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FOREST LITTER DECOMPOSITION AS AFFECTED BY EUCALYPTUS STAND AGE AND TOPOGRAPHY IN SOUTH-EASTERN BRAZIL[1]

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ABSTRACT – Forest litter decomposition is a major process in returning nutrients to soils and thus promoting wood productivity in the humid tropic. This study aimed to assess decomposition of eucalypt litter in the Rio Doce region, Brazil. Leaf litter was sampled under clonal eucalypt stands aged 2, 4 and 6 years on hillslopes and footslopes. Soil and soil+litter samples were incubated at two levels of soil moisture, temperature and fertilization. C-CO_2 emissions from soil measured during 106 days were higher at 32 °C than at 23°C, mainly for the 2-yr-old stand on footslope. When leaf litter was added on soils, C-CO_2 emissions were eight times higher, mainly on footslopes, with no effect of stand age. Leaf decomposition *in situ*, assessed with a litterbag experiment showed a mean weight loss of at least 50% during 365 days, reaching 74% for 2 yr-old stands on footslopes. In comparison with data from the native forest and the literature, no apparent restrictions were found in eucalypt litter decomposition. Differences between *in vitro* and *in situ* results, and between eucalypt and native forest, were most likely related to the response of diverse decomposer communities and to substrate quality.

Keywords: Soil respiration; Litterbag; CO_2 evolution.

DECOMPOSIÇÃO DE SERAPILHEIRA FLORESTAL: EFEITO DA IDADE DO EUCALIPTO E TOPOGRAFIA NO SUDESTE DO BRASIL

*RESUMO – A decomposição de serapilheira florestal é um processo importante ao retornar nutrientes ao solo e, assim, estimular a produtividade da madeira no trópico úmido. Este trabalho objetivou avaliar a decomposição de serapilheira de eucalipto na região do rio Doce, MG. Frações foliares foram amostradas em plantações de eucalipto nas idades de 2, 4 e 6 anos e posições de encosta e baixada. Amostras de solo e solo + fragmentos de folhas foram incubadas em dois níveis de umidade, temperatura e fertilização. A quantidade de C-CO_2 emitida pelo solo no período de 106 dias foi maior na temperatura de incubação de 32 ºC do que a 23 ºC, especialmente em solos de baixada, na idade de 2 anos. A respiração do solo foi intensificada oito vezes pela presença de fragmentos de folhas sobre o solo, principalmente em solos da baixada, e não houve efeito significativo para a idade. A decomposição foliar **in situ**, avaliada em um experimento de sacos de decomposição, apresentou perda média de no mínimo 50% durante 365 dias, alcançando 74% para o eucalipto em dois anos, na baixada. Após a comparação com uma mata nativa e dados da literatura nacional, não foi encontrada nenhuma restrição aparente na decomposição da fração foliar do eucalipto. Diferenças entre os resultados **in vitro** e **in situ** e entre a mata nativa e o eucalipto podem estar relacionadas a uma diferente comunidade de decompositores e à qualidade do substrato foliar.*

Palavras-chave: Respiração do solo; Sacos de decomposição; Emissão de CO_2.

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1. INTRODUCTION

Forest litter decomposition plays an important role in returning nutrients to soil, and is critical to the productivity of fast-growing tree plantations in the humid tropics. However, there have been reports of intense litter accumulations (>25 Mg ha^{-1}) under eucalypt stands in Southeastern Brazil (Gama-Rodrigues et al., 2008; Palha Leite, F., unpublished data), raising concern about proper nutrient cycling. Identifying the causes of such unbalances can be difficult since factors such as phenology and litter quality interact with the biotic and abiotic environment, and also because of seasonal and yearly climate variation. Measuring litter decomposition processes is important in assessing litter dynamics, but difficult because decay rates and decomposer organisms vary over time and space (PRESCOTT, 2005). Additionally, stand age and position in the landscape can affect the decomposition process because of their effect on litter production and site properties, but this has seldom been studied (BARGALI, 1996; ALVAREZ-SÁNCHES; ENRÍQUEZ, 1996).

This study aimed to investigate potential restrictions to eucalypt litter decomposition and nutrient cycling in the Doce River region, which may be related to stand age, topographic position, temperature, soil moisture and fertility. To test this hypothesis, leaf litter from different combinations of ages and topographic positions were incubated at different temperatures, soil moistures and fertilizations. In addition, a litterbag experiment was established to assess decomposition and nutrient release in situ.

