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Environmental quality in *Eucalyptus spp*. plantations determined from functional processes of its litter

Qualidade ambiental em fragmentos de *Eucalyptus spp*. determinada a partir de processos funcionais da serapilheira

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Abstract

The objective of the study was to understand the influence of *Eucalyptus spp*. cultivation on the quality of the environment in which it is inserted. For this, three sampling areas of eucalyptus plantations and a control area composed of heterogeneous vegetation. Measurements of leaf litter mass loss, water retention capacity (WRC) tests, and measurements of the content of macronutrients and organic fractions (lignin, cellulose and polyphenols) were carried out in the litter. The litter samples from the control area showed a decomposition coefficient (k) (0.78; 0.82; 0.87) significantly higher than the samples from *Eucalyptus spp*. (0.51; 0.52; 0.55). For WRC, samples from the control area showed values between 161% and 339%, with an average value of 260%. These were significantly higher than those in the eucalyptus areas, which varied between 72% and 156%, with an average value equal to 112%. As for the content of macronutrients, for the concentration of N, Mg and S in the litter, the samples collected in the control area showed average values significantly higher than the samples from the eucalyptus areas. Regarding the contents of lignin and polyphenols, the samples collected in the eucalyptus areas showed significantly higher values than those presented by the control area. The results obtained showed a strong statistical correlation between the contents of N, Mg, lignin and polyphenols in the sampled leaf material, decomposition rates and water retention capacity. The decomposition of *Eucalyptus spp*. presented slow decomposition, strongly linked to its chemical composition, which hinders the action of decomposing agents.

Keyword:
Ecosystem Processes, Litter decomposition, Litter Water Retention.

Resumo

O objetivo do estudo foi compreender a influência do cultivo de Eucalyptus spp., sobre a qualidade do ambiente em que está inserido. Para tal, foram utilizadas três áreas amostrais (eucaliptais) e uma

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área controle, composta por vegetação heterogênea. Foram realizadas, mensurações da perda de massa da serapilheira foliar, testes de capacidade de retenção hídrica (CRH), e, mensuração da concentração de macronutrientes e das frações orgânicas (lignina, celulose e polifenóis) na serapilheira. As amostras de serapilheira da área controlem apresentaram coeficiente de decomposição (k) (0,78; 0,82; 0,87) significativamente maiores que as das amostras de Eucalyptus spp. (0,51; 0,52; 0,55). Para a CRH, as amostras provenientes da área controlem apontaram valores entre 161% e 339%, com valor médio de 260%. Que foram significativamente maiores que os das áreas de eucaliptais, que variaram entre 72% e 156%, com valor médio igual a 112%. Quanto ao teor dos macronutrientes, para a concentração de N e Mg na serapilheira, as amostras coletadas na área controlem apresentaram valores médios significativamente maiores que as amostras das áreas de eucaliptais. Quanto aos teores de lignina e polifenóis, as amostras coletadas nas áreas de eucaliptais apontaram valores significativamente maiores que os apresentados pela área controle. Os resultados obtidos, apontaram para forte correlação estatística entre as concentrações de N, Mg, lignina e polifenóis, no material foliar amostrado, taxas de decomposição e capacidade de retenção hídrica. A decomposição de Eucalyptus spp. apresentou lenta decomposição, fortemente ligada à sua composição química, o que dificulta a ação dos agentes decompositores.
Palavras-Chave:
Processos Ecossistêmicos, Decomposição da Serapilheira, Retenção Hídrica da Serapilheira.

I. INTRODUCTION

As a direct result of anthropic actions, habitat fragmentation is among the most serious threats to the conservation of ecosystems, changing the dynamics and ecological relations between populations of fauna and flora, and of these with the abiotic environment (AGUILAR; GALLETO, 2004). Human actions intensify ecosystem disturbances, resulting in the loss of habitats and biodiversity, among other environmental disturbances (FOLEY et al., 2005).

