BULLETIN

ofa™ an Association of Floriculture Professionals

January/February 2006 • Number 894

Temperature Effects on Floriculture Crops and Energy Consumption

by Erik Runkle

The high cost of energy this spring is forcing many greenhouse growers in colder climates to re-evaluate different aspects of their production strategies. When we had a surge in fuel prices in 2000-01, *Greenhouse Grower* magazine surveyed growers about what they did differently in response to the increased fuel costs. According to their September 2001 issue, the highest percentage (22%) of respondents lowered their growing temperature. Other growers increased the insulation of their greenhouses (15%), started production later (13%), and consolidated production (12%).

Based on this data, about one-third of the greenhouse operations in the United States either lowered their greenhouse temperature, delayed the start of their production, or both. How do those actions influence crop timing? Did the growers actually save energy? And, as a result of those changes, did growers meet their target marketing and shipping dates? This article will discuss these concepts and provide insight into the answers to these questions.

Continued on page 5

Geranium Nutrient Deficiencies: A Visual Primer for Grower Diagnosis & Correction

by Jonathan Frantz, James Locke, and Dharmalingam Pitchay

The genus *Pelargonium*, which is native to South Africa, is a popular floriculture crop because of its use as a bedding plant, potted crop, or in hanging baskets (USDA Ag Statistics, 2004). A wide range of species and varieties have been bred and introduced, with more than 500 types available in 2004 (M. Taylor and P. Nelson, personal communication). In spite of their popularity and diversity, only the most general nutritional guidelines are available for this crop. Therefore, a key to avoiding nutritional deficiency issues is to recognize the various tell tale signs and combine that knowledge with information gathered from water, media, and tissue testing.

Many patterns of visible nutrient deficiency symptoms are common to many crops, and by learning the role of the different nutrients within the plant, it is possible to predict how a deficiency symptom may show up in different crops. Once the general patterns are known, crop-specific symptoms can be used to fine-tune diagnoses. It is important to remember that not all deficiency symptoms that appear to be nutrient related can be addressed by adding that specific nutrient. Rather, there are times when other management practices

Continued on page 9

Inside this Edition...

OFA Mission Statement
To support and promote floriculture professionals through lifelong learning, career enhancement, and public awareness.

OFA – an Association of Floriculture Professionals
2130 Stella Court
Columbus, Ohio
43215-1033 USA
614-487-1117
Fax: 614-487-1216
e-mail: ofa@ofa.org
home page: www.ofa.org

OFA Bulletin
January/February 2006
NUMBER 894

Published Bimonthly

ofa Forum

Touching Base

by John Holmes, CAE
OFA Executive Director

It's hard to believe that we're already at the start of a new year! Where did 2005 go? For some in the industry it was a banner year; for others it was their last, due to horrible storms and economic downturns.

One nice thing about a new year is that it implies a fresh start with new opportunities. That's certainly how I view it for OFA. Sure, there's always a challenge, but a challenge is sometimes masked as an opportunity if we are prepared and have the right perspective and attitude.

At OFA, we've been preparing for new challenges and opportunities so we can maintain the value of our services and products to you, the customer. We've made and continue to make significant investments to strengthen the infrastructure that supports our products and services. Through prudent fiscal management of controlling costs and minimizing price increases, we've been able to accomplish the following:

- Create a new digital publication, the *OFA e-Bulletin*, to supplement our longstanding and substantive print publication, the *OFA Bulletin*, which has undergone a transformation to include more pages and make it a more attractive and interesting read.
- Update all our print publications to incorporate OFA's new branding, logo, and "look" to educate more of the industry on who we are and draw them into the OFA family of membership and events.
- Establish a very wise financial reserve strategy (savings account) of at least one-half of OFA's operating budget to protect us from financial calamity in times of uncertainty.
- Update our web site (www.ofa.org) to provide you a user-friendly and complete 24/7 resource of information.
- Underwrite the increasingly successful America in Bloom (AIB) program with staff and overhead support.
- Contribute tens of thousands of dollars to the Floriculture Industry Research & Scholarship Trust (FIRST) to not only support on-going programs, but also to provide an outside professional assessment of a potential fundraising/capital campaign.
- Make a $7,000 emergency relief contribution to victims of Hurricane Katrina.
- Support the advocacy efforts of both the American Nursery & Landscape Association (ANLA) and the Society of American Florists (SAF).
- Maintain OFA's standing as the premier national organization and network of over 10,000 floriculture professionals!
- Make overdue building renovations to replace a leaking roof, worn carpeting, broken windows and doors, and bring it "up to code" as a professional office.
- Replace a cumbersome database and update vital computer hardware and software.

Of course, none of this would be possible without your support and the support of a great team of volunteers and staff. OFA is fortunate to have nearly 200 volunteer leaders serving on various committees and the Board of Directors. I certainly appreciate the confidence they've shown in me and the entire staff.

The OFA staff is a group of dedicated and experienced individuals committed to serving you. As mentioned earlier, challenges and opportunities face us all;

America in Bloom
Founding Steward
Platinum

that's also true when we have transitions on staff. Due to the late 2005 departure of Cheryl Cuthbert, OFA's former manager - communications (we wish her well), I've slightly reorganized and added to our staff talent pool.

Laura Kunkle, OFA's able director – member services, is now director – membership & communications. Based on Laura's education and experience in journalism, past and current activities in support of our communications efforts, and the need to keep a close connection between member services, communications, and public relations, she's the right fit.

Along with the continued communications and public relations support of Zaunscherb Marketing Inc (ZMI) and its principal, Frank Zaunscherb, Laura is already surpassing everyone's high expectations!

New to OFA are Brian McLaughlin, our manager – membership & administration and Alicia Wells, our coordinator – special projects. If both names seem familiar, it's because they are.

Brian is a long-time OFA Short Course volunteer and served as our database consultant. He has years of experience in not-for-profit member and customer service, information technology, and event management. He also served in the armed forces for nearly a decade.

Alicia is a former administrative coordinator for FIRST where she supported program administration, promotion, and communications. Along with her first-hand knowledge of the floriculture industry and its participants, she brings a wealth of talent.

All of us at 2130 Stella Court are humbled by your support, appreciative of your commitment, and are dedicated to serving your needs. Thank you!

Foliage Industry Outlook

by Lynn Griffith

I have worked in the foliage industry for close to 30 years as a grower, consultant, analyst, researcher, and author. Florida is the largest U.S. foliage producer, with annual wholesale sales exceeding $300 million. While wholesale foliage is grown in many parts of the state, the Apopka area (just north of Orlando) and the Homestead area (just south of Miami) have the greatest concentration of foliage growers. Palm Beach County was, at one time, a major foliage producing area, but population, development, and high land prices have gradually led to nurserymen either retiring or moving to a different part of the state. California, Hawaii, and Texas also have significant foliage production, though smaller than that of Florida.

While there are significant exceptions, the Apopka area generally produces smaller foliage items – a lot of 3- to 6-inch containers, as well as hanging baskets and dish gardens. The Apopka area did suffer structural and crop damage from the 2004 hurricanes, but the area was generally spared in 2005. Production of smaller foliage items in the Apopka area continues at a reasonably normal pace. The Homestead area generally produces larger specimen foliage items, from 6-inch pots all the way up to very large acclimated trees and palms.

Despite very little media coverage, the Homestead area received very significant damage from Hurricanes Katrina and Wilma in 2005. Many shade houses and greenhouses came down, especially older structures. Shadecloth blew away and many houses were badly damaged or destroyed.

The combination of broken irrigation lines, power outage for as long as two weeks, and scarcity of fuel for pumps made irrigating the sunburned and physically damaged crops especially problematic. Growers, like the general population, were relatively unprepared for these hurricanes, as they were generally not projected to hit major crop production areas. As they passed through Florida, most forecasters projected them to be relatively weak Category 1 storms at most. What really happened was far different.

It has been estimated that Hurricane Wilma had wind speeds of up to 130 miles per hour. The Department of Agriculture estimated storm damage from Hurricane Katrina in the Homestead area at $420 million. Hurricane Wilma was a much larger, more powerful storm as it passed over Florida, causing damage to the area of $500 million. These storms hit less than two months apart, and add to the damage that occurred in most of the state from the four hurricanes that struck Florida in 2004 (Figures 1 & 2, page 4).

What does all this mean for the foliage availability? Larger specimen plants are extremely difficult to find right now because so many were damaged directly or indirectly from the storms. Some growers laid their entire inventory down prior to the onset of the hurricanes. Some plant species were injured while laying on the hot ground cover or in standing water. Larger plant material will take quite some time to recover from storm effects, and production of some foliage items can take years.

Foliage buyer Linda Milark of All About Plants says that aglaonemas are still very difficult to find because a

Continued on page 4

Foliage Industry Outlook

Continued from page 3

number of major growers and cutting producers were severely damaged. Larger tree and palm species will be quite scarce for awhile.

Producers of smaller foliage items were generally less affected in 2005. In addition, many of the smaller foliage items have much shorter production times, often ranging in weeks rather than months or years. Availability of smaller plants in the spring should be reasonably good, while larger plant specimens will be scarce. It is still too early to speculate on the degree of storm-induced price increases, but it should be noted that plant prices have steadily fallen for years as the big box stores absorb a greater and greater percentage of foliage production. Years ago, a much higher percentage of foliage went to independent garden centers and interiorscape companies, but the large retailers have gradually changed all that.

At the same time, other less obvious factors will likely impact the availability of foliage plants. Ever increasing population growth and development are putting the squeeze on large producers in many parts of the United States. As land prices in some areas approach $250 thousand or more per acre, land simply becomes too expensive to farm. Some growers will sell their land at significant profit and retire, while others will relocate to areas where land is less expensive, often using the land sale proceeds to construct stronger greenhouses and larger production areas. Many growers entered the foliage industry in the 1970s and 1980s, and a significant percentage is approaching retirement age. Other growers are considering a change in crops, such as dropping foliage and growing landscape plants. Such a change will eliminate the need for greenhouse structures. With the forecast for storm problems in the next 10 to 15 years and the continued outlook for diminishing returns, many growers on the southern Atlantic coast and the Gulf region adhere to the "one more and I am out of here" mentality.

Costs of land, labor, fuel, pesticides, and fertilizers have all increased, yet the downward pressure on plant prices seems to continue. Greenhouse heating costs and diesel fuel for plant shipments will probably be the highest on record this year. This may make some producers reconsider growing tender varieties such as aglaonema and dieffenbachia.

Winter weather creates other concerns and potential shortages. Storm damaged structures are more difficult to winterize, and most prognosticators are calling for a relatively cold, more active winter season. Midwestern and northeastern growers have already seen evidence of that. No significant cold has yet impacted southern production regions, but January and February freezes make growers of cold-sensitive tropicals uneasy.

Smart growers know that plant sales are significantly influenced by disposable income of the general population. That fern or philodendron basket you are considering directly competes for the spare dollar with music, movies, sports, housewares, and other leisure items. While the economy is reasonably robust these days, any sort of setback in the broad economic picture can affect plant sales. There is good news from those studying the plant markets. They have found that in the more uncertain world today, people are more interested in making their homes comfortable and pleasant. This has led to increased expenditures for landscaping and home improvement; houseplants may be part of that trend as well.

What to do when foliage plants are in short supply? One obvious answer is to substitute more flowering plants for cut flowers, at least where light levels permit. Changing to the more available smaller foliage plants would be a second strategy. Some experienced foliage buyers have recommended spreading foliage purchases to several different nurseries rather than one or two key suppliers. This offers a little extra protection of

Figures 1 & 2. *Hurricane damage was severe in Florida in 2005.*

Interior Plantscape

availability in case of future storms. At the same time, in an environment where foliage plants are scarce, established customers may have a better chance getting limited plant inventory as opposed to new buyers.

Will the foliage industry survive? Certainly, though economic and weather factors have and will create periodic shortages. It is extremely difficult to get a roofer, a fence repairman, a tree company, or any kind of construction-related contractor in Florida and the Gulf region these days. One grower told me he can't even locate hog rings for shade cloth repair, so he is having to recycle them from old pieces of shade cloth.

There has been a move toward larger, more consolidated nurseries in recent years and many of these are good growers who are dedicated to continue foliage plant production. The marketplace will continue to change and evolve as it always does, but foliage plants still play a beneficial role in the interior land environment. Growers will continue to produce interior foliage as long as customers keep buying it.

