Water quality management in landscape nursery production systems

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Research partners

MAES Project GREEEN
Zelenka Nursery
Northland Evergreens
Lincoln Nursery

Significance to nursery industry

Protecting water quality is a critical issue for the fast-growing Michigan landscape nursery industry. In this project we are investigating various strategies to mitigate the impact of field nursery production systems on water quality. This study is part of an overall effort to address several key issues facing the container and field nurseries. Field nurseries in western Michigan have a high potential to affect ground water because the soils in the region are sandy and prone to leaching and the water table often lies just a few feet below the crop root zone. The results of this study will enable growers to develop more efficient management strategies that will reduce production costs and reduce the likelihood of regulatory violations.

The specific objectives of this study are to:

- Evaluate the effects of three nitrogen fertilization treatments on crop growth and on nitrate concentration of water under the crop root zone.
- Determine the logistics of applying relative addition rate (RAR) principles to nursery fertilization practices.

Methods

We established test plots in fields of common yew (*Taxus x media*) and burning bush (*Euonymus alatus* 'Compactus') at three commercial ornamental nurseries in western Michigan. In each field, we installed three treatments with three replications. The treatments are:

- Control – no fertilizer.
- Operational – fertilizer applied at the same time and rates as the rest of the field.
- RAR– fertilization rate determined by periodic measurements of crop growth. Nitrogen is added to the plots in proportion to the amount taken up by the crop.

Measurements

Growth was measured periodically on each crop by measuring crown width and plant height (Color photo page 1A). We used regression equations developed from prior sampling to estimate plant biomass from crown height and width. Foliar nutrient levels were also determined periodically through the growing season. The total amount of N in the standing crop was estimated from plant biomass and foliar nutrient levels.

To determine the concentration of nitrate leaching below the root zone we collected soil water samples using suction lysimeters (Color photo page 1A). The lysimeters were installed to a depth of 18 inches, which is below most of the roots for both species. Soil water samples were collected after each significant rainfall event in 2001.

Two thirds of the plots have <u>shallow groundwater wells installed to measure nitrate concentrations in the shallow groundwater</u> (three to five feet) for the RAR, OPERATIONAL and CONTROL treatments with the two species and two growers. Samples were collected in early February, mid-June and early July. In addition, sample wells were installed in two nearby forests, a nearby fallow field and a recently harvested field. Results are a measure of the combined effects of weather, crop and management on groundwater.

Preliminary results

Initial data from the project indicate that both operational fertilization and relative addition fertilization increased foliar N relative to the unfertilized controls (Figure 1). Initial measurements of crown growth did not differ among treatments.

Operational fertilization increased levels of nitrate in the soil water samples collected in the late spring and early summer (Figure 2). However, the rank order of the treatments may change during the remainder of the season.

Nitrate concentrations of water collected from the shallow wells indicated nitrate levels were higher under the nursery fields than in adjacent fallow areas or forest stands (Table 1). Interestingly, nitrate levels were consistently higher on the RAR and Control treatments than on the Operational plots, although the Operational plots received more nitrogen early in the growing season than the other plots.

Continuing research

Fertilizer application and sampling continue on the plots. The data will be used to develop a nutrient budget for the crops under the various treatments. In addition, ground water sampling continues in the nursery fields, fallow areas and adjacent forest stands.

Table 1. Nitrate concentration (in ppm) of shallow groundwater sampled in and near landscape nursery fields in western Michigan.

Nursery	Feb 27	June 12	July 11
RAR	25.7	19.1	22.1
OPERATIONAL	17.4	11.3	9.8
CONTROL	20.3	14.4	14.1
Fallow		3.5	4.1
Forest		0.6	0.3

Note: Nursery plots averaged across nurseries and species.

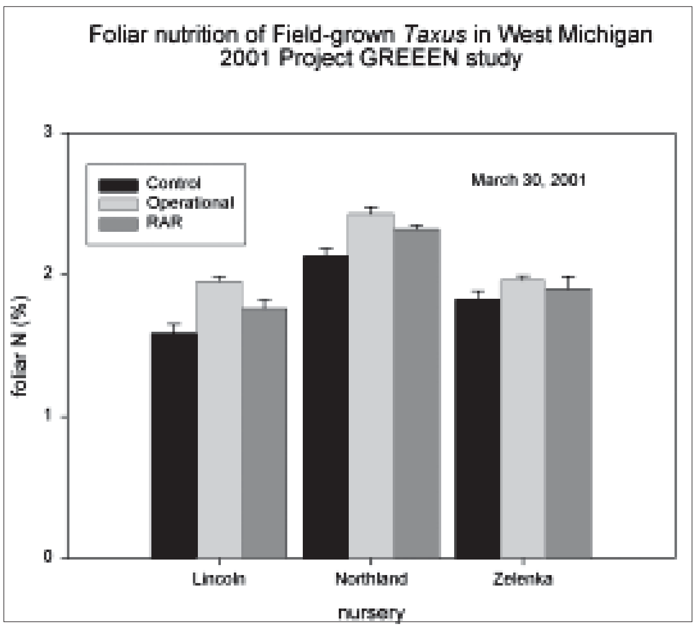

Figure 1. Foliar nutrition of yew grown at three west Michigan nurseries under three levels of nitrogen fertilization.