The loss of biodiversity on Earth has direct and indirect consequences on the quality of life on the planet (BENSUNSAN, 2006). The smaller the amount of native forests, the less resources and conditions will exist in that region and, thus, less species will be able to survive in that location (PÁDUA; CHIARAVALLOTI, 2012). There is a combination of resources and conditions (ecological niche) of a place for each species to be present (SANTANA, 2010). Therefore, the more combinations there are between resources and the conditions of an environment, the greater the biodiversity and the heterogeneity of the landscape, resulting in greater biological diversity (BAPTISTA, 1998).

Among the anthropic activities that cause several environmental disturbances, monocultural activities of tree species are included (FOLEY et al., 2005). Highlighted here is the forestry of *Eucalyptus spp*., which has advanced in several regions and considerably fragmented the natural habitat (GUO; SIMS, 1999). Its

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development has increased in response to the demand from the global commercial timber industry (FORRESTER et al., 2013). Due to its rapid growth, short rotation in planting and the high consumption of nutrients in the soil and water (VIANA, 2004), nutrient cycling is one of the limitations for the establishment of sustainable ecosystems in areas where *Eucalyptus spp*. culture occurs (LEMA et al., 2007).

The cultivation of eucalyptus trees is identified as inducing desertification, in association with the dryness of the soil (CANNELL, 1999), causing a deficit in the water balance of the environmental system (VIANA, 2004). It is also shown to destabilize nutrient cycling and cause allelopathic effects (LIMA, 1996). In *Eucalyptus spp*. cultures, low litter decomposition rates are observed (GAMA-RODRIGUES; BARROS, 2002), which reduces the transfer of nutrients in the interaction between litter and soil (GUO; SIMS, 2001), in addition to concentrating dry matter of low nutritional quality for the microbial chains responsible for the decomposition of plant material (FORRESTER et al., 2006). The continuous use of land for the cultivation of *Eucalyptus spp*. can cause an accumulation of phytotoxins in the soil, impoverishing and further compromising its fertilization capacity (ZHANG; FU, 2009).

Litter is responsible for numerous functions in environmental balance and dynamics (COSTA et al., 2010). It plays an important role in nutrient cycling (ODUM, 1988), since its deposition and decomposition processes are the main sources of nutrient transfer to forest soils (ABER; MELILO, 1991; CALDEIRA et al., 2008). Litter is also related to the storage of moisture and control of water flows in the environment (VALLEJO, 1982), controlling the capacity of water infiltration into the soil (COELHO NETTO, 2003), in addition to minimizing the erosive effects on the soil (VOIGTLAENDER, 2019). Thus, understanding the spatial and temporal dynamics of litter processes becomes an effective mechanism for understanding environmental disturbances (VIERA et al., 2014), transforming it into a powerful indicator of ecosystem quality (ALVARENGA, 2013).
compared to the area control (GUO; SIMS, 1999). Furthermore, it tests whether the litter samples from the control area would present lower decomposition rates when deposited in eucalyptus areas (VOGEL et al., 2007).

This study aims to compare the environmental quality between areas of monocultures of Eucalyptus spp. and areas of heterogeneous vegetation (control), based on analyses carried out on the litter's functionality, namely, the decomposition and water retention capacity, relating it to its nutritional quality. It tests the hypotheses that the areas of eucalyptus plantations would present lower decomposition rates of leaf litter (GAMA-RODRIGUES; BARROS, 2002), less water retention capacity (VALLEJO, 1982), and litter with lower nutritional quality.

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II. Materials and Methods

For the analyses carried out in this study, three areas of *Eucalyptus urophylla* plantations were selected in the city of São João del-Rei (MG, Brazil), aiming at replicating the samples. Also, a control area was determined containing natural vegetation, spontaneous growth or reforestation, presenting a high diversity of species, located in the Ritápolis National Forest (FNR), within the municipal limits of Ritápolis (MG-Brazil) (Fig. 1). In this control area, three points were selected for sampling repetition, with litter predominating in the samples of *Copaifera langsdorffii Desf*., *Dilodendron bipinnatum Radlk*., *Myrcia tomentosa Aubl*., *Protium widgrenii Engl*. and *Tapirira guianensis Aubl*.

