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Pest Control Materials: What's New? What's Effective?

by Raymond Cloyd

Greenhouse producers continue to rely on pest control materials such as insecticides and miticides to deal with insect and mite pests in greenhouse production systems. The availability of new effective products or active ingredients, particularly with different modes of activity, is important so greenhouse producers can incorporate these materials into their rotation schemes.

There are at least five active ingredients that are being tested or have been tested for potential use in greenhouses. These include acetamiprid, milbemectin, flonicamid, thiamethoxam, and dinotefuran. However, because of the initial costs ($70,000,000) and the time involved in production and release (approximately 10 years) of a new active ingredient, companies that manufacture or distribute pest control materials are merging with other companies to obtain additional pest control materials. This had led to new formulations or new combinations of already existing active ingredients, but so far no major increase in new active ingredients. A concern is that the merging of companies may lead to less investment in research to develop new active ingredients. As a result, fewer new active ingredients may be available in the future.

Despite this potential trend, new pest control materials are still being released. The two newest pest control materials that have been available within the last year for use in greenhouses are TetraSan and Pedestal.

TetraSan

TetraSan, which is distributed by Valent USA Corporation, is one of the newest miticides available to greenhouse producers. The active ingredient is etoxazole, which is in the chemical group diphenyoxazoline. TetraSan is formulated as a 5 percent water-dispersible granule (WDG). This miticide is a chitin synthesis inhibitor,

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Greenhouse Computer Control

by Peter Ling

Computers are everywhere nowadays, from office computers to home appliances to cars. Recently I took my car to a garage because the engine light was on. Guess what? The first thing the mechanic did was to hook up a diagnostic computer to check the computer embedded in my car. As a grower, have you wondered what is in a greenhouse computer and how to use it to its full capabilities?

There are three basic components in a computer-based control system – sensors, a computer, and actuators. Sensors are used to collect information that is important for plant growth. The most commonly collected information includes temperature and relative humidity. Other environmental information such as CO_2, light, vapor pressure deficit, and soil tension is also used for more sophisticated plant growth regulation.

Greenhouse control strategies are programmed into the computer to accept set points from growers and make decisions to heat, cool, shade, or water based on information collected by sensors. By controlling actuators such as heater/boiler, roof vent/ exhaust fan, shade cloth, or irrigation/ misting, one will be able to provide favorable environments for plant growth automatically.

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OFA Mission Statement

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

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Message from OFA's New President

by Kathy Benken

I've been thinking a lot lately about the responsibility associated with my saying "yes" to Joe Boarini three years ago about running for vice president of OFA, about becoming the president of OFA, how I came to be here, and what road I traveled.

In fact, the road leading to OFA was filled with detours of major proportions.

Falling in love with and marrying Michael brought me to a place I would never have imagined for myself. Within weeks of saying 'I do," I began to wonder what I had done … committing to a young man and a family greenhouse business at the same time. However, the daily routines became something I looked forward to. I loved the smell of the soil "cooking" as it was sterilized and the dampness of the floors and wood benches.

I'm contemplating how I got to this place in my life with OFA. I remember the moment clearly, as though it were yesterday. In the winter of 1980, my father-in-law insisted that Michael and I attend the Monday night dinner at Short Course in Columbus. I'm not sure if it was the atmosphere, the dinner, the people, the event … or just what it was that excited me about this thing called OFA. The evening was magical. All those people, everyone a part of something I now loved.

The following year we attended the entire Short Course. We went to every session trying to take it all in. I was so excited by the experience that when it was over, I told Michael's dad, "If you never give Michael a raise, I don't care, as long as you let us go to Short Course every year!"

Every year, as Short Course time came around, my excitement would build. I could not wait to see everyone again and learn. I loved the people, the staff, the set up, and the chance to see all the new things at the trade show. Over the years, our list of new and old friends grew. Our involvement in OFA as committee members and as Board members fueled the fire even more. I always thought if OFA grew and needed a satellite office in Cincinnati, I could help.

I never dreamed my love for OFA would bring me to this leadership position. I am honored and blessed by the opportunity to give back.

I may be the first female president of OFA, but not the first president to accept the ever-challenging changes of our industry and our association. The tradition will continue with a strong membership, board, and staff at the heart of OFA – an Association of Floriculture Professionals. This is where tomorrow's traditions will get their start, lifelong friendships will be made, and future OFA presidents are waiting for Short Course to begin.

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Understanding Water Quality: Part 2 – Match Fertilizer to Your Water

by William R. Argo
Paul R. Fisher

Crop production bulletins often make very specific fertilizer recommendations, such as "20-10-20 is the best fertilizer for New Guinea impatiens." In reality, you can't choose the best fertilizer for your greenhouse operation until you consider the irrigation water quality in your own operation. This article provides the information you need to match fertilizers to your water quality.

Water Quality, Media pH, and Plant Nutrition

In Part 1, we discussed how a high water alkalinity tends to result in an increase in the pH of your growing medium over time, but that pH of your irrigation water has only a small effect on root media pH. Understanding the influence irrigation water has on pH management is important because media pH influences the solubility and uptake of a number of essential plant nutrients, particularly the micronutrients iron and manganese.

For example, the solubility of iron decreases as media pH increases. Certain species, including calibrachoa and petunias, are very inefficient at taking iron out of the soil solution, and therefore are very prone to iron deficiency when grown at high media pH (Figure 1).

High pH problems often arise when the water-soluble fertilizer is not acidic enough (contains too little ammoniacal nitrogen) to balance the alkalinity in the water. Alkalinity can be thought of as the lime content of water; and just like adding too much lime to your media, repeated irrigation with excess alkalinity water can raise pH of the growing medium to unacceptable levels. In order to avoid high media pH, you may have to switch to a more acidic (higher ammoniacal nitrogen) fertilizer or lower the water alkalinity directly by injecting acid into the irrigation water.

In contrast, iron and manganese become very soluble at low media pH. Some species, including geraniums and marigolds, are very efficient at taking up iron from the soil solution, and therefore are prone to iron/manganese toxicity when grown at a low media pH (Figure 2).

Frequently, low media pH results from using a water-soluble fertilizer that is too acidic (contains too much

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Figure 1. Iron deficiency in calibrachoa caused by high media pH (6.5).

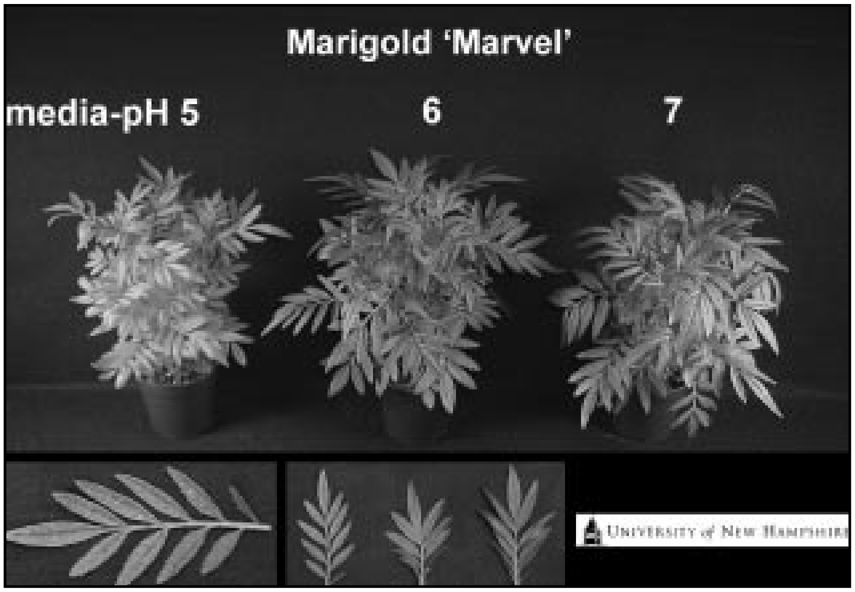

Figure 2. African Marigold 'Marvel' grown at three media pH levels (pH 5.0, 6.0, and 7.0 from left to right). Plants grown at pH 5.5 often show symptoms of iron/manganese toxicity. Research by Paul Fisher and Ron Wik at University of New Hampshire, funded by Proven Winners and Blackmore Co.

Understanding Water Quality: Part 2

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ammoniacal nitrogen) for the alkalinity in the water. The excess acidity of the fertilizer reacts with the root media to lower the pH to unacceptable levels. In order to avoid this problem, you may need to use a less acidic (lower ammoniacal nitrogen) fertilizer.

Learning to balance your water and fertilizer (Table 1) will improve the pH management of your crops. However, sometimes pH problems are caused by other factors, such as adding too little or too much limestone to the mix. In this case, adjusting the water or fertilizer may not be sufficient to "fix" the media problem. Other times, you may experience pH-related problems with only certain crops, not everything. For example, the petunias and calibrachoa may show iron deficiency at pH 6.5, but geraniums and marigolds look fine. In this case, you may want to adjust the water or fertilizer only on the problem crops.

Water Can Supply Essential Plant Nutrients

In general, irrigation water is not a significant source of the primary macronutrients nitrogen (N), phosphorus (P), or potassium (K). However, irrigation water can contain high levels of the nutrients calcium (Ca), magnesium (Mg), and sulfur (S). And just like alkalinity, the concentration of nutrients contained in the irrigation water can vary dramatically between greenhouse operations (Table 2).

Since irrigation water can be an important source of calcium, magnesium, or sulfur, water can contribute a significant amount of the total concentration of these nutrients being applied to a crop. In other words, the water-soluble fertilizer that you apply (like 20-10-20) is not the only nutrient source.

Acidifying Water Can Also Add Further Nutrients

Adding mineral acids to the irrigation water to neutralize alkalinity will also affect plant nutrition. Sulfuric acid, phosphoric acid, or nitric acid can be a significant source of sulfur, phosphorus, or nitrate nitrogen (Table 3). In Part 1 of this article series, we showed how much acid was needed to neutralize alkalinity. For example, 4.2 fluid ounces of 35 percent sulfuric acid would be needed to neutralize 150 ppm alkalinity. Those 4.2 fluid ounces also would supply about 46 ppm sulfur to the irrigation water.

The Fertilizer is Only a Part of the Total Nutrient Solution Supplied to the Crop

The total nutrient solution is the combination of the irrigation water, acid (if it is injected), and the water-soluble fertilizer. The term nutrient solution should be used whenever discussing nutrient management of any crop, because whenever water-soluble fertilizer is applied, it is always in conjunction with irrigation water.

Table 4 presents examples of how to calculate the total nutrient solution (i.e. the total concentration of nutrients applied to the crop) by adding the concentration of nutrients from (a) the water-soluble fertilizer (written on the fertilizer bag); (b) the irrigation water itself (using a laboratory analysis of the water source); and (c) acid injected into the water source (from Table 3).

