

Field Production

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Response of Field-Grown *Ligustrum* to Granular Fertilizer

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Index words: *Ligustrum japonicum* Thunb.

Nature of work: Nitrogen application recommendations for plants grown in native Florida soils are approximately 6 lb N/1000 sq. ft. per year (1) broadcast in multiple applications to the soil surface at the plant base. Recommendations are based on the premise that fertilizer applications will supply the nitrogen requirement for crops grown in a particular soil type. However, data for woody plant fertilization response are lacking for many of the genera grown in Florida soils. The following study was conducted to determine if the broadcast fertilizer application rate (equivalent to 8.6 lb N/1000 sq. ft. per application) commonly used by a central Florida nursery satisfied the nutrient requirements of *Ligustrum japonicum*.

In September 1995, one-gallon *Ligustrum japonicum* were planted in Myakka fine sand (siliceous, hyperthermic Aeric Haplaquods) at Ellenton Nursery, Parrish, Florida. Plants were spaced 10 ft. within a row and 20 ft. between rows; the experiment consisted of 10 rows of approximately 60 plants each. After planting, one-third gallon of Polystart solution [(8-30-5) 4 pt/100gal, Morse Enterprises Limited, Inc., Miami, Florida] and 0.5 lb Florganic fertilizer (6-3-0, derived from digested sewage sludge, Florida Favorite Fertilizer (FFF), Lakeland, Florida) were applied to soil in a 7 sq. ft. area around base of each plant. In October, 0.25 lb of a 12-4-12 granular fertilizer (FFF) was applied to the 7 sq. ft. area at base of each plant and in January 1996, 0.5 lb of a 12-0-12 granular fertilizer (FFF) was applied to the same area at base of each plant. The latter fertilizer did not contain phosphorus because soil test revealed very high phosphorus in the soil. Subsequently, plants in each of three (0.5 and 1.0 lb rates) or four (0.25 lb rate) random treatment rows received 0.25, 0.5, or 1.0 lb of 12-0-12 applied uniformly to the 7 sq. ft. area per plant. Each rate was equivalent to about 4.3, 8.6, and 17 lb N/1000 sq. ft., respectively, per application. These rates of 12-0-12 were applied in April, June, August, and October of 1996, and April and September of 1997. The 0.25 lb rate was applied to all plants in December 1997.

Plants were irrigated as needed with a pressure compensating Netafim emitter [(1 gal/hr) Netafim Irrigation Inc., Altamonte Springs, Florida]. In November 1995, March 1997 and January 1998 the height, widest width and perpendicular width were measured for ten plants near the center of each row. A growth index was calculated as height plus average width.

Results and Discussion: Plants that received 0.25 or 0.5 lb 12-0-12 per 7 sq. ft. per application had similar growth indices (Table 1) throughout the study. Growth indices for the 1.0 lb rate tended to be smaller in March and January. These data indicate that 0.5 lb of 12-0-12 per 7 sq. ft. per application surpassed the nutrient requirements for *Ligustrum japonicum* in view of a similar plant response for the 0.25 lb rate.

Significance to Industry: Plant response to nitrogen application rate may vary due to factors such as plant species and soil type. Nursery operators should conduct tests to evaluate plant response to fertilizer rates under cultural conditions at the nursery. Data from this study indicate that *Ligustrum japonicum* could be fertilized with one half the application rate (8.6 lb N/1000 sq. ft. per application) commonly used by the nursery.

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Table 1. Growth indices [GI = height (meters) + average width (meters)] for field-grown *Ligustrum japonicum* that either received 0.25, 0.50, or 1.00 lb of 12-0-12 per plant for each of 8 applications during Nov. 1995 to Jan. 1998. Fertilizer was applied to 7 sq. ft. of soil surface at plant base. Data presented are mean \pm standard deviation (n=30).

| Date | Granular 12-0-12 Fertilizer (lb fertilizer / app.) | | |
|-------------------|---|---------------|---------------|
| | 0.25 ^z | 0.50 | 1.00 |
| Nov. 1995 | 0.4 \pm 0.1 | 0.5 \pm 0.1 | 0.4 \pm 0.1 |
| March 1997 | 2.4 \pm 0.5 | 2.4 \pm 0.5 | 1.9 \pm 0.4 |
| Jan. 1998 | 4.0 \pm 0.5 | 3.9 \pm 0.5 | 3.4 \pm 0.6 |

Mycorrhizal Assessment of Ornamental Trees Grown in Tennessee Field Soils

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Index Words: Arbuscular mycorrhizae, *Acer rubrum* 'October Glory', *Cornus florida* 'Cherokee Princess', *Prunus serrulata* 'Kwanzan'

