The MAYFLOWER & Floral Notes

A Joint Publication
Massachusetts Flower Growers' Association
& UMass Extension

February 2014

2014 University of Connecticut Perennial Plant Conference

The University of Connecticut is sponsoring the "**Perennial Plant Conference – A Conference for the Landscape and Horticultural Professional**." The conference will be held at the Lewis B. Rome Commons on the University of Connecticut Storrs campus on **Thursday, March 20, 2014**.

This all-day educational conference will address a wide range of topics focusing on herbaceous perennial production, sustainable landscape design, and retail marketing. Topics were selected to appeal to professional landscapers and designers, nursery and greenhouse producers, and retail garden centers. Two concurrent educational sessions will feature nationally recognized speakers from both industry and academia.

The speakers featured at the conference will include:

Stephanie Cohen, Horticultural Consultant, Collegeville, PA who will be speaking on *Mixing it Up: Flowering Shrubs for the Mixed Border*.

Nancy Dubrule-Clemente, Owner of Natureworks in Northford, CT who will be speaking on *The Challenges of Running a Landscape Business with Today's Extreme Climate Extremes*.

Jim Engel, from White Oak Nursery in Geneva, NY who will be speaking on *Top Native Shrubs and How to Use Them in Your Landscape.*

Robert Herman, Horticultural Consultant from New Hartford, CT who will be speaking on *Garden Design Trends in Europe.*

Jane Nadel-Klein, from Trinity College in Hartford, CT who will be speaking on *Fifty Shades of Green: Gardeners and the Green Industry*.

Cheryl Smith, Plant Pathologist from the University of New Hampshire, in Durham, NH who will be speaking on *Cultural Practices and Pest Management Strategies for Low-Input Gardens.*

Lloyd Traven, *O*wner/Partner of Peace Tree Farm in Kintnersville, PA, who will be speaking on *Bringing THE Awesome EVERYDAY!!* as well as *Bringing Fantastic New Plants to Market.*

Mark Weathington, from the JC Raulston Arboretum at North Carolina State University in Raleigh, NC who will be speaking on *Some Like it Hot- Water Wise Plants that Pack a Punch* and *Green Screens AKA Life after Leyland*.

Program and registration information, including online registration, is available at www.2014perennial.uconn.edu.

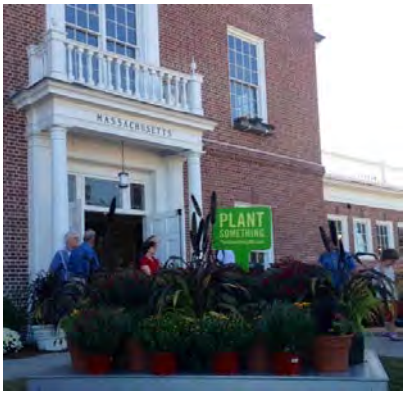
Included with your registration is an information packet, lunch, morning & afternoon snacks, free-parking, and an opportunity to meet speakers and purchase autographed books from the Perennial Plant Conference bookstore. **One pesticide recertification credit** will be offered for attendees from CT, RI, MA, ME, NH, and VT (pending state approval). Additional CEU's are available.

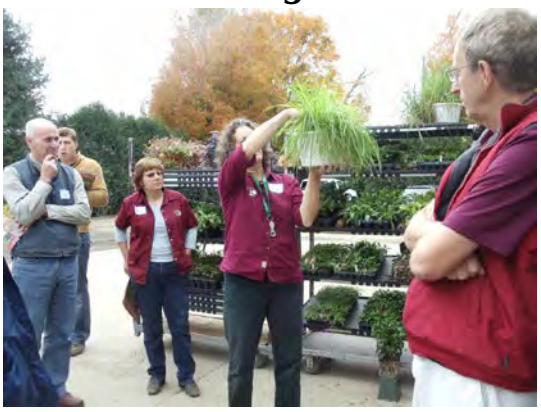
For more information contact Donna Ellis (phone 860-486-6448; email donna.ellis@uconn.edu) or visit our web site at www.2014perennial.uconn.edu.

Association News

Massachusetts Flower Growers' Association
Growers of Quality Plants and Flowers

Some Photos from Recent Meetings





"Plant Something" at Griffin Grower Expo at the Big E (left), demo at the Fall Flower Growers' Meeting at Pioneer Gardens (right) and rapt attention is paid during educational session at the Fall Meeting (bottom).