2. MATERIAL AND METHODS

The study area is located in the Doce River near Belo Oriente, Minas Gerais, Brazil (19°18'S and 42°22'W), with a mean altitude of 336 m above sea level. The natural vegetation is semi-deciduous tropical forest. According to the Koeppen classification, the climate is a tropical humid, with mean annual temperature and precipitation of 25.2°C and 1,000-1,280 mm, respectively. In general, the rainy season is from October to March, comprising about 80% of mean annual precipitation. Potential annual evapotranspiration varies from 950 to 1,200 mm, with an annual water deficit between 30 and 90 mm. The dominant soils in the area are Oxisols and Ultisols of clayey texture developed from Proterozoic granite and gneiss. Soil used in this incubation has pH values from 4.4 to 5.9, and soil organic matter between 13 and 18 g kg^{-1} under eucalypt stands. Under native forest, soil organic matter is higher (28 g kg^{-1}), and soil pH is 5.9.

Soil and leaf litter were sampled in December 7th 2000, under *Eucalyptus grandis* x *E. urophylla* hybrid clonal stands (3 x 2.5 m spacing) aged 2, 4 and 6 yrs on footslope and hillslope positions, and under a native forest on the footslope. For each combination of stand age and topographic position, recently abscised leaves, varying from green to yellow-green colors, were collected in triplicate on the forest floor and stored at 4-7°C for the CO_2-C evolution assessment. Leaf lignin was determined by the acid detergent fiber method of Van Soest and Wine (1968). In each sampling plot described above, soil from the 0-20 cm depth was sampled and stored at 4-7 °C for two weeks before incubation.

Soils were incubated with and without leaf litter fragments. The sampled leaf material was air-dried and cut to approximately 0.5 x 0.5 cm fragments. Subsequently, 15 g of leaf fragments were brought to 80% water retention capacity and placed onto 50 g of air-dried soil sieved <2 mm contained in 0.6 dm^3 glass jars. Incubations were conducted at two levels of temperature, moisture and fertilization. The average minimum and maximum monthly temperatures of the region, respectively 23 and 32°C, were used. Soil moistures were 40 and 80% of the water holding capacity. Fertilization levels were 0 and 5 mL of a solution with 50 mg L^{-1} P(KH_2PO_4), 80 mg L^{-1} N(NH_4Cl), and 80 mg L^{-1} K(KCl).

The CO_2 evolved was trapped with NaOH and titrated with HCl using phenolphthalein as indicator, after addition of $BaCl_2$ to precipitate sodium carbonate (ANDERSON, 1982). The first titration was done after 2 days of incubation, followed by a new incubation for 3 days and titration, and so on, for 4, 6, 8, 10, 12, 14, 20, and 27 days, in a total of 106 days. Results were expressed in CO_2-C mg g^{-1} soil evolved, according to the formula:

$$C\text{-}CO_2 = \frac{[HCl] \times f \times 6 \times (Vb - Va)}{50\ g\ of\ soil}$$

where [HCl] = HCl concentration; f = correction factor for HCl concentration; 6 = equivalent mg of C-CO_2 Vb = volume (mL) of HCl spent with blank; Va = volume (mL) of HCl spent to titrate NaOH from samples.

The experimental design was a completely randomized factorial design, in which the main factors were stand ages in three levels (2, 4 and 6 yrs) and topographic positions in two levels (footslope and hillslope), summing up to six main plots. Additionally, a split-plot was used, as each main plot was subdivided into a combination of three incubation factors in two levels: soil moisture, temperature and fertilization, resulting in eight subplots. As a reference, a nearby native forest on the footslope was sampled and compared with the eucalypt stands on the footslope. Data on accumulated C-CO_2 after 106 days were submitted to analysis of variance followed by the least significant difference (LS Means STDERR PDIFF) or the Ryan-Einot-Gabriel-Welch Q (REGWQ) test of means (SAS, 1990).

