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2. © Cavity size and copper root pruning affect production and establishment of container-grown longleaf pine seedlings. Sayer, M. A. W., Haywood, J. D., and Sung, S.-J. S. Forest Science 55(5):377-389. 2009.

Cavity Size and Copper Root Pruning Affect Production and Establishment of Container-Grown Longleaf Pine Seedlings

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Abstract: With six container types, we tested the effects of cavity size (i.e., 60, 93, and 170 ml) and copper root pruning on the root system development of longleaf pine (*Pinus palustris* Mill.) seedlings grown in a greenhouse. We then evaluated root egress during a root growth potential test and assessed seedling morphology and root system development 1 year after planting in central Louisiana, USA. Seedling size was increased by copper root pruning in small cavities but was unaffected by this treatment in larger cavities. Before planting, copper root pruning increased taproot and secondary lateral root dry weights at the expense of primary lateral root dry weight and increased root growth potential in the top 5 cm of the root plug. Across treatments, survival was 97%, and all seedlings were in the grass stage. Of the lateral root dry weight that elongated during the first year after planting, 33% more occurred in the upper 5 cm of soil when seedlings were treated with copper. Within each cavity size, copper root pruning did not affect the general morphology of 1-year-old seedlings. However, relationships between root collar diameter and root egress by depth indicated that this treatment has the potential to increase the range of cavity sizes used for seedling production. FOR. SCI. 55(5):377–389.

Keywords: copperblock, copper oxychloride, *Pinus palustris* Mill., Superblock, taproot

FOREST REGENERATION in the southern United States benefits from container seedling technology in several ways. For example, with a reduction in the natural extent of longleaf pine from 37.5 million ha in the late 1800s to less that 2 million ha at present (Landers et al. 1995, Outcalt and Sheffield 1996, Outcalt 2000), a major application of container seedlings has been the reestablishment of longleaf pine ecosystems (Johnson and Gjerstad 2006). Container production is also being evaluated for the artificial regeneration of shortleaf pine (Barnett and Brissette 2004) and is providing the forest industry with an effective system for the culture of genetically improved seedlings (Menzies et al. 2001).

Past research has demonstrated that an important benefit of container seedlings is retention of a dense network of fibrous roots within the plug as seedlings are transferred from the nursery to the field (Goodwin 1976, Barnett and Brissette 1986). The root plug protects delicate fine roots from damage during planting, which reduces the likelihood of water deficit and severe planting shock (Becker et al. 1987, Barnett 2002).

The natural root system of *Pinus* species is characterized by a network of fibrous roots extending from large primary lateral roots that reach horizontally through the soil from a taproot. Together, the taproot and several large primary lateral roots provide anchorage as seedlings mature into trees (Coutts 1987). Furthermore, the absorption of water and mineral nutrients by fibrous roots is optimized when large primary lateral roots are healthy and uniformly distributed around the circumference of the taproot.

Container seedling cultural conditions have the potential to alter root system morphology in the nursery. For example, inadequate cavity size relative to the length of the cultural period may limit root system development as seedlings grow and root competition for growing space increases (Romero et al. 1986, South et al. 2005, South and Mitchell 2006). Early evaluations showed that depending on container type, root strangulation and spiraling and an absence of root egress were possible (Barnett and Brissette 1986, Brissette et al. 1991, Romero et al. 1986). In response, container cavities were improved with ribs that train primary lateral roots to grow vertically rather than horizontally (Barnett and Brissette 1986). Modifications also include coatings that chemically prune lateral roots, thereby stimulating new root proliferation at the root plug-soil interface after planting (McDonald et al. 1984, Ruehle 1985, Barnett and McGilvray 2002, South et al. 2005).

Improvements in seedling establishment attributed to the containerization of nursery stock dictate that container-grown southern pine seedlings will continue to be in high demand. Additional gains may be possible with container seedling technology that simulates natural root system morphology after planting. By using root system morphology after seedling production and 1 year after planting and first-year field performance, our objectives were to evaluate the effect of copper root pruning and cavity size on the first-year establishment of longleaf pine.

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