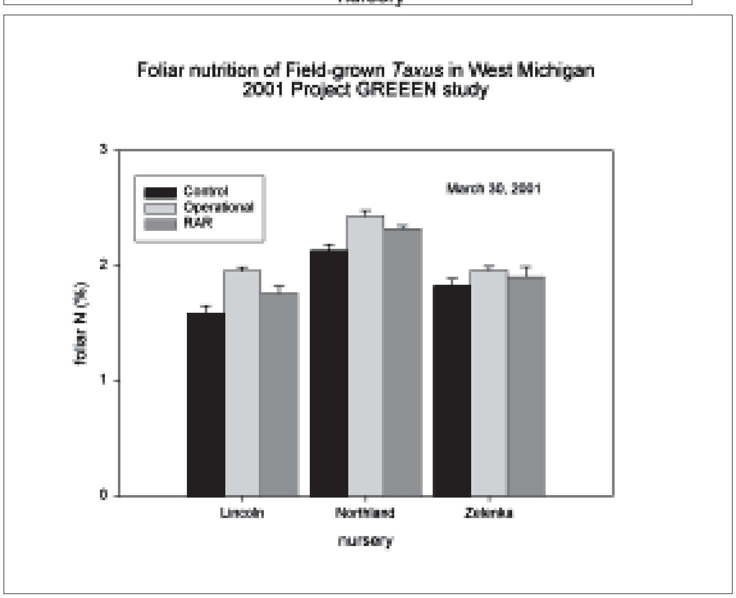

Figure 2. Nitrate concentration of soil water sampled from below the root zone in a field of burning bush at a west Michigan nursery.

Improving water and nutrient management in landscape nursery production systems

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Research partners
Michigan State University Southwest Michigan Research and Extension Center (SWMREC), Zelenka Nursery and J. Frank Schmidt and Sons Nursery

Significance to industry
Proper management of water and nutrients is critical to efficient nursery operations. Results of this project will provide baseline data for nutrient diagnostics for evergreen shrubs and several important shade tree species. The southwest corner of Michigan is presently home to many landscape nurseries. The number of nurseries and production acreage are likely to increase as fruit growers affected by fire blight seek alternative crops.

Goals and objectives
The goal of this research is to understand the response of common landscape crops to irrigation and fertilization. The project is divided into two principle components: Evergreen shrubs and shade trees.

The specific objectives are:

1. To establish a research nursery consisting of leading taxa for southwest Michigan landscape nurseries.
2. To evaluate the impact of various fertilizer regimes on growth and physiology of nursery crops.
3. To determine the impact of irrigation and fertilization on productivity and quality of field-grown woody ornamentals.
4. To develop nutrient diagnostic methods to provide decision support for nutrient management.
5. To develop a research platform that can leverage support for additional research trials (e.g., new plant material trials, herbicide screening, pesticide trials).

Results
Evergreen shrubs

In 2000, we successfully established field plots of 1,400 yew (*Taxus x media* 'Runyan') and arborvitae (*Thuja occidentalis* 'Golden globe'). During the 2001 season, we established irrigation and fertilization treatments in these blocks. Each treatment plot was 15 x 20 feet with approximately 40 plants per plot. The irrigated plots received one inch of irrigation as needed during the growing season via a drip system. Granular fertilizer was applied as ammonium nitrate in two split applications in May and July (Table 1).

Table 1. Fertilizer application rates for yew and arborvitae plots at SWMREC

0 lbs N/ac (Control)	100 lbs N/ac
25 lbs N/ac	150 lbs N/ac
50 lbs N/ac	200 lbs N/ac

Irrigation significantly reduced foliar N concentration of the arborvitae and the taxus (Figure 1). However, irrigation did not significantly affect growth. Fertilization increased growth of taxus up to approximately 100 lbs N/ac. Growth of the arborvitae decreased with increased N fertilization.

