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Influence Of Mycorrhiza, Fertilizer And Watering Regime On Some Physiological Parameters Of Mansonia Altissima A.Chev Seedlings

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Abstract: ***Mansonia altissima is found to be extinction threatened due to over-exploitation without concise effort towards its regeneration. This study investigated the influence of mycorrhiza, fertilizer and watering regimes on physiological parameters on M.altissima seedlings. 3x3x3 factorial experiment was adopted for the study, biomass accumulated by M.altissima seedlings at four weeks interval were used to calculate the Relative growth rate (RGR) and Absolute growth rate (AGR), RGR Result revealed that at final assessment seedlings inoculated with 10g of mycorrhiza, without NPK fertilizer and watered three times a week at pot capacity (M2F1W2) had highest value of 0.28gg^{-1} while seedlings without mycorrhiza and fertilizer and watered three times a week at pot capacity (M1F1W3) gave the least value of 0.02gg^{-1} month, Also Absolute growth rate (AGR) showed that seedlings without inoculation, 1g of fertilizer and watered daily at pot capacity (M1F2W3) performed best with 2.15gg^{-1} month while seedlings without inoculation, without fertilizer and watered three times a week at pot capacity (M1F1W2) gave the least value of 0.23gg^{-1} month. ANOVA, revealed that there were significant ($p<0.05$) differences on the effect of mycorrhiza, fertilizer and watering regime on relative turgidity, seedlings without mycorrhiza had the highest percentage of 59.89%, also seedlings treated with 2g of fertilizer had the highest value of 60.32% while, daily watering seedlings performed best with 60.42% with this relative turgidity result which was above 25% it means that seedlings will recover after re-watering.***

Keywords: ***Mansonia altissima, relative growth rate, absolute growth rate, relative turgidity, inoculation.***

I. INTRODUCTION

Forest and forest products play a very important role in the development of any nation. The utilization of forest resources range from the provision of raw materials for the ever increasing industry to yielding poles and firewood for domestic consumption, regulation of water regime and climate, protection from desertification and satisfaction of recreational needs. Increase in population and increase in demand for forest and forest products have made plantation forestry attractive to tropical foresters.

El-Kassaby (2000), describe the domestication of forest tree species as the process whereby plants are taken from the wild (natural), undomesticated state through a series of sampling and selection stages, with each stage curtailing the genetic variation and ultimately resulting in the production of a somewhat genetically uniform plantation.

The significant contribution of Mycorrhiza to plant is the symbiosis which are characterized by bi-directional movement of nutrients where carbon flows to the fungus and in-organic nutrients move to the plant, thereby providing a critical linkage between the plant root and soil (Garbaye, 1994). In infertile soils, nutrients taken up by the mycorrhiza fungi can lead to improved plant growth and reproduction, as a result, mycorrhiza plants are often more competitive and better able to tolerate environmental stresses than non- mycorrhiza plants.

However, in tropical agriculture systems where most soils are fragile with low fertility, a major beneficial effect of AMF

is their role in maintenance and improvement of soil structure by their external hyphae and the production of a special protein called the glomalin (Diedhiou *et al* 2003). The mechanisms involved are as follows, the growth of external hyphae into the soil to create a skeletal structure that holds soil particles together and the formation of a 'sticky' string bag of hyphae by the glomalin, which contributes to soil aggregate stabilization (Elsen *et al* 2003).

. It is therefore necessary to carry out studies on the influence of mycorrhiza, fertilizer and watering regime on physiological parameters on seedling performance of *Mansonia altissima* in order to know its growth behaviour and ascertain the best way to establish them in plantations, extensively both as mixed and single species stands. This will prevent the species from going to extinction and make it abundant in the forest.

II. MATERIALS AND METHOD

SEED PROCUREMENT

Mansonia altissima seeds were collected from seed store in Forestry Research Institute of Nigeria, headquarters Ibadan.

