

Nutrient Fluxes from Litter and Prunings in an Agroforestry System in Central Amazonia

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1 Introduction

Litterfall and prunings are major components of organic inputs in agroecosystems. They are the main source of organic matter and nutrient for the soil so they are a key determinant of soil fertility especially on nutrient poor soils, like in tropical humid ecosystems (ANDERSON and SWIFT, 1983). In multi-strata agroforestry system, cropping trees are the main component of the system so litterfall and prunings depend on tree species, density and management such as fertilization. Depending on the nutrient cycling capacity of the agroforestry systems, they can be proposed as alternative to natural fallow for soil improvement (YOUNG, 1997). With a better understanding of nutrient cycling, management of nutrient input may improve the production in low input agroforestry systems.

The aim of our study was to quantify nutrient fluxes from litterfall and prunings in an agroforestry system and in a natural fallow and to assess the effect of fertilization on nutrient input.

2 Materials and methods

The study was made in one of the agroforestry systems of the SHIFT program, at the research station of EMBRAPA Amazônia Ocidental near Manaus, Brazil. (3°8 S, 59°52 W, 40-50 meters altitude). The system consisted of a mixed cropping of *Bixa orellana* (annatto), *Bertholletia excelsa* (Brazil nut), *Theobroma grandiflorum* (cupuaçu), *Bactris gasipaes* (peach palm) and *Pueraria phaseoloides* as a cover crop. Distance between rows was 4 m. Two fertilization treatments were compared :

- 30% of the recommended dose for each species, without nitrogen (low fertilization, LF) and
 - 100% of the recommended dose (high fertilization, HF).
- Litterfall was collected in trunk-centered littertraps and prunings were quantified when harvested. In most plots, pueraria had a highly variable growth, so its litter was not taken into account in this study. The macronutrients N, P, K, Ca, and Mg were analyzed in litterfall and pruning leaves.

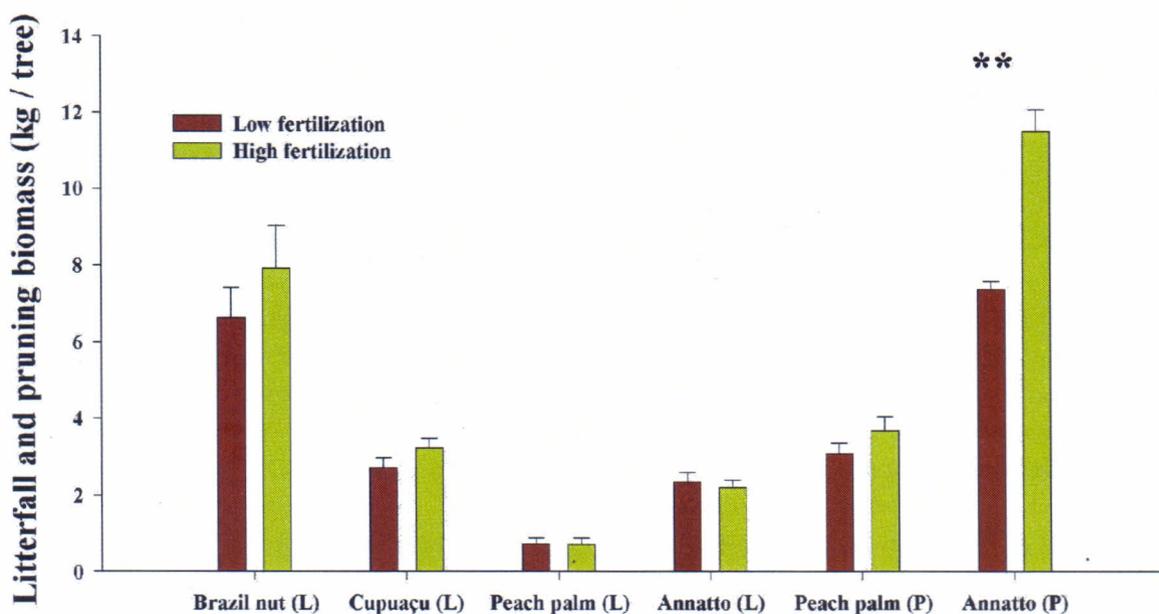


Fig. 1: Litterfall (L) and Pruning biomass (P) (kg/tree) for four species of an agroforestry system (** stands for significant fertilization effect)

