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IN THIS ISSUE

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New Faces and Directions in University of Minnesota Floriculture

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I. Introduction: Mark and I made fundamental changes in the floriculture program at the University of Minnesota. This article outlines some of those changes, new additions to the floriculture team, and new directions we are taking. I encourage all of you to participate in this process.

II. History: Mark and I arrived in Minnesota in October, 1989. At that time we initiated new courses, research and extension activities. Fortunately, Harold Wilkins and Dick Widmer did a wonderful job of organizing a floriculture program that Mark and I could build upon.

Our efforts concentrated on serving the rapidly changing needs of the floriculture industry while dealing with declining student enrollment, budgets, and faculty numbers. Regardless of these impediments, the floriculture program at the University of Minnesota is still one of the best in North America. A large part of this success is due to the unwavering support of the Minnesota Commercial Flower Growers Association and the University.

III. Accomplishments: We would like to outline a few of our accomplishments. We list these in an effort to keep you informed as to what we are doing.

Extension:

1) We revised the Minnesota Commercial Flower Growers Bulletin. The Minnesota Commercial Flower Growers Bulletin received the award of excellence in educational media from the Professional Plant Growers Association; a national award given to 1 publication annually. Your bulletin is distributed to 28 countries, all major floriculture programs in North America, and all institutions teaching floriculture in Minnesota. The floriculture program wrote 42 bulletins during the last year equalling >1260 pages of extension publications.

2) The U of M floriculture program organized the MCFG Association for 2 years. We assisted/ran in 70 monthly, 28 state and regional, and 1 national meeting during the last 6 years.

3) We managed the Cowles Conservatory in the Minneapolis Sculpture Garden (1990-1993).

4) Established new criteria for evaluation of soil tests using soilless media. Specifically, identified acceptable ranges for all macronutrients and added 4 micronutrients plus sodium to the test. We also added water/alkalinity testing. Over 25,000 tests have been evaluated with these new standards.

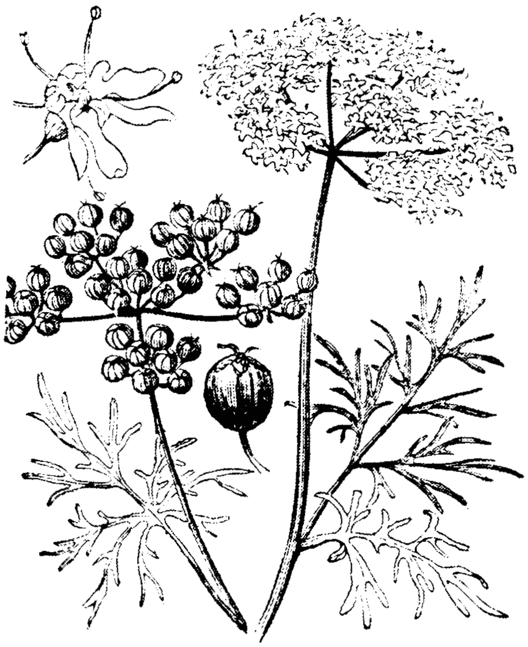
5) We published national extension publications and gave talks throughout the United States. Floriculture faculty at the University of Minnesota speak regularly at extension conferences. During the last 6 years >104 national and >115 state floriculture extension talks were given.

Table 1. Faculty and graduate students associated with the floriculture program at the University of Minnesota.

