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SEEDLING GROWTH PERFORMANCE OF *Khaya senegalensis* (Welw.) C.DC UNDER DIFFERENT LIGHT INTENSITIES AND SOIL TEXTURAL CLASSES

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Abstract
Plant growth and development is influenced by environmental conditions such as light intensity, which refers to the total amount of light that plants receive and degree of brightness that plant is exposed for photosynthesis process and also soil texture control mineralization by influencing aeration moisture status. This study investigates seedling growth performance of Khaya senegalensis (Welw.) C.DC under different Light Intensity (LI) and soil textural classes (25%, 50%, 75% and 100%) and five textural classes of soil (Sand, Sandyloam, Loamy sand, Loam and clay). 4X5 factorial experiment in a Completely Randomized Design (CRD) was used and result from the study revealed that highest mean height (8.72cm) was recorded in seedling under 25%LI, highest collar diameter was recorded in 100%LI and seedling under all treatments produced 4 leaves. It revealed that Khaya senegalensis can strive on wide ranges of soil and radiation. It is a good candidate species for enrichment planting.

Key Words: *Khaya senegalensis, Light intensity, Soil textural classes, Seedling height, Collar diameter*

Introduction

Plants growth relies on a series of interactions that involve the presence of light. Photosynthesis enable plant metabolism processes to take place and provides the energy that facilitates these processes. Light intensity level can have a significant effect on photosynthesis rate which are directly related to plant ability to grow, it refers to the total amount of light that plants receive. It is also described as the degree of brightness that plants are exposed to. Light is an absolute requirement for plant growth and development. However, different plant have different optimum requirements, excessive light intensity are injurious to plants. Subject to physiological limits, an increase in the intensity of light will result to an increase in the photosynthesis and will likewise reduce the number of hours that the plant must receive every day (Manaker, 1991).

Texture refers to the relative abundance by weight, of the size fractions (sand, silt and clay). It relates to many of the ways a soil performs. If a soil is coarse (sandy) water tends to move through it quite well, but it may not retain enough water for plant growth. If a soil is clayey, water will probably move slowly but it should retain water for plant growth. Soil

texture control mineralization by influencing aeration moisture status, affecting the physical distribution of organic materials and hence potential for degradation, and confer some degree of protection through an association of organic materials with clay particles (Howeler *et. al.,* 1993). Soil texture affects plant growth, its water and nutrients supply. The available water holding capacity of soil is related to soil texture scrubs structure so that the pods are soft and porous and roots of seedling can penetrate easily.

The African mahogany (*K. senegalensis*) an exotic species of the meliaceae family stands out for it excellent wood quality, high prices in domestic and international markets, wood appreciated for carpentry woodwork, ship building and products of decorative veneers (Nikiema and Pastermak, 2008). Its wood is considered to be hard with excellent commercial value and physical and mechanical properties similar to Brazilian mahogany (*Swietenia macrophylla*). Slow growth and high number of branches are understandable characteristics of *K. senegalensis.* However, the timber commercial value and water deficit tolerance make the species promising for use to increase the agricultural frontier of forest specie particularly in area unfit due to scarce rainfall (Pinheiro *et al.,* 2001).

The *K. senegalensis* species originated in a tropical wet and dry climate in West Africa (rainfall ranging from 600 to 800 annual mm) and most likely adapts well to semi- arid region of Brazil. The *Khaya senegalensis* saplings tolerate short period of moderate water deficit, however, this type of study is still limited to *K. senegalensis* (Albuquerque *et al*., 2013). Information about *K. senegalensis* growth under abiotic culture practices is scarce, therefore there is need to investigate the species as a candidate for Agroforestry practices and afforestation programme for growth performance under different light intensities and soil textural classes for economic benefit in arid and semi-arid region.

Awodoyin and Olaniyan (2007) reported that *K. senegalensis* is encountered in the farming systems based on varying degrees of protection against bush burning since dispersal and propagation are still at the mercy of nature, with most wild animals relishing the sweet fruit pulp. Unfortunately, most valuable tropical forest and savanna climax species, especially *K. senegalensis* is presently not targeted for planting programme.

