FERTILIZATION IMPROVES BLACK WALNUT GROWTH ON A POORLY DRAINED SITE

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The average height and diameter of black walnut seedlings treated with 12-12-12 analysis fertilizer at the time of planting on a poorly drained site were significantly greater than that of unfertilized seedlings. Both method of placement and rate of fertilizer application positively influenced growth.

Until black walnut (*Juglans nigra* L.) seedlings reach a certain size, they are highly susceptible to weed competition and damage from late spring frosts. Shortening this period by increasing growth through fertilization is one way to minimize this problem. Because method of fertilizer placement has been found to influence fertilizer effectiveness (*7*), this study was initiated to see what effects the method of fertilizer placement and rate of fertilizer had on black walnut growth[1].

Methods

In the spring of 1971, 240 year-old black walnut seedlings were planted at a 3- by 3-meter spacing on the Kaskaskia Experimental Forest in Hardin County, Illinois. The seedlings were planted in a randomized block design containing four blocks with six seedlings per plot. The soil in the area is somewhat poorly drained Wakeland silt loam with slow to moderate permeability and is subject to spring flooding. The soil has been classified as questionable for growing black walnut (*4*).

Ten treatment combinations including three methods of fertilizer placement and four fertilizer rates were used. The fertilizer rates were 0, 13, 227, and 340 grams of 12-12-12 (nitrogen, phosphorus, and potassium) analysis fertilizer per seedling (approximately 0, 136, 272, and 403 kg/ha). The methods of placement were broadcasting, placing in holes, and mixing with the soil. Broadcasting consisted of spreading the fertilizer in a 0.6-meter radius circle around each seedling. Placing in holes consisted of making three equally spaced 0.3-meter deep holes 0.3 meter from each seedling, dividing the fertilizer equally among the three holes, and covering the fertilizer with soil. Mixing with soil consisted of removing the soil from a 0.3-meter diameter by 0.5-meter deep area, mixing it with fertilizer, replacing the mixture, and planting the seedling.

The study site had a well-developed tall fescue (*Festuca arundinacea*) sod that was plowed, disked, and rototilled before planting. Weeds were controlled by spraying a mixture of atrazine, dalapon, and simazine in a 0.6-meter radius circle around the seedlings each spring for 3 years.

Total seedling height and diameter at 0.3 meter above the ground were recorded annually. The data were subjected to analysis of variance and comparisons among treatments were analyzed by linear contrast.

Results and Discussion

After 7 years, both the average height and diameter of the fertilized seedlings were significantly (0.05 level) greater than that of the unfertilized seedlings (fig. 1, table 1). Seedling height and diameter growth were also significantly influenced by fertilizer rate. Seedling heights were significantly different at the 113- and 340-gram rates, and seedling diameter was significantly different at the 340-gram rate (figs. 1 and 2). Seedlings growing in plots where the fertilizer had been mixed with the soil were taller and had larger diameters than seedlings in plots where the fertilizer had been broadcast or placed in holes, but these differences were not statistically different (figs. 1 and 2).

The superior growth of seedlings in plots where the fertilizer had been mixed with the soil was probably due to the better distribution of the fertilizer and the improved aeration. This allowed more root contact, deeper root growth, and hence greater uptake of nutrients. Although no roots were excavated in this study, broadcast fertilizer application appears to encourage shallow rooting and hole placement ap-

[1]This experiment was planned by Robert E. Phares.

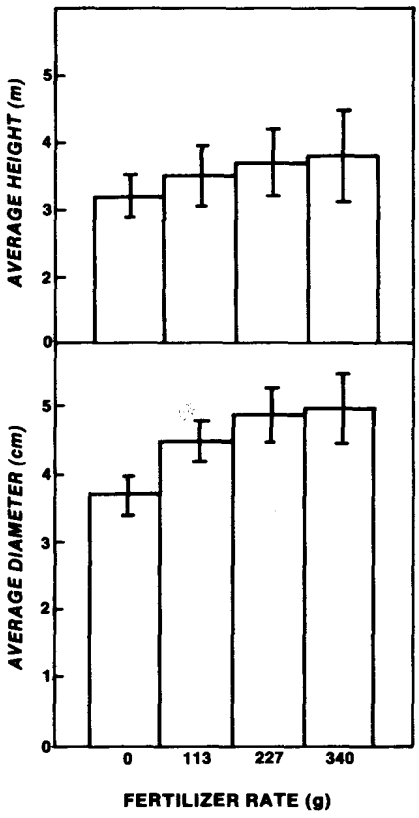

Figure 1.—*The effect of fertilizer rates on height and diameter growth of black walnut after 7 years.*

