# Grass Competition for Nitrogen Around Landscape Trees[1]

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## Abstract

The sod around established saplings was treated with the nitrogenous fertilizer ammonium nitrate and/or the herbicide Roundup (glyphosate). Compared with untreated trees, all treatments increased the shoot growth of black walnut *(Juglans nigra* L.), and the trunk growth of sycamore (*Platanus occidentalis* L.), Norway maple (*Acer platanoides* L.), and honeylocust (*Gleditsia triacanthos* L. inermis Willd.). The response in walnut persisted for 2 growing seasons following application.

**Index words:** fertilization, herbicide treatment, weed competition, yield loss



## Introduction

The roots of plants growing together in a limited volume of soil compete for water, nutrients, oxygen, and space. Trees and shrubs growing in landscape plantings usually coexist with turf grasses. Several studies using woody plants and grasses have partially defined the relative importance of these interacting and interdependent environmental stresses. Greenhouse experiments (2,9) and observations of roots in glass chambers (7) have demonstrated that the suppressing effects of grass on trees can be measured and, when water is not limiting, are most likely due to allelopathy or competition for nitrogen.

Field studies that describe the competition between turf grasses and woody plants have been of short duration (usually 2 years) and have dealt with newly planted apple trees (3,5) or shrubs (4,6,10). Usually the woody plants did not become well-established in the first year, and results were of limited significance. Results from the second year indicated that any suppression of the growth of trees or shrubs was primarily due to competition for nitrogen although allelopathy was occasionally evident. The addition of phosphorus and potassium gave no growth increase (6). Bare soil or mulch, with a minimum radius of 30 cm (12 in), benefited the woody plant. One extended study in a 6-year-old apple orchard, where grass had been established for 2 years, determined that clean cultivation was more important than grass-mowing frequency or nitrogen application (8).

The herbicide Roundup™ (glyphosate) has been shown to be safe for use around young trees and shrubs (1), one or two applications annually to the sod being sufficient to eliminate grass cover. The purpose of this study was to determine the growth of trees established in a grassy site following surface application of a fertilizer and/or herbicide to the sward.

## Materials and Methods

The 4 species of trees used in these trials were black walnut, sycamore, Norway maple, and honeylocust. All were placed in the Illinois Natural History Survey arboretum, 1 mile south of Urbana, IL, as bare-root, 2-year-old seedlings; maple and honeylocust were planted in 1970, sycamore in 1977, and walnut in 1978. The walnuts were spaced 2.1 m (7 ft) between plants, and the other three species were 3.7 m (12 ft) between plants in 100-tree blocks. Average trunk diameters, 1 m above the soil line, prior to treatment in 1980 were: walnut 1.5 cm (0.5 in), sycamore 3.1 cm (1.2 in), maple 8.0 cm (3.1 in), and honeylocust 11.7 cm (4.6 in). The trees were maintained in a bluegrass sod. The grass was mowed weekly or as required.

The sod around the base of the trees was treated with the herbicide Roundup (glyphosate) and/or the nitrogenous fertilizer ammonium nitrate. The circular area of treatment was related to tree size. It was 1.7 m (5.5 ft) in radius around maple and honeylocust and 1.2 m (4 ft) around sycamore. The radius around walnut was 0.6 m (2 ft) in 1980 and 0.8 m (2.5 ft) in 1981 and 1982. Roundup (glyphosate) was applied with a 6-L (1.5 gal) knapsack air compression sprayer at the rate of 4.7 L formulation/hectare (2 qt/A). Ammonium nitrate was uniformly distributed around individual trees by broadcasting at the rate of 880 kg formulation/hectare (6 lb actual N/1000 sq ft).

Thirty trees each of sycamore, maple, and honeylocust were randomly divided to receive (1) Roundup (glyphosate) and nitrogen, (2) nitrogen alone, or (3) no treatment. Each tree received in 1981 the same treatment it had in 1980. The sycamore treatments were repeated in 1982. In the walnut block, previously untreated trees were selected for treatment each year with 10-tree replicates in 1980, 7-tree replicates in 1981, and 15-tree replicates in 1982. In 1982 treatments of walnut varied from the above; they were (1) Roundup (glyphosate) and nitrogen, (2) Roundup (glyphosate) alone, or (3) no treatment. The herbicide and fertilizer treatments were applied on May 2 in 1980 and on May 6 in 1982. In 1981, the herbicide treatment occurred on June 11 following nitrogen treatment on April 13.