Lynn Griffith
A & L Southern Ag Lab
1301 W Copans Rd Bldg D
Pompano Beach, FL 33064
954-972-3255
Fax: 954-972-7885
Lgriff6250@aol.com

Temperature Effects on Floriculture Crops and Energy Consumption

Continued from page 1

The Effects of Temperature on Plants

Temperature is the primary factor that controls how fast (or slow) a plant develops. Generally, the warmer the temperature, the faster a plant grows. It's analogous to how fast you drive your car to get to work. The faster you drive, the earlier you arrive at work. Similarly, the warmer you grow your crops, the quicker they will grow and become marketable. Therefore, if you lower the greenhouse temperature, plants will take longer to become marketable. This applies to plugs, flats, potted crops, hanging baskets, and any other size of plant or container.

Another important concept to understand is "temperature integration." This term describes how plants respond to temperature over a period of time. Simply put, the rate of plant development is dependant upon the average daily temperature from the time you plant the crop. This is a very simple but powerful concept. Plants respond to the temperature constantly; they grow faster as temperature increases, and grow slower as temperature decreases. The exception to this rule is when cool-season crops are grown very warm. At some high temperature these plants begin to experience stress and the rate of crop development begins to decrease.

What is the implication of temperature integration? If your day and night are each 12 hours long, then if you lower your night temperature without increasing your day temperature the same amount, your average daily temperature will decrease. Thus, cooler nights without warmer days will increase the time it takes for your crop to become shippable or transplantable. If your night temperature settings are longer than 12 hours, then you need to offset the shorter day temperature setpoint even more so that your 24-hour average temperature stays the same.

Crops Respond to Temperature Differently

As temperature decreases, there is some temperature at which a plant stops developing. This temperature is called the "base temperature," and it varies from crop to crop. For example, the base temperature for seed petunia is about 39°F (4°C), which means that at or below this temperature, petunias essentially stop growing. For seed vinca (*Catharanthus sp*), the base temperature is much higher, around 50°F (10°C). Experienced growers can often predict which crops have a low base temperature because they are usually grown cooler than plants that have a high base temperature.

We rarely want to grow plants at or near the base temperature because plant development is so slow. One of the few times when a growing temperature near the base temperature is desirable is when you want to hold plants – such as when plants are beginning to flower but you're not able to ship them. Another example is when perennials or bulbs are being vernalized or provided with cooling treatments.

During the winter and spring, floriculture crops are often grown about 20°F to 30°F (11°C to 17°C) higher

Continued on page 6

ofa Grower

Temperature Effects on Floriculture Crops and Energy Consumption

Continued from page 5

than their base temperatures. As temperature increases above the base temperature, plants grow faster and faster. For example, the effect of temperature on crop timing of petunia and vinca is illustrated in Figure 1.

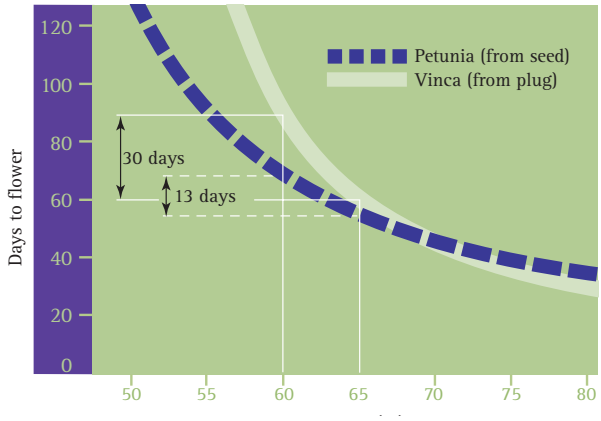


Figure 1. *The effect of temperature on time to flower of petunia from seed and vinca from a small plug. When temperature is decreased, there is a larger delay in flowering for plants with a high base temperature (vinca) compared to plants with a lower base temperature (petunia).*

Lowering the temperature by 5°F has a somewhat small effect at warm temperatures, and has a larger effect at cooler temperatures. For example, lowering the average daily temperature by 5°F from 65°F to 60°F delays a petunia crop (from seed) by about 13 days, and lowering the temperature from 60°F to 55°F delays petunia by 22 days. The effect of lowering the temperature on crop timing also depends on the plant species. For example, lowering the temperature from 65°F to 60°F increases the time to flower of vinca (from a plug) by about 30 days – much longer than the delay in petunia with the same temperature decrease.

Cold-Tolerant and Cold-Sensitive Crops

Plants respond differently to temperature partly because they have different base temperatures. Plants with a base temperature of 39°F (4°C) or lower can be called "cold-tolerant plants" and those with a base temperature of 46°F (8°C) or higher can be called "cold-sensitive plants." We categorize plants by their base temperature because they differ in how they respond to lowering the greenhouse temperature; generally, cold-sensitive plants are more responsive to lowering the

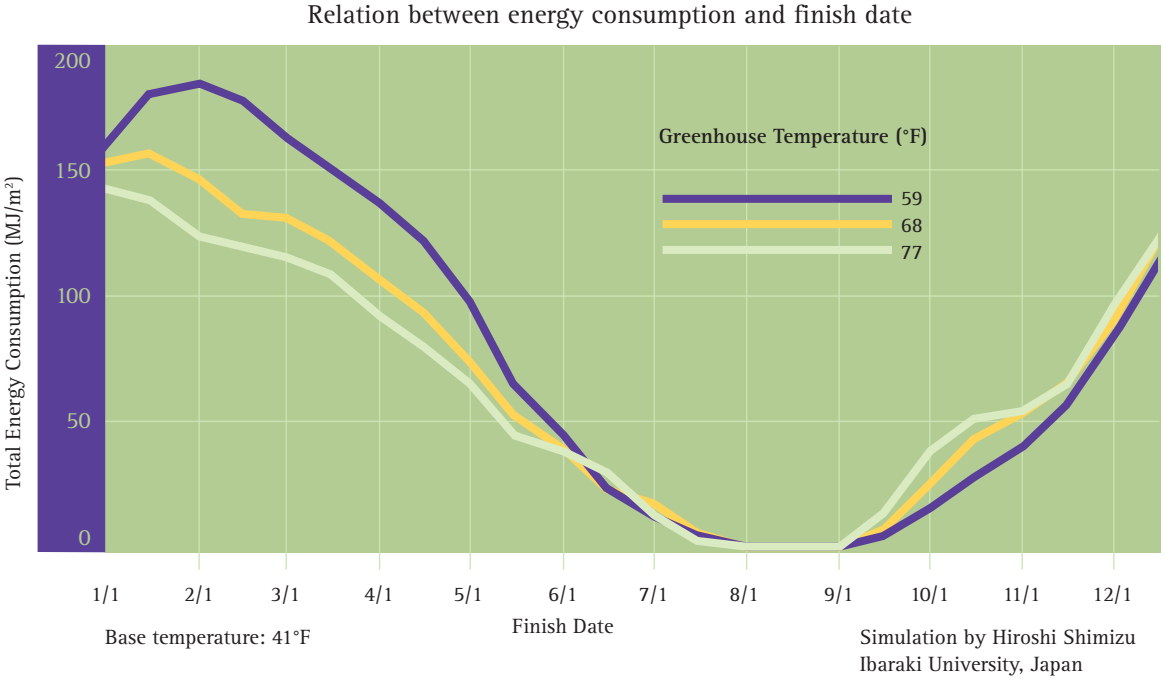


Figure 2. *The estimated amount of energy required to produce a crop at different growing temperatures throughout the year in Michigan. This simulation indicates that the total amount of energy consumed to produce a flowering crop increased as growing temperature decreased from winter through mid-summer.*

Table 1. Plants can be categorized by their base temperature, which is the temperature at or below which crops stop developing. Plants with a base temperature of 39°F (4°C) or lower can be called "cold-tolerant" crops, and those with a base temperature of 46°F (8°C) or higher can be called "cold-sensitive" crops. Information based on research at Michigan State University and published research-based articles.

Plants with a low base temperature (39°F or lower)	Plants with a moderate base temperature (40 - 45°F)	Plants with a high base temperature (46°F or higher)
Ageratum	Calibrachoa	African violet
Alyssum	Coreopsis	Angelonia
Campanula	Dahlia	Banana
Cineraria	Impatiens (seed)	Begonia (fibrous)
Diascia	Salvia	Blue salvia
Easter lily		Caladium
Gaillardia		Celosia
Leucanthemum		Gazania
Marigold (French)		Hibiscus
Nemesia		New Guinea impatiens
Petunia		Pepper
Rudbeckia		Phalaenopsis orchid
Scabiosa		Poinsettia
Snapdragon		Purple fountain grass
Thanksgiving cactus		Rose
Viola		Vinca

Table 2. The effect of temperature on days to flowering of four bedding plants grown from a 288-cell plug. Plants were grown under an average daily light integral of 5.5 $mol \cdot m^{-2} \cdot d^{-1}$, which is typical of early spring conditions in northern greenhouses.

	Average daily temperature (°F)		
Plant	63	68	73
Celosia	52	44	37
Impatiens	31	26	22
Marigold	32	27	24
Salvia	39	33	27

greenhouse temperature than cold-tolerant species. So, if you are determined to lower your greenhouse temperature setpoint, you'll likely delay crop timing more with cold-sensitive crops. See Table 1 for a list of plants categorized by their base temperatures. Ideally, crops with different base temperatures should be grown in separate greenhouses with different temperature setpoints.

The effect of temperature on crop timing of some popular bedding plants can be found in Table 2. There are other factors that influence crop timing, including photoperiod and the average daily light integral. With my colleagues Ryan Warner and Art Cameron, we're continuing work with bedding plants and herbaceous perennials to further understand how plants respond to temperature so that more refined growing temperatures can be recommended.

Does Lowering Temperature Save Fuel?

This is the $10,000 question – in some cases, quite literally. We know that by reducing the average daily temperature, we increase the production time of a crop. To finish crops on the same date as in years past, growers can begin with a more mature crop (such as transplanting from a 128-cell plug instead of a 588-cell seedling), or they need to transplant earlier in the year. If you transplant earlier in the year, chances are you're going to open up greenhouses earlier in the year. Because it will be colder outside, energy consumption for heating is relatively high. A simple question follows: is it economical to increase the production time to compensate for a lower average greenhouse temperature?

During the winter and early spring, it can be more energy-intensive to grow crops at cooler temperatures than to open up the greenhouse later and use a warmer growing temperature. A lower temperature setpoint requires less heating, which translates into less fuel

Continued on page 8

Temperature Effects on Floriculture Crops and Energy Consumption

Continued from page 7

consumption per month. However, a temperature reduction also increases crop timing, which means plants are in the greenhouse longer. A longer production time has several negative consequences, including:

- overhead expenses (cost per ft^2 per week) are greater for that crop
- the crop takes longer to finish, so you will turn fewer crops per year
- a longer crop time means that you will have to heat the crop longer and possibly open up a greenhouse earlier when it is colder outside.

Hiroshi Shimizu at the University of Ibaraki in Japan developed a sophisticated model to predict how much energy is consumed to heat a greenhouse to produce a crop. The simulations are complex and depend on environmental factors (outdoor temperature, light levels, and wind speed), numerous greenhouse factors (glazing type, use of thermal curtain, insulation, etc.), the crop grown, and the greenhouse temperature setpoint. Figure 2 (page 6) illustrates the predicted energy consumption to heat a crop in Michigan with different finish dates and three temperature setpoints. This simulation was based on Michigan weather data, a greenhouse crop with a base temperature of 41°F, and several assumptions for a "typical" double-poly greenhouse. From winter until mid-summer, the model predicts that the total amount of energy used to heat a crop (from transplant to flowering) actually *increased* as the growing temperature decreased. In other words, it was more expensive to heat a crop planted earlier in the year and grown at a cool temperature compared to opening a greenhouse later and using a higher temperature setpoint. The opposite was true for fall crops; an earlier planting date and a lower greenhouse temperature consumed the least amount of energy.

There are other consequences to growing crops in a cool greenhouse. One concern is that plants take longer to dry out, so they stay wet longer. Also, because cooler air holds less moisture than warmer air, the relative humidity can be higher in a cool greenhouse. Pathogens can be more problematic when crops are kept moist and when the humidity is high.

