# Field-Testing the Propagation of Yellow-Poplar Seedlings by Longitudinal Splitting

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*To investigate an inexpensive method for propagating yellow-poplar (*Liriodendron tulipifera *L.), seedlings were split longitudinally and planted outdoors in a seedbed. Seedlings were split into halves, quarters, or left whole. Of the seedlings split into halves, 97% survived; of the quartered seedlings, only one survived. Surviving propagules were halved again, but very few survived. The propagation limit appears to be one cycle of halving.* Tree Planters' Notes 38(4):10-13; 1987.

Techniques for vegetatively propagating yellow-poplar (*Liriodendron tulipifera* L.) were unknown (3, 6, 1) until two decades ago, when successful grafting (2) and rooting (5,4) were achieved. The limits of a greenhouse propagation technique described by Nelson (7), however, require further elucidation, because of the simplicity of the technique. His technique involved longitudinally splitting seedlings into halves (propagules), and then growing the propagules in the greenhouse under a 16-hour photoperiod. The method requires little equipment, which is a decided advantage, and may be useful with selected seedlings when sophisticated equipment is unavailable and for maintaining grafting rootstock. The present study was initiated to determine a) the feasibility of less-expensive field propagation and b) the practical limits to splitting.

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**Methods**

The study began in April 1980 at the Clayton Nursery of the North Carolina Forest Service. Vigorous 1 + 0 seedlings were lifted from the nursery bed and selected for uniformity of root collar diameter of about 0.8 cm. Each seedling was pruned about 8 cm above and below the root collar, and then randomly assigned to one of the following treatments:

1. Split longitudinally into halves.
2. Split longitudinally into quarters.
3. Shoot split longitudinally into halves with one of the halves removed (root intact).
4. Root only split longitudinally with one of the halves removed (shoot intact).
5. Not split (control).

Seedlings were split with a knife so that each propagule contained at least one well-developed lateral bud and root. Split surfaces were coated with lanolin, and the propagules were set in the nursery bed in rows of 6 or 8 (fig. 1A).

The propagules were irrigated as needed, although no fertilizers or growth regulators were applied, in order to minimize the equipment and expense. Treatment 1 contained 72 propagules (36 seedlings), whereas all other treatments contained 12 propagules. Treatment 1 was larger to provide additional material for another study.

Propagule survival was evaluated after one growing season. Annual height growth of the tallest sprout of each plant was also measured to the nearest millimeter, and the number of sprouts was counted. The control, located at the end of the nursery bed, was largely overrun by maintenance equipment, precluding comparison.

The high survival rates of treatment 1 the first year suggested that another cycle of splitting might be possible. Therefore during the second year, twenty of the surviving propagules (of treatment 1) were again halved by the same method, producing four propagules from each original seedling. For comparative purposes 12 propagules of this treatment were not disturbed in the nursery bed, and 20 others were handled like the second-year treatment, but without splitting.

In addition the root volume of each transplanted propagule was determined by water displacement in a 1,000-ml graduated cylinder, because first year results suggested a relationship between root volume and survival. The propagules were grown and measured as described for the first year. The other 18 surviving