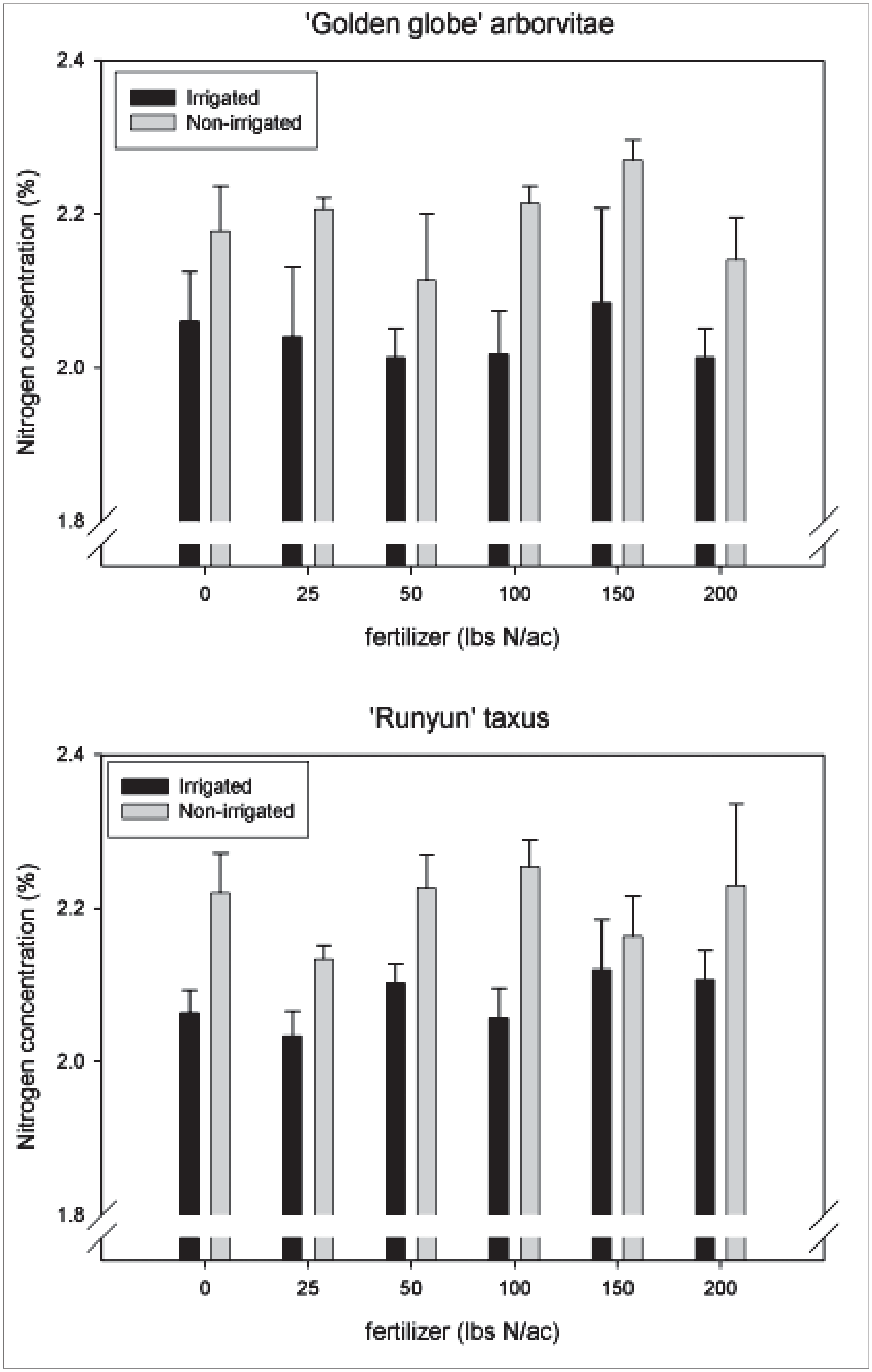
Landscape tree fertigation study

In the spring of 2001 we established plots of 13 species of landscape trees. The trees received one of four fertigation treatments (2 x 2 factorial – with and without irrigation / with and without fertilizer). Fertilized trees received 150 lbs of N/ac via the drip system split into monthly applications. Irrigation was set at one inch per week depending on rainfall.

In the summer of 2001, we determined foliar N values for all the trees. The tree species varied widely in their foliar N concentration (Table 2). Overall, weeping mulberry (*Morus alba*), honeylocust (*Gleditsia triacanthos*), goldenchain tree (*Laburnum x watereri*) and eastern redbud (*Cercis canadensis*) had the highest foliar N levels among the species studied. Foliar N increased with fertilization and decreased under irrigation.

We measured height and caliper growth of the shade trees periodically through the growing season

Figure 1. Effect of irrigation and fertilization on foliar N concentration of 'Golden globe' arborvitae (top) and 'Runyan' taxus (bottom).



(Color photo on page A-1). Stem volume index was calculated as D^2H; where D is the stem diameter at 12 inches and H is the tree height. The growth response of the trees indicated a strong interaction between fertilization and irrigation (Figure 1 on page A-1).

Continuing research

Research on the plots will continue over the next several years. In addition to growth and foliar nutrition, we will examine physiological responses of the trees and shrubs, including photosynthetic responses and biomass allocation to roots and shoots. We will also determine the out-planting performance of the trees and shrubs after transplanting.

Table 2. Mean foliar nitrogen concentration of 13 landscape tree species grown under four combinations of irrigation and fertilization

	Fertigation treatment			
Species	**Control**	**Fert. only**	**Irr. only**	**Irr. + Fert.**
Acer platanoides	2.74ab	2.98a	2.63b	2.78ab
A. rubrum	2.70ab	2.69ab	2.40b	2.88a
A. saccharum	2.46b	2.91a	2.63b	2.68ab
Cercis canadensis	3.26a	3.34a	2.71b	3.12a
Gledistia triacanthos	3.77a	3.78a	3.54a	3.53a
Laburnum 'Vossii'	3.26a	3.45a	3.19a	3.25a
Morus alba	4.64a	4.50a	4.69a	4.62a
Metasequoia	2.86b	3.57a	2.41c	3.03b
Quercus bicolor	2.82a	2.96a	2.46b	2.70ab
Q. coccinea	2.67a	2.77a	2.50a	2.53a
Q. macrocarpa	2.91a	2.94a	2.79a	2.90a
Q. palustris	3.09a	3.28a	2.75b	2.85b
Taxodium distichum	2.92a	2.91a	2.67a	2.87a

Note: Means within a row are not significantly different at p=0.05 level. Means separated by Duncan's multiple range test.