Temperature Effects on Plant Quality

There is one major benefit to growing crops relatively cool in the winter and spring, when light is limiting in northern latitudes. Crops grown cool take longer to flower, so they have a longer period of time to harvest light. Because of this, many plants (especially cold-tolerant crops) are of higher quality when grown at moderately cool temperatures. When ready for transplant, plugs grown at cool temperatures often have thicker stems, better rooting, and greater branching. Similarly, finish crops grown cool can have more branching and produce more, larger flowers. However, there are floriculture crops (such as hibiscus) that do not perform well at cool temperatures. For such tropical plants, plant quality is highest when grown at a moderately warm temperature.

Therefore, there is often a trade-off between high quality crops and crop timing. Cooler temperatures produce higher quality plants, but they take longer to reach maturity, and energy consumption per crop can be higher. Crops grown at warm temperatures develop faster and thus have shorter crops times and require less energy for heating, but the quality of plants is often not as high. If a grower cannot get a higher price for a higher quality crop, then there is little incentive to grow cool.

Erik Runkle
Michigan State University
A240-C Plant & Soil Science Bldg
East Lansing, MI 48824
517-355-5191
Fax: 517-353-0890
runkleer@msu.edu

ofa Grower

Geranium Nutrient Deficiencies

Continued from page 1

(i.e., over watering, pH control, root pathogens) can be changed to eliminate particular symptoms (i.e., iron chlorosis). Once identified, it is possible to salvage the plants from the nutritional disorder if immediate action is taken prior to necrotic lesions or developmental effects are observed that could negatively impact plant quality.

In this article, we summarize the role of each nutrient within plants in general, describe the specific deficiency symptoms observed for geranium, and accompany this text with color photos of typical symptoms for that nutrient deficiency. Finally, Table 1 provides a diagnostic key of nutrients to aid in recognition of geranium-specific deficiency symptoms.

Nitrogen

Protein is essential for all living organisms and is required for growth and development. Nitrogen is one of the main elements in protein. Nitrogen is also a component of nucleic acid, DNA, RNA, genes, chromosomes, enzymes, chlorophyll, secondary metabolites (alkaloids), and amino acids. As a result of its importance in plants, nitrogen deficiency slows down the growth and development of plants. The plants appear stunted with light green lower leaves, while the upper leaves remain green. With

Table 1. Unique symptoms for geranium (*Pelargonium*×*hortorum*) nutrient deficiencies.

Primary Symptom	Secondary Symptom	Element
Uniform Yellowing	• Older leaves develop chlorosis from the leaf margins and slowly progress inward. In some geranium cultivars, **reddish to pinkish pigmentation** develops instead of chlorosis.	Nitrogen
	• Entire plants including petioles and stems, regardless of age, turns chlorotic.	Sulfur
	• Young leaves develop chlorosis within the **distinct zonal band**; developing leaves enlarge with slight marginal cupping.	Zinc
	• Mild chlorosis appears at the base of the leaves and progresses outward to leaf margins.	Copper
Interveinal yellowing	• **Young leaves** develop interveinal chlorosis.	Iron
	• **Older leaves** develop interveinal chlorosis.	Magnesium
Lack of leaf sheen	• **Dullness** starts at the leaf margins and progresses inward towards the petioles.	Copper
Speckles of chlorosis	• Maturing leaves develop **speckles** of chlorosis across the leaves.	Manganese
Leaf necrosis before discoloration	• **Necrosis** develops along the margins of old leaves **without prior chlorotic symptoms**; potassium deficiency symptom is delayed relative to many other greenhouse crops.	Potassium
	• Necrotic spots develop along the veins, and they coalesce and enlarge as the symptoms progress.	Boron
Leaf Wilt	• Lower leaves wilt; geranium is a highly drought tolerant plant, so symptoms in the shoots are minimal, even after the root system dies.	Calcium
Root tissue differences	• **Roots develop light bronze to cream coloration** with numerous, short primary roots.	Zinc
	• Significant reduction in primary and secondary root development.	Copper
	• **Swollen, blackened root tips** with numerous lateral roots closer to the primary roots creating **witches' broom-like** symptoms.	Boron
	• Root system rapidly becomes brown to black and sloughs off.	Calcium
	• Root system becomes **dull, and rust colored.**	Iron
	• **White, healthy roots, but primary roots elongate** much more rapidly compared to control roots.	Phosphorus
Deeper green than normal	• Leaves appear **darker green** at the early stage of deficiency, followed by the development of **necrosis along the margins of older leaves** at advanced stage.	Potassium
	• Leaves appear **darker green** at the early stage of deficiency, followed by the development of **pink to purple pigmentation** along the margins of older leaves.	Phosphorus

Continued on page 10

Geranium Nutrient Deficiencies

Continued from page 9

prolonged nitrogen deficiency, yellowing (chlorosis) or reddish pigmentation of older or lower leaves occurs, depending on cultivars. This is followed by browning and death (necrosis) of leaf margins. Figures 1, 2, and 3 exhibit the visual signs of nitrogen deficiency of two different zonal geranium cultivars.

Figure 1. *At first, the lower leaves develop yellowish-green, uniform chlorosis that slowly progresses from the leaf margins to the mid-leaf. As the chlorotic symptoms progress inward, a greenish-yellow gradient pigmentation follows.*

Figure 2. *Some geranium cultivars develop reddish pigmentation instead of yellow chlorotic symptoms. The red pigmentation progresses to upper maturing tissue.*

Figure 3. *Flowering is earlier and greatly reduced compared to normal plants.*

Phosphorus

Phosphorus is also a component of protein, DNA, RNA, and cell membranes, and is a component of stored energy in plants. In early phosphorus deficiency, plants appear darker green than normal with reduced growth. As the deficiency progresses, the older, lower leaves develop irregular spots of red or purple pigmentation along the leaf margins, which eventually turn brown to dark brown and die. In most cases, lack of phosphorus delays flowering in plants. Figure 4 shows phosphorus deficiency symptoms in zonal geranium.

Figure 4. *Initially, lower matured leaves appear darker green than normal leaves. Then, the initiation of chlorosis develops along the margins and progresses inward toward the acropetal area, while upper mature leaves appear normal.*

Potassium

Potassium is important for movement of sugars and starch formation, pH stabilization, drought tolerance, cell turgor, enzyme activation, and regulation of stomata opening and closing. The leaves of potassium-deficient plants are small and darker green than normal plants. These symptoms are followed by a sudden development of irregular necrotic tissues along the margins and tips of lower, older leaves. The browning eventually covers the whole leaf, giving the leaf a scored appearance. Geranium leaves can be potassium deficient for several weeks before necrotic symptoms develop. Figure 5 shows potassium deficiency symptoms in zonal geranium.

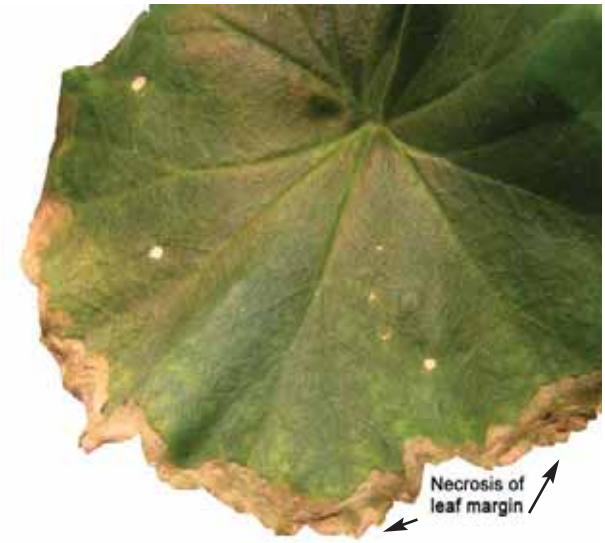


***Figure 5**. Semicircular blackish-gray necrotic spots suddenly develop (like sudden trauma) along the margins of lower matured leaves, without prior chlorotic symptoms. These spots enlarge and spread inward from the leaf edge.*

Calcium

Calcium is required for cell wall structure and cellular signaling and is important in cell division and expansion, building of cell walls, stomatal regulation, and cold tolerance. Unlike other macronutrients, lack of calcium generally affects the growing points. The symptoms first appear on the root tips as a black necrosis (indication of cell death). When deficiency is severe, cell death occurs on the entire primary and secondary roots. The wilting of lower leaves occurs as a result of root death, even though geranium is a normally highly drought-tolerant plant.

Magnesium

Magnesium is a core constituent of chlorophyll (required for photosynthesis). Magnesium is also important in enzyme and cofactor reactions within cells. It is involved in the metabolism and movement of carbohydrate and stabilizing cell membranes. Normally, magnesium deficiency symptoms appear in lower, older leaves with greenish-yellow to yellowish-green chlorosis developing along the leaf margins and tips, which progresses inward between the leaf veins. As the deficiency persists, necrosis develops between the veins and the leaves curl downward. Figure 6 shows magnesium deficiency symptoms in zonal geranium.

***Figure 6.** Interveinal chlorotic symptoms on older leaves, especially in the zonal region for which geraniums are known.*

Sulfur

Sulfur is essential in protein synthesis since it is a constituent of the essential amino acids such as cystine and methionine. Sulfur is also involved in plant photosynthesis and respiration. Initially, uniform light greenish-yellow chlorosis develops on young and/or mature leaves, but rarely on lower, older leaves. As the symptoms advance, uniform chlorosis spreads to the rest of the leaves. Figure 7 shows sulfur deficiency symptoms

***Figure 7.** Recently matured leaves turn lightly and uniformly chlorotic across the leaf. Eventually, the entire plant, except the lower-most matured leaves, appear uniformly chlorotic.*

Continued on page 12

Geranium Nutrient Deficiencies

Continued from page 11

Iron

Iron is an important component of heme and sulfur proteins. DNA and RNA synthesis is restricted in iron-deficient environments. Iron is also involved in chlorophyll formation because iron is an immobile element in the plant. Iron deficiency symptoms develop on young leaves and shoots. Generally, young leaves develop interveinal chlorosis from the base, but in some species it develops from the tips. Over time, the chlorosis intensifies and the pattern becomes less interveinal. Even the stems appear chlorotic. At this point, the chlorotic symptoms are irreversible even if corrective measures are taken.

Figure 8. *Pronounced interveinal chlorosis on new leaves.*

Figure 9. *The edges of the flower petals lose pigmentation and appear bleached-white.*

Eventually, yellow gives way to white. Figures 8 and 9 highlight iron deficiency symptoms in zonal geranium.

Manganese

Manganese plays a significant role in photosynthesis. The formation of free oxygen radicals during the water splitting process and ultimately the release of oxygen is not possible in manganese-free environments. Manganese is the only element that can contribute the necessary electrons for this biochemical process. Young and recently matured leaves develop chlorosis followed by a necrotic stippling on recently matured and matured leaves. Drastic reduction of shoot and root growth is common. Flowering is strongly inhibited. Figure 10 shows manganese deficiency symptoms in zonal geranium.

Figure 10. *Chlorosis is a spotty, speckled pattern across the entire leaf on recently matured to mature leaves.*

Copper

Copper plays an important role in quenching the radicals produced during biochemical processes. It is also a component of proteins and enzymes that are critical to producing chemical energy. Copper is required for lignification, especially xylem formation, and it is moderately mobile to immobile within the plant. Initially, young and maturing leaves appear stunted and misshapen with pointed margins. Overall, the plants appear "Bonsai-like." This is followed by impaired flower development that includes reduced size, premature abscission, or abortion. Sudden death of tissue, with symptoms similar to localized tissue dehydration, develops on recently matured leaves as a result of poor xylem tissue development. Figures 11, 12, and 13 highlight copper deficiency symptoms in zonal geranium.