EXPERIMENTAL SITE

The study was carried out in the West African Hardwood Improvement Project (WAHIP) nursery, Forestry Research Institute of Nigeria Headquarters, Ibadan. The area is between latitude 7^0N and 7.2^0N and longitude 26^0E and 27^0E. The climate is mainly tropical with rainfall patterns ranging between 1000mm and 14500mm, the average temperature is about 30^0C while relative humidity is about 65%. There are two different climatic seasons which are the dry (November - March) and the rainy season (April - October).

Seeds of *Mansonia altissima* were sown directly into poly pots filled with top soil collected from Forestry Research Institute of Nigeria arboretum. The mycorrhiza used was supplied by Agronomy Department, University of Ibadan. The inoculations were carried out according to the method of Carling *et al.*, 1978, and Fagbola *et al*., 2005. Also N:P:K fertilizer were added. Three (3) seeds each were sown directly into the poly pot and were arranged in screen house of Forestry Research Institute of Nigeria. After germination, thinning was carried out to reduce the number of seedlings to one plant per poly pot. A 3 X 3 X 3factorial experiment was used for the study. The treatments were replicated five times. The factors were mycorrhiza, N:P:K fertilizer and water supply. While N:P:K fertilizer and water supply had three levels(N:P:K 0g, 1g, and 2g and the water supply was once in a week, twice in a week and every day(1/7, 4/7 and 7/7 respectively), mycorrhiza also had three levels (myco 0g,10g and 20g (*Glomus deserticola*). The seedlings were watered regularly for six weeks to allow proper establishment before the drought stress treatment commenced.

Dry matter accumulation were carried out in terms of shoot, root, leaves and total weight were estimated after oven drying with the aid of weighing balance at 4 weeks interval.

The code used for the study is as follows:

M1 = 0g mycorrhiza, M2 = 1g mycorrhiza, M3 = 2g mycorrhiza.

F1 = 0g NPK, F2 =1g NPK, F3 =2g NPK.

W1 = once a week watering, W2 = three times a week, W3 = everyday watering.

The parameters assessed are

Absolute Growth Rate (AGR)

Relative Growth Rate (RGR) and Relative turgidity

AGR and RGR of the seedlings were calculated using the formula below as used by Oni, 1989

$$(RGR\ (gg^{-1}WK^{-1}) = \frac{LnW_2 - LnW_1}{t_2 - t_1} \quad \text{.....(1)}$$

Where, LnW_1 and LnW_2 = natural logarithm of weight at time t_1 and t_2

$$AGR = \frac{TDW_2 - TDW_1}{t_2 - t_2} \quad \text{..... (2)}$$

Where TDW1 = Initial total dry weight (g)

TDW2 = Final total dry weight (g)

T1 = Initial time

T2 = Final time

RELATIVE TURGIDITY: The method of (Weatherley, 1950 and Bolanle- Ojo, 2014) were used for determining relative turgidity. A section of *Mansonia altissima* leaf 2 to 3 cm long were cut, immediately weighed and then were floated on distilled water in a staining dish for 24 hours. The dishes were stacked so that evaporation was prevented. After turgid weight was obtained, the dry weight were determined by oven drying for several days at 70^0C until constant weight is attained. Relative Turgidity was calculated as the original water content divided by the turgid water content X 100.

$$\%RT = \frac{\text{Original water content}}{\text{Turgid water content}} X\ 100$$

III. RESULTS

RELATIVE GROWTH RATE (RGR)

The best performance was recorded for seedlings inoculated with 10g of mycorrhiza , 2g of fertilizer and daily watering at pot capacity (M2F3W3) with value of ($0.86gg^{-1}$ month) while seedlings without mycorrhiza, 2g of fertilizer and daily watering at pot capacity(M1F3W3) performed least with $0.04gg^{-1}$ month for the first assessment from first month to second month. At the second assessment, seedlings treated to 20g mycorrhiza, 1g of NPK fertilizer and watered daily at pot capacity (M3F2W3) performed best with value of ($0.26gg^{-1}$ month) while seedlings without mycorrhiza, 1g of NPK fertilizer and watered three times a week at pot capacity (M1F2W2) performed least with $0.03gg^{-1}$ month. At the final assessment from the 3rd month to the fourth month, seedlings inoculated with 10g of mycorrhiza, without fertilizer and watered three times a week at pot capacity(M2F1W2) performed best and seedlings without mycorrhiza and fertilizer and watered three times a week at pot capacity (M1F1W2) performed least with 0.28 and $0.02gg^{-1}$ $month^{-1}$ respectively. (Table 1)

