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Substrate and Reposition of Water in The Germination of *Copernicia Prunifera* (Mill) H. E. Moore (Arecaceae) Seeds

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***Abstract*— Carnauba, *Copernicia prunifera* (Mill) H. E. Moore, is a palm tree native from Brazil with high ornamental value and it is widely used in landscaping in the northeast of the country. Besides being ornamental it also provides many products such as the wax removed from their leaves. Despite its economic and ecological importance, carnauba is still little studied. To elucidate aspects related to seedling production, this work aimed to study the effect of substrates and water reposition in the germination of seeds. The experiment was conducted at the Seed Laboratory of the Department of Plant Production in UNESP/FCAV, Jaboticabal, SP. The experimental design was completely randomized. The treatments were arranged in a factorial 3 x 3 + 1,for example three substrates (vermiculite, sphagnum and coconut fiber) combined with three water reposition regimes(60%, 80% and 100%) + sand with 60% of reposition (control); it were used 4 replicates with 25 seeds each. In every two days it was performed the count of the number of germinated seeds (determined by the appearing of the germination button) and it was made the reposition of water. After the stabilization of the germination it were calculated the germination percentage and the germination speed index (GSI). Data were statistically analyzed and the means were compared by the Tukey test at 5%. Higher germination percentages were observed in vermiculite and in coconut fiber being the fastest germination found in the coconut fiber, regardless of the reposition of water. The percentage of germination and the GSI were not affected by the water repositions regimes, regardless of the substrate.**

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I. Introduction

Palm trees are plants of the *Arecaceae* family and the vast majority of species is commercially propagated by seeds. However, in general, the seed germination is considered slow and uneven and influenced by many factors, among which, the substrate (MEEROW, 1991, BROSCHAT, 1994).

The substrates used for the propagation of seeds have great influence on the germination process, considering that factors such as structure, aeration, water retention capacity and degree of pathogen infestation may vary according to the type of material used, being the vermiculite, the sand and the coconut fiber, much used in the initial stage of growth and development of the plants (BARBOSA and LOPES, 2007)

Yocum (1964) referred to the vermiculite as a suitable substrate for the germination of palm trees, since it is free of pests and diseases, it has good drainage and also a good water retention capacity. Meerow (1991) cites the sphagnum and the vermiculite as appropriated means for nursery conditions. Markus and Banks (1999) recommend the sphagnum for cases of palm seeds whose germination is considered difficult.

Copernicia prunifera (Mill) H. E. Moore is a palm tree that reaches 10 to 15 m tall and that has spankings leaves. In addition to providing wax for many uses and present a great landscape potential, it has a top quality cellulose for the manufacture of paper and wood used for various purposes. The leaves, after drying and removal of the wax, are used by industry in the manufacture of mats, hats and other artifacts (ARRUDA and CALBO, 2004; LORENZI et al., 2004).

Due to the great importance and the lack of information about the production of seedlings of this species, as well as the importance of the substrate and its management in the seed germination process, this work aimed to study the effect of substrates and water reposition in the germination of seeds of *Copernicia prunifera*.

II. MATERIAL AND METHODS

Carnauba fruits were collected from the Experimental Nursery of Ornamental and Forest Plants, UNESP / FCAV. The experiment was conducted in the Laboratory of Seeds Analysis of the Department of Plant Production.

The experimental design was completely randomized. The treatments were arranged in a factorial 3 x 3 + 1, as 3 substrates (vermiculite, sphagnum and coconut fiber) combined with three water reposition regimes (60%, 80% and 100%) + sand with 60% of reposition of water (control); it were used 4 replicates of 25 seeds.

After harvesting, the pericarp and the mesocarp of the fruits were removed by manual friction against a sieve and the diaspores (seeds with adhered endocarp) were rinsed in tap water and dried in the shade for one day.

The diaspores were placed in transparent plastic boxes containing river sand washed and sterilized, fine vermiculite, coconut fiber or sphagnum according to the treatment. The boxes were placed over laboratory benches whose maximum and minimum temperatures were monitored every other day, being the average of the maximum temperature 27,5 °C and the average of minimum 24,5 °C.

