Cores taken from a Beauregard silt loam. In frequently burned forests, new roots near the soil surface are heat-pruned. Over time, therefore, most woody roots occur deep enough to avoid damage by heat.

pine roots near the soil surface are heat-pruned as surface soil temperatures spike. Over time, the cycle of heat-pruning drives woody roots to a depth where heat causes no damage.

Where fire has been excluded or delayed, some woody roots will be vulnerable to heat damage. The injury or death of a small percentage of woody roots may not affect tree vigor. However, chemicals released from wounds caused by fire can attract insects that carry diseases. Together, these insects and diseases often lead to tree mortality.

We are studying how best to time prescribed burning where the risk of insect infestation and disease is high or where fire is absent or delayed to minimize root damage. For example, in young plantings, early initiation of repeated fire will control the future depth of woody surface roots and protect them from heat as seedlings grow into saplings and trees.

Pine roots near the surface of the soil are damaged by fire if they experience extreme heat.

Land managers can train woody roots to avoid heat damage by initiating fire at a young age.

For More Information Scan Here!

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USDA Forest Service
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SRS-RWU-4158

THE ROOT-SOIL INTERFACE— INSIGHT AND SUPPORT

RESTORING AND MANAGING LONGLEAF PINE ECOSYSTEMS

KEY ROLES OF THE ROOT SYSTEM

The sustainability of southern pines depends on continuous expansion of the root system and mycorrhizal network. This is especially true for longleaf pine which, among the southern pines, is the most tolerant of infertile sites and drought. Consequently, it is often the dominant pine in harsh settings.

Pine nutrition is met by the initiation and growth of new roots that forage unexplored soil and form relationships with beneficial mycorrhizal fungi. As roots mature, their role shifts to serving as conduits for the transport of resources and energy and as the basis of vertical stability.

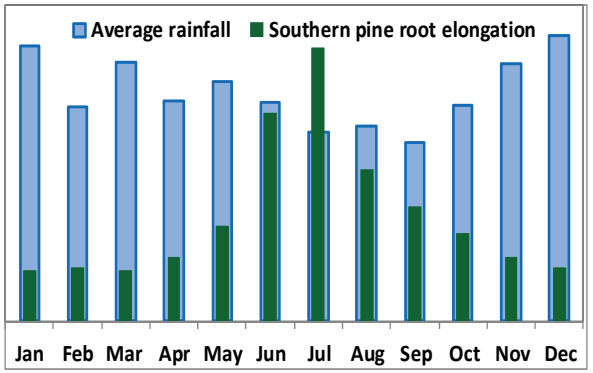
PINE ROOT SYSTEM CHALLENGES

Together with a healthy physiology, soil that allows normal root growth is essential to root system expansion. Field observations have revealed potential constraints to the pine root system, but also that these limitations can be minimized by adjusting silvicultural activities.

Core taken from a Ruston fine sandy loam with pine roots traversing horizontally above an impenetrable layer.

Extreme soil physical properties—Coastal plain soils are often characterized by a strength or "hardness" that prevents root elongation. These extremes may be due to naturally occurring soil bulk densities or to periods of low rainfall that interact with marginally high bulk densities to create root-growth limiting soil strengths.

Southern pines are usually able to avoid inhospitable soil conditions. Studies have shown, for example, that most pine root elongation occurs in spring and early summer when rainfall ensures moist soil and tolerable soil strengths.



Typical patterns of rainfall and pine root elongation in central Louisiana.

Also, soil bulk density and strength are moderated by the movement of roots, insects, and animals. When large enough, decomposing roots produce "old root channels" that allow pine roots to move through patches of hard soil which would normally restrict root elongation. In this way, the distribution of roots and old root channels indirectly aids the expansion of pine root systems. Because fire markedly alters the composition and distribution of vegetation, we are examining whether fire can be applied to conserve positive effects of understory roots on soil physical properties.

Old root channels that are rich in the organic matter of decaying roots, and silt deposited by draining water provide a pathway of least resistance for elongating roots in dense soil.

Root acclimation to fire—New pine roots are abundant in the rich layer of duff and organic soil that accumulates in the absence of fire. Some of these new roots develop into conductive, woody roots and provide anchorage for vertical stability. In longleaf pine ecosystems where repeated fire is a natural process, new

Pine roots and mycorrhizae thrive in the fertile, loose soil and duff below the forest floor.