Asian Journal of Agricultural and Horticultural Research

4(4): 1-10, 2019; Article no.AJAHR.48847
ISSN: 2581-4478

Effects of Seeds Source and Manure Type on Germination and Early Growth of *Khaya senegalensis* (Desr) A. Juss Seedlings in Bauchi State, Nigeria

E. M. Abubakar[1*] and E. K. Rabo[2]

[1]Department of Forestry Technology, Bauchi State College of Agriculture, Yelwa, Bauchi, Nigeria.
[2]Department of Agric Extension and Management, Bauchi State College of Agriculture, Yelwa, Bauchi, Nigeria.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI:10.9734/AJAHR/2019/v4i430029
Editor(s):
(1) Dr. Rasmia Sayed Sayed Darwesh, Professor, Central Laboratory for Date Palm Research and Development, Agriculture Research Center, Giza, Egypt.
Reviewers:
(1) Suzana Jordanovska, Saints Cyril and Methodius University of Skopje, North Macedonia.
(2) Schirley Costalonga, Universidade Federal do Espírito Santo, Brazil.
(3) Grace O. Tona, Ladoke Akintola University of Technology, Nigeria.
Complete Peer review History: https://sdiarticle4.com/review-history/48847

Original Research Article

Received 02 March 2019
Accepted 08 May 2019
Published 01 November 2019

ABSTRACT

Khaya senegalensis (Desr) A. Juss *is a perennial deciduous tree which has many uses in developing nations. The population of the tree is rapidly declining due to no conservation efforts to prevent the species from endanger and extinction.* At the moment there is dearth information on manure types required to raise healthy seedlings of the tree species in the study area. *To conserve this genetic resource, germination and early growth rate experiment was carried out using seeds collected from three locations (*eco-zones) *(Alkaleri, Bauchi and Toro).* Matured seeds of *K. senegalensis* were collected from mother tree stand in the three locations. One hundred and fifty seeds (150) from each location were sown in perforated polythene pots at an average depth of 2-3 cm. After germination i.e. 30 days after planting, different manures were applied to the seedlings. The experiment was laid out in a Completely Randomized Design (CRD) with three treatments, namely: poultry dung, cow dung and NPK manures; the experiment was replicated four times. Data

**Corresponding author: Email: elishaabubakar@gmail.com;*

on seeds germination variables of interest (seedling heights, number of leaves, collar diameter, leaf area, leaf width, leaf length and fresh weights) were measured. Seedlings height were measured using meter rule, collar diameters using a venier caliper, numbers of leaves were determined by manual counting the number of leaves on the seedlings, leaf area was measured by tracing leaves of seedling on a graduated graph sheet. Data collected on seed germination and early growth rate were subjected to descriptive statistics and inferential statistics (ANOVA). Where significant differences occurred, Tukey test was used to separate the means. Based on this finding, germination of seeds commenced after 10 to 14 days. Locations and manure types had significant effects on the mean heights, number of leaves, collar diameter, leaf area, leaf width, length and fresh weights of *K. senegalensis* seedlings in the study area. Thus, for species conservation and genetic heredity, seeds sourced from Bauchi eco-zone was the best with poultry manure as the best performed manure for the raising of *K. senegalensis* seedlings in the study area.

Keywords: Seedling; manure; growth; germination; Khaya senegalensis.

1. INTRODUCTION

Khaya senegalensis is which is commonly called "Mahogany" in English, Madachi in Hausa, *Oganwa* in Yoruba, *Ono* in Igbo; belongs to the family of Meliaceae; and is known as the most suitable indigenous tree species for timber production in Africa. It is a savanna tree, easily recognized by its round evergreen crown of dark shining foliage pinnate leaves and of round capsules [1]. The species is characterized by leaves arranged in a spiral formation clustered at the end of branches; along with white, sweet-scented flowers and fruit changing from grey to black when ripened [2].