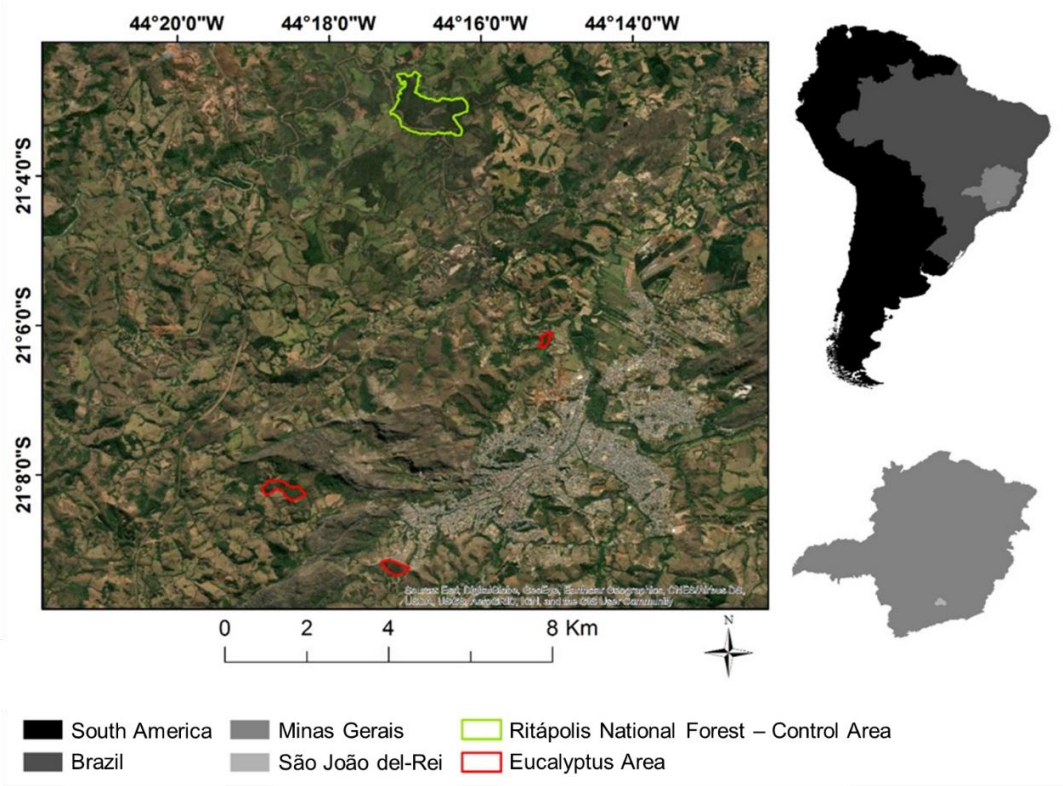

Figure 1: Location map of the study area (Source: Authors)

Both municipalities are located in the Campos das Vertentes mesoregion, in the state of Minas Gerais (Brazil). According to the classification of Köppen and Geiger (1953), the climate of São João del-Rei is Cwa, temperate and humid, with two well-defined seasons, hot and humid summer, and cold and dry winter. The average annual temperature in the municipality is 19°C, and the average annual rainfall is 1437 mm (BARUQUI et al., 2006). Its predominant natural vegetation is determined as cerrado and campo cerrado (CETEC, 1989). It is characterized by fragmented areas of forest, due to land use and occupation (ROSA et al., 2018). Among these areas, a large number of eucalyptus forestry stands out (RESENDE; ALMEIDA; NEGREIROS, 2015).

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The Ritápolis National Forest, located in an ecotonal region of semideciduous seasonal forest and cerrado sensu lato, on the banks of the confluence of the Santo Antônio river with Rio das Mortes, in the southern municipality of Ritápolis. Its area occupies 89.50 ha (IBAMA, 2005). The climate, according to the classification of Köppen and Geiger (1953), is Cwa, with an average annual temperature of 19ºC, and an average annual rainfall of 1470 mm. The predominant vegetation is the Seasonal Semideciduous Forest, which corresponds to 41% of the total area of the Forest, and Campo Sujo and Cerrado, which occupy about 29% (IBAMA, 2005).