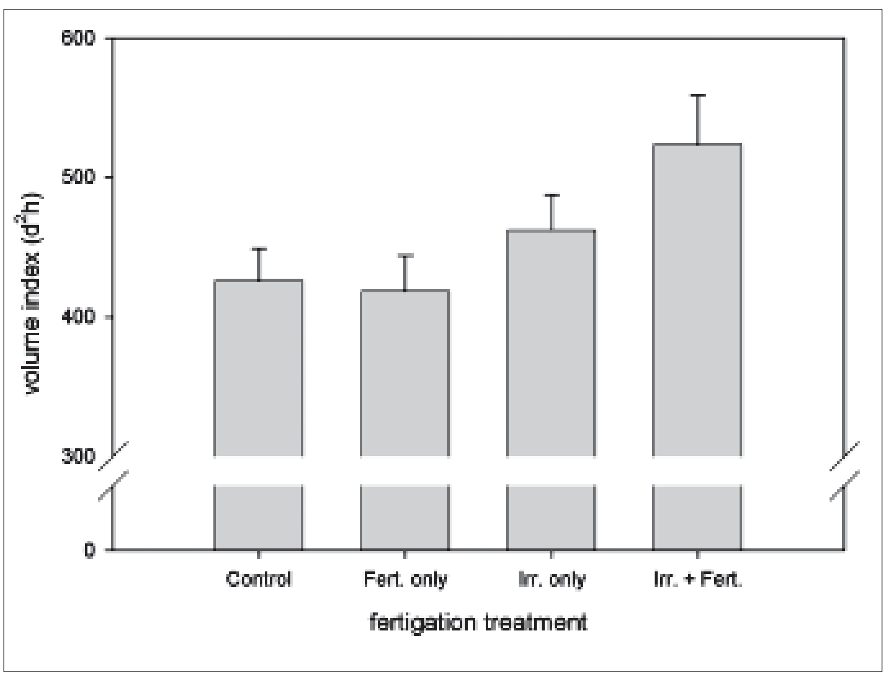


Figure 2. Effect of fertigation on stem volume growth of shade trees. Values are means averaged across all species listed in Table 2.

New automated weather data for the nursery industry in Michigan

Author

Jeff Andresen, Department of Geography and Center for Integrated Plant Systems

Funding

Project Greeen

Industry sponsors

Ottawa County Soil and Water Conservation District, United Horticultural Supply Co., Helena Chemical Co., Wilbro Inc., Green Growth Supply Co., Vans Pines Nursery, Northland Evergreen Nursery Zelenka Nursery

Significance to industry

Thanks to sponsorship by the nursery/ornamental industry in western Lower Michigan, a new fully-equipped automated weather station, including probes to monitor air temperature and media temperatures under polyhouse conditions, was installed at Northland Evergreens, Inc. near West Olive on January 11, 2001 as part of the Michigan Automated Weather Network (MAWN). A photo of Jeff Andresen explaining the weather station is on page A-2, color insert.

Background

MAWN is a program associated with the Generating Research and Extension to Meet Economic and Environmental Needs (GREEEN) Initiative, a joint partnership between the state's major commodity groups and food processors, the state government, the Michigan Agricultural Experiment Station, and Michigan State University that was signed into law in 1998. A major emphasis of the GREEEN initiative is improved efficiency and productivity of agriculture through the expanded use of Integrated Crop Management (ICM) strategies, many of which require highly detailed weather data and information. MAWN is a direct result of this need and is one of more than ten programs comprising the MSU Center for Integrated Plant Systems (CIPS), a new center designed to facilitate the major goals of the GREEEN initiative.

Objectives

The major objectives of MAWN include: provision of quality data, information, and proven methodologies for the expanded use of integrated crop management (ICM) and other weather-dependent management strategies (e.g. irrigation scheduling) in Michigan; facilitation of new research on the use of meteorological data in agricultural management; and the overall reduction of weather-dependent risk in agricultural systems for the grower and the industry.

Materials and methods

The automated weather station chosen for the network is manufactured by Campbell Scientific, Inc. of Logan, UT. Weather variables measured at each station include air temperature and relative humidity at the five-foot level, precipitation, wind speed and direction at the ten-foot level, solar radiation, soil temperature (at two depths) and volumetric soil moisture and leaf wetness. Observations at each station are taken automatically at a minimum of once every 60 seconds. The stations are regularly maintained and serviced by Michigan State University in a consistent manner so as to ensure data quality and reliability.

At the West Olive site, temperature probes were also installed to monitor temperatures inside an adjacent polyhouse covered by material with a 55 percent shading factor. Indoor temperatures were monitored in the air at a two-foot level and in planting medium in two nearby one-gallon plastic containers at a one-inch depth.