A litterbag experiment was set to determine in situ decomposition rates of leaf litter. In each of the eucalypt plots mentioned above, 24 nylon bags of 23 x 23 cm (3-mm mesh) filled with 40 g of recently fallen leaves were placed on the soil between tree rows. Four litterbags were retrieved at intervals of 52 (December. 12th), 64 (February. 20th) days, 46 (April 7th) and 203 days (October. 24th 2001). The total number of litterbags was 432 (3 ages x 2 slopes x 3 replicates x 6 samplings x 4 subsamples). Due to technical difficulties, the 5th and 6th samplings were done together in Oct. 24th, 2001. In addition, 54 litterbags (3 replicates x 6 samplings x 3 subsamples) containing a mixture of recently fallen leaves were distributed randomly in the native forest, and retrieved as above. The leaf material in litterbags was oven-dried at 75°C, weighted and analysed chemically. About 0.5 g of fresh ground litter material was digested with concentrated HNO_3 and $HClO_4$ (JONES; CASE, 1990). From the digest, P (Olsen; Sommers, 1982) and B were determined by spectrometry; K and Na by flame photometry, Ca, Mg, Cu, Mn and Zn by atomic absorption. Total nitrogen was determined by the Kjeldahl method (BREMNER; MULVANEY, 1982). Total carbon was estimated by weight loss on ignition at 550°C (JONES; CASE, 1990).

3. RESULTS

3.1 Leaf litter quality

Table 1 shows the initial nutrient, carbon and lignin concentrations in the leaf litter according to stand age and topographic position. Total N was higher in leaf litter of 2-yr-old stands compared to 4- and 6-yr-old stands. There was no effect of topographic position on nutrient concentrations. No significant differences were found for carbon, lignin concentration and C:N, C:P and lignin:N ratios in eucalypt leaf litter due to stand age and topographic position. The mean C:N ratio of eucalypt leaf litter was 40:1, similar to values reported by Sodré (1999) in Southeast Bahia, Brazil. Leaf litter from the native forest showed high concentrations of Ca, Mg, N, K, Cu and B compared to eucalypt litter.

3.2 C-CO_2 evolved

The accumulated soil respiration after 106 days was affected mainly by temperature and stand age ($P<0.01$), and secondarily by slope ($P=0.052$). In general, soil respiration was significantly higher at age 2 yrs on the footslope (Table 2), and was not affected by moisture and fertilization. When leaf fragments were added on soils, the total C-CO_2 released was affected significantly by temperature and slope ($P<0.01$), but not stand age and moisture (Table 2). Presence of leaf litter fragments on soils increased the C-CO_2 evolved up to 8-fold, when compared to soil respiration (Table 2).

The C-CO_2 evolved was compared among the three eucalypt stand ages and the native forest on footslope position. Despite the lower soil respiration for stand age 4 yrs, there were no major differences under the two vegetation types (not shown). The total C-CO_2 evolved during the experiment was better described by linear functions (Figure 1), in which intercepts and slopes were higher at 32 °C compared to 23 °C, in both topographic positions and vegetation types.

3.3 Litterbag experiment

Litterbag weight loss was fast during the first 60 days, and then slowed down, with little change after 154 days. Weight loss after 120 days was generally lower for stands aged 4 and 6 yrs, compared to the 2-yr stands, reaching ca. 48 % by 365 days. The weight loss was higher under 2-yr-old stands, reaching 74% on footslopes, and 58% on hillslopes, in the 116-365 days period. As a comparison, litterbags in the native forest on footslope showed a weight loss of 68%. However, decomposition rates in the native forest followed a contrasting pattern, being initially lower, increasing in the 52-116 day period, then becoming comparable to eucalypt decomposition rates in the 116-365 day period (Figure 2).

Table 1 – Mean concentrations of nutrients, carbon, lignin and C:N, C:P and lignin:N ratios in leaf litter from eucalypt stands aged 2, 4 and 6 yrs, and native forest.

Tabela 1 *– Média de concentrações de nutrientes, carbono, lignina e taxas de C:N, C:P and lignin:N em frações foliares de povoamentos de eucalipto nas idades de 2, 4 e 6 anos e em uma floresta nativa.*

