Developing Cost-effective and Efficient Floriculture Production Methods: a North-South Research Alliance

PRINCIPAL INVESTIGATORS:

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PROJECT OBJECTIVES:

To improve the efficiency of floriculture plant production through a multi-disciplinary team approach that focuses on scheduling, the environment, energy, nutrient, water, and chemical growth regulator resources.

ACCOMPLISHMENTS:

Photosynthesis was characterized in 13 crops in "normal" and short-term high temperature stress conditions. Twenty eight petunia varieties were grown under 10.5- to 14-hour photoperiods to identify short- and long-critical photoperiods. Those species that have a short critical photoperiod would best be grown for flowering early in spring in the south and west. In contrast, those petunias that have a long critical photoperiod should be grown last in those same areas or in unlighted greenhouses in the north. Five commonly grown bedding plants were grown in growth chambers simulating conditions in a heated greenhouse producing a spring bedding plant crop to simulate the impact of dropping temperatures when natural light levels are low to save energy. The length of the juvenile period and the minimum number of inductive photoperiods necessary for floral induction was determined for more than 10 bedding plant crops. Additionally, the effects of the number of inductive cycles and timing of exposure to the inductive photoperiod on crop quality parameters were evaluated. This will allow for the development of production schedules that reduce production time without compromising crop quality.

Twenty vegetatively propagated bedding plants were received from commercial growers and grown in varying in temperatures in order to determine the influence of temperature on growth and development rate. Temperature and the photosynthetic daily light integral (DLI) were quantified in how they regulate plant development of over 25 herbaceous ornamental crops. Information from these studies will be useful to determine models that can predict effects of temperature and light on production time. This information is being incorporated into Virtual Grower software to estimate heating costs given different production scenarios, different locations, and different times of the year.

The Kalanchoe genus is being evaluated for new candidate crops for commercial adaptation. After evaluating 28 *Kalanchoe* species grown under a variety of conditions, five species were identified with potential as new commercial ornamental crops.

Several studies on growth regulator efficacy were conducted including determining the efficacy of a number of cytokinins (five types) on inducing branching of cacti, succulents, and seed-

propagated bedding plant species, and determining the efficacy of seven commercial growth retardants on limiting stem elongation of 28 *Kalanchoe* species. Tank mixes of insecticides, fungicides, and plant growth regulators were investigated as applications to liners and seedlings, to eliminate a drench in the finished container in the greenhouse or field. This could eliminate pests before introducing them into a greenhouse or field, reduce field losses to disease, and eliminate potential disease vectors by using this technique. The use of a high strength, experimental formulation of paclobutrazol was studied to control internode elongation of floriculture crops. Currently, the work is being repeated to determine if there are differences among application strategies (spray versus drench). In addition, work continues with abscisic acid to evaluate its potential use on bedding plants to increase the postharvest tolerance to drought conditions.

Comparisons were made of various simulated shipping lengths and propagation environments for propagation of vegetative annuals. Rooting, cutting quality, color, chlorophyll content, and cutting survival are being evaluated. For New Guinea impatiens and geranium, the quality rating was higher for fewer days the cuttings were stored. Elevated humidity in the parent-plant environment produced the highest quality of cuttings by visual inspection of cutting quality. No visual differences have been observed in rooting. Many cuttings subjected to 4 days of storage died during the course of the study, while very few from 0 and 2 days of storage died. Stock plant nutrition is also being investigated to determine their effects on the subsequent rooting of excised cuttings. A study has begun that will test various ratios of NO_3^- and NH_4^+ and N concentrations for their effects on rooting, carbohydrate status, and cutting survival with and without simulated shipping in zonal geranium and New Guinea impatiens.

The physiology of water use of cuttings is also being investigated in order to minimize water on the foliage during propagation of vegetative cuttings since this creates opportunities for growth of pathogens, leaching of nutrients, and excess use of water resources. The first experiments have focused on: 1) stomatal functioning from the harvest of cuttings on the stock plant through the postharvest environment and in the first days or weeks of propagation (before root initiation) using poinsettia as the model crop; and 2) quantifying water uptake potential through severed stem tissue. These experiments examine the factors affecting initial water status of the cutting when first stuck and the rate of water uptake through the severed stem tissue, which can inform a baseline for water uptake models or simulations.

Research on pH management is focused on two areas: lime and fertilizers. Laboratory protocols (the LimeR series) are being developed for media companies to measure the reactivity of different lime sources, which affects how quickly lime reacts to achieve a target pH; unreacted residual lime in growing media, which affects buffering to pH change; and how much lime is required for a particular batch of substrate. Models that predict lime reaction and protocols to estimate the lime requirements of different batches of growing media in order to achieve a target pH are being developed. The potential acidity or basicity of a fertilizer written on the fertilizer bag is based on a model developed in the 1920's for soil application of solid fertilizer. Many of the assumptions of this model do not apply to greenhouse culture. Experiments are underway that estimate the pH effect of fertilizers in container production. A draft model of fertilizer

acidity and basicity is being developed based on the charge balance principle where cations (such as ammonium) are acid and anions (such as nitrate) are basic.

Leaching and recharge of nutrients are the topic of water quality research, and aims to understand how to best manage leaching and applied fertilizer concentration during plug and cutting production. It was found that after 1.5 container capacities (about one soil volume) of water is applied, nutrients in the soil are mostly replaced by the applied fertilizer solution. That means it is very easy to leach out pre-plant fertilizer under mist. Tissue nutrient levels tend to drop during the rooting of cuttings, and that petunias can take up nutrients through the leaves even before roots form. Management approaches include ensuring adequate fertilizer is applied during the stock plant phase to have moderate to high initial tissue nutrient levels in cuttings, applying a low fertilizer concentration in the mist, and recharging nutrients after plants are removed from mist.

TECHNOLOGY TRANSFER/IMPACT:

- Five species of *Kalanchoe* were identified as having potential as new commercial ornamental crops.
- Five presentations and articles on water quality and pH management.
- Active participation at the OFA Short Course in Columbus, Ohio, describing specific aspects of research results to growers and allied industry.
- Held two stakeholder workshops and tours that reported ongoing research results, sought input to determine research priorities, and toured commercial facilities in different areas; more workshops are planned in the upcoming years.
- Have reported research results in article series of several leading trade magazines.
- Virtual Grower version 2.5 released July 11, 2009; since its release just prior to the previous FNRI meeting, over 6,500 copies have been downloaded and distributed to growers, educators, and allied industry representatives.
- Presented workshops and informational sessions on Virtual Grower's use to hundreds of growers and allied industry.

COLLABORATORS:

Neil Anderson and Chengyan Yue (University of Minnesota); Art Cameron and Ryan Warner (Michigan State University); Brian Whipker (North Carolina State University); Scott Whiteside (Clemson University); Rosanna Freyre and Sonali Padhye (University of Florida); and Bryon Hand (ARS Toledo, Ohio).

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