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SEED GERMINATION AND EARLY GROWTH PERFORMANCE OF *Casuarina equisetifolia* L. IN DIFFERENT SOWING MEDIA

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Abstract
Poor germination and inadequate silvicultural information are important factors militating against regeneration of Casuarina equisetifolia L. This study investigated effects of different sowing media on its germination and early growth. Fifty viable seeds were sown into each germination tray filled with four sowing media (Topsoil, sawdust, clay soil and river sand as treatment A, B, C and D respectively). Twelve germinants were randomly selected per sowing media and transplanted into polythene pots for early growth assessment. The growth parameters were measured for 16 weeks. Data on germination percentage and early growth parameters were subjected to Analysis of variance (ANOVA). There were no significant difference (P>0.05) among treatments on germination percentages. Treatment B had highest germination percentage 75±3.30% while treatment A and D had 56±2.85% and 25±2.63% respectively. The least was treatment C (19±2.55%). There was significant difference (P<0.05) among treatments on seedling height and collar diameter, but there was no significant difference (P>0.05) on leaf production of C. equisetifolia. The highest mean height was recorded in treatment A (14.64±0.24). Treatments B, C, D had 13.33±0.35, 12.50±0.60 and 12.35±0.59 respectively. The highest collar diameter was recorded for treatment A (2.49±0.12). Treatments B, D, and C had 2.41±0.05, 1.96±0.01 and 1.84±0.01 respectively. The study has shown that the germination percentage of C. equisetifolia improved significantly with sowing media especially sawdust and topsoil. The use of saw dust and topsoil as sowing media for small and large scale propagation of the species is recommended.

Key Words: *Seed germination, Casuarina equisetifolia, Sowing media, Early growth*

Introduction

Casuarina equisitifolia L. commonly called beefwood, ironwood, Queensland swamp oak, whistling pine, she-oak is one of the fast-growing tree species. It belongs to the family Casuarinaceae comprising of four genera and 99 species and subspecies of trees and shrubs which are capable of entering different symbiotic interactions with soil microbes like the nitrogen-fixing actinomycete Frankia, ectomycorrhizal and endomycorrhizal fungi (Zhong *et al*., 2011). Casuarina is potentially a multipurpose species for many industrial,

environmental and livelihood requirements in India. India happens to be the largest Casuarina-growing country in the world having approximately five hundred thousand hectares of plantations located in the Andhra Pradesh, Odisha, Tamil Nadu and Union Territory of Puducherry in the east coast (Warrier *et al*., 2014). It is also one of the five most extensively planted tree crops in the country and is harvested in short rotations of two to five years (Warrier *et al*., 2014). It grows up to 25m tall or even more and slender at younger age but develop a bole to 2 m in girth. It stands straight, somewhat buttressed at the base. It is endemic to Australia and Asia, mostly found on sandy soils near the coast, but can also grow well on other soils. Many species of Casuarina are very important both economically and ecologically. They offer a wide range of goods and services. Casuarina is important in the reclamation of marginal lands, for instance those affected by salt, and in coastal environmental protection (Hassanein, 2010). It is a major source of fuel wood and other wood products. Timber from Casuarina can be used for house construction and charcoal, mine props and Poles for electricity transmission lines and other wood-based industries such as woodchips for paper pulp and veneer for plyboard (ITTO, 2002). Recently Casuarina plantation has gained popularity in desert areas and other arid lands used as wind breaks and in wood lots has increased. Casuarinas are planted to stabilize the moving sand, in agroforestry systems, and for rehabilitation programmes. Species that can replace Casuarinas at the foreshores are not common (Zhong *et al*., 2011). Not so much information is known on seed collection, handling, storage and viability that influence germination and by extension, growth so a wide gap in the available knowledge on Casuarinas (Chu and Kha, 1996). Casuarina was introduced to Vietnam and India (Kondas, 1983; Chu and Kha, 1996). Currently, Casuarina plantation is facing challenges. The problems include (1) reduction in the productivity of plantation; (2) reduction in ecological function, especially wind protection effectiveness; (3) over exploitation; and (4) diseases infestation such as bacteria wilt disease *Ralstonia solanacearum*.

There is paucity of information available on seed germination and early growth performance within *C. equisitifolia* in response to sowing media. This study was therefore carried out to evaluate the seed germination and early growth performance within *C. equisitifolia* in response to different sowing media.

Materials and Methods

The experiment was carried out in the screen house of Federal College of Forestry Jericho Ibadan, Oyo State. The area lies between longitude 07º 26' 15" N to 07º 25'46" N and latitude 03º 54' 22" E to 03º 53' 40" E of the Greenwich meridian. The climatic pattern of the area is tropically dominated by annual rainfall range from 1300-1500 m and average relative humidity of about 65%, the average temperature is about 26º C, the eco-climate of the dry season usually commencing from (November to March) and the raining season start from April to October (FRIN, 2018).

