales, and specials but also give quick and timely gardening tips so folks who travel by look to you as their garden mecca.

If you live in a mature market where there aren't a lot of new houses being built near your garden center, consider advertising with billboards. This has proven effective with some of the state's most successful garden centers. Again, the message needs to be brief and the graphics need to be colorful with high impact.

I am still a fan of postcards. They are inexpensive, are available in garden theme fronts, and can be used to build loyalty and return visits among your most valued customers. I am an advocate of coupons with strong offers such as free this or that, dollars off with certain level of purchase, etc. Generally, I would try to make your offers as general as possible to lure a

wide range of customers. If you do not have a mailing list begin collecting names and addresses from checks and/or have a shopping spree sign up at the register to collect names. If you do this also include a line to collect e-mail addresses. I wouldn't try to substitute e-mail campaigns for direct mail, but I would seek to supplement your mailings with timely e-mail blasts. This has to be done very carefully not to have your message chucked as spam, or worse having your server shutting you down for producing spam. Employing professional assistance is highly recommended.

There are a host of effective, low-cost marketing possibilities contained in Jay Conrad's *Guerilla Marketing* and their sequels. Target a few to try in the coming year. Also, make calls or visits to at least five of your colleagues outside of your immediate market area and find out what they have tried in recent months that was effective in bringing in customers.

In recent years there has been increased attention to improving gross margins, controlling expenses, and controlling inventory. These are important steps to improving profitability. However, the fundamental challenge most garden center retailers have in this new era of retailing is creating a creative, sustained, and effective marketing strategy. Begin networking and reading today in formulating your 2008 strategy.

*Larry has over twenty years of garden center retail experience and chairs the Retail Committee for the NCNLA. Share your thoughts and comments to Larry at [lnewlin@mail.insy.com](mailto:lnewlin@mail.insy.com)*

Excerpted from *VNLA Newsletter*, November/December 2007.

## **THE UNCERTAIN WORLD OF PLANT PROBLEM DIAGNOSTICS**

**Joe Boggs, Horticulture Specialist  
The Ohio State University**

Anyone who has worked on plant problem diagnostics has experienced the vexing condition of remaining at the beginning despite having scrutinized a plant problem from every imaginable angle. The question remains unanswered: What is it?

Challenges with plant problem diagnostics have spawned numerous methods to help us with the diagnostic process. However, there are a number of plant problems that can still cause us to run off the diagnostic track despite our best efforts. Let's take a look at a few of these problems.

**Same symptoms, different causes.** Symptoms that can be caused by multiple problems present serious diagnostic challenges. Iron chlorosis, which is sometimes seen on oak (*Quercus* species) and birch (*Betula* species), produces the symptom of yellowed (chlorotic) leaves with veins that appear faintly green. The symptom only tells us that there is an insufficient amount of iron being provided to the leaf cells. It does not reveal the cause. The culprit could be anything that prevents a sufficient amount of iron from reaching the plant cells to meet their physiological needs.

Nutrient leaf deficiency symptoms can be caused by several problems. These include a nutrient deficiency in the soil; a soil pH (too high or too low) that interferes with the nutrient's availability to the plant; a soil-moisture level that is too low to allow the nutrient to go into solution and travel into the roots; a problem with the roots, such as root damage; or a disruption of vascular flow in the plant's stems. Root damage and vascular-flow disruption each carry long lists of possible causes, including physical damage to the plant or plant pathogenic diseases.

Leaf scorch is another symptom that can be produced by multiple causes. The scorch symptom of brown, necrotic tissue (necrosis equals dead cells) typically first appears along the leaf margins and then spreads inward toward the midvein. Severe leaf scorch can produce total leaf browning and premature leaf drop. However, leaf scorch symptoms only tell us that the plant is unable to provide sufficient water to keep the leaf cells alive.

Obviously, dry soils (drought) can produce leaf scorch symptoms. It may seem counterintuitive, but leaf scorch can also occur at the opposite end of the soil-moisture spectrum. Waterlogged soils cause the roots of some plants to stop functioning. Even with water everywhere, the inactive roots fail to provide even a drop for the plant to drink.

Many of the same problems that cause nutrient deficiency symptoms can also cause leaf scorch. For example, both leaf scorch and nutrient deficiency symptoms can be produced by root damage from construction activity. The root damage can be caused directly from soil excavation or indirectly from soil compaction.

If leaf scorch is produced by an environmental problem, the symptom is sometimes referred to as physiological leaf scorch. Physiological leaf scorch – caused by overwatering – was a common, but difficult to diagnose, problem in areas of the country where drought was intense this past summer. It was a matter of killing trees with kindness.

If roots remain immersed in water, they can begin to die, leaving the root system susceptible to root-rotting fungi. These "Dr. Treevorkians" of the soil first infect dead or dying roots, and then they infect healthy root tissue, which finishes the plant off. Of course, as the plant slowly dies, leaves may first appear scorched.

Leaf scorch can also be caused by the bacterium *Xylella fastidiosa*. This bacterium plugs the trees' water-conducting vascular tissue, primarily in the leaf petiole. The disease is called bacterial leaf scorch, and the symptoms tend to appear very late in the season, around the time the tree begins to show fall color. An infection can easily be misdiagnosed as normal fall leaf senescence, as well as drought damage and root damage.

The bacterium has a very wide host range, and it is spread (vectored) from tree to tree by several species of leafhoppers. Unfortunately, there is no way to field-diagnose this disease with certainty. A positive identification requires tests, such as enzyme-linked immunosorbent assay (ELISA), to be performed on symptomatic leaves and stems. Trees that show recurring leaf scorch symptoms late in the growing season should be tested if all other possible causes for the symptoms have been eliminated.

**The look-alikes.** Symptoms that are not exactly the same, but look very similar, can also lead us down a diagnostic pathway fraught with opportunities for missteps. Certain sucking insects, such as aphids and plant bugs, can produce twisted growth. So can certain herbicides. While the symptoms are very different when viewed side-by-side, they may seem remarkably similar when viewed individually.

Plant cankers are usually described as necrotic lesions on woody stems, branches or roots, with the lesions appearing sunken because of the disintegration of cambium, phloem and bark tissue. Or, the lesions may stimulate the overgrowth of surrounding tissue, producing a raised area. Which is it – sunken or raised bark tissue? Cankers may appear as both.

Symptoms that can be caused by multiple

problems present serious diagnostic challenges.

If sunken, the canker symptom may look just like physical injury. Think of the symptom produced when a lawn mower hits the base of a tree. This is not a canker because the tissue is physically removed, not dissolved away through necrosis. However, the end result may look very similar to a canker, and cankers can indeed occur at the base of trees.

If raised, there is a litany of canker look-alikes – everything from stem galls to insect oviposition injury. Southwestern Ohio last experienced a periodical cicada (*Magicicada* species) emergence in 2004. However, the oviposition damage remains evident on ash (*Fraxinus* species), as well as numerous other tree species. What is also evident on some ash trees are cankers produced by the fungus *Botryosphaeria dothidea*.

The *Botryosphaeria* cankers are longitudinal areas of the stems with distinctly raised tissue. The bark on the canker is usually cracked open. The cicada damage began as longitudinal slits on the stems, but through the intervening years, the wound-response tissue growing along the edges has now produced elongated, raised areas of tissue, with the bark appearing split. Both the cankers and the cicada injury can cause stems to die and leaves to turn brown, or “flag.” Viewed side-by-side, canker and cicada stem symptoms are not identical; however, when viewed individually, they may look remarkably alike.

**Plant problem diagnostic rules.** The lesson learned from all of these diagnostic challenges is to avoid making a “quick draw, shoot from the hip” diagnosis. Take your time, and remember the first rule of plant problem diagnostics: Don't make the symptoms fit the diagnosis; do make the diagnosis fit the symptoms. In other words, always approach diagnosing a plant problem with an open mind, free of preconceived and

biased notions. This is hard to do; however, it is the best method for avoiding diagnostic missteps.

The second rule of plant problem diagnostics is that nothing is surefire. Despite your best efforts, you may remain at the beginning, asking yourself the initial question again: What is it? This is simply part of living the uncertain world of plant problem diagnostics.

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## **DIAGNOSING ABIOTIC DISORDERS IN THE GREENHOUSE**

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Problems can arise in greenhouse production that may involve living (biotic) and nonliving (abiotic) factors. Oftentimes biotic factors present themselves clearly, especially when the causal agent is an insect pest, but plant diseases are a little more difficult to identify. Abiotic factors pose difficulty in accurate diagnosis. Visual diagnosis is a popular monitoring tool; however, using a plant diagnostic lab to identify the source of nutritional problems is still the best way to ensure accurate diagnoses because many nutritional, physiological, insect and disease problems can mimic each other. This article features some of the common abiotic disorders along with a nutritional-disorder guide to assist plant producers.

