Growth, Survival and Sex Expression in Ginkgo

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Abstract. Only 56% of 638 field-planted ginkgo survived in Virginia after 34 to 52 years. Average growth of all trees was 39.2 feet in height and 9.2 inches in diameter, and there were no significant differences between trees of different ages or different sexes. The sex ratio was approximately 1:1, but 58 trees still had not been observed to flower. Four trees were considered to be monoecious, with a few female flowers produced on trees that were predominately male.

The ginkgo (*Ginkgo biloba*) has been a popular landscape tree in the United States ever since its introduction in 1784. Aside from the selection and propagation of male cultivars (5), there has been relatively little practical research in ginkgo in recent years, probably because most of the planted trees existed in streetside locations or as scattered individuals. Therefore, we were most anxious to take advantage of a unique opportunity to study a forest-type planting of ginkgo.

The Blandy Plantation. A total of 524 trees were planted on an irregular 4.5-acre old-field tract at the Blandy Experimental Farm in Boyce, Virginia, between 1929 and 1939. It was impossible to determine, from the records, exactly which trees were planted in which year. Twelve trees were planted in 1929, 220 in 1933, 156 in 1935, and 108 in 1938-39. Data on the planting of the remaining 28 trees could not be found. The source of all of the seed and seedlings was an individual female ginkgo tree on the campus of the University of Virginia in Charlottesville. The seedlings were 1 or 2 years old when outplanted, at a 20-foot spacing between trees and rows.

Survival. A survey made in 1946 showed that 373 (71%) of the original trees were alive. In 1947, 114 seedlings were planted to partially replace those that had not survived. In November, 1982, only 287 (55%) of the original 524 trees were tallied as alive as well as 82 (72%) of the trees planted in 1947. During the growing season of 1982, it was noted that 10 more trees were dead. Whether they had been classified improperly while leafless in November, 1981 or had died during the winter of 1981-1982 could not be determined. Over-all survival of the 638 trees planted from 1929 to 1947 was thus 56% (359 trees).

Because of inadequate observation through the years, no causes of mortality could be determined. However, this rather high mortality rate over a 45-year period may indicate that a *thorough investigation of dead and dying ginkgo trees would reveal some potentially destructive pests on this "pest-free" tree.*

Growth. Heights and diameters (4.5 feet above ground level) were measured for all trees in November, 1981. At this time, the trees planted in 1947 were 35 years old from seed, and the weighted average age of those planted earlier was 47 years. The differences in growth between older and younger trees were decidedly nonsignificant. Older trees averaged 40.1 ft. in height and 9.3 in. in diameter while younger trees averaged 39.1 ft. in height and 8.9 in. in diameter. The largest tree in the entire planting was 60 feet tall and 10.7 inches in diameter. Similarly, there were no consistent or significant differences in growth between trees sexed as males and females. It is obvious that ginkgo is not a fast-growing tree, especially in the environment of a windswept slope in the foothills of the Shenandoah Mountains of Virginia. Trees growing in urban cultivation, whether fertilized or not, would likely exhibit slightly improved growth rates.

Sex Expression. Ginkgo is considered to be dioecious, with different trees producing only

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male or female flowers. Past planting of seedling-origin material in the landscape has resulted, in some cities, in thousands of old and large female trees that cause an annual problem by producing their odoriferous fruit. In addition, we have received several reports of vegetatively propagated "male" cultivars in urban plantings that have produced fruit after reaching sexual maturity in 20 to 30 years. There are at present, no morphological or biochemical methods of determining tree sex without flowers. Even though sex chromosomes have been reported (2,4), giving different interpretations, the possibility of such chromosomes seems unlikely. With all of the problems associated with sex in ginkgo, we were very interested in making observations on flowering and fruiting in the Blandy plantation.

There have been few reports of monoecious ginkgo in the literature. According to Bean (1), most of the old trees in England were male, and branches from female trees were grafted into the crowns to allow for fruit production — most likely as a curiosity. Two truly monoecious trees were reported by Miyoshi (3) in Japan. Both monoecious trees were basically male and fruit occurred on only a single branch in each tree.

There have been several surveys to determine tree sex over the past few years. In October, 1978, it was determined that 135 trees were female on the basis of fruit production. A limited survey made by observation from ground level in May, 1979 identified 32 trees as producing male flowers in that year. A second survey for fruit production was made in November, 1981, without benefit of the fruiting data that had been obtained in 1978, and 128 fruit-producing trees were tallied. Some of the trees that had been judged as females in 1978 (20 trees) produced no fruit in 1981, and some (23 trees) that had no fruit in 1978 did have fruit in 1981. Combining the data of 1978 and 1981, it appeared that 157 trees were female and the rest (212 non-fruiting trees) were male.

A more intensive survey of flowering was made in May, 1982, using an aerial bucket that allowed closer inspection of the tree crowns. Trees were classified as male or female on the basis of flower production. Four trees that had previously not produced fruit were found to produce female flowers and 144 trees produced male flowers. The most intriguing result of this survey was that 4 of the 144 male-flowering trees had been classified as females with fruit produced in 1978 or 1981! Three of these 4 trees also produced from 1 to 7 fruit each in 1982. The monoecious trees reported by Miyoshi (3) were also basically male. However, unlike the Japanese trees, we observed fruit on the main trunk and close to the trunk on several upper branches.

The final documented sex ratio was 157 females to 140 males, well within the probability limits for a 1:1 ratio. Male trees averaged 40.6 ft. in height and female trees averaged 39.6 ft.

A total of 58 trees still could not be properly sexed on the basis of our surveys. These unsexed trees were slower growing than those that had apparently reached sexual maturity, averaging 34.2 feet in height and 6.8 inches in diameter. The fact that some trees still had not produced flowers at more than 45 years of age is a warning to those who might select a non-fruiting tree as a "male," only to find later that their selection was a female.

Flower production is the only accurate guide to sex of a tree. Even when a tree selected for producing only male flowers later proves to be monoecious, the numbers of fruits may be insignificant.

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