Effects of Seed Source on Growth Attribute of *Mitragyna ledermannii* (K. Krause) ridsdale in Niger Delta, Nigeria

Omokhua G.E. and Aiyeloja A.A

Department of Forestry and Wildlife Management, University of Port Harcourt, Nigeria.
Email: Adedapo.aiyeloja@uniport.edu.ng

Abstract: *Mitragyna ledermannii* (K. Krause) Risdale is a highly valued timber species in the tropics, however, inadequate knowledge of the effects of seed source on its silviculture and excessive logging are major problems of the species in regeneration. A nursery experiment was carried out to determine the effects of seed source on growth performance and biomass accumulation of the species in Port Harcourt. Result showed that Seed lot from Uyo showed the highest (88.34%) germination rate; following by the seed lot from Agulagha with 74.36%. The seed lot from Port Harcourt has the lowest (58.23%) germination. Germination was completed within 10 days for seed lot from Uyo, while the seed lots from Agulagha, Yenagoa and Port Harcourt took 14 days, and 16 days to complete their germination respectively. Inception of germination after 14 days of sowing was latest for seed lots from Port Harcourt and Yenagoa. The inception of germination was fastest in the seed lot from Uyo and started after 8 days of seed sowing. Significant differences ($p<0.05$) were observed in seedling total length between the seed sources. The results revealed that the tallest plants were obtained in seed from Uyo with a mean of 60.43cm. This was followed by plants in seeds from Agulagha with a mean of 50.25cm, while the shortest plants with 34.40cm and 28.87cm were obtained in seeds from Yenagoa and Port Harcourt respectively. The effect of site on total dry weight was significant at 5% level of probability, the maximum dry weight per plant (5.90g/plant) was recorded with seeds collected from Uyo, while the minimum dry weight per plant (3.54g/plant) was recorded with seeds collected from Port Harcourt with significant differences between them. The study revealed that the highest collar diameter of the seedlings at the age of six months was 5.00mm recorded for the seeds collected from Uyo. The lowest collar diameter growth of *M. ledermannii* was recorded for seeds (3.50mm each) collected from Yenagoa and Port Harcourt respectively. The study recommends Uyo seed lot for regeneration purposes. Comprehensive investigation on seed source effects is recommended for future study

[Omokhua G.E. and Aiyeloja A.A. **Effects of Seed Source on Growth Attribute of *Mitragyna ledermannii* (K. Krause) ridsdale in Niger Delta, Nigeria.** *Researcher* 2015;7(3):92-96]. (ISSN: 1553-9865). http://www.sciencepub.net/researcher. 14

Keywords: Development, Growth Attribute, *Mitragyna ledermannii,* Silviculture, Seed Source.

1. Introduction

Nature has endowed Nigeria with a rich freshwater swamp ecosystem where *Mitragyna ledermannii* is endemic. *Mitragyna ledermannii* (K. Krause) Ridsdale belongs to the family Rubiaceae. The species can attain a height of over 32m. The bole is cylindrical and straight. The leaves are simple and opposite. Inflorescence is a terminal cyme. The corolla is white and fruit is a spindle-shaped capsule, about 4-8mm long *M. ledermannii* occurs in the fresh water swamps of the Niger Delta region of Nigeria. The wood is traded as "abura" and used for several purposes such as; veneer, plywood, furniture, flooring, light construction, toys, sporting items, vehicle parts, crates, agricultural and domestic tool handles, poles, canoes, containers trays, thatching, ethnomedicine and as wrapping material (Keay, 1989; Burkill, 1997; Hawthrone and Jongkind, 2006; Kofi et al., 2007; Nyemb, 2011).

Seed source investigation is one of the methods of tree improvement which is aimed at improving the genetic quality of tree species because a lot of variations do exist in relative growth rate, stem form and wood characteristics between and within species (Nyemb, 2011). Notably, *M. ledermannii* is in a wild state in the fresh water swamp of Nigeria.

The variations among seed origins in growth rate, stem form or biomass accumulation made it desirable to identify faster plant populations for inclusion in tree breeding programmes through provenance studies. The effects of provenance on silvicultural characteristics of *M. ledermannii* has not been well documented for restoration or regeneration and breeding programme. In addition, increased logging operations in the area had eliminated many mother trees, creating a necessity for artificial regeneration efforts.

This study provided some information on the germination and early seedling growth of *M. ledermannii* as influenced by seed source from local sites in the area under investigation and examined the effects of seed sources on some germination indices, early seedling growth characteristics and biomass

production of *M. ledermannii* in the Niger Delta region of Nigeria.

