LEAF RESIDUE DECOMPOSITION OF SELECTED ATLANTIC FOREST TREE SPECIES[1]

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ABSTRACT –Biogeochemical cycling is essential to establish and maintain plant and animal communities. Litter is one of main compartments of this cycle, and the kinetics of leaf decomposition in forest litter depend on the chemical composition and environmental conditions. This study evaluated the effect of leaf composition and environmental conditions on leaf decomposition of native Atlantic Forest trees. The following species were analyzed: *Mabea fistulifera* Mart., *Bauhinia forficata* Link., *Aegiphila sellowiana* Cham., *Zeyheria tuberculosa* (Vell), *Luehea grandiflora* Mart. et. Zucc., *Croton floribundus* Spreng., *Trema micrantha* (L) Blume, *Cassia ferruginea* (Schrad) Schrad ex DC, *Senna macranthera* (DC ex Collad.) H. S. Irwin and Barney and *Schinus terebinthifolius* Raddi (Anacardiaceae). For each species, litter bags were distributed on and fixed to the soil surface of soil-filled pots (in a greenhouse), or directly to the surface of the same soil type in a natural forest (field). Every 30 days, the dry weight and soil basal respiration in both environments were determined. The cumulative decomposition of leaves varied according to the species, leaf nutrient content and environment. In general, the decomposition rate was lowest for *Aegiphila sellowiana* and fastest for *Bauhinia forficate* and *Schinus terebinthifolius*. This trend was similar under the controlled conditions of a greenhouse and in the field. The selection of species with a differentiated decomposition pattern, suited for different stages of the recovery process, can help improve soil restoration.

Keywords: Litter; Biogeochemical cycle; Basal respiration.

DECOMPOSIÇÃO DE MATERIAL FOLIAR DE ÁRVORES SELECIONADAS DA MATA ATLÂNTICA

RESUMO – A ciclagem biogeoquímica é fundamental para o estabelecimento e manutenção de comunidades vegetal e animal em áreas degradadas. A serapilheira é um dos principais compartimentos dessa ciclagem e a cinética de decomposição de folhas desse compartimento depende de sua composição química e de condições ambientais. Este estudo teve como objetivo avaliar o efeito da composição de material vegetal e de condições ambientais na decomposição de folhas de espécies arbóreas nativas da Mata Atlântica. Foram selecionadas as espécies ***Mabea fistulifera*** *Mart.,* ***Bauhinia forficata*** *Link.,* ***Aegiphila sellowiana*** *Cham.,* ***Zeyheria tuberculosa*** *(Vell),* ***Luehea grandiflora*** *Mart. et. Zucc.,* ***Croton floribundus*** *Spreng.,* ***Trema micrantha*** *(L) Blume,* ***Cassia*** ferruginea *(Schrad) Schrad ex DC,* ***Senna macranthera*** *(DC ex Collad.) H. S. Irwin e Barney e* ***Schinus terebinthifolius*** *Raddi (Anacardiaceae). Para cada espécie foram preparados "litter bags" e colocados na superfície de vasos contendo solo superficial em casa de vegetação e diretamente sobre o mesmo solo no campo,. A cada 30 dias foi determinado o peso do material vegetal seco existente. Foi realizada também a medição da respiração basal do solo para os dois ambientes. A decomposição acumulada dos materiais foliares variou com a espécie, com o teor de nutrientes e com o ambiente. De maneira geral, a espécie que apresentou menor velocidade de decomposição foi a* ***Aegiphila sellowiana*** *e as espécies de maior velocidade foram* ***Bauhinia forficata*** *e* ***Schinus terebinthifolius****. Este comportamento foi semelhante tanto em condições controladas (casa de vegetação) como em condições de campo. Este agrupamento de espécies auxilia os trabalhos de recuperação ambiental, onde podem ser selecionadas as espécies adequadas para cada fase do processo de recuperação.*

Palavras-Chave: Serapilheira; Ciclagem biogeoquímica; Respiração basal.

