RESEARCH REPORT

Clonal and Age Differences in the Rooting of *Metasequoia glyptostroboides* Cuttings

John E. Kuser

As with many other tree species, the rooting of a softwood *Metasequoia* cutting depends upon the source and age of the cutting used

There are large differences in rootability among the clones of many tree species; the differences are especially strong in older individuals. A further problem with rooting cuttings is their dependency on age. Young trees will often root readily, but the same trees may be almost impossible to root when they become older (Zobel and Talbert, 1984).

For the first few years after *Metasequoia* was introduced to the West in 1948 seed was nonexistent, scarce, or sterile. Vegetative propagation was easy by either softwood cuttings (Creech, 1948; Hasegawa, 1951) or hardwood cuttings (Enright, 1958; Connor, 1985). As the original trees became more mature they bore fertile seed more often (Hamilton, 1984) but appeared to require cross-pollination for good yields (Kuser, 1983). At the same time, vegetative propagation became more difficult (Hamilton, 1984).

I became curious about rooting softwood cuttings, a supposedly easy task which I had sometimes found not so easy. I decided to compare rootability of different clones and also to compare the rootability of lower-crown cuttings from (1) thirty-seven-year-old trees, (2) three-year-old seedlings, and (3) three-year-old cutting-grown trees of the same clones as (1).

Materials and Methods

On June 24, 1982, I took ten cuttings each from easily reached branches in the lower crowns of three large trees: (1) the tree at Prospect Hall on the campus of Princeton University ("Prospect"), (2) the Western world's largest *Metasequoia* tree, at the Bailey Arboretum ("Bailey 1"), and (3) a tall tree in the Bailey Arboretum, near the Feeks Road fence ("Bailey 9"). I wounded one side of the bases, dusted them with Hormodin 2®, and stuck them in peat–vermiculite under mist (five seconds every thirty seconds) and light Saran® shadecloth, in a greenhouse propagation room at Cook

College, New Brunswick, New Jersey.

I repeated the experiment three times in 1983 (on June 1, June 23, and July 12) with ten cuttings of each clone on each date, following exactly the same procedure as in the year before. I added three more clones of thirty-seven-year-old trees in the Broadmead grove at Princeton, New Jersey ("Clark 1," "Clark 2," and "Clark 3").

In 1985 I repeated the experiment again, with ten cuttings of each clone, from June 27—July 3. I omitted "Clark 2" and "Clark 3," but added six new trees: a two-meter tree grown from a cutting of "Prospect" in 1982 ("Prospect cutting"), a three-meter 1981 seedling of "Prospect" ("Prospect seedling"), a three-meter 1981 seedling of "Clark 1" ("Clark 1 seedling"), a three-meter 1982 cutting of "Bailey 9" ("Bailey 9 cutting"), and a three-meter 1982 cutting of "Bailey 9" ("Bailey 9 cutting"). I followed the same procedure I had in 1982 and 1983. Noting top dieback among the cuttings within a week, I suspected that high temperatures on bright days in the propagation room were causing desiccation in spite of the mist. So I made a cooled propagation bed in another part of the greenhouse, using light Saran® shade and mist (thirty seconds every seven and one-half

The Metasequoia glyptostroboides *Tree in the Bailey Arboretum from Which the "Bailey 1" Cuttings Were Taken. This and all other photographs accompanying this article were taken by the author.*

The Broadmead Grove in Princeton, New Jersey, Where the "Clark 1," "Clark 2," and "Clark 3" Clones Were Obtained from Thirty-seven-Year-Old Trees for Use in the Experiments Performed in 1983.

minutes) over a bed immediately adjacent to evaporator pads along the north wall. With exhaust fans running during daylight hours, I monitored temperatures twenty-five centimeters above this bed. On bright days when the propagation room reached 39 C, the cooled bed's maximum temperature was 28 C.

On July 23 and 24, I replicated the June 27—July 3 series of cuttings and stuck them in the cooled bed. After observing that the second group of cuttings stayed fresh and healthy for a week, I moved the first group to the cooled bed on July 30.

Results

On August 9, 1982, the following numbers of cuttings had rooted: "Prospect," 3 of 20; "Bailey 1," 10 of 10; "Bailey 9," 8 of 10. In 1983, scarcely any cuttings rooted; there was much top dieback in spite of the mist, and by October 1, only 1 "Bailey 9," 1 "Clark 1," and 1 "Clark 3" (all stuck on different dates) had rooted. The difficulty appeared to be due to high temperatures caused by many bright days during June and July of that year.