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	RGR 1 gg^{-1}	RGR 2gg^{-1}	RGR 3 gg^{-1}
M1F1W1	0.15	0.13	0.09
M1F1W2	0.42	0.17	0.02
M1F1W3	0.06	0.05	0.07
M1F2W1	0.42	0.04	0.14
M1F2W2	0.19	0.03	0.13
M1F2W3	0.34	0.09	0.12
M1F3W1	0.10	0.06	0.20
M1F3W2	0.36	0.06	0.14
M1F3W3	0.04	0.05	0.13
M2F1W1	0.23	0.18	0.16
M2F1W2	0.11	0.11	0.28
M2F1W3	0.16	0.08	0.17
M2F2W1	0.19	0.14	0.17
M2F2W2	0.47	0.13	0.09
M2F2W3	0.78	0.23	0.04
M2F3W1	0.12	0.05	0.09
M2F3W2	0.49	0.03	0.11
M2F3W3	0.86	0.04	0.08
M3F1W1	0.23	0.06	0.20
M3F1W2	0.11	0.05	0.17
M3F1W3	0.32	0.09	0.11
M3F2W1	0.25	0.04	0.08
M3F2W2	0.35	0.16	0.08
M3F2W3	0.33	0.26	0.06
M3F3W1	0.06	0.14	0.07
M3F3W2	0.17	0.07	0.07
M3F3W3	0.19	0.04	0.10

Table 1: RELATIVE GROWTH RATE gg^{-1} month of Mansonia altissima seedlings

ABSOLUTE GROWTH RATE (AGR)gg^{-1}

Seedlings inoculated with 10g of mycorrhiza, 1g of NPK and daily watering at pot capacity (M2F2W3) had the highest value of AGR in the first assessment from 1st month to 2nd month (5.18 gg^{-1} month) while inoculated seedlings without fertilizer and watered three times a week at pot capacity (M2F1W2) had the least value of (0.21gg^{-1} month). By the second assessment, inoculated seedlings with 1g of NPK and watered daily at pot capacity (M2F2W3) were still the best as in the first assessment while seedlings without inoculation, with 1g of NPK fertilizer and watered three times a week at pot capacity (M1F2W2) gave least performance with 4.40gg^{-1} month and 0.21gg^{-1} month respectively. At the final assessment, seedlings without inoculation, 1g of NPK fertilizer and watered daily at pot capacity (M1F2W3) performed best with 2.15gg^{-1} month while seedlings without inoculation, without fertilizer and watered three times a week at pot capacity (M1F1W2) performed least with 0.23gg^{-1} month (Table 2).

	AGR 1 gg^{-1}	AGR 2gg^{-1}	AGR 3 gg^{-1}
M1F1W1	1.10	1.27	1.19
M1F1W2	1.62	1.29	0.23
M1F1W3	0.35	0.29	0.52
M1F2W1	1.62	0.23	1.11
M1F2W2	1.07	0.21	1.18
M1F2W3	2.82	1.26	2.15
M1F3W1	0.37	0.26	1.20
M1F3W2	1.42	0.38	1.08
M1F3W3	0.26	0.39	1.09
M2F1W1	0.66	0.81	1.11
M2F1W2	0.21	0.27	1.08
M2F1W3	0.50	0.34	0.92
M2F2W1	1.12	1.20	2.11
M2F2W2	2.18	1.20	1.13
M2F2W3	5.18	4.40	1.06
M2F3W1	1.00	0.53	1.15
M2F3W2	2.39	0.33	1.13
M2F3W3	4.14	0.48	1.14
M3F1W1	0.66	0.24	1.08
M3F1W2	0.35	0.39	0.92
M3F1W3	1.20	0.54	0.84
M3F2W1	1.54	0.39	0.87
M3F2W2	1.08	0.91	0.57
M3F2W3	2.27	3.46	1.20
M3F3W1	0.32	0.90	0.58
M3F3W2	1.09	0.64	0.74
M3N3W3	1.38	0.37	1.15