1.INTRODUCTION

For the restoration process of a given area, a basic condition is to ensure good enough soil quality conditions for the survival and growth of plants. Therefore, higher soil organic carbon (SOC) and nutrient cycling, particularly by increased litter formation and decomposition, play an essential role in successful growth of introduced species and establishment of species resulting from natural regeneration. The SOC uptake potential and litter decomposition depend on the nature of the decomposing soil biota (macro, meso and soil microfauna), of substrate and climate (Barlow et al., 2007), as well as on the chemical and physical properties of the plant residues, determining its degradability (Lekha and Gupta, 1989; Dias and Griffith, 1998; Griffith et al., 2000). In general, the decomposition rate of plant material has been negatively correlated with the contents of lignin, polyphenols, cellulose, and lignin/N, C/N and C/P ratios, and positively with the levels of N and P (Constantinides and Fowes, 1994; Jamaludheen and Kumar, 1999).

In addition to the high nutrient and energy contents in forest litter, it represents a link between soil and vegetation. At the soil surface, it promotes physical protection, hence reducing the impact of raindrops and runoff. This creates a favorable environment for the establishment of soil fauna and microbial decomposers. This role has been described for the most diverse soils and substrates, e.g., of tropical forests, phyllites containing metal sulfides in a gold mining area, or bauxite-tailing ponds (Dias et al., 2000; Reis, 2006; Ge et al., 2013; Rai et al., 2016).

The amount of litter produced, decomposition rate and nutrient turnover in the soil are key elements for the nutrient balance in forest ecosystems (Lekha and Gupta, 1989). Thus, knowledge about decomposition kinetics of plant material from different species used in environmental remediation programs allows the choice of species that intensify nutrient cycling, by the incorporation of humified material in the soil, contributing to soil surface protection.

This study characterized and compared the decomposition dynamics of leaves of 10 different Atlantic Forest species selected in the region of Viçosa, Minas Gerais, evaluated in the field and a greenhouse, relating the chemical characteristics with the decomposition kinetics of the residues.

2.MATERIALAND METHODS

2.1Characterization of the area and leaf material

Fully mature leaf samples were collected from the mid third of the canopy of the following Atlantic Forest tree species: *Mabea fistulifera* Mart. (Canudo de Pito), *Bauhinia forficata* Link. (Unha de vaca), *Aegiphila sellowiana* Cham. (Pau-gaiola Tamanqueira), *Zeyheria tuberculosa* (Vell) (Ipê-tabaco), *Luehea grandiflora* Mart. et. Zucc. (Açoita cavalo), *Croton floribundus* Spreng. (Lixeira), *Trema micrantha* (L) Blume (Candiúba, Candeeiro), *Cassia ferruginea* Schrad ex DC (Chuva de ouro), *Senna macranthera* (DC ex Collad.) HS Irwin and Barney (Pau-fava), and *Schinus terebinthifolius* Raddi (Anacardiaceae) (Aroeira-Vermelha). The samples were collected in two fragments of Semideciduous Atlantic Forest in Viçosa-MG (Veloso et al., 1991).

The climate (Köppen classification) is Cwa - humid mesothermal, with rainy summers and dry winters. The average annual temperatures range from 26.1 to 14.0 °C and cumulative annual rainfall is approximately 1.300 mm (Vianello and Alves, 1991).

The leaf samples were analyzed for the following properties: total carbon content, by dry combustion (muffle furnace); total nitrogen, by the Kjeldahl method; P content, by molecular absorption spectrometry after nitropercloric digestion; and lignin, cellulose, and silica (acid detergent fiber ash-ADF) contents by the potassium permanganate method. From these results, we calculated the C/N and lignin/N ratio. Subsamples of leaf material were taken to determine the moisture content and for dry weight correction.

2.2Greenhouse experiment

The leaves were cut and placed in litter bags. Each bag was filled with 15 g (fresh weight basis) of leaves of all species. Soil samples from the surface layer (0-10 cm) of a Red-Yellow Latosol under secondary forest were collected, crumbled, divided in 1.0 dm^3 subsamples and filled in plastic pots. The physical-chemical properties of this soil are listed in Table 1. Then the bags containing the plant residues were buried halfway in the pots, leaving the surface uncovered. Deionized water was poured into the pots, onto the soil and litter bags, until water began to drain from the bottom of the pots.