On October 1, 1985, I counted rooted cuttings of both the June 27—July

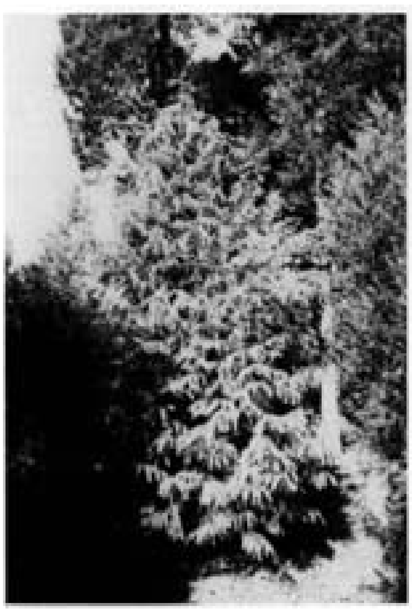
The Lower Part of the Stem of a Ten-Month-Old Seedling of Metasequoia glyptostroboides *Growing in a Two-Gallon Container.*

The Lower Part of the Stem of a Fifteen-Month-Old Rooted Cutting of Metasequoia glyptostroboides. *See Table 1 (page 17) for the results of this and the other experiments described in this report.*

Table 1. Rooting of Softwood Cuttings Taken from Different Clones of *Metasequoia glyptostroboides*

Number of cuttings that had rooted by 1 October 1985 out of a total of 10 cuttings originally stuck on the dates indicated.

Clone	Source of Cutting	Those Stuck 26 June—3 July	Those Stuck 23—24 July
"Prospect"	Mature tree	3	0
"Prospect"	2-m cutting	2	2
"Prospect"	3-m seedling	4	10
"Clark 1"	Mature tree	10	3
"Clark 1"	3-m seedling	10	8
"Bailey 1"	Mature tree	10	5
"Bailey 1"	3-m cutting	10	3
"Bailey 9"	Mature tree	10	8
"Bailey 9"	3-m cutting	10	6
"Bailey 9"	3-m seedling	10	8



A Five-Year-Old Seedling of the "Clark 1" Clone Growing on the Author's Lawn. The tree is about twelve feet (3.7 m) in height.

A Five-Year-Old Rooted Cutting of "Bailey 1" Growing on the Author's Lawn. Like the "Clark 1" Seedling (left), it is about twelve feet (3.7 m) tall.

3 group and the July 23—24 group (Table 1). Those of the second group had retained all their foliage, appeared lush and vigorous, and most often had more roots.

Discussion

The same clonal differences were evident in 1982 and 1985. The two large trees of "Bailey 1" and "Bailey 9" have not lost rootability, while "Prospect" is more difficult to root. There is no difference in rootability between mature trees of any clone tested and young cutting-grown trees of the same clones; apparently, no rejuvenation of these clones occurred in one cycle of rooted cuttings from mature trees and then taking cuttings of these. This conclusion agrees with my field observation that trees grown from cuttings of mature trees are much less branchy and have less taper than seedlings. One might expect that, if rejuvenation had occurred, the trees would grow with seedling form. Rejuvenation may still occur after repeated cycles, or it may not. The difference in rootability of "Prospect seedling" and "Clark 1 seedling" compared to their respective parents. Unfortunately, I have no data on rootability of the parent trees when they were young; however, Mr. Jim Clark of Princeton and Mr. Dick Walters of Maplewood grew many trees of "Prospect" from softwood cuttings in the 1950s, and they say (personal communications) that their rooting success rates were fifty percent to seventy-five percent.

Two Ten-Month-Old Seedlings (left) and Two Fifteen-Month-Old Rooted Cuttings Growing Outside the Greenhouse on November 7, 1986.

Avoidance of high temperatures is important in rooting softwood cuttings of *Metasequoia* during summer. This may be not only a matter of preventing desiccation, but of greater photosynthetic efficiency at lower temperatures. In 1960, Konoe reported that at 20 C, *Metasequoia* grew faster than *Taxodium*, while at 30 C the reverse was true; and in my experiment last summer I noted that, while *Metasequoia* rooted better in the cooled bed than in the hot propagation room, the reverse was true of pitch pine (*Pinus rigida*) stump sprouts.

In 1982, temperatures in the propagation room may have been cooler because of more cloudy days or more whitewash on the glass roof.

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John E. Kuser is associate professor of forestry, Cook College, Rutgers University. He has written several articles on *Metasequoia*, including one in the Summer 1982 issue of *Arnoldia*.