2. Materials and Methods

2.1. Experimental Site

The study was conducted at the forest nursery of the Department of Forestry and Wildlife Management, Faculty of Agriculture, University of Port Harcourt, Port Harcourt, Nigeria. The forest nursery lies between Latitude 04^0 53^1 $38{,}3^{11}$N and Longitude 006^0 54^1 38^{11}E.

2.2. Seeds Collection and Processing

Matured fruits of *M. ledermannii* were collected from 10 plus trees in four (4) seed sources of the Niger Delta (collections were made from Yenagoa (04^0 40^1N, 006^0 05^1E), Port Harcourt (04^0 47^1N, 006^0 59^1E), Uyo (05^0 33^1N, 008^0 25^1E) and Agulagha (05^0 37^1N, 0060 40^1E). After collection, fruits were spread on plastic trays directly under the sun to cause them to open and shed their seeds. The seeds were collected and separated from the empty fruits as soon as they were shed; the seeds were thoroughly mixed per source to form 4 different seed lots for the study.

2.3. Experimental Design and Germination Procedure

A completely randomized design was used with four (4) replicates; the number of seeds per site was four hundred (400) and the total number of seeds for the four (4) treatments was one thousand, six hundred (1600) seeds. Germination was done in bright light in the weaning shed. Seeds were sown according to the site of collection in germination trays measuring 90cm x 60cm x10cm, filled with washed and sterilized river sand. Watering was done in the morning on daily basis. Seed germination was taken to have occurred when the plumule emerged above the soil surface.

Observation on germination was done daily and germination was recorded for two weeks. The process of germination was taken to have been over when no further germination occurred for two weeks. Data were obtained on germination rate, inception of germination and duration of germination respectively. Germination rate was obtained by dividing the number of germinated seeds against the numbers of seeds sown and multiplied by one hundred. The time it took each seed lot to start germination, and the period such germination lasted were observed and recorded per treatment.

2.4. Early Seedling Growth Assessment

At the end of the germination experiment, a total of one hundred and sixty fairly uniform seedlings at two-leaf stage were randomly selected per treatment and transplanted into polypots (30cm x 15cm x 10cm) filled with soil taken from the forest floor and arranged in a completely randomized design with (4) replicates. The following growth parameters were measured at 6 months after transplanting: height (cm) by meter rule; stem collar diameter (mm) by veneer caliper; survival and number of leaves by visual counting and leaf area (cm^2) by plant planimeter.

Biomass production was assessed by collecting five (5) seedlings per treatment. The seedlings were carefully uprooted from the polypots to ensure that the roots were intact. The root, leaf and stem components were separated for biomass determination. The three components were dried separately at 70^oc for 24 hours in a laboratory oven, until a constant weight was obtained using an electronic balance calibrated in grams. Total dry weight (g) was obtained by adding up the leaf, root and stem components of the plants.

3. Results

3.1. Rate, inception and duration of germination

The results of germination indices for the four seed sources in the nursery are as shown in Table 1. Seed lot from Uyo showed the highest (88.34%) germination rate; following by the seed lot from Agulagha with 74.36%. The seed lot from Port Harcourt had the lowest (58.23%) germination.

Germination was completed within 10 days for seed lot from Uyo, while the seed lots from Agulagha, Yenagoa and Port Harcourt took 14 days, and 16 days to complete their germination respectively.

Inception of germination after 14 days of sowing was latest for seed lots from Port Harcourt and Yenagoa. The inception of germination was fastest in the seed lot from Uyo and started after 8 days of seed sowing. The data revealed that germination was most early in the seed lot from Uyo and ended most lately in the seed lot from Yenagoa and Port Harcourt. Similarly, the duration of germination ended most in the seed lot from Uyo and ended most lately in the seed lot from Port Harcourt. There were significant differences in rate, inception and duration of germination in *M. ledermannii* as shown in Tables 2, 3 and 4 respectively.

3.2. Seedling growth Performance

There were significant differences in survival rate of *M. ledermannii* at 5% level of probability (Table 5). Survival rate of *M. ledermannii* was found highest in seed lots from Agulagha and Uyo with 88% and 82% respectively. The lowest survival rate was recorded for seed lot from Port Harcourt (56%).

Significant differences ($p<0.05$) were observed in seedling total length between the seed sources (Table 5). The results revealed that the tallest plants were obtained in seeds from Uyo with a mean of 60.43cm. This was followed by plants in seeds from

Agulagha with a mean of 50.25cm, while the shortest plants with 34.40cm and 28.87cm were obtained in seeds from Yenagoa and Port Harcourt respectively.

The effect of site on total dry weight was significant at 5% level of probability (Table 5), the maximum dry weight per plant (5.90g/plant) was recorded with seeds collected from Uyo, while the minimum dry weight per plant (3.54g/plant) was recorded with seeds collected from Port Harcourt with significant differences between them.