At 30, 60, 90, 120, 150, and 180 days after initiating the experiment, the dry weight of three bags with the

Table 1 – Chemical and physical properties ofa dystrophic Red-Yellow Latosol.
Tabela 1 – *Características químicas e físicas do Latossolo Vermelho-Amarelo distrófico.*

pH	OM	P	K	Ca^{2+}	Mg^{2+}	Al^{3+}	H+Al	P-rem	Sand	Silt	Clay	Color
	dag kg^{-1}	mg dm^{-3}				$cmol_c$ dm^{-3}		mg L^{-1}		dag kg^{-1}		
4.5	4.9	1.7	20	0.1	0.0	1.7	10.8	9.7	42	4	54	5YR 3/3

different plant residues was determined by oven-drying at 70 °C. The greenhouse experiment was arranged in a randomized block, 10 x 6 factorial design, with 10 plant species, 6 sampling times, and 3 replications, resulting in a total of 180 experimental units.

2.3Field test

The field experiment was carried out in a secondary forest in Viçosa - MG, on a Red-Yellow Dystrophic Latosol (Embrapa, 2013). The same soil was used in the greenhouse experiment. Litter bags similar to those used in the greenhouse experiment, containing 40 g (fresh weight) of leaves per species were placed on the soil after careful removal of all litter, fixed with metal clamps and labelled with identification tags.

The bags were collected on the same dates, following similar procedures to determine the residue dry weight as in the greenhouse experiment. A randomized block, 10 x 6 factorial design with three replications was used, with a total of 180 experimental units. The soil microbial activity in the field was estimated by quantifying the CO_2 trapped in the installed gas sampling chambers (Mendonça and Matos, 2005). In each field experimental block, we placed seven chambers after litter removal, three without litter bags, three containing litter bags and an empty chamber, sealed to block any contact with the soil. All chambers were covered with aluminum foil to increase the reflection of solar radiation.

The sides of the plastic chambers (volume of 5,800 cm^3) were buried 3 cm deep in the soil, to minimize gas exchange with the outside. Fortnightly, they were installed in the field for 24 hours, and the first measurement was performed when the bags were first collected (30 days after installation). The data obtained from the greenhouse and field experiments were subjected to analysis of variance, and means compared by the Scott-Knott test, at 5% probability. The cumulative decomposition in the greenhouse (CDG) and field (CDF) were calculated as weight and percentage relative to the weight of the initial dry matter for each sampling period, material and environment. With the mean cumulative decomposition data of each leaf material in each environment, linear regression analysis was performed, with decomposition period as independent variable.

The constant decomposition "k" for each material was estimated using an exponential model (Thomas and Asakawa, 1993), $Xt = Xo\ e^{-kt}$, where xt = remaining weight of the material after 180 days; Xo = weight of the material placed in the forest litter bags and t = 180 days.

For a better comparison of decomposition in the different environments, we calculated the half-life ($t_{1/2}$) of different materials by the following model:

$t_{1/2} = \ln(2)/k$, where "k" is the decomposition constant of each material.

3.RESULTS

Total N contents ranged from 21.0 (*Schinus terebinthifolius*) to 36.7 g kg^{-1} (*Aegiphila sellowiana*); and lignin from 163.1 (*Zeyheria tuberculosa*) to 286.3 g kg^{-1} (*Mabea fistulifera*). Cellulose contents ranged from 158.4 (*Trema micrantha*) to 277.5 g kg^{-1} (*Luehea grandiflora*) (Table 2). These differences affected the C/N and lignin/N ratios, of which the first varied from 13.22 (*Aegiphila sellowiana*) to 25.46 (*Schinus terebinthifolius*), and the second from 5.78 (*Croton floribundus*) to 11.56 (*Schinus terebinthifolius*), respectively.

