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Morphological characterization of *Eucalyptus dunni* and *E. urograndis* face to the hydrogel application. Caracterização morfológica de *Eucalyptus dunni* e. *urograndis* face à aplicação do hidrogel.

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Abstract

This work aimed to morphologically characterize *Eucalyptus dunni* and *E. urograndis* to the application of hydrogel. By determining the morphological parameters of the seedlings and then of the plantations in the field, after the application of the hydrogel, the characterization was carried out. The first stages, was the production of seedlings - where their morphological characteristics were determined. The second was the evaluation of growth in the field - where the morphological characteristics of the plants were determined when applying the hydrogel. The results showed that the morphological characteristics of the seedlings were adequate for the final place (field). In the field, the best result were achieved in T1, thus demonstrating the efficiency of the hydrogel.
Keywords: Seedling production. Field growth. Eucalyptus sp.

Resumo

Este trabalho teve como objetivo caracterizar morfologicamente *Eucalyptus dunni* e *E. urograndis* à aplicação de hidrogel. Mediante a determinação dos parâmetros morfológicos das mudas e de seguida das plantações, em campo, após a aplicação do hidrogel, fez-se a caracterização. A primeira foi a produção de mudas – onde se determinaram suas características morfológicas. A segunda foi a avaliação do crescimento em campo – onde foi determinada as características morfológicas das plantas face a aplicação do hidrogel. Os resultados mostraram que as características morfológicas das mudas foram adequadas para o lugar definitivo (campo). Já em campo, as melhores características morfológicas foram alcançadas no T1, demostrando deste modo a eficiência do hidrogel.
Palavras-chave: Produção de mudas. Crescimento em campo. Eucalyptus sp.

Introduction

Eucalyptus is the common name for the various plant species of the Eucalyptus genus. Eucalyptus genus has more than 700 cataloged species and are large tree type plants. The species are naturally occurring throughout the Australian continent and several islands in Oceania (SILVA, RECH, 2001).

Among the characteristics of this genus, it highlights its rapid growth and its adaptability to various regions around the globe. Another striking feature of this species, is the diversified use of its wood, being widely used in the production of cellulose and paper, coal, firewood, posts, posts; in the civil construction sector, sheets and laminates, among other uses (DE MELLO et al., 2005; GONÇALEZ et al., 2006; TRUGILHO et al., 2015).

Eucalyptus productivity varies a lot, depending on the edaphoclimatic conditions, the species used, the origin of the plant propagule and its degree of improvement, which can also be influenced by the applied silvicultural practices and the different types of management employed (DEDECEK et al., 2005; SOUZA et al., 2006; SOARES et al., 2007).

Eucalyptus dunni is an evergreen tree, with an erect and cylindrical trunk, with smooth bark, grayish-pink at the base, grayish-green in the upper region, peeling off in long, thin and rolled plates. Open or ascending branch forming an elongated and moderately dense crown. Young alternating and opposite leaves, petiolate, greenish-gray, oval-orbicular; then, alternating, lanceolate, dark green, warm, thick and shiny. The fruits are dehiscent woody capsules, with little protruding valves, containing brownish-gray to black seeds (NAVROSKI et al., 2016).

Eucalyptus urograndis is also a perennial tree, resulting from the crossing of the species of *Eucalyptus grandis* and *E. urophylla*. It usually has a smooth peeling skin, sometimes persistent at the base, grayish or bluish-white in color. Open branch forming thin canopy. Simple, lanceolate or broad-lanceolate leaves with elongated apex, leathery, with a slight odor of cineole, green, much lighter on the underside, with numerous essential oil glands and yellowish and quite prominent main vein. Inflorescences in axillary umbels on compressed peduncles, almost sessile, with conical operculum buttons of the same length as the tube, numerous stamens, white. Fruit of the capsule type, woody, conical, dehiscent, containing tiny, dark and angular seeds (COSTA DIAS et al., 2017; FERREIRA et al., 2017).

The present work had as objective to characterize morphologically *Eucalyptus dunni* and *E. urograndis* when applied to hydrogel.

Materials and methods

The experiment was conducted in two stages, that is, the production of seedlings and evaluation of growth in the field. The material used in the present study had a seminal origin, however, the seedlings were produced in the nursery of the Estrela da Floresta Company, located in Alto Catumbela, Municipality of Ganda, Benguela Province.

The climate of this region is considered tropical with two seasons, dry and rainy. The average temperature in the region is 20.2 ° C, the average annual rainfall is 1 333 mm. The vegetation of Alto Catumbela is dominated by steppe formations in the western zone and by formations of the open forest and medium wooded savannah, in the interior areas. The dominant soils show variable fertility, with some very low mineral reserve (LASS et al., 2000; SANGUMBE, TIELVES, 2019).