When using visual diagnosis, one must first account for all other factors that could cause similar symptoms. A number of nutritional-disorder symptoms can also be the symptoms of other causal agents, such as air pollution, pesticide damage, herbicides in or near the crop area, plant growth regulators, pathogenic diseases (particularly viruses) and environmental extremes, such as frost, desiccation or temperature extremes.

A valuable asset for sorting out other casual agents is a crop-production record. Further help can be found in production and pest-control manuals for the crop at hand. Most abiotic disorders are associated with plant nutrition; however, listed in the chart on page 16 are other common abiotic disorders that occur in greenhouses with preventive activities or recommended solutions.

**Nutrient deficiencies.** Nutrient deficiencies

can appear quickly within a crop and subsequently reduce profit by affecting marketability. There are several factors that can inhibit proper nutrition of greenhouse crops.

*pH:* One factor that can introduce nutrient deficiencies in greenhouse crops is the substrate pH. The general pH range for greenhouse crops is 5.4 to 6.8, but maintaining the pH between 5.6 and 6.2 is recommended. Poor uptake of nutrients, particularly boron, copper, iron, manganese and zinc, can occur if the pH of a substrate is above 6.5. Certain macronutrients, like calcium and magnesium, can become less available at pH values below 5.4.

*Improperly working equipment:* An improperly working fertilizer proportioner can cause nutrients to be less than optimum in the substrate. Weekly calibration of the injector is required. The significant problem with equipment failure is the introduction of multiple nutrient deficiencies.

*Water stress:* Constant saturation of the substrate can lead to macro- and micronutrient deficiencies. As oxygen levels are inhibited by overwatering, root growth can be limited and water uptake slowed. Elements, such as calcium, are transported via water flow, and deficiency symptoms can develop rapidly on new growth. Also, the inactivity of root systems due to saturated conditions can lead to inefficient uptake of iron or phosphorus.

*Low soluble salts:* Soluble salts refer to the total dissolved salts in the root substrate at any given time and are measured in terms of electrical conductivity (EC). When the EC content of the root substrate is too low, plant growth is stunted and mineral deficiencies are observed. Low salts are usually due to too many clear water irrigations. Deficiencies among greenhouse crops, like lower-leaf yellowing (nitrogen), lower-leaf purpling (phosphorus) and lower-leaf

interveinal chlorosis (magnesium), are common when values are below 0.75 mS/cm (millisiemens per centimeter).

*Mineral antagonisms:* When certain elements are provided in excess to plants, the uptake of other nutrients may be hindered. One example of a mineral antagonism is the nitrogen-potassium (N-K) interaction, where for most bedding plants a 1N:1K ratio is recommended. Another type of antagonism is the potassium-calcium-magnesium (K-Ca-Mg) interaction. Any one of these elements in excess can cause a decrease in the uptake of the other elements; therefore, a ratio of 4K:2Ca:1Mg should be adopted by bedding plant growers. Excess phosphorus can cause a decrease in the uptake of zinc, iron and copper.

*Temperature:* Temperature can also play a role in the introduction of nutrient deficiencies. One classic example is the effect of low temperature (less than 55°) on the uptake of phosphorus in tomato. Purpling of the lower foliage is the common symptom. Geraniums can also express phosphorus deficiency when they are grown too cool in the spring.

*Disease:* Organisms, like *Pythium*, feed on the nutrients in roots, which causes an inefficient uptake of minerals. Iron deficiency (upper foliage interveinal chlorosis) can occur if root rot pathogens infect the root system. Foliar diseases – particularly fungal diseases – can cause chlorosis of leaf tissue, a direct reflection of harvesting nitrogen from plant cells.

**Essential nutrients.** Sixteen elements are considered to be essential elements for plant growth: boron, calcium, carbon, chlorine, copper, hydrogen iron, magnesium, manganese, molybdenum, nitrogen, oxygen, phosphorus, potassium, sulfur and zinc. These elements have been determined to be essential because they have met these three criteria:

- the lack of the element makes it impossible for the plant to complete the vegetative or reproductive stage of life;
- the element cannot be replaced by supplying another element; and
- the element must exert its effect directly on growth or metabolism.

crucial tool in the identification of a nutrient disorder. Another important aspect in diagnosis is the location on the plant where the symptom is expressed. Understanding the translocation principle in bedding plants will enable growers to diagnose more correctly and will, in most cases, pinpoint the macro or micronutrient disorder.

**Macronutrient/micronutrient translocation.**

Knowing why the deficiency occurred is a

<b>Common abiotic disorder of floral crops</b>		
<b>Disorder</b>	<b>Symptoms</b>	<b>Preventative actions or corrective procedures</b>
Air pollution	Yellow to bleach white shoot tips; wilting; flower drop	Plant-damaging levels of ethylene can be detected in greenhouses if flowers begin to drop quickly or do not bloom. Test heaters each year.
Edema or oedema	Corky growth or pimple-like bumps on leaf lamina	Increase airflow over plants with horizontal airflow fans. Reduce irrigation in clougy weather or humid conditions. Supplemental applications of light can also increase transpiration.
Insufficient spacing	Excessive internode elongation	Use plant growth regulators before plants touch one another if pot-tight crop production is preferred. Space or pinch plants if the chemical approach is not preferred.
Mutation	Variegated patterns in plant tissue	Genetic mutations can occur with plants; therefore, growers should purchase stable cultivars or investigate possibilities of cultivar development (patenting or trademarking).
Photoperiod	Premature flowering or tuber formation; marginal necrosis; reduced growth; plant remains vegetative	Apply extended day- or night-break interruption for plants that need to remain vegetative. Provide black cloth to crops with a short day requirement.
Plant growth regulator overdose	Stunted and crinkled foliage	Check math or utilize a Web-base plant growth regulator (PGR) calculator, like the one found at <a href="http://www.ces.ncsu.edu/depts/hort/floricutlrue/software/index/htm">www.ces.ncsu.edu/depts/hort/floricutlrue/software/index/htm</a> . Growers may also want to check specific gibberellic acid containing PGRs to determine if a corrective spray is labeled to overcome plant stunting.
Sunscauld	Marginal burn or papery burn on leaf lamina	Mist recently transplanted material to minimize the effects of light intensity.
Spray burn	Marginal burn or papery burn on leaf lamina	Spray pesticides during cooler periods of the day. Spray test plots (five to 10 plants) if crop has a flush of new growth.
Water stress	Marginal burn or papery burn on leaf lamina	Irrigate more frequently.

Mobility of the nutrient or the ability of the element to translocate itself to another part of the plant has been determined for the essential elements (chart, page 16). Plants obtain nutrients from the substrate solution via root systems. Nutrients are incorporated into tissues, used for cellular growth and utilized in photosynthesis or in the building blocks of plant tissue.

Initially, nutrients are provided to plants from seed reserves, and then as roots begin to develop, plants extract nutrients from the substrate. Once the nutrients become less available to the plant, the plant has to provide nutrients from older tissues so the actively growing regions (shoot tips and axillary shoots) can continue to develop. Basically, the plant is attempting to promote life by supplying nutrients to the upper growth, which harbors the reproductive structures, enabling the continuation of the species.

Some elements are unable to be translocated. In the following two sections, we have explained the differences in mineral translocation between nitrogen and calcium.

**Nitrogen translocation.** Nitrogen is incorporated into organic molecules, and it is involved in the structures of all amino acids, proteins and many enzymes. As levels of nitrogen decrease in the substrate, nitrogen is translocated from the lowest leaves to the actively growing regions of the shoot tip. Deficiency symptoms appear on the older leaves, and a lighter green color is observed. As symptoms progress, the stem becomes weak, the leaves become small, and the lower leaves drop. Necrosis of the older leaves is an advanced nitrogen-deficiency symptom.

**Calcium translocation.** Calcium plays a major role in cell elongation, and it is an important component in cell walls – it acts as cement

between cells. Calcium is transported with water to plant tissues, but if levels in the substrate are too low, calcium deficiency can occur. Because calcium is immobile, it cannot be translocated to the region of active growth in the shoot tip; therefore, new growth is severely reduced.

Although calcium may be adequate in the lowest leaves, levels in the meristematic region can be too low, causing poor leaf expansion, followed by necrotic patches in the young leaves. Complete necrosis of the shoot is the advanced stage, causing the inability of the reproductive structures to form. If flowers are present when calcium levels become devastatingly low in the substrate, bud abortion occurs.

Abiotic disorders can at times be a challenge to properly identify. When problems occur, know the factors that lead to the specific disorder to assist you in asking the right questions. In addition, take full advantage of outside resources, such as company technical representatives and laboratories for diagnosis, to aid you in determining the possible cause of the disorder.

