FIELD PRODUCTION

Marc Teffeau
Section Editor and Moderator

Twenty-eight students competed In the Bryson L. James Student Research Competition and twenty-nine research projects were presented in poster form, which were displayed for review during the SNA Research Conference and Trade Show, this year. Their research is presented in the topical sections which follow and are designated as Student or Poster papers.

Effects of Controlled-Release Fertilizers on Growth and Nutrient Content of Field-grown Nursery Crops

Dewayne L. Ingram, Brian Roach, and Mike Klahr
Horticulture and Landscape Architecture Department
University of Kentucky, Lexington, KY 40546-0091

Nature of Work: Nursery managers desire to maximize growth of plants under production systems with efficient fertilization practices. Fall fertilization has proven to be effective, but producers have questions regarding nutrient leaching, plant uptake, nutrient distribution in the plant, and predisposition of crop plants to winter injury (1,2,3,4,5). The industry is also seeking more genera-specific fertilizer recommendations. Research was initiated in three Kentucky commercial nurseries with six genera of nursery plants to determine the effects of three fertilizer sources and rates on plant growth and development. Plots were established with *Acer rubrum* 'Red Sunset' and *Euonymus alatus* 'Compactus' at Snow Hill Nursery (Shelbyville, KY) and *Picea abies* (Norway Spruce) and *Pseudotsuga menziesii* (Douglasfir) at Nieman's Nursery (Lexington, KY) in the spring of 1994. Treatments were initiated in *Ilex x* meserveae 'China Girl' and *Picea abies* 'Nidiformis' (Bird's Nest Spruce) at Ammon Wholesale Nursery (Burlington, KY) in the fall of 1994. Treatments included Woodace 29-3-8 (Vigoro Industries product with XC-IBDU), 33-3-6 (Scotts Company product with Poly S coating) and 18-3-3 (uncoated urea as the nitrogen source) applied at 100, 250 and 400 lbs of N/A/yr, split into spring and fall applications. Treatments were replicated a minimum of five times in randomized complete block designs for each genus. Plant size parameters were measured at least annually. Growth index measurements (volume = maximum width x minimum width x height) were recorded for multi-stemmed genera and height and caliper were measured for single-stemmed genera. The timing and magnitude of growth flushes were observed. Leaf samples were taken from the maple and euonymus in July and from the holly and spruce in November for nutrient analysis in July, 1996. Soil samples were taken at the initiation of the experiment and again in August, 1996.

Results and Discussion: Although the general recommendation for nitrogen fertilization of woody plants in the field is about 250 lbs N/A/yr, there are few woody plants for which we have comprehensive nutrient requirement guidelines. The results of this three-year experiment indicate that the 250 lbs N/A/yr is an appropriate recommendation for a wide variety of woody plants and soil types. However, there were differences among the test plants in this study in their responses to

fertilizer source and rate. Observations revealed no significant treatment differences in winter injury or potential injury due to early spring budbreak.

Acer rubrum 'Red Sunset' caliper growth was not influenced by fertilizer source in either year or for the 3-year total (mean=1.2 inches). Change in caliper between years 1 and 2 was greater for the 400 lbs N/A/yr rate than the lower rates, although rate had no effect on caliper growth insubsequent years or cumulatively over the experiment. 'Red Sunset' maple growth in height (3-year mean = 5.2 ft) was not effected by treatments. Soil NO3 content after 3 years of treatments increased significantly with increasing fertilizer rate (8.1, 14.5 and 37.1 ppm, respectfully). However, the higher soil NO3 content did not result in greater N tissue content or growth parameters. Mean tissue N across treatments increased from 1.8% in year 1 to 2.7% in year 3.

Euonymus alatus 'Compactus' caliper growth was not influenced by treatments on any measurement dates. There was a fertilizer x rate interactive effect on growth in height between years 1 and 2 (p=0.05) with 18-3-3 at the 100 lbs N/A/yr rate resulting in greater height growth than the higher rates. The highest rate of the Woodace and Scotts products resulted in a slightly greater growth the second year, but by the third year there were no differences. The Woodace and Scotts fertilizers resulted in greater N (1.9%), K (0.67%) and P (0.2%) foliar content than the18-3-3 after three years. The two higher rates resulted in greater foliar N, P and K than the 100lbs N/A/yr rate. This correlates with the higher soil NO3 content in year 3 at the 400 (39 ppm)and 250 (32 ppm) lbs N/A/yr rates than at the 100 lbs N/A/yr rate (14 ppm).

