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Effect of *Gliricidia sepium* Leaves and Cow Dung on the Growth of *Khaya senegalensis* A. Juss. Seedlings

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ABSTRACT

This study was conducted to assess the potential of *Gliricidia sepium* and cow dung on the growth performance of *Khaya senegalensis*. The samples of *Gliricidia sepium* and cow dung were mixed with 2 kg of topsoil at different ratios as treatments. There were eleven (11) treatments which included: cow dung (10 g, 20 g, 30 g, 40 g and 50 g) + 2 kg soil, *Gliricidia sepium* (10 g, 20 g, 30 g, 40 g and 50 g) + 2 kg soil. The treatments were replicated five (5) times and laid out in Completely Randomized Design (CRD). Variables assessed were plant height, collar diameter, number of leaves and biomass accumulation of component parts of the seedlings. The data collected were subjected to Analysis of Variance (ANOVA) and means were separated using Duncan Multiple Range Test (DMRT) at 5% level of significance. The result showed that there was no significant difference among the treatments at 5%probability level except in plant height. The best performance was recorded in the seedlings raised with T_5 (50 g of cow dung +2kg of soil) in plant height, stem diameter and leaves production with a mean value 10.96cm, 0.32mm and 7.00 respectively. It is therefore, recommended that cow dung of 50g should be applied in raising *K.senegalensis* seedlings.

Keywords: *Khaya senegalensis*, *Gliricidia sepium,* cow dung, seedlings.

Introduction

Organic manures are fertilizers from either plants or animals used for improving soil nutrients and consequently to stimulate and enhance plant growth (Oso, 1995). In Nigeria and other developing countries, the practice of adding organic materials to soils in the nursery has been the common practice in supplementing soil fertility and eventual production of vigorous seedlings (Jackson and Ojo, 1971). *G. sepium* is characterized by fast growth, ability to fix nitrogen, high nitrogen content, tolerance to pruning and to coppicing, good fodder value, high foliage productivity and a vigorous tap root (Kabana, 1983). *Khaya senegalensis* is a

large tropical forest trees that belongs to the family Meliaceae, popularly called the Mahogany tree. It is also known for its large tree of 50 m high and 30m girth (Asiamah, 2000). *Khaya senegalensis* is commonly known as Senegal mahogany, it is an evergreen tree that typically grows to a height of 15 – 20m (up to 35m on fertile soils) and has a diameter at breast height of 1.5m, with a clean bole of 8 – 16m, its natural distribution extends from Mauritania and Senegal East to Northern Uganda with the rainfall range 650– 1800mm (Nikiema and Pasternak, 2008). *K. senegalensis* is a multipurpose tree with a variety of economic and environmental value (Nikiema and Pasternak, 2008). It is one of the major timber species in West Africa owing to its hard and fungus and termite resistant red wood, it is highly valued form of carpentry joinery, furniture, ship building and as a decorative veneer. The bark is used in traditional medicine to treat malaria, diarrhoea, dysentery, anaemia etc. Recently, the stem bark has been found to contain chemical (Limonolds) that exhibit antiproliferative activity against human cancer cell lines (Zhang *et al.*, 2007). It is also a good source of fodder for cattle because of its high dry matter but relatively low crude protein content.

In West Africa, the species has become an important urban amenity tree, commonly planted as a roadside or ornamental shade tree ; it is also increasingly planted in other countries such as South Africa, Egypt, Australia, Sri-Lanka, China, Indonesia Malaysia and Vietnam for both amenity and timber production (Arnold, 2004).

The viability of seed can be prolonged by drying to a moisture content below 5% and storing them at a low temperature of about 50°C (Gamene and Erikson, 2005). The production of healthy vigorous plants require satisfactory growth media, it means that fertility of the growing media is an important factor to consider in the development stage of plants.

Khaya senegalensis grows in forest and is scattered within the higher rainforest savannah wood lands. It is a drought tolerant species but prefers moist site. During the first years, the seedling develop strong deep taproot which makes it the most drought-resistant among the Khaya species. It is also very resistant to flooding and can be considered or planted on swampy soil. Dry zone mahogany remains a dominant species in most of its range (Juss, 2003). *K. senegalensis* is classified as vulnerable on the red list of threatened species of International Union for Conservation of Nature (IUCN) because of over exploitation for timber, fodder and medicine which has resulted in habitat loss and degradation. Hence, this study aims to examine the effect of organic fertilizer on the growth of *K. senegalensis* seedlings.

