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# Survival and 14-Year Growth of Black, White, and Swamp White Oaks Established as Bareroot and RPM®-Containerized Planting Stock

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## ABSTRACT

In this study, we report the results of a comparison of 5-year survival and 14-year growth of black, white, and swamp white oaks grown from planting stock produced by a conventional bareroot method and stock produced by the Root Production Method (RPM®) of Forrest Keeling Nursery. Five-year survival was 100% for black and white oak grown from RPM® stock, but only 63 and 75%, respectively, for trees grown from bareroot stock. The odds ratio for survival of RPM® planting stock of black and white oaks compared to bareroot stock were 21.9 and 12.1, respectively. All swamp white oak survived. After 14 years, diameter growth was greater for the RPM® than bareroot planting stock and ranged from a 35% increase in black oak to a 6% increase in swamp white oak. Average aboveground fresh weight for trees from RPM® planting stock equaled 530 lb compared to 333 lb for trees from bareroot seedlings ( $P < 0.0001$ ). Compared with traditional bareroot seedlings, survival and growth of RPM® oak planting stock was greater through 14 years.

**Keywords:** *Quercus alba*, *Quercus velutina*, *Quercus bicolor*, whole tree weight, afforestation, plantation management, survivability, RPM®

With today's emphasis on shortening timber rotations and biomass production for carbon sequestration, wood products, or feedstocks for energy, research programs have been undertaken to increase tree growth and biomass yields (Boerjan 2005, Heinimo and Junquinger 2009, Paquette and Messier 2010, Sannigrahi et al. 2010, Harfouche et al. 2011, Merkle and Cunningham 2011, Osakabe et al. 2011). A technology that has been under development for more than 2 decades may have an important role to play in creating opportunities for landowners interested in shortening rotations and maximizing yields on a per-acre basis. The Root Production Method (RPM®) technology is a patented procedure for production of air-root pruned containerized planting stock developed and owned by Forrest Keeling Nursery, Elsberry, Missouri (Lovelace 1998). Containerized seedlings produced using the RPM® technology have been touted as being superior in survival and growth to bareroot seedlings (Dey et al. 2004, Krekeler et al. 2006). However, limited long-term scientific evidence supporting these claims exists in the literature. In this study, white (*Quercus alba* L.), black (*Q. velutina* Lam.), and swamp white (*Q. bicolor* Willd.) oak grown as RPM® or bareroot stock were compared on the basis of survival (after 5 years in the field) and growth response (1 year in container and 13 years in the field).

## Methods

### Seed Collection and Handling

Seed was collected from a single mother tree for each of black oak, white oak, and swamp white oak in the fall of 1995 and separated into two equal lots. One lot of each species was placed in plastic bags and stored for 4 weeks under moist conditions at 34° F

before early-November planting in a tree nursery. The other lots were sown in bottomless mesh germination flats (18.5 × 14.5 × 2.5 in. deep) filled with a potting medium consisting of composted rice hulls, pine bark, and sand (4:4:2 by volume) amended with Scott's slow release fertilizer (22-3-8, NPK), micronutrients (Scott's Micro-max granular), and a wetting agent (Terra-Sorb). Germination flats were wrapped in plastic and held inside a walk-in cooler at 34° F.

### RPM® Seedling Production

In early February 1996, germination flats were removed from coolers and placed in a heated greenhouse on wire benches. As roots elongated, air pruning of the tap root occurred at a shallow depth (1.5–2 in.) forcing development of first-order, lateral roots near the root collar. Following completion of the first flush of growth (early March), the largest and most vigorous seedlings were selected (40% cull rate) and potted in plastic bottomless band containers (3.0 × 3.0 × 5.5 in.). These containers were filled with the same potting medium used in the flats, placed on wire benches in greenhouses and grown for approximately 60 days. During early May, seedlings were transplanted into 2.0-gal containers filled with the same potting medium used in the flats, held under mist outside the greenhouses for 2 days, and then lined out under overhead irrigation on white gravel beds for the remainder of their 210-day growing season. RPM® seedlings used in this study had a mean height of 2.23 ft and a mean caliper (1 in. above root collar) of 0.35 in. at the time of planting.

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