Name	Title	Area of Study	Contact Number
Neil Anderson	Research Assoc.	Breeding/Teaching	612-624-3232
Mark Ascerno	Professor/Head	Entomology/Extension	612-624-3278
Pete Ascher	Professor	Breeding/Self Incompatibility/Teaching	612-624-9762
Amy Beaver	Grad. Assist.	Water/Heat Effects on Flower Abortion	612-624-7705
Deb Brown	Associate Prof.	Dial-U, Extension/Teaching	612-624-9703
Allison Cutlan	Grad. Assist.	Medicinal and Essential Oil Plant Cultivation	612-624-0736
John Erwin	Associate Prof.	Environmental Physiology/Extension	612-624-9703
Mary Henry	Grad. Assist.	Agriculture Communications	612-624-0736
Christi Holman	Grad. Assist.	Tissue Culture/Genetic Engineering	612-624-0736
Bud Markhart	Professor	Water Stress Physiology/Teaching	612-624-7705
Greg Nordwig	Grad, Assist.	Asclepias/Fast Cropping Perennials	612-624-0736
Frank Pfleger	Professor	Plant Pathology/Extension	612-624-6290
Robert Quene	Grad. Assist.	Water Stress Tolerance Breeding	612-624-0736
Joe Riehle	Grad. Assist.	Genetic Engineering for Disease Resistence	612-624-0736
Carl Rosen	Professor	Nutrition/Extension	612-625-8114
Mark Strefeler	Associate Prof.	Stress Tolerance/Perennial Breeding/Teaching	612-624-6701
Kerry Strope	Grad. Assist.	Heat Tolerance in New Guinea Imp. Breeding	612-624-9703
Cindy Tong	Assist. Prof.	Postharvest Phys. of Flowering Crops/Teaching	612-624-3419
Nicole Wagner	Grad. Assist.	Greenhouse Design/Reflective Panels	612-624-0736
Ryan Warner	Grad. Assist.	Hibiscus/Fast Cropping Annuals	612-624-0736
Rob Wawrzynski	Reas. Fellow	Greenhouse Crop Entomology/Extension	612-624-3278

Teaching:

The University of Minnesota is one of the largest floriculture graduate programs in North America with 12 graduate students directly involved in floriculture research. Names of faculty and students associated with floriculture are shown in Table 1.



Undergraduate enrollment increased 20% both last year and this year- there are now 133 undergraduates in ornamental horticulture.

The annual test plots are part of the Horticulture Teaching Gardens. Garden size have increasing each year to meet needs of students. Annual trials in Grand Rapids and Morris are still one of the primary ways consumers and growers in those areas identify appropriate plants for outdoor gardens.

We updated undergraduate floriculture teaching coursework. Courses offered in the floriculture undergraduate program are shown in Table 2. Course titles and selection will likely change as we switch to semesters and as student numbers increase.

Research:

We directed our efforts out of traditional pot plant research and focused on bedding plants and cut flowers. These crops are the backbone of the Minnesota industry. During the last 6 years Mark and I published >25 scientific papers and >16 book chapters.

Mark's program focused on breeding annual crops for drought, heat, and disease resistance. My efforts focused on environmental effects on flowering and stem elongation.

Mark and I were tenured. We appreciate the industries candor and input to administrators and committees during this process for each of us.

We developed national research support for our programs. Research at the U of M is directly supported by growers through out the United States.

We renovated the floriculture research/teaching greenhouses. Greenhouses were reglazed, new heating was installed, environmental control was computerized, and we purchased needed irrigation, fertilization, and lighting systems.

We studied temperature, photoperiod, and light effects on a variety of crops.

We studied alternative cut rose production techniques to increase cut rose yield.

Table 2. Coursework offered at the University of Minnesota related to floriculture.

Course	Instructor
Floriculture Spring Crop Prod.	John Erwin
Floral Design	Neil Anderson
Growth Reg. of Hort. Crops.	Bud Markhart
Harvest to Market of Hort. Crops	Cindy Tong
Herbaceous Plant Materials	Neil Anderson
Horticulture Cropping Systems	Mark Strefeler
Indoor Plants and Landscapes	Deb Brown
Plant Propagation	Pete Ascher/Neil Anderson/ Emily Hoover
Potted Plant Production	Mark Strefeler
Seminar	Alan Smith

We identified a model plant to do rapid studies on vernalization of all crops.

We established a new floriculture crops breeding and genetics program; one of less than 10 breeding programs of its kind at public institutions in the U.S.

We developed new selections of New Guinea impatiens that are considerably more drought tolerant than any cultivars available today.