Nature of Work: Arbuscular mycorrhizal (AM) fungi are beneficial soil-inhabiting fungi that naturally establish symbiotic associations within roots of native and crop plants. AM fungi form a network of fungal strands, or hyphae, within and outside of living root tissues, enabling the host plant to increase water, phosphorus, nitrogen, and micronutrient uptake under some circumstances. The benefits of AM fungi are most evident in nutrient-depleted or structurally damaged soils. However, in ornamental nursery field soils where plants may receive regular fertilization and water, the benefits of AM fungi to plant performance are not well defined. Still, mycorrhizal advantages have been aggressively marketed for ornamental production applications. The relationship of field-grown ornamentals and mycorrhizae was explored in November 1999 with a study designed to address two fundamental questions: Do soils in Tennessee's ornamental production areas currently contain populations of AM fungi? Are AM fungi forming associations with trees grown for Tennessee's retail and wholesale trade?

In November, undisturbed soil cores and root and soil samples were collected from production areas surrounding field-grown ornamental trees at four middle Tennessee nurseries and two eastern Tennessee nurseries. The presence and degree of AM associations occurring naturally under production conditions, were assessed in root samples of Red Maple (*Acer rubrum* L. 'October Glory'), Flowering Dogwood (*Cornus florida* L. 'Cherokee Princess'), and Kwanzan Cherry (*Prunus serrulata* Lindl. 'Kwanzan'). Within each nursery, fine-root samples were gathered from 5 plants per cultivar from one 12-inch (30.5-cm) deep hole dug beside each tree. Root samples were labeled, placed in a cooler, and transported to the UTIA research facilities in Knoxville, TN. A composite soil sample comprised of 20 sub-sample units was taken within the nursery production area for each crop and tested for soil pH, soluble salt, potassium, and phosphorus by the UT Soil Testing Laboratory in Nashville, TN.

Mycorrhizal inoculum potential (MIP) of the nursery production soils was also assessed. A 2.25 in x 2.25 in (5.7 x 5.7 cm) modified soil corer was used to gather 5 soil cores from the production rows for each crop at

each nursery. Temperature of the soil, at the time of coring, was also recorded. In a greenhouse, the undisturbed soil cores were maintained at $24\pm 3^{\circ}\text{C}$ and 16:8 (L:D) h and were each planted with 3 *Sorghum bicolor* (L.) Moench. 'DeKalb DK40Y' seeds. Seedlings were grown for 10 weeks, after which roots were carefully harvested. In the laboratory, both *S. bicolor* and tree roots were washed then cleared using a 10% solution of KOH followed by a 3% solution of hydrogen peroxide. To enhance staining intensity, root samples were acidified using a 0.5M solution of HCL. Roots were stained using a 0.05% solution of Trypan blue in lactoglycerol. Finally, roots were kept in lactoglycerol de-staining solution until 2 slides of stained root tissues per sample could be prepared. Using a light microscope, slide-mounted roots were examined for presence of AM fungi. An assessment of the percentage of roots inoculated was made using at least 100 intersections, which were scored with the number of vesicles, arbuscules, and hyphae observed.

Results and Discussion: The ornamental trees sampled in this study had been growing in field soils from 1 to 3 years and presented a range of trunk diameters (Fig. 1). Trees in eastern Tennessee nurseries were generally smaller than trees in middle Tennessee. Regardless of the age or caliper of the trees, only young, fine roots were sampled. These small roots, or rootlets, are continuously regenerated throughout the life of the tree and provide ready inoculation points for AM fungi (10). Overall, field soils in which sampled trees were growing presented a wide range of pH, phosphorus, and potassium levels (Fig. 2). Soil temperatures, which were taken at a depth of 9 in (22.9 cm) were $15\pm 3^{\circ}\text{C}$ ($59\pm 5^{\circ}\text{F}$). *Cornus florida* 'Cherokee Princess' were growing in soils ranging in pH from 4.5 to 7.1 while *Prunus serrulata* 'Kwanzan' trees experienced low to very high soil phosphorus and potassium levels (Fig. 2).

