

Second-Season Top and Root Development of Potted, 1-0, Bareroot *Paulownia Tomentosa* Seedlings¹

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Paulownia tomentosa seedlings were grown in a nurserybed at a density of 64 seedlings per square meter for one growing season. Dormant, 1-0, bareroot seedlings were lifted the following spring and grown in a greenhouse in large pots filled with sand. Three seedlings were removed every 7 days for a period of 49 days to measure top and root growth. Shoot bud break and new roots developed 7 days after planting. Shoot and root growth dramatically increased 21 days after planting with a reduction in original taproot dry weight.

Paulownia tomentosa (Thunb.) Steud. has been of recent interest because of newspaper and magazine articles (4, 5, 6, 7, 8) and recent scientific literature (1, 3, 9) on the growth, site adaptability, and wood value of this species. The University of Maryland's Paulownia Research Center is currently investigating numerous aspects of the site adaptability and silviculture of paulownia (2). Unfortunately, American literature providing even the simplest botanical information on paulownia is scarce.

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Paulownia plantations must either be planted with containerized seedlings, bareroot seedlings, or large root portions for adequate survival and spacing control. Utilizing large root portions is not practical in large plantations because of inaccessibility of root sources and the possibilities of decay and dessication of wounded root portions when planted. Containerized and bareroot seedlings have been successfully grown (1) and planted with good to excellent survival (3).

This study was conducted to investigate the second-season top and root development of 1-0, bareroot *Paulownia tomentosa* seedlings. This information should familiarize foresters and tree farmers with the initial field growth and establishment of planted paulownia seedlings.

Materials and Methods

Twenty-one dormant, 1-0, bareroot paulownia seedlings were removed from a nurserybed in March 1983 and stored in moist sphagnum moss in a paper bag at 3°C for 3 weeks. Seedlings were selected to be of a uniform root diameter (approximately 1 centimeter) and cut to 18-centimeter lengths. Taproots were 17 centimeters and the stem 1 centimeter long. All 21 seedlings were cut to have equivalent fresh weights and were mixed and then separated into seven groups of three seedlings each. Each group of three seedlings was planted at even spacings in a 20-liter plastic pot filled with washed river sand. These pots were placed on a greenhouse bench. Seedling groups received one-half liter of water every day. The photoperiod

Table 1—Second-season¹ shoot and root growth of potted, 1-0, dormant *Paulownia tomentosa* seedlings over a 49-day period

Days of growth	Original	New root dry weight	New primary lateral roots	Shoot buds and shoots	Top dry weight	Total seedling dry weight	New root-to-shoot ratio
	taproot dry weight						
	Gm	Gm			Gm	Gm	
7	1.60	— ²	3.3	6.0	—	1.60	—
14	1.61	—	3.7	5.3	0.10	1.72	—
21	1.17	0.22	12.3	6.3	.53	1.92	0.42
28	1.28	.40	16.3	5.3	.57	2.25	.70
35	1.52	.46	17.3	4.7	.99	2.97	.46
42	1.75	.40	16.0	5.7	.90	3.15	.44
49	1.89	.40	16.0	6.0	1.41	3.70	.28

¹ Mean of three seedlings per entry.

² — = not measurable.

was not enhanced artificially and greenhouse temperatures were maintained continuously at 24° C.

Three seedlings from a single pot were removed for analyses every 7 days. Shoot buds and new primary lateral roots that developed were counted. Shoot lengths and their locations (distance from the root collars) and locations of new primary lateral roots were tabulated. Paulownia tops (shoots plus leaves), new roots, and original taproots were dried at 65° C for 48 hours and weighed. Photographs were taken before all measurements.