A grower using the nutrient solution from example 1 in Table 4 may have problems with phosphorus deficiency, magnesium deficiency, or sulfur deficiency, because these nutrients are not being supplied in the nutrient solution. In example 2, a grower may only have to worry about phosphorus deficiency, because all other nutrients are being supplied in adequate amounts. In example 3, all nutrients are supplied in adequate amounts.

Table 1. Fertilizers and Alkalinity. Approximate guidelines to match fertilizers with water alkalinity in order to achieve a stable media pH over time. Use these values as a starting point only. It is up to the grower to make changes in media pH that are based on actual pH measurements in the crop. Adapted from Argo, W.R. and P.R. Fisher. Understanding pH management for container-grown crops. Meister Publishing, Willoughby, Ohio.

Calcium carbonate equivalency (lbs./ton)	% Acidic Nitrogen = (ammonium + urea)/total N	Examples	Alkalinity concentration (ppm $CaCO_3$) that provides a stable media pH
> 500 acidic	>50%	20-20-20, 25-10-10	200-300*
150-500 acidic	40%	20-10-20, 21-5-20	120-200*
150 acidic to 150 basic	20-30%	20-0-20, 17-5-17	60-120
> 150 basic	<15%	13-2-13, 14-0-14	30-60

At these alkalinity concentrations, we recommend that you consider injecting acid into the irrigation water to lower alkalinity directly. That approach provides more flexibility in your choice of fertilizer.

However, the grower in example 3 may observe excessive, leggy growth because considerable phosphorus is supplied by the acid.

The nutrient solutions in Table 4 are fundamentally different from one another, even though the same 15-0-15 water-soluble fertilizer is being used, because of differences in the water quality or concentration and type of acid. These examples illustrate why you cannot just look at the fertilizer bag to determine what nutrients are being applied to the crop and why it is important to know more about your irrigation water than just its alkalinity.

Waste Ions

Some ions contained in irrigation water are either not needed by the plant, or the plant requirement is so low that only small amounts are used. Examples of waste ions are sodium (Na) or chloride (Cl). Generally, their presence in irrigation water at high concentrations increases the risk of salt buildup in the root media. Even calcium, magnesium, or sulfur can be considered a waste ion if their concentration is too high or it is difficult to balance their concentration in the nutrient solution with water-soluble fertilizer.

With most ions (including Na, Cl, Ca, Mg, or S), excessive concentrations can be removed with reverse osmosis purification. High salt concentrations can also be managed by leaching at a heavier rate than the commonly recommended 20 percent to remove any excess salt buildup. If increasing the leaching rate, you will also have to increase the fertilizer concentration of all nutrients supplied to the crop, because leaching washes out all salts from the container including nutrients.

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Table 3. Acids used for irrigation water acidification.

Type of Acid	Nutrients added with 1 fluid ounce of acid per 100 gallons
75% Phosphoric	32 ppm P
85% Phosphoric	36 ppm P
35% Sulfuric	11 ppm S
93% Sulfuric	30 ppm S
61% Nitric	17 ppm N

Example. These are the steps to calculate the concentration of sulfur (in ppm S) added to irrigation water when 4.2 fluid ounces per 100 gallons of 35 percent sulfuric acid is injected to neutralize 150 ppm alkalinity.

Volume of acid added (in fluid ounces	x	Nutrients supplied with the addition of 1 fluid ounce per 100 gallons	=	Amount of S added
4.2	x	11	=	46 ppm S

Table 2. Average and median values for irrigation water pH, EC, and nutrient concentration in the United States. Research by Bill Argo, John Biernbaum, and Darryl Warncke. (For more information, see HortTechnology 7(1):49-51).

	Units	Average	Median	Range
pH		7.0	7.1	2.7 to 11.3
EC	(mS/cm)	0.6	0.4	0.01 to 9.8
Alkalinity	(ppm)	160	130	0 to 1120
Calcium (Ca)	(ppm)	52	40	0 to 560
Magnesium (Mg)	(ppm)	19	11	0 to 190
Sulfur (S)	(ppm)	27	8	0 to 750
Sodium (Na)	(ppm)	33	13	0 to 2500
Chloride (Cl)	(ppm)	33	14	0 to 1480
Boron (B)	(ppm)	0.2	0.02	0 to 11.7
Floride (F)	(ppm)	0.1	<0.01	0 to 8.3
Ca:Mg Ratio		5.0	3.2	<0.1 to 150
SAR[1]		2.6	0.7	0 to 280

[1]Sodium-adsorption ratio, which is a formula that compares the concentration of sodium to the combined concentration of calcium and magnesium.

Understanding Water Quality: Part 2

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Boron is a special example of a waste ion. Even though it is an essential plant nutrient, the presence of boron in irrigation water at high concentrations can cause significant challenges. Unfortunately, the difference between deficient, adequate, and toxic levels of boron are very small. In general, it is recommended that the maximum concentration of boron in the nutrient solution is 0.5 ppm for poinsettias and 1.0 for most other crops.

Unlike most other waste ions, boron cannot be effectively removed with reverse osmosis purification. Instead, the only option for managing excessive boron levels is to maintain a media pH above 6.0 and use calcium-based fertilizer. The idea is that the high pH and calcium will cause excess boron to precipitate out of the soil solution, making it unavailable to the plant. Another option for controlling high boron in the water is to change water sources.

Ideal Nutrient Levels vs. Manageable Nutrient Levels

For irrigation water sources, it is commonly recommended that the ideal calcium, magnesium, or sulfur concentrations should be between 40 and 120 ppm Ca, 20 and 40 ppm Mg, or 30 and 60 ppm S. However, remember that greenhouse crops receive a total nutrient solution that includes nutrients from irrigation water, acid, and water-soluble fertilizer combined. As long as the concentration of all nutrients in the irrigation water is within a manageable range (Table 5), nutrients can be supplemented or the proper balance can be obtained with the addition of water-soluble fertilizer or acid.

OFA Grower

Table 4. Fertilizer, irrigation water, and acid can all contribute nutrients to the crop. The water-soluble fertilizer used in each example is 15-0-15 "dark weather special" and represents the concentration of macronutrients supplied by the 15-0-15 fertilizer at 200 ppm N. The water quality in example #1 is a pure water source, common to the East Coast. The water quality in examples #2 and #3 is a well water source common to the Midwest. In example #2, sulfuric acid is also added to neutralize 150 ppm alkalinity; and in example #3, phosphoric acid is used for alkalinity control.

Example #1	N	P	K	Ca	Mg	S
(Pure water source, no acid)	Concentration given in ppm					
Water-soluble fertilizer	200	0	165	150	0	0
Water	0	0	0	20	6	3
Acid	0	0	0	0	0	0
Total nutrient solution from #1	200	0	165	170	6	3
Example #2						
(Midwest well water, sulfuric acid)						
Water-soluble fertilizer	200	0	165	150	0	0
Water	0	0	0	90	40	10
35% Sulfuric acid (4.2 fl oz/100 gal)	0	0	0	0	0	46
Total nutrient solution from #2	200	0	165	240	40	56
Example #3						
(Midwest well water, phosphoric acid)						
Water-soluble fertilizer	200	0	165	150	0	0
Water	0	0	0	90	40	10
75% Phosphoric acid (3.1 fl oz/100 gal)	0	101	0	0	0	0
Total nutrient solution from #3	200	101	165	240	40	10

Editor's Note: Part 1 of this series of articles appeared in the May/June issue of the *OFA Bulletin.* That article, also by William R. Argo and Paul R. Fisher, was entitled "Understanding Water Quality: Part 1 – Water pH, Alkalinity, and Control of Media pH."

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Table 5. Guidelines for greenhouse irrigation water. Values given in ppm unless otherwise noted.

symbol		Manageable range	Comments
pH		4.5 to 9.0	Water pH can affect the solubility of some fertilizer salts and the efficacy of insecticides, fungicides, and growth regulators. In general, the higher the pH, the less soluble are these materials. However, high water pH by itself is not a good indicator of what other ions are in solution or how the irrigation water will affect media pH or nutrition management. The closer water pH is to 4.5, the lower the alkalinity level. At a water pH of 4.5, the alkalinity concentration is zero; and small additions of acid can drop to hazardous levels for plants and people. Although rare, irrigation water with a naturally occurring pH of less than 4.5 is an indication of the presence of an acid source and should only be used with extreme care.
Alkalinity	CCE (Calcium carbonate equivalents)	< 300 ppm $CaCO_3$	The ideal alkalinity concentration is dependent on many factors including the type of fertilizer used as well as how frequently clear water is applied to a crop. If fertilizers with higher levels of ammoniacal nitrogen (more acidic) are used, then the desired alkalinity concentration can be higher. High alkalinity can lead to high pH problems (micronutrient deficiencies), but can easily be reduced to a more desirable level with the addition of a strong mineral acid. Low alkalinity can lead to low pH problems (micronutrient toxicity), but can be better managed by selecting less acidic (low ammoniacal nitrogen) fertilizers.
EC		< 0.75 mS/cm < 1.5 mS/cm	Maximum level for plugs and propagation. Maximum level for irrigating pot crops.
Calcium	Ca	< 150 ppm	High levels of Ca are not particularly detrimental to plant growth, except that they may be an indication of high salt levels in the water or a lack of balance with Mg. Low levels of Ca in the water can be supplemented with the addition of calcium nitrate-based fertilizers.
Magnesium	Mg	< 75 ppm	High Mg levels are rare, and as long as they are in the proper ratio with Ca, are not a problem. However, high levels of Mg can be an indication of high salt levels in the water. Low Mg levels in the water can be supplemented or the proper balance with Ca obtained with the addition of Mg-based fertilizers.
Sulfur	S	< 120 ppm	High S levels in raw water are rare. However, sulfuric acid is frequently used for alkalinity control; and therefore in areas of the country with high alkalinity, high S levels are common. Adding high levels of S into irrigation water will increase water EC and may interfere with Ca uptake under certain situations.
Iron	Fe	< 2.0 ppm	Except for iron, it is uncommon to find high levels of micronutrients in irrigation water. If high levels of a specific micronutrient are present, then the irrigation water may have to be considered a source of that micronutrient, and the water-soluble fertilizer program should be adjusted accordingly. Water treatments that oxidize the water, such as treatments with ozone or potassium permanganate, can effectively remove these ions from the water.
Manganese	Mn	< 0.5 ppm	
Zinc	Zn	< 0.5 ppm	
Copper	Cu	< 1.0 ppm	
Boron	B	< 0.5 ppm	It is uncommon to find high levels of B in irrigation water. In a small number of cases, boron is at a high enough level to force changes in the fertilizer boron concentrations. For example, if boron were present in the irrigation water at 0.5 ppm, then it could probably be eliminated from the water-soluble fertilizer. Boron is not effectively removed with reverse osmosis purification. To compensate for extremely high boron levels in irrigation water (>1.0 ppm), the general recommendation is to keep the media pH above 6.0 and use calcium-based fertilizers, or find a new water source.
Sodium	Na	< 50 ppm	Sodium and Cl are waste ions, and their presence in irrigation water can be an indication of high salt levels. High Na levels can also be an indication of low Ca and Mg levels, and high B levels in the water. High Na levels can cause a degradation in media physical properties over time, particularly in media containing field soil.
Chloride	Cl	< 70 ppm	
Total chlorine	HOCl & OCl-	< 2.0 ppm	Chlorine (not chloride) can produce phytotoxicity on sensitive plants at concentrations above 3 to 5 ppm.
Fluoride	F	< 1.0 ppm	Fluoride is added to many municipal water sources. Fluoride can be removed from water with activated carbon filters; or sensitive crops can be protected by keeping the media pH above 6.0 and using calcium-based fertilizers.