Data on responses of sycamore, maple, and honeylocust were determined from annual diameter measurements at established points on the trunks following initial measurements in the spring of 1980. Response data on walnut were determined by measuring the annual linear growth of the topmost (or longest) twig.

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## Results and Discussion

Treatment of the soil with the surface-applied ammonium nitrate or the herbicide Roundup (glyphosate), singly or in combination with the ammonium nitrate, increased the annual growth of trees growing in a bluegrass sod (Table 1). With trees uniformly spaced at 3.7 m (12 ft), the larger trees (honeylocust) responded the least, the smaller trees (sycamore) responded the most. Compared with untreated trees during the years of treatment, nitrogen alone increased the growth of honeylocust by 2%, maple by 4%, and sycamore by 22%. Nitrogen plus Roundup (glyphosate) increased the growth of honeylocust by 4%, maple by 9%, and sycamore by 52%. The increases in the growth of honeylocust and maple were not statistically different from the growth achieved with no treatment.

In the walnut test, the response to a single treatment with nitrogen and/or Roundup (glyphosate) persisted for 2 or more growing seasons. Nitrogen increased growth in the first and second years by 57% and in the third year by 24% compared with the growth of untreated trees. Nitrogen plus Roundup (glyphosate) increased growth in the first, second, third, and fourth years by 92, 77, 27, and 15%, respectively. The increases in growth were statistically significant only during the first and second years following treatment. When Roundup (glyphosate) was applied alone (1982) it increased the growth of walnut by approximately 20%.

The rapid growth of woody plants can be beneficial or detrimental to the landscape. Owners usually prefer that newly planted or transplanted woody perennials attain an optimal size in the shortest reasonable time. These plants should remain at an optimal size for the longest period possible before they become too large for the site. Once established, woody plants in most sites increase in annual growth when nitrogen fertilizers are applied. The percentage increase is greatest when the plants are young and widely spaced, and it decreases as the plants become larger and must compete with additional plants for water, nutrients, and light. Previous studies have shown that grasses compete with and restrict the early growth of woody plants. This study demonstrates that the competition continues through the sapling stage and that benefits of applied nitrogen are increased when the sod around the base of the trunk is killed.

In this study with nitrogen applied at the rate of approximately 300 kg actual nitrogen per hectare (250 lbs/A) in the early spring, it can be postulated that nearly half of the nitrogen was used by grass, since tree growth almost doubled once the competition was eliminated. In another study with lower rates of application, nitrogen was more beneficial to the grasses than to the woody plants (6). Additional variables that would alter nitrogen uptake by each host are plant species and stage of growth, soil moisture and type, as well as time of nitrogen application.

The use of Roundup (glyphosate) to obtain an area free of perennial bluegrass around the woody stem was effective for 2 or more years; however, it did not prevent annual grasses and weeds from inhabiting the treated area by midsummer. In a lawn the use of a mulch to attain the same grass-free site would be more esthetically pleasing.

**Table 1. Annual growth of trees following treatment of the sod with ammonium nitrate and/or glyphospate.**

| Tree species and year of treatment | Glyphosate & Nitrogen | Nitrogen | Glyphosate | Untreated |
|---|---|---|---|---|
| | (Diameter increase, mm) | | | |
| **Sycamore** | | | | |
| 1980 | 21.5** | 15.0 | | 12.5 |
| 1981 | 23.1** | 19.4* | | 15.1 |
| 1982 | 26.6** | 23.8 | | 20.0 |
| **Maple** | | | | |
| 1980 | 16.0 | 15.3 | | 15.0 |
| 1981 | 16.3 | 15.6 | | 15.0 |
| **Honeylocust** | | | | |
| 1980 | 17.3 | 16.9 | | 16.5 |
| 1981 | 18.3 | 18.4 | | 180. |
| | (Height increase, cm) | | | |
| **Walnut** | | | | |
| 1980 1980 | 34.5** | 27.2 | | 18.3 |
| 1981 | 43.7** | 37.8** | | 23.4 |
| 1982 | 83.8 | 81.0 | | 67.6 |
| 1983 | 87.9 | 71.1 | | 76.7 |
| 1981 1981 | 69.9** | 55.9* | | 33.8 |
| 1982 | 134.6** | 114.0** | | 75.4 |
| 1983 | 101.0 | 98.8 | | 77.0 |
| 1982 1982 | 76.2** | | 49.0 | 42.4 |
| 1983 | 71.1* | | 52.8 | 42.9 |