There was a fertilizer x rate interaction on *Picea abies* 'Nidiformis' growth expressed as the change in plant volume. Growth was greatest when fertilized with Woodace at the 100 ratecompared to the 250 and 400 lbs N rates. An opposite, nonsignificant trend was noted in the 18-3-3 fertilizer treatments. There was no statistical difference in growth due to rate of the Scotts fertilizer. Foliar tissue analysis for this species is not currently available. The soil NO3 content (95 ppm) was not affected by treatments, although NH4 content increased (9, 21 and 34 ppm for the 100, 250 and 400 lbs N/A/yr rates, respectfully) with increasing fertilizer rate.

Growth of *Ilex x* meserveae 'China Girl' was not affected by treatments. Growth the second year was more than twice the measured growth the first year, which is probably a function of the relative change in size over this period. The initial soil nutrient content of this block was moderate to high. However, soil NO3 content was greater with the 400 (104 ppm)

than the 250(52 ppm) and 100 (32 ppm) lb N/A/yr rates. Soil NH4 content followed a similar trend. Foliar N(2.1% mean), P (0.20% mean) and K (0.93% mean) levels were not affected by treatments.

Picea abies caliper was not influenced by treatments. A trend (p=0.10) was noted for the effect of fertilizer rate on change in plant height. The general trend was for greater growth at the 100 and 250 lbs N/A/yr rate of Woodace than at the 400 lb N/A/yr rate. These was also a trend for increased height with increasing rate of 18-3-3. There were no differences in growth response to the different rates of the Scotts product.

Pseudotsuga menziesii caliper in years 1 and 3 and cumulatively over the experiment was greatest at the 100 lbs N/A/yr rate compared to the 250 and 400 rates across fertilizers. The same trend (p=0.08) was noted for height increase. Height increase in year #3 was greater with 18-3-3 than with the Scotts product while Woodace's effect was intermediate. Total height over the 3years revealed a trend (p=0.08) of Woodace and 18-3-3 resulting in more shoot growth than Scotts.

It appeared that the location of the maple and holly in a given row may have influenced growth during the study more than fertilizer treatments. This is particularly interesting because of the seemingly uniform soil conditions on these sites.

No marketable differences in plant growth due to fertilizer source or rate were noted for the Douglas fir, Norway spruce, euonymus, 'Red Sunset' maple, or 'China Girl' holly. The optimum fertilizer rate for Bird's Nest spruce was dependent upon fertilizer source.

Significance to the Industry: There is little evidence that applications of nitrogen fertilizers applied at rates greater than 250 lbs N/A/yr increases quality or growth of the plants in the field study. However, nitrogen application rates in nurseries commonly exceed this amount. Based on the data presented here, the selection of a fertilizer for field production should be based on the total cost and compatibility with other cultural practices. One issue that was not addressed in the study was the potential advantage of controlled-release fertilizers over readily soluble inorganic fertilizers with regard to the required frequency of

application. Application of controlled-release fertilizers only one time per year may offset higher product costs compared to multiple applications of readily- available, inorganic fertilizers.

Literature Cited:

1. Bir, R.E. and G.D. Hoyt. 1993. Soil nitrate movement in a drip irrigated field shade tree nursery. Proc. SNA Res. Conf. 38:139-143.

2. Bir, R.E. and G.D. Hoyt. 1994. Soil nitrate movement in an overhead irrigated field shade tree nursery. Proc. SNA Res. Conf. 39:152-155.

3. Good, G.L. and H.B. Tukey, Jr. 1969. Root growth and nutrient uptake by dormant. *Ligustrum ibolium* and *Euonymus alatus* 'Compacta'. J. Amer. Soc. Hort. Sci. 94:324-326.

4. Raker, R.J. and M.A. Dirr. 1973. Effect of nitrogen form and rate on appearance and cold acclimation of three container-grown woody ornamentals. Scientia Horticulturae 10:231-236.

5. Warren, S.L., W.A. Skroch, and G.D. Hoyt. 1993. Optimizing shade tree production: ground cover, nitrogen rate, and timing of nitrogen application. Proc. SNA Res. Conf. 38:144-147.

Nursery Tree N Fertilization and Ground Water Contamination In Middle Tennessee

Reed W. Cripps and W. Edgar Davis
Tennessee Tech University, School of Agriculture,
Cookeville, TN 38505

Nature of Work: Recently there has been renewed concern about groundwater contamination with nitrates whose source is Middle Tennessee Nursery's. The purpose of this paper is to review the hydrology of Middle Tennessee and the recent literature on N fertilization of field and container grown Nursery Stock in relation to their potential to contaminate groundwater.

Results and Discussion: The primary aquifer groups in Middle Tennessee are Horizontal Carbonate Aquifers with Significant Overburden (Highland Rim), Horizontal Carbonate Aquifers without Significant Overburden (Central Basin), and Fractured Noncarbonate Aquifers without Significant Overburden (Cumberland Plateau). Most of the Ornamental Tree Nurseries occur on the Highland Rim, so that area will be emphasized.