Pest Control Materials

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which means it disrupts the molting process by preventing mites from forming a new skin (cuticle).

TetraSan is labeled for both twospotted spider mite (*Tetranychus urticae*) and Lewis spider mite (*Eotetranychus lewisi*). It is active on the egg, nymph, and larvae stages. TetraSan does not kill adults. However, female adult mites that are treated will not produce viable eggs. This miticide works within seven days of application. TetraSan has translaminar properties similar to the miticides abamectin (Avid) and chlorfenapyr (Pylon), meaning that the material penetrates leaf tissues and forms a reservoir of active ingredient within the leaf. This provides extended residual activity, up to 21 days, which is similar to many of the newer mite control products. The label rate is 8.0 to 16.0 ounces per 100 gallons of water. TetraSan has a 12-hour restricted entry interval (REI). This miticide cannot be applied to poinsettias after bract formation.

Research conducted at the University of Illinois has demonstrated that TetraSan is very effective in controlling twospotted spider mite, providing more than 80 percent efficacy for up to 21 days (Figure 1). However, it may be best to initially use an adulticide to reduce an existing mite infestation.

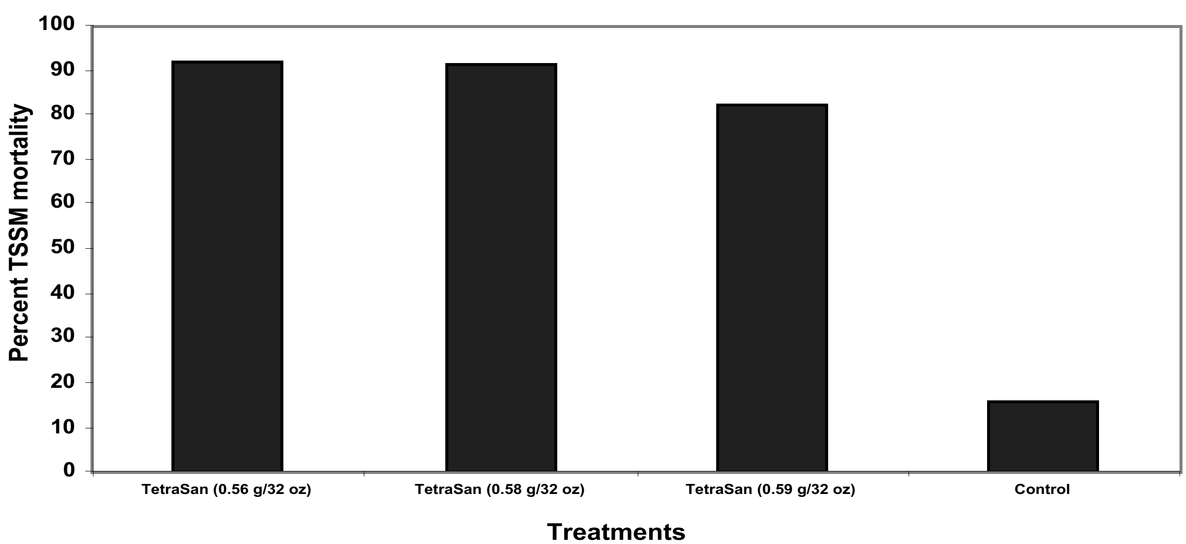
Pedestal

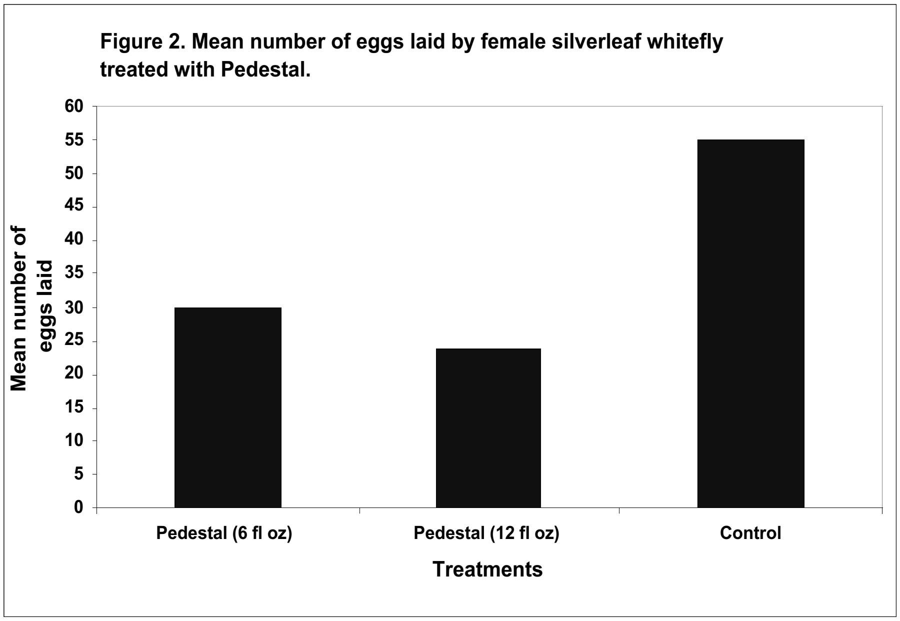
Pedestal is a new insecticide registered for use in greenhouses that is available through Crompton/Uniroyal Chemical Company. Pedestal is an insect growth regulator in the chemical class benzoylphenyl urea that is formulated as a soluble concentrate (SC) with 10 percent active ingredient. The active ingredient is novaluron. It is labeled for whiteflies, thrips, leafminers, and armyworms. The label rate is 6.0 to 8.0 ounces of product per 100 gallons of water. Pedestal works by ingestion, but it does have some contact activity. The material works by interfering with cuticle formation (chitin synthesis inhibitor), which means that it disrupts the normal molting process. This prevents nymphs or larvae from reaching adulthood. Since Pedestal is an insect growth regulator, it has no effect on adult stages. Pedestal is slow acting due to the mode of action, with population reduction in three to five days after application. No more than two applications of Pedestal can be made per crop per year. There is a 30-day interval between Pedestal applications. It has a 12-hour REI. Pedestal should not be applied to poinsettias, because they are sensitive to labeled rates.

Research at the University of Illinois has demonstrated that Pedestal provides some control of Western flower thrips (*Frankliniella occidentalis*). However, since the material is only active on the immature stages, it may not provide sufficient control if there are overlapping generations present with a variable age structure (eggs, immatures, pupa, and adults present at the same time). Pedestal may be useful in a rotation program when pest populations are low. Research on whiteflies has shown that Pedestal reduces adult female whitefly fecundity. That is, the adult females treated with Pedestal lay fewer eggs than non-treated adults (Figure 2). This means that two stages of the life cycle (i.e. immature and adult) may be negatively affected by applications of Pedestal.

Greenhouse producers have an array of effective pest control materials for most of the major insect and mite pests encountered during the production season. However, the prospect of fewer

Figure 1. Percent mortality of twospotted spider mite (TSSM) treated with various rates of TetraSan miticide.





active ingredients becoming available in the future means that greenhouse producers need to exercise proper stewardship of pest control materials to preserve their longevity and existence.

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Greenhouse Computer Control

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To make sure a computer-controlled system works, all three components will have to work individually and together as a system. For sensors to work properly, it is best to make sure 1) sensors are placed at a location where local environment is most important to plant growth; 2) sensors are measuring authentic environmental conditions; and 3) sensors are calibrated. Sensors are best placed right next to the plants, shielded from direct sunlight, and in a location that is most representative to the whole growing area. Aspirated sensors can be used anywhere in an area that has uniform climate. In the case of large climate variations from one end of the growing zone to the other, environmental condition will not be improved just because it is controlled by the computer. Good air mixing by circulating air, instead, is essential to achieving climate uniformity.

Control strategies can be simple, single events or sophisticated operations that require well-orchestrated multiple events. Turning on a heater when the temperature is below the set point is a simple, single event. Enrichment of carbon dioxide needs a bit more coordination to be efficient. For example, CO_2 injection should be stopped when ventilation is needed for cooling. There is no reason to add CO_2 if it will be vented out without being used by plants. To further improve plant growth efficiency, light level, CO_2 level, and nutrient concentration could all be controlled using supplemental lighting, CO_2 enrichment, and fertigation, respectively. Coordination of individual control events is critical for all of them to work together effectively and efficiently.

Maintenance is just as important for greenhouse computers as for cars. Sensor calibration for a greenhouse computer system is similar to a tune-up for a car. A finely tuned system performs at a higher level and is more trustworthy. On the contrary, if sensor readings are not reliable, performance of the computer control system is predictably unacceptable. To be able to trust your greenhouse computer control system, one must have confidence in the accuracy and reliability of sensor readings. It is a good idea to calibrate your temperature and light sensors annually and relative humidity sensors semi-annually. It is also a good idea to install easy-to-read dial thermometers and hygrometers next to computer sen-sors, so one can make quick checks that computer sensor readings are reasonable.

Adopting a computer control system for automated greenhouse control is like learning to drive a car. The more you know about the potentials and limitations of the system, the more you can benefit from it. A greenhouse computer control system is expensive initially; yet, it is a proven technology that has been adopted to reduce labor expenses, to enable more precise control of plant growth and development. To justify the financial investment and be able to get the most out of a system, a little more time investment to attend educational programs on greenhouse computer control is warranted.

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Fungicide Chemistry: What Works

by Stephen G.P. Nameth

If we define "new chemistry" as something that has been released with the last six months, then there are no "new" products; however, there are products that have been introduced within the last year or two (or more). These products have had a chance to be put to the test by growers and academia. Some work well and some not so well. The products that, in my opinion, have been shown to work well are the products I will cover in this article.

Although the efficacy of a product is going to vary depending on the organisms and not all products are labeled for all diseases, the products discussed here are products that consistently work well overall. No experimental products will be discussed.