Table 2: ABSOLUTE GROWTH RATE (AGR)gg^{-1} of Mansonia altissimaseedlings

EFFECT OF MYCORRHIZA, FERTILIZER AND WATERING REGIME ON RELATIVE TURGIDITY OF *M. ALTISSIMA* SEEDLINGS

There were variations in the mean relative turgidity of the seedlings treated to effects of mycorrhiza, fertilizer and watering regime. The mean separation of relative turgidity for mycorrhiza application ranged between 56.09% and 59.89% with highest value recorded in seedlings without mycorrhiza (M1) and least in seedlings treated to 10g of mycorrhiza (M2). Mean separation of relative turgidity under fertilizer application showed that seedlings with 2g of NPK fertilizer (F3) had the highest value of 60.32% while seedlings with 1g of NPK fertilizer and those without fertilizer F2 and F1 had almost the same mean percentage of 57.06% and 57.07% (Table 3 and 4).

Also, (Table5) reveals that once a week watering W1 had the highest mean separation among the watering regime with 60.42% while W3 which is daily watering had the least value of 54.94 ANOVA reveals that there were significant difference on the effect of mycorrhiza, fertilizer and watering regime on relative turgidity based on all the three factors and also on the interactions between the factors (Appendix 1).

Mycorrhiza	Mean	P - value
M1	59.89± 0.68	0.00*
M2	56.09± 0.66	0.00*
M3	58.46± 0.72	0.00*

**significant at (p<0.05)*

Table 3: Effect of Mycorrhiza on the relative turgidity of M. altissima seedlings

Fertilizer	Mean	P – value
F1	57.07± 0.64	0.91^{ns}
F2	57.06± 0.62	0.91^{ns}
F3	60.32± 0.68	0.00*

**significant at (p<0.05)*

Table 4: Effect of Fertilizers on the relative turgidity of M. altissima seedlings

Watering Regimes	Mean	P – value
W1	60.42 ± 0.68	0.00*
W2	59.09 ± 0.63	0.00*
W3	54.94 ± 0.66	0.00*

**significant at (p≤0.05)*

Table 5: Effect of Watering Regime on the relative Turgidity of M. altissima Seedlings

IV. DISCUSSION

Arbuscular mycorrhiza are obligate biotrophs and the symbiosis formed between the host plant and fungal partner is normally mutualistic (Smith and Read, 2008). However, evidences suggest that the symbiosis can range from parasitic to mutualistic depending on the host plant and Arbuscular Mycorrhiza (A.M) fungal species involved (Kilronmos, 2003). Soil physical, chemical and other associated characteristics as well as environmental conditions (Diop *et al.*, 1994, Loth 1996, Weber and Claus 2000). Hence, an attempt to specifically understand the contribution of introduced AMF in a controlled environment before the prevailing conditions in the field is important. Mycorrhiza inoculation can have positive effect (Michelsen and Rosendahl 1990, Osonubi *et al.*, 1991, Noyd *et al.*, 1995, Fagbola *et al.*, 2005 and Kareem *et al.*, 2012); negative effect (Hetrick *et al.*, 1990, Taylor and Harrier (2000) or non-significant (Manjunath and Habte, 1988) effects on the growth of plants.

Water is a significant factor in tree growth and development in the tropics (Awodola and Nwoboshi, 1993). Water is required by plants to manufacture carbohydrate and as a means for transportation of food and mineral elements. Various vital processes in plants such as cell division, cell elongation stem as well as leaf enlargement and chlorophyll formation depends on plant water availability (Price *et al.*, 1986). The knowledge of the response of the seedling under conditions of restricted moisture may provide an indication of its response to increased water stress. Also, the evaluation of the morphological and physiological growth of plants at period of restricted moisture is useful for the isolation of plants with seedling characteristics acceptable for afforestation in drought prone environments.