At the end of the experiment, cumulative decomposition in the greenhouse (CDG) varied significantly between species. The lowest value was observed for *Luehea grandiflora* (26.2%) and the highest for *Schinus terebinthifolius* (61.0%) (Table 3). The leaves of these two species had very similar cellulose contents and C/N ratios, but very contrasting lignin contents and lignin/N and C/P ratios, ranging from 25 to 36% (Table 2).

After 30, 90 and 120 days of decomposition, based on the Scott-Knott test, three groups of species were separated according to the decomposition rate, defined as slow-decomposing group (*Zeyheria tuberculous*, *Aegiphila sellowiana* and *Cassia ferruginea*),

Table 2 – Content of nitrogen, carbon and phosphorus, lignin (Lig) and cellulose (Cel) and the carbon/nitrogen ratios (C/N), carbon/phosphorus (C/P) and lignin/nitrogen (Lig/N) of leaf samples of the studied species.
Tabela 2 – *Teores de nitrogênio, carbono e fósforo, lignina (Lig) e celulose (Cel) e as relações carbono/nitrogênio (C/N), carbono/fósforo (C/P) e lignina/nitrogênio (Lig/N) das amostras foliares das espécies estudadas.*

Species	N	C	P	Lig	Cel	C/N	C/P	Lig/N
				g kg^{-1}				
Mabea fistulifera	29.9	503.7	1.5	286.3	192.1	16.9	335.8	9.6
Bauhinia forficata	28.8	444.7	2.3	167.9	240.6	15.4	193.3	5.8
Aegiphila sellowiana	36.7	485.2	1.6	246.3	242.4	13.2	303.3	6.7
Zeyheria tuberculosa	24.4	517.4	1.7	163.1	263.5	21.2	304.4	6.7
Luehea grandiflora	21.4	525.4	1.1	177.9	277.5	24.6	477.6	8.3
Croton floribundus	32.6	527.4	1.4	188.4	250.0	16.2	376.7	5.8
Trema micrantha	26.5	479.4	1.2	175.3	158.4	18.1	399.5	6.6
Cassia ferruginea	27.2	588.4	1.3	184.2	172.4	21.6	452.6	6.8
Senna macranthera	29.2	574.3	1.9	210.7	167.0	19.7	302.3	7.2
Schinus terebenthifolius	21.0	534.6	1.4	242.7	251.7	25.5	381.9	11.6

Table 3 – Percentage of cumulative decomposition per sampling period and species, under greenhouse conditions.
Tabela 3 – *Decomposição acumulada percentual em cada época de coleta, para cada espécie, em casa de vegetação.*

Species	Days					
	30	60	90	120	150	180
	%					
Mabea fistulifera	13.7 **b**	23.7 **b**	25.4 **b**	26.2 **b**	30.5 **b**	42.1 **b**
Bauhinia forficata	21.8 **a**	30.9 **a**	31.4 **a**	40.1 **a**	46.0 **a**	56.3 **a**
Aegiphila sellowiana	2.2 **c**	17.0 **c**	22.6 **b**	24.9 **b**	28.4 **b**	50.5 **a**
Zeyheria tuberculosa	7.2 **c**	7.2 **d**	11.4 **c**	16.5 **c**	30.5 **b**	38.4 **b**
Luehea grandiflora	12.7 **b**	15.8 **c**	17.4 **b**	20.4 **b**	20.4 **b**	26.2 **b**
Croton floribundus	11.5 **b**	20.9 **b**	21.1 **b**	23.4 **b**	30.4 **b**	39.6 **b**
Trema micrantha	10.9 **b**	21.2 **b**	23.5 **b**	29.2 **b**	29.2 **b**	44.2 **b**
Cassia ferruginea	5.1 **c**	5.1 **d**	10.2 **c**	10.9 **c**	29.4 **b**	33.0 **b**
Senna macranthera	17.9 **a**	28.2 **a**	34.1 **a**	39.4 **a**	42.0 **a**	44.1 **b**
Schinus terebinthifolius	11.7 **b**	29.8 **a**	29.8 **a**	38.6 **a**	48.0 **a**	61.0 **a**