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# IMPACT OF MULCHES ON LANDSCAPE PLANTS AND THE ENVIRONMENT – A REVIEW

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There is a vast array of mulch materials available for landscape use, benefiting plants and soils through weed suppression, evaporation reduction, and other environmental modifications. Given the available choices, it can be difficult to determine which mulch materials are best suited for a particular landscape. The purpose of this review is to provide a comprehensive analysis of the scientific research on the benefits and drawbacks of mulches used in ornamental and urban landscapes.

## Introduction

The term ‘mulch’ is derived from the Germanic work ‘molsh’, which means soft. Though not all mulches are soft, for many the word connotes the soft, spongy layer found in forest ecosystems. Mulches are defined as materials that are applied to, or grow upon, the soil surface, as opposed to materials that are incorporated into the soil profile (amendments). Therefore, any material laid or grown over the soil surface can be considered a mulch, though some materials are more beneficial than others.

## Comparative Benefits of Mulches

*Improved soil moisture.* Exposed to heat, wind, and compacting forces, bare soil loses water through evaporation and is less able to absorb rainfall or irrigation as it becomes increasingly compressed. Weeds can increase evapotranspiration of soil moisture by 25% in a summer day. In contrast, mulches will increase soil water by increasing percolation and retention, reducing evaporation, and reducing weeds. An early study demonstrated that a layer

of straw only 3.8 cm (1.5 in) thick reduced evaporation by about 35% compared to bare soil. Later, Kacinski demonstrated that most mulched soil has greater water retention than bare soil, with the exception of competitive living mulches such as turf.

What is less consistent is how different mulch types influence water movement. For instance, black plastic generally inhibits water movement between the soil and the above-ground environment, thus limiting recharge. Soil water recharge is dependent upon infiltration, which in turn is influenced by surface permeability. Activities and products that compact soils and/or create hydrophobic conditions will limit recharge while increasing runoff and erosion. Plastics, geotextiles, fine-textured organic mulches, sheet mulches, and mulches with waxy components are poor choices in this regard. Therefore though these mulches may initially increase soil water retention since evaporation is reduced, over the long term they will create soils that are unnaturally dry.

In contrast, there is a wide variety of mulching materials that do not limit soil water infiltration and retention: their one similarity is that they are all permeable materials. Most comparative studies among mulch types indicate that organic mulches conserve water more effectively than inorganic; organic and inorganic are better conservers than synthetic and all are better than bare soil. Mulches with demonstrated ability to retain water include gravel and stone, livestock manure, and a vast array of plant materials. These consist of rapid decomposers such as grass clippings, leaves and local crop residues; moderate decomposers including hay and straw, coir pith, and jute; and slowly decomposing timber residues including sawdust, and barks and chips from both hard – and softwoods. Cover crops are generally less effective than either organic or inorganic mulches as they must compete with other landscape plant materials for

water.

From a practical viewpoint, an appropriate mulch will significantly reduce the amount of irrigation needed for all landscapes, and in some cases can eliminate it altogether. In addition to protecting soil reserves, coarse organic mulches will hold water much like a sponge, thereby capturing rainfall and irrigation water for later release and preventing runoff. Less runoff and improved retention will translate to reduced need for supplemental irrigation. In addition, mulch protection from drought stress can also protect trees and shrubs from subsequent environmental stresses such as cold injury.

*Reduced soil erosion and compaction.* Mulch will protect soils from wind, water, and traffic-induced erosion and compaction, all of which contribute directly to root stress and poor plant health. Though living mulches are often the most effective in this regard, holding the soil matrix together even on the steepest slopes, they may not be the best practical or economic choice. Grass sowing, for instance, can reduce erosion but often increases runoff compared to other mulch choices.

Adding even a thin organic mulch will protect soils. Straw mulch in combination with an erosion net was found to decrease erosion by 95% over bare soil treatment in a forest plantation. Studies underscore the importance of leaving fallen vegetation on forest sites. [It is important to note that mulches cannot be used to ‘stabilize’ slopes but only reduce soil loss. Slope stabilization requires an engineering solution, not a horticultural one.]

Compaction is a common ailment of urban soils; while the impacts of foot and vehicular traffic are self-evident, it’s less obvious that rainfall will compact unprotected soils. Adding organic mulch such as bark or jute disperses the direct impact of water droplets, feet, and tires, thus

restoring soil aggregation and porosity. It is better to apply mulch before compaction occurs rather than after the fact. Research has demonstrated that proactive mulching will protect soil integrity, while the same mulch applied after compaction could not reverse bulk density changes even after two years.

*Maintenance of optimal soil temperatures.*

Mulches protect soils from extreme temperatures in that soils can be kept cooler in hot conditions and warmer in cold conditions. Temperature extremes will kill fine roots and while rarely killing established plantings, they can induce a chronic stress as the plant expends energy to generate new fine roots. Hot or cold surface soils can kill new transplants that have not had time to generate a large root mass and established into deeper, more moderate, surrounding soils.

Coarse mulches are more temperature moderating than finely textured mulches of the same general category; for example, the soil under cobbles is cooler than that under gravel, and the soil under leaf mulch is cooler than that under compost. Likewise, thicker applications of organic mulches are more temperature moderating than thin application. Once again, coarse mulches are better in this regard as thick layers of finely textured mulches can inhibit both water and gas transfer.

Among mulch categories, living and organic mulches are more temperature moderating than inorganic mulches. Chunky inorganic mulches such as gravel and lava rock are more effective temperature moderators than solid inorganic surfaces such as concrete. Synthetic mulches including asphalt, fabrics and plastics are poorest in this regard, routinely raising the underlying soil temperature as deep as 12 in below the surface. For some special applications (such as soil solarization to kill pests), this might be desirable, but not for

general landscape or garden maintenance. Black plastic mulches can either raise or lower soil temperatures, probably depending on how much light is absorbed by the plastic and whether heat is retained or reflected. Clear plastic mulches routinely raise soil temperatures since radiation (including infrared wavelengths) is transmitted through the plastic and heat is retained.

Living mulches, such as turf, release water vapor through evapotranspiration and reduce surface temperatures by evaporative cooling, though they use more soil water than non-living mulches. Interestingly the soil temperature beneath turf was shown to be higher than that below mulch, perhaps because soil beneath turf was drier and thus less protected against high temperatures.

*Increases soil nutrition.* Living and organic mulches can increase, decrease, or have no effect upon nutrient levels depending upon mulch type, soil chemistry, and particular nutrients of interest. As living and organic mulches decompose under appropriate water and temperature levels, nutrients are released into the soil and become available for root uptake or microbial use. Generally, green and animal manures used as mulch supply nutrients at higher rates than other mulch choices (such as straw, bark and wood chips) and often perform better than inorganic fertilizers. While immediately available nutrients are sometimes desirable for a landscape, it is important to note that overapplication of these materials can lead to excess mineral availability, causing damage to plants, soil organisms, and nearby watersheds. Therefore, nutrient-rich mulches should be applied sparingly and may be most effective as part of a mulch layer.

While living mulches often compete for nutrients as well as water, this characteristic can be valuable on landscapes where fertility is too high. Fast-growing plant materials will reduce

soil nutrient levels as can microbial activity in low-fertility organic mulches. This has been helpful in restoration of ecosystems with naturally low fertility, allowing native plants to compete more effectively with invasive species. Low nutrient mulches such as uncomposted bark or straw were found to decrease nitrogen levels of soil water while not impacting plant nutrition, thus reducing watershed pollution.

*Reduction of salt and pesticide contamination.* Many landscapes experience salinity stress besides those found near marine coastlines. Arid landscapes in particular are often highly saline as evaporating water leaves behind salt crusts. Irrigation water in arid environments and improperly treated graywater (domestic, non-sewage waste water) can also contain high levels of salts from fertilizers, detergents and other chemical sources. Container plants that are over-fertilized will likewise experience increasing levels of salts.

Because mulches reduce evaporation, more water is left in the soil and salts are diluted. Furthermore, organic mulches can reduce the effect of salt toxicity on plant growth or actively accelerate soil desalinization. Plastic mulches are not effective in this regard, probably because they are not able to bind ions as organic materials can. Organic mulches can also help degrade pesticides and other contaminants, presumably by providing increasing microbial populations that degrade pesticides.

*Increased binding of heavy metals.* Organic as well as living mulches can be effective in removing heavy metals from landscape and garden soils. Common urban contaminants such as lead and cadmium can be removed from the soil solution by mulched leaves. A mixture of compost and woodchips was found to decontaminate forest soils by complexing copper into a less toxic form.

