Research Article

Influence of Arbuscular mycorriza on the growth potential of *Termarindus indica.* L seedlings

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ABSTRACT

An experiment was carried out to investigate the influence of Arbuscular mycorrhiza on the growth potential of *Termarindus indica* seedlings. *T. indica* is recognized highly around the world for its nutritional and high health promotion values. The seeds of *T. indica* were collected, extracted, and sowed into a germination box. After germination, thirty (30 healthy seedlings were carefully selected and were transplanted into polythene pots filled with 2kg of topsoil and applied different quantities of Arbuscular mycorrhiza. The treatments used were (25g, 50g, 75g and 100g, 125g) and control without the use of A.mycorrhiza. The experiment was laid in a Completely Randomized Design (CRD). The parameters assessed were plant height (cm), stem diameter (mm), leaf area, chlorophyll content and number of leaves. Data collected were subjected to Analysis of Variance (ANOVA) and the means were separated using Duncan Multiple Range Test (DMRT). The results showed that (T3) 50g of A. mycorrhiza with 2kg of top soil had the best performance in terms of height with mean value of 60.14 cm, stem diameter with mean value of 4.37 mm and number of leaves with a mean value of 13.33, leaf area with mean value of 41.17m and chlorophyll content with mean value of 83.4333mm while the least performance was observed in T1 (2kg of top soil) having a mean value of 9.67cm^2 in number of leaves , stem diameter with mean value of 2.07 mm, height with a mean value of 28.46 cm , leaf area with a mean value of 16.0 m. and chlorophyll content with a mean value of 13.2367cm. However, from the result, it was observed that, the interaction between A. mycorrhiza and soil nutrients were significant because of positive A. mycorrhiza influence on young seedlings of *T. indica.*

It is therefore recommended that 50g of A. mycorrihza should be adopted for raising the *T.indica* in the nursery to have quality, healthy, good vigor and high production of the species.

KEYWORDS: *Termarindus indica*, Arbuscular Mycorrhiza, Growth-Potential, Seedlings.

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Résumé

Une expérience a été menée pour étudier l'influence de la mycorhize arbusculaire sur le potentiel de croissance des semences de Termarindus indica. T. indica est hautement reconnu dans le monde entier pour ses valeurs nutritionnelles et de promotion de la santé. Les graines de T. indica ont été collectées, extraites et semées dans une boîte de germination. Après germination, trente (30 plants sains ont été soigneusement sélectionnés et ont été transplantés dans des pots en polyéthylène remplis de 2 kg de terre végétale et appliqués différentes quantités de mycorhizes arbusculaires. Les traitements utilisés étaient (25g, 50g, 75g et 100g, 125g) et contrôle sans l'utilisation de A. mycorrhiza. L'expérience a été posée dans un plan complètement randomisé (CRD). Les paramètres évalués étaient la hauteur de la plante (cm), le diamètre de la tige (mm), la surface foliaire, la teneur en chlorophylle et le nombre de feuilles. Les données recueillies ont été soumises à une analyse de la variance (ANOVA) et les moyennes ont été séparées à l'aide du Duncan Multiple Range Test (DMRT). Les résultats ont montré que (T3) 50 g d'A. mycorrhiza avec 2 kg de terre végétale avaient les meilleures performances en termes de hauteur avec une valeur moyenne de 60,14 cm , diamètre de la tige avec une valeur moyenne de 4,37 mm et nombre de feuilles avec une valeur moyenne de 13,33, surface foliaire avec une valeur moyenne de 41,17 m et teneur en chlorophylle avec une valeur moyenne de 83,4333 mm alors que la moindre performance a été observée en T1 (2 kg de terre végétale) ayant une valeur moyenne de 9,67 cm2 en nombre de feuilles , diamètre de la tige avec une valeur moyenne de 2,07 mm, hauteur avec une valeur moyenne de 28,46 cm , surface foliaire avec une valeur moyenne de 16,0 m. et teneur en chlorophylle avec une valeur moyenne de 13,2367 cm. Cependant, d'après les résultats, il a été observé que l'interaction entre A. mycorhiza et les nutriments du sol était significative en raison de l'influence positive d'A. mycorhiza sur les jeunes plants de T. indica.

Il est donc recommandé d'adopter 50 g d'A. mycorrihza pour l'élevage de T. indica en pépinière afin d'avoir une qualité, une bonne santé, une bonne vigueur et une production élevée de l'espèce.

MOTS-CLÉS: Termarindus indica, Mycorhize arbusculaire, potentiel de croissance, Semences.

Introduction

One of the requirements for a successful plantation program is adequate knowledge of nutrient relations of tree species particularly at the seedling stage. This is because the success of any plantation programme depends on the successful production of an adequate number of seedlings of the right quality at the right time. These seedlings should be properly raised to improve the quality of planting stock used for the establishment of the plantation.