Based on MIP tests, which used *Sorghum bicolor* as a mycorrhizal trap crop, all soils were found to be inoculative, regardless of soil type or nursery location (Fig. 3). Arbuscular structures were clearly visible in sorghum roots and were produced in soils from all nurseries. Mycorrhizal fungi encountered in this study were not identified taxonomically and likely include more than one species. However, mycorrhizal structures, including characteristic hyphae, vesicles, and arbuscules occurred among all 3 species of trees (Fig. 4). Hyphae were generally abundant in all samples while vesicles, the storage and possibly propagative structures of mycorrhizal fungi, were less common. Hyphae and vesicles are formed by several types of fungi in plant tissues and may not represent mycorrhizal forms. The presence of mycorrhizal fungi is generally confirmed, however, by the presence of arbuscules: highly branched, tree-like structures that aid in exchange of substances between mycorrhizae and host. Arbuscules were observed in tree root samples taken

from all nurseries except Fairview Nursery in eastern Tennessee, where only hyphae and vesicles were observed (Fig. 4). As often occurs with woody host species, arbuscules were difficult to observe and counts are probably underestimated.

In field and laboratory tests, several ornamental and crop plants have demonstrated increased drought tolerance, reduced pathogen pressure by competitive exclusion of pathogenic organisms, activation of plant defense mechanisms, increased growth, and general benefits to plant health when colonized by AM fungi (1, 2, 3, 5, 8). Successful artificial inoculation of ornamental plant materials has been achieved during propagation (4, 6, 7, 9). This allows the fungi to mature with the host tissues, requires less fungal inoculum, and is probably the most efficient way to establish this symbiosis. Research, including cost efficiency, is needed to demonstrate greater benefits among field-produced ornamentals from cultured AM fungi than soil-native species.

Significance to Industry: Increasingly in recent years, catalogs and sales literature of several companies have incorporated mycorrhizal inoculation products, which are often marketed for use as an amendment to soil-less media, in propagation, and as an aid to production in field soils. Tests conducted among field soils of middle and eastern Tennessee nurseries revealed that in all soils, native AM fungi colonized seedlings of a *Sorghum bicolor* trap-crop. Roots of 3 economically important tree species had a high degree of naturally-occurring fungal colonization. Ornamental growers in Tennessee do not need to supplement field soils with AM fungi.

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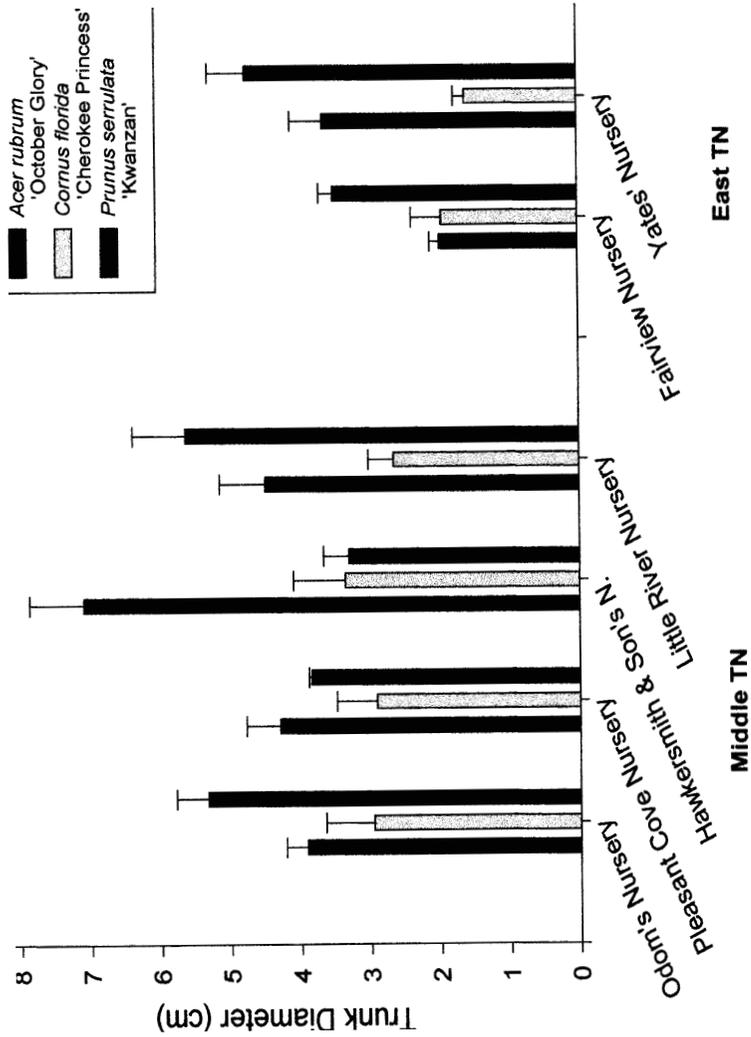


Figure 1. Variation in trunk diameters of field-grown ornamental trees (mean \pm SD of 5 trees per crop), from which fine roots were sampled, in middle (left) and eastern (right) Tennessee nurseries.