Age	Slope	N	P	K	Ca	Mg	Zn	Cu	Mn	B	C	Lignin	C:N	C:P	Lignin:N
Yrs		g kg^{-1}					mg kg^{-1}				%				
2	Footslope	15.0a	0.71a	1.2a	12.3a	1.6a	23.9ab	12.4a	1024a	14.0ab	52.28a	35a	33.9a	645a	22.7a
4	Footslope	11.4b	0.62bc	0.9ab	6.6b	1.3b	41.1a	9.8a	572bc	7.9b	47.23a	28a	42.2a	762a	25.0a
6	Footslope	11.5b	0.53c	1.0ab	8.9b	1.6a	25.5ab	9.1a	348c	5.8b	42.18a	35a	37.9a	796a	31.5a
2	Hillslope	14.4a	0.71ab	1.0ab	13.8a	1.5ab	24.1ab	13.5a	890ab	17.7a	48.89a	32a	34.0a	689a	22.3a
4	Hillslope	10.6b	0.53c	0.7bc	12.9a	1.6a	14.4b	9.3a	605ab	9.3ab	47.60a	36a	45.1a	898a	34.1a
6	Hillslope	11.0b	0.52c	0.5c	7.7b	0.8c	15.7b	10.7a	286c	11.8ab	54.34a	31a	48.5a	1045a	27.7a
Native forest	Footslope	18.6	0.90	1.6	23.8	2.5	37.8	16.5	603	33.7	50.00	37	26.8	556	19.9

Means (n = 3) at the same column followed by the same letter are not significantly by REGWQ test (P< 0.05).

Table 2 – Total evolved C-CO_2 from soils under eucalypt, as affected by stand age, topographic position, temperature and moisture, after 106 days of incubation.

Tabela 2 *– Total de C-CO_2 emitido em solos sob eucalipto, conforme afetado pela idade do povoamento, posição topográfica, temperatura e umidade, durante 106 dias de incubação.*

Subplot	2	4	6	2	4	6
Soil	Footslope			Hillslope		
	C-CO_2 (mg g^{-1} soil)					
23 °C	0.658***a	0.508^{ns} a	0.537* a	0.639^{ns} a	0.513^{ns} a	0.473** a
32 °C	1.346a	0.632bc	0.937b	0.751bc	0.553c	0.918b
40% FC[1]	1.134^{ns} a	0.587^{ns} b	0.593^{ns} b	0.638^{ns} b	0.495^{ns} b	0.704^{ns} b
80% FC	0.870a	0.552a	0.881a	0.752a	0.571a	0.687a
Non-fertilized	1.044^{ns} a	0.517^{ns} b	0.799^{ns} ab	0.641^{ns} b	0.466^{ns} b	0.573^{ns} b
Fertilized	0.960a	0.622b	0.675 ab	0.749ab	0.600b	0.818ab
Means	1.002a	0.570b	0.737b	0.695b	0.533b	0.695b
Soil + Litter	Footslope			Hillslope		
	C-CO_2 (mg g^{-1} soil)					
23°C	4.416* a	4.514$^{**}_{s}$ a	4.667^{ns} a	4.967 ^{ns} a	4.117^{ns} a	4.807^{ns} a
32°C	5.567a	6.256a	5.682a	4.775a	4.572a	4.587a
40% FC	5.079^{ns} ab	5.702^{ns} a	4.955^{ns} ab	5.293^{ns} ab	4.479^{ns} b	4.493^{ns} b
80% FC	4.904a	5.068a	5.394a	4.449a	4.211a	4.901a
Non-fertilized	4.886^{ns} a	5.549^{ns} ab	5.109 ^{ns} ab	4.639^{ns} ab	4.400^{ns} b	4.675^{ns} ab
Fertilized	5.097a	5.221a	5.240a	5.103a	4.289a	4.719a
Means	4.991ab	5.385a	5.174a	4.871ab	4.345b	4.697ab

Means (n = 3) followed by the same lowercase letter (at rows) are not significantly different by the LS means test (P<0.05). Significant differences between the two levels of each factor are indicated by *(P< 0.05), ** (P<0.01), *** (P<0.001), ns (non-significant).

4. DISCUSSION

4.1 C-CO_2 evolved from soil and leaf litter

The non-significant effect of substrate moisture and fertilization indicates that 40% water holding capacity and current soil fertility were sufficient for an optimal soil respiration in this study. Correlations between CO_2 emission rates and water content vary according to soil moisture conditions. Kiese and Butterbach-Bahl (2002) reported that CO_2 emission rates were positively correlated with moisture in dry soils, but negatively correlated when water-filled pores were>50-60%, because of limited O_2 diffusion in the soil matrix. Other authors proposed that C-mineralization and CO_2 emission rates are incremented by drying and wetting cycles (VANGESTEL et al., 1993; FIERER; SCHIMEL, 2002).