During the experiment period, the average annual temperature for the studied region was 20.27°C, with the minimum monthly average being 15.26°C (July), and the maximum 23.29°C (January), while annual rainfall was 1359 mm (Fig. 2).

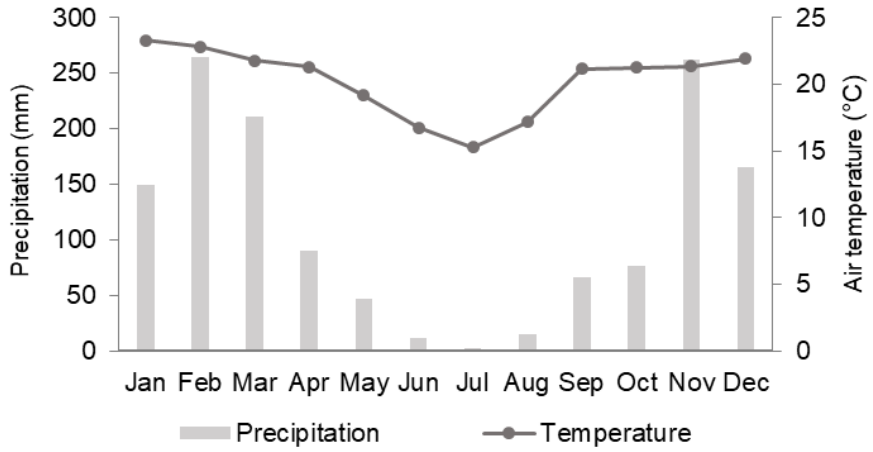

Figure 2: Rainfall and air temperature during the period of study of litter decomposition. (Source: INMET)

The decomposition of leaf litter was evaluated using the litter bags method (BOCOCK; GILBERT, 1957). It enables measuring, on a temporal scale, the mass loss of the measured material (SCORIZA, 2012). 2 mm-thick porous mesh litter bags measuring 15 cm x 20 cm were used. These were filled with the leaf fraction of the litter just deposited on the soil surface, the layer called A000L of the litter (MILLER, 1974).

The material collected in the sample areas was placed in an oven at 75°C in the laboratory, until it reached constant weight. After this process, a leaf fraction of 5 g of litter was placed in each litter bag, then deposited in the selected areas (GUO; SIMS, 1999; VIERA et al., 2014). The distribution of litter bags in the sampling plans followed the design of a "crossover" experiment: In the control area, 12 samples of material collected were deposited in their own area, plus 12 samples of *Eucalyptus urophylla* litter, with three repetitions made for the species of each area, totaling 36 litter bags of each, following the same standard used in the control

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area for the eucalyptus areas. The cross-distribution of samples aimed to evaluate the influence of the environment on the decomposition of the sampled materials.

The material was collected monthly. Three litter bags containing *Eucalyptus urophylla* and three containing samples of species from the control area were collected from each sampling plan. The experiment lasted one year, making it possible to measure mass loss during dry periods and wet, high-precipitation periods (COSTA; GAMA-RODRIGUES; CUNHA, 2005). The collected litter bags were transported to the laboratory, where the screening process was carried out, to separate the leaf fraction from the other parts. Then, the leaf fraction was stored in an oven at 75°C, where it remained until it reached constant weight, for the final weighing. Finally, the leaf litter mass loss was measured (SCORIZA et al., 2012; SILVA-JUNIOR et al., 2014).

The dry weight of the remaining leaf fraction in the litter bags after each collection was calculated from the equation proposed by Guo and Sims (1999):

$$W\% = Wt / W0 \times 100 \quad (1)$$

Where: **W%:** percentage of leaves remaining in litter bags; **Wt:** dry weight (g) of leaves remaining at time t (t = 1, 2, 3, ..., 12 months); **W0:** initial dry weight (g) of the leaves.

To calculate the decomposition coefficient (k) of leaf litter fraction, the exponential model adjustment was used (THOMAS; ASAKAWA, 1993):

$$Xt = X0 * e^{-kt} \quad (2)$$

Where: **Xt:** dry weight (g) of material remaining after t days; $X0$**:** initial weight (g) of dry material at time zero (t = 0); **k:** decomposition constant; **t:** time in days.

