Root Initiation and Development in Sycamore Seedlings and Cuttings

After one growing season, cuttings produced greater root and top-dry-matter. Height and diameter growth of both seedlings and cuttings increased significantly with deeper planting.

H. E. Garrett

Associate Professor of Silviculture School of Forestry, Louisiana Tech University, Ruston, Louisiana

Research for the paper was conducted while the author was a graduate student at Southern Illinois University, Carbondale, Illinois.

Various researchers (3,5,7) have demonstrated that sycamore *(Platanus occidentalis L.)* can be satisfactorily grown from either cuttings or seedlings. However, few reports deal with rooting relationships and the links of roots to growth-either height or diameter-even though the vigor and degree of establishment of the plant may be highly dependent upon the development of its root system. Recent advancements (2,6,9,10, 11,12) in the growth and utilization of juvenile sycamore fiber resulting from the "short rotation concept" manifests the need for additional root-growth knowledge, especially as it relates to possible coppice regeneration candidates. The objective of this study was to explore further the rootgrowth correlations of sycamore.

Methods

To better understand the rootgrowth response, a November planting of both cuttings and seedlings was made at two depths-10 and 20 inches. The planting site, one mile southwest of Carhondale, Illinois, was surrounded by flourishing natural stands of the study species. The soil was a silt loam of the Bonnie series having low organic matter, slow permeability, and a high available water capacity.

Treatment consisted of placing onehalf pound of 12-12-12 fertilizer, contained in a perforated bag, in an 8-inch diameter hole and covering the bag with approximately 3 inches of soil before the planting stock was positioned. Following planting, all exposed tops were sheared at ground level. Weed control was mechanical with both mowing and shallow cultivation used. In total, 26 replications of four trees each were established.

After one growing season, twelve replications of intact plants were removed by using a trenching machine and digging forks. Root development and top growth were measured and analyzed. Fourteen additional replications were removed at weekly intervals during the late winter and early spring to establish further the time and characteristics of rooting.

During the study period, neither precipitation nor temperature varied significantly from their respective annual averages. Precipitation measured 40.63 inches, while the mean annual temperature was 58.1°F. However, the spring season did deviate from normal with March, April, and May having a combined precipitation deficit of 5.39 inches. The average temperature for March was 38.3°F, a departure of -7.9°F from normal, while April and May had above average temperatures of 61.9 and 71.5°F, respectively.

Results and Discussion

Root growth does not occur during the winter and early spring when sycamore is planted in Southern Illinois, although winter growth has been -reported for this species under milder climatic conditions (7). Root initiation for 10-inch plantings of both cuttings and seedlings occurred during the last two weeks of April, whereas 20-inch plantings showed no root development until the first two weeks of May-a lag of approximately two weeks. Rooting occurred first on the old root system of both shallow- and deep-planted seedlings, and on cuttings in the vicinity of injured basal tissue. In all instances bud-break preceded root-growth initiation, a phenomenon also observed by others (1,8).

After one growing season no significant differences were detected between the root systems or height and diameter growth of cuttings and seedlings. Cuttings did, however, produce greater root- and top-dry-matter than did seedlings-an average of 201.5 to 181.5 grams of root material and 226.6 to 215.1 grams of top material, respectively. Bole weight of cuttings and seedlings was comparable; however, cuttings produced an average of

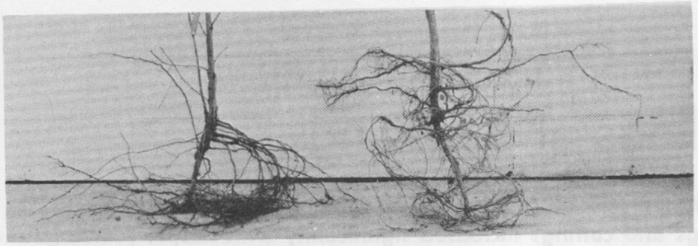

Figure 1.—The effects of 10- and 20-inch planting depths on root development in sycamore seedlings.

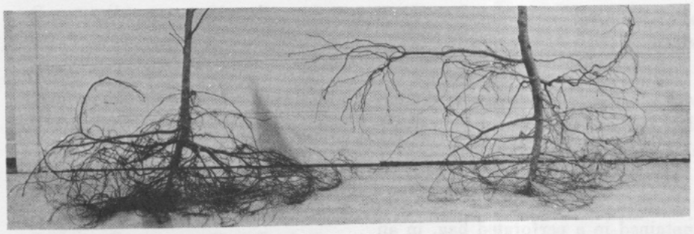

Figure 2.—The effects of 10- and 20-inch planting depths on root development in sycamore cuttings.

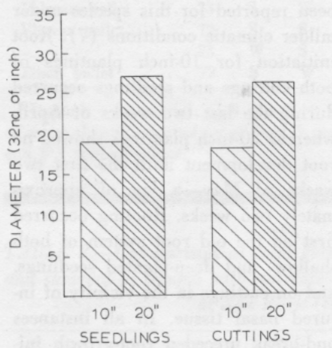

Figure 3.—The effects of planting depth and planting stock on height growth of 1-year-old sycamore.