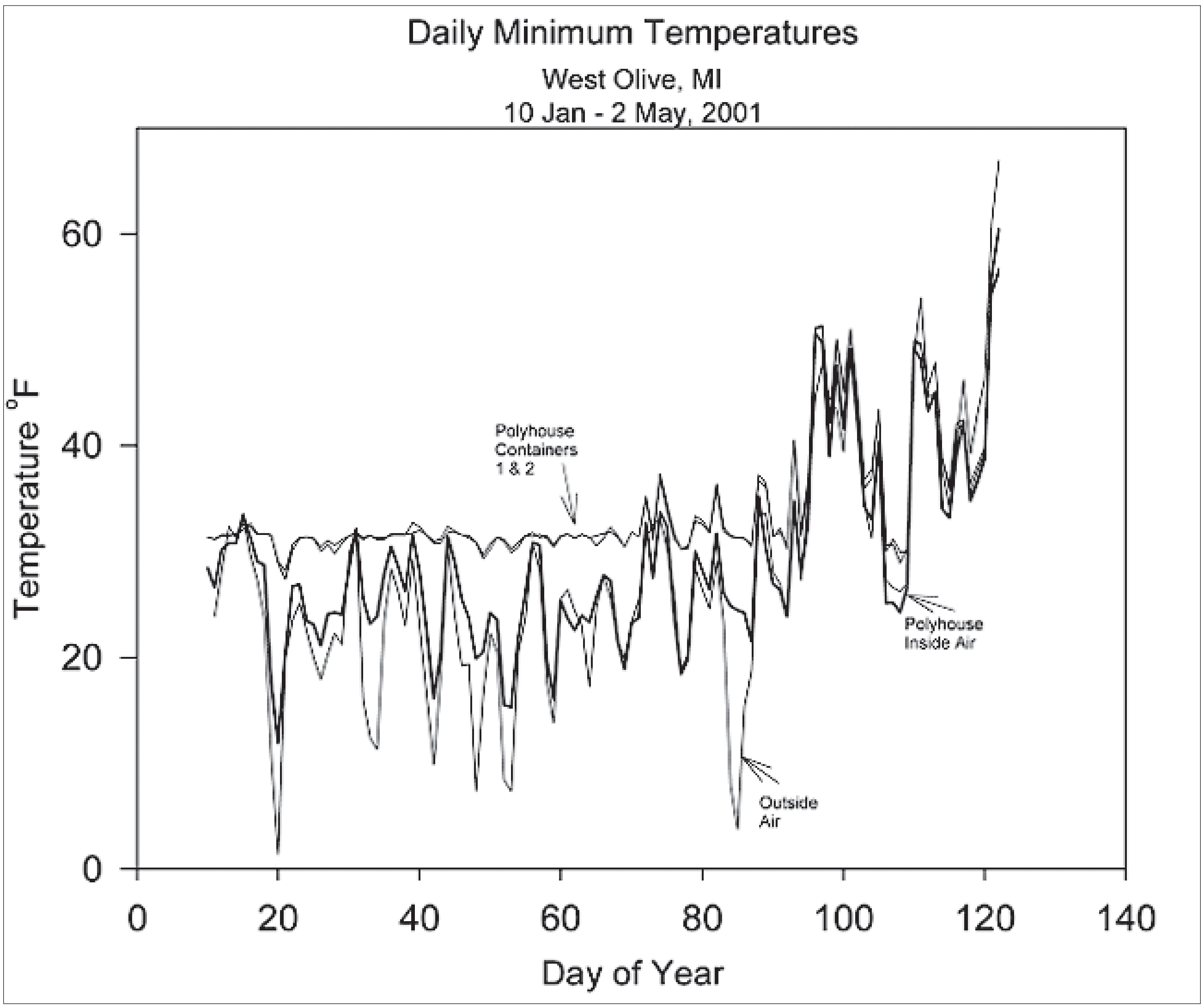
Results

Daily minimum temperatures from January 10 through May 2 of this year for locations inside and outside of the polyhouse are given in Figure 1. As can be seen in the figure, the temperature moderating effects of the polyhouse were significant. Absolute minimum temperatures during this period were 1.4°F, 11.9°F, 28.2°F, and 27.4°F, for outside air, inside air, inside container medium #1 and inside container medium # 2, respectively. Greatest differences in air temperature between inside and outside the polyhouse exceeded 40°F on some bright, sunny days during March, April and May (data not shown). During nighttime/early morning hours on relatively clear, calm nights when radiational cooling was strong, indoor/outdoor differences were as much as 10°F. Container medium temperatures inside the polyhouse were very similar in both containers and remained close to the freezing mark prior to day 90 (March 31), after which warmer temperatures thawed the medium and resulted in greater day to day temperature fluctuations. Growing degree day totals (not shown) derived from the temperature data inside the polyhouse during this period were consistently greater than those from the outside air temperatures, with a difference of more than 225 units as of May 2. This translates roughly into a difference of 25 to 35 calendar days (i.e. phenologically, one would expect to reach a given growth state 25 to 35 days earlier inside the polyhouse versus outside). The 200+ additional GDDs in the early season are also significant from a climatological perspective, representing from 5 to 15 percent of the entire (outdoor) growing season base 50°F total GDD accumulation for this area of west central Michigan.

All information is available over the Internet 24 hours per day, 7 days per week at: www.agweather.geo.msu.edu

The www.agweather.geo.msu.edu site will be undergoing upgrades during the winter and early spring of 2002, with new links and options regarding access to MAWN data.

Figure 1. Daily minimum temperatures within a polyhouse, at West Olive, MI, 10 JAN 2001 - 2 MAY 2001.



Turning perennials inside out

Authors

Bridget Behe, Art Cameron, Kathy Kelley, Elizabeth Moore, Erin Nausieda, Beth Fausey, Royal Heins, and Will Carlson, Michigan State University Department of Horticulture

Funding

American Floral Endowment

Significance

People bring order to their lives through categorization and organization: we simply like to group things. Even in the garden, creating groups of sun-loving or shade-loving plants creates an organization that works well. What about growing perennials indoors as potted flowering plants? What might be the potential of using some perennials indoors first before planting them in the garden? Turning perennials inside out may break a few rules or just cause a ruckus.

The ability to investigate and discover the "program" to cause flowering on a certain date for a few crops has been revolutionary. Poinsettia and chrysanthemum are economically powerful flowering pot plant crops because plant scientists uncovered their secrets and created a "program" to enable commercial greenhouses to induce flowering on any date of the year. Programming typical garden perennials for early sales is a relatively more recent phenomenon but one that sets the stage for another revolution.

Garden centers have benefited from programming perennials because perennials, like annuals, sell better when open flowers are present. Observing some of these programmed perennials led researchers to notice a few that were ideally suited for the tabletop given their smaller, more compact habit in the pot and floriferousness. Watching them a bit more, some impressed us with their ability to look good, even after two weeks indoors. Yet, there are those industry professionals and avid gardeners who believe that "forcing" perennials and marketing them to the general public would be misleading and wrong since it would ruin the flowering potential in subsequent years. In our unsubstantiated trials (including plantings made in our MSU demonstration gardens and our own backyards) - we have never observed any serious problems - at least none that we could relate to the fact that the plants had been forced, but where was the evidence?

Project goals

The specific objectives of this work were: 1) to modify production procedures to produce more compact plants in smaller containers, more suitable for marketing as indoor pot plants and then 2) to quantify performance of programmed perennials indoors as potted plants and afterwards in the garden and 3) compare this to the performance of perennials grown and transplanted in a more traditional manner.