To obtain the water retention capacity (WRC) of the leaf fraction, the methodology proposed by Blow (1955) was used, which consists of laboratory analyses of the litter samples collected in the field. The collected samples are immersed in water for a period of 90 minutes, to be weighed in order to obtain the initial weight.

Soon after, the samples are placed in an oven at 85ºC, where they remain until they reach constant weight, registered as the final dry weight of the samples. The water retention capacity was calculated as a function of the final dry weight of the sampled material, such as:

$$(PI - PF / PF) \times 100 = \text{Stored Moisture Content} \quad (3)$$

Where: **PI** = initial wet weight; **PF** = Final dry weight.

The content of macronutrients (N, P, K, Ca, Mg, S) was quantified, in addition to the levels of lignin, cellulose and polyphenols in the samples. N was determined by the Kjeldahl method (BREMNER; MULVANEY, 1982). After nitric-perchloric digestion, P was determined by colorimetry, K was read by flame photometry, S by

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turbimetry, and Ca and Mg in an atomic absorption spectrophotometer (BATAGLIA et al., 1983; MALAVOLTA; VITTI; OLIVEIRA, 1989). To determine the cellulose and lignin content, the method of Van Soest and Wine (1968) was used. The content of polyphenols was determined by the Folin-Denis reagent in a basic medium (ANDERSON; INGRAM, 1996).

For tests of the species-specific effect, the decomposition rates, water retention capacity and nutrient contents were compared between the litter samples from the eucalyptus areas and the control area, using Student's t-test for head-to-head comparisons (Control Area x *Eucalyptus spp*.). For tests related to the effect of the environment, the decomposition rates were compared between samples of eucalyptus and control area litter stored in different areas, also using Student's t-test.

Pearson correlation analyses were also carried out between the decomposition data and leaf water retention capacity, with the nutrient concentrations of the litter samples, in order to verify how the chemical characteristics of the samples affect the decomposition rates and water retention capacity.

III. RESULTS

For the litter decomposition rates measured in the control area, the natural litter samples (control) presented a higher percentage of leaf mass loss during the experiment when compared with the samples of the eucalyptus species (Fig. 3). In this area, the average of the decomposition coefficient (k), for samples from the control area, was k = 0.82. Meanwhile, the samples of *Eucalyptus urophylla* showed an average value of k = 0.59 (Table 1). The loss of leaf mass was significantly higher for the litter samples collected in the control area compared to the samples of eucalyptus (Student's t-test, p <0.05)

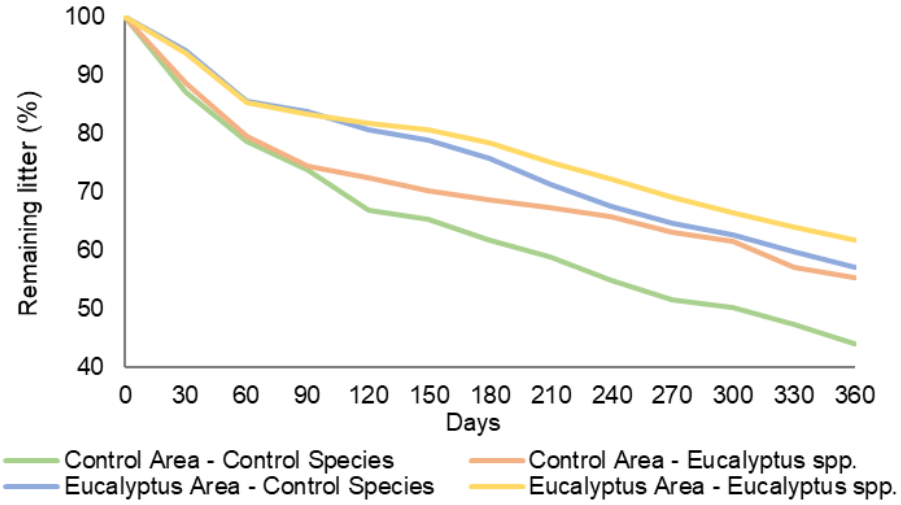

Figure 3: Average of the percentage of leaf material remaining in the litter bags, over the duration of the experiment.