In the present study, C-CO_2 evolved from soils under ages 2 and 6 yrs were respectively 60 and 100% higher at 32°C compared to 23 °C. Vasconcellos (1994) and Grisi et al. (1998) incubated different Brazilian soils at 15 °C and 35 °C and found differences between treatments only at 35°C. This suggests that microbial activity for these tropical soils is triggered above 15 °C, most likely between 15 and 23 °C.

Despite the initially higher N, P and Ca concentrations in leaf litter under 2-yr-old stands (Table 1), there were no differences due to age in total C-CO_2 evolved when leaf fragments were added on soils (Tables 2). This

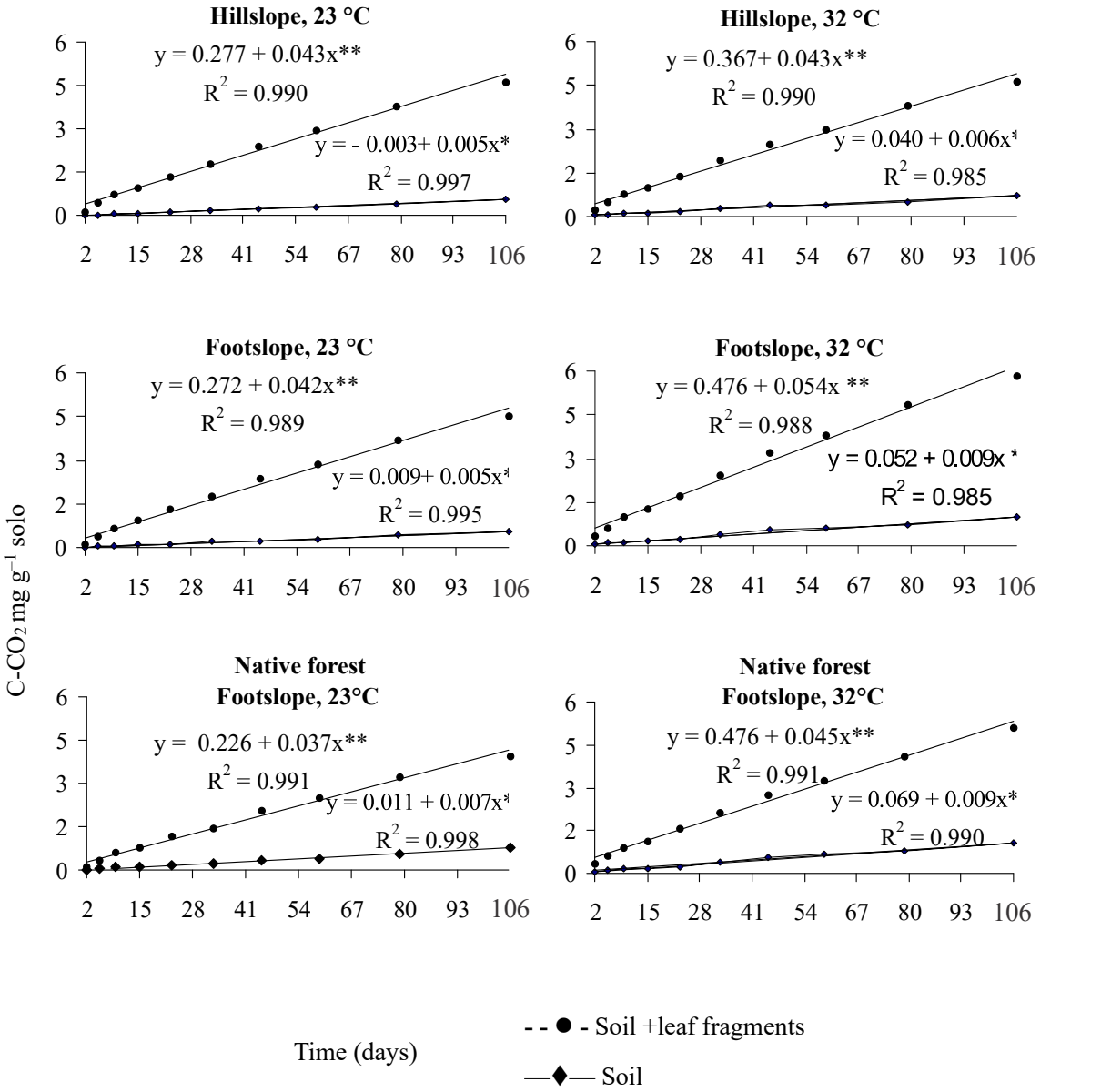

Figure 1 – Evolved C-CO_2 (mg g^{-1} soil) from soils and soil+leaf fragments under eucalypt forest (means of 3 stand ages) and native forest, affected by topographic position and temperature, during 106 days of incubation.