MATERIALS AND METHODS

Study area

The experiment was carried out at the central nursery of Forestry Research Institute of Nigeria, Ibadan. The nursery is located between latitude 7°23` to 7° 24`N and longitude 3°51` to 3° 52`E with annual rainfall range between 1,300 – 1,500 mm and relative humidity of 71%. The mean maximum and minimum temperature are 31.9°C and 24.2°C respectively (FRIN, 2013).

Topsoil was collected at the *Gmelina arborea* plantation within the premises of Federal College of Forestry, Ibadan. The topsoil was air-dried and sieved with 2mm sieve and spread in a germination box. *K. senegalensis* collected at Seed Section of Forestry Research Institute of Nigeria, Ibadan (FRIN) were broadcast into germination box and watered daily for three (3) weeks.

Pre-planting soil and amendments (cow dung and *G. sepium*) analyses were carried out to determine their nutritional composition. The *Gliricidia sepium* leaves collected from a mother tree in FRIN and cow dung collected from the College's cattle ranch were air-dried for 3 weeks and ground into powdery form. Both organic fertilizers were weighed with a bean analytical balance into different ratio and mixed with the soil according to respective treatments. The treatments include:

T_1 - 10 g of cow dung + 2 kg of topsoil
T_2 - 20 g of cow dung + 2 kg of topsoil
T_3 - 30 g of cow dung + 2 kg of topsoil
T_4 - 40 g of cow dung + 2 kg of topsoil
T_5 - 50 g of cow dung + 2 kg of topsoil
T_6 - 10 g of *G. sepium* leaves + 2 kg of topsoil
T_7 - 20 g of *G. sepium* leaves + 2 kg of topsoil
T_8 - 30 g of *G. sepium* leaves + 2 kg of topsoil
T_9 - 40 g of *G. sepium* leaves + 2 kg of topsoil
T_{10} - 50 g of *G. sepium* leaves + 2 kg of topsoil
T_{11} - Control 2 kg of topsoil

The treatments were replicated five (5) times.

Two weeks old seedlings of *K. senegalensis* were pricked into polythene pots filled with the treatments and watered immediately. The following variables were assessed for the period of twelve (12) weeks: Plant height (cm) with the aid of a graduated ruler, Stem diameter (mm) with the aid of venire calliper and Number of leaves were taken by counting the leaves on each stand.

Biomass accumulation was determined after the growth study. Three seedlings per treatment were selected and sectioned into leaves, stem and root; the samples were oven-dried at 70°C for twenty-four (24) hours and weighed until constant weight was achieved.

The experiment was laid out in Completely Randomised Design and the data collected were subjected to Analysis of Variance (ANOVA) and means found to be significant were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability.

Pre-planting analysis of Soils

Soil properties	Values
Available P (mg/kg)	2.95
Organic C (g/kg)	9.53
PH (H_2O)	5.54
Total N (g/kg)	1.03
Exchangeable acidity	0.14
Exchangeable bases (C mol/kg)	
Ca (C mol /kg)	2.20
Mg (C mol/kg)	0.21
Na (C mol/kg)	1.67
K (C mol/kg)	0.40
ECEC (C mol/kg)	4.62
Particle size (g/kg)	
Sand	768
Silt	88
Clay	144
Textural class	Sandy loam

Laboratory Analysis of the used *Gliricidia sepium*

Parameters	Values
% N	4.166
% P	0.405
% K	1.125
% Ca	0.670
%Mg	0.581
pH	6.500
% Organic Carbon	29.735
% Organic Matter	51.790

S**ource**: Laboratory analysis, 2015

Laboratory Analysis of the used cow dung

Parameters	Values
C	18.23 Cmol/kg
N	1.34Cmol/kg
P	1.5Cmol/kg
K	0.6701Cmol/kg
Na	1.34Cmol/kg
Ca	2.34Cmol/kg
Mg	0.21Cmol/kg
Cu	20.4mg/kg
Zn	120.6mg/kg
Fe	340mg/kg
Mn	115mg/kg

Source: Laboratory analysis, 2015

RESULTS AND DISCUSSION

Plant Height of *K. senegalensis* seedlings as influenced by cow dung and *G. sepium*

It was observed that there were significant differences (p=0.05) in height of *K. senegalensis* seedlings grown with different quantities of fertilizers (Table 1). However, the highest plant height was observed when T_5 (10.96 cm) was used as an amendment while the least plant height was observed when the soil was not amended (control) with 8.81 cm (Figure 1). Plants height was markedly influenced by all pots receiving treatments. This is accordance with the study of Anderson (2008) who used poultry droppings and NPK on the growth of *K. senegalensis* and observed that poultry droppings an example of organic manure, performed best on *K. senegalensis*. This however, indicates that organic manure from animal source may perform better than those from plant source, although the result may not be significantly different from one another.