Compass, Cygnus, and Heritage (strobilurins)

The products that fall within this group have made a very significant impact on fungal disease management in greenhouse floral crops and are the most significant introductions in the last two years. The active ingredient of strobilurins is a natural antifungal compound derived from the *Strobilurus tenacellus*. The three most common products associated with this group are Compass, Cygnus, and Heritage. Compass and Heritage are the most popular and have the greatest range of efficacy to the greatest number of fungi. Good-to-excellent control has been shown with these two products for Alternaria, Botrytis, downy mildew, fusarium, powdery mildew fungi, and rust fungi. All of the strobilurins have limited systemic activity and work well when combined with other contact fungicides. Since they are a natural product, they are considered to be "green fungicides," which is to their advantage.

Recent concerns with the strobilurins in terms of fungal resistance have prompted many to downplay the significance of this group. Like all antifungal compounds that work well, overuse can be a problem and caution should be taken to use the strobilurins as one part of a sound, integrated disease control program.

Decree

The active ingredient in this product is fenheximide. Decree is labeled for control of *Botrytis cinerea*, and this product works very well in controlling this most common of the greenhouse fungi. At this point, there has been no discussion of resistance with this compound; however, like all products, its use should be limited. For best results, steps should be taken to reduce Botrytis via cultural controls.

Contrast

The active ingredient in this product is flutolanil. Contrast is labeled for control of a variety of foliar and stem-rotting fungi including *Rhizoctonia solani*. This product has been shown to have very good-to-excellent control of Rhizoctonia stem rot. Like Decree, there has been no evidence of pathogen resistance at this point.

Coppers

Of course coppers are not "new." Quite the contrary, copper is one of the oldest known fungicides. However, in recent years there has been a resurgence in the use of coppers for the control of bacterial and fungal diseases. Some of the newer copper formulations are combined with other traditional fungicides as a new twist on an old theme. Copper-based products such as Phyton-27 (copper pentahydrate), Camelot (copper linoleate), Kocide 2000 (copper hydroxide), and Junction (copper hydroxide plus mancozeb) consistently show good control of a variety of foliar bacterial and fungal-induced diseases. Some strains of bacteria have developed resistance to copper. If resistance is suspected, rotate to a noncopper-based product.

Note

All of the products mentioned here should only be used as part of an integrated disease management program that incorporates both cultural and chemical controls. If that is practiced, these products that "work well" will continue to do so for a longer time.

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It Used to be So Easy When I did it All Myself

by Lisa Wenke Ambrosio

I am a third-generation "Wenke" in the family business. I have seen the business grow from a small, 3-acre farm in which my entire family worked long, miserable hours to a Top 100 bedding plant factory that supports more than 100 families. This growth has taken place over the past 30 years due mostly to my father and my uncle's hard work and good decisions. It's not my turn yet, but the day is coming. Am I going to be ready?

Back when Lorence and Dennis were developing this business, they were out in the greenhouse all the time. They were the ones who watered the crop, shipped the crop, sold the crop, and answered the phone at the same time. They knew exactly how to motivate their growers, because the grower was either themselves or another family member. They did not have to worry about the shipping manager making the right decision about the quality of product to ship, because they were the ones making the decision themselves. There was no lack of communication between the sales manager and the production manager, because they were one and the same. They had one rotary dial phone in every greenhouse, and everyone would run to it every time it rang.

The so-called office parts of the business were also simple. Payroll was done by my mother and my aunt late at night every other week. My mother knew every employee's name, their spouse, their children, and many other details. The old punch clock was accurate and reliable, plus many of the employees were family members who didn't really need a paycheck. They did not have a 401(k) plan, health insurance, and worker protection laws. They knew that they were making money in June if the amount of money that was deposited in the checking account was enough to pay back the operating loan, buy a new truck, and go on vacation.

Lorence and Dennis knew everything that was important to know about the business. Things were simple. They knew that if they grew a quality crop, it would sell at a good price. Everything was perfect.

Or was it perfect? I think if I sat down and asked Lorence and Dennis if their lives really were better back then or now, the truth would be that now is better. Back when they did it all themselves, they really did do it all themselves. That included the back-breaking work of loading the trucks and getting ready for the transplanters and coming back to the greenhouses after a long day to close the vents. Sunday was never a day off; it was only a day when fewer people were around. Every time there was a snowstorm, they would worry about the greenhouses. And one year when the greenhouses caved in under the pressure of the snow, the sense of doom was very real.

A lot has changed since then. Some of the change has come because Lorence and Dennis decided to keep expanding, and some of the change has come because the industry has changed. But no matter what caused the changes, the situation has changed. It's not as simple as it used to be. There is no way "to do it all myself" even if I wanted to.

About 25 years ago, Lorence and Dennis really started moving away from doing it all themselves. They partnered with my other uncle, Larry Boven, and purchased Sunbelt Greenhouses. They built a second location in Kalamazoo. They hired managers to run the locations where they could not be. They hired growers to grow the crop. They delegated, and the job got done. Some would say that the job was done better.

Dennis tells the story of a time years ago when he threatened to take the hose away from a grower and do it himself. But before this could happen, Lorence stopped him and said, "If you water the crop today, be prepared to do it yourself for the next 20 years." That grower's name is Andrew Kieboom. He became the production manager and worked at Wenke Greenhouses for many years before starting his own greenhouse business. Today he is considered to be one of the best growers in Kalamazoo. Dennis has been delegating more and more ever since.

There are two major benefits that come from delegating the work to others: 1) new opportunities become available once the owner/managers have the time to look around; and 2) the jobs can be done better and more efficiently if you hire the right people and give them the right tools. Years ago, Wenke Greenhouses was a spring bedding plant flat grower only. Now we are a supplier of plugs, liners, and geraniums to growers across the country; we have a substantial retail business; we sell directly to our own garden center customers while also expanding our sales with our brokers; and we utilize our greenhouse space profitably all year round. We are diversified enough that we believe we can survive a downturn in any part of the business.

The challenge for me (and for anyone who has to work through other people) is that I can no longer say that I know everything that I need to know about the business firsthand. I only get into the greenhouses three times a

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It Used to be So Easy

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week, so I have to have confidence in other people to do the job. I need to find ways to understand and measure what is happening in the business so I can make the right decisions. Even more important is that I need to inspire confidence in the employees so that I really can take the reins from Lorence and Dennis and continue the success that they have started. I need to find a way to share my goals and expectations with the managers and employees so we can work together efficiently and effectively. It's all too easy to think the employees know about something I know only to discover later that they had never been told.

We have some of the very best people in the industry working at Wenke and Sunbelt Greenhouses. One of our greatest assets is that we have been able to retain our best employees for many years. They do the job better than Lorence, Dennis, or I could ever do. In addition, my husband is now a part of the business and an important partner for me.

The industry has changed dramatically in the past 30 years. Lorence and Dennis came from a time when there was a huge demand for our product. They only needed to concentrate on being quality growers. Times have changed to the point that I not only need to be a quality grower, but also an expert in marketing and business management. We are now very complex. We have expensive computer systems, 401(k) plans, profit center accounting, and hundreds of different items that we grow. We have more than 300 employees, and prices for our products are going down.

Delegation has allowed my father, Lorence Wenke, to pursue an ambition in politics. He is now a Michigan state representative who is hoping to become president of the United States someday. He no longer knows how to open a vent in the greenhouse. Delegation has allowed my Uncle Dennis to golf on Saturday mornings in May. Now my husband and I are the ones working the long hours. I hope I can learn from them to delegate the responsibilities and inspire other people to do the job so that I, too, can enjoy the world around me.

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Academic Update: Colorado State University

by Steven E. Newman

Floriculture in the Rockies

Floriculture continues to be a strong program in the College of Agricultural Sciences at Colorado State University (CSU), and it is a significant component of Colorado agriculture. Floriculture has long been a part of Colorado State, and truly began to flourish with the hiring of Professor W.D. "Bob" Holley in 1949. With Professor Holley's leadership, the floriculture program developed into a strong program in the land-grant tradition based on education, research and Extension. During the early days, Professor Holley steered the campus program toward building a strong relationship with the Colorado greenhouse industry and carnation production. Professor Holley, together with Drs. Joe Hanan, Ken Goldsberry, and later, David Hartley introduced fiberglass glazing, pad and fan cooling, injection fertility, and steam pasteurization to the Colorado carnation growers – helping Colorado become the carnation capital of the world. Students trained under Holley, Hanan, Goldsberry, and Hartley represent much of the current floriculture leadership of the world.

The carnation industry in Colorado flourished until fuel and labor expenses became prohibitive, allowing offshore cut flower production to come into its own. What were once primarily carnation greenhouses were converted to alternative crops including cut roses, bedding plants, and blooming pot plants. More recently however, there are fewer cut rose growers; but there has been a remarkable increase in greenhouse tomato and fresh market herb production. Greenhouse products from Colorado are enjoyed nationwide.

Education

The floriculture concentration of the horticulture curriculum at CSU maintains about 30 full-time undergraduate students. The curriculum is similar to many other floriculture curricula throughout the country, except that all floriculture juniors and seniors are required to complete on-campus practicum experiences and formal internships. Several CSU floriculture students have completed internships through the Vic and Margaret Ball program of the American Floral Endowment, with many of the major U.S. arboreta and botanical gardens, and traditional greenhouse and nursery enterprises. CSU floriculture graduates continue to be in high demand by Colorado greenhouse growers as well as other U.S. floriculture enterprises.

Colorado State University has invested considerable effort in developing distance education opportunities. I have been teaching greenhouse management and floriculture crops courses on-line. These courses are rigorous and demanding, covering the same materials taught on campus; yet, the student may never set foot on campus while earning upper level credits toward a degree. Many of the students enrolled in these courses are graduate distance students pursuing a Master of Agriculture degree at CSU. Others are industry professionals looking for additional professional training, as well as traditional students needing to complete the course at a time other than the traditional schedule.

Floriculture Research

The year 2001 represented a significant transition in the floriculture research program at Colorado State when David Hartley rejoined the faculty as the W.D. Holley Professor of Floriculture after retiring from the Paul Ecke Ranch. The Holley Professorship is endowed by the Colorado Floriculture Foundation and receives additional support and funding through local greenhouse enterprises as well as allied industry sponsors including Crompton/Uniroyal and Benary Seed companies.

Hartley's research program has focused on greenhouse production practices of novel vegetative annual and perennial plants. Work has included development of plant growth regulator application studies on newly released annual and perennial species, photoperiod studies on Rudbeckia selections, and Flora Star evaluations.

More recently, and in response to the extreme drought along the Front Range of Colorado, Hartley, graduate student Yvette Hansen, and I are conducting studies to determine crop water coefficients for popular bedding plant species. This work is being cosponsored by Welby Gardens of Denver and the Colorado Floriculture Foundation. The objective of this work is to document water use patterns of popular bedding plant species and to demonstrate that bedding plants can be successfully planted during periods of drought.

Recently completed research work by Ph.D. candidate Nusret Ozbay has evaluated the use of Trichoderma for the control of Fusarium crown rot of hydroponic greenhouse tomatoes. Ozbay determined that tomatoes grown with Trichoderma and infected with crown rot have fruit yield equal to that of plants not infected with crown rot. This is significant in that there are currently no fungicides labeled for greenhouse tomatoes to control crown rot. Other pathology studies include Phythium and Rhizoctonia control studies with Hurricane on bedding plants sponsored by Syngenta.