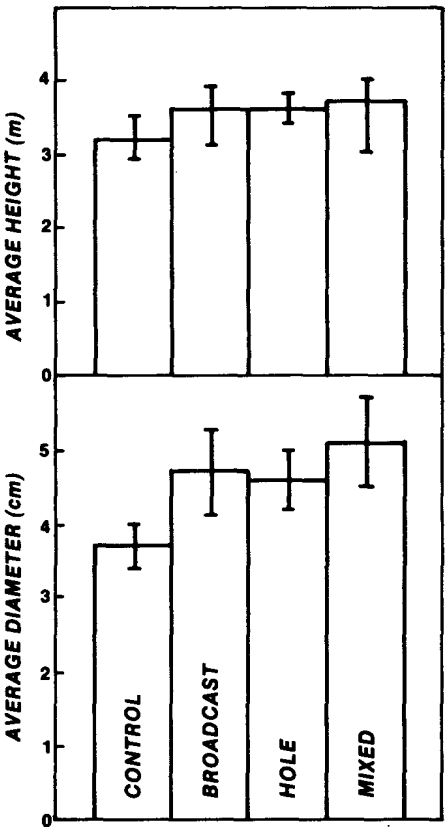

Figure 2.—*The effect of fertilizer placement on height and diameter growth of black walnut after 7 years.*

pears to encourage roots to be concentrated in small areas near the fertilizer (*7*).

In the third growing season, the seedlings were subjected to a hard early spring frost. Fertilized seedlings were more severely damaged but recovered more quickly from the frost damage than did unfertilized seedlings. Fertilization may have reduced the frost-hardiness of the seedlings in a fashion similar to that described by Yasunobu (*8*) for Japanese chestnut (*Castanea cremata* Sieb. & Zucc.).

The slow rate of growth during the first year is not unusual for black walnut. However, neither height nor diameter growth for the 7 years was as good as might be expected on a good black walnut site (*6*). Utilizing site index curves developed by Losche and Schlesinger (*5*), fertilization increased the site index in this study from 35 to 39. Funk et al. (*2*) found that planting a mixture of black walnut and autumn-olive (*Elaeagnus umbellata* Thunb.), a nitrogen-fixing plant, increased the site index from 40 to 57 on a marginal black walnut site. Losche (*3*) reported that the growth of black walnut on imperfectly drained soils is limited in part by the reduced rooting zone. Moreover, Auten (*1*) reported that permeable soil is important for black walnut growth. Therefore, much of the poor growth in this study is probably due to the slow permeability of the poorly drained soil.

Practical Applications

The cost of fertilizer and placement averaged $1.50 per seedling. Fertilized seedlings averaged 0.5 meter taller and 1 centimeter larger in diameter than unfertilized seedlings after 7 years. Mixing the fertilizer with the soil was most effective, but cost the most. It is too early to recommend fertilization or a method of fertilizer placement, but it is encouraging that the application of fertilizers at the time of planting can improve the growth of seedlings on marginal sites. However, the recent results of Funk et al. (*2*) indicate

Table 1.—*The effect of fertilizer placement and rates on the average cumulative height and diameter growth of black walnut for 7 years*

Type of fertilizer placement	Fertilizer rate (g)	Height (m)							Diameter (cm)						
		1971	1972	1973	1974	1975	1976	1977	1971	1972	1973	1974	1975	1976	1977
Control	0	1.0	1.1	1.4	2.0	2.5	3.0	3.2	0.4	1.4	1.4	1.6	2.4	3.1	3.7
	113	1.0	1.1	1.5	2.1	2.6	3.1	3.4	0.5	1.5	1.2	1.9	2.8	3.4	4.1
Broadcast	227	1.0	1.2	1.7	2.3	2.9	3.4	3.6	0.5	1.8	1.5	2.4	3.2	4.6	4.9
	340	1.0	1.1	1.7	2.4	3.0	3.6	3.9	0.5	1.7	1.4	2.2	3.1	4.1	5.0
	113	1.0	1.1	1.5	2.2	2.8	3.3	3.6	0.5	1.5	1.3	1.8	2.7	3.6	4.3
Hole	227	1.0	1.1	1.6	2.2	2.8	3.3	3.6	0.5	1.7	1.3	2.0	2.9	3.7	4.6
	340	1.0	1.4	1.7	2.3	2.9	3.5	3.7	0.5	1.7	1.2	2.2	3.3	4.1	5.0
	113	1.0	1.1	1.6	2.2	2.8	3.3	3.6	0.5	1.7	1.4	2.2	3.1	4.0	5.0
Mixed	227	1.0	1.1	1.7	2.5	3.0	3.6	3.8	0.6	1.7	1.4	2.1	3.4	4.3	5.4
	340	1.0	1.2	1.6	2.5	3.1	3.7	3.9	0.5	1.7	1.3	2.1	3.3	4.0	4.9

that greater growth might be realized on marginal sites by planting a mixture of autumn-olive or some other nitrogen-fixing plant.

Summary

An application of 12-12-12 analysis fertilizer at the time of planting can stimulate growth of black walnut seedlings planted on Wakeland silt loam soils. However, growth does not equal that of black walnuts planted on good sites.

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