Table 1: ANOVA for the Effect of Fertilizers on the Growth of *K. senegalensis* seedlings

Variable	SV	Df	SS	MS	F	Sig.
Height	Treatment	10	19.58	1.96	4.15	0.00*
	Error	44	20.77	0.47		
	Total	54	40.35			
Stem Girth	Treatment	10	0.01	0.00	0.79	0.64^{ns}
	Error	44	0.06	0.00		
	Total	54	0.07			
Leaves Production	Treatment	10	1.92	0.19	0.31	0.97^{ns}
	Error	44	27.17	0.62		
	Total	54	29.08			

**significant at (p=0.05) and* ns- not significant (p>0.05)

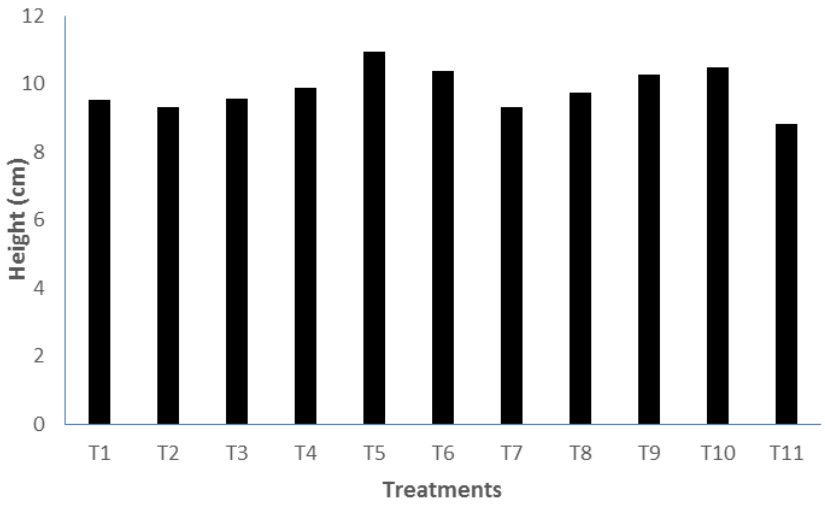

Figure1: Mean Height of *K. senegalensis* Seedlings

There was no significant difference observed (p>0.05) in stem diameter of *K. senegalensis* seedlings among all treatments used (Table 1). However, the mean value shows that the seedlings grown with T_5 gave the highest value of stem diameter (0.32 mm) while seedlings grown with T_7 gave the least growth in terms of collar diameter (0.26 mm) (Figure 2). Both cow dung and *G. sepium* manures have positive effect on the stem diameter of *K.*

senegalensis seedlings and this is in accordance with the findings of Munson *et al.*(1985) which was also supported by El Siraf *et al.* (2008) that organic manure had significant effect on the stem diameter of *Eucalyptus saligna.* Shokeye (2007) also observed that mixture of horse dung and *Leucaena leucocephala* enhanced the stem diameter growth of *Khaya grandifoliola*.

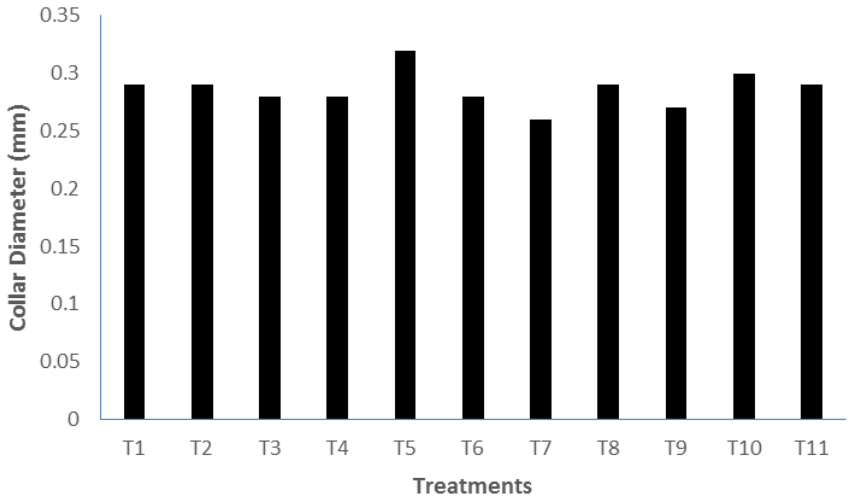

Figure 2: Mean Collar diameter of *K. senegalensis*

Leaves Production of *K. senegalensis* seedlings as influenced by cow dung and *G. sepium*

