| SalvaTerra | FINE ROOT ISOTROPY IN EUCALYPTUS GRANDIS PLANTATIONS: TOWARDS ROOT BIOMASS PREDICTION | Ref. 18 |
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| J. Maurice | Brazil | 180 | 18 000 | CIRAD, USP-ESALQ | Program BRAFAGRI (MAP), CIRAD, USP-ESALQ | Jun. 2008 | Dec. 2008 | CIRAD, ESALQ/USP | laclau@cirad.fr |

## Detailed description of the project

Eucalyptus plantations cover more than 20 million hectares throughout the world and their environmental impact has been widely discussed. Many studies have been carried out to assess root biomass in Eucalyptus plantations and the role of fine roots in total underground carbon allocation. Several process-based models have been developed to predict yields, water use, and resource use efficiencies in Eucalyptus plantations. Ecophysiological mechanisms are simulated with a wide range of complexity aboveground, but below-ground processes are still modeled with great uncertainty. Predictive equations making it possible to estimate root length densities (RLDs) from root counts on trench walls would facilitate studies of fine root distributions in these tropical plantations and would contribute to improve current process-based models.

For several decades, a robust and low cost methodology has been developed to evaluate the RLD with respect to time and to space on agricultural land, based on the counting of root impact. Nevertheless, studies attempting to establish predictive equations of RLDs from root counts on trench walls are scarce in forest environments.

The objectives of the study were to assess the changes in fine root anisotropy and specific root lengths throughout the development of Eucalyptus grandis (W. Hill ex Maiden) plantations and to establish a predictive model of root length density (RLD) from root intercept counts on trench walls.

The study was conducted at the ESALQ/USP experimental station in Itatinga, in the state of São Paulo. Fine root anisotropy was studied in a chronosequence of E. grandis plantations that covered the whole rotation (6 years) and was representative of commercial plantations in southern Brazil (seedlings from the same half-sib family selected by the genetic improvement program of the Suzano Bahia Sul Company).

## Services provided

The study was coordinated by J.P. Laclau, researcher at CIRAD. J. Maurice coordinated the field study with the support of Eder Araujo da Silva (Floragro's expert): data collection, and laboratory treatment and measurement. More than 20 people (technicians, students) participated in the field study over 6 months. After the data collection period, an article was written and finally published in the international review "Plant and Soil" (2010, 334 (1-2): 261-275). The article presents the following results:

Fine root densities (<1 mm in diameter) were studied in 6-, 12-, 22-, 28-, 54-, 68- and 72-month-old E. grandis plantations established on deep Ferralsols in southern Brazil. Fine root intercepts (Nt) were counted on 3 faces of soil cubes (1 $dm^3$ in volume) and fine root lengths (L) were measured inside 576 soil cubes, sampled between depths of 10 cm and 290 cm.

An overall isotropy of fine roots was demonstrated by paired Student's t-tests between the numbers of fine roots intersecting each face of the soil cubes at most stand ages and soil depths. Specific root lengths decreased with stand age in the upper soil layers and tended to increase in deep soil layers at the end of the rotation. A linear regression established between Nt and L for all the soil cubes sampled accounted for 36% of the variability of L. Such a regression computed for mean Nt and L values at each sampling depth and stand age explained only 55% of the variability, as a result of large differences in the relationship between L and Nt depending on stand productivity. The equation RLD= 1.89 x LAI x Nt, where LAI was the stand leaf area index and Nt was expressed as the number of root intercepts per $cm^2$, made it possible to predict accurately ($R^2$=0.84) and without bias the mean RLDs ($cm.cm^{-3}$) per depth in each stand, for the whole data set of 576 soil cubes sampled between 2 years of age and 6 years of age, (the end of the rotation).