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

J. Alegre[1], R. Vega[2], P. Gutiérrez[3], F. De Mendiburu[4], E. Schrevens[5]

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 generate C accumulation to conserve 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 C 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. The LUS 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). Litterfalls were collected in quadrants of 1 m^2 and then weighed, oven-dried at 75°C, weighed again, and results transformed to dry matter per hectare. Nutrients were analyzed in the dry matter litterfalls and converted to reserves of nutrients in kg ha^{-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*.

Tables 1 and 2 summarize the dry matter production of the litterfall, organic carbon and macroelement amounts (kg ha^{-1}) for the different LUS. Reserves of nutrients and C 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. The cover crop with legumes with centrosema or kudzu with perennial crops and woody trees protected the soils and incorporated

[1]Julio Alegre , Professor, National Agrarian University La Molina (UNALM), Lima, Peru; [2]Ruby Vega , Assistant Professor, UNALM, Lima, Peru; [3]Pedro Gutiérrez, Graduate student, UNALM, Lima, Peru; [4]Felipe De Mendiburu, Professor, UNALM, Lima, Peru; [5]Eddie Schrevens, Professor, Leuven University, Leuven, Belgium. Corresponding author: Julio Alegre, email: jalegre@lamolina.edu.pe.

more N than other non-legumes. The native and improved pastures were overgrazed, resulting in very low nutrients and C 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 N. After long-term studies with different LUS under Ultisols of the Peruvian Amazon, the nutrient recycling process with appropriate plants can work only for N and K but not for P, so it is recommended to fertilize soils with inorganic natural sources of P.

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

References

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