K. senegalensis is commonly found in the north central geopolitical zone namely: Niger, Kogi, Benue, and Plateau States among others [3]. The species has high traditional medicinal values. The tree is native to Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Ivory Coast, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Mali, Niger, Nigeria, Senegal, Sierra Leone, Sudan, Togo and Uganda. It is found in riparian forests and higher-rainfall savannah woodlands; in moist regions it is found on higher ground.

The tree species is valued for high-class furniture, construction purposes, joinery, building, cabinet work, ship building and in the production of' decorative veneers [4]; and recommended for utilization purposes for which surface quality is of high importance [5].

The present and future demand for African mahogany was increasing in the later part of the 20th century, large individual trees of Mahogany species in natural stands started becoming increasingly rare [6]. *K. senegalensis* is regarded as one of the extinct indigenous wood species in the society [7]. It natural regeneration is very poor, due to shoot borer (*Hypsipyla robusta*) attacks, which prevent its success in plantations within the native area in West Africa [4].

To conserve and restore *K. senegalensis* in the study area*,* there is the need to assess growing media in order to raise healthy seedlings for the tree plantation establishment. For this to be achieved, the plant species would requires favorable soil texture to grow and reproduce in response to an interaction of dynamic and over changing components in the environment; the reduction or excess of any of these growth factors would affects the plant growth [6]. This study aimed at finding different growing media for seed germination and early growth rate and seedling vigor of *K. senegalensis.*

2. MATERIALS AND METHODS

2.1 The Study Area

The experiment was carried out in Bauchi State, Nigeria. The experimental seeds were collected from three eco-zones in Bauchi state, namely: Alkaleri, Bauchi and Toro eco-zones s in Bauchi State, Nigeria.

2.1.1 Alkaleri local government area

Alkaleri is one of the 20 local government areas of Bauchi State in Nigeria, with its headquarter at Alkaleri; located between 10°15'58" N and 10°20' 07" E. It has land area of 5,918km² and a population of 329,424 [8]. The predominant tribes in the area are 'Kannuri, Fulani, Dugurawa and Jukun'. Socio-economic activities include: farming, hunting, civil service, business, etc.

2.1.2 Bauchi local government area

Bauchi Local Government Area is located between latitude 10°22' north of the equator and longitude 9°42' East of the Greenwich Meridian at an elevation of 607.4m above sea level. It has land area of 3,687km² with a population of 493,840 [8]. The predominant tribes are 'Gerawa, Fulani and Hausa'. Human cultivation include: farming, hunting, business, civil service, among others [9].

2.1.3 Toro local government area

Toro is one of the local government areas of Bauchi South Senatorial Districts of Bauchi State in Nigeria, with it headquarter at the Toro which is located at Latitude 5°40' and 7°40'N and longitude 5°00' and 6°30' E. It has an area of 6,932km² with total population of 350,404, [10]. The predominant tribes are 'Jarawa, Fulani and Ribina". Socio-economic activities include: farming, hunting, civil service and business, among others [8].

2.2 Experimental Design

Matured seeds of *K. senegalensis* (Desr) A Juss were collected from mature mother tree of superior phenotypic traits within three locations (eco-zones) (Toro, Bauchi and Alkaleri towns) in Bauchi State, Nigeria. In this study, the locations are referred to as seeds source. The matured seeds were not given any pre-treatment before being planted in the month of March to May.

Two seeds of *K. senegalensis* were sown at an average depth of 2 cm in each polythene pot and later thinned to one stand per pot after germination [11]. It took the seeds between 9 to 15 days to germinate. One hundred and fifty seeds (150) from each location were sown in perforated polythene pots; this was to ensured water drainage. Manure types were applied to the seedlings 30 days after planted, i.e. after germination was assessed. Top soil and organic manure were collected within Bauchi town. Seedlings were irrigated daily within the experimental period of 3 months [12]. The experiment was laid out in a Completely Randomized Design (CRD) with three treatments, namely: poultry dung, cow dung, and NPK fertilizer; the experiment was replicated four times.