Something Different

We'd all rather see greenhouses being built than demolished, but here (http://youtu.be/6oibm2WeJeM) is an "action" YouTube video of the old French Hall greenhouses being picked apart in the fall. Kind of sad. All that's left now is empty space.

Aphids and Thrips

It is important to begin the spring growing season free from pests. Some growers have been growing winter specialty salad greens (such as kale, Swiss chard, bok choy, claytonia etc) in their greenhouses, and are now transitioning to their spring ornamental crops.

Aphids are a common insect pest on winter greens. Sometimes, an existing thrips population can migrate onto salad greens, too. Check plants carefully for thrips by tapping foliage over a sheet of white paper to dislodge larvae and adults. Plant symptoms appear as distorted growth or small, silvery spots (feeding injury) on leaves.

Aphids are hard to detect because they often blend in with the color of the salad greens. Often, growers first notice the white 'dust-like' shed aphid skins and realize they have an aphid infestation. Other signs of aphid activity include shiny honeydew, the presence of ants, curled new leaves, and distorted growth.

Insecticides labeled for greenhouse greens include: Group 18 B products - azadirachtin (Molt X, Neemix 4.5, Aza-direct and many others), Group 3A -pyrethrins (PyGanic) and products in IRAC groups that are not classified such as Beauveria bassiana (Botanigard and Mycotrol), horticultural oil, and insecticidal soap (M-Pede). Beauveria is often tank mixed with an insect growth regulator (IGR) such as as azadirachtin.

Biological controls are best used preventively and natural enemies are less effective when aphid populations are high and already causing plant damage. Talk to your plant supplier about any pesticide residues on incoming plants which will adversely affect a biological control program before starting your program.

Here is the type of aphid, where to look on plants and biological control options:

> Cotton/melon aphid (plant interior, grouped on stems and flowers) - *Aphidius colemani*
>
> Green peach aphid (typically located on terminal growth) - *Aphidius colemani*, *Aphidius matriacariae*
>
> Foxglove aphid (lower leaves and causes more foliar distortion) - *Aphidius ervi*, *Aphelinus abominalis*
>
> Potato aphid (generally scattered throughout plant) - *Aphidius ervi*

Mixtures of different parasitoid species are used when multiple aphid species are present. Parasitoids are shipped as aphid mummies from which parasitoid adults soon emerge (during shipping). Do not allow the aphid mummies to get wet. They should be used preventatively to suppress or regulate aphid populations.

The predatory midge, Aphidoletes aphidimyza, can be used as clean up, but works best, when the days are longer (beginning in April). This predatory midge can feed on over 60 different species of aphids.

Leanne Pundt, UConn Extension and Tina Smith UMass Extension, UMass Greenhouse Update, February 13, 2013

Greenhouse Cleanup

Clean your greenhouse as soon as you can rather than waiting until just before spring crops are started. Cleaning early will eliminate over-wintering sites for pests and reduce populations for the next crop cycle. Greenhouse pests will overwinter in weeds and protected areas in unheated greenhouse, especially if the winter is unseasonably warm. Remove any leftover plants and debris and clean the floor of soil, organic matter and weeds. Clean areas around furnaces and along sidewalls where small weeds are usually found. Use weed barriers, repair tears in worn weed barriers and do not use stone on top. Stone will trap soil and moisture and create an ideal environment for weeds, diseases, insects and algae. It is also a good time to correct any drainage problems and low spots in greenhouses.

Many growers are now using an acid based cleaner such as GreenClean Acid Cleaner® or Strip It™ to thoroughly clean surfaces prior to using a sanitizer. These products remove mineral deposits, fertilizer buildup and algae.

Next, disinfect the growing and plant handling areas, and irrigation system. There are several different types of disinfectants that are currently used in the greenhouse for plant pathogen and algae control including quaternary ammonium compounds (Greenshield®, Physan 20® KleenGrow™), hydrogen dioxide (ZeroTol 2.0®, Oxidate 2.0®), hydrogen peroxide plus peroxyacetic acid (SaniDate 12.0) and sodium carbonate peroxydrate (Green Clean Pro®). All these products have different properties, so read and follow label directions. Chlorine bleach (10%) may be used for pots or flats, but is not approved for application to walls, benches or flooring. If possible, disinfectants should be used on a routine basis both as part of a pre-crop clean-up program and during the cropping cycle.