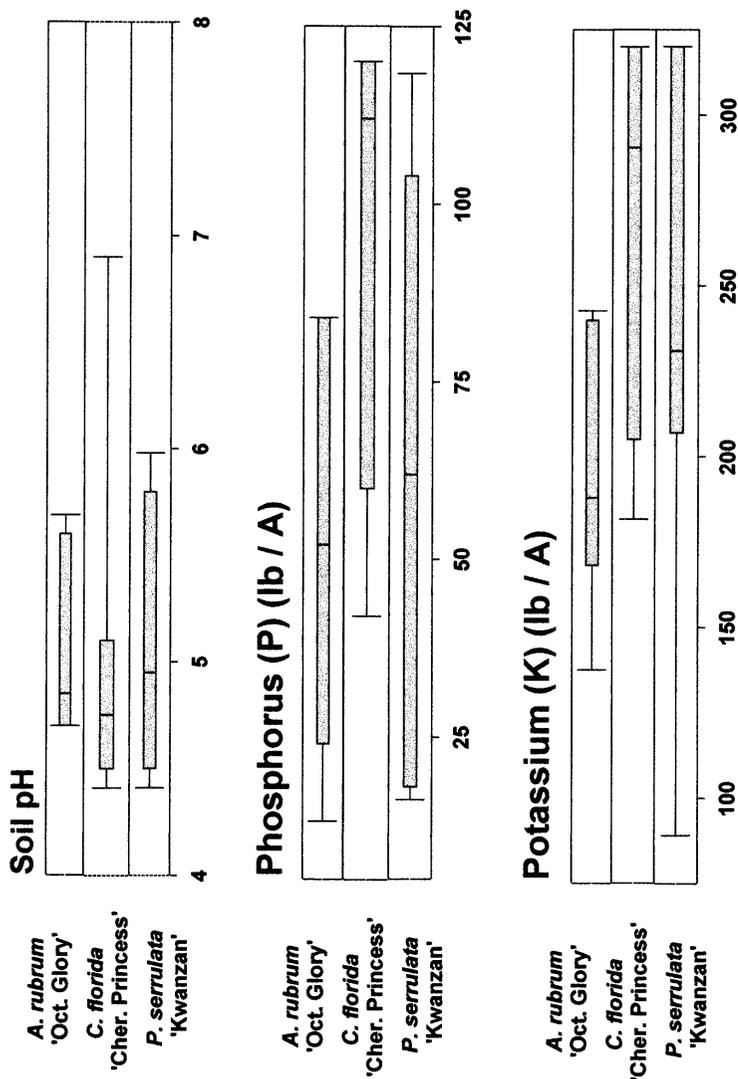


Figure 2. Results of field soil tests from six sampled Tennessee nurseries. The range (shaded area) and median (vertical line within shaded area) of soil pH, phosphorus (P lb/A), and potassium (K lb/A) are shown for each sampled crop.