Annual and Perennial Bedding Plant Trials

The Colorado State University Annual Trial Garden, under the direction of Dr. Jim Klett, continues to grow and expand. With a new and expanded garden site, the trial now tests more than 1,000 selections, both in the ground and in containers. The new site is also now an All-American Trial Garden site as well. In the summer of 2003, a new shade facility constructed with grant funds from the Colorado Garden and Home Show, will be planted with shade species such as New Guinea impatiens. The Colorado State Annual Trial Garden is not only a respected research site, but has become a popular garden spot enjoyed by the citizens of Fort Collins. More information is available at: http://www.flowertrials.colostate.edu/index.htm.

For more than 20 years, Klett has maintained an herbaceous perennial garden. The garden continues to grow and change as it matures; an ornamental grass section was recently added. Data is collected and tabulated annually. Celia Tannehill and Klett have recently published a 20-year summary of the plant performance including peak blooming times. The title is *Best Perennials for the Rocky Mountains and High Plains*, and copies can be obtained by contacting the Colorado State University Cooperative Extension Resource Center at (877) 692-9358 or on-line at: http://www.cerc.colostate.edu/titles/573A.html.

Extension and Outreach

The floriculture cooperative Extension team at Colorado State University includes Laura Pottorff and me. We work directly with the commercial greenhouse industry and provide educational programs and traditional greenhouse site visits. Pottorff has established a pathology diagnostic service, which has recently proven valuable while local growers deal with the recent Ralstonia outbreak We are also working directly with the Colorado Greenhouse Growers Association to promote and direct a newly established certification program for greenhouse professionals. For more information, go on-line to: http://www. colostate.edu/Depts/CoopExt/Adams/greenhouse.htm.

Much of the floriculture Extension programming at Colorado State includes direct collaboration with industry trade associations. I maintain an active role with the Colorado Greenhouse Growers Association (serving on their board in an *ex officio* role), as well as the National Greenhouse Manufacturers Association and the Government Relations Committee for the Society of American Florists.

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"Soaps" and Detergents: Should They be Used in Interior Plantscapes?

by Raymond Cloyd

Interior plantscapes such as offices and conservatories are sensitive environments because of the high volume of public traffic and potential exposure to insecticides from residues or odors. As a result, the types of insecticides that can be used to manage insects are limited. However, insecticides classified as biorational or "reduced risk" (including insect growth regulators, horticultural oils, and insecticidal soaps) are used in interior plantscapes because they generally leave minimal residues, are less toxic to humans, and are short-lived in the environment because they degrade rapidly in the soil. In addition, soaps are generally nontoxic to the user unless ingested at high doses.

Insecticidal soaps are used to control a variety of insect and mite pests including aphids, scales, mealybugs, and two-spotted spider mite. A soap is a substance derived from the activity of an alkali such as sodium (hard soap) or potassium (soft soap) hydroxide on a fat. Fats are generally a blend of particular fatty acid chain lengths. Soap is a general term for the salts of fatty acids.

Soaps may be combined with fish, whale, vegetable, coconut, corn, linseed, or soybean oil. For example, "Green Soap" is a potassium/coconut oil soap that was used widely as a liquid hand soap in public restrooms. It is now available as a hand soap or shampoo, and has been shown to be effective, as an unlabeled insecticide, in controlling soft-bodied insects including aphids.

Soft-bodied pests such as aphids, scale and mealybug crawlers, thrips, whiteflies, and mites, including two-spotted spider mite (*Tetranychus urticae*), are most susceptible to soap applications. Soaps generally have minimal activity on beetles and other hard-bodied insects, although this is not always true; soaps have been shown to kill hard-bodied insects like cockroaches. Soaps are effective only when insects or mites come into direct contact with the spray. Dried residues on plant surfaces have minimal insect or mite activity as soap residues degrade rapidly.

The mode of action of soaps is still not certain because there are three ways that soaps may kill insect and mite pests. First, soaps may work by penetrating the fatty acids through the insect's outer covering (cuticle) and dissolving or disrupting cell membranes. This disrupts cell integrity, causing cells to leak and collapse, destroying respiratory functions, and resulting in dehydration and death of the insect. Second, soaps may act as insect growth regulators, interfering with cellular metabolism and the production of growth hormones during metamorphosis. Third, soaps may block the spiracles (breathing pores), interfering with respiration.

There are a variety of fatty acids; however, only certain fatty acids have insecticidal properties. This is based on the length of the carbon-based fatty acid chains. Most soaps with insect and mite activity are composed of long-chain fatty acids (10- or 18-carbon chains), whereas shorter chain fatty acids (9-carbon chains or less) have herbicidal properties; so using materials that have short-chain fatty acids can kill plants. For example, oleic acid, an 18-chain carbon fatty acid which is present in olive oil and other vegetable oils, is very effective as an insecticidal soap.

There is a misconception that any soap or detergent can be used as an insecticide. Although only a few select soaps have insecticidal properties, many common household soaps and detergents including Palmolive®, Dawn®, Ivory®, Joy®, Tide®, and Dove®, which are unlabeled insecticides, have some activity on many soft-bodied insects when applied to plants as a 1 percent or 2 percent aqueous solution. However, reliability is less predictable than soaps formulated as insecticides.

Examples of research demonstrating the effectiveness of various dishwashing liquids and detergents on insect and mite pests are:

1) Palmolive®, Dawn®, Joy®, Ivory®, and Dove® effectively reduced the numbers of sweet potato whitefly (*Bemisia tabaci*), green peach aphid (*Myzus persicae*), cabbage aphid (*Brevicoryne brassicae*), and two-spotted spider mite on a variety of vegetable crops.

2) Dawn Ultra® dishwashing liquid was found to be effective on German cockroach (*Blattella germanica*), causing 100 percent mortality.

3) Ivory® liquid dishwashing soap tested at 0.4 percent to 3.0 percent concentrations was effective in controlling spider mites, aphids, and psyllids.

4) Ivory® liquid dishwashing soap was effective against aphids, spider mites, psyllids, and thrips at 1 percent and 2 percent concentrations.

5) New Day® dishwashing detergent when used at 2.0 ml/L was highly active on whiteflies providing 95 percent mortality of silverleaf whitefly (*Bemisia argentifolii*) nymphs. New Day contains cocamide DEA and dodecylbenzene sulphonic acid as the active ingredient.

Interior Plantscape

6) Aqueous solutions (0.1 percent to 2.0 percent concentrations) of two "soft" soaps caused nearly 100 percent mortality on two household insect pests: cricket and cockroach.

7) Ivory® liquid dishwashing soap and Tide® detergent were effective in reducing populations of aphids, citrus red mite (*Panonychus citri*), psyllids, and greenhouse thrips (*Heliothrips haemorrhoidalis*) on landscape plants.

Despite these examples, dishwashing liquids and laundry detergents are primarily designed to dissolve grease from dishes and clean clothes – not to kill insects. These materials may cause plant injury by dissolving the waxy cuticle on the leaf surfaces. Registered, commercially available insecticidal soaps are less likely to dissolve plant waxes than household cleaning products. Additionally, plants with pubescent (hairy) leaves may be more susceptible to phytotoxicity from dishwashing liquids and detergents. Dishwashing liquids and laundry detergents, like insecticidal soaps, lack any residual activity and thus more frequent applications are needed. However, too many applications will harm certain plant types. In addition, detergents are chemically different from soaps and may cause phytotoxicity. In fact, many hand soaps are not necessarily pure fatty acids.

Most importantly, these solutions are not registered insecticides. Soap companies don't intend for their products to be used as insecticides, as they have not gone through the Environmental Protection Agency (EPA) registration process. The type of fatty acid, length of the carbon-based fatty acid chain, and concentration in many laundry and dish soaps is not known. In addition, the insecticidal effectiveness of these products may be compromised by the presence of coloring agents or perfumes. This often leads to inconsistent results. Certain laundry and dish soaps will precipitate in "hard" water, thus reducing their effectiveness.

Despite the activity of some dishwashing liquids and laundry soaps on insect and mite pests, their use should be avoided in interior plantscapes primarily because they are not registered insecticides. Even more important is that a pest control company will generally stand behind a product when there is a problem. If a dish or laundry soap is used and plants are injured, there is no recourse.

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Supplemental Lighting

by A.J. Both

Introduction

Supplemental lighting is used in greenhouses to increase crop production during time periods with low levels of solar radiation. These time periods usually occur during the winter months, but cloudy summer days can be as dark as some of the darker winter days. Thus, if crop production is on a tight schedule, supplemental lighting may be required year-round. Sometimes, photoperiod lighting is also defined as supplemental lighting. But since the light intensities required are very low, and, thus, photoperiod lighting consumes limited amounts of energy, it is not considered in the context of this discussion. Despite the installation and operating costs associated with supplemental lighting systems, growers are discovering the benefits. These systems can help improve crop quality, keep production on schedule, and reduce the length of the growing cycle. Thus, growers produce a higher quality product while keeping their production schedules on target, and they are able to produce more crops per year. In this article, several of the most important aspects of supplemental lighting systems will be discussed.

Light Units

The preferred unit for measuring light for plant production is µmol m^{-2} s^{-1} (pronounced: "micromol per meter squared per second"). This unit expresses the amount of particles (photons or quanta) of light incident on a unit area (m^2) per unit time (second). The portion of the light spectrum the plants use for photosynthesis is called Photosynthetically Active Radiation (PAR, 400-700 nm, nm = nanometer), and it is expressed in the unit of µmol m^{-2} s^{-1}. Sensors used to measure PAR are called quantum sensors and have carefully designed filters such that no light outside the PAR waveband is measured. Our human eye is able to detect light in a slightly larger waveband of approximately 380-770 nm. To measure light in this waveband, a footcandle meter (or a lux meter) can be used. But measurements with a footcandle meter include some light with wavelengths outside the waveband used by plants for photosynthesis. Therefore, using a footcandle meter introduces a small error when we are only interested in measuring the amount of light available to plants for the process of photosynthesis. For this reason, the use of a footcandle meter is not recommended when evaluating the light environment for plant production. It is possible to convert a measurement taken with a footcandle meter into a µmol m^{-2} s^{-1} value, but the correct conversion factor depends on the light source and is, in the case of mixed light sources, not always easily determined.

MH or HPS?

The most efficient lamps used for supplemental lighting in greenhouses are the so-called high intensity discharge (HID) lamps. Two such lamps are the metal halide (MH) and the high-pressure sodium (HPS) lamps. MH lamps produce a more white-colored light, while HPS lamp light is more yellowish orange (similar to street lamp light). HPS lamps are slightly more efficient in converting electric energy into PAR light and have an average rated lamp life up to three times longer than MH lamps. MH lamps produce a little more blue light that is important for the proper development of some crop species. Because of their higher efficiency and rated lamp life, HPS lamps are most often used for supplemental lighting in greenhouse operations. Common lamp wattages are 400, 600, and 1,000 watt.