*Improved plant establishment and growth.*

Mulches are used globally to enhance establishment of many woody and herbaceous species. There are hundreds of controlled studies demonstrating that mulches improve seed germination and seedling survival, enhance root establishment and transplant survival, and increase overall plant performance when compared to unmulched controls. Practically, this translates to healthier trees and shrubs requiring less maintenance and chemical application.

Seedling emergence and survival presents a management conundrum: we want to encourage desirable plants yet prevent weeds from establishing. Unfortunately, mulches do not distinguish between weeds and desirable plants. For this reason, many mulches are not appropriate for annual flower beds and vegetable gardens. On the other hand, these same mulches are excellent choices for repelling weed colonization. Success in this respect may be determined by mulch depth and/or seedling maturity. Deeper mulches are associated with improved weed control and are not the best choices for areas that are to be seeded rather than planted, especially if the species of interest have small seeds.

Improved water retention and reduced weed growth are correlated with increased root growth and exploration by desirable plants. Therefore, mulches allow roots of trees and shrubs to extend and establish far beyond the trunk compared to bare soil and thus become increasingly stabilized.

Mulch choice is important in determining how well roots will explore the underlying soil. Root development and density is greatest under organic mulches. Sheet and film mulches that act as barriers to water and air movement will encourage root growth on top of the mulch, which can eventually injure desirable plants

when and if the sheet mulch is removed.

Roots tend to grow into organic mulch layers, but by and large these are fine roots whose presence is transient. Generally, these roots exploit water and nutrient resources in mulch until conditions become unfavorable (e.g. when mulch begins to dry in the summer). These roots die back and new feeder roots appear when resources are more available. In any case, it does not appear to injure the plant to have roots exploring the mulch layer. However, roots will also colonize landscape fabrics and if these materials are eventually removed they could cause extensive damage to fine root systems. This is one reason not to use landscape fabrics around woody plants.

As early as 1942, researchers found that mulched trees grew 67% better than those grown on bare soil. The best mulches for overall plant performance are organic materials, consistently rated as the best or second best in comparative field trials. Gravel and stone are generally not as effective as organic mulches in optimizing plant performance. Sheet mulches can also produce disappointing results. Not surprisingly, competitive ground covers such as turf grasses result in reduced growth even compared to bare soil conditions.

*Reduction of disease.* Physically, mulches will reduce splashing of rain or irrigation water, which can carry spores of disease organisms up to the stems or leaves of susceptible species. Additionally, the populations of beneficial microbes that colonize many mulch materials can reduce soil pathogens either through direct competition for resources or through chemical inhibition. Regardless of the mechanism involved, disease reduction is an important benefit of many mulches. Mulches maintain an optimal soil environment, which in turn supports healthy plants that are less susceptible to opportunistic pathogens.

Mulches can combat disease organisms directly as well. Western red cedar (*Thuja plicata*) heartwood contains thujaplicin, a water-soluble tropolone not only inhibitory to various bacteria and fungi, but with anti-tumor activity as well. In addition to plant-derived antibiotics, healthy organic mulches may also contain a variety of soil microbes that can exert biological control over pathogens, either through resource competition or enzymatic degradation. Many microbes produce cellulose enzymes that attack the cell wall of pathogens such as cinnamon fungus (*Phytophthora cinnamomi*). Mulching soils to encourage populations of indigenous, beneficial soil microbes will increase the effectiveness of biological control in managing disease. Some mulches, however, can increase the incidence of disease by exacerbating already poor soil conditions (e.g. using a plastic mulch).

*Reduction of weeds.* Mulching as a means for landscape weed control is highly effective, though the mechanism(s) responsible for control are not completely understood for all mulch types. Nearly all mulches reduce light, which will stress existing weeds and prevent the germination of many weed species, especially those with small seeds. The physical barrier created by mulches can prevent weeds from emerging, though this effect is temporary and disappears as mulches decompose. Certain organic mulches, especially wood chips, may control weeds chemically through the leaching of allelopathic chemicals naturally occurring in the wood. Additionally, the protected soil habitat created by the use of mulches can increase beneficial organisms that prey upon weeds or eat their seeds.

Living mulches can reduce weed problems through both competition for resources and allelopathy. Ideally, cover crops and ground covers suppress weeds seed germination and establishment while having little effect on

desirable plants. This ideal is realized in situations where ground covers occupy a different niche than the desirable plants (e.g. trees and large shrubs whose roots are typically deeper than ground covers). If ground covers are too much like other plants in the landscape, such as low-growing herbaceous perennials, than they may compete more directly for limited resources like water, nutrients and sunlight.

Although they can be highly effective in immediately eliminating weeds, plastic films and landscape fabrics should not be used as a long-term approach of weed control in landscapes. White and green plastics do not eliminate photosynthetic radiation, thus allowing weeds to continue to grow underneath. Regardless of mulch color, eventually, weeds will colonize soil above these mulches and some weeds can pierce and grow through plastic films. Replacement of plastics and fabrics is not only time-consuming and expensive but also damages the roots of desirable plants that invariably will grow through and over these mulches.

Organic mulches are variable in their weed-controlling abilities. Nutrient-rich, finely textured materials like compost are not satisfactory mulches for weed control. Instead, they act as a fertile base and potential seed bank for establishment of new weeds or enhancement of perennial weeds. Weed seeds that settle on top of organic mulches are more likely to germinate, especially if the mulch layer are thin (meaning seedling roots can more quickly reach the underlying soil). Applying two, rather than one organic mulch layer results in significantly less seed germination.

Organic mulches that are coarse, applied in thicker layers, and/or less nutrient-rich are more effective in controlling weeds – sometimes even better than herbicides.

## Mulch Problems – Real and Perceived

*Acidification.* Organic mulches such as wood chips and bark are thought by some to be soil acidifiers. No scientific research supports this, and in fact studies refute this perception.

It's likely that in artificial conditions, such as nursery production, that woody materials do have an acidifying effect when they are used as part of a potting medium. Release of phenolic acids is one stage of the decompositions of woody material, and if this material comprises the bulk of medium then acidification is likely to occur. In a field situation, however, where the woody material is used as a mulch (and not worked into the soil), any acidification will be localized within the mulch layer and have little effect on the vast underlying soil environment below. Thus, soil acidification due to mulching with woody plant material is unlikely to occur under real world conditions.

*Allelopathy.* Allelopathy is the inhibition of seed germination and growth of plants through the release of chemicals and apparently plays a large part in the weed-controlling behavior of many organic and living mulches. A few growth-inhibiting substances have been isolated and identified, including the classic example of juglone (and juglonic acid) which is produced in all parts of black walnut (*Juglans nigra*).

Seeds and seedlings, whether weeds or desirable species, are most sensitive to mulch suppression as they do not have the extensive root systems of established plants. It is unlikely that any properly applied landscape mulch will have allelopathic effects on established landscape plants, but is most likely to injure newly planted or shallowly rooted plants in the landscape. For such plantings, a short period of composting and correct application of woody mulch will prevent damage.

*Competition.* As mentioned earlier, living mulches can be competitive with landscape plants for water, nutrients, and space. Thus, turf grass must be kept away from newly installed shrubs and trees and can easily be replaced with an organic mulch.

*Chemical contamination.* As with composts, woody mulch quality is influenced by the source of materials. Mulches created from branches and tree trimmings often contain a diversity of leaves, wood, and bark, which contributes to a highly functional mulch. In contrast, woody mulch made from wood recovered from construction and demolition debris can contain pressure-treated lumber. Mill wastes that contain formaldehyde and other wood processing residues reduce survival of tree seedlings when used as a mulch.

*Disease.* Mulches made from diseased plant materials can contain those pathogens. For this reason, many mulches are composted or otherwise treated at temperatures that kill the pathogens along with other harmless or beneficial organisms. Therefore, many commercially available organic mulches are relatively sterile.

While mulches made from diseased wood can contain viable populations of pathogens such as honey locust canker (*Thyronectria austro-america*), few examples of disease transference exist in the literature. It is not surprising that so few examples of mulched-mediated disease transmission have been documented. The pathogen of interest must be present in such a way as to fit the epidemiology of the disease cycle; simply existing in a mulch source is not enough.

While disease transmission from mulch to tree is unlikely, there is greater probability of infection if backfill soil is amended with wood

chips.

Many landscape pathogens are both opportunistic and pervasive in the soil environment. *Armillaria* spp., for instance, are widespread in many soils as a decomposer but can become pathogenic under unhealthy soil conditions. Healthy soil communities, on the other hand, have diverse fungal and bacterial species, many of which are symbiotic partners of plant root systems. These beneficial species can outcompete pathogens as long as soil conditions remain optimal for root growth. When soils become compacted and anaerobic, plants decline and become susceptible to opportunistic pathogenic microbes – always present but inactive in healthy soils.