Figura 1 *– Emissão de C-CO_2 (mg g^{-1} soil), em solos e fragmentos foliares sobre o solo, em florestas de eucalipto (média de três idades) e floresta nativa, conforme afetada pela posição topográfica e temperatura, durante 106 dias de incubação.*

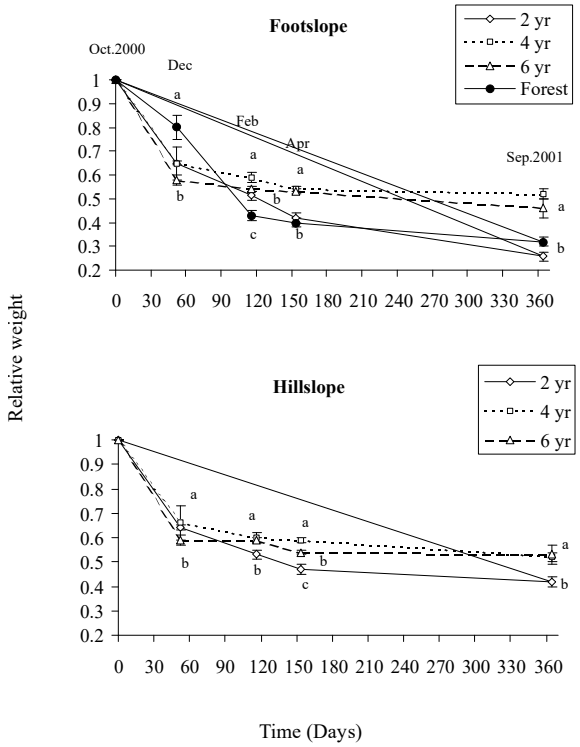

Figure 2 – Litterbag weight loss of 2, 4, 6 yr-eucalypt stands on footslope and hillslope and a native forest on footslope, from Oct. 24th 2000 to Oct 24th 2001.

Figura 2 *– Decomposição foliar (litterbags) em povoamentos de eucalipto nas idades de 2, 4 e 6 anos sob baixada e encosta e uma floresta nativa sob baixada, de 24 de outubro de 2000 a 24 de outubro de 2001.*

indicates that substrate quality was not a limiting factor to microbial activity, which is corroborated by the non-significant effect of fertilization. Fertilization of eucalypt stands has been shown to increase mineralization of added nutrients, but not litter decomposition rates (RIBEIRO et al., 2002; O'CONNELL; MENDHAM, 2004). Soil respiration on footslopes was higher than on hillslopes, despite the similar substrate chemistry (Table 1). This difference may be caused by a diverse microbial composition, since more mycelia were visible on footslope samples. The constant rates of C-CO_2 release from soils and soil + leaf litter (Figure 1) indicated a homogeneous lability of the organic substrates respired during the 106 days incubation.

The similar soil respiration rates between eucalypt and native forest on footslopes contrasts with the reportedly higher values for soils under native forest, usually higher in soil organic carbon, fertility and pH (DELLA BRUNA et al., 1991; FIALHO et al., 1991; CARVALHO et al., 1997; SODRÉ, 1999; ASSIS JÚNIOR et al., 2003). This trend indicates that labile C pools are equivalent, and the higher soil organic matter under native forest is mostly in stable forms that did not undergo decomposition during the incubation period. In Oxisols, the recalcitrant pool of soil organic matter associated to Fe/Al hydroxides and clays controls mineralization of N (SIERRA; MARBÁN, 2000) and probably also C. The similarity between the two vegetation types also occurred when leaf litter was added on soil, which suggests similar leaf litter quality, despite the lower nutrient contents and higher C:N, C:P and lignin:N ratio in eucalypt litter (Table 1). Accordingly, early-stage CO_2 release from eucalypt and other tree species litter was not affected by initial N and lignin contents (BERNHARD-REVERSAT, 1998). Fisher and Binkley (2000) pointed out that litter quality indicators such as C:N and lignin:N do not always relate well to field and laboratory decomposition, which restricts their wide use. Luo and Zhou (2006) agree that multiple interacting factors render soil respiration understanding very difficult.