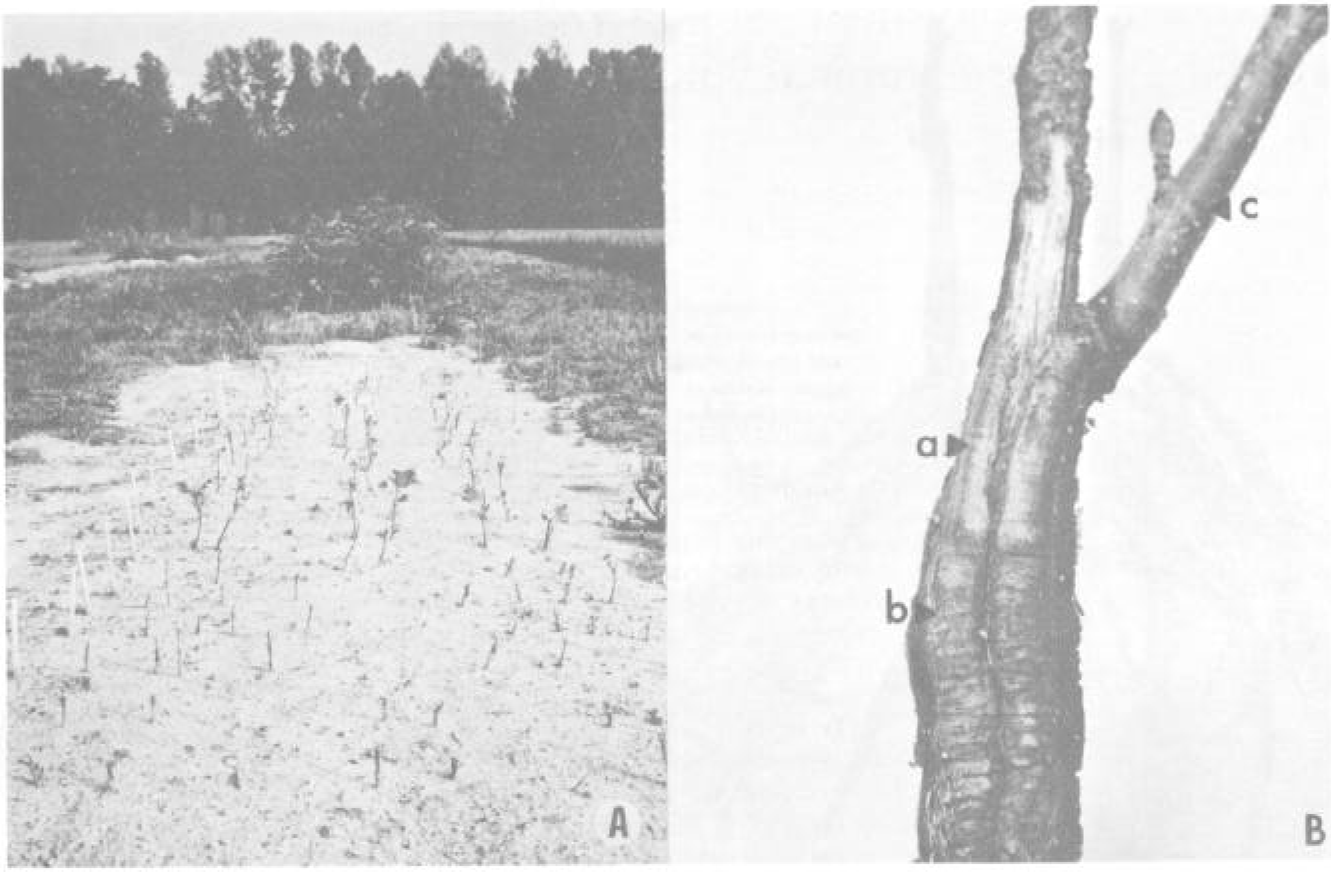


Figure 1—*Propagation of yellow-poplar seedlings.* A—*Nursery bed.* B—*Callus growth of the stem (a) and root (b) with the new shoot (c) formed from a pre-existing lateral bud.*

propagules of treatment 1 were used in producing photographs, dried specimens, and in a separate anatomical study of propagule recovery.

**Table 1**—*Mean growth and survival of splitting treatments after one growing season*

| Treatment no.[a] | Height growth (cm) | | Mean no. of sprouts | No. of plants surviving | Percent survival |
|---|---|---|---|---|---|
| | Mean | Range | | | |
| 1 | 19.8 | 5.7–41.5 | 1.5 | 70 | 97.2 |
| 2 | 15.1 | 15.1–15.1 | 1.0 | 1 | 8.3 |
| 3 | 23.2 | 14.9–45.6 | 1.5 | 12 | 100.0 |
| 4 | 23.3 | 9.2–40.4 | 2.3 | 11 | 91.6 |
| 5 | 8.3 | 4.1–12.9 | 1.3 | 7 | 58.3 |

[a]1 = Entirely split into halves, 2 = entirely split into quarters, 3 = shoot only split into halves, 4 = root only split into halves, 5 = not split (control).

**Results**

Splitting seedlings into halves was a successful propagation technique (figs. 1B and 1C) with shoots developing from pre-existing lateral buds. Propagules callused nearly completely along the cut surface, to the highest formed new shoot (fig. 1B). The old stem above the new shoot died. Survival of halved seedlings was 97%, and annual height growth averaged 19.8 cm (table 1).

All quartered seedlings died, except for one propagule that grew 15.1 cm. All seedlings with only the shoot split survived, and growth averaged 23.2 cm. Survival of root-split propagules was 92% and these seedlings grew an average of 23.3 cm. Sixty percent of the control seedlings survived and resprouted after being overrun, and they grew an average of 8.3 cm. All propagules formed more than one sprout, but the sprout located highest on the propagule always exhibited the greatest growth.

Survival of the propagules halved a second time was very poor, only 10%. Those surviving were small, with low vigor, and averaged 3.0 cm in annual height growth (fig. 1D). In comparison,


**Figure 1**— C—*Seedling split into halves.* D—*Propagule of treatment 1 halved a second time.*

the propagules transplanted, but not halved, averaged 9.5 cm in growth with 75% survival. Notably, a significant positive correlation existed between root volume at time of resplitting and subsequent height growth (r = 0.62, P = 0.01). Growth of propagules not disturbed averaged 19.1 cm, with all surviving.

**Discussion and Conclusions**

First-year propagule growth of halved seedlings was comparable to that of seedlings only partly split, and also to that reported by Nelson (7) for greenhouse propagation. These similarities, as well as the high survival rate, demonstrate not only considerable regenerative capacity, but also the feasibility of inexpensive field propagation.

The technique may also be applicable to other fast-growing hardwoods like sweetgum and sycamore, but individual testing would be necessary. Conversely, poor growth and survival after the second cycle of halving reflect the severe physiological stress caused by resplitting. The importance of a large root system in moderating stress is well-illustrated by the positive relationship between root volume and growth and by the complete survival of propagules without split-roots (treatment 3).

Treatments quartering seedlings were unsuccessful principally because quartering increases the surface area of the wound, and often loosened the bark and phloem from the stem. Separation of bark from xylem occurs readily in the spring and has been reported in other species (8).

Propagation by longitudinal splitting has limited utility, largely because only two propagules can be produced from each seedling. Further cycles of halving are not useful because of the very high mortality rates. A 1-year recovery period between cycles might help, but the delay would be costly and the propagules would probably grow too large for efficient handling. This paper defines the practical limit of field propagation at one cycle of halving.

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