Organic growers have limited options for disinfectants. Oxidate 2.0® and SaniDate 12.0 are currently listed by the Organic Material Review Institutes (OMRI), see www.omri.org. Ethyl or isopropyl alcohol is also allowed under the organic standards, although not used as a general disinfectant (flammable), it is used by growers to disinfect propagation tools. Organic growers should always check with their certifying organization before using any material new in their growing practices.

Tina Smith, UMass Extension and Leanne Pundt, UConn Extension, UMass Greenhouse Update ,October 2013

A Publication of the UMass Extension Greenhouse Crops & Floriculture Program

Floral Notes Newsletter

Volume 26, No. 4 http://extension.umass.edu/floriculture January-February 2014

In This Issue

Greenhouse Plant Disease Diagnostic Workshop

March 19, 2014, 9:00 AM -1:00 PM

Room 107 Fernald Hall, University of Mass, Amherst, MA

8:30-9:00 Registration

9:00-1:00 Workshop led by Bess Dicklow, UMass Extension Plant Pathologist

This workshop will be held in a laboratory at the University of Massachusetts campus and therefore space is limited. Registration will be on a first come, first serve basis. The program will include a lecture to review the basics of diagnostic plant pathology followed by a hands-on workshop using diagnostic test kits for viruses and root diseases of greenhouse crops. We will also use microscopes to view fungal root pathogens such as *Thielaviopsis*, *Rhizoctonia* and *Pythium* and foliar pathogens such as Downy mildew and *Botrytis* that were covered in the lecture. Four contact hours for pesticide recertification have been approved. Registration includes parking pass, refreshments, and handouts.

Make check payable to: University of Massachusetts and send to Greenhouse Plant Diagnostics, 203 French Hall, University of Massachusetts, Amherst MA 01003.

For more information contact: Tina Smith, Univ. of Mass, Amherst (413)545-5306, tsmith@mnext.umass.edu

Website: http://extension.umass.edu/floriculture/

Tips for Producing Transplants from Seed

Tina Smith and Douglas Cox
UMass Extension Greenhouse Crops & Floriculture Program
Amherst, MA

Here are some tips for growers propagating plants from seed this winter.Begin by using fresh seed. If using leftover seed from the previous year, it should be tested for germination first. Place a specific number of seeds, such as 10 or 100 on a moistened paper towel. Fold the moistened paper over the seeds and put it in a plastic bag in a warm place. Take the paper out and inspect the seeds twice a day, spraying with water as needed to maintain moisture around the seeds. After the usual number of days required to germinate that variety, count to see how many have germinated and calculate the percentage of germination.

Growing media

Test the growing medium on site and at a soil test lab prior to seeding for pH and soluble salts. For optimum seed germination for most crops use a growing media with a pH of 5.7 to 6.2 and low soluble salts. Many seedling problems often relate to pH and soluble salts.

Also test irrigation water by submitting samples to a commercially laboratory. Brian Krug, UNH shows how to properly take a water sample in this Greenhouse Grower Floricast segment: http://www.greenhousegrower.com/video/plant-culture/v-how-to-take-a-water-sample/

To prevent damping-off, use a preventative biofungicide (protectant), either a commercial growing medium where it is already incorporated into the medium, or as a spray or drench. Damping-off is a disease of germinating seeds and young seedlings. Several fungi cause damping off including *Rhizoctonia* and *Alternaria* and the water molds *Pythium* and *Phytophthora*.

Streptomycin lydicus (Actinovate SP), *bacillus subtilis* GB03 (Companion) and *Trichoderma harzianum*, strain T-22 (Rootshield), *Trichoderma harzianum* strain T-22, and *Trichoderma virens* strain G-41 (RootShield Plus+) can all be used for seedlings (including vegetable seedlings). Note: Actinovate SP, and RootShield are OMRI listed (organic).

How a mix is handled can affect the air and water content of the mix. Air space results in good drainage and is important for healthy seedlings. Compacted media will reduce air space and lead to poor root development and difficulty with roots penetrating the media. To minimize compaction, containers, cell packs and plug trays should be lightly filled with growing medium and the excess brushed away. The medium should not be packed down, tamped down, or filled pots tapped down on the bench. The pots and trays should never be stacked directly over one another.

Another consideration is the moisture content of the mix prior to filling containers. When water is added to dry components such as peat, they hydrate and swell. This swelling helps to create more aeration by preventing the particles from nesting within one another. This is especially important in plug production. Water should be added to the mix before it is placed into the container. It is best to moisten, then mix and allow to sit overnight prior to use. If that is not possible, waiting at least a couple of hours after adding the water will help the hydration process.