Figure 11. *Maturing leaves are smaller with dull green appearance (lacks luster or shine) that progresses inward from the leaf edge.*

Figure 13. *The flower petals are pleached at the edges and begin to wilt earlier, starting at the petal edges.*

Figure 12. *After losing luster, chlorosis progresses from the leaf base outward toward the leaf margins.*

Figure 14. *Young leaves develop veinal chlorosis from the leaf base.*

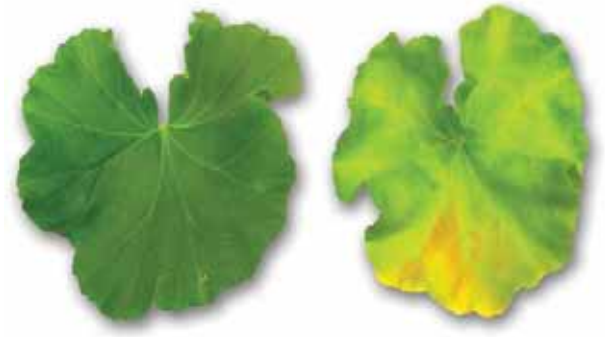


Figure 15. *The veinal chlorosis spreads to adjacent tissue until the entire leaf appears chlorotic. Pink-to-orange pigmentation develops interveinally.*

Zinc

Zinc is an integral component of protein. So far, more than 80 zinc-containing proteins have been reported. One of them, referred to as 'Zinc Fingers', is actively involved in DNA transcription. This means protein synthesis will be affected. As a result, zinc deficiency severely affects plant growth. Young and recently matured leaves develop marginal cupping, veinal chlorosis, and necrosis. Some plants develop purple/pinkish pigmentation. Shoot and root growth is reduced. Figures 14, 15, and 16 show zinc deficiency symptoms in zonal geranium.

Continued on page 14

Geranium Nutrient Deficiencies

Continued from page 13

Figure 16. *Flowers are smaller with gaps between the petals. The petals are spoon-shaped and light colored.*

Figure 17. *Initially, symptoms develop on the roots rather than the shoots. Primary and secondary roots are short, stiff, thick and stubby with necrotic tips and halted growth. Secondary roots are short and stubby, and are located in close proximity to the tips of the primary roots, giving the appearance of a witch's broom.*

Boron

Boron is an essential element in plants for cell division, cell wall formation and stabilization, lignification, xylem differentiation, membrane integrity, auxin activity, and inhibition of callose formation, nucleic acid metabolism, pollination, and reproduction. Like calcium, boron disorders develop on the shoot and root meristem and on young leaves. The symptoms first develop on the roots three to four days earlier than the shoots. Overall, the roots are thick and short. Primary roots develop thick, swollen root tips with numerous short, secondary roots developing close to the tips, resembling witches' broom-like growth. Meanwhile, foliage becomes darker and glossy. Young and recently matured leaves become thick, leathery, and brittle with severe distortions. Loss of apical dominance is a common symptom in the roots and shoots. Figures 17 and 18 feature boron deficiency symptoms in zonal geranium.

Causes of Deficiencies

Lack of the nutrient in the media or fertilizer, excessive leaching and watering, low or high pH, and elevated EC can all lead to nutrient management problems. Be aware of competition between nutrients (i.e., cations can inhibit other cations) and the role your water quality and media type may play in delivering nutrients to your plants (ozonation systems, copper injectors, fine particle size, etc.). Container size and geometry also can influence deficiency symptoms through potential water and nutrient holding capacities.

Figure 18. *The leaves are thick and brittle. Primary veins appear chlorotic (yellowish), and necrotic spots (corky tissue) develop close to the veins in the basipetal area. Small, water-soaked necrotic spots appear on the bottom of the leaves of maturing leaves adjacent to the veins.*

The length of time to get obvious foliar deficiency symptoms relates to the sensitivity of geranium to a particular element (Table 2). In this case, geranium is more sensitive to nitrogen, calcium, and boron, and less sensitive to potassium.

Table 2. Length of time to get obvious foliar deficiency symptoms.

2 to 3 weeks	3 to 4 weeks	4 to 5 weeks	5 to 6 weeks	More than 6 weeks
Nitrogen	Magnesium	Phosphorus	Manganese	Potassium
Calcium	Iron	Sulfur	Copper	
Boron		Zinc		

More information

We've only had room to touch on some issues related to plant nutrition. For more information, try these websites and books that have been useful to us:

- aggie-horticulture.tamu.edu/greenhouse/nursery/guides/index.html
- muextension.missouri.edu/explore/agguides/hort/index.htm
- www.ashs.org/resources.html
- www.ces.ncsu.edu/depts/hort/floriculture/def/
- www.unce.unr.edu/publications/FS02/FS0265.pdf
- www.utextension.utk.edu/publications/horticulture/default.asp#greenhouses
- Epstein, E. and A.J. Bloom. 2005. Mineral nutrition of plants: principles and perspectives. 2nd edition Sinauer Associates, Inc. Sunderland, MA
- Handreck, K and N. Black. 2002. Growing media for ornamental plants and turf. 3rd edition. UNSW Press, Sydney, Australia
- Marschner, H. 1995. Mineral Nutrition of Higher Plants. 2nd edition. Academic Press, Cambridge, UK
- Mengel, K. and E. A. Kirkby. 2001. Principles of plant nutrition. 5th edition. Kluwer Academic Publishers. Dordrecht, The Netherlands
- Mills, H.A. and J.B. Jones, Jr. 1996. Plant Analysis Handbook II. MicroMacro Publishing, Inc., Athens, GA
- Nelson, P.V. 1998. Greenhouse Operation and Management. 5th edition. Prentice Hall, Upper Saddle River, NJ
- Pitchay, D.S., J.M. Frantz, J.C. Locke, C. Krause. 2005. Towards a Healthy Plant. Available by request from Ohio State and Michigan State Extension Services
- Reed, D.W. 1996. Water, media, and nutrition for greenhouse crops. Ball Publishing, Batavia, IL
- White, J.W. 1993. Geraniums IV. Ball Publishing, Batavia, IL

Disclaimer

Mention of a trademark, proprietary product, or vendor does not constitute a guarantee or warranty of the product by the USDA, and does not imply its approval to the exclusion of other products or vendors that also may be suitable.

Jonathan Frantz
USDA-ARS
2427 Hempstead
Toledo, OH 43606
419-530-1531
Fax: 419-530-1599
Jonathan.frantz@utoledo.edu

James Locke
USDA ARS ATRU
University of Toledo
Mail Box #604
2801 W Bancroft St
Toledo, OH 43606
419-530-1595
Fax: 419-530-1599
James.locke@utoledo.edu

Dharmalingam Pitchay
University of Toledo
Mail Box #604
2801 W Bancroft St
Toledo, OH 43606
419-530-1576
Fax: 419-530-1539
ldelp@utnet.utoledo.edu

How to Take A WhizBang! Physical Inventory

by Bob & Susan Negen

Why bother taking an accurate physical inventory? The inventory of merchandise in your store is probably both the biggest asset and expense in your business. Knowing exactly what you own is the first step in managing your inventory. Great inventory management is your key to higher profits! Here are three ways having an accurate inventory count will improve profits.

Shortage. Shortage or overage in inventory can usually be attributed to one of several factors:

- Theft – internal or external
- Incorrect ringing of sales in the store
- Paperwork problems in receiving merchandise, transfers, or return to vendors (RTVs)

Shortages from theft and incorrect ringing directly eat into your store's profits. Determining which factor or, more likely, which combination of factors is responsible for your shortage/overage takes some detective work. Knowing where the shortage problems are and how severe they are in each area will give you the starting point for your search.

Your inventory affects your bottom line. Don't risk paying extra taxes! If you over estimate the dollar value of your inventory, your cost-of-goods will go down, your profit (on paper!) will go up, and you'll pay taxes on income you didn't actually earn. No one wants to give Uncle Sam more than he is actually due!

But don't sell yourself short, either. If you under estimate the dollar value of your inventory, you'll show less profit, which may have a negative effect on your relationship with your banker, investors, or your spouse who always thought the store was a crazy idea anyway ("Dear, don't you think it's time you found a 'real' job?").

To get a true picture of how well your business is doing you need to have an accurate accounting of how much inventory you own.

POS updating. Remember the old adage "garbage in, garbage out"? Bad inventory numbers make your POS system nothing more than a very expensive cash register. Make sure your investment in a POS system pays.

There are many possible methods for counting your inventory.

Here's a look at some of the favorite ones being used by storeowners today and an explanation of one better than all the rest.

The yellow pad method. This is the favorite method of most retailers who don't have a computerized POS system. Using this method, you give everyone a yellow pad and have them attack the store, writing down a list of all the products they find. Unfortunately, with this method there is no way to ensure that your entire inventory is counted ONCE and ONLY ONCE. It's far too easy to miss merchandise or double count merchandise. This is the method Bob originally used in his stores and if you want to hear a good business story, call and ask him about the very last time he ever did inventory this way!

The scavenger hunt method. This method is a favorite of retailers who do have a computerized POS. In this method you take a print out of the inventory the computer says you should have on hand and go look for it. Sounds good, but in addition to all the same problems you have with the yellow pad method, there is one more problem: it doesn't take into account any merchandise that may be on your floor but not in your computer. OK, in theory nothing should be on the floor that's not in the computer, but it happens.

The "little bit at a time" strategy. This is a strategy that gets combined with both of the methods above and compounds their problems! Using this strategy, your inventory gets counted a little bit at a time over a period of days, weeks, or months. One day during store hours you'll count the container department, and the next you'll count the giftware. While this might work to correct on-hand counts in your POS for buying purposes, it doesn't work at all for getting an accurate total of your entire inventory. And that is what you need for creating a true profit and loss statement and for figuring out your shortage – a "snapshot" of exactly how much inventory you own at one specific point in time. You should count the entire store all at once, after the close of the business day.

An Inventory Counting Method that Works. This method is a combination of the best practices used by very large retailers and refined for use by small- and mid-sized independent retailers. The "big boys" have spent literally hundreds of years, millions of dollars, and a gazillion man-hours learning and perfecting how to count a wide variety of merchandise. The stakes for them are very high, so they've worked very hard to get it right. There's no need for you to reinvent the wheel – we've figured it all out for you.

Using this method you:

- systematically map out your store
- clean, organize, and correctly tag all merchandise
- develop a strategy for efficiently using all your sales staff to help
- count all your merchandise once and only once
- ensure counts are correct with a system of double checks
- complete a full count of your store in one night
- compile and analyze your inventory results

Get FREE business building ideas delivered to your e-mail every week. Sign up for your "WhizBang! Tip of the Week" at www.WhizBangTraining.com.

Bob and Susan Negen
WhizBang! Training
212 South Harbor #301, Grand Haven, MI 49417
616-842-4237 • Fax: 616-842-2977
talktous@whizbangtraining.com

The Art and WOW of Container Gardens

by Rita Randolph

The Inherited Art of Growing Plants

I was raised in the greenhouse and nursery business, with overnight, out-of-town trips for plants considered as a vacation. My father, Jack Randolph, started the nursery just after World War II, and my mother, Ruth, joined him as the greenhouse operator, while he pursued landscaping and most of the outdoor production. On family outings, we would trot through botanical gardens and other horticultural businesses, and on our way, we collected plants to bring back for ourselves. The youngest of five, I ended up being the one to stay behind and take over the family business.

Since the early 1970s, I have spent most of my spare time searching for new plants to grow and add to our collection. Most of the plants we vegetatively propagate are tropical, and we add these to annual and perennial container combinations for a colorful effect. Our first attempts at container mixes were more than 30 years ago, when my mother started making them with the comment that "*something* in there will like you," meaning that if the customer neglected or stressed the container combination, something would survive, leaving the customer with at least one good plant! We would add ferns and ivy to the shady impatiens mixes, and tried a variety of goodies in the sunnier mixes.

Soon we discovered the added retail value of having more interesting or unique items in the planters. Most of our customers are true gardeners and appreciate a design that includes some dramatically different selections. Many long-term customers educate themselves, just as we do, about the new plant introductions by reading all the best gardening magazines and becoming collectors themselves. Adding the newest and best flowers or foliage to your plant pallet will attract those who are very willing to pay for a unique, colorful, artistically arranged mixed container – especially if it comes in a great pot.

The "Art" of Combining

The real *art* to container mixes is pairing the plants with others in a complimentary or contrasting manner, yet keeping an eye out for predictable behavior or growth habits. Your containers may look fabulous at first but grow into awkward shapes later in the season. By planning on their predicted growth habits, your mixes will stand the test of time in the garden setting and require less maintenance. Pruning plants into submission should not be a requirement of the customer! Plan your mixes so that the outstanding-feature plants remain dominant, and filler material contrasts and cohabitates with the one next to it. An example of this would be alternating flowering plants with foliage color as you work around the perimeter of the container. Alternanthera and Iresine varieties would compliment a Verbena or Lantana variety next to it (Figure 1). Coleus might work as well, and so on.