Results and Discussion

Shoot buds and new primary lateral roots developed after 7 days, but these had no measurable dry weight. Numbers of shoot buds and new primary lateral roots of seedlings after 14 days were similar to those after 7 days and also had no measurable dry weight (table 1 and fig. 1). After 21 days of growth, top and root growth had accelerated to measurable weights and shoot growth continued geometrically throughout the remainder of the 49-day period. Root dry weight and number of new primary laterals did not increase between the 28th and 49th day, resulting in a decline in new root-to-shoot dry-weight ratios during that period. Original taproot dry weight was reduced sometime between the 14th and 21st days of growth

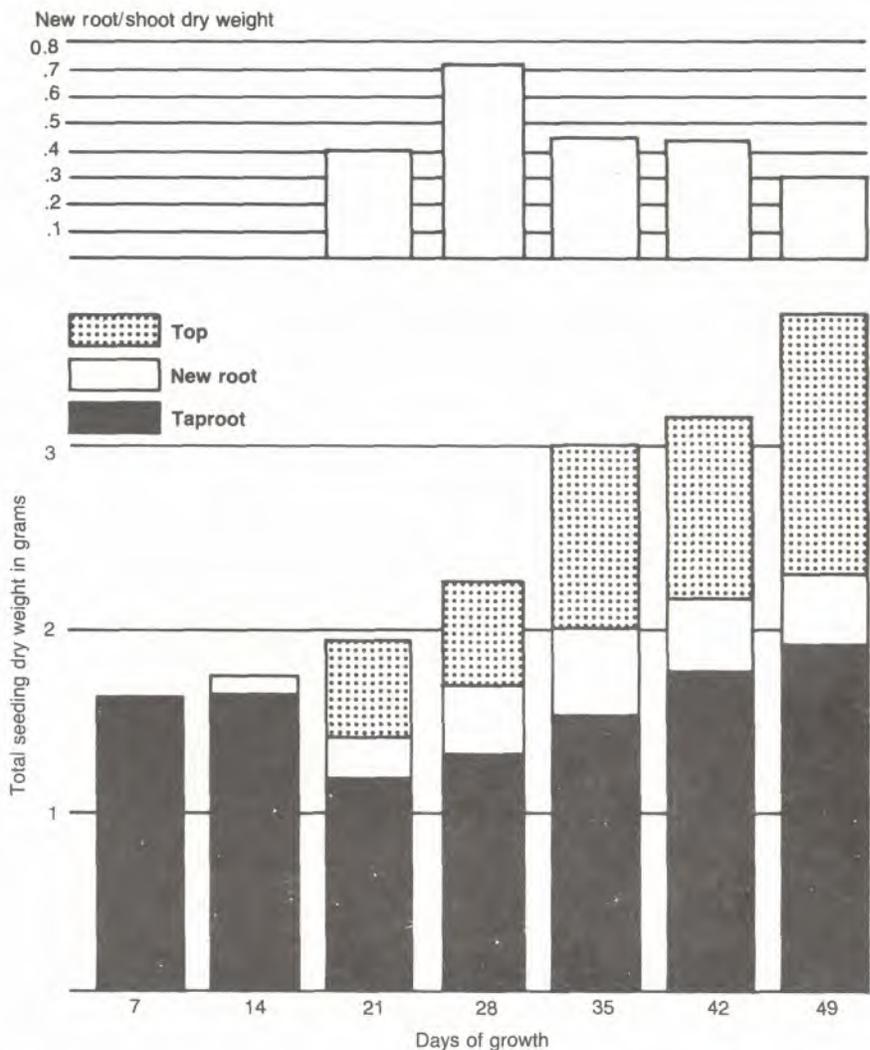


Figure 1—Second-season mean total seedling dry weight and new root-to-shoot dry-weight ratio of potted, 1-0, dormant *Paulownia tomentosa* seedlings over a 49-day period. The mean is of three seedlings per entry. The total seedling dry weight is separated into three components.

(table 1 and fig. 1) in conjunction with top and new root growth.

Taproot growth increased linearly between 21 and 49 days of growth.

Figures 2 through 8 show the new growth from 1-0, bareroot seedlings over a 49-day period.

Figure 4 shows the dramatic increase in top and root development of seedlings after 21 days of growth. Most new shoots developed within a 3-centimeter zone below the root collar, but some appeared up to 6 centimeters below the root collar. Figure 5 shows an increase in secondary root development. New roots developed from many locations on the taproot including the callused zone at the cut end of the taproot.