Given the distance between wood chip mulch and plant roots, it's doubtful that pathogens would travel far under healthy soil conditions. It does, however, point out the importance of keeping wood chip mulches away from the trunks of trees and shrubs as moist trunk conditions are at risk of pathogen infection. In addition, only unprocessed wood should be used in making wood chips. Mulches derived from shipping pallets and other wood packing materials, especially if uncomposted, could introduce exotic plant pathogens.

Though they do not qualify as disease organisms, other fungal species should be mentioned as possible nuisances in woody mulches. The artillery fungus (*Sphaerobolus stellatus*) can be found on landscape mulches where it can propel sticky spore masses onto the sides of nearby light-colored cars and houses. Spent mushroom compost has recently been identified as an antagonist to this fungus and might be a wise choice as a mulch component in affected landscapes. The colorfully named 'dog vomit fungus' (*Fuligo septica*) – actually a slime mold – creates a bright yellow mass on woody mulches. This is not a pathogenic species but may be of questionable aesthetic value.

*Flammability.* A recent comparison of 13 landscape mulches found rubber mulch to be the most flammable, followed by fine textured organic mulches (dried pine needles, straw, shredded bark), coarse textured organic mulches (chipped wood, bark nuggets, cocoa shells), mulches with higher water content (composted yard waste and sod). And finally brick chips (which never ignited). These comparisons should be carefully considered when mulching in regions where there is significant fire danger.

*Nitrogen deficiency.* A common misconception about woody mulches is that they impose a nutrient deficiency upon plant materials. This is based on the fact that woody mulches have a high C:N ratio and nitrogen will be 'tied up' by microbes during the decomposition process. Furthermore, woody materials that are used as amendments incorporated into soil or potting mixes will create zones of nitrogen deficiency, which is visualized by spindly, chlorotic growth of plants in these zones.

Experimental research reveals that neither nitrogen immobilization nor growth suppression occurs as a result of using woody materials for mulch. To the contrary, many studies have demonstrated that woody mulch materials actually increase nutrient levels in soils and/or associated plant foliage. A zone of nitrogen deficiency exists at the mulch/soil interface, possibly inhibiting weed seed germination while having no influence upon established plant roots below the soil surface. For this reason, it is inadvisable to use high C:N mulches in annual beds or vegetable gardens where the plants of interest do not have deep root systems.

*Pests.* Many organic mulches, especially those based on wood products, have an underserved reputation as 'pest magnets.' In fact, many of these wood-based mulches are not attractive to pest insects but are actually insect repellent.

A common concern is whether wood-based mulches are attractive to termites. In fact, one recent study compared subterranean termite (*Reticulitermes virginicus*) activity underneath both organic (bark and wood) and inorganic (gravel) mulches. The greatest termite activity was found beneath the gravel mulch. In regions where subterranean termites are potential pests, organic mulches should be selected that are low in nutrients.

*Weed contamination.* Mulches lacking pedigrees can be carriers of weed seeds and other undesirable plant parts. While controlled research on this problem is lacking, anecdotal evidence suggests that improperly treated crop residues and composts as well as bark mulches are often carriers of weed seed. Woody mulches may contain invasive species associated with tree materials that are chipped. Many of these species, such as English ivy (*Hedera helix*), can easily grow from seed or regenerate vegetatively, thus colonizing landscapes. If it is not possible to document the mulch source, it might be prudent to use it on a small area of the landscape and monitor it for problems before using it more widely.

A successful mulch must be deep enough to suppress weeds and promote health soils and plants: research has demonstrated that weed control is directly linked to mulch depth, as is enhanced plant performance. Coarse materials are more effective in this regard as their depth will not have the negative impacts found with fine-textured materials.

Excerpted from *J. of Environmental Horticulture* 25(4):239-249. December 2007.

## Research Briefs

### *Container Production:*

**Cyclanilide to promote branching of woody ornamentals.** Woody ornamental shrubs often require multiple prunings during nursery production to develop compact, well-branched plants. However, significant labor costs and loss of plant biomass that can lengthen production time are incurred with mechanical pruning. Cyclanilide (CYC) is an experimental growth regulator from Bayer Environmental Science. Results from experiments with 12 woody shrubs indicate that plants outgrew the effects of one treatment of CYC, but that multiple CYC applications increase plant branching, compaction and overall quality. However, injury, although transitory, was severe enough to discourage weekly or biweekly applications at concentrations above 100 ppm. (A.S. Holland, G.J. Keever, J.R. Kessler, Jr. and F. Dane)

*Excerpted from J. Environ. Hort. 25(4):191-196 December 2007.*

**Cyclanilide promotes lateral branching in woody landscape species.** Application of foliar sprays of cyclanilide (CYC) in the range of 54 to 112 ppm promoted lateral branching of ‘Muscogee’ crape myrtle, ‘Compacta’ inkberry holly, ‘Pinkie’ and Eleanor Tabor™ Indian hawthorn, and ‘Girard Rose’ azalea. For these plants, lateral branching was promoted with little or no reduction in plant size. However, application to Fraser photinia resulted in phytotoxic symptoms of leaf yellowing, blotching and curling, and an increased susceptibility to entomosporium leaf spot. Treated crape myrtle also had a delay in flowering. (T.J. Banko and M.A Stefani)

*Excerpted from J. Environ. Hort. 25(4):215-220 December 2007.*

**Cyclanilide to increase branching in containerized whip production.** Cyclanilide (CYC) foliar applications to container-grown whips during periods of active shoot elongation increased branching in one-year old whips that normally do not branch until the second year of production. The origin of lateral branching can be controlled by timing of CYC application. Sprays of 56 ppm were not as effective as 112 ppm and sprays of 223 ppm did not increase branching and reduced growth, so 112 ppm is the recommended application rate. Species tested in this study included Autumn Blaze serviceberry, Prairie Fire crabapple, Avondale Chinese redbud and Greenspire linden. (T. Sternberg and D.K. Struve)

*Excerpted from J. Environ. Hort. 25(4):221-228 December 2007.*

**Fertilization of Rosa ‘Mariandel®’ in compost amended peat.** Based on this research the following alternatives are advised for nurseries when compost is included in the substrate: (a) apply fertilizer at 6 weeks after potting (at the latest) if fertilization is coupled with irrigation (i.e. fertigation); (b) use controlled release fertilizer with a low initial releasing profile as opposed to Osmocote exact standard that releases its content constantly. (Y. Amha and H. Bohne)

*Excerpted from J. Environ. Hort. 25(4):197-203 December 2007.*

**Preemergent herbicide affect on cold hardiness of container azaleas.** There was no clear trend that the preemergence herbicides tested caused a loss or gain in cold hardiness in ‘Tradition’ azalea. However, some preemergence herbicides caused a significant increase or decrease in cold acclimation of stems and leaves at selective sampling dates and temperatures. More research is needed on the potential of preemergence herbicide as well as

other pesticides, to reduce the cold hardiness of ornamentals. (M.A. Czarnota and O.M. Lindstrom)

*Excerpted from J. Environ. Hort. 25(4):211-214 December 2007.*

**Growth retardants applied to Coreopsis verticillata ‘Moonbeam’.** Under greenhouse conditions, rapid growth in small containers may result in excessively tall, leggy plants that are unmarketable. This study looked at various growth retardants.

**Bonzi** – not as effective as other growth retardants tested, even at rates up to 120 ppm. When used in a tank mix with B-nine, Bonzi was not as effective as B-nine alone.

**Royal Slo-Gro** – increased plant size and delayed flowering

**A-Rest** – as a drench was effective in reducing plant size but not as effective as B-Nine or Cutless at the rates tested.

**Cycocel** – not effective at the rates used but when combined with increasing rates of B-Nine did result in improved plant quality.

**B-Nine** – when applied as a foliar spray, resulted in the highest quality plants of all treatments; equally effective when applied at 5100 or 7650 ppm.