We identified traits associated with drought and heat tolerance in New Guinea impatiens and determined the inheritance of those traits.

We conducted populations genetics research on native plants; *Lythrum* and *Echinacea* to provide needed information on the evolution of weedy plants from cultivated plants and the impact of introduction of new plants into a native environment.

II. New Directions:

New Teaching Directions-

We established a new degree program called a Master's of Agriculture'. This degree is specifically designed for those who received an undergraduate degree in another field but would like to receive advanced training in horticulture.

Course titles and emphasis will change again as we switch to semesters in the comming years. We are considering adding greenhouse food crop production and garden center management to our curriculum.

New Research Directions-

The floriculture industry in the United States has changed dramatically. Changes include:

1) The industry is based more on specialized production by fewer, larger, growers.

2) More and more people are buying their product at chain stores and gardens centers and fewer are purchasing at florists.

3) The two fastest growing floriculture crops are bedding plants and perennials.

4) A desire for alternative crops has increased. Traditional crops are suffering as alternative pot plant, bedding plant, and blended crops (container gardens) sales increase.

ultimately leads to greater nonuniformity in flowering time and plant form at flower.

Seedling Development Prior to Induction- After germination, grow seedlings at constant 18-20°C (65-68°F). In addition, seedlings should be grown under high light conditions under long-days. Ideally you should grow seedlings under daylight plus 500 footcandles (100 $u$mol m^{-2} s^{-1}) with an 18 hour photoperiod. Transplant seedlings to the final pot when crowded in a plug tray.

Flower Induction- Flower induction is generally recommended 2-3 weeks after transplanting seedlings when the roots reach the edge of the pot for 4" crops (Heins et al., 199?) and 8-10 weeks after transplanting for 6" crops (Moe, 1977). All plants should have at least 6 leaves when induced.

Lower temperature to 7-12°C (45-54°F) for 4-6 weeks to induce flowering in cineraria plants (Hildrum, 1969; Post, 1942). The number of days from start of cooling to flowering decreases as plant age increases. The interaction between plant age and cooling time is related more to plant size rather than age where the larger the plant, the more rapid the induction. We recommend that plants should be under higher light conditions during induction (1000 footcandles minimum; 200 $u$mol m^{-2} s^{-1}(daylight plus supplemental lighting)).

Table 2. Recommended media nutrient levels for Spurway and Sat. Paste Extraction procedures for cineraria production,

Nutrient	Spurway	Sat.Paste
pH	6.0 - 6.8	6.0 - 6.8
Sol. Salts	<150	1.2 - 1.5
NO_3	150 - 180	100 - 120
NH_4	0 - 5	-
P	3 - 7	5 - 7
K	50 - 60	100 - 120
Ca	120 - 150	120 - 150
Mg	40 - 50	40 - 50
Fe	0.15 - 0.25	0.30 - 0.40
Mn	0.15 - 0.25	0.30 - 0.40
Zn	0.15 - 0.25	0.30 - 0.40
B	0.15 - 0.25	0.15 - 0.25

Forcing- After flower induction, grow cineraria at constant 10-18°C (50-64°F). Start lighting plants when buds are visible until anthesis with florescent or high pressure sodium lights during the night to reduce flowering time 2-3 weeks.

Lower forcing temperature result in higher the final plant quality. Warmer forcing temperatures, reduce quality and production time may increase. Temperatures should not exceed 20°C (68°F) during the finishing stage. When finished at constant 52-55°F, 9 weeks will be required to bring the crop to flower after induction. Finishing at 48 or 59°F will lengthen the finishing time compared to 52-55°F (Wilkins, 1974).

Nutrition- Cineraria are a low feed requiring crop. Feed with constant 100-0-100 ppm (N-P-K) at every watering. Apply phosphorus occasionally as a 'starter' fertilizer drench. Since many growers use phosphoric acid to adjust pH, additional phosphorus is often not necessary in Minnesota. If 'ebb and flow' benches are used, stock tank solution should be 30-50 ppm of N and K.

