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Effect of Propagation Media on the Germination and Early Seedling Growth of *Eucalyptus camaldulensis* Dehnh

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ABSTRACT

Inadequate knowledge of propagation techniques for *Eucalyptus camaldulensis* inhibits its domestication by farmers. Thus, this study investigated the effect of propagation media on the germination and early seedling growth of *E. camaldulensis.* Healthy and viable seeds of *E. camaldulensis* were broadcasted on four different propagation media - Top soil (control), Sawdust, Riversand, mixture of Topsoil and Riversand in a Completely Randomized Design layout with three (3) replicates. Germination studies were conducted for two (2) weeks at the end of which seedlings were thinned down to two per polypot to make a total of two hundred and forty (240) seedlings used for early seedling growth assessment. Data were collected on germination percentage, seedling height, leaf number and collar diameter and analyzed using One way Analysis of Variance (ANOVA). Germination percentage varied significantly ($p < 0.05$) among the four propagation media with the highest (23.83%) and the lowest (13.83%) germination percentage recorded in sawdust and topsoil + river-sand, respectively. The growth parameters were significantly affected ($p<0.05$) by the growth media. The highest leaf number was recorded in topsoil+riversand (9.88) while the lowest was recorded in sawdust (5.00); the highest plant height(5.06cm) in topsoil+riversand while the lowest in sawdust (2.44); the highest collar diameter (0.14cm) in topsoil (control) while the lowest was in the rest of the media. Sawdust should be used for the germination of *E. camaldulensis* seeds while Topsoil and a mixture of topsoil+riversand should be employed to nurture juvenile seedlings for enhanced performance.

Keywords: Domestication, Germination, Plantation, *Eucalyptus camaldulensis,* Growth media

INTRODUCTION

Seeds are important starting materials for propagation of many vital tree species. Seed germination is the emergence of the embryo from the seed. To supply large quantity of healthy seedlings, proper nursery techniques are required. Seed germination is influenced by many factors such as the substrates used, environmental factors such as oxygen, water, temperature and for some plant species, light (Hartmann *et al.*, 2001).

Eucalyptus camaldulensis is an evergreen tree belonging to the Family Myrtaceae. It usually grows between 40-45 m in height, depending on its location and it is often planted for shade, windbreak, ornamental, amenity purposes and as a source of nectar to produce high-quality honey (Abou *et al.*, 2006). It is widely used as an afforestation species due to its fast growth, high productivity and short rotation (Agboola and Adedire, 2002). The tree grows straight under favourable environmental conditions but can develop twisted branches in drier conditions

(Adedunloye *et al.,* 2007). The wood of *Eucalyptus camaldulensis*is is used mainly for firewood, charcoal production, poles, posts, tools and paper pulp. Other uses include construction (especially) bridges and wharves) flooring, ship building, railway sleepers, mine timber, furniture and packing cases. It is also use for veneer, plywood, turnery, fiber and particle board (Azene, 2007). Leaves are grey blue, alternate, drooping, 8-22cm long, 1-2 wide, often curved or sickle shaped, tapering, short pointed at the base. Fruit are very small capsules at the end of thin stalks, 5-8mm, valves 4, containing minute seeds (Orwa *et al.,* 2009).

The time of flowering in natural stands depends on the climate of a given location. Pollination is by insects such as blow flies, ants and bees, and by birds and small mammals, seeds ripen about 6, months later. *Eucalyptus camaldulensis* does not develop resting buds and grows whenever conditions are favourable. (Orwa *et al.,* 2009)

The seed is the most important element in plant production and has a very great influence on the success or failure of both natural and artificial regeneration (Nwoboshi, 1982). All seeds contains an embryo (sometimes more than one) which develops into seedling and have a supply of reserve substances which sustains the seedling in the embryo stages of growth before it becomes self- supporting (Black *et al.,* 2006).Seed of *Eucalyptus camaldulensis* are dispersed by water, insects, and wind (Bonney, 2003). Seed stored at 25^{o} c had germination rate of 91% after 5 years, and 87% after 10 years (Gunn, 2001).

Planting medium is considered to be important and necessary for growth and development of a plant and provides the basic necessities required by the plant. The propagation media or substrate is essential for production of quality trees seedlings. A good propagation medium provides sufficient anchorage and support to the plants and allows oxygen diffusion to the roots and permit gaseous exchange between the roots and the atmosphere (Abad *et al.,* 2002). *Eucalyptus camaldulensis* is helpful in the socio economic life of rural and urban populace for preventing the indigenous forests from being destroyed, for controlling soil erosion, for replacing indigenous forest tree species for fuel-wood (Bayle, 2019). There is inadequate information on the type of propagation media required for raising this species in the nursery due to the tiny nature of the seeds. It is in view of this that the study was designed to determine the effect of propagation media on the germination and early growth of *Eucalyptus camaldulensis* to promote the success of seed propagation of the species in the nursery, use in afforestation programmes. .

