Productivity of forest stands developed on a soil succession with different mineral weathering rate: A complex relationship

C. CALVARUSO*[12], L. SAINT-ANDRÉ[1], G. KIRCHEN[1], P.-O. REDON[3] AND M.-P. TURPAULT[1]

[1]INRA, UR1138 INRA-BEF, centre of Nancy, F-54280 Champenoux (*correspondence:chriscalva@hotmail.com)
[2]EcoSustain, Environmental Engineering Office, Research and Development, F-57330 Kanfen.
[3]Andra, R&D Division, Centre de Meuse/Haute-Marne, Route départementale 960, F-55290 Bure.

In non-fertilized forests, weathering of soil minerals and atmospheric deposits represent the main sources of mineral nutrients for plants, and internal cycling allows to efficiently recycle nutrients. In these ecosystems, roots and root-associated microorganisms play a key-role in tree nutrition through nutrient mobilization and acquisition. This work aims at comparing the stand productivity on a soil succession with different mineral weathering rate. The forest of Montiers (NE of France) was chosen to support the study because it presents, under the same climate, a great diversity of soils, from deep acid to shallow calcareous, on which rests a mature and homogeneous beech forest. In 2009, 27 soil profiles were sampled in an alocrisol, a calci-brunisol and a rendisol. The water and nutrient stocks, as well as the root density and the deep enrooting were determined. Trunk diameter and height were measured, and biomass was then estimated in 2009 and 2013 on about 2400 trees. A fertility index (simulation of the height at 100 years of dominant trees) and a foliar diagnosis (fresh leave mineral concentration) was also determined for the three soils. From these data, we proposed the conceptual model below. Through adaptation mechanisms in response to environmental contraints, i.e., increase of root density in the soil surface and root prospection in deep horizons, biological processes can control nutrient mobilisation and acquisition thus maintaining forest productivity.