Methodology

Experiment Site

The study was carried out at the Tree Improvement Nursery and Silviculture Nursery of the Department of Sustainable Forest management, Forestry Research Institute of Nigeria, Jericho Hill, Ibadan, Nigeria (FRIN). FRIN is located within longitude 07°23'18"N to 07°23'43"N and latitude 03°51'20"E to 03°51'43"E. Mean annual rainfall is about 1548.9 mm, falling within approximately 90 days. The mean maximum temperature is 31.9°C, minimum 24.2°C while the mean daily relative humidity is about 71.9% (FRIN, 2016).

Experimental Design

The experimental design used for the study was 4x5 factorial experiments in completely randomized design. Factor A: 4 light intensities and Factor B: 5 textural classes. Each textural class of soil was replicated 10 times under each light intensity.

Experimental Procedure

Five different textural classes of soil namely: sand, loamy sand, sandyloam, loam and clay were prepared using soil textural composition. Two hundred seedlings with good vigour and relatively uniform growth were randomly selected and transplanted into medium sized (10 X 18cm) poly pot filled with 2 kg of the prepared soils and these were exposed to different light intensities: 100%, 75%, 50% and 25% of full day light.

Each soil textural class was replicated 10 times under each light intensity. A total of fifty seedlings were placed under each light intensity chamber. The light intensity chambers used for the experiment were made of wood of 5cm x 5cm in thickness with interval dimensions of each light screening chamber being 1.8 x 1.2 x 1.3m. The wooden frames were covered on all sides with single, double and triple layers of synthetic green 1mm mesh net to achieve varying levels of light intensity.

Seedlings put under light screening intensive chambers with one layer of mesh net is for 75% of light intensity, those under cages with double layer of mesh net stand for 50% light intensity, those under light screening chambers with triple layers stand for 25% light intensity while those in the open field were exposed to 100% light intensity (Akinyele, 2007 and Agbo-Adediran, 2014). Light intensity within and outside the light screening chamber was measured with a light meter. Growth variables assessment commenced exactly two weeks after transplanting for 16 weeks duration.

Result

Table 1: Compositions of different textural classes of soil

Textural Class	Composition	Percentage (%)
Loamy sand	Sand	80
	Silt	10
	Clay	10
Sandy loam	Sand	65
	Silt	20
	Clay	15
Loam	Sand	50
	Silt	28
	Clay	22

Source: Foth (1984)

Table 2: Mean Values for the Effect of Different Light Intensities on the Growth of *K. senegalense* Seedlings

Light Intensities	Height (cm)	Collar diameter (mm)	Number of leaves
100%	9.21 ± 0.28	3.64 ± 0.21	4.20 ± 0.41
75%	8.72 ± 0.34	3.42 ± 0.20	4.18 ± 0.38
50%	8.91 ± 0.33	3.35 ± 0.13	4.30 ± 0.28
25%	9.36 ± 0.26	3.44 ± 0.18	4.21 ± 0.23

Mean±SE followed by the same superscripts in column are not significantly different (p>0.05)

Table 3: Mean Separation for the Effect of Soil Textural Classes on the Growth of *K. senegalense* Seedlings

Soils	Height (cm)	Collar diameter (mm)	Leaves Production
Clay	8.69 ± 0.45^{b}	3.10 ± 0.11^{c}	4 ± 0.14^{b}
Sandyloam	8.80 ± 0.31^{ab}	3.48 ± 0.11^{ab}	5 ± 0.11^{a}
Sandy	8.49 ± 0.29^{b}	3.29 ± 0.10^{bc}	4 ± 0.14^{b}
Loamysand	9.73 ± 0.37^{a}	3.73 ± 0.12^{a}	4 ± 0.14^{b}
Loamy	9.52 ± 0.27^{ab}	3.72 ± 0.15^{a}	4 ± 0.14^{b}

Mean±SE followed by the same superscripts in column are not significantly difference ($p>0.05$)