The seeds of *C. equisetifolia* were collected from seed store of Forestry Research Institute of Nigeria (FRIN), Jericho, Ibadan. A total 200 seeds were sorted and a lot of 50 seeds were sown in

germination trays containing different sowing media and kept in a humidified environment. The sowing media comprised of Top soil (Treatment A), Saw dust (Treatment B), Clay soil (Treatment C) and River sand (Treatment D). The experiment was laid in a Completely Randomized Design (CRD) in three (3) replicates. The trays were watered daily. Daily observation of emergence was made to determine the effects of the four sowing media on the germination of seeds of *C. equisetifolia.* Germination records were discontinued and considered to have been completed when no additional germination took place in five weeks.

At the end of the germination experiment, 12 seedlings were randomly selected per sowing media and transplanted into polythene pots. Each polythene pot was regarded as individual replicate to make total experimental unit of 48.

Data were also collected on early seedling growth parameters (seedling height (cm), collar diameter (mm) and number of leaves produced weekly). The growth parameters were measured for 16 weeks. The height of seedling in each pot was measured using a graduated meter rule. The vernier caliper was used to measure the collar diameter of the seedlings while the production of new leaves was recorded by visual counting.

Data collected on germination and early seedling growth was subjected to analysis of variance (ANOVA) in a completely randomized design. Percentage seed germination was calculated as;

$$\% \text{ germination} = \frac{Number\ of\ seed\ germinated}{Number\ of\ seed\ sown} \text{ x } 100$$

Results

Seed Germination

The result on effect of four (4) different sowing media on the germination of *C. equisetifolia* is shown in Table 1. The result shows that the highest germination percentage was recorded for treatment B (sawdust) which had 75±3.30%. Treatment A (Topsoil) and D (River sand) had 56±2.85% and 25±2.63% respectively. The least was Treatment C (clay soil) which had 19±2.55%. The mean germination percentage of species with the four sowing media was statistically not different at 5% level of significance as presented in Table 2.

Table 1: Mean Germination Percentage of *C. equisetifolia* sown in different sowing media

Treatment	Mean±S.E. (%)	Lower bound	Upper bound	Minimum	Maximum
A (Topsoil)	56±2.85	2.88	4.24	3.00	4.00
B (Sawdust)	75±3.30	3.02	4.48	3.25	4.25
C (Clay soil)	19±2.55	2.99	3.39	3.00	3.25
D (River sand)	25±2.63	2.39	4.11	2.75	4.00

Table 2: Analysis of Variance (ANOVA) for Germination Percentage of seeds of *C. equisetifolia* sown in different sowing media

Source of variation	Sum of square	Df	Mean sum of square	F	Sig.
Treatments	0.844	3	0.281	1.612	0.238ns
Error	2.094	12	0.174		
Total	2.938	15			

Ns = not significant at P>0.05

Seedling height (cm)

The result on early growth performance of *C. equisetifolia* using four different sowing media is shown in table 3. It shows that the highest mean height was recorded in treatment A (Top soil), which has 14.64±0.24 cm followed by treatment B (sawdust). C (clay soil) and D (river sand) had 13.33±0.35 cm, 12.50±0.60 cm and 12.35±0.59 cm respectively. The mean seedling heights of the species with the four sowing media were statistically significant at 5% level of probability.

Table 3: Mean weekly seedling height (cm) of *C. equisetifolia* raised different sowing media

Treatment	Mean±S.E.	Lower bound	Upper bound	Minimum	Maximum
A (Topsoil)	14.46 ± 0.24^{ab}	14.09	15.17	13.15	15.41
B (Sawdust)	13.33 ± 0.35^{c}	12.53	14.13	12.15	15.30
C (Clay soil)	12.50 ± 0.60^{a}	11.14	13.85	9.87	15. 59
D (River sand)	12.35 ± 0.59^{b}	11.02	13.68	9.92	15.22

Mean with same alphabet along the column are not significantly different from one another at p<0.05 probability level

Table 4: Analysis of Variance for height of seedlings raised from different sowing media

Source of variation	Sum of square	Df	Mean sum of square	F	Sig.
Treatments	32.872	3	10.957	4.936	0.006*
Error	79.915	36	2.220		
Total	112.787	39			

*=significant at P<0.05

Collar Diameter (mm)

The result of diameter growth of *C. equisetifolia* using four different sowing media is shown in table 5. The result shows that the highest diameter growth was recorded for treatment A (Top soil) with a value of 2.49±0.12 mm. Treatment B (sawdust), D (river sand) and C (clay soil) had 2.41±0.05 mm, 1.96±0.08 mm and 1.84±0.01 mm respectively. The mean collar diameters of the species with four sowing media were highly significant at 5% level of probability.