Tamarind (Tamarindus indica L.) belongs to the Fabaceae family; it is a multipurpose tree with slow growth., Tamarind (*Tamarindus indicaL.* is a member of dicotyledonous family Fabaceae and belongs to the subfamily Caesalpinoideae. It is a diploid species with chromosome number 2n = 24 (Purseglove, 1987). The name of tamarind is derived from an Arabic word *"Tamarind*- E- Hind" meaning "Date of India" popularly known as "Indian Date". Tamarind is a short trunked, multi-stemmed, large, evergreen, or semi-evergreen tree growing up to 30 m with a trunk of about 8 m circumference and a crown diameter of up to 12m.Tamarind trees start bearing fruits at the age of 13to 14 years and continue to produce fruits even after 60years and some up to 200 years. Half the pod weight of tamarind is contributed by pulp. The pulp contains both sugars (30-40%) and organic acids (8-18%), predominantly tartaric acid. Pulp is also a rich source of vitamins, minerals and calcium. The pulp is widely used as a spice for souring curries, chutneys and certain beverages. Tamarind is native of the Dry Savanna of Tropical Africa and probably some parts of

South India. It is cultivated throughout the tropics and subtropics of the world and has become naturalized at many places. India is the main producer and consumer of tamarind in the world. It is estimated that India produces 3 million tons of fruits and exports the tamarind products worth of Rs. 50 cores per annum (Kotech and Kadam,2002).

Tamarind is traditionally propagated from seed; tamarind produces relatively large seeds that average about 11-12.5 mm in diameter. They are flattish, shiny brown to blackish, with a hard impermeable seed coat. Germination of tamarind seed is epigeal. On an average, tamarind seeds begin to germinate about 13 days after sowing, but may take a month to sprout (Joker, 2000).

The significant contribution of *Arbuscular mycorrhiza* 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 *A. mycorrhiza* fungi can lead to improved plant growth and reproduction, as a result, A. mycorrhiza plants are often more competitive and better able to tolerate environmental stresses than non- mycorrhiza plants. Tamarind fruit pulp is used for seasoning, as a food component, to flavour confections, curries and sauces, and is a main component in juices and certain beverages. Tamarind fruit pulp is eaten fresh and often made into a juice, infusion or brine (El-Siddig*et al.,* 1999; El-Siddig*et al.,* 2006), and can also be processed into jam and sweets, The medicinal value of tamarind has been mentioned already in traditional Sanskrit literature (El-Siddig*et al.,* 2006).Traditionally, tamarind products, leaves, fruits and seeds have been extensively used in traditional Indian and African medicine (Jayaweera (1981) and Parrotta (1990) both cited in El-Siddig*et al.,* 2006).

Arbuscular mycorrhiza fungi belong to the order Glomales and form highly branched structures called arbuscules, within root cortical cells of many herbaceous and woody plant species. Arbuscular mycorrhiza fungi (AMF) can be found in almost all habitat and climates (Barea, *et al.,* 1997) and at different depth of soil (Michelsen and Rosendahl 1990). Although the occurrence and efficiency of AMF have been widely examined in most valuable undomesticated fruit trees (Mathur and Vyas, 2000), little is known of the mycorrhizal status and responsiveness of inherently slow growing indigenous timber tree species such *T. indica.*

Hence, the study is necessary to understand the role of arbuscular mycorrhiza inoculation as well as macro-nutrient deficiency on growth and development of the seedlings of *T. indica*inthe tropical environment. The result serves as a means to enhance the realization of full and wider benefits from the species.

MATERIALS AND METHODS

The experiment was carried out at forestry Research Institute of Nigeria Ibadan, Oyo State. Nigeria. The area's climate is tropical, dominated by rainfall patterns ranging between 1400mm-1500mm. The mean maximum temperature is 31.9^{0}C, minimum 24.2^{0}C while the mean daily relative humidity is about 71.9%. The eco-climate of the area is rainfall with two distinct seasons which are dry season (usually from November to March) and wet season (usually from April to October (Afolabi *et al.* 2021).

The materials used for the study of the influence of *Arbuscular mycorrhiza* on the growth potential of *Tamarindus indica* are seeds, polythene pots, topsoil, Glomus morae mycorrhiza, river sand buckets sensitive scale, vernier caliper. The seeds of T. indica were obtained from seed section of

Figure 1. Tamarindus leaves and fruit pod

Figure 2. Tamarind flower

Sustainable Forest Management Department of FRIN, the Arbuscular mycorrhiza was obtained from the Agronomy Department of University of Ibadan ,the inoculation was carried out according to Kareem *et al* 2012 in which mycorrhiza were added into three-quarter of the soil in each polythene pot before the remaining one-quarter of the soil is added into the polythene pot; The mycorrhiza were been added in four levels (25g, 50g, 75g and 100g ,125g) and control.