How much water to add to the mix? Plug mixes should have a 2:1 water: dry substrate ratio (67% moisture content). The rule of thumb is, the smaller the cell, the more water to add prior to planting.

The media should be damp to the touch but not wet. A simple test for moisture content of the medium is to take a handful after adding moisture and squeeze it. No drops of moisture should come out. When your hand is opened, the medium should still retain its shape. If it falls apart right away, it is too dry. When pressed lightly and it should fall apart. The correct amount of moisture will result in less shrink or settling of the media.

For more information see: "Greenhouse Substrates and Fertilization" http://www.ces.ncsu.edu/depts/hort/floriculture/plugs/ghsubfert.pdf , by Douglas A. Bailey, William C. Fonteno, and Paul V. Nelson Dept. of Horticultural Science, NCSU

Containers

Transplants can be grown in all types and sizes of containers. Seeds are sown in open seed flats or in single-cell (plug) trays. Before sowing, decide whether germination and finishing will occur in the same container or whether seeds will be sown in one container followed by transplanting to a finishing container.

When sowing in open seed flats, growers often sow in rows. Seedlings are easier to handle and damping- off disease is easier to manage. However, if seed is sown too thick, crowded seedlings will result in stretched plants and create high humidity around seedlings that favor damping-off diseases not to mention the difficulty to transplant.

Many growers use plug trays for some of their crops. Studies have shown that plug trays with deeper cells have better drainage and oxygen in the medium due to deeper columns. However, the importance of providing optimum temperature and moisture during germination is more critical than depth of the plug tray.

Sowing

If using plug trays, seed placement in the cell is important. Seeds placed near the edge of the cell are likely to desiccate.

If covering seed, use medium or coarse vermiculite to create a micro-environment of high humidity. Fine vermiculite can result in buried seed. Some seed need light to germinate; these are covered lightly or left uncovered. A mist system will help keep these moist.

Be sure plug flats are watered evenly and gently, especially for very small seed to avoid burying seed. Often the success or failure of plug germination is directly related to the moisture applied to the seed. Temperature and moisture requirements are determined by the crop being grown. Once the seeds have germinated, the growing medium can be allowed to partly dry between waterings.

Move seed trays into a germination chamber or propagation area to receive necessary humidity and water as soon as possible after sowing. It helps to group crops by temperature needs. Do not allow germinating seeds to be interrupted by dryness by remaining in the seeding area too long.

Warm temperatures and uniform moisture are needed to ensure successful germination and get the plants off to an even start, whether seeds are germinated on the bench or in germination chambers. Many germination chamber systems are commercially available including custom built germination units. Growers often use bottom heat or root zone heating to provide warm, even temperatures. Rubber tubing or mats with hot water are placed on the bench top under the plants. A weed mat barrier is placed on the top of the bench to help spread the heat with skirts on the side to help contain the heat. It is important to remove flats from the germination chamber as soon as radicles break through the seed coat to avoid seedling stretching. Experience and experimentation with your total seeding system is the key to uniformity and success.

When using a germination chamber, it is important that the correct amount of moisture for germination is used until trays are taken out onto the bench.

Fertilizing

The choice of fertilizer will determine the type of plant growth as well as adjusting the media pH. Peat-lite fertilizers used for general crop production such as 20-10-20 will promote more shoot growth, softer plugs, fewer roots and result in a lower media pH. Most growers have found it better

to use a special plug fertilizer such as 13-2-13 (high nitrate, low phosphorus plus minors) that will give more toned growth, better roots and maintain a higher media pH.

Media EC levels should be monitored to avoid high soluble salts, which damages roots and promotes root rot. Beginning in Stage 2 (opening of the cotyledons) a dilute fertilizer program (25-50 ppm N) is normally started and the rate of application is gradually increased as the seedlings grow larger and approach transplanting with guidelines below.

Seedling or plug stage of development	**Water-soluble fertilizer program**
Stage 1: Germination and root emergence.	No fertilizer
Stage 2: Opening of the cotyledons.	25-50 ppm N
Stage 3: Development of 1st set of true leaves.	50-100 ppm N
Stage 4: 1st set of true leaves to transplant.	>100 ppm N

Rinse off fertilizer when applied on sunny days to avoid burning growing tips and tender young leaves. Crops sensitive to this problem include salvia, coleus, ageratum and snapdragons.