There was no significant difference ($p>0.05$) in the leaves production of *K. sengalensis* seedlings among all treatments used (Table 1). However, the mean values shows that the seedlings grown with T_1, T_2, T_3, T_5, T_6, T_7, and T_8 has the highest number of leaves while seedlings grown with T_4, T_9, T_{10} and T_{11} has the least among the treatments (Figure 3)

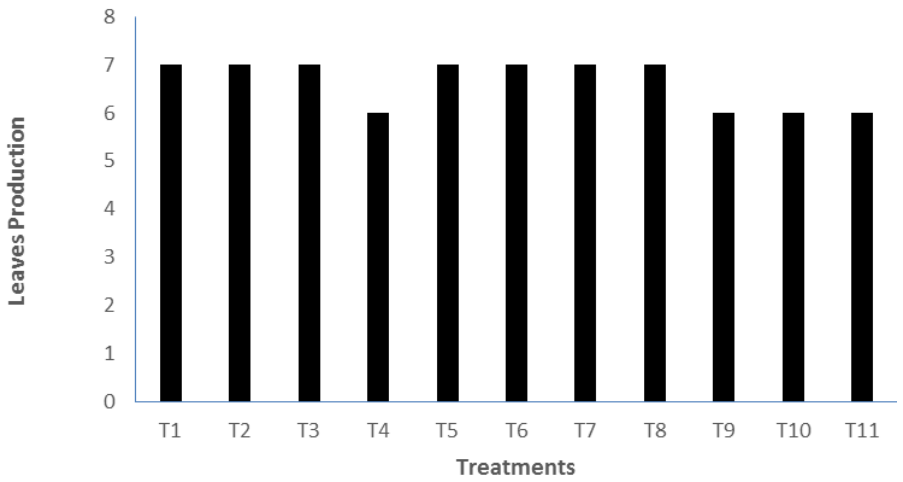

Figure3: Mean Leaves Production for *K. senegalensis* Seedlings

Leaf Dry Weight (LDW) of *K. senegalensis* seedlings as influenced by cow dung and *G. sepium*

There was no significant difference (p>0.05) in the LDW of *K. senegalensis* seedlings among all treatments used (Table 2). However, seedlings grown with T_3, T_4, T_5 and T_{11} gave the highest mean value of LDW (2.67 g) while seedlings grown with T_1 gave the least growth in mean LDW (1 g) (Figure 4).

Table 2: ANOVA for the effects of cow dung and *G. sepium* on the biomass accumulation of *K. senegalensis* Seedlings

Variable	SV	Df	SS	MS	F	Sig.
Leaf Dry Weight	Treatment	10	1.335	0.134	0.355	0.953^{ns}
	Error	22	8.267	0.376		
	Total	32	9.602			
Stem Dry Weight	Treatment	10	2.303	0.23	0.345	0.957^{ns}
	Error	22	14.667	0.667		
	Total	32	16.97			
Root Dry Weight	Treatment	10	1.394	0.139	0.46	0.898^{ns}
	Error	22	6.667	0.303		
	Total	32	8.061			

ns- not significant (p>0.05)

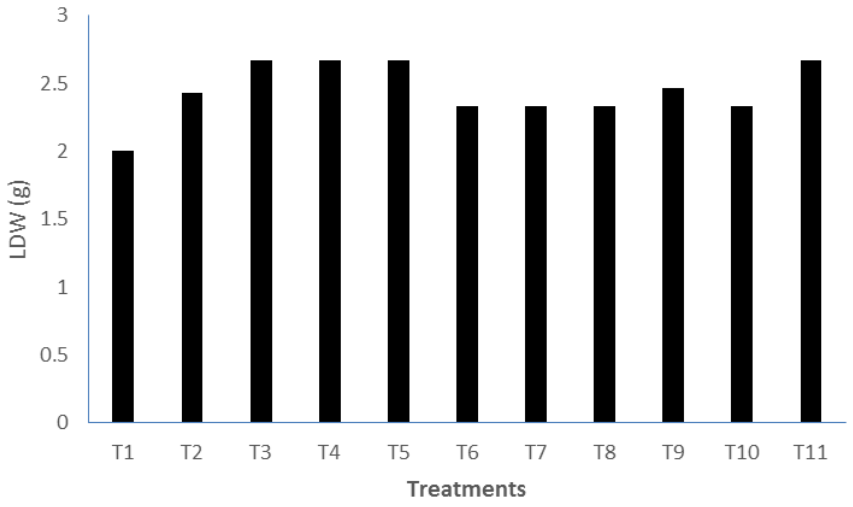

Figure 4: Mean LDW of *K. senegalensis* Seedlings

Stem Dry Weight (SDW) of *K. senegalensis* seedlings as influenced by cow dung and *G. sepium*

There was no significant difference (p>0.05) in the SDW of *K. senegalensis* seedlings among all treatments used (Table 2). However, seedlings grown with T_5 gave the highest mean value of SDW (2.33 g) while seedlings grown with T_7 and T_9 gave the least growth in mean SDW (1.33 g) (Figure 5).