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In the sample areas of eucalyptus species domain, the litter samples containing the species collected in the control area also showed a higher percentage of leaf mass loss when compared to the species of *Eucalyptus urophylla* (Fig. 3). In these sampling plans, the species collected in the control area showed an average value for the decomposition coefficient of k = 0.55, while the species from the eucalyptus areas showed k = 0.48 (Table 1). Statistical differences were found between the samples of the different species (Student's t-test, p <0.05).

Table 1: Decomposition coefficient (k), of the litter samples deposited in the study areas.

Sample Area	Species	Decomposition Coefficient (k)			Average	Standard Deviation
Control Area	Control Species	0.78^{A}	0.82^{A}	0.87^{A}	0.82	0.05
	Eucalyptus urophylla	0.62^{B}	0.57^{B}	0.58^{B}	0.59	0.03
Eucalyptus Area	Control Species	0.55^{A}	0.51^{A}	0.52^{A}	0.53	0.02
	Eucalyptus urophylla	0.48^{B}	0.47^{B}	0.50^{B}	0.48	0.02

*Different letters between lines within the same sample area indicate statistical differences between samples (Student's t-test, p <0.05).

Regarding the influence of the environment on decomposition, the loss of leaf mass was more accelerated in the control area, compared to the eucalyptus areas. Thus, when comparing the decomposition rates in the different environments for the control species, we found that the samples showed significantly higher values of decomposition coefficient (k) (Student's t-test, p <0.05) when deposited in the control area (Table 2). A similar result was observed for the samples of *Eucalyptus urophylla*, which, compared among each other, showed significantly higher k values (Student's t-test, p <0.05) when deposited in the control area (Table 3).

Table 2: Decomposition coefficient (k) for the litter samples of the control species deposited in the different sample areas.

Sample Area	Decomposition Coefficient (k)			Average	Standard Deviation
Control Area	0.78^{A}	0.82^{A}	0.87^{A}	0.82	0.05
Eucalyptus Area	0.55^{B}	0.51^{B}	0.52^{B}	0.53	0.02

*Different letters between the lines indicate statistical differences between the samples (Student's t-test, p <0.05).

Table 3: Decomposition coefficient (k) for the litter samples of the species of *Eucalyptus urophylla* deposited in the different sample areas.

Sample Area	Decomposition Coefficient (k)			Average	Standard Deviation
Control Area	0.62^{A}	0.57^{A}	0.58^{A}	0.59	0.03
Eucalyptus Area	0.48^{B}	0.47^{B}	0.50^{B}	0.48	0.02

*Different letters between the lines indicate statistical differences between the samples (Student's t-test, p <0.05).

For water retention capacity, the litter samples collected in the control area showed significantly higher values than the samples from the eucalyptus areas (Student's t-test, p <0.05; Table 4). The samples from the

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control area showed values that varied between 161.36% and 338.27%, with an average value of 260.31%. For the samples from the eucalyptus areas, the values varied between 72.24% and 155.86%, presenting an average value equal to 112.91.

Table 4: Percentage of water retention capacity for samples from the control and eucalyptus areas.

	Water Retention Capacity (%)					Average	Standard Deviation
Control Species	161.36	168.83	197.51	205.61	291.18	260.31^{A}	69.10
	295.73	301.97	306.93	335.68	338.27		
Eucalyptus urophylla	72.24	83.32	89.49	102.12	106.95	112.91^{B}	27.82
	116.27	121.54	129.07	152.22	155.86		

*Different letters indicate statistical differences between the sample averages (Student's t-test, p <0.05).

As for the content of macronutrients in leaf samples, for the N, Mg and S content in the litter, the samples collected in the control area had an average value significantly higher than the samples collected in the eucalyptus areas. For the content of other macronutrients (P, K), no statistical differences were found between the samples (Student's t-test, p <0.05; Table 5).

Table 5: Average values for the content of macronutrients in the litter sampled from the different areas. Values in parentheses are relative to the standard deviation.