MATERIAL AND METHODS

Study Area

The study was conducted at the Forestry Nursery of the Federal University of Agriculture Makurdi. Geographically, the site is located at Latitude 07^0 45′ and 07^0 50᾽N and Longitude 08^0 45′ and 08^0 50′E, having an Elevation of 98 meters above sea level (Egbe *et al,* 2012). The climate is tropical with clear distinct to dry and rainy season, with a mean annual rainfall of 1000mm – 1500mm, the mean annual temperature is 30^0C and relative humidity is 65 – 96 percent (Ekhuemelo and Musa, 2015). The vegetation of the study area is Guinea Savanna, having very green trees and grasses during the rainy season, while the grasses turn brown during the dry season.. The vegetation constantly experience bush fires every dry season. The trees usually are about

12-15m high and are rarely up to 27m or even 30m (Ekhuemelo and Musa, 2015).

Seed Collection, Preparation and filling of poly pot

Seeds of *Eucalyptus camaldulensis* were collected from Forestry Nursery Federal University of Agriculture Makurdi. The collected seeds were carefully sorted out by hand picking to obtain healthy and viable seeds for sowing. polypots of size 14x13cm were filled with different propagation media namely: (1) Topsoil, (2)River-Sand, (3)Sawdust and (4) A mixture of Topsoil and River-Sand. Seeds of *Eucalyptus camaldulensis* were broadcasted in the poly pots filled with propagation media. This was monitored for two (2) weeks for germination and thereafter thinned down to two (2) seedlings per poly pot for early seedling growth assessment for six (6) weeks. Watering was done daily after sowing.

Experimental Design

The experiment was arranged in a completely randomized design (CRD), having ten (10) poly pots allotted to each propagation medium and replicated three times, to make a total of 120 polypots used in the experiment. The experiment was observed for the duration of eight (8) weeks. Two hundred and forty (240) seedlings were used for the assessment of early seedling growth.

Data Collection

The experiment was monitored daily for germination. Germination was considered to have stopped when there was no further seedling emergence after two (2) weeks. Germination percentage was obtained by dividing the number of germinated seed by total number of seed x 100%. Early seedling growth was monitored weekly for a period of six (6) weeks. Growth parameters assessed were seedlings height measured with the aid of a rule calibrated in centimeter and taken from the ground level to the terminal leaf/bud), number of leaf was counted) and seedling collar diameter measured with the aid of an electronic veneer caliper.

Data Analysis

Data analysis was carried out using one way analysis of variances (ANOVA), and where significant differences occurred between the treatments, Fisher's Least Significant Difference (LSD) *at* $\alpha_{0.05}$ was used to separate the means.

RESULTS

Effects of propagation media on the germination of *Eucalyptus camaldulensis* seed

The highest germination percentage at the end of two weeks was recorded in sawdust (23.83%) and the least was observed in Riversand (13.83%) (Table 1).

Table 1: Effects of propagation media on the germination percentage of *Eucalyptus camaldulensis* seed

Weeks/ propagation media	Topsoil(control)	Sawdust	River-Sand	Topsoil+River-Sand	p-value
Wk 1	0.00	0.00	0.00	0.00	0.00
Wk2	15.17 ± 5.11^{a}	23.83 ± 6.85^{b}	17.67 ± 6.97^{ab}	13.83 ± 2.99^{a}	0.03

Effect of propagation media on seedling height of *Eucalyptus camladulensis*

The highest mean plant height was recorded in mixture Topsoil and River-Sand (5.06cm)

while the least was recorded in Saw dust (2.44) (Table 2).

Effect of propagation media on leaf number of *Eucalyptus camaldulensis* seedlings

The highest number of leaves was recorded in a mixture of Topsoil and River-Sand (9.88 ±4.75) and the least was recorded in sawdust (5.00 ± 0.95) (Table 3).

Effect of propagation media on collar diameter of *Eucalyptus camaldulensis* Seedlings

The highest mean collar diameter was observed in Topsoil (control) (0.14 ± 0.05) and the least was observed in the rest of the media (0.10 ± 0.00) (Table 4)

Table 2: Effect of propagation media on seedling height of *Eucalyptus camaldulensis*

periods	propagation media (cm)				
	Topsoil(control)	Sawdust	River-Sand	Topsoil+River-Sand	p-value
Wk 3	2.80±0.87^{b}	2.16±0.46^{a}	2.20±0.93^{a}	2.05±0.82^{a}	0.01
Wk4	3.19±0.60^{ab}	2.20±0.40^{a}	2.25+0.53^{a}	2.29±0.58^{a}	0.00
Wk5	3.33±0.91^{b}	2.33±0.54^{a}	2.30±0.63^{a}	2.52±0.79^{a}	0.00
Wk6	3.42±0.92^{b}	2.35±0.62^{a}	2.43±0.66^{a}	3.29±b.64^{a}	0.00
Wk7	3.50±0.68^{b}	2.38±0.56^{a}	2.54±0.80^{a}	4.52±1.50^{c}	0.00
Wk8	3.55±0.68^{b}	2.44±0.08^{a}	2.57±0.67^{a}	5.06±2.00^{c}	0.00

Means on the same row with different superscript are statistically significant (P<0.05)

Table 3: Effect of propagation media on leaf number of *Eucalyptus camaldulensis* seedlings