The study revealed that the highest collar diameter of the seedlings at the age of six months was 5.00mm recorded for the seeds collected from Uyo. The lowest collar diameter growth of *M. ledermannii* was recorded for seeds (3.50mm each) collected from Yenagoa and Port Harcourt respectively.

Leaf production in *M. ledermannii* did not vary significantly between treatments. Uyo and Agulagha seed sources had 12 leaves each while Yenagoa and Port Harcourt sources had 10 leaves each. Although numerically different, there were no significant differences in leaf production at 5% level of probability.

Seed source significantly affected leaf area at 5% level of probability. Table 5 also showed that the highest leaf area of 30.80cm^2 was recorded for seeds from Port Harcourt.

Table 1: Seed source effect on germination indices of *Mitragyba ledermannii*

Site	Germination (%)	Inception of germination (days)	Duration of germination days
Yenagoa (04^0 40^1N, 006^0 05^1E)	71.59b	14C	14B
Port Harcourt (04^0 47^1N, $006^0$$59^1$E)	58.23c	14c	16c
Uyo (05^0 33^1N, 008^0 25^1E)	88.34a	81a	10d
Agulagha (05^0 37^1N, 006^0 40^1E)	74.36b	12b	14b

Means in the same column with the same subscript are significantly different from each other at 5% level of probability.

Table 2: Analysis of variance for seed source effect on germination rate (%) of *Mitragyna ledermannii*

Source of variation	Df	Sum of square	Mean square	Fcal
Site	3	1986	662	4.012
Error	12	1980	165	
Total	15	3966		

Site effect is significant at 5% level of probability.

Table 3: Analysis of variance for the effect of seed source on inception of germination of *M. ledermannii*

Source of variation	Df	Sum of square	Mean square	Fcal
Site	3	1232	411	4.23
Error	12	1165	97	
Total	15	2397		

Seed source effect was significant for inception of germination at 5% level of probability.

Table 4: Analysis of variance for the effect of seed source on duration of germination in *M. ledermannii*

Source of variation	Df	Sum of square	Mean square	Fcal
Site	3	1316	439	4.39
Error	12	1204	100	
Total	15	2520		

Seed source effect is significant for duration of germination at 5% level of probability.

Table 5: Survival and growth performance of M. ledermannii from 4 sites at 6 months of growth

Site	Survival (%)	Shoot length (cm)	Root length (cm)	Total seedling length (cm)	Collar diameter (mm)	Leaf production	Leaf area (cm^2)	Total dry weight (g)
Yenagoa	75b	20.64c	13.76c	34.40c	3.50c	10a	25.78b	3.54b
Port Harcourt	56c	17.32c	11.65c	28.87c	3.50c	10a	25.46b	3.63b
Uyo	82a	36.26a	24.17a	60.43a	5.00a	12a	30.80a	5.90a
Agulagha	88a	30.15a	20.10b	50.25b	4.00b	12a	29.52a	4.80a

Means with same letter in column do not differ at 5% level of probability.

4. Discussion

Germination behaviour in plant species have been reported by various authors. For instance, Mahmud *et al*., (2005) reported that *Leucaena leucocephala,* Acacia *auriculiformis* and *A. tortilis* had germination percentages of 80%, 68% and 8% respectively. The highest germination recorded in this study was 88.34% for *M. ledermannii* which is close to the 80% reported for *L. leucocephala.* The lowest germination of 8% reported by the authors is very low when compared with the 58.34% reported in this study.

The results on effects of treatments on germination inception and germination duration in this study are similar to that reported by Soliman and Abbas, (2013). It was found that *Cassia fistula* germination recorded a positive relationship between treatments involving germination inception and germination duration.

Variations in growth characteristics of Sycamore trees (*Acer pseudoplatanus*) due to site factors were reported by Kadunc and Kotar (2005). Results from treatments with different levels of H_2SO4 varied from 2-23 days and 11-35 days for germination inception and germination duration of *C. fistula* respectively.

Zeita and Stampfli (2008) also reported that seed source had significant effect on the growth of *Bronus erectus* seedlings while Luechanimitchit and Viri Yabuncha, (2001) observed similar trend on (Casuarinas seed source trials in Thailand where seeds collected from local source had superior performance in seedling biomass over foreign source. Sources of seed can have profound implications on the success of regeneration efforts, because most species exhibit adaptive genetic variation within their natural range (Manmud, 2005; Eleanor *et al*, (2007).