intermediate (*Mabea fistulifera*, *Luehea grandiflora*, *Croton floribundus,* and *Trema micrantha*) and fast-decomposing species (*Bauhinia forficata*, *Senna macranthera* and *Schinus terebinthifolius*) (Table 3). However, after 150 and 180 days, the test identified only two groups, consisting of intermediate-decomposing (*Mabea fistulifera*, *Zeyheria tuberculous*, *Luehea grandiflora*, *Croton floribundus*, *Trema micrantha*, *Cassia ferruginea,* and *Senna macranthera*) and fast- decomposing species (*Bauhinia forficata*, *Aegiphila sellowiana* and *Schinus terebinthifolius*) (Table 3).

In the field, the decomposition rate of the plant residues varied largely throughout the experimental period (Table 4). At the end of the experiment, the mean cumulative decomposition (MCD) of the different residues was 67% higher in the field than in the greenhouse. The values ranged from 37.3% for *Aegiphila sellowiana* to 91.9% for *Mabea fistulifera*. These rates are similar (50-75%) to those observed for native rainforest species (Gama-Rodrigues et al., 2003), and higher than those of eucalyptus (29 - 33%), for which decomposition is only effective during the rainy season (Costa et al., 2005).

By the Scott-Knott test, it was possible to separate the MCD values into three groups after 60, 90, 120, and 180 days of decomposition (Table 4). At the end of the experiment, three species were classified as slow-decomposing (*Luehea grandiflora*, *Aegiphila sellowiana* and *Trema micrantha*), one as intermediate (Croton *floribundus*) and six as fast-decomposing species (*Mabea fistulifera*, *Bauhinia forficata*, *Zeyheria tuberculous*, *Cassia ferruginea*, *Senna macranthera,* and *Schinus terebinthifolius*).

From the regression analysis of the mean values of cumulative decomposition (CD) among species, in the field (CDF) and greenhouse (CDG), in function of a given decomposition period (sampling), the following predictive models of degradation were established:

Table 4 – Percentage of cumulative decomposition per sampling period and species, in the field
Tabela 4 – *Decomposição acumulada percentual em cada época de coleta, para cada espécie, em campo*

Species	Days					
	30	60	90	120	150	180
	%					
Mabea fistulifera	28.9 **b**	54.2 **a**	64.3 **a**	67.7 **a**	88.8 **a**	91.9 **a**
Bauhinia forficata	31.5 **b**	50.7 **a**	55.8 **a**	64.7 **a**	82.3 **a**	82.3 **a**
Aegiphila sellowiana	19.5 **c**	23.8 **c**	29.3 **c**	32.3 **c**	35.2 **c**	37.3 **d**
Zeyheria tuberculosa	35.1 **b**	39.5 **b**	44.3 **b**	76.7 **a**	82.0 **a**	89.3 **a**
Luehea grandiflora	16.1 **c**	31.4 **b**	43.7 **b**	48.6 **b**	48.6 **b**	49.6 **c**
Cróton floribundus	23.3 **c**	36.0 **b**	60.6 **a**	67.5 **a**	67.5 **a**	67.5 **b**
Trema micrantha	13.9 **c**	19.7 **c**	32.8 **c**	32.8 **c**	35.6 **c**	43.6 **d**
Cassia ferruginea	14.1 **c**	27.2 **c**	43.4 **b**	59.8 **b**	77.2 **a**	88.5 **a**
Senna macranthera	35.8 **b**	56.5 **a**	67.0 **a**	71.8 **a**	75.3 **a**	87.7 **a**
Schinus terebinthifolius	54.2 **a**	60.4 **a**	64.3 **a**	69.8 **a**	73.4 **a**	88.6 **a**

CDF = 9.015 + 21.135T (R^2 = 0.982) and CDG = 5.861 + 5.841T (R^2 = 0.966). The slope of the first line indicates that decomposition in the field was more intense than in the greenhouse.