Figure 3. arrangement of seedlings at the Nursery

The uniform seedlings of *T. indica* were carefully transplanted into 2kg of polythene pots already filled with topsoil. Growth parameters were assessed such as leaf production, plant height, collar diameter, leafarea, chlorophyll content and the experiment lasted for 16 weeks. The experimental design used for the experiment was completely Randomized Design (CRD). This consists of 6 treatments and 5replicates making a total of 30 experimental units Data generated from growth parameters measurement was subjected to Analysis of Variance (ANOVA) and means separation with Duncan Multilple Range Test (DMRT) at 5% probability level of significance.

RESULTS AND DISCUSSION

The result presented in table 1 below showed the effect of A. mycorrhiza on the number of leaves of *T. indica* seedlings raised with 50g of A. mycorrhiza (T3) performed best with the mean

value of 13.3 followed by seedlings raised with 75g of A. mycorrhiza (T4) with the mean value of 12.3. Seedlings used as the control (T1) performed least with the mean value of 9.6667 from the observation. However, the result obtained revealed that leaf numbers of the seedlings vary because of the different levels of *A. mycorrhiza* applied to them. However, the increased number of leaves in A. mycorrhiza inoculated plants compared to non-mycorrhiza ones has been reported for other species (Kilronomos, 2003, Kareem*et al.*2012). The greater leaf number measured from treatments inoculated with 50g of mycorrhiza could be due to enhanced nutrient uptake probably as a result of increased root surface area that ultimately improved plant growth rate (Ortas and Ustuner 2014). Birhane*et al.* (2012), also reported a positive mycorrhizaeffect on the growth of Boswellia papyrifera seedling over control seedlings, due to significantly improved phosphorus nutrient. The result from the Analysis of variance indicated that there was significant difference among the treatment at 5% level of probability.

RESULT OF SOIL ANALYSIS

SAMPLE	TOPSOIL
pH (H_20)	6.02
O.C%	3.22
O.M%	5.65
TN%	0.29
Na (mol/kg)	3.214
Ca (mol/kg)	10.277
Mg (mol/kg)	5.006
K (mol/kg)	0.212
Fe (mg/kg)	51
Cu (mg/kg)	2
Mn (mg/kg)	340
Zn (mg/kg)	11
P (mg/kg)	1.06071
Pb%	0.5
Col%	0.02
Sand%	72.5
Clay%	12
Silt%	10.3

Source: laboratory Analysis, (FRIN 2022).

Table 1: **Showing the mean of value Influence of Arbuscular mycorriza on the growth potential of *T. indica***

Variable	Treatment	Mean±SE
Plant Height	0	28.5±0.65310a
	25	40.4±0.45005b
	50	60.1±0.68328d
	75	46.1±0.99413c
	100	43.8±1.33128c
	125	40.8±0.11050b
Stem Diameter	0	2.1±0.03528a
	25	2.2±0.05783a
	50	4.4±0.03283d
	75	3.7±0.09713b
	100	3.4±0.12667c
	125	2.1±0.04910a
Leaf Production	0	9.7±0.333333a
	25	11.0±0.57735b
	50	13.3±0.66667c
	75	12.3±0.33333bc
	100	11.7±0.33333b
	125	12.0±0.00000bc
Leaf Area	0	16.0±0.25423a
	25	31.8±0.92559d
	50	41.2±0.43975e
	75	32.6±0.79919d
	100	25.4±0.55149c
	125	22.0±0.47876b
Chlorophyll content	0	13.2±0.35900c
	25	26.8±1.03125e
	50	83.4±0.63803f
	75	68.7±0.46427b
	100	38.3±0.59678d
	125	23.6±0.28638a

The result in table 1 above revealed the influence of A. mycorrhiza on the height of *T. indica*seedlings. It was observed that seedlings raised with 50g of mycorrhiza (T3) performed best with the mean value of 60.1, followed by seedlings raised with 75g of mycorrhiza with the mean value of 46.0800. Seedlings raised with T1 (control) had least height with the mean value of 28.4567 from the observation. However, the result obtained revealed that height of the seedlingsvaries because of the different levels of mycorrhiza applied to them. Therefore, these findings support the observations made by Michelsen and Rosendahl (1990) on *Acacia.* auriculiformis, *Albizia*lebbeck and *Leucenialeucocephala*. Similarly, Read and Boyd (1986) reported that A. mycorrhiza inoculation increased plant growth, mostly in height and root growth development. The result from the Analysis indicated that there was significant difference among the treatment at 5% level of probability.