Literature data from *in vitro* studies showed that mean daily soil respiration for eucalypt stands and native/secondary forests in Brazil is 0.015 and 0.03 mg C-CO_2 g^{-1} soil d^{-1}, respectively (Table 3). These values are proportional to the mean soil organic carbon concentrations of 20.5 and 26.5 g kg^{-1}, for eucalypts and native vegetation, respectively. In this study, mean soil respiration from eucalypt and native forest were respectively 0.007 and 0.008 mg C-CO_2 g^{-1} soil d^{-1}. These values are low compared with the means and similar only to those of low-carbon soils in Table 3, and may be caused by lower soil organic carbon contents.

4.2 Litterbags

The significant effect of topography on C-CO_2 evolved *in vitro* by both soil and soil+leaf fragments was reflected into higher decomposition *in situ* only for 2-yr old stands, which lost 74% of litterbag weight on footslopes, compared to 58% on hillslopes.

Leaf litter decomposition was faster in the youngest eucalypt stands, as reported for branch litter in India (BARGALI, 1996). The effect of stand age on litter decomposition in situ, but not on C-CO_2 emission in vitro, suggests differential responses by decomposer

Table 3 – Overall means for soil organic carbon, C-CO_2 evolved from soil and leaf litter on soil, under eucalypt plantation, and native/secondary vegetation in Brazil.

Tabela 3 *– Médias gerais de carbono orgânico do solo, C-CO_2 emitido do solo e de folhas fragmentadas sobre o solo, sob plantação de eucalipto e vegetação nativa ou secundária, no Brasil.*

Plant cover	Location Brazil	Age (yrs)	Incubation (days)	Depth (cm)	Soil/ clay%	Organic carbon (g kg^{-1})	C-CO_2 evolved Soil	Soil +leaf fragment	Source*
							—— (mg g^{-1} soil d^{-1}) ——		
Eucalyptus sp.	Viçosa, MG	18	24	0-20	Oxisol	32.3	0.050	-	1
Eucalyptus sp.	Viçosa, MG	8	28	0-10	53 %	38.0	0.015	0.066	2
Eucalyptus robusta	Viçosa, MG	25	7	0-10		28.2	0.026	-	3
E. grandis/*E.urophylla*	Southeastern	7	7	0-10		7.7	0.006	-	4
Eucalyptus sp.	Itatinga, SP	-	44	0-20	25-35 %	12.0	0.009	-	5
Eucalyptus sp.	Southeast Bahia	6	30	0-20	12 %	31.0	0.042	0.103	7
E. camaldulensis	Vazante, MG	-	20	0-10	35-60 %	-	0.044	-	8
E. grandis/*E.urophylla*	Aracruz, ES	7	7	0-10	33 %	7.7	0.005	-	9
E. grandis	Guanhães, MG	7	7	0-10	59 %	12.3	0.006	-	9
E. grandis	Luís Antônio, SP	7	7	0-10	6 %	4.9	0.002	-	9
E. grandis	Lençóis Paulista, SP	7	7	0-10	13 %	6.8	0.009	-	9
E. urograndis	Aracruz, ES	1	28	0-10	24 %	21.4	0.002	-	10
E. urograndis	Aracruz, ES	3	28	0-10	21 %	29.4	0.005	-	10
E. urograndis	Aracruz, ES	5	28	0-10	23 %	27.0	0.003	-	10
E. urograndis	Aracruz, ES	15	28	0-10	24 %	24.2	0.003	-	10
E. camaldulensis	Unaí, MG	14[r]	28	0-5	Oxisol, 40%	24.1	0.009	-	11
Eucalypt Mean ± stderr.						20.5 ± 2.8	0.015 ± 0.004	0.085±0.01	
Secondary forest	Viçosa, MG	18	24	0-20	Oxisol	43.4	0.071		1
Secondary forest	Viçosa, MG	-	28	0-10	51%	58.0	0.021	0.094	2
Native Forest	Itatinga, SP	-	44	0-20	25-35 %	14.9	0.026	-	5
Secondary forest	-	-	150 (15°C)	-	22%	28.8	0.002	-	6
Secondary forest	-	-	150 (35°C)	-	22%	28.8	0.011	-	6
Secondary rainforest	Southeast Bahia	-	30	0-20	20%	33.0	0.072	0.100	7
Secondary rainforest	Southeast Bahia	-	30	0-20	36%	42.0	0.059	0.112	7
Native Cerrado	Vazante, MG	-	20	0-10	35-60 %	-	0.067	-	8
Rainforest	Aracruz, ES	-	7	0-10	33%	11.1	0.008		9
Cerrado/Rainforest ecotone	Guanhães, MG	-	7	0-10	59%	18.4	0.014		9
Cerrado	Luís Antônio, SP	-	7	0-10	6%	3.8	0.004		9
Cerrado	Lençóis Paulista, SP	-	7	0-10	13%	10.9	0.013		9
Native Cerrado	Unaí, MG	-	28	0-5	Oxisol, 40 %	24.6	0.008	-	11
Forest Mean ± stderr						26.5 ± 4.6	0.029±0.007	0.102 ± 0.005	

