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LIMING SOILS ABOVE pH 5.2 DOES NOT INCREASE *POPULUS* GROWTH

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ABSTRACT.--Describes a 5-year study of the effects of different liming rates on soil pH, and on *Populus* growth.

KEY WORDS: *Populus*, soil pH, lime rate, depth, year, growth.

Soil pH of 6-7 was once thought necessary for optimum growth of *Populus* (Smith 1957, Smith and Blom 1966). Later studies show wider pH ranges to be acceptable for *Populus* growth (Burg 1980, Wolkowski and Schulte 1980, Timmer 1983). However, none of these studies were conducted in a long-term field planting involving intensively cultured *Populus* plantations.

To determine the pH range that would promote good *Populus* growth in intensively cultured plantations, we studied the effects of different liming rates on soil pH and related the resulting soil pH's to *Populus* growth. In addition, the change in soil pH was monitored for 5 years.

PROCEDURE

The study site was an old field at the Harshaw Forestry Research Farm near Rhinelander, Wisconsin. It had a well-drained Pence sand with pH that averaged about 5.2 to 5.6 throughout the upper 46 cm. This was the most acid soil at the Research Farm.

Nine 11- x 11-m treatment plots were replicated three times, trees were spaced at 1 x 1 m. Treatment plots were limed in the fall of 1980. Three rates of lime were applied: 0, 16, and 31 mt/ha. The lime was incorporated into the soil to a depth of 15 cm with a rototiller. The plots were planted in the spring of 1981 with hardwood cuttings of *Populus* clone NC-9922 (the parentage of this clone is unknown, but it appears morphologically similar to *P. deltoides* var. *Angulata* x *P. trichocarpa*). This clone was chosen for its superior growth rate.

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After each growing season, we measured the heights of 25 trees in the center 5- x 5-m core of each plot. Diameters (d.b.h.) were measured only the last 3 years of the study. Soil samples were taken at the 0- to 13-cm, 13- to 25-cm, and 25- to 46-cm depths, except during the third year, and pH was determined in the laboratory by the soil slurry/glass electrode method (University of Wisconsin-Extension) and recorded as soil pH in water (pHw). Data were analyzed by ANOVA.

The plots were manually fertilized with granular NH4NO3 at the rate of 112 kg N/ha/year. When soil moisture tension, as monitored by tensiometers, reached 0.5 bars, the trees were irrigated.

Weeds were controlled with a pre-plant application of Linuron (2 lbs. A.I./acre) and occasional spot applications of glyphosate herbicide in the first 2 years.

RESULTS AND DISCUSSION

Liming produced significant changes in soil pH by depth and time. The highest application rate of lime raised soil pH at the 0- to 13-cm depth from 5.2 to 7.0 during the first year and to 7.5 by the fifth year (table 1). At the 13- to 25-cm depth, soil pH increased from 4.9 to 5.6 the first year, and then to 6.8 by the fifth year, reflecting the gradual leaching of lime through the soil. At the 25- to 46-cm depths, pH showed little change over the 5 years. Although liming significantly increased pH in the upper 25 cm of soil, treatments

did not differ significantly in either tree heights or diameters after 5 years. Tree height and diameter showed no response to liming and were similar for all treatments (table 2).

Table 1.—*Soil pH at three depths, before liming and 1 and 5 years after liming. (pH values not followed by the same letter are statistically significant based on Tukey's procedure.)*

Lime aplied (mt/ha)	Soil depth	Year 0	1	5
	cm			
0	0-13	5.3 ab	5.2 ab	5.4 ab
16	0-13	5.2 ab	6.7 c	7.2 cd
31	0-13	5.2 ab	7.0 cd	7.5 d
0	13-25	5.2 ab	4.9 a	5.5 ab
16	13-25	5.3 ab	5.4 ab	6.7 c
31	13-25	5.1 ab	5.6 ab	6.8 cd
0	25-46	5.6 ab	5.3 ab	5.8 b
13	25-46	5.5 ab	5.4 ab	5.8 b
31	25-46	5.4 ab	5.1 ab	5.7 b

Table 2.—*Tree heights and diameters 5 years after liming. Standard deviations are shown in parentheses.*

Lime applied (mt/ha)	Tree height	Diameter
0	7.3 (1.095)	5.0 (1.777)
16	7.1 (0.978)	4.9 (1.480)
31	7.5 (0.868)	5.2 (1.416)

Soil pH in the range of about 5.0 to 7.5 seems adequate for growth of hybrid *Populus* clones similar to NC-9922. However, there is some evicence that lime should be applied before planting if soil pH tests below 5.0 (Wolkowski 1980). If soils are limed, they should not need retesting for pH for several years (at least 5 years in our study) because we found that pH levels did not decrease over that time.

LITERATURE CITED

Burg, Van Den J. 1980. **The influence of pH on the growth and foliar composition of Poplar.** Populier. 17(2): 27-31.

Liegal, E. A.; Simpson, C.; Schulte, E., eds. 1970. **Wisconsin procedures for soil testing, plant analysis and feed and forage analysis.** Soil Fert. Ser. 6. Madison, WI: University of Wisconsin, Department of Soil Science, College of Agriculture and Life Sciences. 4 p.

Smith, J. H. G. 1957. **Some factors indicative of site quality for black cottonwood (*Populus trichocarpa* Torr. & Gray).** Journal of Forestry. 55(8): 578-580.

Smith, J. H. G.; Blom, G. 1966. **Decade of intensive cultivation of poplars in British Columbia shows need for long-term research to reduce risks.** Forestry Chronicle. 42(4): 359-376.

Timmer, V. R. 1983. **Growth and nutrition of hybrid poplar cuttings at varying soil pH.** In: Agronomy abstracts, 1983 annual meeting;1983 August 14-19; Washington, DC. Madison, WI: American Society of Agronomy: 212.

Wolkowski, R. P.; Schulte, E. E. 1980. **The effect of soil pH on the growth of tissue-cultured hybrid poplars in the nursery.** In: Agronomy abstracts, 1980 annual meeting;1980 November 30-December 5; Detroit, MI. Madison, WI: American Society of Agronomy: 207.

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