*Significantly different from untreated trees (P = 0.05)
**Significantly different from untreated trees (P = 0.01)

## Significance to the Nursery Industry

Weed scientists for years have provided data that establish the detrimental effects of weeds on field and forage crop yields. This paper contributes to the growing base of data that establish the extent of yield loss of trees from weeds. Young trees that do not shade a substantial portion of their root area may have their potential growth reduced by 50% due to weed competition. If a sufficient quantity is applied, nitrogen fertilization will compensate for a portion of this loss, but a combination of fertilizer and herbicide treatments is significantly more effective.

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# Rooting of Three Landscape Species in Gasifier Residue-Based Propagation Media[1]

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**Abstract**

The rooting of azalea (*Rhododendron indicum* L. 'Prudence'), privet (*Ligustrum sinensis* L.), and boxwood (*Buxus microphylla japonica* L. 'Richardii') hardwood cuttings in 5 propagation media composed of combinations of gasifier residue (GR), Canadian sphagnum peat (P), and/or horticultural perlite (Per) indicated that superior root initiation and root development occurred in several GR:P media mixtures. Rooting of both azalea and privet was greater in the 3GR:1P medium than in 1P:1Per. Boxwood root development was superior in both the 1GR:1P and 3GR:1P media than the 1P:1Per medium. The percent air space of gasifier residue-based media did not change over 16 weeks of greenhouse exposure, however there was nearly a 50% reduction of air space in 1P:1Per medium.

**Index words:** *Rhododendron* sp., *Juniperus, Buxus,* % air space, propagation

## Introduction

The nursery industry has successfully used a large variety of materials and media combinations to propagate woody plant cuttings (4,11,14). Preferred characteristics of a propagation medium are: 1) consistent quality, 2) absence of disease and insect pests, 3) absence of toxic chemicals, 4) ability to hold and supply water, 5) light weight, and 6) adequate drainage and aeration (4,10).

Sphagnum peat moss is a common component in propagation media, however, it has several drawbacks when not properly managed including excessive water retention, poor aeration, high cost and fluctuating supplies. Calcined clay, vermiculite, perlite, expanded plastic, sand, and pine and hardwood bark are among the materials used to improve one or more deficiencies of peat moss (4,14). However, the first 4 components are relatively expensive, and bark is presently being evaluated as an alternative fuel source, as a result supplies may become limited and more costly to the nurseryman in the future. Residue from the gasification of bark and wood chips has been successfully used as a container medium for woody plants (12). Present supplies of residues are limited and localized, however, with the predicted growth of gasifier-based power generation significant quantities may become generally available in the near future. Physical characteristics determined for gasifier residue alone and in combination with pine bark, Canadian sphagnum peat, and/or sand have indicated that a medium composed of 3GR:1P (by volume) has excellent aeration and water-holding characteristics (13).

A major physical characteristic of a successful rooting medium is the % air pore space (6,7,10), which depends on the depth and the particle size distribution of a medium (2,15). Recommendations for medium aeration (air pore space) range from 5 to 30% of the medium volume, depending on the species and the method of measurement (1,2,3,5,9). DeBoodt and Verdonck (2) suggest a 20-30% air pore space based on a medium at 10 cms (4 in) tension for the "ideal substrate." In addition, a medium must be resistant to loss of this aeration during the propagation cycle. Cuttings are commonly misted to reduce net water loss, however, this tends to saturate moderately to poorly drained media, and reduce aeration and subsequent rooting of cuttings. The objective of this study was to determine the potential of several gasifier residue-based media for the propagation of three common landscape species.

## Materials and Methods

Hardwood terminal cuttings [10 cm (4 in) long] of azalea, privet and boxwood were taken on January 3-5, 1983 from stock plants grown in full sunlight. Leaves

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