Table 5: Mean weekly collar diameter (mm) of *C. equisetifolia* raised from different sowing media

Treatment	Mean±S.E.	Lower bound	Upper bound	Minimum	Maximum
A (Topsoil)	2.49±0.12^{ab}	2.23	2.76	2.03	3.08
B (Sawdust)	2.41±0.05^{ac}	1.77	2.15	1.61	2.44
C (Clay soil)	1.84±0.01^{cd}	2.29	2.53	2.19	2. 71
D (River sand)	1.96±0.08^{bd}	1.62	2.05	1.56	2.59

Mean with same alphabet along the column are not significantly different from one another at p<0.05 probability level

Table 6: Analysis of Variance for collar diameter (mm) raised different sowing media

Source of variation	Sum of square	Df	Mean sum of square	F	Sig.
Treatments	3.161	3	1.054	12.864	0.000*
Error	2.948	36	0.082		
Total	6.109	39			

*=significant at P<0.05

Leaf Production

The mean weekly result on leave production of *C. equisetifolia* using four different sowing media is shown in table 7. The result shows that the highest production of leaf was found in treatment A (Top soil) with 12.47±0.41 and Treatment D (river sand had 12.35±0.65. Treatment B (sawdust) had 11.91±0.60 and the least was treatment C (clay soil) which had 1.43±0.54. The mean seedling leaf productions of the species with the four sowing media were not significantly different at 5% level of probability with a value of 0.544.

Table 7: Mean weekly seedling leaf production of *C. equisetifolia* (cm) raised from different sowing media

Treatment	Mean±S.E.	Lower bound	Upper bound	Minimum	Maximum
A (Topsoil)	12.47±0.41	11.42	13.28	10.60	14.70
B (Sawdust)	11.91±0.60	10.56	13.26	8.00	14.20
C (Clay soil)	11.43±0.54	10.22	12.64	9.60	14. 90
D (River sand)	12.35±0.65	10.99	13.94	9.40	15.90

Table 8: Analysis of Variance for leaf production raised different sowing media

Source of variation	Sum of square	Df	Mean sum of square	F	Sig.
Between Treatments	6.700	3	2.233	0.724	0.944ns
Error	111.056	36	3.085		
Total	117.756	39			

Ns = not significant at P>0.05

Discussion

This study shows that *C. equisetifolia* is difficult to germinate if sown in an unsuitable media. In this study different germination responses were observed for the various sowing media. Treatment B (sawdust) with a value of 75±3.30% as the highest germination percentage is at variance to the findings of Okunomo (2000 and 2004) who obtained a higher germination percentage in top soil with *Dacryodes edulis* and *Persia americana*

respectively. Okunomo (2010) recorded a higher germination percentage in topsoil with *Parkia bicolor*. Agboola *et al.* (2001) also reported in his study, the highest germination percentage in topsoil with *Terminalia ivorensis*. The result disagrees with the study of Dickens (2011), who reported apparent high germination in river sand with *Irvingia wombolu*. Similarly, Hassanein (2010) obtained highest germination percentage in sand media (sharp river sand) with *Bauhinia variegate* and *Delonix regia*. These depict that different species vary in germination in different sowing medium. It implies that physiological and morphological features of the seeds as well as characteristic texture, structure and chemical composition of the sowing media play significant role on the seed germination.

The highest seedling height observed in treatment A (topsoil) compared with seedlings raised from other sowing media does not agree with the work of Okunomo, (2010) who obtained higher seedling height in poultry droppings than other treatments (topsoil, sharp sand, sawdust, clay soil, cow dung and pig manure) with *Parkia bicolor*. The result also agrees with the study of Hassanein (2010) who obtained highest seedling heights in topsoil with *B. variegate* and *Delonix regia*.

Highest collar diameter observed from seedlings raised from topsoil followed by sawdust, river sand and clay soil disagrees with Okunomo (2010) who recorded the least collar diameter with *P. bicolor* seedlings raised in top soil. The result from Leaf production depicts that top soil influenced seedlings raised from top soil in comparison with other sowing media. The implication of the result is that utilization of suitable sowing/growing media is essential for production of quality seedlings. The sowing media influences the growth and development of plants. It means Nursery sowing/growing media influence quality of seedlings produced (Agbo and Omaliko, 2006). This study has contributed to some knowledge on the silvicultural techniques of *C. equisetifolia*. In addition, an understanding of some aspects of the biology of the species through this study is vital for large scale production of seedlings of the species to meet afforestation programme. The seedling growth attributes revealed in this study are relevant in the development of growth models for the species, since tree height and diameter are among the important growth characteristics relevant in useful plants needed by man.

Conclusion

This study has shown that the germination percentage of *C. equisetifolia* improved significantly with sowing media especially sawdust and topsoil. This will play an important role in ensuring uniform and maximum germination of the species in the nursery and any subsequent afforestation or re-forestation programme. This result will be most useful to forest nursery practitioners and other scientists working for sustainable management of this species.

With regards to the situation on the effects of different sowing media on germination and early growth of *C. equisetifolia*, further to this an assessment of the effectiveness of more different sowing media on germination and early growth of *C. equisetifolia* could be undertaken. This could be done using techniques demonstrated in this study. The growth of the species during the early stage of *C. equisetifolia* and comparing the rate of growth with different sowing

media in controlled areas should be considered.

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