The growth evaluation in the field was carried out at the Ngongoinga Experimental Farm of the Faculty of Agricultural Sciences of the José Eduardo dos Santos University. The farm is limited to the Northeast by the Caluapanda stream, to the south by the Culimañala River, and to the west by the Línea Férrea de Benguela Forest Reserve.

The soil characteristic of the area is of the Ferralitic type with red color and a hydrogenation potential that varies between 5.3 and 6.2. It presents low content of organic matter, low capacity for exchange of cations, higher in the horizon A (superficial) and with low contents of Nitrogen, Phosphorus and Potassium. This area has an average annual temperature ranging from 19º C to 20º C, with an average altitude of 1,700 meters. The relative humidity of the air is 60 to 70% at most in January and minimum in August (35 - 40%), considered a warm temperate climate. Precipitation values range from 1 100 mm to just over 1 400 mm (MADEIRA, RICARDO, 2015; SANGUMBE, TIELVES, 2019).

The seedlings were installed in tubes. The substrate used was composed of peat, rice husk and osmocote (46% + 46% + 8%), in a nursery with a capacity of approximately 100,000 plants. The morphological parameters determined in the present study were as follows: height of the aerial part, the diameter of the collection, the length of the root, the total dry mass and the Dickson index.

The height of the aerial part (H) - was determined from the level of the substrate to the tip of the last leaf, with the aid of a ruler graduated in centimeters. The diameter of the collection (DC) - was measured at the substrate level, with the aid of a digital caliper, with millimeter precision. The determination of the dry mass of the aerial part and the dry mass of the root were carried out since the separation of the aerial and root part of the plant, with subsequent drying of the materials in an oven with forced ventilation at 80 ° C until constant weight, being weighed with the aid of electronic scale, with milligram precision. The root length (CR) - was determined with the aid of a ruler graduated in centimeters and was measured in the root part of the plant, after its separation. The total dry mass was obtained by adding the dry mass of the aerial part and the dry mass of the root. The DQI was determined according to height, diameter of the collection, dry matter of the aerial part, dry matter of the root, using the following formula (DICKSON et al. 1960):

$$IQD = \frac{MST\ (g)}{\left[\frac{H\ (cm)}{DC\ (mm)}\right] + \left[\frac{MSPA\ (g)}{MSR\ (g)}\right]}$$

Where: MST = total dry mass; MSPA = dry mass of the aerial part; MSR = dry root mass; H = height of the aerial part; DC = neck diameter.

Planting was done using a completely randomized block design with three treatments, with three replications.

Table 1 - Illustration of the experimental design.

Species	***E. urograndis***			***E. dunni***		
Repetitions	1st	2nd	3rd	1st	2nd	3rd
Treatments	T1	T1	T1	T1	T1	T1
	T2	T2	T2	T2	T2	T2
	T3	T3	T3	T3	T3	T3
Witness	TES	TES	TES	TES	TES	TES

In the first treatment, both *E. urograndis* and *E. dunni* were applied hydrogel and were not watered. This hydrogel was used as follows: - Four grams per liter and 1 liter of this solution was applied to each of the plants in this treatment. In the second treatment, the hydrogel was not applied, but watering was performed every 15 days. In the third treatment, watering followed the interval of 20 to 20 days. In the control, of course, no watering was carried out, nor was the hydrogel applied, each of these treatments included in the control consisted of 25 seedlings. The evaluations were carried out during the months of June, July, August and September every 30 days.

The data obtained were submitted to statistical analysis in which the T test was determined to the morphological characteristics of the seedlings, the comparison of the means of treatments of the morphological parameters.

Results and discussion

Morphological characteristics of *Eucalyptus dunni* and *E. urograndis* seedlings

The morphological characteristics of the *E. dunni* and *E. urograndis* seedlings are shown in table 2. There was no significant difference between the heights, root length, dry matter of the aerial part and dry matter of the root between *E. dunni* and *E. urograndis*. While for the collected diameter, *E. dunni* was 91.58% smaller than *E. urograndis*. The green matter of the aerial part 41.17% greater E. *urograndis* than *E. dunni*. The green root matter was 16.52% lower in *E. urograndis* than *E. dunni*. The total dry matter was 33.8% lower in *E. dunni* than *E. urograndis*. Dickson's quality index was 66.22% higher in *E. urograndis* than in *E. dunni*.

Table 2 - Summary of morphological characteristics of *Eucalyptus dunni* and *E. urograndis* seedlings (two months after sowing).