Seedling problems and possible causes

Problem: Seedlings exhibit a corkscrew habit or lay down in the seedling tray or the radical hooks and grows along the soil surface without penetrating the surface. **Possible causes:** Compacted media in the cell or high soluble salts or high media pH.

Problem: Upward cupping of leaves. **Possible causes:** Poor rooting and thickened roots indicate high soluble salts or growing too dry or sodium (perhaps high levels in irrigation water). An inward curl of leaves indicates excessive light for shade plants.

Problem: Downward cupping of leaves. **Possible causes**: Overwatering or dysfunctional heater causing phytotoxicity and ethylene to be produced.

Problem: Tip abortion combined with dark green foliage color. **Possible causes:** High soluble salts and/or high ammonium.

References

Bailey D.A., Fonteno W.C. and P. V. Nelson. Greenhouse Substrates and Fertilization
http://www.ces.ncsu.edu/depts/hort/floriculture/plugs/ghsubfert.pdf

Cox Douglas. Fertilizing Bedding Plant Seedlings.
http://extension.umass.edu/floriculture/fact-sheets/fertilizing-bedding-plant-seedlings

Damping Off, New England Greenhouse Update.
http://negreenhouseupdate.info/updates/damping

Sawaya Melhem. Growing in the Green: It's time for a tune-up.
http://www.greenhousecanada.com/content/view/2451/38/

Reduce Pesticides with Simple Steps to Go Organic

Kelley Andrew Sullivan
Greenhouse Horticulturist & IPM Plant Health Specialist
Mount Auburn Cemetery
Cambridge

If you're using pesticides now and want to go organic but are afraid to embrace a new journey try small changes. Start with one or two OMRI Listed organic products in a Spray Rotational Program (SRP) and build from there. Alternating between treatment combinations can be very effective at keeping pests below your thresholds. Incremental changes will lead you toward being successful with organic controls.

A Spray Rotation Program is part of our aphids and thrips management program at Mount Auburn Cemetery's Greenhouses. The program involves combining products in weekly rotations to take advantage of multiple modes of action such as by contact, systemic, and insect growth regulation.

Prior to 2012 we used a neem concentrate/horticultural oil combination treatment to enhance efficacy. When the treatment was halted for more than two weeks aphids would gain back their foothold. Weekly neem/oil treatments were necessary to maintain aphid populations at a low level with minimal leaf damage. Thrips were also a problem since they can hide among the stems, leaves, and flower buds protected from contact sprays. Neem/oil works well as a contact knockdown treatment. But since most of the chemicals have been extracted from the concentrate its systemic value appears to be minimized. Our observations over the past three years concur. So we looked for other organic products that would increase our treatment program's modes of action.

One such product is *Beauveria bassiana*; a fungus that occurs naturally in the environment that penetrates the cuticle of insects or is ingested then releases lethal toxins inside the insect's body causing death. Fungal spores encompass the insect causing further spread among the pest population. The fungus is best used as a suppressant with low populations or after knocking down the population with neem/oil.

In 2012 *B. bassiana* combined with horticultural oil and rotated in alternating weeks with neem/oil was very effective for us at eliminating aphids and thrips. With one use thrips on our impatiens all but disappeared. *B. bassiana* and neem concentrate in rotational combinations increased our effectiveness at maintaining pest thresholds. Even so both are most effective by contact with insects and are apt to not remain long on the plants. We wanted to add to our treatment program a more systemic way to controlling pest populations.

That's where *Azadirachtin* comes into play. *Azadirachtin* is extracted from the Neem plant and causes insects to stop molting. This OMRI listed growth regulator increases the effectiveness of B. bassiana by disrupting the molting process which allows more time for the fungal spores to work. In 2013 *Azadirachtin* was added to our spray rotation program to keep pest populations low.

If you don't feel comfortable with the results or your infestation level increases and you feel that you have to use a pesticide, please don't give up on using organics. Continue trying to keep the infestation levels low using your new spray rotation program.

We have found that neem concentrate/horticultural oil is great as a knockdown treatment while the fungus *B. bassiana* and Azadirachtin work well in maintaining low pest populations. Of course being proactive with cultural management, data record keeping, and building upon past success and failures are also important actions you can take to have a successful organic IPM program.

Hopefully, medium to high infestations occur less for you which would be a good time to introduce beneficial insects to your program. With the gradual elimination of pesticides you will find that beneficials will become more prevalent in your greenhouses and fewer controls will have to be used to maintain the health of you and your crops.

