EFFECTS OF TURF COMPETITION AND FERTILIZER APPLICATION ON TRUNK DIAMETER AND NUTRIENT COMPOSITION OF HONEYLOCUST[1]

by Houchang Khatamian, John C. Pair and Robert Carrow

Abstract. Bare-root field grown honeylocust (*Gleditsia triacanthos* 'Skyline') was planted in established bermudagrass and fertilized at planting with two rates each of Nitroform (38-0-0) and ProGrow (31-5-6). A 60 cm turf clearing around the tree trunk was maintained using glyphosate. Tree trunk diameter was the same for the first growing season regardless of the treatment. In the second growing season, Nitroform at 227 g/tree resulted in greater trunk diameter than the control plants. ProGrow at 278 g/tree gave growth similar to the Nitroform. Doubling the fertilizer rate did not increase tree growth. Fertilized plants had a greater foliar N and chlorophyll content and appeared greener than the control plants.

Transplanting landscape tree species into a turfgrass sod may be harmful to the normal establishment and overall growth of woody plants. Rapidly growing turfgrass species, such as bermudagrass (*Cynodon dactylon*), tend to grow around the tree trunk where they may compete with tree roots for water and nutrients. This problem seems to be more of a detriment to tree growth when young trees are transplanted into a mature and established turf since the turfgrass already has a well-developed root system.

The beneficial effects of fertilizing established trees and shrubs are well-known. However, information on fertilizer application to ornamental trees and shrubs at planting time is rather limited. A general recommendation has been that tree fertilization should start after the establishment of trees, i.e. one to two years after planting (4). Fertilizing of trees at planting, therefore, has not generally been practiced or recommended.

Harris (3) found that the trunk circumference and height of *Magnolia grandiflora* and *Zelkova serrata* were slightly greater where turfgrass was not a competitor. Application of N fertilizer increased tree growth, particularly those trees that had turf growing around their trunks. Root growth of sycamore maple (*Acer pseudoplatanus*) was significantly reduced by a full cover of perennial ryegrass (*Lolium perenne*) (8). Leaf and stem growth of sycamore maples also was decreased. Silver maple (*Acer saccharinum*) rooting was restricted when planted in an established Kentucky bluegrass (*Poa pratensis*) sod (10). Similar growth reductions were noted with aspen (*Populus tremuloides*), silverberry (*Eleagnus commutata*), and Western snowberry (*Symphoricarpos occidentalis*) when these species were grown in a bromegrass (*Bromus inermis*) sod (2).

In a more recent study (11), *Ilex cornuta* 'Burford Nana,' *Juniperus chinensis* 'Hetzi,' *Pinus thunbergi* and *Ligustrum vicaryi* were grown in established bermudagrass, using one of three clearings (0, 75, and 150 cm) and three fertility treatments (fertilizer applied on ground surface). All plants grew much larger when turf was cleared from the base of the plants. Except for holly and privet, the plant response was the same for the two sizes of turf clearings.

In another study (7) growth and development of forsythia (*Forsythia intermedia* 'Lynnwood Gold'), azalea (*Rhododendron* X 'Corsage'), yew (*Taxus media* 'Hicksii'), and Japanese barberry (*Berberis thunbergii*) were suppressed significantly when grown in a two-year-old stand of Kentucky bluegrass, red fescue (*Festuca ruba*) and colonial bentgrass (*Agrostis tenuis*). Additional fertilizer applied to the turfgrass was evidently more beneficial to the sod than to the shrubs. Percent foliar N was higher for forsythia, azalea and yew in the bare ground and bark mulch treatments than in

1. Contribution No. 84-44-J, Department of Horticulture, Kansas Agricultural Experiment Station. This research was supported in part by the BFC Chemicals Inc. and The Kansas Arborists Association. Honeylocust plants were courtesy of J. Frank Schmidt and Son. Nitroform and ProGrow were supplied by BFC Chemicals and O.M. Scott Co., respectively.

the turf treatments.

The objectives of the present research were to determine the effect of fertilizer application at planting time on tree growth, in the presence or absence of a turfgrass sod.

Materials and Methods

On June 6, 1980, honeylocust (*Gleditsia triacanthos* 'Skyline') trees were planted in a five-year-old stand of a hybrid clone of bermudagrass in a clay loam located at the Wichita Horticulture Research Center. Bermudagrass was chosen since it is a deep-rooted, warm season turf with the potential to compete vigorously with tree establishment. The turfgrass was mowed, watered and fertilized adequately prior to and during the period of the trial. All of the trees were bare-root field grown stock measuring 2.0 to 2.5 cm in diameter and 1.8 to 2.4 m in height.

Treatments (Table 1) consisted of: 1) no turf clearing vs. turf clearing to a 60 cm diameter around the tree base, and b) fertilizer application at planting with Nitroform (38% N) at 227 or 454 and ProGrow (31-5-6) at 278 or 556 grams applied per tree. In addition each treatment was supplemented with 227 g of superphosphate (20%) and 75 g of potash (0-0-60). ProGrow treatments received less phosphate and potash to compensate for 5 and 6% phosphate and potash present in the formulation. No N fertilizer was applied to the control trees.