Low or no ammonium nitrate feeds are preferred to limit ammonium toxicity and excessively large leaves. Mix your own fertilizer using calcium and potassium nitrate fertilizers or use a 'dark weather' type premixed fertilizer. If you mix your own fertilizer, apply phosphorus periodically to maintain P in the desired range. Suggested soil test standards are shown in Table 2. Tissue test standards for cineraria are shown in Table 3.

Cinerarias are high water requiring plants. Plants often wilt on bright, sunny days even when the medium is kept moist (Wilkins, 1974).

Table 3. Tissue test standards for cineraria production.

Nutrient	Recommended Levels
Nitrogen (%)	3.3 - 3.8
Phosphorus (%)	0.3 - 0.5
Potassium (%)	4.5 - 5.0
Calcium (%)	1.5 - 2.2
Magnesium (%)	0.4 - 0.5
Iron (ppm)	70 - 150
Manganese (ppm)	95 - 170
Zinc (ppm)	20 - 35
Copper (ppm)	5 - 20
Boron (ppm)	30 - 35

pH-Cineraria are very susceptible to high pH induced iron deficiency. Maintain pH at 5.8 - 6.8. pH > 7.0 will result in iron deficiency. Iron deficiency is characterized by interveinal chlorosis of upper leaves. Eliminate iron deficiency by reducing pH to recommended range, make sure you are applying iron in fertilizer. In addition, I regularly see magnesium deficiency on cineraria. Magnesium deficiency is characterized by interveinal chlorosis of lower leaves. Eliminate magnesium deficiency by applying magnesium nitrate through fertilizer or periodic drenches with magnesium sulfate (epsom salts; 8oz/100 gallons).

"Drench with fungicides for both *Pythium* and *Rhizoctonia* control monthly."

Diseases-Root rots can be a persistent problem with cineraria. Drench with fungicides for **both** *Pythium* and *Rhizoctonia* control monthly. Substances that control *Pythium* include Subdue and Banrot. Substances that control *Rhizoctonia* include Cleary's 3336, Terraclor, and Banrot. This is especially important early in development.

Cineraria are very susceptible to tomato spotted wilt virus (TSWV) and impatiens necrotic spot virus (ISWV). Symptoms of TSWV infestation include spots on leaves, distortion of young leaves, and overall stunting of plant growth. If symptoms are obvious, plants should be destroyed. TSWV is spread by the western flower thrip. Therefore, control thrips to control the spread of this disease. Never carry infected plants through greenhouses with healthy plants as the infected thrips may be moved throughout your facility. Send infected plants to a disease clinic for an ELISA test to confirm that the disease is present.

Verticillium wilt is a soil borne disease that causes rapid wilting of the plant and death. *Phytophthora erythroseptica* can cause wilt of larger basal leaves and petiole epinasty (Lucas, 1977). Mosaic or streak viruses can infect cineraria and cause crop losses (Jones, 1944; Singh et al., 1975). Both these viruses can be seed transmitted or transmitted by aphids or thrips.

Insects-Major insect problems of cineraria include mites, aphids, whiteflies, thrips and caterpillars. Currently, thrips are a major pest although whiteflies can also be a problem. Consult your state extension specialist for appropriate chemical controls for these pests. Scout regularly!

Growth Regulators-Cineraria often require a growth retardant application to control growth, particularly if they are grown warm. Apply B-Nine (2,000 - 5,000) to the crop 2 weeks after plants are removed from the cold flower induction treatment. Although Sumagic and Bonzi probably limit elongation, these materials may be difficult to use since stem contact is necessary. Excessive B-Nine application especially during flower induction/initiation will delay flowering 5-14 days.

Harvesting-Cineraria are sold when the first flowers start to open. The most frequent problem with cineraria is over or under watering. Overwatering results in root rots. Recommend that cineraria be placed in a cooler part of the home in bright light conditions. Postharvest life can be extended from 10 to 20 days by increasing light from 0 to 250 footcandles.

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"Cineraria are very susceptible to infection by tomato spotted wilt virus and impatiens necrotic spot virus."