RESPONSE OF *Khaya senegalensis* (Desr.) SEEDLINGS TO PLANT HORMONES

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ABSTRACT

Khaya senegalensis is valued for its wood qualities, beautiful figurative timber grains, brown colour, and use for production of quality furniture and household utensils. This study assessed the early growth response of Khaya senegalensis seedlings to four different treatments: Indole-3-Acetic acid (A), Kinetin (K), 50:50 Kinetin and Indole-3-Acetic acid (KA), and control (C). The hormones were assessed at four concentrations (doses); 1 mg/ml (P_1), 3 mg/ml (P_3), 5 mg/ml (P_5) and 7 mg/ml (P_7). The treatments were applied on the leaves and stems of seedlings and total height, collar diameter, number of leaves and leaf area were monitored. The hormonal type and dose significantly affected seedling height and collar diameter. The interaction effects had a significant influence on leaf area and height of seedlings. The 50:50 Indole-3-Acetic acid and Kinetin combination at 1 mg/ml yielded the highest height (14.03 cm), collar diameter (1.79 mm) and number of leaves (8). This could have positive implications in nursery production of Khaya senegalensis seedlings.

Keywords: Indole-3-Acetic acid, Kinetin, Early growth, *Khaya senegalensis*

INTRODUCTION

Khaya senegalensis (Desr.) is an important tree species from the *Meliaceae* family, naturally found in tropical Africa (FAO, 2003). The common names include Dry Zone Mahogany, *Khaya* wood, Gambia mahogany, Senegal mahogany and African mahogany (Nikles *et al.*, 2008). It is highly valuable both socially and economically in Nasarawa State, Nigeria. The leaves are used as feed for livestock, while the bark is used to locally treat diseases such as liver fluke, hookworms, scorpion bites, constipation and ulcers (Walter, 2001). The tree species is treasured for its beautiful figurative timber grains and brown colour. It has a good surface-finish and is used for furniture and cabinet works, decorative veneers, flooring, joinery, boat building, construction, and manufacture of household utensils (TRADA, 2004). However, the species is threatened by heavy exploitation and habitat loss. There is need for production of high quality seedlings to ensure increased propagation and sustainable use of the species.

Tree growth hormones are naturally occurring organic molecules which affect various parts of productivity; and help to alleviate biotic and abiotic stresses (Davies, 2010). They are compounds that are effective at low concentrations; and control the response, growth and development of trees. The action of hormones involve the process of signal transduction, which is the conversion of intracellular or extracellular signals into cellular responses. Growth hormones are synthesized in the laboratory, to increase the quantity available for commercial applications. Some tree hormonal classes include auxin, abscisic acid, ethylene, gibberellins, cytokinins, salicylic acid, strigolactones, brassinosteroids and nitrous oxides.

The slow growth of many indigenous tree species, make investors to focus on fast growing exotic tree species. This has negative consequences on biodiversity and availability of indigenous tree species. Therefore, there is a need for the development of techniques that would increase early growth and development of indigenous species such as *Khaya senegalensis*. This study evaluated the growth response of *Khaya senegalensis* seedlings to different plant hormones.

MATERIALS AND METHODS

Study Area

The research was carried out at the nursery of the Department of Forestry and Wildlife Management, Faculty of Agriculture, Nasarawa State University, Keffi, Nigeria (Figure 1). It is located along longitude of 8º35′ N and latitude of 8º33′ E, in the Guinea Savannah zone of North-Central Nigeria at an altitude of 177 m above sea level. The monthly maximum and minimum temperature ranges from 35.06ºC to 36.40ºC and 20.16ºC to 20.50ºC, respectively. Monthly average relative humidity and rainfall are 74.67% and 168.90 mm, respectively. The major soil types in the region belong to the category of oxides or tropical ferruginous soils. Laterite crust occurs in extensive areas on soils of the basement complex while hydromorphic soils are common along the Benue trough and flood plains of major rivers. Other soil types in the area include: ultisols, alfisols, entisols, inceptisols, vertisols and oxisols (Lyam, 2000).

Preparation of Plant Hormones and Experimental Procedure

The hormone solutions were prepared by using ethanol to dissolve 1 mg, 3 mg, 5 mg and 7 mg of 50:50 Indole-3-Acetic acid and Kinetin. Equal amounts of Kinetin were also dissolved in ethanol, while distilled water was used to dissolve Indole-3-Acetic. Thereafter, more distilled water was added to make 8 ml of solvent for each media. A hand held sprayer was used to apply the solution to leaves and stems of uniformly growing seedlings and 1 L of water was applied to the soil per week. The experiment was laid out in a completely randomized design. The treatments were administered for two months and data on total height, collar diameter, number of leaves and leaf area were collected, weekly.