Tree holes were dug with a 50 cm diameter auger mounted on a tractor. To ensure proper root distribution, the smooth, hard surface created by the auger was broken up with a spade prior to planting. Trees were kept in cold storage and placed in a large container filled with water prior to planting. Corrective root and shoot pruning was done as needed at planting. The experiment was a split plot design consisting of three replications and a total of 30 trees planted at a spacing of 2.1 × 2.4 m.

Fertilizers were applied around the tree root zone while backfilling the planting hole. Caution was exercised so that root contact with the fertilizer particles was minimized. Equal amounts of water were applied to each tree by means of a watering basin 20 cm in height around the trunk at planting time and throughout the trial period as needed. Turf was watered regularly and fertilized with 1 lb N/1000 sq. ft. three times in the season.

Plant growth was monitored periodically by taking trunk diameter measurements at 15 cm above the ground. The trunk diameter is strongly correlated to the overall shoot growth and it is a good substitute for shoot growth measurements in deciduous woody plants (5).

A 60 cm turf clearing around the tree trunk was maintained by spraying glyphosate herbicide, at a concentration of 20 ml in one liter of water, on the tree base.

During July 1981, healthy leaves with petioles attached were collected from the midsection of the current season's growth of each tree and prepared for tissue analysis by standard procedures. N and P were determined on the sulfuric acid digest (6) using a Technicon colorimetric autoanalyser. Chlorophyll was determined using the procedure of Arnon (1).

Results and Discussion

Tree growth. Turf competition and the fertilizer treatments did not significantly affect the trunk diameter of honeylocust during the first growing season (Table 1). The growth rate during the first

Table 1. Effect of turf competition and fertilizer application on trunk diameter of 'Skyline' honeylocust[y]

Treatment	*New growth 1980 (cm)*	*Total growth 1980-81 (cm)*	*Total diameter increase %*
Fertilizer (g/tree)			
Nitroform 227	0.18	1.27	53.2
454	0.20	1.31	54.5
ProGrow 278	0.24	1.27	51.2
556	0.26	1.09	48.4
Control	0.24	0.83	33.2
Turf clearing			
yes	0.24	1.18	49.0
no	0.21	1.13	46.6
LSD (5%)			
FT[z]	n.s.	0.16	19.0
TC	n.s.	n.s.	n.s.
FT × TC	n.s.	n.s.	n.s.

[z] FT = fertilizer treatment, TC = turf clearing.
[y] Trunk diameter measurements were made in October 1980 and October 1981.

season was slower than the second one, probably due, at least in part, to the extreme and unusual heat and drought of the summer of 1980.

After two growing seasons, plants receiving 227 grams of Nitroform with turf clearing grew better than the control plants. At the lower rate, the ProGrow treatment resulted in a trunk diameter increase similar to that from Nitroform. Doubling the fertilizer rate did not significantly increase tree growth. In fact, trees receiving 556 grams of ProGrow actually grew less than those fertilized with half that amount. Twice the rate obviously was more than the amount needed to obtain optimum tree growth. Although 227 g/tree Nitroform gave almost the same trunk diameter increase as twice the amounts, one cannot be certain how this compares with an optimum fertilizer level since only two rates were used. Future research is needed to investigate this point.

Turf clearing around the tree trunk tended to have no significant effect on trunk diameter increase. Perhaps the competition from the turfgrass in the present study was not as harmful to honeylocust as that reported for other species in the literature (6, 7, 11). Also, in the present study the honeylocust trees were irrigated separately from turf.

Additional N favored the growth of trees, as measured by trunk diameter, regardless of the turf clearing. Nielsen and Wakefield (7), reported that additional fertilizer as a top dressing was more beneficial to the turfgrass than the shrubs. The fertilizer in the present study was placed in the hole around the root system of the trees and beneath the turfgrass roots.

Foliar N, P, and chlorophyll. The foliar N concentration (% of dry weight) of honeylocust receiving Nitroform and ProGrow was greater than those of the control plants (Table 2). Trees receiving 454 grams of Nitroform had the highest N level (2.51%) compared to the lowest N level (1.56%) found in control trees. Plants with turf growing around their trunk had significantly less foliar N than those without turf regardless of the fertilizer application. This lower foliar N level was apparent particularly with the control plants.

Richardson (8), and Nielsen and Wakefield (7) also reported that turf competition had a negative effect on foliar N content. Apparently, there is a competition for N between the tree and turf roots which results in limiting the tree growth. Doubling of the rate of applied fertilizer increased the leaf N level with both fertilizer carriers. Plants with high N level visually appear greener than those with a lower N content. Whether at single or double rate, the Nitroform resulted in higher leaf N than ProGrow. As expected, control plants had the lowest foliar N. The foliar N levels of trees receiving Nitroform or ProGrow were within the guidelines recommended for deciduous trees (9). However, the N content of control trees was somewhat below the recommended standards.

