Progress Report to
Oregon Department of Agriculture/Oregon Association of Nurseries

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Title: Improving Nutrient and Water Use Efficiency of Container-Grown Nursery Plants

PI: Guihong Bi, Truck Crops Experiment Station, Mississippi State University, Crystal Springs, MS 39059, Ph. (601) 892-3731, Email: gbi@pss.msstate.edu
Co-PI: Carolyn Scagel, USDA-ARS/HCRL, Corvallis, OR 97330, Ph. (541) 738-4063, Email: scagelc@onid.orst.edu

Project background and justification:
The production of high quality container-grown nursery plants requires adequate nutrients and water during production. However, over-fertilization and irrigation can be detrimental to plant growth. Over-fertilization in combination with frequent irrigation can also lead to significant losses of nutrients into the environment and reduces the efficiency of fertilizer and water use. With water restrictions and increased energy and fertilizer cost, the need is intensifying for more efficient use of water and fertilizers.

Proper irrigation management is a key component of fertilizer management. The dynamic link that exists between nutrients and water in plant production implies that research aimed at enhancing the efficiency of nutrient use should be coupled with knowledge of how water management influences nutrient management and vice versa. Efficient management of fertilizer and water inputs based on optimal plant needs (performance) and optimal time of application (uptake) will reduce overall water and fertilizer use and enhance plant performance. For the proposed research, plants grown at different fertilizer rates and different water availability will be used to assess the influence of nutrient and water status on plant growth, and nutrient and water use efficiency. The knowledge obtained from this project will help develop integrated nursery production practices that optimize nutrient and water use.

Project objective:
Using container-grown plants, we will investigate the influence of different fertilizer rate and water availability on plant growth, and fertilizer and water use efficiency.

Overview of methods and time lines:
Plant culture and treatments (Spring - Fall 2013): Hydrangea and azalea liners will be obtained from a nursery in Spring 2013. Plants will be potted into 1-gal. or 6'' containers. For each plant type, twenty plants will be randomly assigned to one of five nitrogen treatment groups (0N, 5N, 10N, 15N, 20N). Starting in early June, each group will be fertigated twice weekly for 20 weeks (400 ml per pot) with one of five different N concentrations (0, 5, 10, 15, or 20 mM N from NH_4NO_3), using a modified Hoagland's solution. Water treatments will be initiated the same time as fertilizer treatment by applying either 1x (W) or 0.5x (D) volumes of water at each irrigation to half of the plants in each nitrogen treatment group. Volumes of water used for irrigation will be recorded throughout the growing season.

Measurements (Spring - Fall 2013). Plant growth index (height plus width1 plus width2 divided by 3), leaf gas exchange and leaf temperature will be measured twice monthly. These growth and physiological parameters will be used for determining if plants are under water stressed conditions.

Plants from each treatment will be harvested prior to leaf fall. Plants will be separated into roots, stems, and leaves. Leaf area will be measured. All samples will be dried in an oven, and ground for mineral nutrient analyses. The dry weight will be recorded for each tissue.

Mineral nutrient analyses (Winter 2013). Samples will be analyzed for concentrations of C (carbon), N (nitrogen), phosphorus (P), potassium (K), sulfur (S), calcium (Ca), magnesium (Mg), boron (B), copper (Cu), iron (Fe), manganese (Mn), and zinc (Zn).

Preliminary Results:
The experiment is still ongoing. Below is the preliminary results.

Encore azalea
For Encore azaleas 'Chiffon', 1-year old rooted liners were potted into 1-gal containers filled with pine bark in April, 2013. Results showed that nitrogen (N) rate had a significant effect on plant growth index (PGI). Plants in 15 and 20 mM N are significantly larger than plants in 0 and 5 mM N. For leaf SPAD reading, nitrogen treatment showed significant influence on SPAD, with mean SPAD value significantly increased with increasing nitrogen concentration from 0 to 20 mM N.

There was no significant difference on daily water use of azaleas among different treatment combinations. By the end of September, irrigation frequency had a significant effect on plant photosynthetic rate, with plants irrigated twice a day having significantly higher photosynthetic rates that those irrigated once a day. The total number of flowers was significantly higher on plants receiving 10 mM N than those received 0, 5, 15 mM N.

Hydrangea
For hydrangea, rooted *Hydrangea macrophylla* 'Merritt's Supreme' cuttings were potted into 6'' containers filled with Sun Gro #4 in late May, 2013. Results showed that nitrogen rate had a significant effect on plant growth index. Plants from 20 mM nitrogen treatment had significantly higher PGI than plants from 0, 5, and 10 mM nitrogen treatments. Both nitrogen rate and the interaction between nitrogen and irrigation frequency had significant influence on PGI of hydrangeas. Plants fertilized with 20 mM nitrogen and irrigated once a day had significantly higher PGI than plants from all other treatment combinations.

As for leaf SPAD values, plants from 0 mM nitrogen treatments had lower SPAD than plants from all other N treatments. For daily water use, nitrogen rate had a significant effect on the daily water use of hydrangeas, with plants from 15 and 20 mM N treatments having higher daily water use than plants from 0 and 5 mM N treatments.

By the end of September, nitrogen rate had a significant influence on photosynthetic rate of hydrangeas, and plants from 0 mM N treatment had significantly lower photosynthetic rates than plants from other N treatments.

Both azalea and hydrangea plants from each treatment were harvested prior to leaf fall in December 2013. Plants were separated into roots, stems, and leaves. Leaf area were measured. All samples were dried in an oven, and will be ground for mineral nutrient analyses.