**Cutless** - when applied as a foliar spray, resulted in the highest quality plants of all treatments, but Cutless is not labeled for application to greenhouse-grown ornamentals. (J.R. Kessler, Jr. and G.J. Keever)

*Excerpted from J. Environ. Hort. 25(4):229-233 December 2007.*

**WholeTree substrates used for production of annual vinca.** Peat moss and pinebark, the primary components of growth substrates used in the production of container-grown herbaceous crops have availability concerns. WholeTree is a substrate made from whole pine trees

(aboveground portions: wood, bark, needles, cones, etc.) and consists of approximately 80% wood fiber. It is sustainable and available in close proximity to major horticultural production areas. Utilization of the entire shoot will maximize the biomass yield and reduce the production costs associated with manufacturing. Substrates made from loblolly pine, slash pine and longleaf pine were tested in the production of annual vinca. By 54 days after potting there were no differences in plant growth indices between the *WholeTree* substrates and pinebark. Root growth was similar among all treatments. Based on these results, *WholeTree* substrates have potential as an alternative, sustainable source for producing short-term horticultural crops. (G.B. Fain, C.H Gilliam, J.L. Sibley and C.R. Boyer)

*Excerpted from HortTechnology 18(1):13-17, January-March 2008.*

**Growth of chrysanthemum in pine tree substrate.** A pine tree substrate (PTS), produced by grinding debarked loblolly pine offers potential as a viable container substrate for greenhouse crops. PTS was compared to a commercial peat-lite (PL) substrate comprised of 45% peat, 15% perlite, 15% vermiculate and 25% bark. It required about 100 mg/l N more fertilizer for PTA compared to PL to obtain comparable growth. Although there is added production cost with extra fertilizer, there are cost advantages with PTS compared with peatmoss substrates. For example, PTS can be ground to a particles size that provides acceptable water and aeration levels in the substrate without the added expense of incorporating perlite or vermiculite, which are normally added to peatmoss. In addition, PTA can be produced locally where loblolly pine trees can be grown, reducing the transportation costs associated with peatmoss. (R.D. Wright, B.E. Jackson, J.F. Browder, J.G. Latimer)

*Excerpted from HortTechnology 18(1):111-115 January - March 2008.*

### ***Field Production:***

**Depth of main lateral roots of nursery trees in Ohio before and after harvest.** Established trees are declining or dying in the landscape as much as 10 years after landscape installation due to excess soil over the roots deposited during production, harvest, landscape installation or during the subsequent landscape maintenance. This survey evaluated deciduous trees in Ohio before harvest (7 nurseries) and after harvest (8 brokerage facilities) determine the depth of main lateral roots providing evidence about when that excess soil is deposited. Main lateral roots originate at the root-shoot junction in trees and are also referred to as the root flare or buttress roots. In the nursery survey, differences in the depth of main lateral roots were found among nurseries and production year. The average depth was 2.4 inches deep in the soil profile. From the broker survey, both brokers and propagation methods showed differences. The average depth was 3.4 inches of excess soil over the main lateral roots. Trees propagated by cuttings had deeper main lateral roots than trees propagated by seed or budding. This makes sense since cuttings are planted 3-4 inches deep for vertical stability (prior to root initiation) and this soil is never removed during the transplant process. Main lateral roots were greater than 1 inch deep for most trees, which is deeper than industry standards allow. The fact the excess soil is deeper at brokerage firms than in the nursery indicates that soil is added (possibly inadvertently) during harvest or at least not removed during harvest. (R. G. Rathgens, T.D. Sydnor and D.S. Gardner)

*Excerpted from J. Environ. Hort. 25(4):187-190. December 2007.*

## **Landscape:**

**Landscape performance of herbaceous perennials irrigated with saline water.** Water shortages in the Southwest have resulted in the need to use reclaimed water to irrigate urban landscapes. This study evaluated the growth responses and general performance of 10 perennials and groundcovers grown in raised beds irrigated with saline solutions at three levels of salinity. *(In the East, we don't have quite the same problem with water shortages producing the need to irrigate with saline reclaimed water but there are instances where saline irrigation might be used and knowledge of tolerant perennials would be valuable.)* Yarrow (*Achillea millefolium*), firewheel (*Gaillardia aristata*), lantana (*Lantana x hybrida*), honeysuckle (*Lonicera japonica*), and rosemary (*Rosmarinus officinalis*) could be irrigated with saline water at a salinity level of up to 5.4 dS/m with little reduction in growth and aesthetic appearance. Black-eyed Susan, purple verbena, garden verbena and spike verbena suffered unacceptable injury. *Note: honeysuckle (L. japonica) is considered invasive in DE and is not recommended for landscape use.* (G. Niu, D.S. Rodriguez and L. Aquiniga)

*Excerpted from J. Environ. Hort. 25(4):204-210 December 2007.*

**Salt spray tolerance with two ornamental grasses.** *Miscanthus sinsensis* 'Gracillimus' (maiden grass) and *Pennisetum alopecuroides* 'Hamelin' (fountain grass) were tested for tolerance to 100%, 50%, 25% and 0% seawater salt spray. As seawater concentration increased, root, shoot, whole-plant biomass gain height, inflorescence number and visual quality decreased for both cultivars. However, fountain grass was slightly more tolerant of salt spray than maiden grass. (S.M. Scheiber, D. Sandrock, E. Alverex and M.M. Brennan)

*Excerpted from HortTechnology 18(1):34-38 January - March 2008.*

**Factors influencing consumers' selection of landscape service providers.** In a 10% response rate survey mailed to consumers in the metro-Philadelphia area, "quality of work" played the most important role in the evaluation and selection process of landscape service providers. Landscape contractors should think about how they can best communicate the level of quality of work they perform. Examples could include demonstration of awards won for design and installation or examples of completed projects. "Referrals from friends and/or family is another important resource used by consumers seeking a landscaping service provider. (M.S. McCoy, K.M. Kelley and D.T. Stearns)

*Excerpted from HortTechnology 18(1):148-153. January - March 2008.*

**Live plants and window views of green spaces affect employee job satisfaction.** A job satisfaction web survey was administered to office workers in Texas and the Midwest (450 responses). Results indicate that individuals who worked in offices with plants and windows reported that they felt better about their job and the work they performed. This study also provided evidence that those employees who worked in offices that had plants or windows reported higher overall quality-of-life scores. There were no differences based on age, ethnicity, salary, education level and position among employees. (A. Dravigne, T.M. Waliczek, R.D. Lineberger and J.M. Zajicek)

*Excerpted from HortScience 43(1):183-187. February 2008.*

### *Christmas trees:*

**Flammability or Douglas Fir and Fraser Fir Christmas trees.** Concerns about Christmas trees as a potential fire hazard have increased regulations governing where and how trees can be displayed. Although statistics show only 0.1% of annual household fires in the United States originate in Christmas trees, these laws and regulations create difficulties for Christmas tree producers, retailers and end users of real trees. In these studies, flammability was closely related to moisture content (MC), with or without flame retardants. Flames self extinguished when MC was  $\geq 60\%$ . When displayed in water, the MC of branches actually increased to levels above the initial values. SafeTree Christmas Tree Fire Retardant and RapidCool FRX Christmas Tree Retardant were not effective. These results confirm that displaying a cut Christmas tree in water is the most reliable way to maintain its freshness and to reduce potential fire hazards. (G. Chastagner, L.E. Hinesley and J. Owen)

*Excerpted from HortScience 43(1):203-2057. February 2008.*

### **Turf:**

**Establishing Ky bluegrass and perennial ryegrass mixtures on football fields.** Three seeding dates were tested: late summer (August), dormant seeding in late fall (November) and spring (April). Ky bluegrass (KBG) and perennials ryegrass (PRG) blends and a PGR blend were seeded. Traffic was simulated on the fall following the spring seeding. Summer seeded plots provided the best quality turf for all KBG:PRG blends and dormant seeding resulted in the lowers quality. Turf seeded with 100% PRG was less sensitive to seedling date. Summer seeding resulted in the least amount of broadleaved weeds with

dormant seeding having the most weeds. The most consistently desirable results may be obtained with a mixture containing 70% to 80% KBG and 30% to 20% PRG, respectively. Mixtures dominated by KBG should be seeded in late summer for best results. (*Editor's Note: These studies were conducted in Wisconsin, so their results aren't directly applicable to Delaware, but seeding time and broadleaf weed data are consistent with what we see in Delaware.*) (J.C. Stier, E.J. Koeritz and M. Garrison)

*Excerpted from HortScience 43(1):240-244. February 2008.*

### **Pests:**

**Evaluation of sources of entomopathogenic nematodes.** The following nematodes and sources were evaluated for pre-application survival based on eight shipments/samples of each EPN product received during a 5-month period.

*Steinernema feltiae* – NemaShield, Nemasys, Gnat Not, Horticultural Scanmask

*Heterorhabditis indica* – GurbStake-Hi.

Gnat Not – ½ the shipments contained 40-70% living EPN; the other ½ contained 99%; overall was more than 85%

Nemasys – 98% survival

Horticultural Scanmask – 56% survival

Grubstake-Hi – more than 85%

Nemashield – as low as 50% but typically between 65 and 75%

Nemashield and Nemasys – only suppliers with return policy.