2.3 Data Collection

Data on seeds germination from each location were observed and recorded from the 3rd day of seeds planted until the end of emergence (30 days after sowing). Four seedlings were randomly selected from each treatment and the growth variables (such as seedling heights, number of leaves, collar diameter, leaf area, leaf width, leaf length and fresh weights) of interest were measured. Seedlings height were measured from the collar region to the apex of the seedlings by the used of plastic meter rule. Collar diameters were measured using a veneer caliper. Numbers of leaves were determined by manual counting the number of leaves on the seedlings. Leaf area was measured by tracing four (4) leaves of seedling on a graduated graph sheet. Six seedlings from each treatment were selected and leaf area assessed as reported by Aluko et al. [13]. Seedling fresh weights were determined at the final day of data collection; the fresh weights of the seedlings were taken with an electronic weighing scale.

2.4 Data Analysis

Data collected on seed germination and early growth rate (seedling heights, number of leaves, collar diameter, leaf area, leaf width, leaf length and fresh weights) were subjected to descriptive statistics (such as percentages, mean and standard deviation) and inferential statistics (two-way analysis of variance (ANOVA), using SPSS [14] statistical. Where significant differences occurred, Tukey test was used to separate the means.

3. RESULTS

3.1 Effects of Seeds Source on Germination Rate of *Khaya senegalensis* Seeds in Bauchi State, Nigeria

The results of this finding on effects of seed sources on germination rate of *K. senegalensis* seeds from different source (locations) were shown on Fig. 1. Germination commenced on the 14th day through the 26th day. The result on germination rate was tested, and the ANOVA result showed significant differences (p<0.01) from the 14th day of seed germination to the twenty six day. On the 26th day after planting, seeds collected from Bauchi eco-zones were observed to have the highest (36%) germination rate, followed by seeds collected from Alkalerieco-zones which had a germination rate of 34% while Toro eco-zones recorded the lowest germination rate (27%) in the study area.

3.2 Effect of Manure Types on Mean Height Growth, Number of Leaves and Collar Diameter of *Khaya senegalensis* Seedlings Sourced from Different Eco-zones s, Bauchi State, Nigeria

The result on the effect of manure types on the mean height growth of *K. senegalensis* seedlings sourced from different location in Bauchi state is presented on Table 1. Based on the results of this finding, there was significant (p=0.0002) effect between the manures (fertilizers) type on the seedlings growth. Seedlings from the three different locations (eco-zones s) treated with poultry and cow manures fertilizer performed better compared with inorganic fertilizer. Poultry manure had the highest (15 cm) mean height growth of seedlings sourced from Toro eco-zones, followed by cow dung which had 14 cm while the least mean height of 12 cm was recorded under inorganic manure. In Bauchi eco-zones, cow dung had the highest (17 cm) mean height growth of seedlings while the least mean height of 14 cm was recorded under inorganic manure. Seeds sourced from Alkaleri zone (16 cm) were observed as the highest mean height under poultry dung, 15 cm from cow dung, 14 cm was recorded under Control while the least mean height of 14 cm was observed under inorganic manure.

The result of this finding on mean number of leaves of *K. senegalensis* seedlings (Table 1) was tested and the ANOVA result showed significant difference (p=0.0001) between the manure types. Poultry manure had the highest (9.50) mean number of leaves sourced from Alkaleri eco-zones, followed by cow dung which had 9.33 as the mean number of leaves (Bauchi) while inorganic manure had 6.71 mean number of leaves which was less than that of poultry manure, cow dung and the Control. In Toro eco-zones, poultry and cow dung manures had the highest (8.54 and 8.52) mean number of leaves while inorganic fertilizer had the lowest (6.71) mean number of leaves. Seeds sourced from Bauchi zone showed poultry dung and cow dung manures thrift best with the highest mean number of leaves 9.33 and 8.56 while NPK and Control had 7.64 numbers of leaves.