Effect of mycorrhiza, fertilizer and watering regime on some physiological characteristics, revealed that Relative Growth Rate (RGR) and Absolute Growth Rate (AGR) were not affected by these three factors, they all favoured the RGR and AGR of the seedlings of *M. altissima*, RGR and AGR has been used to examine growth as affected by differing levels of fertilizers (Van Den Driessche, 1982), soil moisture (Fredericson *et al.*, 1993) although variation in RGR and AGR among these treatment seedlings was due mainly to differences in morphological parameters which was whole plant dry weight,

The interaction of these three factors also did not affect the relative turgidity of the seedlings of *M. altissima.* The relative turgidity of the seedlings was above 25% which showed that the seedlings will recover after re-watering. If the relative turgidity percent was below 25%, the seedlings will not recover after re-watering (Todd *et al.*, 1961).

V. CONCLUSION AND RECOMMENDATION

Interaction between mycorrhiza, fertilizer and drought stress resulted in enhancement of growth and development of *M.altissima* seedlings indicating that arbuscular mycorrhiza was not parasitic. However, fertilizer was found to excert more influence than mycorrhiza in respect of the morphological and physiological characteristics of *M.altissima* seedlings.

Drought stress [watered once per week], partially stressed [watered trice per week] and unstressed [watered daily] all had high relative turgidity it was shown that the higher the volume of water applied the lower the relative turgidity which implies that the drought stress seedlings had higher relative turgidity.

The use of different arbuscular mycorrhiza should be employed in raising the seedlings of *M. altissima* to enhance growth and development due to slow growth rate experienced over the years; Daily watering of *M. altissima* at nursery stage should be adopted since it produces seedlings with the best morphological and physiological features. In a situation where there is scarcity of water, mycorrhiza could be used to enhance drought tolerance.

APPENDIX 1

SV	df	SS	MS	F	Sig.
M	2	198.57	99.29	790.01	0.00*
F	2	191.43	95.71	761.58	0.00*
W	2	440.64	220.32	1753.05	0.00*
M * F	4	836.40	209.10	1663.76	0.00*
M * W	4	355.67	88.92	707.49	0.00*
F * W	4	462.29	115.57	919.59	0.00*
M * F * W	8	371.95	46.49	369.94	0.00*
Error	54	6.79	0.13		
Total	80	2863.74			

**significant at ($p \leq 0.05$)*

ANOVA for the Effect of MFW on the Relative Turgidity of M. altissima Seedlings

REFERENCES

[1] Awodola, A. M., and Nwoboshi, L. C. (1993). Effect of source of potassium and frequency of moisture application on growth and macronutrient distribution in seedlings of Parkia biglobosa (R. Br.ex.G.Don). Nigeria Journal of Forestry, 23 (2) 98- 108.

[2] Bolanle-Ojo, O.T. (2014). Seedling growth performance of Artocarpus heterophyllus Lam. As influenced by different light intensities and watering regimes. M.Sc thesis Departmentof Forestry, University of Ibadan, Nigeria pp77.

[3] Carling D.E Riehle W.G, Broom M.F and Johnson D.R. (1998). Effect or a vesicular – arbuscular mycohhiza fungus on nitrogen reduyctase and nitrogen activities in modulating and non-modulating soybeans.phytopathol 68:1590-1596.

[4] Diedhiou P.M. Hallman J and Oerke E.C. (2003).Effects of arbuscular Mycorrhizal fungi and a non-pathogenic Fusarium oxysporum on Meloidogyne incognita infestation of tomato. Mycorrhiza 13: 199-204.

[5] Diop, T.A, Gueye M, Dreyfus BL, Plenchatte C, Strullu D.G. (1994). Indigenous arbuscular Mycorrhiza fungi associated with Acada albida. In different areas of Senegal. Appl Emiron microbial 60: 3433-3436