This study shows the sequence of new shoot and root development and growth of 1-0, bareroot paulownia. These seedlings were grown under greenhouse conditions with adequate moisture, light, and atmospheric and soil temperatures in a porous, sandy medium, which allowed rapid development and growth. Field conditions would probably delay development and growth and alter

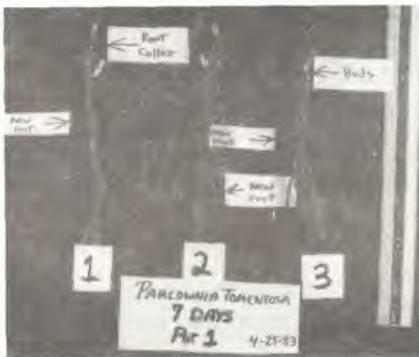


Figure 2—Seedlings after 7 days of growth. Note early roots and shoot buds.

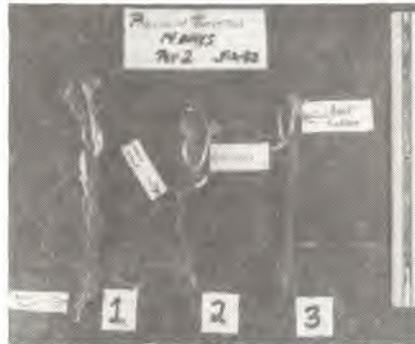


Figure 3—Seedlings after 14 days of growth. Note shoot elongation and shoot formation several centimeters below root collar.



Figure 4—Seedlings after 21 days of growth. Note the dramatic increase in root initiation and growth.

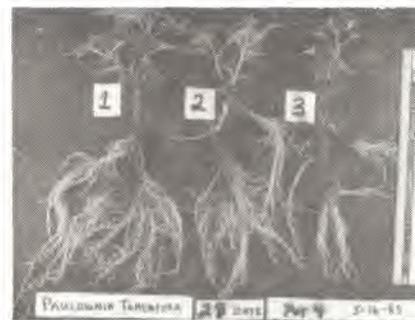


Figure 5—Seedlings after 28 days of growth. Note the advanced development of a fibrous root system with new secondary lateral roots.



Figure 6—Seedlings after 35 days of growth.

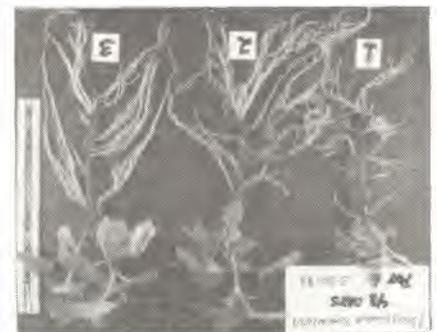


Figure 7—Seedlings after 42 days of growth.



Figure 8—Seedlings after 49 days of growth.

new root-to-shoot ratios because of various edaphic and atmospheric variables. Nonetheless, this study may provide the tree planter a better understanding of how paulownias develop and grow after planting.

Literature Cited

1. Beckjord, P. R. Containerized and nursery production of *Paulownia tomentosa*. *Tree Plant. Notes*. 33(1): 29-33; 1982.
2. Beckjord, P. R.; Weil, R.; Kundt, J. Silviculture and site adaptation of *Paulownia tomentosa* in Maryland. College Park, MD: University of Maryland, Agricultural Experiment Station; 1982. 9 p.
3. Beckjord, P. R.; McIntosh, M. S. *Paulownia tomentosa*: effects of fertilization and coppicing in plantation establishment. *South. J. of Appl. For.* 7: 81-84; 1983.
4. Carpenter, S. B. This "princess" heals disturbed land. *Amer. For.* 83: 22-23; 1977.
5. Carpenter, S. B.; Graves, D. H. *Paulownia*: a valuable new timber source. Lexington, KY: University of Kentucky, College of Agriculture, Cooperative Extension Service. 1979; For-11. 7 p.
6. Larson, R. O. The Paulownia tree. Sheboygan, WI: American Paulownia Corp.; 1981. 3 p. The address of the publisher is Box 554, 1221-A, Superior Ave., Sheboygan, WI 53081.
7. Sprow, C. H. The princess awakens. *Am. For.* 87(2): 36; 1981.
8. Preston, D. Paulownia: miracle tree or passing fancy? *Amer. For.* 89(5): 15-19, 47-52; 1983.
9. Tang, R. C.; Carpenter, S. B.; Wittwer, R. F.; Graves, D. H. *Paulownia*—a crop tree for wood products and reclamation of surface mined land. *South. J. of Appl. For.* 4: 19-24; 1980.