In Toro eco-zone, untreated seedlings had 3.47 cm and poultry manure had 3.47 cm as the highest effect on the mean collar diameter, followed by cow dung manure which had 3.42 cm while inorganic manure had the lowest (3.04 cm) collar diameter as observed in the study area. Cow dung manure in Bauchi eco-zones had the highest collar diameter of 3.82 cm while inorganic manure was the least with effect on collar diameter of 3.13 cm. In Alkaleri eco-zones, collar diameter under cow dung manure performed better which had mean collar diameter of 4.02 cm, while untreated seedlings had the lowest mean collar diameter of 3.27 cm. Based on the result of on the mean collar diameter (Table 1), there was significant effect seeds source and manure types; with Tore had a p= 0.001, Bauchi (p= 0.001) and Toro had p= 0.001.

3.3 Effect of Manure Types on Mean Leaf Length and Width of *K. senegalensis* Seedlings Sourced from Different Eco-zones s, Bauchi State, Nigeria

Effects of manure type on the leaf length and width of *K. senegalensis* seedlings in the study area was assessed and the result of this finding is shown on Figs.2 and 3. Between the growing periods of 2nd week to 12th week, result recorded on leaf length ranged from 4.95 cm to 11.15 cm (Fig. 2) and leaf width between 2.28 cm to 4.55 cm (Fig. 3). Based on the result recorded, on the 2nd week (i.e. 4weeks after seeds planting) seedlings from Bauchi eco-zones had the highest leaf length of 6.25 cm while 4.95cm was the lowest leaf length recorded from seedlings under Toro eco-zone of Bauchi state. On the 12th week of the experiment, seedlings under Bauchi zone was the highest (11.15 cm) while 10.35 cm was the lowest leaf length recorded under Toro eco-zone in the study area.

The result recorded for leaf width of *K. senegalensis* seedlings on the 2nd week was 3.15 cm under Bauchi eco-zone which had the highest leaf width while 2.28 cm (under Toro) was recorded as the lowest leaf width. On the 12th week of the experiment, seedlings with leaf width under Bauchi zone was still the highest (4.55 cm) while 4.21 cm was the lowest leaf width recorded under Alkaleri eco-zone in the study area.

3.4 Effect of Manure Types on Mean Leaf Area and Fresh Weight of *Khaya senegalensis* Seedlings Sourced from Different Eco-zones s, Bauchi State, Nigeria

Fig. 4 shows the effect of manure types on leaf area of *K. senegalensis* seedlings in the study

area. The result revealed that poultry manure, inorganic manure and Control had no significant effect on the leaf area of *K. senegalensis* seedlings while cow dung manure had significant (p=0.04) effect on the leaf area of the seedlings sourced from the three seeds location. Alkaleri eco-zone had the highest mean leaf area of 44.15 cm^2 on application of poultry dung manure followed by Bauchi eco-zone under poultry manure and cow dung manure had a mean leaf area of 40.55 cm^2 while inorganic manure had 31.77 cm^2 (Toro), 38.95 cm^2 (Bauchi) and 40.55 cm^2 in Alkaleri eco-zones. The least mean leaf area of 25.32 cm^2 (Toro), 30.92 cm^2 (Alkaleri) and 32.83 cm^2 (Bauchi) were recorded under untreated seedlings in the study area.

Fig. 5 shows effects of manure type application on the Fresh Weight of *K. senegalensis* seedlings from the three eco-zones s in Bauchi state. The highest fresh weight (31 g) was recorded under cow-dung and inorganic manures application in Bauchi eco-zones while poultry manure application in Toro eco-zone had a fresh weight of 29 g while the least fresh weight of 16 g was recorded under Control in Alkaleri eco-zone.

4. DISCUSSION

K. senegalensis seed germination showed significant variation ($p<0.05$) between the three seeds sourced. This could be as result of seed location or polymorphism phenomenon. Polymorphism of mahogany seed is one of the obstacles to uniform germination and successful plantation establishment [15]. The period at which seed germination occurred is in line with the report of Robertson et al. [16], who reported that germination in mahogany seed commences after about 10 to 14 days. The result also agrees with study of Algunaid et al. [17], who reported that the differences in mahogany seed germination between locations may be attributed to the effect of environmental conditions and water availability in each location.