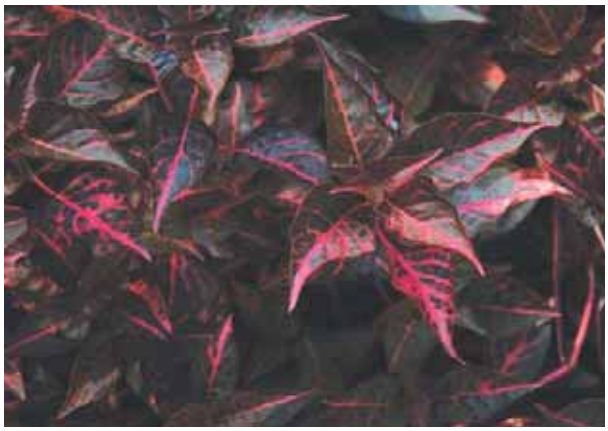


Figure 1. *Alternanthera is one example of unusual colorful foliage used between flowering plants in containers.*

Texture and their contrasting partners is an appealing aspect of container gardening as it draws your eye in to see exactly what's going on. When highly textured or linear foliage, like ornamental grasses, are placed next to smooth, round or simple-leaved plants, the result is a pleasing contrast. The grass-like foliage can soften and break up monotony in bushy, round combinations. Long lily-like foliage or spiking leaf shapes will raise the viewpoint in a container, keeping your eye on the move, and providing some much needed "action." Too many plants with dwarf or low growth habit can render the container sedimentary and complacent.

Color, texture, contrast, and height relationships between the plants in the container make it all work – or seem dizzy. It becomes important to manage putting strong foliage colors placed in between them. Spiking flowers such as phygelius or salvia may benefit from the addition of another tall, linear foliage form to supplement the pot should you need to deadhead or cut them back. Also, many large pots can afford to have more that one tall plant in them.

That Special Touch

When finishing the container mix, keep in mind to under-plant most of your work with low growing plant material, as this dresses and finishes the area nearest the soil. Many sunny mixes will have a microclimate of shade under their foliage nearest the soil, and many

Continued on page 18

The Art and WOW of Container Gardens

Continued from page 17

shade loving plants can be used this way. *Selaginella* 'Club Mosses', and *Lysmachia* 'Creeping Jenny' are wonderful to top-dress with. Small creeping plants or low growing spreaders work wonderfully to hide the soil and give a container mix that special touch. In the case of most smaller pots or succulent/cactus mixes, we top dress with pea-gravel or decorative rock in various colors to compliment the mix of plants or the color of the pot (Figure 2). This also prevents soil-splatter when watering the container by conveniently dispersing the water. Adding a decorative rock or piece of driftwood to an open area in the design would add a personal touch, provide a secretive aspect, and create the impression of a vignette or miniature scene.

Figure 2. *Decorative gravel is used for top-dressing many containers, giving them a "finished look."*

Perennial Performance

Perennials and evergreens comprise the greatest growth potential in container gardening today. The value of a plant that performs – and comes back – is a serious temptation when purchasing. Quality and plant health is always a customer's first consideration. Secondly, being a perennial is usually the next most important item. Evergreen perennials, such as the grass-like sedges, heuchera, selaginella, and young or dwarf conifers, will further the success of a container mix, especially in the cooler months of the year (Figures 3 and 4). Thirdly, how you have combined it with others on the retail display bench or in containers will ultimately lead to the purchase. A finished container sample strategically placed on the bench will help things along.

Figure 3. *Dwarf conifers and evergreens can be used in tabletop containers year-round.*

Figure 4. *A perennial planting of Heuchera, Tradescantia 'Sweet Kate', and Fescue.*

ofa Garden Center

The Succulent Side

Sedums and succulents are quickly becoming popular container choices for all types of gardeners (Figure 5). Novice and experienced plant collectors both love to house these plants in groups of single specimens or several varieties spilling out of one gorgeous pot. Their seductive foliage can be "petable" or "taboo" to touch! They come in all forms and sizes. Familiar varieties like 'Jellybeans' and 'Hen-and-Chicks' are great for filling and spilling out of containers. Upright components might include *Euphorbia* 'Pencil Cactus' or Agaves.

Figure 5. *A dripping urn of succulents at the home of Thomas Hobbs in Vancouver, British Columbia.*

The perennial varieties are especially in demand, so it helps to do a little research. Many suppliers have both upright and trailing varieties of sedums, and they come in a multitude of foliage colors and leaf sizes. Some containers can have both hardy and tender species combined, but you might want to label them appropriately or be sure your customer is aware of the hardiness factor of each. One of the most appealing aspects of succulent container mixes is that you can go on a summer trip and return to find that the plants are still alive and look great. We recommend adding extra drainage materials like pea-gravel and sand to these special collections.

The "WOW" Factor

The Rule of Three

You've undoubtedly heard of the plant design theory The Thriller, The Filler, and The Spiller. This term has been around for such a long time because its simplicity usually works. This is also known as the "Rule of Three." This and other odd numbers in combinations are often applied to container mixes. One chooses a tall plant, usually of linear shape, another medium-sized selection that will spread and be bushy, and the third "spiller" that is cascading in nature. Most of our garden center collections can easily fill these roles. Wonderfully profitable designs are achieved in this way.

The "Rule of Three" also works with color choices for your designs, like three primary colors or three colors in a harmony. As primary colors, choose red, yellow, and blue. You could also add white, silver-metallic colors, or chartreuse green. Primary colors are pretty lively and exciting. They are usually placed in high-action areas of the garden or where they need to be seen from a distance. A harmony would be three of one single color family, or with colors close to each other on the color wheel, such as purple, violet, and lavender, or red, rose, and light pink. These combinations will sooth and calm you (Figure 6).

Figure 6. *A silver collection of Lemon Grass, Artichoke, Arizona Cypress, and others, in a lead-look container.*

Continued on page 20

The Art and WOW of Container Gardens

Continued from page 19

Size up the Foliage

Using these simple rules, you can create designs that work well when combining a plant that has large leaves, one with medium-sized leaves, and another with fine-textured or small leaves. The leaf size and texture relationship of the foliage is very important to keep your eye interested and entertained. Too many plants with small leaves can make a design seem "hairy," such as too many varieties of verbena in one pot. Just as simply, too many round, medium-sized leaves clunky. Even some of my favorite plant varieties, like the variegated geraniums and rex-type begonias, would begin to look more like a "plant collection" rather than an "artistic design."

The wonderful thing is that when properly combined with other varieties, these combinations have the potential to be *both*. One of our most popular mixes has been adding Athyrium (Japanese Painted Fern) and *Festuca glauca* 'Sheep's Fescue', or *Carex* 'Frosty Curls' to our Rex begonia collections (Figures 7 and 8). The finer foliage of *Asparagus retrofractus* 'Ming Fern' breaks up and compliments the beautiful foliage of the popular variegated heirloom geraniums 'Occold Shield' and 'Tricolor'.

Achieving Color Depth

Getting a collection of plants to work together may entail combining five or more plants. Once you have selected the main three characters and colors, adding an additional group to the mix underneath, among or intertwined, can increase the 3-D effect of a container mix. These additional plants can give the container

Figure 7. *'Rex Begonias' in a mix.*

Figure 8. *Heirloom Geraniums' large and outstanding leaves will benefit from the addition of fine-textured foliage.*

"depth," especially if these plants seem to glow or shine from the inside. Plants with light green and golden foliage are the perfect solution for under-planting a container, whether it is large or small in scale.

The soft glow of chartreuse colors goes with most every combination. I have yet to find a color it doesn't compliment, especially when the color theme is bright monochromatic, polychromatic, and full of color. Chartreuse colors are daydreamy, whimsical, and strongly attractive to most onlookers. *Plectranthus* 'Troy's Gold' and *Tradescantia* 'Trading Gold' are two of my personal favorites (Figures 9 and 10).

Silver foliage is uniting with pastels and many monochromatic mixes, and can make a harmonic color scheme "sing." The soft tones of blue, rose, and shades-

Figure 9. *Plectranthus 'Troy's Gold' is a favorite for under-planting taller plants of all kinds in container mixes.*

Figure 10. *Tradescantia 'Trading Gold' is a favorite for underplanting taller plants of all kinds in container mixes.*

of-white mixes are well suited to the softness of silver foliage of artemesia and lotus, yet the addition of other deep colors of dark foliage plants work just as effectively in certain instances. For example, deep rose pink and burgundy foliage plants, like *Alternanthera* 'Calloway Pink', or *A.* 'Gay's Delight', can add a new dark dimension to a collection, enriching and adding a backdrop to the colors of jewel-tone flowering plants that may be added (Figure 11). All this colorful foliage gives the onlooker something to enjoy, even if flowers are not currently present.

Containers Complete the Selection

Listen to the Plants

Once you've experimented with fabulous plant collections, the container you choose to put them in can mean the difference between a nice mix and an exceptional grouping.

I have been found walking around our empty containers with some plants in my hands, holding them up for comparison and compatibility, asking, "Who wants to go with us?" and, "What pot do you want to go in?" Listening to the plants is a lot like shopping for fabric or a searching for a shirt and tie that go together. The same rules of contrast and compliment apply. Even though you

Figure 11. *The colorful foliage of Alternanthera 'Calloway Pink' adds depth and compliments the colors of jewel-toned flowering plants.*

may not be able to describe the act of listening, it seems to come naturally the more it is practiced! I heard a phrase once, "What thrills one person, chokes another," so be prepared for almost any reaction to your new container designs, including laughter. At Randolph's, we believe that great plants deserve great pots.

Rita Randolph
Randolph's Greenhouses
1690 Airways Blvd
Jackson, TN 38301
731-422-2768
Fax: 731-988-9889
randolphsgreenhouses@charter.net

Stimulating Flower Sales during the Late Winter & Early Spring Doldrums

by Gary Anderson

Flowers make the "Bleak Midwinter" less bleak. They can raise spirits and redirect thoughts to a cheerful anticipation of spring and the new growing season. The challenge is to lure potential customers into the flower shop where flowers and creative merchandizing can work their magic.

Sales between Christmas and Valentine's Day, and then on to Easter are slow in large part to a lack of traditional reasons for buying flowers. With a late Easter in 2006, this period is even longer than usual. Inclement weather usually slows the shopping pace. If only more people could be enticed into flower shops, the potential for impulse sales would increase. Enjoyment of the purchases would be heightened because of the contrast with the winter landscape and the increased time many spend indoors.

Flower shops need to work extra hard at creating an appealing ambience during the winter months. Advertising and promotion needs to remain at a high level, letting customers know of specials for the home, like arrangements featuring forced flowering branches and spring bulbs. Special events, like bulb forcing workshops or seminars on creative display of flowering houseplants, can draw customers by stimulating their seasonal interests. It is a great time of year to promote the sale of cut flowers in hand-tied bouquets. Showing the customer creative ways to display flowers can often result in added sales of containers and accessories.

Transition quickly into the spring look. Avoid lingering displays of Christmas merchandise. Change colors and accessories to forward-looking themes of the coming season. Consider some of the following tips for successful post-Christmas merchandising.

Feature the Living Symbols of Spring

- **Fresh Cut Flowers and Branches.** Spring flowers and forced branches satisfy longing hopes for the growing season. Tulips, daffodils, iris, and acacia are traditional symbols of spring. Don't forget the long-awaited forced branches of pussy willow, forsythia, quince, and the newly emerging leaves of curly willow.
- **Forced Bulbs.** Emphasize forced bulbs as an element of window sill gardening when the weather is still inclement. The therapy associated with the process of forcing and the beauty of the products is double reason for encouraging this endeavor. Sell bulbs at different stages of development. Some indoor gardeners gain satisfaction from starting with the dormant bulb. Others want instant beauty and prefer flowers at peak bloom. Offer some partially forced for those who want fast results but enjoy the dynamics of the final days of opening.
- **Blooming Plants.** Have available a good selection of spring blooming plants in various sizes. Cyclamen, primroses, calceolaria, cineraria, small colored calla lilies, and azalea bring instant cheer to a table or window sill in winter. Some customers will appreciate the smaller sizes and may be enticed to buy a collection or several as gifts for friends or shut-ins – impulse buying at its best. If they don't see them, they won't buy.

