Sustainability Of Longleaf Pine Stands Regenerated With Container-Grown Stock

Several LLP studies were established with container stock at the Palustris Experimental Forest in central Louisiana to evaluate long-term effects of container type (Cu coating or none) and size and nursery nutrient rate on longleaf pine (LLP) seedlings. We have observed the followings.

- ✓ Seedling nursery development, early field growth, and percent of seedlings exiting the grass stage increased with increasing cavity size, increasing nursery nutrient rate, and late season P loading.
- ✓ Seedlings grown in Cu-cavities for lateral root pruning grew as well in nursery and two years after planting as the non-Cu seedlings. However, height growth from the Cu seedlings exceeded that of the non-Cu seedlings since year four in field.
- ✓ Fertilizer incorporated into soil before planting increased the growth of competing vegetation instead of LLP seedlings during the first two years after planting.

Indeed, these results confirmed the benefits of using container stock to regenerate LLP stands. However, assessment of root system architecture from these studies showed that there were both short- and long-term negative effects of container on LLP seedlings and saplings, and thus the stand sustainability.

Direct seeded stock

Bareroot stock

Container stock

30+-year-old LLP trees, each with good root system architecture: a huge and long taproot; lateral roots extending horizontally into all directions; and most lateral roots not spiraling or "bird cage"-like.

CONCLUSIONS

Longleaf pine sapling and tree stability comes from vertical anchorage from the taproot and sinkers and horizontal anchorage from lateral roots that horizontally extending into all directions.

Growing LLP in Cu-coated cavities helped ameliorate, partially, the negative physical limitations imposed on lateral roots by the hard cavity wall.

Much improvement in the container deign, nursery culture, and handling and planting container stock is still required to meet the increasing needs for container LLP seedlings to regenerate and restore LLP plantations and ecosystems in a sustainable way in the southern U.S.

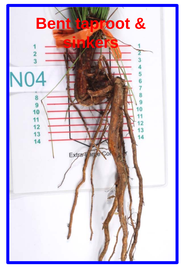
Problematic Root System Architecture of Longleaf Pine Seedlings and Saplings from Container Stock

The "off-centered" seed placement (not by design) in the cavity resulted in this LLP seedling taproot pressing against the cavity wall and its lateral roots not extending into all horizontal directions.

Seedlings with their taproots readily visible usually are not culled at planting.

Seedlings like this one are usually planted because their deformed root systems are not readily visible.

Root system architecture is set early during nursery culture. The inherent characteristics of container root plug makes it impossible to cull LLP seedlings with deformed root system before planting.

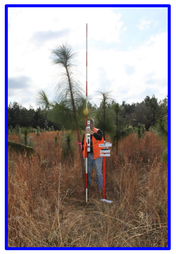


LLP seedlings from non-Cu cavities 15 months after planting. Each LLP had a deformed root system with their lateral roots not providing horizontal anchorage. Seedling on right did not have vertical anchorage due to its bent taproot and sinkers.

LLP seedlings from Cu-coated cavities 15 months after planting. All LLP had several lateral roots exploring the upper 10 cm of soil for nutrient and water. Bent taproot or sinkers are present in two LLP. Copper coating helped reduce lateral root deformity, but only partially.

Deformed root system architecture did not improve after planting. As long as there are no sever drought, too much rain, or strong wind events, container LLP seedlings can continue their growth and remain standing.

Aug, 2009: 11 months after Hurricane Gustav (Sept, 2008)



Jan, 2010: 5 months after the first sighting of leaning in mid August, 2009 when there was no noticeable wind storm or rain.

Saplings with leaning or sinuous stems were found in all stock types of Cu (yes or no) and cavity size since year four after planting.

Deformed root systems of toppling over/leaning 10-y-o LLP trees from container stock. Taproots were very short and they did not have sinkers extending downward. These trees lacked vertical anchorage provided by a taproot or sinkers.