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Abstracts Book

Unexpected Root Growth and Functioning in Very Deep Rooted Eucalyptus Tree Plantations: Ontogeny or Adaptation to Abiotic Stresses?

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Functional and architectural plant root models simulate root architecture, growth dynamics, mortality, fine root distribution and water and nutrient uptake within the whole soil profile but with a unique set of parameters, usually measured within the topsoil only. They implicitly hypothesize that root growth and functioning is homogeneous throughout soil depth. Moreover, various observations have shown that trees have the capacity to explore very deep soil layers whatever soil and climate conditions, even where no drought is encountered. However, deep rooting strategies are often assumed to result from an adaptation of trees to withdraw water at depth when topsoil dries out. Here we report on changes in fine root behavior, morphology and anatomy with soil depth when comparing shallow roots to those growing down to 17-m in eucalypt plantations in Brazil, using various methods: root intersect measurements on pit walls, permanent pits equipped with (mini)rhizotrons, in-growth and sequential cores, analyses of rhizosphere properties and root anatomy, as well as modeling approaches. We show that very small densities of deep fine roots can have a key functional role for tree survival during extreme drought periods and make it possible to take up nutrients at depth, leached from the upper soil layers or naturally present in the subsoil. Unexpectedly, lower fine root mortality, higher elongation rate, fewer number but larger xylem vessels, higher increase of organic C and available K concentrations in the rhizosphere were found for deep compared to shallow fine roots. Very fast fine root exploration at depth > 4m was found in humid tropics, with no water stress conditions and high resource requirements of trees. Our results suggest a territorial strategy providing access to resources at great depth, suggesting an ontogenetic determinism in addition to the effect of the environment on deep fine root colonization.

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