Installation Considerations

When installing supplemental lighting systems in greenhouses, several factors should be considered. First, the average amount of solar radiation for the location should be investigated. This will give an idea of the range of solar radiation conditions at the site. One way to determine the amount of light available for crop production at a particular location in the United States is to consult the database of solar radiation data maintained by the National Renewable Energy Laboratory in Golden, Colorado (http://www.nrel.gov). This database contains solar radiation data for 239 locations across the United States and its territories. For plant production purposes, the solar radiation data can be converted into the units of mol m^{-2} d^{-1}, indicating the daily sum (integral) of light available for photosynthesis (1 kWh m^{-2} d^{-1} = 7.49 mol m^{-2} d^{-1}).

Second, the type of greenhouse structure, glazing, and equipment installed will have an impact on the transmission of sunlight.

Third, the type of crop (or crops) grown in the greenhouse will determine the plant's requirements (such as light intensity, duration, or light integral).

Fourth, the available space in the greenhouse to hang lamps will have an impact on the uniformity of supplemental lighting (the less space available for taller crops in lower greenhouses, the less uniform the light distribution).

Finally, the plant's requirements should be compared to the available amounts of sunlight to calculate the necessary amounts of supplemental lighting. It is usually not economical to install lighting systems that provide high light intensities in greenhouses because of the large number of lamps required. Therefore, supplemental lighting systems can be designed to provide a certain light integral during a 24-hour period such that the sum of the supplemental light integral and the solar radiation integral meet the plant's requirements for even the darkest day of the year. The light integral supplied by the supplemental lighting system depends on the average light intensity provided by the lamps and the duration of operation. The light intensity supplied by commercial supplemental lighting systems usually is not higher than 200 µmol m^{-2} s^{-1} (or 0.72 mol m^{-2} hr^{-1}, or 17.3 mol m^{-2} per 24-hour period).

Light Uniformity

In addition to light intensity, light uniformity is an important factor to consider when designing lighting systems for greenhouses. In general, except when clouds are passing overhead or when structural elements create shading patterns, sunlight is uniform from one location to the next inside a greenhouse. However, due to the distance between lamps and the distance between the lamps and the crop, supplemental lighting systems will always provide non-uniform lighting patterns over a plant canopy. It is the task of the designer to optimize light uniformity by carefully calculating the light distribution from each lamp and the different paths the light can travel from each lamp to the crop underneath. Fortunately, computer software programs exist to assist the designer with this complicated task and in general, a careful design results in very acceptable light distribution and uniformity over a crop canopy.

Reflectors

Most supplemental lighting units are outfitted with a reflector that directs the light generated by the bulb downward onto the crop. Different manufacturers use different materials and designs. The trick is to design a reflector that directs the light away from the bulb and spreads it uniformly over the crop. Reflectors should not be too big, because they may block significant amounts of solar radiation from reaching the crop. Installed in greenhouses, reflectors tend to get dirty over time and need to be cleaned periodically for optimum reflectivity.

Off-Peak Operation

To make the operation of a supplemental lighting system as economical as possible, these systems are sometimes operated exclusively during periods of the day with off-peak electricity rates (e.g. from 10 p.m. to 6 a.m.). However, during the darker months, this could result in two light periods for a crop during every 24-hour period (one starting at sunrise, ending at sunset, and followed by a (short) dark period; the other continuing with the supplemental lighting period, and followed by a brief dark period before sunrise). Not every crop might thrive under these conditions. Some crops require an extended dark period (e.g. tomatoes), resulting in the use of supplemental lighting during hours of the day with more expensive electricity rates. Careful (computer) control of the operation of lighting systems will help reduce operating costs.

Daily Light Integral

For some crops, and especially for the vegetative growth phase, a (linear) relationship exists between total amount of light received and plant growth. This relationship brought forth the idea of providing plants with the same light integral (or light sum) every day of the year and independent of the amount of solar radiation received. Whenever the amount of light provided by sunlight would be less than the target light integral, the remainder would be added with a supplemental lighting system. Whenever a crop would be in danger of receiving more than the target light integral, a shade curtain would be deployed. Controlling such a lighting system with the goal of providing the exact same light integral every day of the year is only feasible with the help of computer software. Such software has been developed, and it enables the computer to keep track of the amount of light received since sunrise. By comparing the amount of light received with a calculated prediction of the total amount of sunlight received at sunset and knowing the desired daily light integral, the computer determines when to operate the lighting or shading system. In addition to making sure the plants receive the same light integral every day, the control system can also make maximum use of the hours of the day with off-peak electricity rates to operate the supplemental lighting system.

Shading

In addition to supplemental lighting, greenhouse growers can use shading techniques to control the crop's light environment. The goal is to reduce the amount of sunlight reaching a crop in order to prevent radiation (heat) stress or to prevent the daily light integral from overshooting its target. Growers can apply a shading compound or fabric on the inside or outside of the greenhouse. The shading compounds are usually applied in the spring and removed in the fall. Shading fabrics can be installed to remain in place part or most of the year and can be operated manually or mechanically (in that case usually controlled by a computer system). Some shade fabrics are designed so that, once deployed, they act as an energy curtain by preventing warm greenhouse air from rising all the way to the greenhouse roof and cooling down against the colder glazing material.

Carbon Dioxide Enrichment and Supplemental Lighting

For photosynthesis, plants need both light (PAR) and carbon dioxide. Both need to be available in sufficient quantities for neither one to become the limiting factor (e.g. if there is enough light but not enough carbon dioxide, carbon dioxide becomes the limiting factor and vice versa). Therefore, when using supplemental lighting to increase plant production, it is important to maintain sufficiently

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Supplemental Lighting

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high carbon dioxide concentrations inside the greenhouse. Especially during the colder months of the year, when (very) low ventilation rates are needed to maintain the desired greenhouse temperature, the carbon dioxide concentration inside the greenhouse can drop significantly because little or no fresh air (with more carbon dioxide) enters the greenhouse.

Under these low ventilation conditions, it may be economically feasible to boost the carbon dioxide concentration inside the greenhouse to levels as high as three times the ambient concentration, resulting in increased photosynthesis and thus plant growth. Research indicated that within certain limits, it is possible to reduce the required daily light integral, while at the same time, increasing the carbon dioxide concentration for the same overall plant production. This result points to possible significant savings because adding carbon dioxide to the greenhouse environment is cheaper than adding supplemental light. Computer control software is needed to assist the grower with the decision of when to add carbon dioxide to the greenhouse, what target concentration should be used, and when to operate the supplemental lighting system. During the warmer months of the year, when (significant) ventilation is required to maintain the target greenhouse temperature, carbon dioxide enrichment is not cost effective because the released carbon dioxide would be immediately exhausted from the greenhouse.

Lamp Replacement

Maintenance of supplemental lighting systems is important and should not be overlooked. Just like any other piece of equipment, failures do occur and need to be corrected as soon as possible. Lamp failures create non-uniform light distribution patterns, which can quickly lead to non-uniform plant production. In addition to incidental failures, the light output of lamps slowly degrades over time. The rate of degradation depends on the type of lamp used and the operating conditions (e.g. temperature). By knowing the approximate rate of degradation (check with the manufacturer), a lamp replacement schedule can be developed such that the overall light intensity does not drop below a certain minimum acceptance level. Instead of replacing all lamps at once, which can be expensive, lamps can be replaced in groups (e.g. one greenhouse bay at-a-time, or better yet, every other lamp or every other third lamp, etc.).

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Enfermedades de Plántulas de Temporada
("Diseases of Bedding Plants")

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Editor's Note: This translation is from the January/February 2003 *OFA Bulletin* article entitled "Diseases of Bedding Plants" written by Steve Nameth, The Ohio State University (OSU). This translation is provided by Claudio Pasian, OSU. In some cases, Pasian provided what he calls an "interpretative translation" – reading the paragraph and then putting the concepts into his own words without translating word by word, sentence by sentence.

El manejo de enfermedades es una de las mayores inquietudes que tiene un cultivador de plántulas de temporada o plantas de cantero. Hongos que atacan plantas, bacterias, y virus son microorganismos responsables de causar numerosas enfermedades en las plántulas de temporada. Las enfermedades causadas por hongos son las más comunes pero no necesariamente las mas importantes. Dependiendo de la planta huésped, otros patógenos como bacterias y virus tienen la capacidad de causar enfermedades con consecuencias económicas severas.

El objetivo de este artículo es el de familiarizar al lector con algunas de las enfermedades de las plántulas de temporada más comunes y dar información sobre su control y/o manejo de las formas más económica posible. A continuación, las enfermedades se describen de acuerdo a la parte de la planta que atacan.

Enfermedades de Plantines (“Plugs”)

Las enfermedades de los plugs se pueden dividir en dos tipos: enfermedades de pre-emergencia y enfermedades de post-emergencia. Las enfermedades de pre-emergencia ocurren antes o durante la germinación de la semilla. El síntoma obvio de esta enfermedad es que la plántula nunca emerge y se tiene (resulta?) una celda plug vacía. Enfermedades de post-emergencia ocurren una vez que la plántula ha emergido del medio de cultivo y ya ha producido los cotiledones y las primeras hojas verdaderas. El síntoma más obvio del volteo de las plántulas (“dumping off”) es su marchitamiento y posterior caída sobre el medio del cultivo. En la mayoría de los casos, la muerte de las plántulas antes de la emergencia está causada por tres hongos patógenos: *Pythium* sp., *Rhizoctonia* sp., y *Thielaviopsis* sp.

El volteo de las plántulas de post-emergencia en la mayoría de los casos está causado por los hongos *Pythium* sp., *Rhizoctonia* sp. y *Botritis* sp. Como todas las enfermedades que afectan plugs también afectan a las mismas plantas una vez que han crecido, los detalles de las mismas serán cubiertos mas adelante en este artículo.

Pudrición de la raíz y del cuello

Pudrición de la raíz causada por Pythium

Esta es una de las enfermedades más comunes en los invernaderos y está causada por el hongo *Pythium* sp. El hongo primero ataca el ápice (el extremo) de las raíces y si las condiciones favorables para la enfermedad continúan, se traslada hacia arriba pudriendo la raíz y el tallo. Los síntomas de esta enfermedad incluyen el marchitamiento, la falta de vigor, y deficiencias de nutrientes. Las raíces afectadas se ven de color marrón y de aspecto pulposo (“mushy”). En las etapas finales de la enfermedad, la totalidad de las raíces se ve de color marrón. Una vez que el hongo a llegado al cuello y al tallo los mismos se ven de color negro y al tocarlos se sienten muy blandos. Este estado avanzado de la enfermedad se denomina pierna negra (“black leg”). Utilizar un medio de cultivo con buen drenaje (buena porosidad aérea) representa un paso importante en el control y prevención de esta enfermedad. Compuestos químicos como mefenoxam y trifloxystrobin se encuentran entre los mejores para controlar esta enfermedad.