	N	P	K	Ca	Mg	S
	g/kg^{-1}					
Control Species	17.80^{A} (0.70)	0.67^{A} (0.21)	4.00^{A} (1.00)	14.10^{A} (2.82)	2.60^{A} (0.30)	1.87^{A} (0.31)
Eucalyptus urophylla	8.40^{B} (1,92)	0.30^{A} (0.10)	3.70^{A} (1.13)	14.40^{A} (4.49)	1.10^{B} (0.27)	1.13^{B} (0.15)

*Different letters in the same column indicate statistical differences between the samples (Student's t-test, p <0.05).

For the content of organic fractions, regarding the levels of lignin and polyphenols, the samples collected in the eucalyptus areas showed significantly higher values than those in the control area. For cellulose content, no statistical differences were found between samples (Student's t-test, p <0.05; Table 6).

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Table 6: Average values for the concentration of organic fractions (lignin, cellulose and polyphenols), in the litter sampled from the different areas. Values in parentheses are relative to the standard deviation.

	Lignin	Cellulose	Polyphenols
	g/kg^{-1}		
Control Species	176.51^{A} (1.31)	166.66^{A} (13.17)	32.47^{A} (8.72)
Eucalyptus urophylla	217.33^{B} (6.03)	190.33^{A} (8.62)	64.67^{B} (7.02)

*Different letters in the same column indicate statistical differences between the samples (Student's t-test, p <0.05).

IV. Discussion of Results

The data presented on the decomposition of litter corroborates a characteristic pattern for *Eucalyptus spp*. (GAMA-RODRIGUES; BARROS, 2002; COSTA; GAMA-RODRIGUES; CUNHA, 2005; VALADÃO et al., 2019; WANG et al., 2019). This pattern is represented by a slow decomposition of the leaf mass (GUO; SIMS, 1999), due to the chemical quality of the plant material, characterized mainly by high concentrations of lignin and polyphenols (FACELLI; PICKETT, 1991; FERNANDES; NASCIMENTO; CARVALHO, 2007). In this context, the results obtained indicated a strong positive correlation between the decomposition of litter and the N (r = 0.97), Mg (r = 0.96) and S (r = 0.92) contents, and a strong negative correlation with the levels of lignin (r = -0.98) and polyphenols (r = -0.94) (Pearson's correlation, p <0.05; Table 7).

Vegetable materials containing a higher content of N point to more accelerated decomposition rates, compared to materials with lower N contents (LIU; FOX; XU, 2003). As for lignin and polyphenols, their high content is associated with low litter decomposition rates (DINIZ; PAGANO, 1997). These elements are constituents of the structure of organic materials that persist in the leaves of *Eucalyptus spp*. (COSTA; GAMA-RODRIGUES; CUNHA, 2005). They are linked to the low palatability of organic material for edaphic fauna (CABANÉ et al., 2004), a factor that contributes to low rates of decomposition in eucalyptus areas (GAMA-(RODRIGUES; BARROS; SANTOS, 2003).

Table 7: Pearson's correlation coefficients, between the decomposition coefficient, water retention capacity, nutrient content (N, P, K, Ca, Mg and S) and organic fractions (cellulose, lignin and polyphenols) of leaf litter.

	DF	WRC	N	P	K	Ca	Mg	S	Lignin	Cellulose	Polyphenols
DF	1.00	0.97**	0.97**	0.81	0.24	-0.15	0.96**	0.92*	-0.98**	-0.87*	-0.94**
WRC		1.00	0.97**	0.85*	0.19	-0.11	0.97**	0.89*	-0.98**	-0.85*	-0.94**

Pearson's correlation coefficients, ** (p <0.01) and * (p <0.05). DF - Coefficient Decomposition; WRC - Water Retention Capacity.