Materials and methods

Originally, we chose 11 species of perennials based on their potential suitability as pot plants, their popularity in the garden and their successful programming properties. The species planted in 1999 were *Aquilegia flabellata* 'Cameo Mix' Siebold & Zucc., *Campanula carpatica* 'Blue Clips' Jacq., *Campanula portenschlagiana* Roem. & Schult., *Coreopsis grandiflora* 'Sunray' Per., *Echinacea purpurea* 'Magnus' Moench, *Lavendula angustifolia* 'Hidcote Blue' Mill. and *Leucanthemum* x *superbum* 'Snowcap' L. Four species were added in 2000: *Gaura lindheimeri* 'Whirling Butterflies' Engelm. & A. Gray., *Geranium dalmaticum* Rech.f., *Pennisetum setaceum* 'Rubrum' Chiov. and *Veronica spicata* 'Red Fox' L. Although pennisetum is not a perennial plant in Michigan, it has become a popular garden plant within the past few years and warranted inclusion in the study.

Ten plants of each species were used as a comparison or "control group," which were grown in a 61°F greenhouse with natural light. All plants in the other four treatments were forced in the greenhouse. Half of the forced plants were programmed to flower on May 15 and the other half was programmed to flower on June 1. All of the plants flowering on May 15 were subjected to a three-day simulation of shipping (no water, no light), followed by two weeks of in-store display simulation (72°F, fluorescent lights). The post-harvest treatment ended when the other forced plants flowered on June 1, at which time all plants were installed in full-sun flower beds, with sandy-loam soil, on the MSU campus.

Trial beds were established on the Michigan State University campus. Beds were dug to a depth of 24 inches and were slightly raised to improve drainage. The campus is located in mid-Michigan, classified as Zone 5 on the USDA hardiness map.

Beds were in full sun and overhead irrigation was not used until the second year. At planting, half of the plants that were programmed to bloom on May 15 and June 1 were cut back two to three inches above the ground. Plants were installed on one to two foot centers on May 31 for 1999. Typical landscape maintenance activities were used including deadheading, weed removal, and supplemental irrigation. Fertilization was applied annually with a slow release fertilizer at planting.

Data were collected on several key features of the plants: bloom quality, foliage quality, overall plant quality, percent of plant in bloom and of the floral tissue, what was in bud, open or fading. The quality data were collected on a five-point scale and were based on the All America Selection standards (5=excellent, 4=good, 3=average, 2=poor, 1=unacceptable). Data were collected for plants in their first season on a weekly basis until the first frost. Data for plants in their second season were collected weekly during bloom and monthly at other times.

We expected to see differences in the initial flower quality of plants that were cut back at installation, since their flowers would be removed. Yet, we hypothesized that at some point the cutback plants would re-flower and there would be no visible difference between those treatments. We supposed that post-harvest treatment might initially reduce the quality of flowers and foliage once transplanted outdoors but cutting plants back would speed the similarity in appearance. We didn't suspect any difference in over-winter survival would be seen.

After collecting and analyzing data, we found some plants did well indoors and out, while others were better suited to one location or the other. Understanding where the plants perform well will help marketers position how they market these "new" pot plants. Based on their post-harvest and garden performance, we grouped the species/cultivars into three categories for consideration by growers and retailers.

Results

Category I: Good in the home, great in the garden

Plants in this category showed no detrimental effect on garden performance as a result of forcing or postharvest treatment. All treatments generally performed equally well. Cutting back plants at installation did not greatly improve garden performance. As a result, these species may be forced successfully for an early market date, to be used first indoors, or they may be marketed for use only outdoors. Examples included *Coreposis grandiflora* 'Sunray', Echinacea and lavender.

Category II: Good in the home, okay in the Garden

Aquilegia, *Campanula carpatica* 'Blue Clips', *Campanula portenschlagiana* and *Geranium dalmaticum* all fit into this category. *Leucanthemum* x *superbum* 'Snow Cap' did well in both indoor and garden trials, but has an unpleasant odor that may not be evident until you place it indoors. The *Saxifraga arendsii* 'Triumph' is near the end of this category alphabetically and at the bottom in terms of performance. *Sedum* 'Brilliant' was superb indoors and a "look alike" for a kalanchoe. These plants show great potential for marketing as indoor potted plants but may require some additional instructions to improve the likelihood of success for consumers who want to plant them outdoors.

Category III: Not good in the home, but still great in the garden.

Gaura lindheimeri 'Whirling Butterflies' was a hopeful candidate, but flowers abscised nearly immediately on placing in the interior environment. It was still great in the garden, but too leggy and too messy for further consideration as a forced pot plant. Like gaura, *Perovskia atriplicifolia* 'Longin' is great in the garden but not a viable candidate for interior enjoyment. Flowers shattered very quickly, and created a messy appearance.

Category IV: Not very good in the home or garden.

Delphinium 'Butterfly Blue' may have attracted us with the popularity of blue delphiniums, but didn't fare well in our evaluations. Perhaps another cultivar is worth investigating.

Overall, this research brings together many years of work devoted to forcing perennials along with some anecdotal evidence researchers had that some of these may be good indoor pot plants. While we still have some additional work to do, there is enough evidence here that further investigation is warranted. Many species or cultivars were classified as having good potential in the home and garden. Forcing appeared to have little detrimental effect on the garden performance of any of the forced plants.

Photoperiod, temperature and chilling requirements for forcing blooms of flowering shrubs

Authors

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Industry partner

Spring Meadow Nursery

Funding

Spring Meadow Nursery, Fred C. Gloeckner Foundation

Significance

Behe and VanderWoude conducted a study in three garden centers in Grand Rapids to investigate how selected perennials and flowering woody shrubs sell when not in flower. All six test species sold at least 100 percent faster when in flower than without flowers. Flower scheduling can be controlled for most plants by manipulating photoperiod and temperature. Currently, there is little information regarding photoperiod and temperature requirements for most flowering shrubs. Since 1992, the herbaceous perennial research program at Michigan State University has focused on flowering physiology and cultural information to enhance sales of perennials. Basic photoperiod and temperature requirements for programming the time of flowering for over 50 herbaceous perennials have been developed. This expertise will be utilized to develop the procedures to schedule flowering of woody shrubs.