Soileau (1988) reported no nitrate contamination of sampled well water in Middle Tennessee above 10 PPM NO_3^--N. Soileau (1988) also reported that levels of nitrate in sampled well water were greater in the Highland Rim, than either the Central Basin or Cumberland Plateau Provinces. Soileau (1988) attributed this to the Limestone formations of the region, which characteristically contain many solutional features. Potential ground water contaminants can move relatively unrestricted through channels and fractures in these carbonate rocks. Important hydrogeologic features of the Highland Rim include Karst and Non-Karst Areas, large areas of very old alluvium and steep to flat drainageways leading to Resevoirs. Many of the drainageways developed along fractures in the limestone and are a critical point along with sinkholes and depressions were surface water closely intermingles with ground water. Most of the water wells on the Highland Rim are located 40 B 80 ft from the surface in unconsolidated material above solid limestone bedrock (Fitzgerald, 1998). Appropriate fertilization of nursery trees is not most growers greatest concern. This lack of concern has resulted in relatively few fertilization studies and improper use of fertilizers by many Nurserymen. Recent studies have indicated that nurserymen overuse N fertilizer. Appropriate rates of N fertilization for dryland nursery tress ranges form 25 to 50 LB/acre (Cripps 1992) . Irrigation increases tree response to N fertilization, and vegetative growth in middles competes

with the trees for water and N (Bir et al. 1991, Warren et al. 1993). It has also been shown that excess soil N leaches below the root zone of Nursery trees (Bir and Hoyt, 1993, Bir and Hoyt, 1994). It is unclear what happens to this vadose zone nitrate below the roots of trees on the Highland Rim, because the overburden often exceeds 50 ft. and is very clayey, greater nitrate absorption and possibly denitrification occur. Given the relatively small amount of land occupied by nurseries it seems likely the impact of nitrate leaching from field grown ornamental trees on overall ground water nitrate levels is small. However in areas were excess fertilization has occurred for a long period, or in Karst regions there is potential for nitrate ground water contamination.

Increasingly production nurseries in Middle Tennessee are switching to container production. Container production requires large irrigation and N fertilizer inputs. If not managed properly significant amounts nitrate can be lost from container nurseries via runoff. Gilliam et al (1996) showed that incorporating or dribbling slow release fertilizers and application of fertilizers to different blocks over several irrigation events could reduce the N load moving off container yards. Use of Collection ponds, grass filter strips, and wetlands have been shown to effectively intercept runoff nitrate before it enters surface waters. Because of the Highland Rim have many sinkholes, depressions and caves it is important to mitigate contamination of surface waters in order to protect groundwater quality.

Significance to Industry: Because of the Karst Hydrology of the Highland Rim it is important to control nitrate runoff and leaching to prevent ground water contamination.

Literature Cited:

1. Bir, R.E. and G.D. Hoyt. 1994. Soil nitrate Movement in an Overhead Irrigated Field Shade Tree Nursery. Proceed. SNA Research Conf. 39:152-155.

2. Bir, R.E. and G.D. Hoyt. 1994. Soil nitrate Movement in a Drip Irrigated Field Shade Tree Nursery. Proceed. SNA Research Conf. 38:139-143.

3. Bir, R.E., J.L. Conner, and T.G. Ramesy, 1991, The Affect of Nitrogen Application Techniques on the Growth of Drip Irrigated Flowering Dogwood, Oriental Dogwood, Red Maple, and Mountain Laurel. Proceed. SNA Research Conf. 36:148-151.

4. Cripps, R.W., 1992, N Fertilization on Growth of Field Grown Woody Ornamentals. Proceed. SNA Research Conf. 37:128-132.

5. Matthews, M.R., F.A. Miller, III, R.P. Betson, M.S. Foxx, W.F. Harris, Jr., T.J. Chu, and A.M. Duda. 1984. Ground-Water Situation Assessment of the Tennessee Valley Region. Vol. II B Appendices. Tech Rpt. Series, Div of Air and Water Resources. 345+p. Office of Natural Resources and Economic Development, TVA, Knoxville, Tennessee

6. F.S. Fitzgerald. 1998. Personal Commuications with certified professional geologist.

7. Soileau, J.M. 1988. An Overview of Ground-Water Nitrate and Fertilizer Nitrogen Consumption the Tennessee Valley Region.TVA. Muscle Shoals, AL

8. Warren, S.L., W.A. Skroch, and G.D. Hoyt, 1993, Optimizing Shade Tree Production: Groundcover, Nitrogen Rate, and Timing of Nitrogen Application. Proceed. SNA Research Conf. 38:144-147.