Captivating All the Senses

Compelling Color. Color always heads the list of elements that impact customer emotions. Everyone is ready for a change from the rich colors and glitzy accessories of Christmas. Feature pastels as well as a triad of bright, clear yellow, red, and blue. The sudden removal of December's excess of lights right at the beginning of the darkest, coldest months of winter can be depressing. Continue to use miniature electric lights in novel ways, such as with mirrors or inside glass jars or cubes, or among houseplants. Novelty lights such as red hearts for Valentine's Day or pastel globes for Easter can offer a welcome change and a chance for increased sales.

A Fresh Breath of Spring. Take advantage of the captivating fragrance of spring. Add to the appealing essence of fresh flowers and foliage with some of the more powerful aromas of hyacinth, paperwhite narcissus, and gardenia. Don't overpower customers' senses with over-mature blossoms and stagnant air. Delicately perfumed potpourri can also create a clean and fresh sense of the spring landscape.

Captivating Sounds. Don't let any of the senses go unstimulated. Use audio to create the sound of spring. Running water, chirping birds, and peeping frogs are all sounds of nature that are anticipated and appreciated. Why not add some soft sprightly music?

Packaging for the Season

Protect. Wrap all fresh cut flowers and living plants for safe winter transport. This seems obvious, but many sensitive plant materials are sent out the door without proper wrap – only to suffer chilling injury or certain death.

Entice. Use appealing wrapping materials that feature the color and design of spring. Pastel tissue used in color harmonies that complement the flowers will increase

ofa Florist

their perceived value and serve as a hallmark of quality service. Don't overlook the myriad of sheer ribbons and colored raffia that can wrap up the sale with an extra special touch.

Keep customers coming during those long winter non-holiday periods by launching into spring. Everyone is ready for a change. Create a fresh, appealing, and ever-changing ambience that will stimulate sales and lift the spirits of shop personnel.

Gary Anderson, Ph.D.
The Ohio State University
Agricultural Technical Institute
1328 Dover Road
Wooster, OH 44691
Phone: 330-287-1241
Fax: 330-287-1333
anderson.35@osu.edu

Congressional Action Days – Will You Be There?

by Lin Schmale & Jeanne Little

The Society of American Florists' Congressional Action Days will be held in Washington, D.C. on March 20-21, 2006. For more information, log onto the SAF web site, www.safnow.org, or call 800-851-9495.

On March 21, Members of Congress, their top staff members, and key representatives of federal agencies will stream into the Cannon Caucus Room on Capitol Hill, barely stopping to put on their name tags, to enjoy the once-a-year floral displays, to carry home their own arrangements, and – most importantly – to meet with the floral industry. We may be biased – but we are told that our event is considered the favorite reception on Capitol Hill – the Society of American Florists' annual Congressional Reception. We hope you, too, will be there. You can make a difference! The reception is held as the concluding gala event of SAF's Congressional Action Days, March 20 and 21.

This year, SAF is targeting increased attendance – more retailers, wholesalers, and growers, from more states, to tell the story of the industry to their Members of Congress. In 2005, thanks to Congressional Action Days lobbying, and particularly to the lobbying of leaders from the Ohio industry and OFA, the Floriculture and Nursery Research Initiative was increased by $250,000 – to a new total of $6.25 million. This year, SAF would like to top that and see an even bigger increase – but it takes constituents, telling their own stories to their own congressmen and congresswomen, to make it happen. Other issues will be highlighted as well – perhaps immigration reform, tax reform, health care reform – but all of key importance to your business.

There's more to Congressional Action Days than the reception. What else will you be doing?

Monday morning, at the Congressional Action Days Kick-Off Breakfast, Democratic strategist Bob Beckel and conservative columnist Cal Thomas will attempt to bridge the Red-Blue divide as they discuss the issues that are making Congress such a contentious body this year. Both are experienced, witty, and insightful veterans of the Washington scene – and their conversation will be enlightening, thought-provoking, and fun. These sessions are small enough so that attendees can – and do – ask questions from the floor.

Monday continues with the issues briefing – a session during which attendees will get all the information, education, and details they need to be able to present our key issues the next day as they meet with their congressional representatives and their staffs. It might sound intimidating – trust us, it is not! Before attendees step foot out of the hotel to go to Capitol Hill, they'll all feel well-prepared.

There is another top-notch speaker during lunch, and then it's on to the afternoon's planned session on deceptive telephone practices. Why does this issue continue to bedevil our industry? Why have florists in some states succeeded in getting their state legislatures to pass laws – and do those laws then get enforced? Why is national legislation unlikely? What, if anything, can we do about this problem?

Monday winds up with the SAFPAC Reception and Dinner – and the speaker will be Judy Woodruff – who has covered politics for CNN, NBC, and PBS for two

Continued on page 24

Congressional Action Days – Will You Be There?

Continued from page 23

generations, and has covered every presidential election since 1976. The session is titled "Inside Politics," and it will be well worth your contribution to SAF's Political Action Committee, SAFPAC, to hear her speak and, again, have the opportunity to interact with one of Washington's famous faces.

SAFPAC, by the way, is the floral industry's political action committee, through which individuals can pool their campaign contributions to make a bigger splash. SAFPAC is one of the key tools in helping the industry gain recognition among all of the competing voices here in Washington.

Tuesday starts off with a breakfast talk from a member of Congress – which will be especially interesting in this election year. The Congressional approval rating, as we write this, is not high – and at least some Republicans worry about losing the House and/or the Senate. Have the Republicans lost their way? Do the Democrats have a message? Good fuel for thought – and discussion.

Next, the Congressional Action Days crowd heads up to Capitol Hill, to meet with their elected representatives. Meetings are scheduled to allow groups of attendees from the same state to work as a team, as much as possible, as they discuss the key issues SAF has identified for Congressional Action Days 2006. And at 6 p.m., the doors open to that famous reception, and floral industry members have, again, a chance to meet – this time socially – with their representatives, staff, and, of course, with each other.

What will the key issues be this year?

As we write this, in late November, it's difficult to predict exactly what issues SAF will take to the Hill in March. We can, however, make a best guess at some strong probabilities. It takes from 10 to 15 years, on average, to get a significant bill passed through Congress – so it is likely that the issues carried to the Hill will be familiar ones: research funding, healthcare, immigration reform, perhaps some kind of tax reform.

It's even a little difficult to say as we write this article exactly what the political situation will be by the time you read it in January! But unless you've spent the fall of 2005 in the Antarctic, you are aware that things have been divisive and, well, not particularly pretty, politically speaking.

Former House Majority Leader Tom Delay, known as "Tommy the Hammer," for his ability to whip fellow Republican representatives into line to support the leadership on key votes, is under indictment. Senate Majority Leader Bill Frist is under suspicion. The Bush Administration is besieged with the investigation into possible improper leaks to the press, with continued controversy over the Iraq war, and with a budget that looks much less rosy than pre-Katrina.

Republicans in both the House and the Senate are distancing themselves from President Bush – not abnormal for a second-term presidency, but it is unusual to have it happen this early in the second term. That distancing, and the continued controversy, means not only that the president will have a harder time getting his proposals passed by Congress, but it also means that Republicans will have a harder time getting their proposals through the almost evenly divided Congress, as moderate and conservative Republicans battle not only with the Democrats, but with each other.

Last fall, everyone thought the agenda was set: finish the appropriations bills, do budget reconciliation, possibly pass an economic stimulus package, and take action on immigration reform – all before Thanksgiving! As you know, Congress recessed for the Thanksgiving break leaving several appropriations bills unfinished. Separate, and relatively divergent, budget reconciliation bills were narrowly approved in both House and Senate, but key issues remain unresolved until Congress reconvenes in December.

Given all this disarray, what issues will be timely in March?

Each year, SAF identifies three (or at the most four) issues which Congressional Action Days participants take to the Hill, to present the industry's position to their elected leaders. It is difficult to predict, at press time, exactly what those issues will be, particularly in light of the political uncertainty currently reigning in the nation's capitol. However, many of the industry's key issues remain unresolved, and are likely to continue in their unresolved status even by next March.

Research funding will certainly be one issue we ask participants to discuss with their representatives – this is a multi-year effort, depending on appropriations bills which are passed every year. The Floriculture and Nursery Research Initiative has literally changed the face of research funding in this country, and we desperately need to expand it beyond its current $6.25 million. This year, we plan to make a strong effort to do just that.

Depending upon what happens between now and then, it is extremely likely that we will still be pushing for a final, acceptable program of immigration reform – one that addresses not only enforcement, but also a workable guest worker program and some kind of acceptable solution to those undocumented workers who are already here – many of whom are working in the

ofa Advocacy

green industry and in other segments of agriculture.

The topic of health care improvements is likely to be another of the key issues. SAF has long supported association health plans, and the Senate may, at last, be ready to act on some version of that legislation. Increasing health care costs remain a problem for employers in the floral, and other, industries. Association health plans will not provide a comprehensive solution, but they could provide one component of a solution.

Repeal of the "Death Tax" is unlikely, given the current economic and budget pressures – but the issue needs to be kept alive (no pun intended). Other bits and pieces of tax reform are also possible.

These topics are long-term, important ones that have been "on the industry's plate" for several years. They are also topics that we have a good chance of influencing Congressional decisions on – but only if members of the industry step forward to raise their voices.

As a result of Congressional Action Days' visits in previous years, members of the floral industry have been invited back to Washington to appear at press conferences with House of Representatives leadership. They have been invited to testify at Congressional hearings. They have established relationships with their elected representatives which can – and do – help put a face on the floriculture industry. Congressional Action Days literally plays a major role in helping the decision makers better understand the day-to-day realities faced by you, the business owners and constituents. We greatly appreciate our attendees every year – and we hope that you'll be one of them this March!

Lin Schmale & Jeanne Little
Senior Directors of Government Relations
Society of American Florists
1601 Duke St
Alexandria, VA 22314
800-851-9495
lschmale@safnow.org
jlittle@safnow.org

January and the Tyrant of "Ought"

by Michael Cunningham

I wonder if your Januarys are like those I normally experience. For example, last year we had three salesmen stop by the first week in January. This may not be unusual for some nurseries, but is a pretty good haul of salesmen for us. I was just beginning to wonder why we were getting so much attention when one of the salesmen mentioned that he liked to make calls in January because it was a slow month. He figured we'd have more time to talk, and he was right. January is a slow month. I am not exactly hibernating in my den, but the tasks before me are less urgent than they will be in another month.

For instance, I have a mental list of repairs to make, but none have to be made right away. As I was rolling up the sidewalls on the greenhouses, as I do on January mornings when the sun comes out or the air is above freezing, I noticed that another of the hand cranks was broken. That is four now that I need to replace. I ought to go ahead and order four cranks and maybe a spare from the manufacturer, but they cost a $187 a piece, which seems like a lot if they are going to break so easily. It's actually the reducing gear that breaks. Maybe I could buy the reducing gears from another supplier to replace those and save myself some money. But what I really ought to do is figure out how to keep them from breaking. It's probably a maintenance problem. These are the kind of cranks that ride up a guide bar on four metal casters. These casters eventually rust and freeze up so the crank no longer rides smoothly up the guide bar. Often the crank gets cocked on the guide bar and binds up so that I have to kick it with my foot to get it moving. I am sure the gears are not designed to take the torque of a stubborn crank that will not rise without a kick. What I ought to do is go ahead and shell out for new cranks, but instead I resolve to do a better maintenance job to keep those casters turning. In any case, I need to do something because I don't like the way those four houses with broken cranks heat up on sunny days.

