Potential Release of Macronutrients and C Sequestration of Different Land Use Systems in the Peruvian Amazon

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INTRODUCTION

The natural process of recycling in the humid tropics is the basis of sustainability of most land use systems (LUS). Knowing the rate of decomposition and potential release of nutrients in litterfall is very important to predict short, medium and long term interventions to guarantee productivity and sustainability, and also to generate carbon accumulation to preserve soils and mitigate effects of climate change (Alegre *et al*., 2005;). Agricultural and climate change research have identified land uses, cropping systems, and soil management practices that could help decrease greenhouse gas emissions from soils and this phenomenon has been called *carbon sequestration*. The carbon sequestration potential of soils can be greater in degraded soils, in which prior inappropriate management caused significant loss of soil organic matter (Lal, 2014). The objectives of this study were to compare seven different LUS in the humid tropics of Yurimaguas, Peru, for their potential release of macronutrients and for the carbon accumulation in their litterfall.

MATERIAL AND METHODS

Description of study site

The study was conducted in seven systems from the humid tropical forest in Yurimaguas, Peru. The seven land use systems were a 30-year-old secondary forest, a 30-year-old multi-strata agroforestry system (*Cedrelinga cateniformis* and *Centrosema macrocarpum*), three perennial crops of oil palm (*Elaeis guineensis*) associated with kudzu (*Pueraria phaseoloide*), heart of palm (*Bactris gasipaes*) and peach palm for fruit (*Bactris gasipaes*) associated with kudzu, degraded pasture (native pasture with a predominance of *Axonopus compressus*), and improved pasture (*Centrosema macrocarpum* and *Brachiara brizantha*) (Figure 1).

Figure 1. Some of the LUS evaluated: A. Degraded pasture; B. Peach palm with kudzu as a cover crop; C. Oil palm with kudzu; and D. Multi-strata agroforestry system with *cedrelinga* and *centrosema*.

Description of litterfall sampling

Litterfall samples were collected in two sections, by blocks in each plot using a quadrat of 1 m^2 under the canopy and between the plants in the systems with trees, and one section in the pastures. Sub-samples were dried at 70 °C.

Determination of organic carbon and macronutrients

The organic carbon content was determined on the dry samples by Loss-on-ignition method. The nitrogen was determined by Kjedahl method, phosphorus by colorimetric method, potassium, calcium and magnesium by atomic absorption spectrometry, and Sulphur by the turbidimetry method (Jackson, 1970).

CONCLUSION

After long-term studies with different LUS under low fertility soils of the Peruvian Amazon, the reserves of nutrients and organic carbon were greater in LUS with trees and cover crops and in the secondary forest because of greater dry matter and plant diversity, while they were very low for pasture reserves.

Phosphorus was the most limited nutrient and reserves in the litterfall were very low because of low recycling, while calcium had the second greatest reserves after nitrogen.

RESULTS

Table 1. Dry matter and organic C of the litterfall of different LUS in the Peruvian Amazon.

Land Use System		Dry matter of litterfall	Organic C
		kg ha^{-1}	
Forest	Secondary forest	7,860 a*	2,870 a
Agroforestry system	Multi-strata	9,030 a	3,330 a
Crops	Oil palm	9,120 a	3,370 a
	Heart palm	9,100 a	3,360 a
	Peach palm	1,650 b	654. b
Pasture	Improved pasture	1,770 b	744. b
	Degraded pasture	1,560 b	786. b
	P < (0.05)	***	***

*Means with the same letter for each column are not different at P=0.05 level by the Waller-Duncan multiple comparison test.

Table 2. Macroelement amounts of the litterfall of different LUS in the Peruvian Amazon.

Land Use System		Macroelement					
		N	P	K	Ca	Mg	S
		kg ha^{-1}					
Forest	Secondary forest	143a*	4.40a	7.84a	81.8a	11.3a	10.7
Agroforestry system	Multi-strata	172a	5.20a	9.13a	88.8a	13.4a	12.4
Crops	Oil palm	174a	5.23a	9.20a	89.4a	13.5a	12.6
	Heart palm	174a	5.22a	9.19a	89.3a	13.5a	12.6
	Peach palm	11.7b	0.63b	2.06b	20.0b	3.17b	1.34
Pasture	Improved	13.4b	0.51b	1.88b	19.8b	3.49b	1.53
	Degraded	18.8b	0.67b	2.73b	18.3b	3.15b	2.80
	P < (0.05)	***	***	***	***	***	***

*Means with the same letter for each column are not different at P=0.05 level by the Waller-Duncan multiple comparison test.

Table 3. Carbon-Nitrogen ratio of different LUS in the Peruvian Amazon.

Land Use System		C/N
Forest	Secondary forest	20.6c*
Agroforestry system	Multi-strata	19.3c
Crops	Oil palm	19.3a
	Heart palm	19.3a
	Peach palm	55.9a
Pasture	Improved	55.6a
	Degraded	43.1b
	P < (0.05)	***

*Means with the same letter for each column are not different at P=0.05 level by the Waller-Duncan multiple comparison test.

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