RESULTS

The highest mean height (12.80±2.11 cm), collar diameter (1.72±0.17 m), number of leaves (7±1.80) and leaf area (12.87±2.15 cm^2) were observed in the 50:50 combination. On the other hand, the lowest height (11.09±1.26 cm), collar diameter (1.45±0.17mm), number of leaves (6.0±1.38) and leaf area (12.24±17 cm^2) were observed in the control treatment (Table 1). There was a significant difference in the effect of plant hormone on seedling height and collar diameter (Table 2). The hormonal dosage significantly affected seedling height and number of leaves ($p=0.0003$). The highest values were observed for P_1 (Table 3). The interaction effects of hormone type and dosage level also indicated significant differences for height ($p=0.018$) and leaf area ($p=0.016$). The highest interaction effect was observed for $KA+P_1$ (height = 14.03 cm, collar diameter = 1.79 mm) (Table 4), although the highest leaf area (14.75 cm^2) was observed for $A+P_1$. The control treatment had the lowest interaction effect.

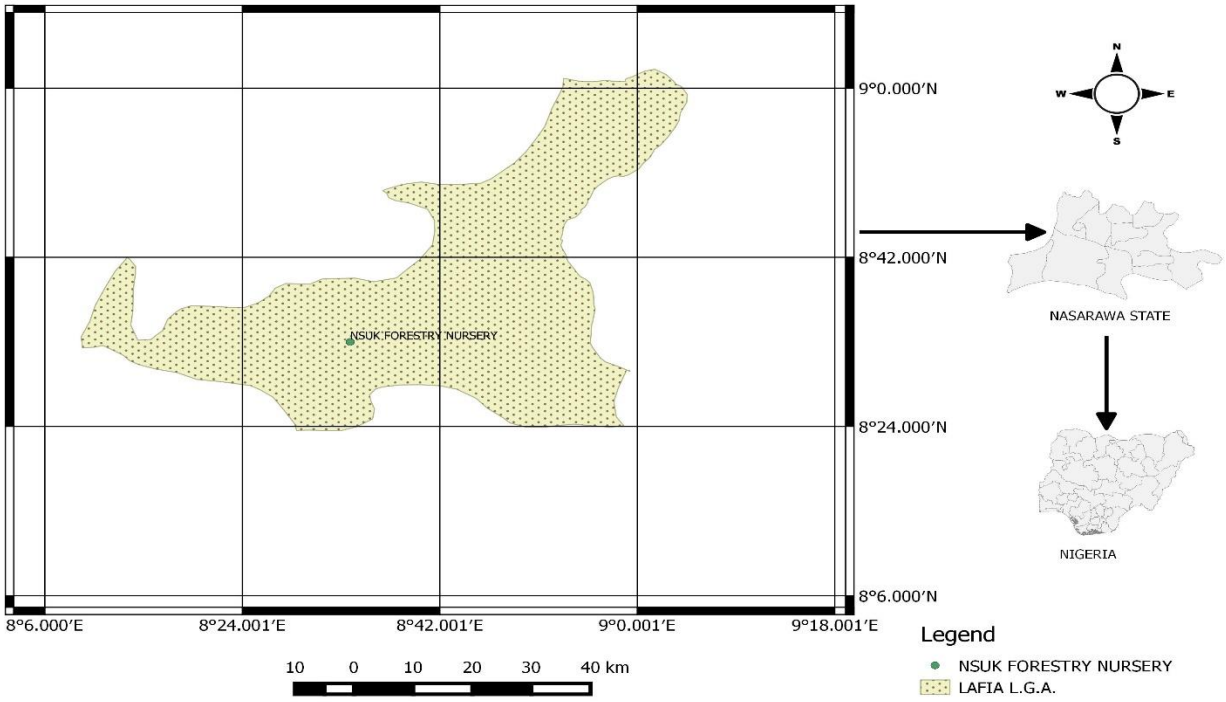

Figure 1: Location of the nursery of the Department of Forestry and Wildlife Management, Nasarawa State University, Keffi, Nigeria (inset: Map of Nasarawa State and Nigeria)

Table 1. Growth variables of *Khaya senegalensis* seedlings treated with different plant hormones

Variables	Hormones	Mean±SD	Lower class	Upper class	Min.	Max.
Height	A	12.16±1.39	11.65	12.68	9.68	15.05
	C	11.09±1.26	10.58	11.60	8.39	13.90
	K	12.20±1.98	11.69	12.72	9.21	16.93
	KA	12.80±2.11	12.29	13.31	9.51	18.45
Collar Diameter	A	1.65± 0.16	1.60	1.70	1.22	1.91
	C	1.45± 0.17	1.40	1.49	1.13	2.01
	K	1.59± 0.14	1.54	1.63	1.32	2.08
	KA	1.72± 0.17	1.67	1.77	1.34	2.19
Leaf Number	A	6.71± 1.60	6.24	7.17	3.75	9.88
	C	6.25± 1.38	5.78	6.71	3.00	9.88
	K	6.58± 1.47	6.12	7.05	3.88	12.00
	KA	7.05± 1.80	6.59	7.52	5.00	13.75
Leaf Area	A	12.89±2.49	12.21	13.58	8.82	21.39
	C	12.24±2.17	11.55	12.93	8.39	16.44
	K	12.87±2.15	12.18	13.56	8.33	18.76
	KA	12.81±2.33	12.12	13.50	7.76	19.98