The foliar P concentrations of fertilized trees were similar, but control trees had a significantly higher P level (Table 2). The only explanation for such disparity may be that the fertilized trees had a dilution effect as a result of higher growth rate when compared to the control trees, or P may have accumulated if N was somewhat limiting.

Turf competition had no effect on the leaf chlorophyll (a + b) content (Table 2). The trees receiving N fertilizer had a higher leaf chlorophyll level than the control trees. The highest chlorophyll level in the leaf tissue (3.41 mg/g fresh wt.) was observed in trees receiving 454

Table 2. Effect of turf competition and fertilizer application on foliar N, P and Chlorophyll concentration of 'Skyline' honeylocust.

	Foliar tissue analysis[z]		
	N	*P*	*Chlorophyll*
Treatment	*(% of dry wt.)*		*(mg/g fresh wt.)*
Fertilizer (g/tree)			
Nitroform 227	2.22	0.16	2.62
454	2.51	0.18	3.41
ProGrow 278	1.93	0.18	2.28
556	2.17	0.18	3.22
Control	1.56	0.32	1.31
Turf clearing			
yes	2.22	0.21	2.77
no	1.95	0.19	2.39
LSD (5%)			
FT[y]	0.23	0.05	0.55
TC	0.14	n.s.	n.s.
FT × TC	n.s.	n.s.	n.s.

[z] Foliar samples were taken in July 1981

[y] FT = fertilizer treatment, TC = turf clearing

grams of Nitroform compared to the lowest (1.31 mg/g fresh wt.) level found in the control plants (Table 2). Trees with a higher chlorophyll level were greener in appearance than the ones with a lower chlorophyll content. The increased levels of foliar N and chlorophyll in the plant tissue are desirable in woody ornamental trees and shrubs to enhance the quality and growth of these plants. It is evident from these data that fertilizers from slow release carriers can be applied safely at planting time to increase tree growth and quality, especially under turf competition.

Literature Cited

1. Arnon, D.I. 1949. *Copper enzymes in isolated chloroplasts: polyphenoloxidase in Beta vulgaris.* Plant Physiol. 24: 1-15.
2. Baily, A.W., an R.K. Gupta. 1973. *Grass-woody plant relationships.* Can. J. Plant Sci. 53: 670-676.
3. Harris, R.W. 1966. *Influence of turfgrass on young landscape trees.* Proc. Int. Hort. Congr. 17: 80.
4. Harris, R.W. 1983. Arboriculture, care of trees, shrubs and vines in the landscape. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.
5. Khatamian, H. and R.J. Hilton. 1977. *The relationship between shoot growth and area of trunk cross-section in several woody plant species.* HortScience 12(3): 255-257.
6. Linder, R.C. and C.P. Harley. 1942. *A rapid method for the determination of nitrogen in plant tissue.* Science 96: 464-466.
7. Nielsen, A.P. and R.C. Wakefield. 1978. *Competitive effects of turfgrass on the growth of ornamental shrubs.* Agron. J. 70: 39-42.
8. Richardson, S.D. 1953. *Root growth of Acer pseudoplatanus L. in relation to grass cover and nitrogen deficiency.* Meded. Landbouw. Wageningen. 53: 75-97.
9. Smith, E.M. 1972. *A survey of foliar mineral element content of nursery-grown ornamentals.* HortScience 7(3), Sec 2:321.
10. Whitcomb, C.E. and E.C. Roberts. 1973. *Competition between established tree roots and newly seeded Kentucky bluegrass.* Agron. J. 65: 126-129.
11. Whitcomb, C.E. 1981. *Response of woody landscape plants to bermudagrass competition and fertility.* J. Arboric. 7(7): 191-194.

Department of Horticulture
Kansas State University
Manhattan, Kansas 66506

ABSTRACT

SHIGO, A.L. 1983. **Trees—treatments and tradeoffs.** Arbor Age 2(6): 16-17, 20-21.

Arborists have a very difficult job. They must constantly make rapid decisions on what to do for the client's trees. The decisions must be based on a great number of factors: tree species, location, soil type, wounding history, pruning history, hazard risk, environment, regulatory laws, owner's wishes, etc. It is not easy, yet some decisions must be made in a short time. Time is money. You won't make much money talking to the tree or to the tree owners. Neither will help the tree. Nature does not deal in absolutes. There will always be exceptions to every rule or recommendation. Controversy, even arguments, arise when a new adjustment for an old treatment is discussed. I know this very well as a result of our work on wound dressings, cavity filling, scribing, cabling and bracing, injections, and pruning. The purposes of this article are to discuss briefly these subjects in light of what a tree is, and to indicate that there always are trade-offs that must be made with the new adjustments.