Table 4: Mean Values for the Interaction Effect of Light intensity and Soil Textural Class on the Growth of *K. senegalense* Seedlings

Light Intensity	Soils	Height (cm)	Collar Diamater (mm)	Leaf Production
100%	Clay	8.65 ± 0.63	3.14 ± 0.23	4.08 ± 0.28
	Sandyloam	8.94 ± 0.65	3.73 ± 0.21	4.59 ± 0.29
	Sandy	8.31 ± 0.66	3.45 ± 0.26	3.91 ± 0.23
	Loamysand	10.37 ± 0.68	3.97 ± 0.25	4.08 ± 0.27
	Loamy	9.76 ± 0.69	3.91 ± 0.24	4.36 ± 0.25
75%	Clay	8.26 ± 0.70	3.20 ± 0.23	3.90 ± 0.26
	Sandyloam	8.03 ± 0.66	3.21 ± 0.21	4.46 ± 0.26
	Sandy	8.10 ± 0.65	3.02 ± 0.22	3.69 ± 0.28
	Loamysand	9.36 ± 0.67	3.79 ± 0.29	4.64 ± 0.29
	Loamy	9.84 ± 0.69	3.89 ± 0.28	4.19 ± 0.25
50%	Clay	7.54 ± 0.61	2.92 ± 0.26	4.04 ± 0.24
	Sandyloam	9.66 ± 0.64	3.50 ± 0.24	4.61 ± 0.22
	Sandy	8.77 ± 0.67	3.24 ± 0.23	3.81 ± 0.23
	Loamysand	9.40 ± 0.69	3.55 ± 0.25	4.51 ± 0.26
	Loamy	9.17 ± 0.65	3.55 ± 0.29	4.51 ± 0.25
25%	Clay	10.30 ± 0.68	3.14 ± 0.28	3.83 ± 0.24
	Sandyloam	8.59 ± 0.69	3.46 ± 0.27	4.35 ± 0.29
	Sandy	8.79 ± 0.66	3.45 ± 0.22	3.79 ± 0.28
	Loamysand	9.80 ± 0.67	3.60 ± 0.23	4.50 ± 0.26
	Loamy	9.31 ± 0.65	3.55 ± 0.21	4.58 ± 0.25

Mean±SE followed by the same superscripts in column are not significantly different ($p>0.05$)

ANOVA Result for the Effect of Different Light Intensities and Soil Textural Classes on the Growth of *K. senegalense* Seedlings

Variable	SV	df	SS	MS	F	Sig.
Height (cm)	LI	3	12.52	4.17	0.90	0.45ns
	S	4	47.43	11.86	2.55	0.04*
	LI * S	12	55.91	4.66	1.00	0.45ns
	Error	180	838.86	4.66		
	Total	199	954.71			
Collar Diameter (mm)	LI	3	2.23	0.74	1.25	0.29ns
	S	4	11.99	2.30	5.06	0.00*
	LI * S	12	3.11	0.26	0.44	0.95ns
	Error	180	106.62	0.59		
	Total	199	123.95			
Leaves Production	LI	3	0.425	0.14	0.18	0.91ns
	S	4	16.20	4.05	5.04	0.00*
	LI * S	12	3.39	0.28	0.35	0.98ns
	Error	180	144.52	0.80		
	Total	199	164.53			

ns- not significant ($p>0.05$) *significant at ($p\leq0.05$)

Discussion

Effect of light intensities on the height, collar diameter and leaf production of K. senegalense seedlings

Analysis of Variance (ANOVA) indicated that there was no significant difference ($p>0.05$) in the effect of light intensities on the height, collar diameter and leaf production of *K. senegalense* seedlings. The mean seedling height for the light intensities ranged from 8.72 to 9.36 cm, with the highest mean height from seedlings placed under 25% light intensity (LI) and the lowest mean height from seedlings placed under 75% LI (Table 2). The mean seedling collar diameter for light intensities ranged from 3.35 to 3.64 mm, with the highest mean collar diameter obtained from the seedlings placed under 100% LI while the least mean collar diameter was obtained from seedlings placed under 50% LI (Table 2). All the seedlings of *K. senegalense* placed under each light intensity produced 4 leaves which was the mean leaves production (Table 2).