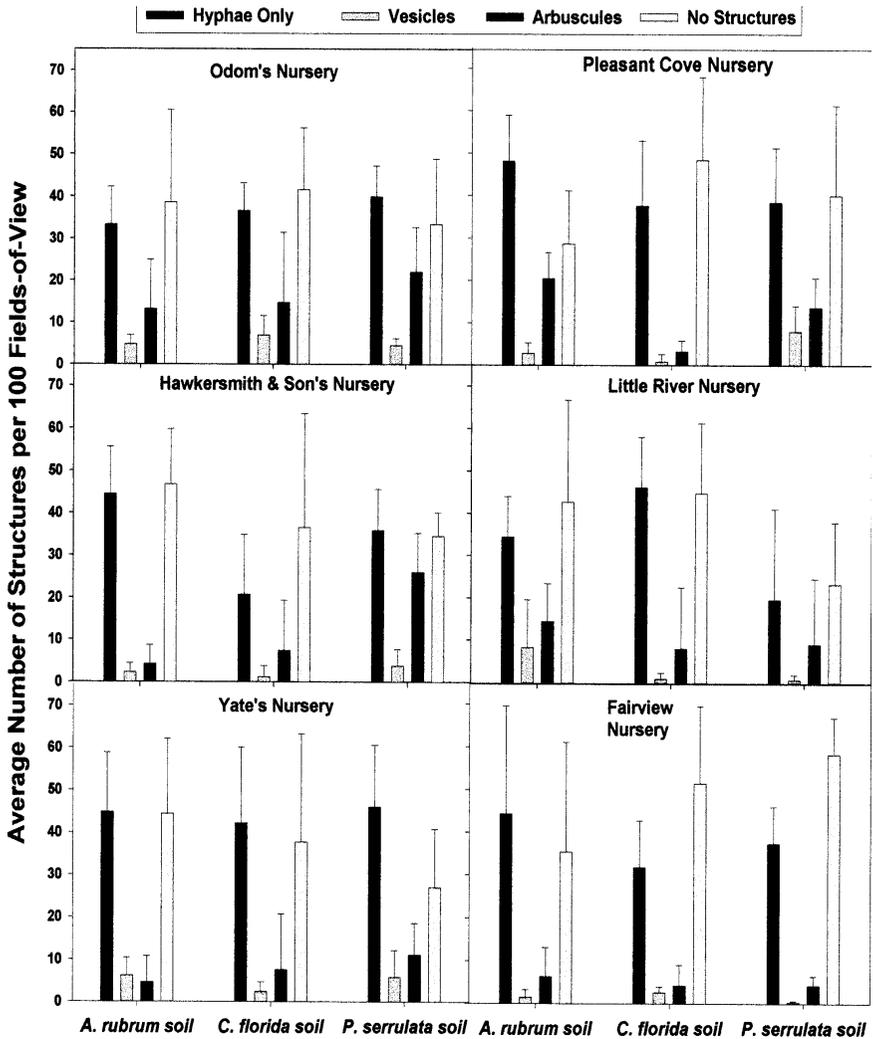


Figure 3. Means (\pm SD) of mycorrhizal inoculum potential (MIP) of field soils collected among field-grown ornamental shade trees in middle (top 4) and eastern (bottom 2) Tennessee nurseries.

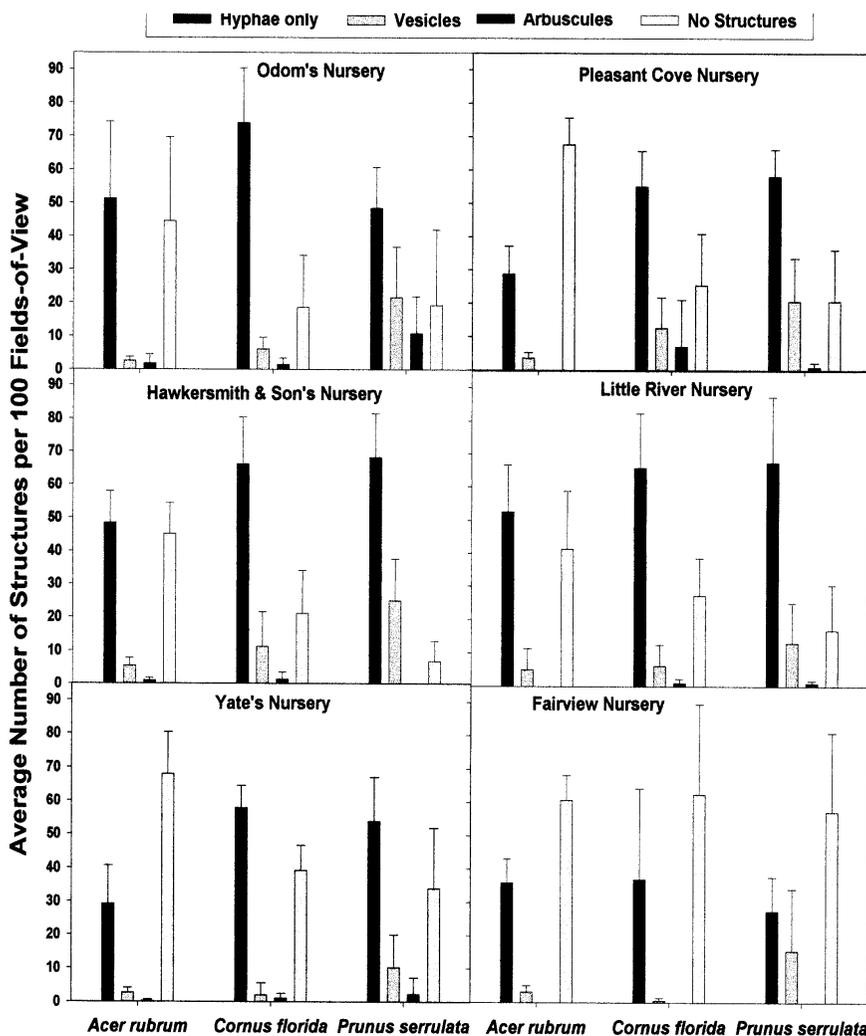


Figure 4. Means (\pm SD) of mycorrhizal structures observed among fine roots of 3 ornamental shade trees in middle (top 4) and eastern (bottom 2) Tennessee nurseries.