The CD correlation values in the greenhouse and in the field were highest after 150 days for CDG and after 30 days ($r = 0.796$, $p<0.01$), 60 days ($r = 0.754$, $p<0.01$) and 90 days ($r = 0.604$, $p<0.05$) for CDF. This result suggests a similar behavior in the cumulative weight loss of plant residues under greenhouse conditions after 150 days as of cumulative weight loss in the field after 30, 60 and 90 days.

4.DISCUSSION

Correlation analysis between the CDG values and variables related to the chemical composition of leaves showed a significant positive correlation between P and CD30 ($r = 0.539$, $p<0.05$) and MCD180 ($r = 0.527$, $p<0.05$), and a negative correlation for C/P ratio, with a correlation coefficient of -0.427 ($p<0.01$) increasing to -0.631 ($p<0.05$) from CD30 to CD180, respectively. Hence, the low P content seems to be limiting to the decomposition process.

The correlation coefficient between the mean cumulative decomposition (MCD) observed after 60 days and the other periods of decomposition decreased from 0.968 ($p<0.01$) after 90 days to 0.700 ($p<0.01$) after 180 days. This suggest that an evaluation of the decomposition rate after 60 days could be enough to assess the decomposition kinetics of the different species.

In general, the species forming the fast-decomposing group were grouped as such in all periods, and only the decomposition rate of *Senna macranthera* slowed down towards the end, being overtaken by *Aegiphila sellowiana*. The other species, initially classified as slow to intermediate-decomposing after 120 days, were allocated in the intermediate group thereafter. This suggests a modification of the lability of residual leaf compounds over time, as reported by Aita and Giacomini (2003).

Although several studies reported that the crop residue decomposition rate is inversely proportional to its lignin concentration (Constantinides and Fowes, 1994; Jamaludheen and Kumar, 1999), this was not observed in our study. The lignin/N ratio and cellulose concentration were the best indicators of the decomposition dynamics. Moreover, N release from plant residues was inversely related to the C/N and lig/N ratios and directly related to total N concentrations in plant biomass, and to N and C of the water-soluble fraction. This result was explained by the fact that after the initial rapid decay of the easily decomposable fraction of the dry matter, the remaining compounds are more recalcitrant against the microbial attack, as for example lignin and polyphenols (Aita and Giacomini, 2003).

The species with the most divergent performance from the expected was *Schinus terebinthifolius*. For this species, a slower decomposition than of the other species was expected, due to the high amounts of lignin and cellulose, as well as the high C/N, C/P and lig/N ratios. Nevertheless, the cumulative decomposition of the leaves of this species was the highest (Table 3), possibly because they are membranous, thin and flexible, arranged in compounds of relatively small leaflets, resulting in a larger specific surface area for microbial attack (Mackensen et al., 2003).

In the field, environmental factors such as rainfall, temperature, soil faunal activity, nutrient availability, and allelopathic compounds interact with the residues and affect the decomposition kinetics. Thus, apart from the strong influence of the physical and chemical characteristics of the plant material, as observed in the greenhouse, the role of soil bioturbation was evidenced by these results, since residue decomposition of most species was intensified under field conditions.

The species that differed most from the expected behavior, based on their chemical characteristics, were *Schinus terebinthifolius*, *Trema micrantha* and *Aegiphila sellowiana* under greenhouse conditions, and the decomposition rate of *Schinus terebinthifolius* was the highest in the field, probably due to higher C/P and C/N ratios (381.9 and 25.46, respectively). However, based on the Scott-Knot test, this species was classified in the fast-decomposing species group and had a high percentage of decomposed material under both conditions.

The other two species with a behavior different than expected, *Trema micrantha* and *Aegiphila sellowiana*, were intermediate and fast-decomposing in the greenhouse, respectively. However, they had the lowest decomposition rates of all species studied in the field. Interestingly, the decomposition rate of these plants was very similar in both environments (Tables 3 and 4). For these two species, the physical and chemical characteristics and their interaction with environmental factors were probably more relevant in determining the decomposition speed than the biotic component. Corroborating this statement, their decomposition rates in the field were highest in March, during the summer peak of rainfall.