Periods	Propagation media				
	Topsoil(control)	Sawdust	River-Sand	Topsoil+River-Sand	p-value
Wk 3	3.86±1.10^{a}	3.93±0.98^{a}	4.17±2.12^{a}	3.88± 0.60^{a}	0.86*
Wk4	4.19±1.86^{ab}	4.00±0.00^{a}	4.92±1.17^{b}	4.65±1.05^{ab}	0.02
Wk5	4.33±1.23^{a}	4.17±0.15^{a}	4.70±1.14^{a}	4.88±1.79^{a}	0.16*
Wk6	5.48±2.20^{b}	3.89±1.13^{a}	5.78±1.41^{b}	5.29±3.07^{b}	0.00
Wk7	7.05±3.10^{b}	4.30±1.20^{a}	6.68±1.42^{b}	6.82±2.87^{b}	0.00
Wk8	9.45±4.75^{b}	5.00±0.95^{b}	6.40±2.89^{a}	9.88±4.75^{b}	0.00

Means on the same row with different superscript are statistically significant (p<0.05)

Table 4: Effect of Propagation media on collar diameter of *Eucalyptus camadulensis* Seedlings

Periods	Propagation media				
	Topsoil(control)	Sawdust	River-Sand	Topsoil+River-Sand	p-value
Wk 3	0.10 ± 0.06^{a}	0.10 ± 0.00^{c}	0.10 ± 0.00^{b}	0.10 ± 0.00^{a}	1.00*
Wk4	0.10 ± 0.00^{a}	0.10 ± 0.00^{c}	0.10 ± 0.00^{b}	0.10 ± 0.00^{a}	1.00*
Wk5	0.13 ± 0.63^{b}	0.10 ± 0.00^{a}	0.10 ± 0.00^{a}	0.10 ± 0.00^{a}	0.00
Wk6	0.13 ± 0.11^{b}	0.10 ± 0.00^{a}	0.10 ± 0.00^{a}	0.10 ± 0.04^{a}	0.06*
Wk7	0.12 ± 0.03^{b}	0.10 ± 0.00^{a}	0.10 ± 0.00^{a}	0.10 ± 0.04^{a}	0.00
Wk8	0.14 ± 0.05^{b}	0.10 ± 0.00^{a}	0.10 ± 0.00^{a}	0.10 ± 0.00^{a}	0.00

Means on the same row with different superscript are statistically significant ($p<0.05$)

DISCUSSION

The role of propagation media on the germination and early seedling growth of *Eucalyptus camaldulensisn* has proved successful in this study. The highest germination percentage recorded in sawdust medium is in agreement with Abhirami *et al* (2010) and Omokhua *et al.,* (2015) who found sawdust as the best suitable medium for the germination of African nutmeg (*monodora myristica*) and *Terminalia ivorensis* seed respectively. The result however is contrary to Okunomo *et al* (2004) and Amonum *et al,* (2019) who obtained the highest germination percentage in top soil and River-Sand with *Dacrylodes edulis* seed.

The highest mean seedling height was recorded in the mixture of Topsoil and River-Sand. The result supports the work of Dickens (2011) who observed the highest seedling height in River-Sand in *Irvingia wombolu* but disagrees with the findings of Mhango *et al*, (2008) who reported that sawdust produced the highest seedling height in *Upaca kirkiana.* This finding is also in agreement with the work of Sabo (2002) who considered the mixture of Top soil and River-Sand as the best for seedling height growth in *Eucalyptus tereticornis*. The highest seedling height in the mixture could be attributed to the high nutrient of the media and high porosity of the River-Sand (Purwantaro, 2016) which has good aeration and low water holding capacity.

The result on the highest seedling number of leaves was recorded in the mixture of Top soil and Riversand while the least was recorded in saw dust. The result corroborates the findings of Ratna *et al.* (2006) who found that mixture of Top soil and River-Sand improved the number of leaf in banana *Raja seria*. The result however disagrees with the work of Dickens (2011) who reported that Riversand as the medium that recorded the highest number of leaves in *Irvingia wombolu* seedlings.

The highest seedling collar diameter was recorded in top soil while the rest of the media recored the lowest. This is in agreement with the work of Sabo (2002) who recorded the highest seedling collar diameter in topsoil. However the result is contrary to Dickens (2011) and Omokhua *et al.,* 2015 who recorded highest seedling collar diameter in Riversand in *Irvingia wombolu* and in sawdust in *Terminalia ivorensis.* The effect of top soil on seedling collar diameter could be attributed to the presence of organic matter. This is because organic matter in growth media regulates water and nutrient availability which enhance seedlings production (Peter Onoh *et al.,* 2014).

CONCLUSION

The study shows that sawdust significantly improves the germination of *Eucalyptus camaldulensis* seed than the rest of the propagation media while Topsoil and Riversand significantly improved seedling early growth of the species. Thus, it is recommended that for improved germination of *Eucalyptus camaldulensis* seeds in the nursery sawdust should be adopted as the planting medium while Topsoil and Riversand should be employed for improved early seedling growth.

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