

## Nitrogen management for perennial crops in Amazonia

Schroth, Götz <sup>(1)</sup>, D'Angelo, Sammya A. <sup>(2)</sup> and Rodrigues, Maria R. L. <sup>(2)</sup>

<sup>(1)</sup> Universität Hamburg, Hamburg, Deutschland, <sup>(2)</sup> Embrapa Amazônia Ocidental, Manaus, Brazil

Nitrogen is a growth-limiting nutrient in many forest and agricultural ecosystems in temperate and tropical climates. It has always played a prominent role in tropical agroforestry and land use research, because through the inclusion of legume trees, leguminous cover crops and food and fodder legumes, a substantial contribution can be made to the nitrogen requirements of land use systems. In fact, biological nitrogen fixation makes nitrogen the only truly renewable nutrient and the only nutrient whose exports with harvest products need not necessarily be compensated by external additions for sustainable land use without mining of soil reserves. However, on many or most sites a supplement of mineral nitrogen fertilizer is necessary to obtain maximum yields.

The Oxisols of central Amazonia are extremely poor in almost all nutrients, but are relatively well supplied with nitrogen. Several perennial crops did not respond to applications of mineral nitrogen with increased yields. Furthermore, subsoil accumulations of nitrate, indicative of leaching of excess nitrogen, seem to be common under agricultural systems with and without nitrogen fertilization and have even been observed under primary forest. The nitrogen-sufficiency of perennial crops on these soils is apparently related to the rather large mineralization rates of soil nitrogen, which have been measured both under forest and under agricultural vegetation. In tree crop agriculture and agroforestry, nitrogen cycling can be further increased through the inclusion of leguminous cover crops. Under a *Pueraria* cover crop, significantly increased rates of nitrogen mineralization and nitrogen concentrations in the soil solution indicated a pool of readily available nitrogen for perennial crops - within the limits of their root systems. This latter condition is critical, as the spatial separation of nitrogen supply and demand caused by excessive spacing of tree crops and limited lateral development of their root systems may lead to leaching losses of nitrate from the soil in the interspaces between the trees. Optimum tree spacing, inclusion of semiperennial crops in the inter-tree spaces during the initial development of the trees, and encouragement of the lateral root development of the trees through appropriate management measures can reduce unproductive nitrogen losses and improve the nitrogen supply of the trees. If such measures are taken, a productive tree crop agriculture on central Amazonian Oxisols does probably not depend on external nitrogen inputs.