[6] El-kassaby, Y.A (2000). Effect of forest tree domestication on gene pools. In: Forest Conservation and Genetics. Principle and practice. Eds Young, A. Boshier, D. and T. Boyle. P197-213. (SIRO and CABI publishing)
[7] Elsen, A. Beeterens, R., Swennen, R. and De Waele D. (2003). Effects of an arbuscular Mycorrhizal fungus and two plant-parasitic nematodes on Musa genotypes differing in root morphology. Biology and fertility of Soils 38:367-376.
[8] Fagbola, O., Oyetunji, O.J, Osonubi, O and Mulongoy, K. (2005). Greenhouse evaluation of two woody hedgerows as affected by arbuscular mycorrhiza fungus (AMF), soil quality and moisture.journal of Archives of Agronomy and soil science Vol 51 No3 pp 335-349
[9] Frederickson, T. S, S M Zedacker and J. R Seiler,(1993) Interference interaction in simulated pine – hardwood seedlings stands For. Sc, 39, 383- 395.
[10] Garbaye, J. (1994). Helper bacteria: A new dimension to the mycorrhiza symbiosis. New Phytol 128:179 – 210.
[11] Hetrick, B.A.D, Wilson, G.T, Todd, T.C. (1990). Differential responses of C3 and C4 grasses to mycorrhiza symbiosis, phosphorus fertilization and soil micro-organism Can J Bot 68:461-467
[12] Kareem, A.A., Akinyele, A.O., Adio, A.F., and Iroko, O.A., (2012). Preliminary Investigation of the effect of Arbuscular mycorrhiza and water stress on Afzelia africana (Smith) In different soil Media, Journal of Sustainable Environment Management Vol 4: 56 - 62
[13] Klironomos, J.N. (2003). Variation in plant response to native and exotic arbuscular mycoohiza fungi Ecology 84:2292-2301
[14] Loth, C. (1996). Abundance of arbuscular mycorrhiza fungi sporse at different native site in dependence of sludge applications Bodenkultur 4:89-96.
[15] Manjunath, A. and Habte, M. (1988). Development of vesicular arbuscular mycorrhiza infection and the uptake of immobile nutrients in Leucaena leucocephala. Plant Soil 106: 97-103.
[16] Michelsen, A. Rosendahl, S. (1990). The effect of Vesicular arbuscular mycorrhiza fungi, phosphorus and drought stress on the growth of Acacianilotica and Leucaena leucocephala seedlings. Plant Soil 124: 127-134
[17] Noyd, R.K, Pfleger, F.L, Russette, M.P. (1995). Interaction between native prairie grasses and indigenous arbuscular mycorrhiza fungi: implication for reclamation of tacomte iron ore tailing. New phytol 129:651-660
[18] Oni, O. (1989). The reproductive Biology of West African Hardwood (Terminalia ivorensis A. Chev.)Ph.D thesis, University of Ibadan, Nigeria, pp306.
[19] Osonubi, O. Mulongoy, K. Awotoye, O.O. Atayese, M.O. and Okali, D.U.U. (1991). Effects of ectomycorrhiza and vesicular-arbuscular mycorrhiza fungi on drought tolerance of four leguminous woody seedlings. Plant Soil 136:131-142.
[20] Price, D.T., Black, T.A. and Kelliher, F.M (1986). Effects of salaunderstorey Removal on photosynthesis rate and stomata conductance of young Douglas-Fir Trees Canadian Journal of Forest Resources. 16: 90 – 97
[21] Smith, S. E and Read, D. J. (2008). Mycorrhiza Sysbiosis, 3rd edn. Academic Press, London, UK. pp156
[22] Taylor, J. and Harrier, L. (2000). A comparison of nine species of arbuscular Mycorrhiza fungi on the development and nutrition of micro propagated Rubus idaeus L pp 240
[23] Todd, G.W., Ingram F.W. and Stutte, C.A (1961): Relative turgidity as an indicator of drought stress in cereal plants. Production of the Oklahama Acade Mic of Science, pp 55 – 60.
[24] Van den Driessche, R. 1982. Relationship between spacing and nitrogen fertilization of see.dlings in the nursery, seedlings size and outplanting performance. Can. J. For. Res. 12: 865- 875
[25] Weatherley, P. E. (1950). Studies in the water relations of the cotton plant. I. The field measurements of water deficits in leaves. New Phytol. 49: 81-97.
[26] Weber, G. and Claus, M. (2002). The influence of chemical soil factor on the development of V.A mycorrhiza of ash (Fraxinos excelsior) and sycamore (Acer pseudoplatamus) in pot experiment, J plt nutri soil science 163:609-616