(E.X. Caamano, R.A. Cloyd, L.F. Solter and D.J. Fallon)

*Excerpted from HortTechnology 18(1):84-89 January - March 2008.*

**Aerated steam or fumigation with metam sodium eradicates *Phytophthora ramorum* from potting soil.** All pathogens in the infested potting medium were killed by aerated steam heat treatments of 50°C or higher. Metam sodium concentrations of 1.0 mL/L of medium or greater also eradicated all pathogens from the potting medium and soil. These results show that aerated steam treatment or fumigation with metam sodium can effectively sanitize soil-less potting medium infested with *P. ramorum* or other soilborne pathogens as well a *P. ramorum*-infested soil beneath infected plant containers. In addition, steam treatments to 70°C did not melt plastic plug trays. (R.G. Linderman and E.A. Davis)

*Excerpted from HortTechnology 18(1):106-110  
January - March 2008.*

#### ***New Introductions:***

**‘Blue Myth’ *Trichostema*.** Blue Myth is a perennial subshrub with woolly blue flowers and aromatic foliage. It has a fine texture and grows 2 feet high by 2 feet wide. Blue Myth is hardy to Zone 9 so it should be grown as a container plant in Delaware. Peak flowering is in spring, but shearing the plant will increase flower production. *Trichostema* generally grows in full sun with well-drained soils. Tissue-culture propagules can be obtained by contacting Dr. Jon Lindstrom, 316 Plant Science, Department of Horticulture, University of Arkansas, Fayetteville, AR 72701 or tranell@uark.edu. (B.L. Dunn and J.T. Lindstrom)

*Excerpted from J. Environ. Hort. 25(4):250-251  
December 2007.*

#### **‘Cranberry Star’—A fancy leaved caladium for containers and shady landscapes.**

‘Cranberry Star’ is intended for use in containers and shady landscapes. Its

performance was outstanding both in pots and landscapes and far superior to ‘Marie Moir’, a cultivar that has a leaf color and pattern that is closest of all cultivars in the commercial trade. It also outperformed ‘Candidum’ and ‘Miss Muffet’, two cultivars that are considered very profitable to grow by the tuber-producing industry and valued in the pot and landscape industries. Although extensive research and evaluations of this cultivar have been performed on small acreages, tuber producers are encouraged to plant only limited quantities of ‘Cranberry Star’ until they have gained experience in producing this cultivar. Standard postharvest treatment of tubers is recommended and preplant hat water treatment of tubers is encouraged to prolong their life. A patent will be applied for by the Florida Agricultural Experimental Station and production of this cultivar is to be with a licensing agreement with the Florida Foundation Seed Producers, P.O. Box 309, Greenwood, FL 32443. Information on tuber availability and propagation agreements can be obtained from the Florida foundation. (Z. Deng, B.K. Harbaugh and N.A. Peres)

*Excerpted from HortScience 43(1):252-254.  
February 2008.*

# Publications

**Professional Management Guide** for Insects, Diseases and Weeds of Trees and Shrubs in New England

This updated 2008-09 guide tells you what is current and legal for use in all the New England states. This is the way to stay current with pesticide information. This manual offers the latest on virtually all the insects, diseases, and weeds of woody plants in New England; current and legal listings of chemical compounds labeled for the management of these pests. Price: Replacement update alone-\$26, update plus three-ring binder-\$30.00. For more information visit website at [www.umassgreeninfo.org](http://www.umassgreeninfo.org)

**Establishment and Maintenance of Landscape Plants II.** Carl E. Whitcomb, 2006 Lacebark, Inc., P.O. Box 2383, Stillwater, OK 74076. 340 p., inc. index and glossary. \$59.00, hardback. ISBN 0-9613109-7-9. Updates in this newly revised edition include a helpful glossary, descriptions of new products and new methods for improved plant establishment, and modifications to make the book user-friendly for amateur gardeners.

**Best Practices for Wildlife Control Operators.** Paul D. Curtis and Jull Shultz. 2008. Written with wildlife control professionals in mind, this practical training manual focuses on best practices, the prevention of wildlife damage, and a realistic assessment of job risks for wildlife control operators. Published by Thomson Delmar Learning; available from [www.delmarlearning.com](http://www.delmarlearning.com) (ISBN-13: 9781418040949); \$80.95; 368 p.

# Pesticides/IPM

The UD Pesticide Info web site <http://ag.udel.edu/extension/pesticide/index.php> gives the schedule through April & has links to On-Line training

March 26, 2008. Testing at DDA 8 am to noon

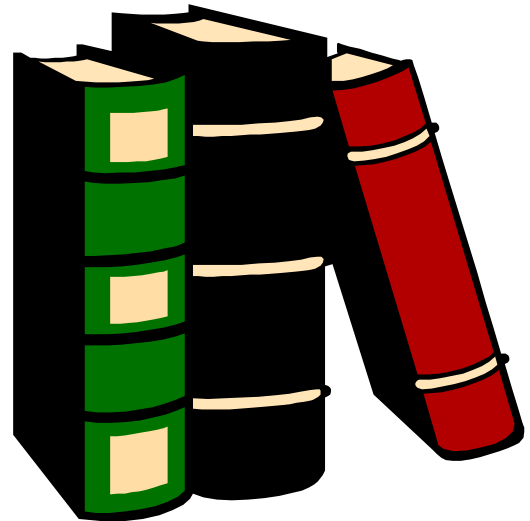
April 23, 2008. Testing at DDA 8 am to noon

## PRODUCT CANCELLATIONS

Chloroneb – on residential lawns and turf, as well as on lawns and turf at parks and schools.

Denatonium Benzoate -- in or on conifers and deciduous, non-bearing trees, shrubs, flowers, and other ornamental plants.

Nicotine (in or on lawns and outdoor ornamentals), 4-Aminopyridine (formulated as powder), and Fenoxycarb (indoor residential):



# Calendar

**March 13, 18 & April 1** – 2008 Ornamentals Short Course Programs. Plant Material Uses Series. New Castle County Extension Office, Wyoming Road, Newark, DE. 7:00pm – 9:00pm, cost \$35 or \$10 for each session. Session 3: Plants in Groups or Masses, 3/13, Session 4: Drought Tolerant Plants, 3/18, Session 5: Problem-Free Plants, 4/1 (pesticide credits will be awarded for Session 5). Contact Dot Milsom (302-831-2531).

**March 11, 20 & 27** – 2008 Ornamentals Short Course Programs. Deciduous Tree Series, 3 Sessions throughout the month of March at the Research & Education Center, Georgetown, DE. 4:00pm – 6:00pm. Cost: \$25 or \$10 for each session. Session 1: Cultural Concerns (nutrient management credits will be awarded), 3/11, Session 2: Diseases (pesticide credits will be awarded), 3/20, Session 3: Insects (pesticide credits will be awarded), 3/27. Contact Dot Milsom (302)831-2531.

**March 14** – Friends of Agriculture Breakfast Series, Michael Scuse, Delaware Secretary of Agriculture-“Current Activities in Delaware Department of Agriculture”. Modern Maturity Center, 1121 Forrest Ave., Dover, DE. Registration for each breakfast \$15, time 7:15 a.m. For more information contact Alice Moore (302)831-2504.

**March 17-19** – 31<sup>st</sup> Annual DSA Seminar & Exposition, Clarion Conference Center, Ocean City, MD. For more information call DSA (302)856-7303. E-mail [rcjester@udel.edu](mailto:rcjester@udel.edu). Visit on the Web at [www.delmarvasafety.com](http://www.delmarvasafety.com)

**March 18** – UDBG Plant Sale Preview Talk/slide show, Girl Scout Building on the College of Agriculture & Natural Resources campus in Newark, DE. 7:00pm – 9:00pm. This talk is free and open to the public. It will include a small, select plant silent auction.

**March 19** – Pruning for Professionals-grow healthy trees, 9:00 a.m. to 3:00 p.m. Sponsored by Penn State Extension Chester County. Build your: Technique and skill level, International Society of Arboriculture CEU's will be offered. Penn Township Park, 260 Lewis Rd, West Grove, PA 19390. Phone: (610)696-3500, email: [cab46@psu.edu](mailto:cab46@psu.edu)

**March 27** – UDBG Guided Plant Walk, departing from Fischer Greenhouse, (in back of Townsend Hall) Newark, Delaware. 4:00pm – 5:30pm. This plant walk is free with a reservation (302)831-2531. Dr. John Frett will lead this tour of plant sale items so buyers can see plants

established in the landscape in larger or mature sizes.

**March 27** – Pennsylvania Floral Industry Association Present the Interior Landscape Technician Symposium, Longwood Gardens, Kennett Sq., PA., 8:00 a.m. registration, cost \$85 member, \$95 non-member. Pesticide licenses recertification credits will be given. Requests and general information: call Keith at PFIA (717)238-9758 or toll-free (800)234-3779.