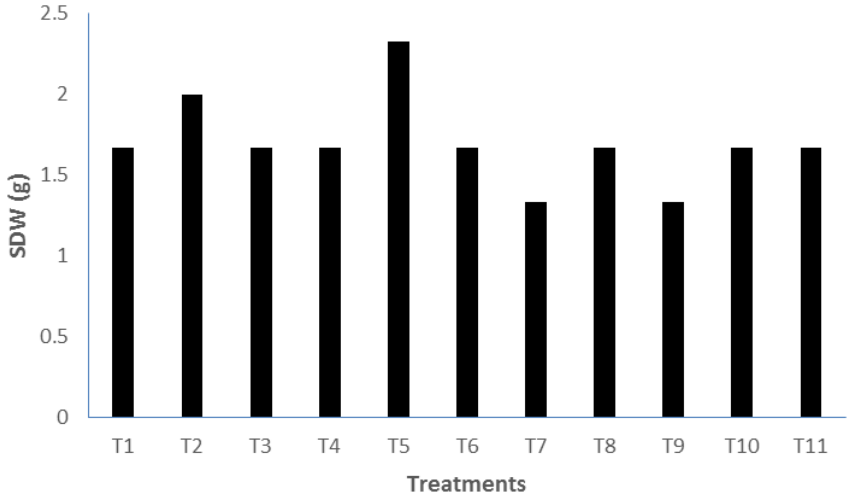

Figure 5: Mean SDW of *K. senegalensis* Seedlings

Root Dry Weight (RDW) of *K. senegalensis* seedlings as influenced by cow dung and *G. sepium*

There was no significant difference (p>0.05) in the RDW of *K. senegalensis* seedlings among all treatments used (Table 2). However, seedlings grown with T_2, T_5, T_7 and T_9 gave the highest mean value of SDW (1.67 g) while seedlings grown with T_{11} gave the least growth in mean SDW (1 g) (Fig. 6).

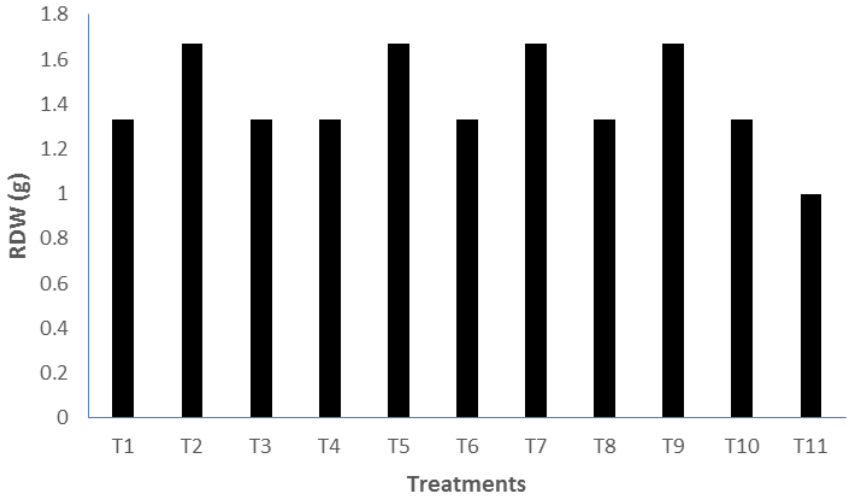

Figure 6: Mean RDW of *K. senegalensis* Seedlings

CONCLUSION AND RECOMMENDATION

From the results obtained, T_5 with 50g of cow dung performed best on *Khaya senegalensisc /* seedlings in plant height, stem diameter, and leaf production, than any other treatments because of its organic materials which are chemically, physically and biologically improved. The differences in the treatments were not significant at 5% level in stem diameter and leaf production except in the plant height. Therefore, the experiment revealed that cow dung can influence the growth and development of *K.senegalensis* seedlings. The study also showed the potentials of cow dung over *G. sepium* leaves for improved growth of *K. senegalensis* seedlings. It can be concluded that addition of cow dung as manure to *K. senegalensis* seedlings will better produce healthy and vigorous seedlings in a short period of time rather than using *G. sepium* leaves.

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