Pudrición negra de la raíz

La causa de esta enfermedad es el hongo *Thielaviopsis* sp. Algunas plántulas de temporada son más susceptibles a esta enfermedad que otras. Violas, pensamientos (pansy), vinca y petunia son muy susceptibles si se las cultiva en condiciones ambientales adversas. Las plantas afectadas por esta enfermedad se ven atrofiadas (sin crecimiento) y de aspecto enfermizo. Amarillamiento de las hojas es un síntoma común. Las raíces infectadas se ven de color negro y de aspecto pulposo. Las plantas que están bajo estrés causado por el desbalnce del pH o por un alto nivel de sales en la mezcla de cultivo están más susceptibles a la pudrición negra. Compuestos químicos como el thiophanate-methyl y el triflumizole ofrecen un excelente control.

Pudrición del cuello causado por *Rhizoctonia* sp.

Esta enfermedad comienza en el cuello (la parte del tallo que esta al nivel de la superficie de la la mezcla cultivo) y se desplaza hacia arriba por el tallo el cual se vuelve blando, pulposo. La planta se marchita. Con el tiempo el hongo circunda todo el tallo y la planta muere. En muchos casos las raíces se ven sanas pero el cuello esta podrido. Compuestos químicos como el azoxystrobin y thiophanate-methyl pueden controlar esta enfermedad.

Marchitamiento causado por el taponamiento del sistema vascular

Estos marchitamientos están causados por una variedad de patógenos. Los más comunes son los hongos *Fusarium* sp. y *Verticillium* sp., y la bacteria *Xanthomonas campestris* pv. *Pelargonii* (Xcp). Los dos hongos mencionados pueden infectar plántulas de distintas especies usadas como anuales de temporada mientras que Xcp solo infecta a los geranios. Los síntomas de todas estas enfermedades son similares. Las plantas infectadas se marchitan bajo condiciones de estrés hídrico, especialmente durante las horas de más calor del día. Si los tallos de plantas infectadas se cortan en forma transversal, el sistema vascular se ve de color oscuro. Este síntoma es utilizado para diagnosticar la enfermedad. El marchitamiento causado por el taponamiento del sistema vascular es una enfermedad muy común en cultivos de ciclamen.

La incidencia de estas enfermedades es menor comparada a otras enfermedades de plántulas para el jardín y en general no causan perdidas económicas importantes. Prevenir estas enfermedades es más efectivo que curarlas. El producto fluoxinil da buen resultado para controlar el marchitamiento vascular en ciclamen.

Enfermedades de las hojas

Quemazón de la hoja causada por el hongo Botritis

Esta enfermedad, también llamada moho gris, es la más común de todas las enfermedades en los invernaderos. El agente causal es el hongo B*otritis ciñera*. Puede atacar un número muy grande de cultivos ornamentales y puede permanecer en el invernadero todo el año. El hongo produce numerosas esporas que pueden ser esparcidas a través de corrientes de aire por todo el invernadero. Cuando las condiciones ambientales son ade-

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Enfermedades de Plántulas

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cuadas, las esporas que se han depositado sobre las plantas germinan y el hongo penetra la planta huésped. La temperatura optima de germinación es entre 72 y 77 F (22 C y 25 C). La penetración del hongo raramente ocurre en un tejido sano, siendo lo más común que la penetración ocurra a través de una herida.

Los síntomas de esta enfermedad cambian de acuerdo al cultivo y a las condiciones ambientales del invernadero. Se caracteriza por la aparición de manchas foliares, quemazón de las flores, pudrición del pimpollo floral, cancro del tallo, pudrición del cuello y el tallo, y volteo de las plántulas. El crecimiento del hongo esta caracterizado por la presencia de micelio (fibras muy delgadas) de color que va de gris verdoso a marrón. Si se toca este micelio, se produce una nube de esporas. El tejido afectado es de un color marrón, de textura blanda y a veces tiene un aspecto acuoso.

Mantener dentro del invernadero condiciones ambientales que no favorecen el crecimiento del hongo y la germinación de esporas es fundamental. Si se mantiene la humedad relativa por debajo de 85%, si se hace circular el aire dentro del invernadero y si se mantiene adecuada separación entre las plantas, se puede minimizar la ocurrencia de esta enfermedad. Ventiladores (abanicos) deben usarse para obtener un buen movimiento del aire por encima de las copas de las plantas. Las plantas que tienen lastimaduras deben protegerse con un funguicida o bien se deben remover del invernadero porque las heridas son la entrada perfecta para este hongo. Hay muchos fungicidas cuya etiqueta indica que son efectivos contra la Botrytis. Los que contienen azoxystrobin, chlorotalonil, enhexamid, y productos que contienen mezclas como el thiophanate methyl mas el chlorotalonil son buenos para controlar esta enfermedad.

Mildiu polvoriento

Varios hongos pueden causar esta enfermedad. La enfermedad se caracteriza por el crecimiento del hongo con aspecto de pelusa mullida blanca sobre las hojas y los tallos. Esta enfermedad se ve favorecida cuando las noches son frescas y húmedas y los días son cálidos y soleados. Cambiar estas condiciones ambientales del invernadero es fundamental para controlar esta enfermedad. Buen movimiento del aire y compuestos químicos que contienen azoxystrobin y piperalin producen un buen control.

Mancha bacteriana de la hoja

En condiciones de alta humedad en el aire y condensación sobre las hojas, la mancha bacteriana puede ser un problema. La mayoría de las manchas bacterianas de las plántulas de jardín son causadas por la bacteria *Pseudomonas* sp. Las manchas causadas por esta bacteria en las hojas son pequeñas, circulares, aguachentas y rodeadas de un halo violáceo. Si la enfermedad no se frena, las manchas se agrandan y se juntan y la hoja entera tendrá un aspecto aguachento purpúreo y de pudrición. La difusión de esta enfermedad se puede disminuir evitando mojar las hojas cuando se riega y manteniendo condiciones ambientales que favorezcan el secado rápido de la superficie de las hojas. Funguicidas conteniendo cobre frenan la dispersión de la bacteria de planta a planta.

Antracnosis de las hojas

Esta enfermedad puede ser causada por varios hongos y puede ser un problema serio en algunos huéspedes. La enfermedad se caracteriza por manchas de color gris - gris oscuro que se encuentran principalmente en las hojas viejas. En muchos casos estas manchas comienzan en el borde de las hojas y luego se mueven hacia el interior de las mismas. Es necesario evitar que las hojas permanezcan mojadas por periodos largo de tiempo. Productos conteniendo mancozeb ayudan a controlar esta enfermedad.

Virus

Muchos virus pueden infectar a las plántulas de jardín; sin embargo solo unos pocos son de importancia económica. Los virus como el virus del mosaico del tabaco (TMV), el virus del mosaico del pepino (CMV) y el virus de la macha anillada del tabaco y el tomate (TRSV) pueden infectar a las plántulas de jardín y dependiendo del huésped, pueden causar la perdida del cultivo. (Las siglas presentadas responden a las siglas del nombre en inglés.) Síntomas de estas enfermedades virales incluyen: mosaico, moteaduras, anillos amarillos, amarillamiento general, atrofia del crecimiento.

De todas los virus que infectan a las plántulas de jardín, los más severos pertenecen al grupo de los topso-virus: el virus de la mancha necrótica del Impatiens (INSV), y el virus del marchitamiento moteado del tomate (TSWV). Estos dos virus tienen una lista de huéspedes bastante amplia. Síntomas de estas enfermedades incluyen, pero no están limitados a, manchas amarillas o necróticas (muertas) en tallos y hojas, mosaico en las hojas, muerte de hojas y tallos, manchas negras en tallos y hojas, manchas circulares de anillos concéntricos, amarillamiento general, falta de vigor o de crecimiento, plantas pequeñas.

El INSV y el TSWN pueden ser transportados dentro del invernadero por los trips. Si estos virus no se controlan se pueden distribuir por todo el invernadero muy rápidamente y producir daños importantes. Si los trips son un problema, deben ser controlados.

La mejor defensa contra estos virus es no permitir que los mismos no entren en el invernadero. Al elegir material de propagación de las plantas se debe poner énfasis en semillas y esquejes (gajos) que estén libres de virus.

El control de enfermedades de los plantines para jardín es un proceso de tres pasos: prevención, detección, y control. Si los cultivadores ponen énfasis en la prevención, el control puede que no sean necesarios.

Enfermedades de Plántulas de Temporada ("Diseases of Bedding Plants") Survey

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1. Was this article understandable and useful for your Spanish-speaking workers? **Yes** **No**
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Carving the Best Part of the Christmas Turkey

by Lloyd R. Traven

Every year in the United States, during the weeks leading up to Thanksgiving, the frenzy begins. The day after Thanksgiving, it's as if a massive switch has been thrown, and the population begins the annual lemming-like process known as "Christmas shopping." Normally reserved Americans magically transform from responsible, diligent workers, entrepreneurs, and parents, to become mindless, glaze-eyed purchasing machines! Forget family finances; who cares about high credit card rates? We **need** the hottest toy for the kids, the coolest video game, the slickest cell phone, the fastest computer – and we want it NOW!

This change is so sudden, so dramatic that retailers have dubbed the day after Thanksgiving "Black Friday." We all, especially those of you who retail, think that this refers to how crazy and stressful it is in malls, shopping districts, and on the streets trying to get to the stores. The truth, however, is that retailers feel this is the day they finally go "into the black," or start to show a profit for the year. A successful Christmas season is crucial for retailers to allow enough profit to continue and expand operations.

Simply stated, there is no time of year when Americans are more willing to spend their money! Unfortunately, growers and plant retailers generally have failed to capitalize upon this desire, nay, the need to spend, spend, spend. In fact, almost exactly the opposite is true. As an industry, we have taken what is perhaps the signature symbol of the holiday season and turned it into a loss leader. Box stores now use the magnificent poinsettia to get you in to buy drills, toys, and sweaters.

Growers all over North America now generally see Christmas as a season to "cover overhead" or to "keep workers around so they are there for spring." The huge quantities required by the box stores and mega-chains cause a drive for consistent expansion by the largest growers, making it more difficult to service smaller independent retailers. The demand for a price structure allowing a 6-inch product sold at 5 for $10 by the big boxes has also caused a dilution of quality standards to a level that causes an environment of commodity pricing.

The reality that the buying power and pricing demands of the chains creates for the growers' bottom line staggers the mind. After all, many of these crops have a production cycle of months, not weeks. Input costs are relatively high, with expensive cuttings, multiple PGR applications, multiple fungicide/insecticide applications, poor light and high heat demand, sleeves, pot covers, and difficult delivery conditions. Contrast this with spring vegetative annuals – short cycles, high demand, better weather, easier delivery. Can someone explain why, during a period of willingness to spend money like no other time of year, we would knowingly price a premium product as a money-loser? Unfortunately, it appears so ingrained with the large suppliers and large retailers that it is a "done deal." The case, fortunately, is radically different for small- to mid-sized growers and retailers! We have the chance to make real, serious money the second half of the year!