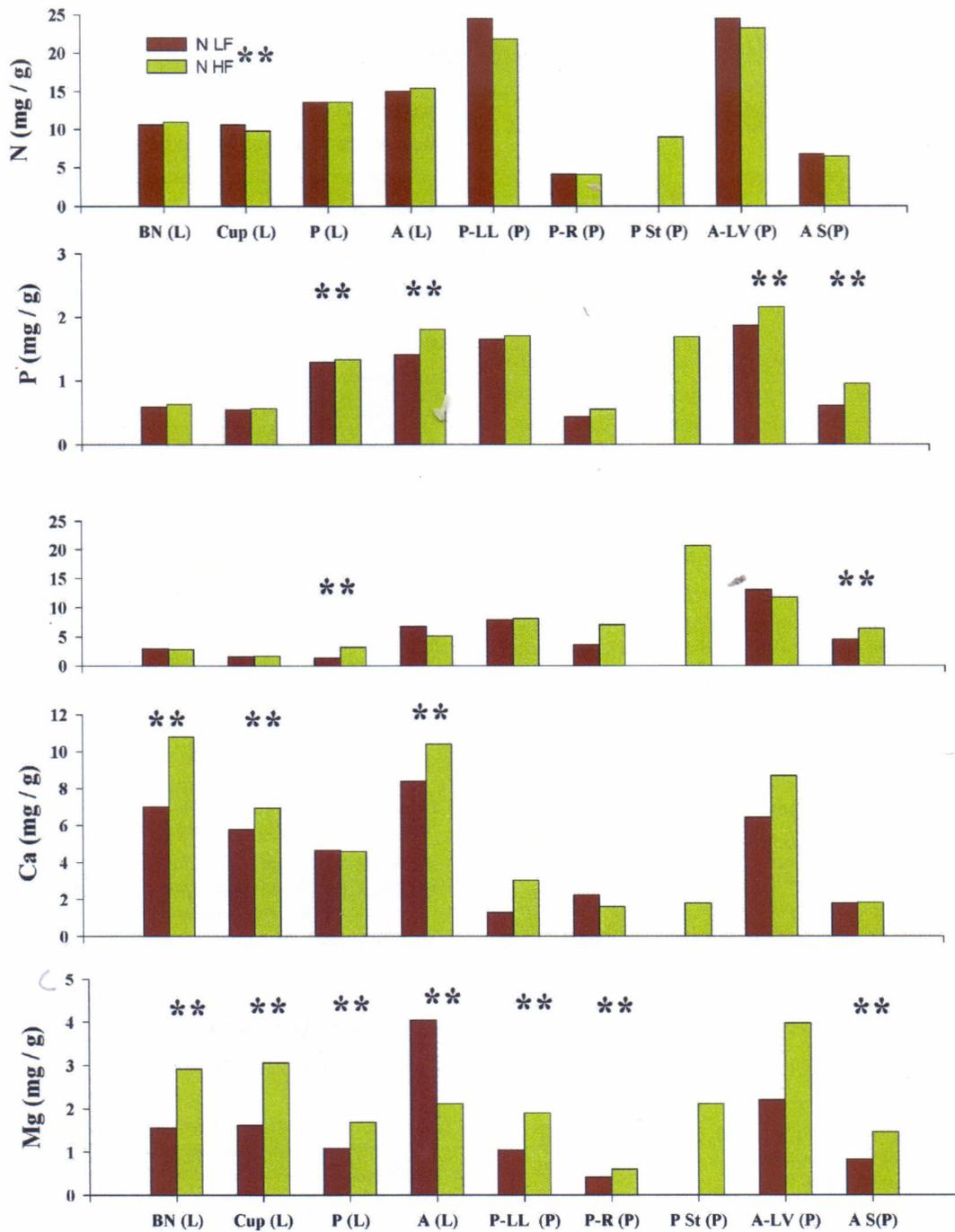


Fig. 2: Annual mean nutrient concentration (mg / g) in fine litterfall (L) and prunings (P) from an agroforestry system. ** stands for significant fertilization effect. BN= Brazil nut, Cup=Cupuaçu, P=peach palm, A=Annatto, LL= leaflet, R= rachis, St=stipe, LV=leaves, S=Stem

The effects of fertilization on litterfall, pruning biomass and nutrient contents were assessed by ANOVA followed by a Tukey-test or by an appropriate non-parametric test if ANOVA conditions were not met.

3 Results/Discussion/Conclusions

In the agroforestry system, there was no difference in annual litterfall in any species between the two fertilization levels treatments (Fig. 1). Only the amount of annatto prunings was significantly higher in the high fertilization treatment (HF). Pruning biomass was higher than litterfall in the agroforestry system (Tab. 1). Litterfall was lower in the agroforest than in the natural fallow.

	Litterfall	Prunings	Total input
Agroforestry system LF	1.48	2.13	3.61
Agroforestry system HF	1.62	2.97	4.59
Fallow	5.07		5.07

Tab. 1: Annual litterfall and pruning biomass (t/ha) in an agroforestry system at high (HF) and low (LF) fertilization levels and in a natural fallow

There were more differences between the two fertilization treatments for nutrient content (Fig.2). Differences were often found for magnesium, calcium and phosphorus. The most significant differences were found for prunings and for annatto and peach palm litterfall.

Potassium and magnesium inputs were higher in the agroforestry system with high fertilization than in the fallow, but only potassium was higher in the low fertilization treatment than in the fallow (Tab. 2).

	N	P	K	Ca	Mg
Agroforestry system LF	44.5	4.00	25.3	15.7	5.21
Agroforestry system HF	55.9	5.94	36.2	24.3	11.0
Fallow	77.4	6.17	20.6	40.3	10.6

Tab.2: Mean annual input of nutrients (kg/ha) in an agroforestry system at high (HF) and low (LF) fertilization levels and in a natural fallow

Differences in nutrient inputs between the two fertilization levels were mainly due to higher biomass and nutrient concentration in prunings in the high fertilization level treatment. Litterfall was similar in the two fertilization treatments but variations in litterfall nutrients were found for Ca and Mg. Unpruned trees had higher litterfall than annatto and peach palm but showed less variations in nutrient concentrations according to fertilization treatment.

Litterfall was lower in the agroforest compared to the fallow and to the natural forest (7.8-8.8 t ha⁻¹) (LUIZÃO, 1989), due to the low plant density and the low plant productivity. As pruning amount constituted a great part of organic input, they appear to be of great importance for maintaining a ground cover.

The role of Pueraria in the recycling of organic matter was not assessed in this work but appeared to be of great importance for organic matter input because in the plots exhibiting a high Pueraria growth, organic input in the agroforest was higher than in the fallow and the natural forest (LEHMANN et al., 2000).

4 References

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