Importance of *Pueraria phaseoloides* for the N cycle in tropical tree production

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Apart from their effects on soil protection, legume cover crops have an important role for nutrient cycling in fruit production systems in the humid tropics. The objective of this study was to analyse the biomass production and nutrition of *Pueraria phaseoloides* as a cover crop grown in three different agroforestry systems (System 1: *Theobroma grandiflorum*, *Bactris gasipaes* and *Hevea* spp; System 2: *Theobroma grandiflorum*, *Bactris gasipaes*, *Bertholletia excelsa* and *Bixa orellana*; System 3: *Theobroma grandiflorum, Hevea* spp, *Cocus nucifera* and *Citrus sinensis*) at two levels of fertilisation (100 % + additional dose of P and 30 % of fertilisation recommended to individual useful plants), and its potential to contribute to the N stocks of the cropping system by biological N_2 fixation. The study was conducted on experimental plots with the dimensions of 32 by 40 m using three replications planted in 1993. The soil of the study site is a Xanthic Ferrasol (FAO/UNESCO). For estimating the aboveground biomass, the litter and plant nutrition of *Pueraria*, five sub-samples of 0.25 m^2 were collected from the area between the tree rows in each plot in June 1998. The samples were dried at 70°C for 48 hours and nutrient contents (N, P, S, K, Ca, Mg, Fe, Mn, Zn and Cu) were measured using standard analytical procedures. The biological N_2 fixation was determined in both the dry and rainy season in system 1 (100% fertilisation) using ^{15}N isotope dilution. Three different reference plants were used which had similar growth characteristics and were not fixing atmospheric N_2 (*Rolandra fruticosa, Maieta* sp, and a Cyperaceae species). Ammoniumsulfate with 10 atom%^{15}Nexcess was applied at a rate of 50 mg m^{-2} in microplots of 1 m^2. Statistical analyses were done with ANOVA using a randomized complete block design.

The K and Ca contents in the biomass were influenced by fertilisation indicating that nutrient applications to the trees can improve cover crop nutrition. As a consequence, a positive correlation was found between the aboveground biomass and the K contents ($R=0.51$; $P< 0.03$). Additionally, N and P contents ($R=0.63$; $P<0.005$) as well as N and Mg contents ($R=0.56$; $P< 0.01$) were significantly related to each other. However, the type of cropping systems was the main factor controlling growth and the nutritional status of *Pueraria*. The aboveground biomass and litter of *Pueraria* ranged from 2.2 to 6.1 and from 2.7 to 7.7 Mg ha^{-1}, respectively. The highest aboveground biomass and litter production was found in systems 3 with the most scattered plant distribution. The N content of *Pueraria* reached 57-177 Kg ha^{-1} in the aboveground biomass with similar values in the litter of 48-165 Kg ha^{-1}. In contrast, the amounts of Ca in the litter were enriched in comparison to the biomass, whereas K was depleted due to rapid leaching from decomposing litter. With the exception of K, the nutrients stocks in *Pueraria* litter were more than twice as high as the nutrients applied by fertilisation. Consequently, nutrient turnover of *Pueraria* was an important process in the nutrient cycling of the fruit tree production system. The N in *Pueraria* derived from biological N_2 fixation estimated by ^{15}N enrichment reached values from 9 to 45 % and was higher throughout the wet than the dry season. Thus, 32-158 Kg N ha^{-1} of the biomass N were derived from atmospheric N_2, exceeding the amounts of N added by fertilisation.

The large nutrient uptake and return through litter indicated a rapid nutrient cycling at the plant-topsoil interface, thus reducing leaching and keeping nutrients in available form. The considerable amount of biologically fixed N_2 was a relevant and important addition to the N pool of the cropping systems.