In the first 30 days, cumulative decomposition in the field (CDF) was correlated with the lig/N ratio ($r = 0.590$, $p<0.05$) and CDF60 with leaf P ($r = 0.542$, $p<0.05$) and the C/P ratio ($r = 0.509$, $p<0.01$). The decomposition rates correlated negatively with the lig/N and C/P ratios, although the short time of 30 days may not have represented the field conditions. Among the nutrient contents, phosphorus best predicted the decomposition rate.

Both CDF and CDG were more intense in the first three months, corresponding to January, February and March, when higher amounts of labile compounds are available. However, associated with this chemical factor, these are the warmest and wettest months in this region, further enhancing soil faunal activity (Figure 1). This factor accelerated the field decomposition rate in March, which was not observed in the greenhouse. Thus, in April, when decomposition in the greenhouse stagnated, the microbial activity in the field still indicated a favorable environment for decomposition. Relationships between temperature and moisture with the decomposition rate are commonly reported in the literature (Couteaux et al., 1995; Gama-Rodrigues and Barros, 2002). Studies on secondary forests in Rio de Janeiro state pointed out the importance of climatic factors in the decomposition rate of plant residues. During the dry and cold season, after 85 days, only 61-65% of material remained. In another, longer evaluation, over 180 days between fall and winter, 32-37% of the original material remained until the end (Toledo, 2003).

The influence of rainfall on decomposition accumulation and rate is evidenced in tropical regions such as the Amazon. There, during the dry season, the litter decomposition rate becomes slower (216 days until 50% of the residues were decomposed in upland forest) than in the rainiest season (37 days in upland forests). Although there is a controversy about the role of soil fauna in decomposition studies using litter bags (Prescott, 2005), the factors contributing to this dynamic in the rainy season are mainly an efficient action of macro-arthropods (termites), and intense root penetration into rotting material, aside from the intense microbial activity (Luisão, 1982).

Previous studies indicated the predominance of three taxonomic groups of bioturbation in this area: termites, ants, and beetles (Sarcinelli et al., 2009). The relevance of termites and ants for the soil fauna community was ascribed to their social habit of building large nests made of mineral soil particles and organic matter from decaying or humified plant material, accelerating the decomposition processes in undisturbed soil. In this area, the proportion of ants accounted for more than 50% of the total community. Moreover, the Collembola (microphages) also influenced the decomposition of plant residues by fragmenting them and playing an important role in soil microstructure formation, creating a favorable balance between bacteria and fungi, producing enzymes (Nunes, 2003). Termites also have a key function in soil structure formation in Latosols (Schaefer, 2001; Sarcinelli et al., 2013).

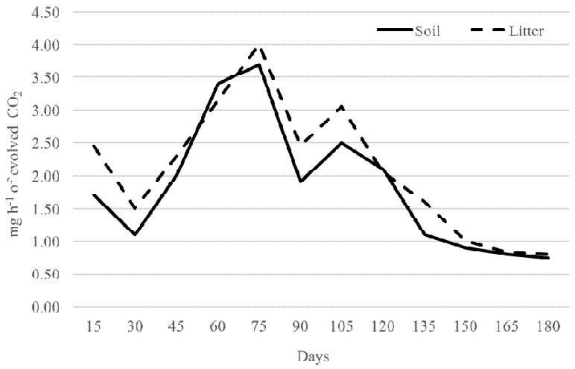

Figure 1 – Carbon emitted from the field within 24h in collectors placed directly on the litter and on the soil, measured every 15 days of the 180-day experimental period.

Figura 1 *– Carbono evoluído no campo por um período de 24 h em coletores colocados diretamente sobre a serapilheira e sobre o solo, a cada 15 dias ao longo dos 180 dias do período experimental.*

In the last two experimental months in the greenhouse, moisture increased and moss and fungal growth appeared on the soil surface of pots and decaying materials, indicating greater microbial activity, associated with a period of high decomposition. In the same period in the field, the monthly decomposition rate of four species (*Zeyheria tuberculous*, *Luehea grandiflora*, *Croton Floriundus*, *Aegiphila sellowiana*) declined, probably due to complex biotic and abiotic factors, as indicated by decreasing CO_2 emission (Figure 1).