**March 27** – May 1 -Deciduous Flowering Shrubs II, Longwood Gardens Continuing Education 2008. (6 sessions)-Visitor Center Auditorium, 1:00 p.m. -3:00 p.m. cost \$149 passholder, \$159 non-passholder. Code #081EPDFA. Evening session: 7:00 p.m. – 9:00 p.m. Code #081EPDFE. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**March 29** – Gardening: Special Saturday Program, What is a Native Plant?, Jody Payne, 10 a.m.-12 p.m., Invasive Plants, Carol Levine, 10 a.m.-12 p.m. A Native Perennial Garden, Brad Roeller, 12:30 p.m.-2:30 p.m., The Special Virtues of Native Plants, Sara Stopek, 12:30 p.m.-2:30 p.m., Woody Natives for Area Gardens, Brad Roeller, 2:45 p.m.-4:45p.m., Native Plants for Urban Gardens, Gardening, Sara Stopek, 2:45 p.m.-4:45 p.m., #GAR 202 Section A. The New York Botanical Garden, Continuing Education Program, Bronx, NY 10458-5126. To register, or for more information, call (717)817-8747. Cost \$31 non-members, \$28 members.

**April 2-May 7** – Small Flowering Trees, Longwood Gardens Continuing Education 2008. Visitor Center Auditorium,(6 sessions), 1:00 p.m. 3:00 p.m., cost \$149 passholder, \$59 non-passholder. Code #081OPSTA. Evening sessions 7:00 p.m. – 9:00 p.m. Code #081OPSTE. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**April 5** – Copeland Native Plant Seminar. Ashland Nature Center, Barley Mill and Brackenville Roads, Hockessin, DE 19707. Sponsored by Delaware Nature Society and Mt. Cuba Center. Time 8:30am – 2:30pm, cost DNS members \$65/Non-members \$85. For more information call: (302)239-2334 or email: [john@delawarenaturesociety.org](mailto:john@delawarenaturesociety.org)

**April 9-10** – Back to Basic's-2008. Held at the Chester County Solid Waste Authority. “Tree & Shrub transplanting, planting site preparation, mulching, total care and why”-Bring your landscape crew for training (two sessions: April 9<sup>th</sup>, English, April 10<sup>th</sup>, Spanish) 9:00 a.m. – 12:00 p.m. Cost \$30. For more information contact Cheryl A. Bjornson, [cab46@psu.edu](mailto:cab46@psu.edu)

**April 9** – Green and Sustainable-What’s Our Responsibility? Longwood Gardens Continuing Education 2008., Ballroom, 7:00 p.m., cost \$15. Code #081SLGSE. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**April 17-19** – The Mt. Cuba Center Trillium Symposium. Join the world’s leading trillium experts to discover and share unique scientific, conservation, and gardening knowledge about this magnificent woodland treasure. For more information visit [www.trilliumsymposium2008.org](http://www.trilliumsymposium2008.org).

**April 26** – Annual UDBG Plant Sale, 9:30am – 4:00pm. The UDBG Spring Plant Sale is held on Ag Day each year. Plants include perennials, tender perennials, shrubs, small flowering trees, evergreens and shade trees. Plant sizes range from quarts to 5 gallons. Call (302)831-2531

**April 26** - Annual Rare Plant Auction. The Delaware Center for Horticulture. Longwood Gardens, Kennett Sq., PA. Call (302) 658-6262, ext. 103; e-mail [jmatassino@dehort.org](mailto:jmatassino@dehort.org); [www.rareplantauction.org](http://www.rareplantauction.org)

**May 14** – Weed Identification Walk. Walk. Longwood Gardens Continuing Education 2008., Acer Room, 9:00 a.m. – 12:00 noon, cost \$70 passholder, \$79 non-passholder. Code #081PFWIM. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**May 14** – Turf for the Professional. Walk. Longwood Gardens Continuing Education 2008., Acer Room, 1:00 a.m. – 4:00 p.m., cost \$70 passholder, \$79 non-passholder. Code #081PFTPA. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**May 17** – Digital Garden Photography. Longwood Gardens Continuing Education 2008. Auditorium, Outdoors & Conservatories, 9:30 a.m. – 3:30 p.m., cost \$129 passholder, \$139 non-passholder. Code #081BODGD. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**June 17** – Pest Walk with Brian Kunkel & Bob Mulrooney at Goodstay Center in Wilmington, Delaware. 4:00pm – 5:30pm. Cost is \$10 (pesticide credits will be awarded).

**June 19** – Pest Identification Walk. Longwood Gardens Continuing Education 2008., Acer Room & Outdoors. 9:00 a.m. – 12:00 noon, cost \$70 passholder, \$79 non-passholder. Code #081PFPIM. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**June 19** – Plant Disease Identification Walk. Longwood

Gardens Continuing Education 2008., Acer Room & Outdoors, 1:00 p.m – 4:00 p.m., cost \$70 passholder, \$79 non-passholder. Code #081PFPDA. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**June 25** – Wetland Training Courses 2008. Maryland Wetland Permit Courses, cost \$200. Course Descriptions & Registration available online at [www.wetland.org](http://www.wetland.org) or Call (410)745-9620

**July 10-11** – Wetland Training Courses 2008. Introduction to Wetland Botany, cost \$380. Course Descriptions & Registration available online at [www.wetland.org](http://www.wetland.org) or Call (410)745-9620

**August 4-5** – Wetland Training Courses 2008. Advanced Plant Identification, cost \$380. Course Descriptions & Registration available online at [www.wetland.org](http://www.wetland.org) or Call (410)745-9620.

**August 12** – Shade Perennials. Longwood Gardens Continuing Education 2008., Visitor Center Auditorium, 1:00 p.m.-3:00 p.m., cost \$149 passholder, \$159 non-passholder. Code #082EPSQA. Evening sessions: 7:00 p.m. – 9:00 p.m., Code #82EPSQE. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**August 20** – DNLA Summer Turf and Nursery Expo. University of Delaware Botanic Gardens, Newark, DE. Contact Valann Budischak, 610-274-2166.

**August 20-21** – Wetland Training Courses 2008. Living Shoreline Design and Construction, cost \$380. Course Descriptions & Registration available online at [www.wetland.org](http://www.wetland.org) or Call (410)745-9620

**September 8-11** – Wetland Training Courses 2008. Grasses, Sedges, and Rushes, cost \$700. Course Descriptions & Registration available online at [www.wetland.org](http://www.wetland.org) or Call (410)745-9620.

**September 10** – Greenhouse and Interiorscape Pests. Walk. Longwood Gardens Continuing Education 2008., Acer Room, 3:00 a.m. – 6:00 p.m., cost \$70 passholder, \$79 non-passholder. Code #082PFGIA. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**September 11** – Pest Identification Walk. Longwood Gardens Continuing Education 2008., Catalpa Room & Outdoors, 9:00 a.m. – 12:00 noon, cost \$70 passholder, \$79 non-passholder. Code #082PFPIM. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**September 11**– Plant Disease Identification Walk. Longwood Gardens Continuing Education 2008., Catalpa

Room & Outdoors, 1:00 p.m – 4:00 p.m., cost \$70 passholder, \$79 non-passholder. Code #082PFPDA. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**September 19** – Weed Identification Walk. Walk. Longwood Gardens Continuing Education 2008., Catalpa Room, 9:00 a.m. – 12:00 noon, cost \$70 passholder, \$79 non-passholder. Code #082PFWIM. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**September 19** – Turf for the Professional. Walk. Longwood Gardens Continuing Education 2008., Catalpa Room, 1:00 a.m. – 4:00 noon, cost \$70 passholder, \$79 non-passholder. Code #082PFTPA. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**October 1-Nov 5** – Deciduous Trees, Longwood Gardens Continuing Education 2008. Visitor Center Auditorium, 9:00 a.m. – 11:00 a.m., cost \$149 passholder, \$159 non-passholder. Code #082OPDTM. Or evening sessions: 7:00 p.m. – 9:00 p.m., Code #82OPDTE. Phone (610) 388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**October 6-8** – Wetland Training Courses 2008. Evaluation for Planned Wetlands, cost \$600. Course Descriptions & Registration available online at [www.wetland.org](http://www.wetland.org) or Call (410)745-9620

**October 11** - Digital Garden Photography. Longwood Gardens Continuing Education 2008. Auditorium, Outdoors & Conservatories, 9:30 a.m. – 3:30 p.m., cost \$129 passholder, \$139 non-passholder. Code #082BODGD. Phone (610)388-1000 ext. 559. Website: [www.longwoodgardens.org](http://www.longwoodgardens.org)

**November 10-14** – Wetland Training Courses 2008. Wetland Delineation, cost \$900. Course Descriptions & Registration available online at [www.wetland.org](http://www.wetland.org) or Call (410)745-9620