Nutrient Status and Leaf Chlorosis of Seed Geraniums Grown with Organic Fertilizers

Douglas Cox
Stockbridge School of Agriculture
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Amherst

In an earlier *Floral Notes* article (Cox, 2013) I reported on trials with plant extract fertilizers and a granular organic fertilizer for seed geranium. Overall, plant growth and flowering with the organic granular fertilizer Sustane and liquid plant extract fertilizers Bombardier and Espartan was similar to that with Plantex chemical water-soluble fertilizer.

The greatest shortcoming of the organic fertilizers was the development of foliar symptoms probably due to nutrient disorder(s). A uniform, mild chlorosis indicative of N deficiency appeared on Sustane plants. Symptoms appeared about 35-40 days after planting, close to the 45-day limit of nutrient release claimed by the manufacturer of Sustane. Leaves of Espartan and Bombardier plants displayed a marked interveinal chlorosis (Figure 1), characteristic of magnesium deficiency in most plants, but the symptoms were not similar to those described in Geraniums IV (White, ed., 1993). In the present study, symptoms occurred on upper leaves rather than the lower leaves described in the reference. Considering the large amount NH_4-N in the leachate collected from plants fertilized with plant extracts "ammonium toxicity" might be the cause of this chlorosis.

Figure 1. Chlorosis occurring on some leaves of plant extract fertilizers.

Combining soluble Espartan or Bombardier with granular slow-release Sustane prevented the N deficiency symptoms which occurred with Sustane and reduced the intensity of interveinal chlorosis caused by the application of Espartan and Bomdardier.

What caused the interveinal chlorosis which afflicted the organically fertilized plants? To answer this question I collected leaves for nutrient analysis to hopefully discover the cause of the problem.

Review of the organic fertilizers tested in the earlier trial

Plant extract fertilizers were "Bombardier" 8-0-0 and "Espartan" 2.0-3.03-2.6 manufactured by Agroindustrial Kimitec of Almeria, Spain and distributed in the U.S. by American Clayworks and Supply Co. of Denver, CO (product donor). Both fertilizers are made from fermented sugar beet molasses and, in the case of Bombardier, also fermented glucose syrup. The methods of manufacture account for the differences in nutrient analysis and the amount of organic matter and fulvic acid each fertilizer contains. Each liquid has the dark color and consistency of molasses, but both fertilizers are soluble in water. Both Bombardier and Espartan are acceptable for organic production according to USDA/NOP.

The granular fertilizer tested was Sustane 8-4-4, 45-day slow release fertilizer. Sustane is made by Sustane Natural Fertilizer, Inc. of Cannon Falls, MN from aerobically composted turkey litter, hydrolyzed feather meal, and potassium sulfate. Sustane fertilizers have been tested fairly extensively and have been

found to be suitable for nursery crop and bedding plant production. Sustane 8-4-4 is certified by OMRI for organic use.

How the plants were grown

'Ringo 2000'seed geranium plugs were potted on 9 April 2013 in 4½-inch pots of Fafard 3B soilless mix. Plants were fertilized with 225 ppm N from Plantex (20-2-20) chemical fertilizer, Bombardier, or Espartan plant extract fertilizers. Potassium phosphate was added to the Bombardier solution to supply P and K. Sustane (8-4-4) granular fertilizer was incorporated with the growing mix prior to planting at a rate of 7 gm/pot (0.25 oz./pot). In other treatments some fertilizers were applied in combination: Bombardier + Sustane or Espartan + Sustane. Water-soluble fertilizer was applied at every other watering. The same amount of nitrogen (N) was supplied by all six fertilizer treatments. Where combinations were applied, one-half of the N was supplied water-soluble fertilizer and the other half by Sustane. The experiment ended 10 June, 62 days after transplanting, and recently-mature leaves were sampled for analysis and growth medium EC and pH were determined by the 1:2 method.

Results of nutrient and growth medium analysis

A look at Table 1 reveals that there are many significant statistical differences (numbers followed by different letters) in the levels of nutrients taken up by plants in the different fertilizer treatments. In some circumstances these differences might explain plant performance. Statistical differences, however, do not imply deficiency or excess of nutrients. A low nutrient level, for example could still be in the normal range for geranium. Of most relevance here would be the nitrogen (N) and magnesium (Mg) results.

The N content of Sustane leaves was much lower than N in the leaves sampled from the other fertilizer treatments and was well below the published normal range for geranium (White, ed., 1993). Symptoms combined with N analysis results confirms N deficiency in Sustane plants.