Charact.	H (cm)	DC (cm)	CR (cm)	MVPA (g)	MVR (g)	MSPA (g)	MSR (g)	MST (g)	MVT (g)	IQD
Eucalyptus dunni										
Average	36.3a	0.53b	20.4a	125.7b	35.1a	37.1a	8.69a	45.8b	160.8b	5.1b
Desv.	4.7	0.1	1.9	12.1	4.5	4.7	2.1	6.8	10.0	0.4
Eucalyptus urograndis										
Average	46.1a	6.30a	17.0a	213.7a	29.3b	47.9a	13.86a	61.8a	242.9a	15.1a
Desv.	22.87	0.70	1.02	110.04	3.26	3.21	6.86	6.32	109.01	5.05

Values with different letters in the same row indicate significant differences with $p < 0.05$ (Tukey test).

The morphological characteristics presented by *Eucalyptus dunni* and *E. urograndis* seedlings are within the range described and / or found by several authors such as da Silva et al. (2004), Lopes et al. (2007) and Gomes et al. (2002) in edaphoclimatic working conditions similar to the present work. This behavior of *Eucalyptus dunni* and *E. urograndis* seedlings is also justified taking into account the origin of the seeds and the uniformity in the substrate preparation process.

The seeds were obtained in markets in South Africa, specifically in the city of Pretoria. They presented little impurity, good germination power and therefore an acceptable germination vigor. The substrate, according to the literature is an important factor for the seedling nutrition process, due to the mixtures used for these plants, this substrate presented in our understanding the necessary nutrients for the germination and vigor of the plants, reason of the reach of the morphological characteristics above.

Hydrogel efficiency in *Eucalyptus dunni* and *E. urograndis* plantations

Four months after planting, T1 showed high averages, that is, height, stem diameter and height-diameter ratio, whether in *E. dunni* and *E. urograndis*, differing from all other treatments, except for the relationship diameter height that was equal to T2. Between T2 and T3 there was only difference in their height, with the diameter of the collection and the height diameter ratio being the same for *E. dunni*. For *E. urograndis* these treatments will differ in all characteristics. Lower averages were presented by *Eucalyptus dunni* and *E. urograndis* in the control.

Table 3 - Summary of the analysis of height (H), stem diameter (DC) and height-to-diameter ratio (H / DC) of *Eucalyptus dunni* and *E. urograndis* in the field (Four months after planting).

Treatments	H (cm)	DC (cm)	H/DC	H (cm)	DC (cm)	H/DC
	E. dunni			***E. urograndis***		
T1	148.92a	36.52a	4.21a	176.76a	28.42a	6.47a
Desv.	16.72	4.74	0.78	30.09	4.29	1.41
T2	95.92b	34.02b	2.93b	136.76b	23.42b	6.22a
Desv.	16.72	4.74	0.69	30.09	4.29	1.79
T3	73.92c	33.52b	2.30b	96.76c	20.92c	5.03b
Desv.	16.72	4.74	0.63	30.09	4.29	1.91
Witness	48.92d	28.52c	1.82c	76.76d	13.92d	7.15c
Desv.	16.72	4.74	0.69	30.09	4.29	4.50

Values with different letters in the same row indicate significant differences with $p < 0.05$ (Tukey test).

The behavior shown by treatment 1, that is, obtaining high averages compared to other treatments, is justified by the application of hydrogel at the time of planting, since according to Freitas et al. (2002), the addition of hydrogel to the soil at the time of planting, optimizes the availability of water, reduces losses through percolation and leaching of nutrients and improves soil aeration and drainage, accelerating the development of the root system, which in turn it is essential to increase the height and diameter of plants.

Also, the application of hydrogel according to Fernandes (2011) reduces the evaporation of water from the soil, reduces the frequency of irrigation by up to 50% and favors the growth of plants, as water and nutrients are more available to the roots. In the case of treatment 1, irrigation was reduced to 100% and even so, good results were obtained, substantiating more and more the idea that the hydrogel conserves moisture in the soil.

El-Rehim et al. (2004) and Ekebafe et al. (2011) state that the roots of the plants to which the hydrogel is applied in the plantation develop and grow inside the hydrogel granules, thus providing a greater contact surface between roots, water and nutrients. In this way, the hydrogel contributes to minimize water loss through runoff, irrigation costs, and seedling mortality. Although the root dry mass of plants in the field has not been determined, Felippe et al. (2016) states that the use of hydrogel favors an increase in the root dry mass of plants.

T2 during the four months received about 12 liters of water or two liters of water per month. The third treatment received 9 liters of water after four months, that is, an average of 1.5 liters per month. As mentioned earlier, the witness did not receive any additional water during the four months.

Fernandes (2011) in his study on hydrogel and watering shift in the initial growth of *E. urograndis* obtained similar results, that is, better means of the morphological variables evaluated (height, diameter and height-diameter ratio) in relation to the treatments in which the periodic watering. For Fernandes (2011), these evaluations were made at 46 days after planting the species.

Conclusion

The application of the hydrogel in the plantations was efficient, since the treatment that received this product reached better morphological parameters in comparison with the others.

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