*1. Fialho et al. (1991); 2. Della Bruna et al. (1991); 3. Gama-Rodrigues et al. (1997); 4. Gama-Rodrigues (1997); 5. Carvalho et al. (1997); 6. Grisi et al. (1998); 7. Sodre (1999); 8. Assis Junior et al. (2003); 9. Gama-Rodrigues et al. (2008); 10. Barreto et al. (2010); 11. Zinn et al. (2011).

communities. The remaining litter mass after 365 days was higher for eucalypt (41%, mean of three ages) on footslopes than for the native forest (32%). These values represent a much faster decomposition than reported by Costa et al., (2005) for eucalypt plantations in Rio de Janeiro. Differences in nutritional quality between vegetation types, and also among eucalypt ages, may have influenced the activity of larger decomposers (meso and macrofauna) rather than soil microbiota. Litter decomposition is influenced by substrate quality and climate (AERTS, 1997), but also by the physical-chemical environment and decomposer organisms (GONZALES; SEASTEDT, 2001). Lack of decomposer fauna was suggested by Mesquita, Workman and Neely (1998) as responsible for slow decomposition in a *Cecropia*-dominated secondary rainforest in Amazon. The main decomposing fauna may vary according to the landscape, vegetation and period. On footslopes in this study, ants were common in both native forest and eucalypts, whereas earthworms were noted only under eucalypt stands. In an Amazon upland rainforest, Cornu et al. (1997) observed the dominance of

earthworms and termites, the latter responsible for 40% of the litter disappearance in the wetter period (LUIZÃO; SCHUBART, 1987). Decomposition of eucalypt leaf litter by termites was reported by Bernhard-Reversat and Schwartz (1997) in Congo.

Paul and Polglase (2004) suggested that rainfall and temperature explain better decomposition in situ than litter chemistry alone. Investigating the initial three months of Eucalypt litter decomposition in Congo, Ngao et al. (2009) reported that C mineralization were first driven by soluble organic compounds and then by soluble phenolic compounds, but relations between litter quality and decomposition varied strongly in the dry and rainy seasons. Sierra and Marbán (2000) reported higher N mineralization in clayey Oxisols with increasing water content, especially for acid soils and temperatures >30 °C. Sierra (2002) reported that N mineralization was higher under fluctuating than under constant temperature, and higher temperatures had a stronger effect on recalcitrant than on labile N. Eucalypt leaf decomposition in this study was faster than reported for native species in Caribbean islands (LORANGER; PONGE, 2002) and Amazon rainforest (MESQUITA; WORKMAN; NEELY, 1998; SMITH et al., 1998), comparable to legume tree plantations in Amazon (SMITH et al., 1998), and lower than in Mexican rainforest (ALVAREZ-SÁNCHES; ENRÍQUEZ, 1996).

5. CONCLUSIONS

Data presented here suggest that no inherent limitations to decomposition of eucalypt litter in the studied sites occur. Thus, the large litter layer stocks reported are most likely due to intense litter production in the area. The differences in decomposition patterns of eucalypt and native forest litter are most likely related to the respective soil decomposer communities and their response to rainfall.

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