The leaf decomposition rates showed a temporal change, being more accelerated at the beginning of the experiments, followed by a reduction when the experimentation period progressed. The beginning of the

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experiments coincided with the period of greatest precipitation, which provides greater loss of mass of the material (COSTA; GAMA-RODRIGUES; CUNHA, 2005). Another factor is that initially the material contains elements that are richer in high-lability compounds (MOMOLLI, 2011) and, over time, only the less labile parts of the organic material, such as lignin and polyphenols, remain (CARVALHO et al., 2009), which makes decomposition difficult (CABANÉ et al., 2004) and therefore slower (LIMA et al., 2015).

Regarding the influence of the medium on the loss of leaf mass, it is observed that the species showed higher decomposition rates when incubated in the control area (Fig. 3). This factor is linked to the great heterogeneity of plant species in this area, which provides greater availability of resources and conditions, favoring greater biological wealth and diversity (PÁDUA; CHIARAVALLOTI, 2012), including a more diversified edaphic fauna, providing more accelerated litter decomposition rates (GONZÁLEZ et al., 2001; FERNANDES; NASCIMENTO; CARVALHO, 2007). This is added to the fact that the areas of *Eucalyptus spp*., as they are monocultures, offer less conditions for decomposing agents to coexist (PÁDUA; CHIARAVALLOTI, 2012), providing low rates of decomposition in these areas (VOGEL et al., 2007).

In addition to these factors, there are still differences in the amount of moisture present in these areas, a factor of great importance for the decomposition of litter (MELOS; SATO; NETTO, 2009). As noted, the control area showed greater capacity for water retention than the areas of *Eucalyptus spp*. (Table 4). This indicates a greater amount of water stored in the soil/litter interaction compartment (COELHO NETTO, 2005) in the control area environment, providing higher decomposition rates in this area (COSTA; GAMA-RODRIGUES; CUNHA, 2005). Thus, a strong positive correlation ($r = 0.97$) was established between water retention capacity and litter decomposition (Pearson's correlation, $p < 0.01$; Table 7). Also, within this context, the values reported in this study for the WRC of the control area are similar to the values reported in forest areas (VALLEJO, 1982; FREITAS, 2003; MONTEZUMA, 2005).

This greater capacity for water retention by the material in the control area is linked to absorption and adsorption factors (VOIGT; WALSH, 1976). The environment of the control area provided a more accelerated decomposition of the litter, generating leaves with more areas for water absorption (VALLEJO, 1982), in relation to the leaves of *Eucalyptus spp*., where the fraction of the A000L litter (MILLER, 1974) is more preserved, in addition to the high content of lignin and polyphenols found in the litter of eucalyptus trees. These organic fractions of the foliage work as a layer that waterproofs them, making it difficult for them to retain water (CABANÉ et al., 2004). This study establishes a strong negative correlation between the lignin ($r = -0.98$) and polyphenol ($r = -0.94$) content with water retention capacity (Pearson's correlation, $p < 0.01$; Table 7).

92
ISSN eletrônico 2177-2738
RA'EGA, Curitiba, PR, V.57, p. 81 – 97, 08/2023
http://dx.doi.org/10.5380/raega.v57i0.86168

V. CONCLUSIONS

The samples collected in the control area showed significantly higher values regarding litter decomposition rates and water retention capacity, compared to samples collected in eucalyptus areas. They also indicate better nutritional quality. This confirms the hypotheses that address the importance of species-specific effects in the ecosystem processes evaluated here.

Regarding the influence of the environment on the ecosystem processes, the samples deposited in the control area points presented more accelerated litter decomposition than those deposited in the eucalyptus areas. This indicates a better functioning of the ecosystem in the control area, highlighting the importance of conserving ecosystems that have greater diversity of fauna and flora species.

The decomposition of *Eucalyptus urophylla* corroborated a pattern presented by national and international literature, presenting a slow decomposition, strongly linked to its chemical content. The results pointed to a strong statistical correlation between the N, Mg, lignin and polyphenol contents in the sampled leaf material and its decomposition rates and water retention capacity.

The analyses carried out in this study proved to be effective for understanding how forest ecosystems work. They made it possible to observe that ecosystems in areas with less human intervention have a more efficient functioning. This highlights the importance of protecting environments that present diversity of fauna and flora species. It becomes essential to think of a less predatory soil management, so as not to harm the functioning of ecosystems and consequently bring future problems to society.

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