Magnesium (Mg) content of leaves from Espartan and Bombardier plant extract fertilizer treatments were slightly below Plantex and Sustane levels, but were within the published normal range for geranium (White, ed., 1993). Mg deficiency, therefore, does not seem to be an explanation for the interveinal chlorosis.

Table 1. Nutrient content of 'Ringo 2000' seed geranium leaves as affected by fertilizer.

Fertilizer	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Mn (ppm)	Zn (ppm)	Cu (ppm)	B (ppm)
Plantex 20-2-20	3.30a	0.33c	1.74b	0.48c	0.30ab	137a	83^{ns}	23a	7a	25a
Sustane 9-4-4	1.55b	0.31c	0.76d	0.58ab	0.32a	34b	110	11c	5b	16b
Espartan 2.7-3.0-2.6	3.43a	0.75a	1.99a	0.57ab	0.22c	42b	109	16b	5b	11d
Espartan + Sustane	2.96a	0.64ab	1.58b	0.62a	0.27b	45b	107	16b	6b	12c
Bombardier 8-0-0	3.27a	0.66ab	1.37c	0.50bc	0.27b	36b	100	16b	5b	12c
Bombardier + Sustane	2.98a	0.59b	1.16c	0.50bc	0.28ab	41b	109	15b	6b	13c

Considering growth medium EC and pH, the application of Espartan fertilizer led to higher levels of soluble salts (EC) and lower pH than the other treatments. While EC level was low-medium by 1:2 test standards, pH was much too low for geranium. A pH below 5.8 may lead to iron/manganese ("bronze

speckle") toxicity. However, none of the plants in this study showed evidence of this disorder and leaf Fe and Mn contents were not in excess.

Table 2. Fertilizer effects on growth medium EC and pH.

Fertilizer	EC (mS/cm)	pH
Plantex 20-2-20	0.41c	5.6ab
Sustane 9-4-4	0.27c	5.6ab
Espartan 2.7-3.0-2.6	1.52a	4.8c
Espartan + Sustane	0.84b	4.9c
Bombardier 8-0-0	0.60bc	5.8a
Bombardier + Sustane	0.42c	5.4b

In conclusion, leaf analysis confirmed that the foliar chlorosis on plants fertilized with Sustane granular organic fertilizer was caused by N deficiency. However, it seems doubtful that a deficiency of Mg was the cause of the interveinal chlorosis on leaves of plants from Espartan and Bombardier plant extract fertilizers.

The only possible common nutritional cause of the interveinal chlorosis is ammonium toxicity. Since most organic fertilizers are high in ammonium a look at this seems worthwhile. Leaf analysis for ammonium is not a common practice in commercial leaf tissue testing, but it can be done fairly easily. So the next study will examine the possibility that ammonium is the cause of leaf interveinal chlorosis.

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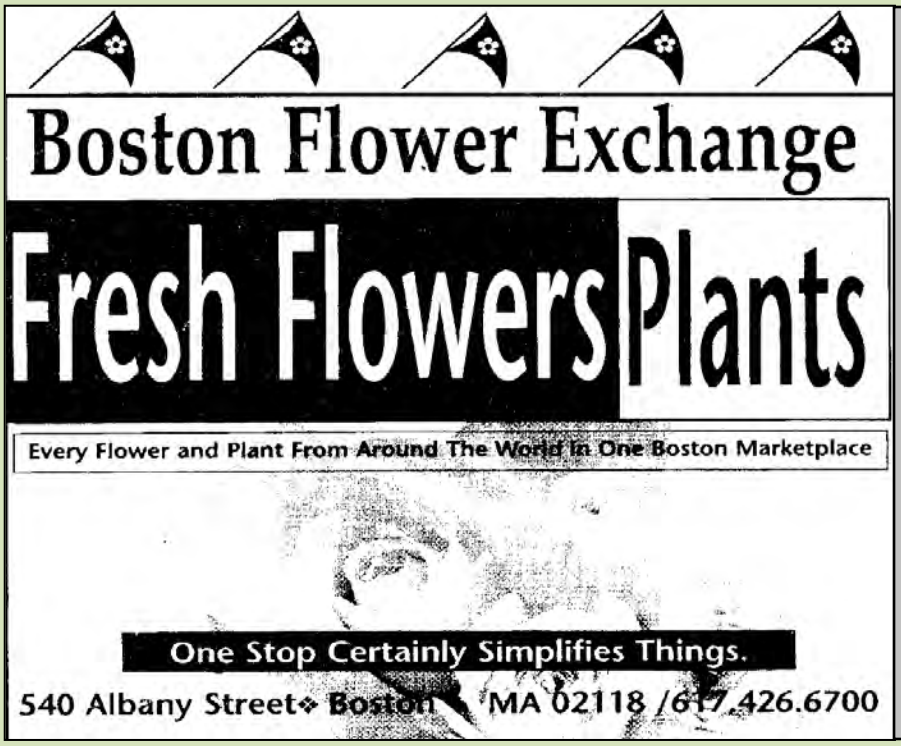