The normal flowering time and literature on related plants indicate that the three taxa selected for this study (*Hibiscus syriacus*, *Itea virginica* and *Weigela florida*) are long-day plants. In addition to photoperiod effects on flower initiation, flower/inflorescence size, plant height and flower bud number, temperature has been reported to influence these parameters for many plants as well. *Hibiscus moschuetos* is an obligate long-day plant. Average daily temperature is also involved in regulating flower initiation and development and a similar response is likely for *H. syriacus*.

Objectives

The objectives of this research are to determine critical photoperiod and temperature requirements for flower forcing of three traditionally outdoor shrubs, *Hibiscus syriacus*, *Weigela florida* and *Itea virginica*, and to determine the market potential of these shrubs in flower.

Materials and methods

During the first year, the characteristics needed to schedule flowering were determined. Plants were cold treated for 10 weeks at 41°F prior to implementation of treatments. Critical photoperiod was determined by growing plants under photoperiods of 10, 12, 13, 14, 16, 24 hours or night interruption from 22:00 to 2:00. Extended photoperiods and night interruption were provided by incandescent lamps. To determine temperature effects, plants were grown at 57°F, 63°F, 68°F, 73°F, 79°F and 84°F under a 16-hour photoperiod. Plants were evaluated over a 14-week period for both critical photoperiod and temperature experiments. Ten replicates of each plant in five-inch square pots were used for photoperiod and temperature treatments. Data collected were: date of first visible flower bud/inflorescence; date of flowering; flower/inflorescence number at date of flowering; flower/inflorescence size; plant growth; and plant quality.

Progress to date

These results are part of an on-going project; their interpretation may change by the time the project ends. Plants were received from a commercial propagation nursery in 2 ¼ inch plugs. This size material was used in an attempt to evaluate flowering on small plants. When adopted by the industry, the use of small plants will enable growers to keep costs to a minimum. *Hibiscus syriacus* flowered well starting from this size but flowering was sporadic on *W. florida* and *I. virginica*. The photoperiod experiment was repeated with larger plants for *W. florida* and will be repeated with larger plants for *I. virginica*.

***Hibiscus syriacus* Lavender Chiffon™**

Flower development was strongly affected by temperature. Plants grown at or below 68ºF averaged less than one flower per plant at the end of five weeks while those grown at 73°F or 79°F had a maximum of 6 or 13 flowers, respectively. The temperature experiments all took place under a 16-hour photoperiod.

The photoperiod experiment was conducted at the same time as the temperature experiment in a 68°F greenhouse. Since the temperature effect was unknown at the time, flowering was poor. The best flowering results were for photoperiods greater than or equal to 14 hours and the night interruption treatment. The best flowering was seen for the 16-hour photoperiod with supplemental light. The rapid set of flower buds at temperatures of 73°F or greater (up to 13 flower buds in five weeks on a plant less than 20 inches) indicate this may be a valuable plant for the industry. However, plant aesthetics need improvement (leggy plants). Further studies will investigate photoperiods at higher temperatures and effects of growth regulators on height control.

Weigela florida Wine and Roses™

Plants started from 2 ¼ inch plugs did not flower within the 15 weeks of evaluation for either the photoperiod or temperature experiments. The photoperiod experiment was repeated using plants that had been grown for one growing season in one-gallon containers. Plants under all photoperiods reached full bloom within five weeks of imposing treatments, with an average of 13 flowers per plant. The cultivar used has purple foliage. However, in the glasshouse, foliage had only a slight purple tint. This phenomenon has been observed for other red to purple foliaged plants under glass or poly. In other red or purple foliaged plants, exposure to a few days of direct sunlight has resulted in development of proper pigmentation. (In a separate project at MSU, we are investigating mechanisms to enhance purple pigmentation under glasshouse production). Experiments using growth regulators to control legginess are being conducted on this plant.

Itea virginica Little Henry™

Plants used for flower forcing flowered sporadically, most likely due to the size of the starting material. The study will be repeated with larger size starting material in 2002.

Self-felting wool pellets as a means of weed control during propagation and liner production

Authors

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Industry Partners

Spring Meadow Nursery, Grand Haven, MI.
Walters Gardens, Zeeland, MI.
Wilbro, Inc., Norway, S.C.

Funding

MSU Project GREEEN
Spring Meadow Nursery, Grand Haven, MI.
Wilbro, Inc., Norway, S.C.

Significance

Economic pressure to produce quality plants in the least amount of time involves an intensive use of water, fertilizers and pesticides. Unfortunately, these practices also provide optimal conditions for weeds and the necessity for frequent applications of herbicides. Alternative strategies, such as the use of Wulpak (self-felting pellets), may be an environmentally friendly method to help control weeds, either alone or in combination with herbicides. Many species, especially herbaceous perennials, are sensitive to herbicides. Thus, wool pellets may provide weed suppression without causing a phytotoxic response. Wool pellets may also bind herbicides to the layer of wool, which reduces leaching into the root zone and herbicide contamination of runoff.

Project goal

Our objectives were to determine weed control efficacy of Wulpak wool pellets alone and in conjunction with herbicides or Spinout during propagation and liner production.