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Carving the Best Part of the Christmas Turkey

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For the rest of us, Christmas is literally a time to shine, to strut our stuff, and to glow. We have an opportunity to grow spectacular product (not just poinsettias) in different configurations and combinations, ranging from the tiniest sizes (1-inch self-watering or arrangement packs) up to the world-famous Texas-sized pieces grown by PJ Ellison's superb operation and seen at the White House.

Unique forms can be produced also. At Peace Tree Farm, we specialize in tree-form poinsettias. Last year, we experimented with a "Column Poinsettia," and we have also seen examples of cone-shaped and wreath-shaped poinsettias. We produce the "typical" 5 ½-foot tall tree, but also have pushed the size **down** to as small as 10 inches tall, while still maintaining exactly the same scale and appearance as their larger cousins. Additionally, we produce sizes in between. We have named these sizes the Desktop, Countertop, Tabletop, and Hearth trees. Imagine a Desktop tree on every desk at a large corporation; then compare the dollars brought in to what a typical mass-market 4 ½-inch plant on each desk brings in. Remember to consider also the delight and wonder that the person receiving this wonderful gift feels compared to receiving a typical 4-inch pinched plant for their cubicle. After all, isn't this what we really are selling – beauty, delight, joy, wonderment? In the drive for the "lowest price, every day," margin erosion, and the mantra of cost-cutting, we seem to have lost sight of our trump card -- we grow flowers, and nothing on the planet compares to them for sheer beauty.

What is required to be successful at Christmas is a different mindset, a willingness to try to be different, rejecting the "tried and true." How many growers held on and continued to grow the Hegg varieties for a few extra years because they were comfortable? How many resisted change to newer, greatly superior cultivars, and ended up being several years behind on the learning curve? Why do we still produce the bulk of the crop in 6-inch pots, even though we compete with operations that dwarf us and have far more technology? The time is NOW to think totally outside the box; in fact it is time to throw the box away!

In no way do I want to indicate that this discussion is limited to poinsettias. In fact, given the public perception of poinsettias as a grocery/box store product that is poorly displayed and maintained, the greatest opportunities may lie in other non-traditional products. Be careful, however, not to forget the old standby crops like amaryllis, cyclamen, and hiemalis begonias. Many of these items, when treated with care and attention to details, can be exceptionally profitable – especially when growing different colors and upgraded sizes. The key, above all else, is the quality, and your ability to find customers who understand that quality costs money.

We also believe strongly that there is a market waiting for crops that are out of season for Christmas or are unusually early. Examples of this would include ranunculus (there is nothing better than somebody gasping and asking "Is that real?"), spring bulbs (we have developed a nice niche for tulips, "Tete-a-Tete," hyacinths after December 15 when everyone is SOOOO tired of poinsettias), clay-potted herbs, foliage and flowering topiary (geraniums, coleus, fleurettes, rosemary), and rex and other foliage-type begonias. We call this type of product line the "<u>Un</u>-settia" – anything that is not screaming "I am a red poinsettia."

We also like to push other colors not usually seen at Christmas, because there are a lot of people desperate for alternatives. This is the genesis for all of those fantastic novelty poinsettias and the weird new colors and bract forms. Many growers may look at them and say "Yuck," but the consumer says "Yahoo!" 'Winter Rose'? 'Carousel'? 'Chianti'? 'Plum Pudding'? 'Merlot'? 'Strawberries and Cream'? 'Avant Garde'? 'Lemon Snow'? What grower would have thought that they would become so popular so rapidly? Currently, 65 percent of all our poinsettias at Peace Tree Farm are dedicated to these novelty cultivars, especially for the smaller trees. The fact that we are growing a highly specialized configuration in very unusual sizes, coupled with novel colors and bract forms, allows us to command the price structure we have determined we need to remain profitable throughout the second half of the year.

Marketing is a Must

The production side of growing niche-type products requires an unusual attention to details. Diligent pest control is a must. Timely PGR applications are critical – imagine a 10-inch tall poinsettia tree with stretched branches! All aspects must be done properly if you hope to command premium prices. Fertilization, soils, containers, shipping – nothing second rate, no scrimping! Accurate environmental control and proper conditions are also crucial – no cheating! But nothing, repeat nothing, is more critical than dedication to marketing. There must be not only focus on the particular product specialty, but also differentiation from the competition. You optimize the facility and equipment to reach a specific goal, but part of that goal must be setting your product and operation apart. This can be via product selection and size, color choices, service, or unique and unusual products. It always comes back to quality! Of course, you can differentiate with lower prices too.

There is no time of year where niche marketing has greater potential than Christmas. Part of this marketing may be educating both your customers and the ultimate consumers. An excellent example of this would be the poinsettia festival at Ellison's Greenhouse in Texas, drawing literally thousands of people from local areas and other countries! Breeders make sure to place every possible new variety there, because this event has become so well-known both locally and internationally that a huge vote of confidence can actually make the difference between commercial success and faded glory. This prominence did not just happen by chance or luck. Rather, it took years of diligence, refining, advertising, and fine-tuning to get to this point. Likewise, every person in the company dedicated himself or herself to producing exceptional material for sale both retail and wholesale. This philosophy must come from the top down. The payoff for Ellison's is that they are able to command premium pricing, remain profitable, and get the respect of their peers and customers! A full parking lot is always a good sign.

Another outstanding example is Bob Frye of the Plantation in Lincoln, Nebraska with his unbelievable geraniums. His whole concept of niche marketing and what is required for a successful program provides a blueprint for those who are willing to take the leap of faith and dedicate their operation to the idea. Before you even think about the marketing aspects of his concept, however, it is imperative that you realize that it all starts with the plants! Simply put, it is not the brand, not the tag, not the POP, not the advertising – it's the sheer knockout oomph – the Flower Power. Only after this has been done does the creation of excess demand begin to happen, and it is only when there is excess demand that you can get the price you dream about charging.

There is a cardinal rule at Peace Tree Farm, and I believe the same rule applies at the Plantation – never discount your material. Sometimes, it is better to toss something on the pile than to give it up cheaply. Also remember, never sell anything that is less than beautiful. It will be the only plant your customer remembers, and they will remember it forever and tell all their friends!! For 20 years, the motto at Peace Tree Farm to our wholesale customers has been "Plants You'd Buy for YOURSELF." Simply, if it's not good enough for your home, why would you allow it in your store? This belief and the focus on it have served us well and profitably.

At Peace Tree Farm, we have tried very hard to make our customers aware of the potential of our products, and why **their** customers will want it enough to pay premium prices for it. Some "get it," others don't see my point at all, and that's ok. As long as we are able to produce and sell a product that generates three times the sales price per unit, in the same time, for almost the same input cost, we are not concerned that some don't see eye-to-eye with us. What is important to note, however, is that this type of marketing is almost the opposite of the norm – where you listen to what the customer wants and for how much money and then determine how to do that. Simply, we decide what we want to grow for what price and convince them they want it! Again, this is a totally different marketing philosophy – one that works only if you try as hard as you can to walk the walk, as well as talk the talk.

So often we hear growers say that "I make all my money in the spring, and I spend the rest of the year just trying to hold onto it." At Peace Tree Farm, we try as hard as we can to build on the profits of spring. This philosophy, and our focus on achieving this goal, has allowed us to continuously reinvest in our business, giving us the potential for continued success. If you want your business to generate income both halves of the year, consider stepping back and re-evaluating how you run your business and how you see the worth of your product and yourself. You may be very surprised, and satisfied, with the results! Merry Christmas.

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O.F.A.S. Releases New "Tips" Book

O.F.A. Services Inc., a subsidiary of the OFA, just released the new *Tips on Growing Vegetative Annuals* during the 2003 OFA Short Course in July.

This full-color manual features sections on 21 vegetative annuals. A page for each crop contains production information on topics such as media, pH, light, temperature, and fertilizer requirements. For each crop, color photos show de-tailed flower, stem, leaf, habit/form, and combination and landscape plantings.

Tips on Growing Vegetative Annuals is primarily authored by John Gaydos, Proven Winners; Steve Jones, Bodger Botanicals; Jack Williams, The Flower Fields; and Mark Wilson, Simply Beautiful.

This book can be ordered through O.F.A. Services Inc. by contacting OFA at 2130 Stella Court, Columbus, Ohio 43215. Phone: 614-487-1117; fax: 614-487-1216; ofa@ofa.org; www.ofa.org.

OFA News

OFA Election Results Announced

OFA – an Association of Floriculture Professionals announced at its July annual meeting the election of the OFA president, vice president, and five new members to the board of directors.

President – Kathleen Benken, OCF, of H.J. Benken Inc., Cincinnati, Ohio.

Vice President – Jim Broderick of Plantland Garden Centers, Columbus, Ohio.

The five new directors are: **Grower At-Large – Bobby Barnitz,** Bob's Market and Greenhouses Inc., Mason, West Virginia; **Retail At-Large – Jody Brown-Spivey**, Expressions Floral Design Studio, Columbus, Ohio; **Ohio Grower – Terry Diefenbacher**, Diefenbacher Greenhouses Inc., Cincinnati, Ohio; **Ohio Grower – Earl Robinson**, Meadow View Growers Inc., New Carlisle, Ohio; and **Allied At-Large – Valerie Eason**, Eason Horticultural Resources Inc., Crestview Hills, Kentucky.

OFA Alex Laurie Winners Announced

A. Jeremy Bishko, University of New Hampshire, **Paul R. Fisher,** University of New Hampshire, and **William R. Argo**, Blackmore Company, were named recipients of the OFA Alex Laurie Award, in July at the OFA Short Course.

This year's award was presented for the paper "Quantifying the pH-Response of a Peat-based Medium to Application of Basic Chemicals," as published in HortScience, a publication of the American Society for Horticultural Science.

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For information on upcoming OFA events, visit our Web site: www. ofa.org

Upcoming OFA Outreach Educational Opportunities

July 31 - Aug 2	**FloralWorld™** – Atlanta, Georgia
September 7	**Ohio Certified Florist (OCF) Testing** Columbus, Ohio
September 10	**Corsage Retail Hands-On Workshop** David Hale, AIFD HJ Benken, Cincinnati, Ohio
October	**"Getting Ready for the Holidays"** Retail Hands-On Workshop Cleveland Plant & Flower Co – Charleston, West Virginia – Columbus, Ohio – Toledo, Ohio
	Interior Plantscape Recertification Engledow Group, Indianapolis, Indiana
	Garden Center Outreach Seminars
Fall	**Grower Outreach Seminars**
January 2004	**Partnering for Profitability** Texas A&M University

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