Resilience from perturbation of architectural scheme through planting varies largely in Pinus pinaster

Frédéric Danjon, Antoine Danquechin Dorval and Céline Meredieu

INRAE, Univ. Bordeaux, BIOGECO, F-33610 Cestas, France

Container plantation is a widespread propagation technique for woody plants. However it is likely to heavily alter young root architecture and thus could modify long-term anchorage. The French *P. Pinaster* forest is now regenerated by planting. In their first 15 years, pines are mainly anchored by a rigid vertical and deep taproot. Older trees are anchored by a rigid cage mainly composed of regularly spaced strong shallow roots from which branch secondary sinkers. The main framework of the central part of the root system is established at 4-years-old with a clear identification of root types.

We measured 3D coarse root architecture of 300 3 to 5-years-old *P. pinaster* saplings planted in 16 stands. They were compared to 30 direct seeded trees from one stand. We set up and used an original architectural analysis to characterise deformations and thus root type modification in order to examine the resulting root architecture and potential stability.

The root system of planted trees was 1.8 cm deeper on average than seeded trees, few plugs showed on the soil surface or were crushed. Vertical deviation of the first order root peaked at a 40° average just under the plug vs. 20° in the seeded trees. When the taproot was not vertical in the 4 cm long zone under the plug, 30% of the taproots did not recover their verticality. Conversely, only 7% lost it when the below plug zone was vertical. Laterals branching from the stump are typically shallow roots. The distribution of the lateral roots along the taproot were not modified by container planting and the largest ones grew from what was the upper half of the plug. Heavy deformations of laterals due to nursery growth in grilled and vertically grooved containers and by planting were located within 6 cm radial distance from the taproot. When the 6 first cm of a lateral root were maintained in a non-horizontal position, 27% of these originally shallow roots grew as oblique roots and 17% as sinkers. Conversely, when horizontal at base, 89% of the lateral roots remained shallow. The mean azimuth angle between shallow horizontal roots is mainly determined by their number at 12 cm radial distance from the first order root, which is lowered when shallow roots loss their plagiogravitropism. Ten planted stand showed significantly larger clustering of azimuth of their shallow roots resulting in significantly larger angle between shallow roots.

The studied planted stands showed low mortality and a small number of badly planted seedlings. They displayed a very large variability in type and degree of deformations which could not be related to variables like the planting season or the type of soil preparation. A variable fraction of planted trees showed a high resilience as they were able to grow a root system which is likely to provide a good anchorage. We concluded that change in root tropism is likely to weaken the anchorage of the trees both in juvenile or mature stage.