Procedures

Three experiments examined timing of Wulpak application and weed control capabilities of Wulpak and herbicides during propagation and liner production of five herbaceous perennials and two woody species. Species tested were Siberian bugloss (*Brunnera macrophylla*), royal fern (*Osmunda regalis*), spotted deadnettle (*Lamium maculatum* 'White Nancy'), butterfly bush (*Buddleia davidii*), Oriental poppy (*Papavar orientale* 'Carneum'), *Hydrangea serrata* 'Blue Bird' and *Itea virginica* 'Henry's Garnet.' Flats were inoculated with three species of weeds, hairy bittercress (*Cardamine hirsuta*), liverwort (*Marchantia* spp.), and yellow woodsorrel (*Oxalis* spp.) by placing flats of these weeds every three feet in the growing area. The propagation timing study consisted of three treatments: an application of Wulpak (1668 $g{\cdot}m^{-2}$ of surface) prior to sticking, an application to rooted liners, and a control consisting of no Wulpak. Two other experiments examined effects of Wulpak and herbicides or SpinOut (copper hydroxide) on weed control and plant growth and consisted of five treatments applied to rooted liners: Wulpak (1668 $g{\cdot}m^{-2}$), Wulpak treated with SpinOut, the herbicides isoxaben (Gallery 75DF) and prodiamine (Factor 65 WG), and a control.

Results and conclusions

Applications of Wulpak suppressed weeds, but its use is questionable during propagation of cuttings. However, once cuttings were rooted, the application of Wulpak + SpinOut and Wulpak alone enhanced shoot and root dry weight accumulation in all species (Tables 1, 2, and 3). The negative effect of Wulpak was higher mortality for the herbaceous species (Table 3 on page 19). Lower survival and limited growth during propagation for cuttings stuck in flats already containing a Wulpak mulch layer was probably caused by higher substrate moisture levels. Reducing the amount of water applied could potentially solve the problem.

Table 1. Effect of Wulpak treatment on dry weight accumulation, survival and weed density 75 days after treatment for Hydrangea serrata 'Blue Bird'.

Treatment	Shoot dry weight accumulation per plant (g)	Root dry weight accumulation per plant (g)	Plant survival (%)	Weed density per flat (%)
Wulpak + SpinOut	11.2 a	5.8 a	90.1 a	0.2 b
Wulpak	10.0 a	4.8 ab	94.4 a	0.5 b
Wulpak + Gallery	7.1 ab	4.7 ab	86.1 a	0.7 b
Control	4.6 bc	2.4 bc	86.1 a	1.3 ab
Wulpak + Factor	0.9 c	0.1 c	77.8 b	5.0 a

Mean separation among treatments by Tukey's Studentized Range (HSD) test, $P \leq 0.05$.
Treatments with identical letters are not significantly different.

Table 2. Effect of timing of Wulpak application on plant visual rating, survival, weed density and weed dry weight per flat. Data is averaged over species.

Treatment	Visual rating	Plant survival (%)	Weed density per flat (%)	Weed dry weight per flat (g)
No Wulpak (Control)	4.6 a	99.3 a	16.2 b	1.6 b
After rooting	4.5 a	92.8 a	5.2 b	0.9 b
Prior to sticking	2.6 b	36.9 b	76.4 a	8.9 a

Mean separation among treatments by Tukey's Studentized Range (HSD) test, $P \leq 0.05$.
Treatments with identical letters are not significantly different.

Table 3. Effect of Wulpak on root and shoot dry weight accumulation, survival, and weed density per flat of *Brunnera macrophylla*, *Buddleia davidii*, *Lamium maculatum* 'White Nancy,' *Osmunda regalis*, and *Papavar orientale* 'Carneum.'

Treatment	Root dry weight accumulation per plant (g)	Total shoot dry weight per flat (g)	Plant survival (%)	Weed density per flat (%)
Brunnera				
No Wulpak	2.27 ab	35.8 ab	93.8 a	8.0 ab
Wulpak	2.99 a	42.9 a	83.7 ab	2.0 b
Wulpak + Spinout	1.72 ab	41.4 a	92.5 a	1.0 b
Wulpak + Gallery	1.29 b	21.0 b	68.7 b	15.0 a
Buddleia				
No Wulpak	0.39 ab	51.4 a	100.0 a	67.5 a
Wulpak	0.68 a	50.7 a	87.5 a	16.2 bc
Wulpak + Spinout	0.63 a	52.3 a	95.0 a	3.7 c
Wulpak + Gallery	0.31 b	25.7 b	43.7 b	50.0 ab
Lamium				
No Wulpak	1.27 a	43.1 a	96.0 a	20.0 ab
Wulpak	0.35 c	40.8 a	61.0 b	38.7 a
Wulpak + Spinout	0.51 bc	50.8 a	74.0 ab	5.5 b
Wulpak + Gallery	0.89 ab	43.2 a	60.0 b	10.0 b
Osmunda				
No Wulpak	1.20 a	10.8 a	92.5 a	100.0 a
Wulpak	0.50 a	1.5 b	12.5 b	100.0 a
Wulpak + Spinout	1.33 a	9.6 a	65.0 a	100.0 a
Wulpak + Gallery	0.69 a	1.1 b	20.0 b	100.0 a
Papaver				
No Wulpak	0.71 ab	12.5 a	71.0 a	20.0 b
Wulpak	0.79 a	10.7 a	46.2 b	21.2 b
Wulpak + Spinout	0.96 a	11.2 a	52.2 ab	5.5 c
Wulpak + Gallery	0 b	0 b	0 c	100.0 a

Mean separation among treatments by Tukey's Studentized Range (HSD) test, $P \leq 0.05$.
Treatments with identical letters are not significantly different.