Some nurserymen cover their houses with white poly-film in order to reduce heat build-up, but I prefer to use clear poly with a roll-up side for ventilation. The drawbacks are that I spend about 45 minutes a day rolling up and rolling down, and I never seem to be able

Continued on page 26

January and the Tyrant of "Ought"

Continued from page 25

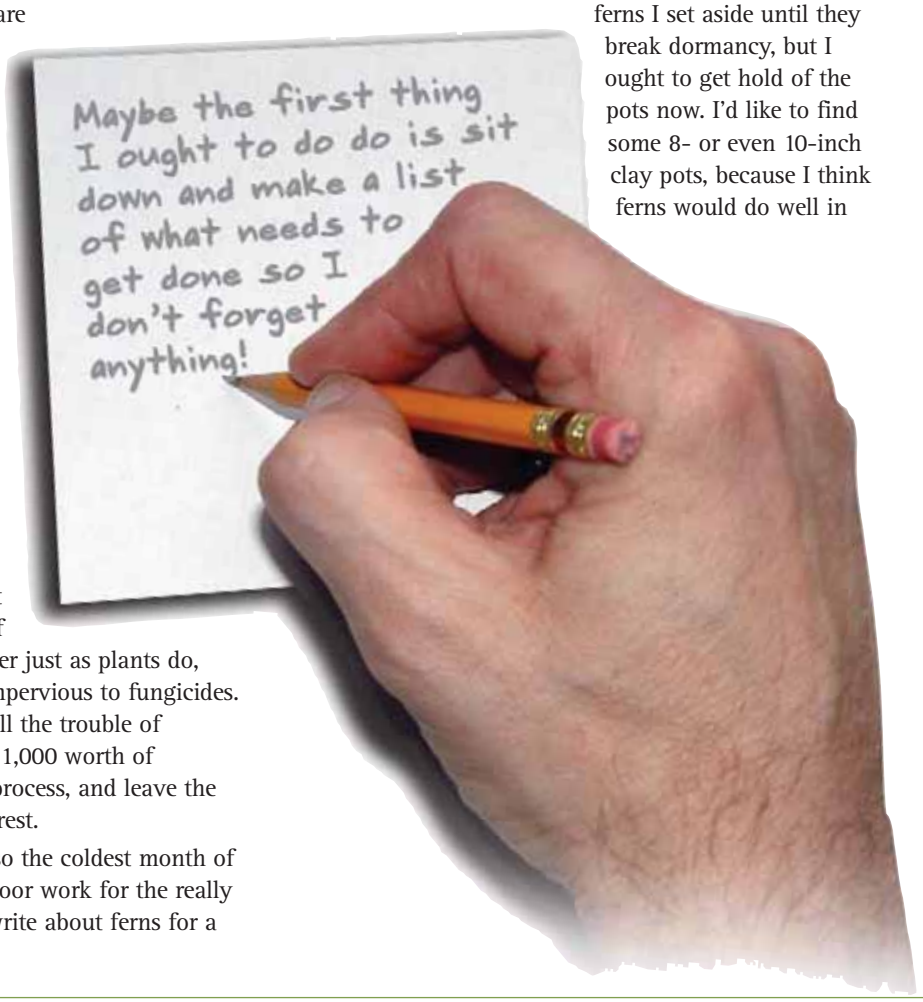
to do the maintenance required. Right now the big problem is that many of the straps that hold the sides snug against the houses are broken. So many are broken that some of the sides are flapping in the wind like sails and are letting in way too much cold air. Luckily during that cold spell in December we also had snow, which piled up between the houses and shouldered against the roll-up sides, sealing them tight. But we usually don't have snow with severe cold, so I ought to get new straps put up before it gets cold again. The straps we used before were black polypropylene, which deteriorates after a few years. I bought a 1,000-foot roll of white nylon strapping, which I expect will hold up better. I ought to cut the roll into 5-foot lengths tomorrow morning, then when it warms up a bit in the afternoon I could start tacking the straps in place every six feet along the sides of the houses. I ought to do this before we get some more serious cold, but maybe the heat build-up is the more urgent problem. Maybe I ought to do something about those broken cranks first.

January is a slow month, but this year it won't be as slow as it sometimes is because we didn't finish cutting everything back in December. We are over-wintering 13 houses full of perennials this year, and in December we went through only five of them, weeding and cutting back. It would be good if by the end of January I could finish the cutting back, which I figure is about three week's work for two people, but everyone is laid off and I don't like trying to be two people in January when things are supposed to be slow.

The other thing I didn't get to do when I was putting plants away for winter is apply a fungicide drench. I have enough Subdue Maxx and Cleary's 3336 on hand to do the drench now, but I wonder if it's too late. I wonder if soil pathogens go dormant in winter just as plants do, over-wintering as resting spores impervious to fungicides. I ought to find out before I go to all the trouble of drenching. I would hate to waste $1,000 worth of chemicals, damaging roots in the process, and leave the fungal spores cozy in their winter rest.

January is a slow month but also the coldest month of the year, so I like to save some indoor work for the really cold days. This year I planned to write about ferns for a brochure we can hand out to customers. I took a gamble and doubled our order of fern liners this year, and now I think I ought to hedge my bet by doing something extra to promote them. I have Casa Flora's list of their 10 best selling hardy ferns, and I thought I would write about those 10 at some length, focusing on what distinguishes each, so that a customer, having read the brochure, would feel that he knew those 10 ferns and could choose among them. As the grower, writing promotional materials is not really my job, but I ought to do it anyway. And if I'm going to do it, I'd better do it now, for it certainly won't get done later.

I must not forget another idea I had for promoting ferns. Last summer, when ferns were selling so well, I thought ahead and saved back one of each kind, with the intention of shifting them into larger pots and growing them on for display purposes. The ferns we grow for sale spend only a few months in gallon pots and in that short time don't really show what they can do. My idea is to produce a sampling of mature ferns that can be set around in the sales area and show customers what they can expect for their money. I won't need to re-pot the ferns I set aside until they break dormancy, but I ought to get hold of the pots now. I'd like to find some 8- or even 10-inch clay pots, because I think ferns would do well in



clay. Water evaporates from the sides of a clay pot, which should help keep a fern's roots as cool as a forest floor.

So much of what I do is like this thing with the ferns: it requires thinking ahead a year or more and setting up a plan and moving from stage to stage. It sometimes seems that nothing is discrete and simple and without premeditation. Even something as straightforward as putting a name tag in each pot to correctly identify the plant it contains requires research, planning, a computer, a multistage process, and lots of niggling little details. I begin to be nostalgic for a time when we simply grabbed a popsicle stick, wrote the name on it, and stuck it in the pot. A nurseryman near us has a bold solution: he doesn't tag anything. If the customers don't know what the plant is, they can ask. It's tempting, but for now I'm stuck with something more complicated.

My next step in the process is to unbox the labels that came from my supplier back in December. They were ordered in August, in time for the early-order discount. Every nursery has its own way of organizing tags. What I do is spread them out in alphabetical order on six trestle tables in the attic of the barn. The tables are already half full with tags left in inventory, and I will mix these new tags in with them. That will not, however, be the end of the acquisition of tags. Our plant orders have changed considerably since August, so I will have to put together a new tag order to reflect the additions. Also, there will be about 25,000 tags that we will have to print ourselves because my supplier doesn't make them. I ought to print those tags in January, otherwise I'll find myself in the middle of the planting season having to stay after dark to print up the next day's tags.

I ought to print those tags, but I can't until I make a master list of tags needed and place the supplementary tag order; and I can't do that until I work through the pile of acknowledgments and see which of the plants we ordered we are still supposed to get; and I can't spend all my time in the office.

For one thing, it is much easier to do maintenance and repairs on the greenhouses when they are empty, and January is just about the only time we have some empty houses. I could spend a week just on fans and heaters. I know right now of two inflator fans that aren't working, for the poly on two houses has that saggy-baggy-elephant look. I ought to find out if they are shot or not; sometimes if you turn their little hamster runs by hand they will struggle into life and gradually pick up speed, spitting out seeds, insect carcasses, and nameless fluff until they are operating properly. A stubborn HAF fan can also sometimes be reincarnated with a little finger power. Before I start up the HAF fans, I ought to find that bottle of oil with the syringe-like cap, grab a stepladder, and lubricate the fans. I ought to tighten the fan belts on the exhaust fans while I am at it, because some were barely turning last spring. It would be smart to get all the fans in good working order, but what I really must do is make sure all the heaters are working before I start filling up the houses with vulnerable young plants.

There are often bird's nests in the heat exchangers, and the mud daubers love to build their adobe hideaways in the gas manifold. I can do such cleaning as is required, but I regret to say that I have never learned to make repairs. I say regret because I should have learned and because these heaters, exposed to the elements as they are, frequently need repair. I'm starting to think the best thing to do is what George Pealer does at Millcreek Gardens: when the houses are uncovered in the spring, he disconnects the heaters, removes them, and stores them in a barn. That's what I ought to do too, but there isn't enough storage space in the barn for what already goes there. I ought to learn how to work on the heaters, but I know I won't – it's too far down on my list of things I need to learn.

I am on much sounder footing when it comes to matters of irrigation, and over the last three years I have been updating our systems. I have been redoing the overhead sprinkler lines in all the houses, using mini-wobblers for the sprinklers and putting them eight feet apart to get a 100 percent overlap, which gives fairly uniform coverage. There is only one house left with the old sprinklers, and I really ought to redo that house now so that I can be done with this phase of the planned improvements. The next step is to get a faucet and hose in each house. The overhead sprinklers are fed by water from the pond, while the faucets are county water. At this point eight houses still don't have county water run to them, so when I hand water in those houses I have to put two or three hoses together and drag it around. I ought to get county water to the eight houses for the simple fact that I know I will do a better job of hand watering if I make it more convenient for myself.

If I am going to order plumbing supplies, I might as well order extra fittings for emergency repairs, because I will certainly have to make emergency repairs. And I might as well order what I will need to plumb up the two new houses– oh, yeah, I almost forgot, we have the parts for two new houses, and they will have to be put up sometime in January. It's the only time to do it really. How could I have forgotten the two new houses? Maybe the first thing I should do is sit down and make a list of what needs to get done so I don't forget anything!

Michael Cunningham
3866 Spring House Lane
Cincinnati, OH 45229
513-221-6047
mandpc@fuse.net

Ask the Doctor

Stephen A. Carver, Ph.D., OFA

Yao-Chien Chang and Bill Miller have written an excellent series of articles describing the work they have done at Cornell University's Department of Horticulture. The latest article appeared in the September 2005 issue of the *Journal of the American Society for Horticultural Science*. Complete citations for this and the other articles are listed at the end of this review. In addition to being the basis of this issue's Research Review, these articles will also provide the material for "Ask the Doctor," because they present a problem common to oriental lilies, along with the authors' efforts to identify the cause, the conditions under which it occurs, and management techniques to help manage the problem. Because this review can only touch on the high points of their efforts, you are encouraged to read these articles for yourself.

There is a problem observed on many cultivars of oriental lilies including 'Star Gazer'. The authors have named the problem "upper leaf necrosis" (ULN). It can be found affecting oriental lilies in all regions of the United States, in the Netherlands, and elsewhere. ULN can be observed at any time the lilies are grown. It has been seen on oriental lilies grown under glass and under plastic. The symptoms are typically confined to the leaves at the top of the plant. When severe, they can be seen as a necrosis or death of leaf margins and tips. Occasionally, the leaf necrosis will be accompanied by a curling and distortion, which means the value of the crop is compromised.

Based on the symptoms and their similarity to known problems on other crops, the authors postulated that a calcium deficiency might be involved. They tested the hypothesis in several ways. Chang and Miller re-examined the nature and location of the symptoms on the plant, the pattern of symptom development during the course of production, and the impact environmental and cultural conditions had on the incidence of injury. They reviewed the function of calcium in crop development, its movement in plants, factors that can limit its availability in any portion of a plant, and the symptoms that typically develop. Finally, they ran tissue analysis of affected and healthy tissues, manipulated cultural and environmental conditions that would directly affect calcium availability in injured leaves, and observed the impact of calcium treatments on symptom development and leaf calcium content.

Symptoms & Complicating Conditions

- While symptoms of ULN may be observed on any of the top 15 or so leaves of the plant, they are usually most severe on the two leaves just below the bottom bud.
- Symptoms may be seen as tiny depressed spots (which may be hard to see) on the leaf undersides along the margins. The spots may be accompanied by a yellowing (chlorosis) of the leaf margins.
- In severe cases, early symptoms appear as water-soaked areas that can be almost an inch long along the leaf margins. The injured tissue quickly turns brown. This dead tissue can cause the leaf to curl or distort as leaf growth continues. In more severe cases, dead (necrotic) areas developed inwards from both margins to the center, causing leaf tip death. Severely affected leaves may not fully expand and may occasionally be purplish in color.
- In the authors' studies, symptoms typically developed 30 to 50 days after planting. They note, however, that bulb cold treatments can affect the number of days for stems to emerge following planting. Bulbs used by the authors typically emerged in six to eight days after planting and were grown on at about 62°F target temperature, day and night.
- Flower buds were rarely affected by ULN, even though they were associated with highly distorted leaves.
- Symptoms can begin developing in "susceptible" leaves starting up to three days prior to their unfolding. The sides of the unfolded leaves typically overlap each other before the flower buds become visible.
- Symptoms were more significant on lilies grown under shade. There is some data that indicates supplemental lighting during the winter increases leaf calcium content and may diminish ULN. There is also some evidence that lilies grown under conditions of higher relative humidity will have more significant symptoms.