Analysis of Variance (ANOVA) indicated that there was significant effect ($p\leq0.05$) of soil textural classes on the height, collar diameter and leaf production of *K. senegalense* seedlings. Seedlings grown using loamy-sand had the highest mean collar diameter with the value 3.73 mm while seedlings grown using clay had the least mean collar diameter with the value 3.10 mm (Table 3). Mean separation result for soil textural classes showed that mean collar diameter of seedlings grown using clay, and sandy soils were not significantly different ($p>0.05$) from each other as well as the mean collar diameter of seedlings grown using sandy-loam, loamy-sand and loamy soils (Table 3). Seedlings grown using loamy-sand soil had the highest mean height of 9.73cm while seedlings grown using sandy soil had the least with 8.49 cm (Table 3). Mean separation result for soils showed that the mean height of the seedlings grown using clay, sandy-loam, sandy and loamy soils were not significantly different ($p>0.05$) from one another while the mean height of

the seedlings grown using sandy-loam, loamy-sand and loamy soils were not also significantly different ($p>0.05$) from one another (Table 3). All the seedlings had mean leaves production of four (4) except seedlings grown using sandy-loam that had five (5) mean leaves produced (Table 3). Mean separation result for soil textural classes revealed that the mean leaves produced by seedlings grown using clay, sandy, loamy-sand and loamy soils were not significantly different ($p>0.05$) from one another but significantly different ($p\leq0.05$) from the mean leaves produced by seedlings grown using sandy-loam (Table 3).

Interaction effect of light intensities and soil textural classes on the height, collar diameter and leaf production of K. senegalense seedlings

Analysis of Variance (ANOVA) indicated that there was no significant difference ($p>0.05$) in the interaction effect of light intensities and soil textural classes on the growth of *K. senegalense* seedlings. Interactions of light intensities and soil textural classes showed that seedlings grown using loamy-sand placed under 100% LI had the highest mean height of 10.37 cm while seedlings grown using sandy-loam placed under 75% LI had the least with 8.03 cm (Table 4). Interaction of light intensities and soil showed that the highest mean collar diameter of 3.97 mm was recorded for seedlings grown using loamy-sand placed under 100% LI while the least was recorded in seedlings grown using clay placed under 50% LI with the value 2.92 mm (Table 4). Interaction of light intensities and soils showed that the mean leaves produced by the seedlings ranged from 3.79 to 4.64 (Table 4).

Conclusion and Recommendation

The result from this study indicated that the different light intensities; interaction of light intensities and soil textural classes did not significantly enhance the vegetative growth of *K. senegalense* seedlings. This implies that the species was able to utilize any of the light intensities for optimum growth. This finding is in agreement with the research of Bolanle-Ojo (2014), who reported that there was no significant difference in height, collar diameter and leaf production of the seedlings of *Artocarpus heterophyllus* subjected to different light intensities and also Oyedeji (2012), who reported that there was no significant difference in height and leaf production of the seedlings of *Dialium guineense* subjected to different light intensities. Akinyele (2007) and Aderounmu (2010) reported that light intensities significantly affected the growth of *Buchholzia coriacea* and *Vitellaria paradoxa* seedlings. Also, this study indicated that soil textural classes significantly enhanced the vegetative growth of *K. senegalense* seedlings. Within the different soil textural classes, the height and collar diameter of *K. senegalense* seedlings was higher in loamy-sand than in other soil textural classes. Clay gave the lowest growth in height and collar diameter of the species. The higher acidic content of clay might be responsible for the lower yield of the species (Ritu *et al*., 2010). This finding is in line with the work of Sah *et al.* (2003) who reported that higher content of clay reduced the growth of plants.

Light and edaphic factors (soil) are germane for propagation; the study shows that *K. senegalense* is suitable for enrichment planting, its seedling maintains vigour with textural classes

which implies it can survive in all the ecological zones and light intensity (LI) do not influence changes in morphological features, physiological and biochemical process.

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