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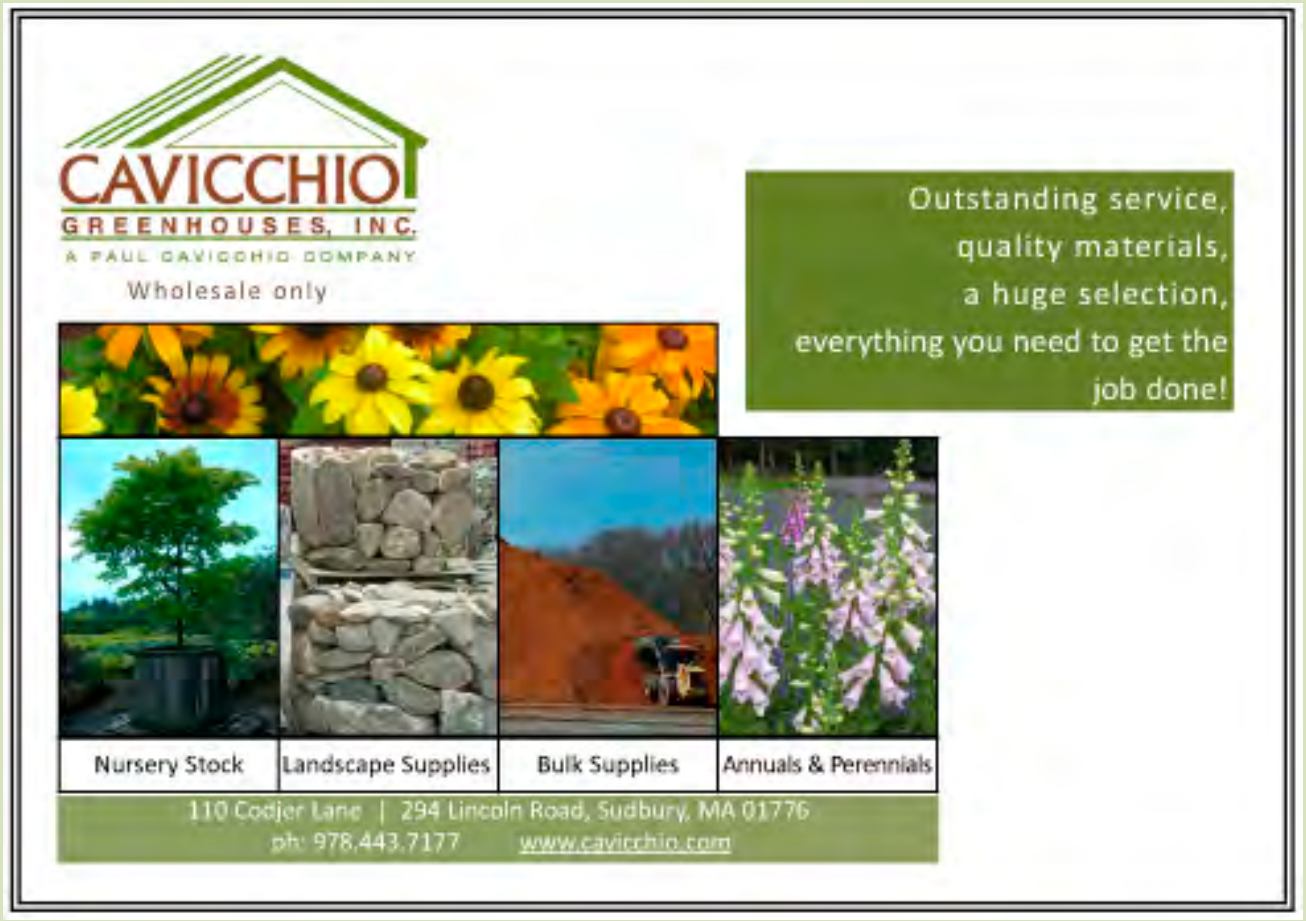

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