Calcium in Plants

- Calcium is an essential macronutrient in plants. It is a component of plant cell walls. In addition, it helps maintain cell membrane stability and cell integrity. Membranes of calcium deficient tissues become leaky, i.e. cell "fluids" can escape, resulting in cell death.
- Calcium moves "up" in plants in the xylem or water conducting vessels. Once calcium ions leave the xylem and move to the cells, they are "tied-up" and become unavailable for redistribution to other parts of the plants. Numerous studies have shown that calcium content in leaves, flowers, or fruit is tied closely to the level of transpiration from the organ. Thus, the higher the rate of transpiration, the greater the movement of calcium into the leaf, flower, or

Ask the Doctor

fruit. Fruits and young leaves typically have low rates of transpiration.

The Authors Found That:

- Scales of the 16- to 18-cm bulbs that the authors used generally had a low calcium concentration which couldn't meet the demand of expanding upper leaves.
- Transpiration rates from the unfolded leaves were significantly reduced because, until the flower buds appeared, the leaves tightly overlapped each other.
- Manually unfolding the leaves prior to flower bud appearance reduced symptoms of ULN. The practice also increased transpiration and calcium content.
- The authors found that ULN is not a significant problem on plants grown from smaller bulbs. But when these smaller bulbs are planted in a calcium-free nutrient solution in sand culture, ULN symptoms developed.
- Foliar analysis revealed a six-fold drop in calcium content in injured leaves compared to that found in similar leaves from healthy plants. The amount of calcium in ULN-affected leaves was below levels considered sufficient for Easter lilies and, presumably, oriental lilies.
- Daily calcium chloride or calcium nitrate foliar sprays to run-off of the upper foliar at 25 mM were very effective in minimizing ULN, especially when accompanied by 5ml of the spray directed at the shoot apex. Spray applications were begun 30 days after planting and continued for 14 days. Bulb soaks, however, were not.

The authors concluded that there are two primary mechanisms that lead to symptoms of upper leaf necrosis. "The first is a very low bulb calcium content that cannot meet calcium demand when the upper leaves are expanding. The second is that young expanding leaves of *Lilium* 'Star Gazer' are highly overlapped before flower buds are visible. This leaf 'enclosure' reduces transpiration of young leaves and encourages the development of ULN."

Yao-Chien Chang and Bill Miller shared some strategies for minimizing ULN.

"As a result of this research, growers interested in using calcium foliar sprays to reduce this problem could be advised to spray calcium nitrate or calcium chloride at no more than 25 mM daily, for 14 days starting 30 days after planting. Furthermore, an effort to direct spray into the congested leaves should be made. Whether or not this is an economically viable treatment would need to be determined by the individual grower."

They also noted that observations imply that reducing the relative humidity and providing supplemental lighting (both of which can enhance transpiration rates) may help reduce the severity of upper leaf necrosis.

References:

- Chang, Y.C. and W.B. Miller. 2003. Growth and calcium partitioning in *Lilium* 'Star Gazer' in relation to leaf calcium deficiency. J. Amer. Soc. Hort. Sci. 128:788–796. Abstract can be read at the following web location: http://www.electronicipc.com/JournalEZ/detail.cfm?code=04200011280602&CFID=440755&CFTOKEN=7E661BC0-491C-490F-939FF63A2885DFA8
- Chang, Y.C., K. Grace-Martin, and W.B. Miller. 2004. Efficacy of exogenous calcium applications for reducing upper leaf necrosis in *Lilium* 'Star Gazer'. HortScience 39:272–275. Abstract can be read at the following web location: http://www.electronicipc.com/JournalEZ/mo/detail.cfm?code=04200020390203&CFID=440755&CFTOKEN=7E661BC0-491C-490F-939FF63A2885DFA8
- Chang, Y.C. and W.B. Miller. 2004. The relationships between leaf enclosure, transpiration, and upper leaf necrosis on *Lilium* 'Star Gazer'. J. Amer. Soc. Hort. Sci. 129:128–133. Abstract can be read at the following web location: http://www.electronicipc.com/JournalEZ/detail.cfm?code=04200011290120&CFID=440755&CFTOKEN=7E661BC0-491C-490F-939FF63A2885DFA8
- Chang, Y.C. and W.B. Miller. 2005. The development of upper leaf necrosis in *Lilium* 'Star Gazer'. J. Amer. Soc. Hort. Sci. 130:759–766. Abstract can be read at the following web location: http://www.electronicipc.com/JournalEZ/detail.cfm?code=04200011300517&CFID=440755&CFTOKEN=7E661BC0-491C-490F-939FF63A2885DFA8

ofa

ofa Management

Labor Compliance Winter Checkup

by John Wargowsky

Editor's Note: *OFA is a sponsor member of MAAHS, a unique non-profit consortium of associations, organizations, and employers organized to improve the working and earnings environment for Mid American employers. One of the methods is to serve as a resource for a wide array of human resource issues through newsletters, manuals, a web site, phone consultation, and workshops.*

Mid American Ag and Hort Services (MAAHS) suggests employers take a few minutes during the winter to check labor compliance issues that sometimes get missed. These include posting the OSHA Injury and Illness 300-A Annual Summary, making sure IRS W-4 forms are signed by employees, reviewing poster compliance, and reporting new hires.

Posting OSHA 300-A Summary Form

After the end of the year, employers must review the 300 Log to verify its accuracy, summarize the 300 Log information on the 300A summary form, and certify the summary (a company executive must sign the certification). This information must then be posted for three months, from February 1 to April 30. Employers must post a copy of the Annual Summary in each establishment, where notices are normally posted. Visit www.osha.gov/recordkeeping/index.html for more information.

IRS Form W-4

A number of agricultural and horticultural employers receive notices from the Social Security Administration (SSA) that some of the Social Security Numbers (SSN) submitted through the annual employer W-2 reports do not match SSNs in the SSA database. Employers should make sure that they have signed W-4s (Employee's Withholding Allowance Certificate) for each employee. This verifies the employer's information is based upon what the employee provided. Visit www.irs.gov/pub/irs-pdf/fw4_04.pdf for the form.

Posting Compliance

MAAHS consistently receives inquiries about what labor law posters should be displayed in a prominent place in businesses. Each business that employs one or more people will have federal and state posting requirements. MAAHS provides information on posting requirements for Indiana, Kentucky, and Ohio employers and how to obtain the posters from government agencies for free. An option to order posters electronically or have laminated posters shipped at reasonable prices is also offered. Visit www.midamservices.org and click on "Labor Laws" and then "Posting" for more information.

New Hire Reporting

Federal Law requires all employers to report employees who are newly hired, rehired, or who return to work after a separation of employment. Indiana employers may visit www.in-newhire.com or call 866-879-0198. Kentucky employers may visit www.newhire-usa.com/ky or call 800-817-2262. Ohio employers may visit www.oh-newhire.com or call 888-872-1490.

Contact MAAHS to learn more about becoming an employer member and receiving compliance assistance.

John Wargowsky
Mid American Ag & Hort Services Inc
PO Box 182383
Columbus, OH 43218
614-246-8286
Fax: 614-246-8686
labor@ofbf.org
www.midamservices.org

ofa News

OFA Short Course Update

Our committee members worked hard during the fall OFA Short Course planning committee meetings to recommend sessions and speaker ideas. Now we have to start making the phone calls to confirm the speakers so we can put together a perfect Short Course for you.

Here is a quick overview of what each of the industry segments are planning for their programs.

Grower – This committee is thrilled about the fresh, not-like-any-other-year program they've planned. The tracks of sessions are divided into general production, advance production, and crop diagnostics and management. The topics focus on the greenhouse grower's issues at hand: production, energy, and profitability.

Management & Marketing – This committee chose topics to help the industry survive and thrive in tough times. These topics include: controlling costs, marketing, partnering for profits, industry trends, and personal development.

Garden Center – This year's theme for the garden center education is profitability. Some of the session topics include: inventory control, margin management, contemporary merchandising, and Gen X and Y shoppers. The garden center tour will be a "retail" tour; it will have a twist unlike past tours.

Interior Plantscape – This year there will be Saturday workshops for technicians and managers. There will be hands-on training for the techs and HR, training, and scheduling topics for the managers.

Florist – The layout of this year's program is two Saturday workshops (afternoon and evening), a Sunday morning workshop, three Sunday stage shows, the design contest, and big names to draw you in.

Industry Newcomer Outreach – This energetic group has planned leadership sessions on Saturday, Sunday education, and a special activity on Monday with lots of entertainment.

Although this report is only on the educational session component of the Short Course, the trade show is going strong with exhibitors signing up as fast as ever!

So, this is just the start of planning for this year's OFA Short Course that takes place **July 8–11**. We will be providing you updates along the way so you too can catch the excitement of our program.

OFA Member Benefits

- The *APPI Savings Solution Program* can reduce the costs of a company's energy, utility, and telecommunications services – including electricity, natural gas, water, recycling, waste removal, freight, credit card processing, and voice and data communications. APPI, an independent utility consulting firm, is compensated only when it delivers savings and/or refunds to OFA members. To get started, APPI will perform a free audit of your company's energy, utility, and telecommunications bills. For more information, call 800-520-6685, visit www.appienergy.com, or contact OFA.
- **Research Abstracts**: OFA is now providing a link on the OFA Web site (www.ofa.org, Members-Only Access area) to the abstracts of research articles published in the three journals of the American Society of Horticultural Science. This research covers the entire range of crop production issues important to growers. These listings will also give authors, publication and issue, and a hot link to the ASHS Web site, where you can read a summary of the papers and more.
- **OFA members receive a 20 percent discount on all *OFA Tips...* books**, now available through the Ball Bookshelf, as well as a discount on all Ball Publishing titles. Visit www.ofa.org or www.ballbookshelf.com for more information. Proof of OFA membership is required. Your ID number is listed on your *OFA Bulletin* label. You will also need to use the special code "OFAMBR" to receive the discount.
- Ohio-based OFA members can participate in the **OFA worker's compensation group rating program**. This program is administered by Compensation Consultants Inc. (CCI). For more information or a no-cost, no-obligation quote, contact Cathy Bennett at CCI – 800-837-3200, ext. 7106; cathy.bennett@ccitpa.com, or www.cciworkerscomp.com.
- ***Florists' Review* magazine** is available to OFA members for a reduced fee. Sign up through OFA and save nearly 30 percent on the subscription cost to *Florists' Review*.

ofa News

OFA Resource Directory Arriving Soon

The OFA Resource Directory will be mailed in late February to all active members. This valuable resource connects you to other floriculture professionals and companies across the world. In addition to the member listing, the Directory provides information about OFA's board of directors, committees, staff, membership benefits, publications, and partnerships.

OFA Member Decals Available

Show customers you're a member of the industry's leading association by proudly displaying your OFA membership window decal. To receive additional decals, contact the OFA office.

OFA Event Calendar

February 17-19, 2006	**OFA Board & Committee Meetings** - Columbus, OH
April 2, 2006	**Ohio Certified Florist Written Test** - Columbus, OH
July 8-11, 2006	**OFA Short Course** - Columbus, OH
July 10, 2006	**Ohio Certified Florist Written & Hands-On Tests** - Columbus, OH
October 20-23, 2006	**OFA Board & Committee Meetings** - Louisville, KY

Remember to circulate the *OFA Bulletin* among your staff members. This information is designed to be valuable for all areas of your business.

www.ofa.org

ofa
an Association of Floriculture Professionals

2130 Stella Court
Columbus, Ohio 43215-1033 USA

Address Service Requested

NON-PROFIT ORG.
U.S. POSTAGE
PAID
COLUMBUS, OHIO
PERMIT NO. 644