The chemical characteristics studied were not sufficient to predict the decomposition kinetics of the species in the field. Thus, an integrated assessment with physical properties is necessary to understand the behavior of these species under controlled conditions (greenhouse). In the field, the interaction between biota and climate affected the decomposition pattern of the plant material. These changes were however not constant since the decomposition rates of some species were apparently unaffected (*Trema micrantha* and *Aegiphila sellowiana*), whereas in others, such as *Mabea fistulifera*, *Zeyheria tuberculous* and *Luehea grandiflora*, the decomposition pattern changed considerably.

The differences between plant decomposition rates in both environments was clearly shown by the mean decay constant ("k") and half-life ($t_{1/2}$) (Table 5). The mean "k" values obtained in the field (0.0088 g g^{-1}) were about 2.7 times higher than those in the greenhouse (0.0033 g g^{-1}). In terms of magnitude, the "k" values in the greenhouse were near those observed for litter of three coastal Restinga forests (0.0028 - 0.0032 g g^{-1}) (Paula et al., 2009).

The mean time until 50% of the residues were decomposed ("$t_{1/2}$") was 2.1 times higher in the greenhouse (234.4 days) than in the field (113.1 days). In comparison, in Restinga forest litter, a period 217 - 247 days was reported (Paula et al., 2009), compatible with the range of values observed in the greenhouse.

The "k" values in the greenhouse were only correlated with the P contents ($r = 0.500$, $p<0.01$) and the C/P ratio ($r = - 0.585$, $p<0.05$) of leaves, while no significant correlation was observed in the field. The same pattern was observed for the half-life values, which were only correlated with P amounts ($r = - 0.564$, $p<0.05$) and C/P ratio ($r = 0.696$, $p<0.05$). These results confirm the previous statements that leaf P and C/P are key drivers of plant residue decomposition under greenhouse conditions.

5.CONCLUSIONS

1. The cumulative breakdown of leaf material varied according to the plant species and environment, and was significantly higher in the field than under greenhouse conditions.

2. The levels of N, P, lignin and cellulose and the C/N, C/P and lignin/N ratio could be used to estimate the decomposition kinetics of leaf residues of different Atlantic Forest species.

3. The grouping of species based on the decomposition rate and chemical characteristics were similar both under controlled conditions (greenhouse) and in the field. Each group of plants can be deployed at different stages for improving environmental restoration.

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Table 5 – Decomposition constant of (k) and half-life ($t^{1/2}$) values of different leaf materials after a decomposition period of 180 days in the field (DF) and under greenhouse conditions (DG)

Tabela 5 – *Valores da constante de decomposição (k) e do tempo de meia vida ($t^{1/2}$) dos diferentes materiais foliares após um período de 180 dias de decomposição em condições de campo (DF) e de casa de vegetação (DG)*

Species	K constant		Half-life $t^{1/2}$	
	DF	DG	DF	DG
	g g^{-1}		dia	
Mabea fistulifera	0.0140	0.0030	49.5	228.8
Cassia ferruginea	0.0096	0.0046	72.1	150.9
Senna macranthera	0.0026	0.0039	267.6	177.3
Zeyheria tuberculosa	0.0124	0.0027	55.9	257.7
Schinus terebinthifolius	0.0038	0.0017	181.9	410.2
Bauhinia forficata	0.0062	0.0028	111.1	247.6
Croton floribundus	0.0032	0.0032	218.0	213.9
Luehea grandiflora	0.0120	0.0022	57.8	310.8
Trema micrantha	0.0116	0.0032	59.8	214.6
Aegiphila sellowiana	0.0121	0.0052	57.3	132.5
Mean	0.0088	0.0033	113.1	234.4

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