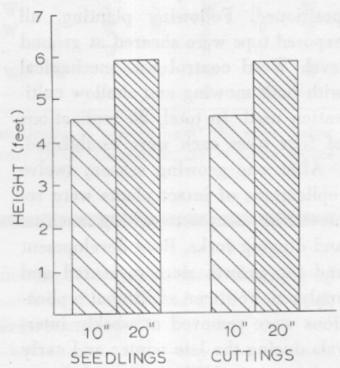

Figure 4.—The effects of planting depth and planting stock on diameter growth of 1-year-old sycamore.

24 percent more dry branch weight than did seedlings. Root/shoot ratios based on oven dry weights for cuttings and seedlings were 0.89 and 0.84, respectively. Cuttings and seedlings at both planting depths produced root systems that were well distributed along the underground portion of the planting stock (table 1, figures 1 and 2).

Depth of planting was found to be of much greater importance in root development, and ultimately height and diameter growth, than was type of planting used. Stock planted 20 inches deep produced significantly greater dry root matter than did stock planted 10 inches-244.2 and 138.4 grams, respectively. Diameter and length of roots in the first two 5 inch taproot sections were greater for the 20-inch stock, although the differences were not significant (tables 2 and 3). Ten-inch stock produced a root/shoot ratio of 0.89, and 20-inch plantings a ratio of 0.84. The number of roots produced within the upper ten inches of soil were comparable (table 1).

The overall effect of the increased absorptive root surface area of the deeper plantings was a significant increase in both height and diameter growth. Ten-inch plantings produced an average annual height growth of 55 inches while the 20-inch plantings, by comparison, grew 71 inches-an increase of 29 percent (figure 3). Of even greater significance, however, was an observed difference of 42 percent in diameter growth (figure 4). Diameter growth usually starts later and lasts longer than height growth of the same tree and, as a result, is more sensitive to degree of establishment and "current-growing-season" carbohydrate production (4).

TABLE 1.—Number of lateral roots for sycamore cuttings and seedlings by five-inch taproot sections

Planting depth and stock	Number of roots by five-inch taproot sections 1	2	3	4
10" sycamore seedling ..	9[1]	7	–	–
20" sycamore seedling ..	5	8	4	5
10" sycamore cutting ...	7	9	–	–
20" sycamore cutting ...	4	7	5	5

[1] Means based on roots greater than ⅛" diameter.

These differences, although important after only one growing season, might take on added meaning when future growth is considered. However, as this analysis was limited to four months, the writer hesitates to predict differences in growth for later growing seasons. The hypothesis is that the superior root systems, resulting from (1) the use of cuttings

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leaves were removed from those remaining. Twenty cuttings from each group were treated in Ethephon soaks of 500 ppm for 24 hours and 100 ppm for 6 hours. Cuttings were examined for root initiation and callusing at 30-day intervals.

Results

Effects of treating the March and April cuttings are shown in table 1. The most successful treatment was 5,000 ppm ethephon with a soaking period of 6 hours. Cuttings soaked at concentrations of 500 ppm and 1,000 ppm were less successful than the 5,000 ppm treatment.

Shortening the soaking period from 6 hours to 2 and 4 hours decreased rooting success at the abovementioned concentrations. and in creasing the concentrations for 2and 4-hour periods did not give consistent results. But it was found that rooting success at lower concentration levels was increased by lengthening the soaking period to 24 hours. Ethephon concentrations above 500 ppm decreased rooting success during the 2.4-hour soaking treatments.

Rooting success was highest in early spring and in most cases the treatments were less effective as time for bud burst approached. Previous small tests by the author have shown that rooting could be achieved after chilling requirement of the buds had been met.

Other treatments attempted as shown in table 1 were not successful. There appeared to be no benefit in soaking the entire cutting in Ethephon. Treatments were most successful when only they I-a-al end was soaked. Also there was no benefit achieved by removing the terminal bud. Combining the Ethephon soak with quick dip treatments in IIIA was not beneficial.

Rapid shoot elongation was difficult to obtain following treatment of hardwood cuttings with Ethephon. Although not used in this series of tests, treatment with gibberellic acid aids in the initiation of shoot growth after rooting i 11. Treatments applied to softwood cuttings were not successful.

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over seedlings and (2) the deeper planting over the more shallow planting, are indicative of degree of establishment and should result in accelerated growth for at least the first few years.

TABLE 2.—Lateral root diameter for sycamore cuttings and seedlings by five-inch taproot sections

Planting depth and stock	Mean root diameters in 32nd of an inch by five-inch taproot sections 1	2	3	4
10″ sycamore seedling ..	8[1]	6	–	–
20″ sycamore seedling ..	10	7	6	5
10″ sycamore cutting ...	8	7	–	–
20″ sycamore cutting ...	12	7	7	6

[1] Means based on roots greater than ⅛″ diameter.

TABLE 3.—Lateral root length for sycamore cutting and seedlings by five-inch taproot sections

Planting depth and stock	Mean root length in inches by five-inch taproot sections 1	2	3	4
10″ sycamore seedling ..	24[1]	20	–	–
20″ sycamore seedling ..	29	24	19	13
10″ sycamore cutting ...	24	21	–	–
20″ sycamore cutting ...	29	24	18	9

[1] Means based on roots greater than ⅛″ diameter.

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