A = Indole-3-Acetic acid, K = Kinetin, and KA = Kinetin+ Indole-3-Acetic acid, C = Control

Table 2: Effects of plant hormones on *Khaya senegalensis* seedlings

Hormones	Height (cm)	Collar diameter (mm)	Number of leaves	Leaf area (cm^2)
KA	12.80 [a]	1.72 [a]	7.05 [a]	12.80
A	12.16[a]	1.65[b]	6.71[ab]	12.89
K	12.20 [a]	1.59 [b]	6.58[ab]	12.87
C	11.09[b]	1.45[c]	6.25[ab]	12.24

K = Kinetin, C = Control, A = Indole-3-Acetic acid, KA = Kinetin+Indole-3-Acetic acid

Table 3: Effects of doses of hormones on K*haya senegalensis* seedlings

Hormones	Height (cm)	Collar diameter (mm)	Number of leaves	Leaf area (cm^2)
P_1	12.02[ab]	1.63[a]	7.06[ab]	12.89
P_3	12.62[a]	1.63[ab]	7.17[a]	12.87
P_5	12.03[ab]	1.56 [b]	6.49[bc]	12.81
P_7	11.59[b]	1.57[ab]	5.86[c]	12.24

P_1 = 1 mg/ml, P_3 = 3 mg/ml, P_5 = 5 mg/ml, P_7 = 7 mg/ml

Table 4: Interaction effects of hormone type and dosage levels on *Khaya senegalensis* seedlings

Hormones	Height (cm)	Collar diameter (mm)	Number of leaves	Leaf area (cm^2)
KA x P_1	14.03 [a]	1.79 [a]	8.34 [a]	12.32 [cd]
KA x P_3	13.22[abc]	1.78 [a]	7.65[ab]	13.62[abc]
C x P_3	11.29[def]	1.40[ef]	7.05[abc]	11.41 [d]
K x P_5	12.62[abcd]	1.59[bcd]	7.04[abc]	12.33 [cd]
A x P_3	12.36[bcde]	1.68[abc]	7.01[bc]	11.52 [d]
A x P_1	12.28[bcdef]	1.68[ab]	7.00[bc]	14.75 [a]
K x P_3	13.63[ab]	1.66[abc]	7.00[bc]	13.37[ab]
K x P_1	10.89 [f]	1.55[bcd]	6.53[bcd]	13.01[abcd]
A x P_7	11.95[cdef]	1.59[bcd]	6.44[bcd]	12.98[abcd]
KA x P_5	12.37[bcde]	1.68[abc]	6.41[bcd]	12.335 [cd]
A x P_5	12.06[cdef]	1.63[bcd]	6.40[bcd]	12.33 [cd]
C x P_1	10.88 [f]	1.50 [de]	6.39[bcd]	12.76[bcd]
C x P_5	11.05[ef]	1.36 [f]	6.13 [cd]	12.63[bcd]
KA x P_7	11.58[def]	1.64[bcd]	5.80 [cd]	12.95[abcd]
K x P_7	11.67[def]	1.55 [cd]	5.79 [cd]	11.77 [cd]
C x P_7	11.14[ef]	1.52 [de]	5.43 [d]	12.27 [cd]
Sig.	**0.019**	**0.15**	**0.312**	**0.017**

K = Kinetin, C = Control, A = Indole-3-Acetic acid, KA/K+A = Kinetin+Indole-3-Acetic acid, P1 = 1 mg/ml, P3 = 3 mg/ml, P5 = 5 mg/ml, P7 = 7 mg/ml.

DISCUSSION

The hormone types influenced the height, collar diameter, number of leaves and leaf area of *Khaya senegalensis* seedlings, with Kinetin and Indole-3-Acetic acid combination having the highest influence on early growth. Ross (2018) stated that Kinetin was the main cytokinin hormone widely used to promote cell division

and differentiation in plants. It also has the ability to confer resistance to various abiotic stresses such as drought and inadequate nutrients (Gangwar *et al*., 2010). The Indole-3-Acetic acid is an auxin that could regulate growth and developmental processes such as cell division and elongation, tissue differentiation and apical dominance. It could also influence plant's response to light, gravity and pathogens (Fu and Wang, 2011).

The dosage levels affected seedling height and number of leaves, with the low concentration having the highest effect. Swarup *et al*. (2007) stated that the greatest effect of hormones occur at specific stages during the plant's life, with diminished effects occurring before or after this period. In addition, the interaction effect of hormone type and dosage level indicated that the combined used of Kinetin and Indole-3-Acetic acid at low concentration was most effective for seedling growth.

CONCLUSION

Hormones are vital chemical substances which accelerate the growth of plants. *Khaya senegalensis* seedlings were positively affected by Kinetin and Indole-3-Acetic acid at low doses. The 50:50 combination increased seedling growth performance when compared with individual hormones.

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