The substrates used were medium texture vermiculite, sphagnum, Golden-Mix coconut fiber type 80® - stringy and without a basic fertilizer and washed and sterilized river sand.

In every two days it was performed the count of the number of germinated seeds (using as germination criterion the appearing of the germinal button) and it was made the reposition of water. After the stabilization of the germination it was determined the percentage of germination using the formula proposed in the Rules for Seed Analysis (BRAZIL, 2009). The Germination Speed Index (GSI) was calculated using the formula proposed by Maguire (1962).

The germination percentage data were transformed into arc sin $(x/100)^{1/2}$. Statistical analysis was performed and the averages were compared by Tukey test at 5% of probability.

III. RESULTS AND DISCUSSION

The interaction between the substrates and the water reposition regimes it was not significant for the percentage of germination neither for the GSI (Table 1).

Table 1. Mean squares and averages for percentage of germination and Germination Speed Index (GSI) of carnauba *Copernicia pruniferas*eeds submitted to different substrates and water reposition regimes.

Causes of Variation	G.L.	Germination (%)[1]	GSI
Control x Factorial	1	777,69**	0.4094**
Substrate	2	2109,27**	1,1578 **
Water reposition	2	$3,84^{NS}$	$0,0533^{NS}$
Substrate x Reposition	4	$6,11^{NS}$	$0,0166^{NS}$
Residue	30	383,41	0,7113
CV		5,53	11,13
Means – Substrate			
Vermiculite		73,24[1](91,68)[2]a	1,2433 b
Sphagnum		50,79 (60,04) b	1,2325 b
Coconut fiber		74,24 (92,62) a	1,7758 a
Sand (control)		51,39 (61,06)	1,0800
Means – Water reposition			
60%		66,68 (84,32) a	1,3783 a
80%		66,03 (83,50) a	1,3792 a
100%		65,56 (82,88) a	1,4942 a

Means followed by the same letter do not differ by Tukey test at 5% probability.

[1] Arc sin $\sqrt{x/100}$ transformed data

[2] Unprocessed data

Highest averages of germination percentages were observed in vermiculite and coconut fiber being the fastest germination in the coconut fiber, regardless of the reposition of water. The percentage of germination and the GSI were not affected by the different water repositions regimes, regardless of the substrate.

The result of this work reinforces the indication in the literature (YOCUM, 1964; MEEROW, 1991), which considers in general, the vermiculite one of the most suitable substrates in the germination of palm seeds.

The superiority of the vermiculite was also observed by Batista et al. (2011) for the palm *Syagrus oleracea* and by Andrade et al. (1999) in the germination of seeds of the *Euterpe edulis* palm, however, Bovi et al. (1989), also studying the germination of seeds of *E. edulis*, found no differences between vermiculite and sand.

As for the palm *Bactris gasipaes*, Ledo et al. (2002) observed that the sand provided higher percentage of germination when compared with the vermiculite. Beckmann-Cavalcante et al. (2012) studying the germination of seeds of *Euterpe oleracea* and *E. edulis* palms in different substrates (sand, medium vermiculite, coconut fiber and soil + dung – 3:1 with water reposition of 100%) observed that sand, coconut fiber and vermiculite were the most suitable for the germination of juçara seeds and for the açaí there was no difference between the substrates. Oliveira et al. (2009) also found that the type of substrate did not affect the emergence of seeds of the palm tree *Copernicia hospita*.

The difference of the results may be related to the temperature, the seeds size and/or physical dormancy related to the impermeability of the endocarp of the different species.

The vermiculite is a substrate that has been used with satisfactory results for seed germination due to factors such as light weight, ease of handling, good water holding capacity (SILVA et al., 2002; GUEDES et al., 2010) which are very important characteristics for recalcitrant seeds (TAVARES et al., 2008) ensuring the moisture for the seeds, preventing desiccation (BECKMANN-CAVALCANTE et al., 2012).

IV. CONCLUSION

Higher germination percentages were observed in vermiculite and coconut fiber. The fastest germination was in coconut fiber, regardless to the needed reposition of water. The percentage of germination and the germination speed index were not affected by the different water reposition regimes, regardless of the substrate.

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