The result presented in table 1 above revealed the influence of mycorrhiza on the stem diameter of *T. indica* seedlings. It was observed that seedlings raised with 50g of A.mycorrhiza (T3) performed best with the mean value of 4.3 followed by seedlings raised with 75g of A mycorrhiza (T4) with the mean value of 3.7. Seedlings raised with T1 (control) performed least with the mean value 2.0667 from the observation. However, the result obtained revealed that the stem diameter of the seedlings varies because of the different soil samples applied to them. Therefore, the increase in stem Girth recorded in this experiment can be attributed to A.mycorrhiza ability to improve symbiosis and suggested phosphorus nutrition as an important benefit. Greater responsiveness to and dependence of glomusmoceae is characteristics of A. mycorrhiza plants grown at lower soil phosphorus concentrations and low tissue phosphorus concentrations (Smith and Read 1997). The result from the Analysis of Variance indicated that there was significant difference among the treatments at 5% level of probability.

The result presented in table 1 above revealed the influence of mycorrhiza on the leaf area of *T .indica* seedlings. It was observed that seedlings raised with 50g of A .mycorrhiza (T3) performed best with the mean value of 41.1733 followed by seedlings raised with 75g of A mycorrhiza (T4) with the mean value of 32.5733. Seedlings raised with T1 (control) performed least with the mean value 16.0000 from the observation. However, the result obtained revealed that the leaf area of the seedlings varies because of the different soil samples applied to them. Therefore, the increase in leaf area recorded in this experiment can be attributed to A .mycorrhiza ability to improve symbiosis and suggested phosphorus nutrition as an important benefit. The result from the Analysis of Variance indicated that there was significant difference among the treatments at 5% level of probability.

The result presented in table 1 above revealed the influence of mycorrhiza on the chlorophyll content of *T. indica* seedlings. It was observed that seedlings raised with 50g of A.mycorrhiza (T3) performed best with the mean value of 83.4333 followed by seedlings raised with 75g of A mycorrhiza (T4) with the mean value of 68.7267. Seedlings raised with T1 (control) performed least with the mean value 13.2367 from the observation. The increase in chlorophyll content recorded in this experiment can be attributed to *A .mycorrhiza* ability to improve symbiosis and suggested phosphorus nutrition as an important benefit.This is in line with Analysis of leaf chlorophyll content of Paddy plants during vegetative stage grown in soil media containing macroalgae organic fertilizer (Kurniawan *et al,* 2021) The result from the Analysis of Variance

indicated that there was significant difference among the treatments at 5% level of probability.

CONCLUSIONS AND RECOMMENDATIONS

The study showed a positive influence on *T. Indica*seedlings if inoculated properly with *A.mycorrhiza*. However, from the data analyzed it was observed that, the interaction between mycorrhiza and soil nutrients was significant because of positive mycorrhiza influence on young seedlings of *T. indica*.

The increase in number of leaves, stem girth and plant height, leaf area, chlorophyll content recorded indicates mycorrhiza displayed no parasitic effects on any of the treatments, but it served as a growth promoter on all of the treatments applied. However, the effects exerted on the seedlings were dependent on thequantity of mycorrhizal applied at different levels as its observed. Consequently,50g of mycorrhiza (T3) had best influence in all parameters with respect to the morphological characteristics of seedlings of *T.indica*

RECOMMENDATION

From the results obtained, it is therefore recommended that; the use of 50g of A. mycorrhiza should be employed in raising the seedling of *T. indica* to increase production in the nursery hence sustainable tree production. Furthermore, more research works of A. mycorrhiza on tree species should be encouraged in order to enhance their growth.

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Table 2 : Showing the ANOVA Table of Influence of Arbuscular mycorriza on the growth potential of *T. indica*

Variables	Source of variance	Df	Sum of Squares	Mean Square	F	Sig.
	Treatment	5	1579.826	315.965	163.341	.000*
Plant Height	Within Groups	24	23.213	1.934		
	Total	29	1603.038			
	Treatment	5	12.523	2.505	149.276	.000*
Plant Girth	Within Groups	24	.201	.017		
	Total	29	12.724			
Leaf Production	Treatment	5	23.333	4.667	8.400	.001*
	Within Groups	24	6.667	.556		
	Total	29	30.000			
	Treatment	5	1161.839	232.368	203.226	.000*
Leaf Area	Within Groups	24	13.721	1.143		
	Total	29	1175.560			
	Treatment	5	6991.609	1398.322	1241.224	.000*
Chlorophyll Con	Within Groups	24	13.519	1.127		
	Total	29	7005.127			

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