Nutrient requirements of Amazonian tree crops - consequences for agroforestry use and management

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With very few exceptions, Amazonian soils are severely limited in nutrients, and this is a major obstacle to agricultural and agroforestry development of the region. Rapid depletion of chemical soil fertility after clearing a site for agricultural use leads to its early abandonment. Low soil fertility is therefore intimately related to deforestation. For sustainable land use, detailed knowledge of crop nutrient requirements is essential to avoid both degradation of soil fertility and productivity, and unproductive losses of applied nutrients by leaching. Unfortunately, such knowledge exists for hardly any perennial crop species in the region.

We studied soil fertility and plant nutrition in multi-strata agroforestry systems with several perennial crop species at four fertilization levels during one year to obtain information on growth-limiting nutrients and to develop optimum sampling schemes for foliar analysis for the different species. The species included were peach palm (*Bactris gasipaes*), cupuaçu (*Theobroma grandiflorum*), Brazil nut (*Bertholletia excelsa*), annatto (*Bixa orellana*) and the cover crop *Pueraria phaseoloides*. Leaf samples were collected at four different times, and three leaf ages were analyzed separately for macronutrients. Here, detailed results are reported for peach palm and cupuaçu. Both species responded to fertilizer inputs with increased yields. For cupuaçu the fertilization effect was most pronounced during early development, whereas the fertilization rates of older trees could probably be reduced without negative effects on yields. The fertilizer effect seemed to be mostly due to P, whereas N seemed to have no effect on crop yields. The yield increases of peach palm seemed to be due to a combination of P, Mg and possibly K. N fertilizer was taken up by the palms but did not seem to influence yields. Beside P fertilization, regular applications of dolomitic lime seem to be the most important measure of soil fertility maintenance on this type of soil.

For both species there were pronounced differences in nutrient concentrations between age classes of leaves and sampling dates. This illustrates the need for base-line studies, like the present one, to identify optimum sampling protocols for foliar diagnosis of nutrient deficiencies and fertilizer requirements. Our results indicate that for both tree crop species a combination of two sampling dates per year would be more sensitive for the detection of differences in nutrient supply than a single collection.