The significance of seed source on germination and early seedling growth characteristics in *M. ledermannii* was slightly surprising due to the narrow range of environmental factors among the sites. A number of factors can influence the amount of site variability in plant species. This could be attributed to the amount of climatic characteristics, edaphic diversity and anthropogenic interference as well as the extent of continuity and discontinuity of the species across its natural range. Hence, it could be suggested that a knowledge of the genetic, environmental diversity and influences across the species geographical range is very vital for any successful effort in the regeneration of *M.ledmannii.*

It could be deduced from the study that variation in seed source attributes, developed due to genetic factors, which varied in different parts of the species natural range. Hence, the population of such species developed may shows different levels of variation when raised together in a similar environment such as a forest nursery. It could also be concluded that seed source variation could occur especially among species that are found in a wide biome. Thus any species that contain large seed source divergence may create the best opportunity for harnessing genetic advantages.

5. Conclusion

This study has shown that seed source had profound impact on the germination and early seedling growth of *M. ledermannii* hence, characteristics that determine the degree of variability could influence morphological and physiologically traits of seeds and seedlings from different sources of the species. The study has provided some information on the Silviculture of *M. ledermannii* for use by foresters.

Therefore, it can be recommended that seeds of Uyo origin are most suitable for use in any regeneration efforts of *M. ledermannii* in Nigeria. Further investigation is recommended to confirm the effects of seed source on genetic and environmental factors influencing the species growth attributes for use especially in breeding programmes.

Corresponding Author
Dr. Aiyeloja, Adedapo Ayo,
Department of Forestry and Wildlife Management,
Faculty of Agriculture,

University of Port Harcourt, Nigeria.
Email: Adedapo.aiyeloja@uniport.edu.ng

References

1. Burkill, H.M (1997): The useful plants of West Tropical Africa. 2nd Edition. Vol. 5 families 5-2 Addende-Royal Botanical Garden, Kew Richmond, United Kingdom, 686pp.
2. Correct citation of this article: Nyemb, Nyunai, 2011. Mitragyna ledermannii (K. Krause) Ridsdale. In: Lemments, R.H.M.J., LOUPPE, D. & Oteng-Amoako, A.A. (Editors). Prota 7(2): Timbers/Bois d'oeuvre 2. [CD-Rom]. PROTA, Wageningen, Netherlands.
3. Hawthorne, W. and Jongkind, C., (2006): Woody plants of Western African forests: a guide to the forest trees, shrubs and lianes from Senegal to Ghana. Kew Publishing, Royal Botanic Gardens, Kew, United Kingdom. 1023pp.
4. Kadunc, A. and M. Kotar (2005) Factors influencing growth of mature sycamore trees (Acer pseudoplatanus L.) an Carbonate Bedrock.
5. Keay, R.W.J (1989): Trees of Nigeria. Oxford University Press, London. 476pp.
6. Koffi Dje, Madeleine Vangah-Manda, Koffi Daho Adoubryn, Louis Penali Kone, Moussa Kone, Frederic Guede-Guina. (2007). Antimalarial activity of Mitragyna ciliate (Aubrev and Pellegr) (Rubiaceae) Preliminary study. South African Journal of Botany, vol. 73(2), pp. 226-229.
7. Luechanimitchit, P and C. Viriyabuncha (2001): International provenance trail of Casuarina junghuhiana Miqiin Sisaket province. Thailand. Silvicultural Research Report 2001 Silvicultural session, Department of Forestry, Bangkok.
8. Mahmud, S., Rafigul, A.T.M. and Mohiudin (2005): Germination behavior and initial growth performance of eight multipurpose tree species. International Journal of Agriculture and Biology. Vol 7, No. 4: 539-542. http://www.ijab.org.
9. Nyemb, Nyunai, (2011). Mitragyna ledermannii (K.Krause) Ridsdale. In: Lemmens, R.H.M.J; Louppe, D. and Oteng –Amoako, A.A. (Editors). Prota 7(2): timber/Bois d'oeuvre 2. [CD-Rom] PROTA, Wageningen, Netherlands.
10. O' Brien, E.K., Mazanec, R.A and Krauss, S.L (2007): Provenance Variation of ecologically important traits of forest trees: implications for restoration.Availableonhttp://onlinelibrary.wiley.com/doi/10.1111/j.13652664.2007.01313./pdf/enhanced.
11. Syed, M, V.K. Gupta and H.C. Pandey (2013): Studies of phenotypic and genetic variation in various growth characters in Neem (Azadirachta indica A. Juss) germplasm.
12. Zeita, M and Stampfli, A. (2008): Long-term assessment of seed provenance effect on the establishment of the perennial grass Bronus erectus Journal of Vegetation Science 19: 821-839, DO1: 10.3170/2008-8-19455.

3/21/2015