This finding on the effect of manure on the mean height of *K. senegalensis* seedlings from the zones implied that poultry manure was the best performed manure for the raising of *K. senegalensis* seedlings in the study area, followed by cow dung manure. Inorganic manure performed poorly in all the three seeds sourced. This could be as a result of high doses of inorganic manure application, since absorption of this element can affect the metabolic processes. This showed that inorganic manure had little or no positive effect on the mean height growth of *K. senegalensis* seedlings.

K. senegalensis seedlings grown on different manure type had significant effect on the seedlings mean height, if seeds are sourced from Toro, Bauchi or Alkaleri eco-zone. The difference could be as a result of effect from geographical location (seeds source) that influenced the differences between the eco-zones.

Seedlings treated with poultry dung or cow dung manure had faster growth rate than plants treated with inorganic manure. Ajari et al. [18] reported that poultry manure increase plant height when compared with other sources of manure; comparatively high nitrogen content of poultry manure buttresses the vegetative growth of plants. The negative effect of inorganic manure may be as a result of effect of inorganic manure application when applied on high rate.

Based on this finding, for better number of leaves of *K. senegalensis s*eedlings in the study area, poultry dung and cow dung manure are the best manure type to raise *K. senegalensis s*eedlings in the study are. The result on the number of leaves agrees with the study of Carl and Peter [19], who reported that organic manure steadily releases available nutrients over time and not like inorganic manure which releases nutrients within a short period to plant; this could result to negative effects if not properly checked. The result on poultry manure which showed the highest mean number of leaves in Alkaleri eco-zone may be as a result of higher concentration of nitrogen than cow dung. The result also confirms the findings of Swiader et al. [20] which reported that the best soil for growing seedlings is the one that is well drained and has a relatively high amount of organic matter.

The result on effects of manure type application on collar diameter implied that there was no need for manure application when *K. senegalensis* seedlings are to be sourced from Toro and Alkaleri eco-zones while if the seeds were sourced from Bauchi, there will be need for manure application.

Based on the treatments variation in leaf area of *K. senegalensis* seedlings, cow dung had the best mean leaf area among the three eco-zones. The highest mean leaf area was recorded in seedlings treated with cow dung and poultry

dung manures (organic manures). May be organic manures have further enhanced growth performance of the seedlings compared to the inorganic manure. This result agrees with the work of Ogunwale et al. [21], who reported that the addition of organic matter content resulting from organic fertilizer application helps to improve nutrient availability to plants, especially in tropical soils that are generally low in soil organic matter.

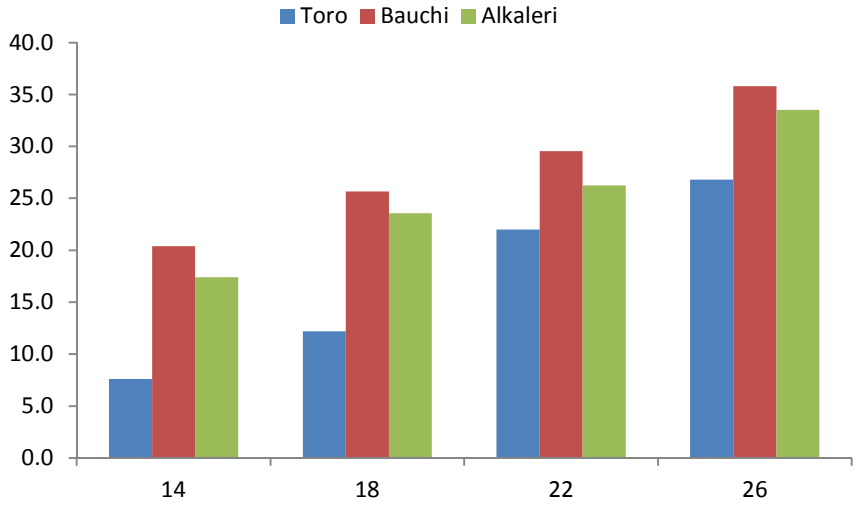

Fig. 1. Effects of seeds source on germination rate of *K. senegalensis* seeds sourced from different location in Bauchi State, Nigeria

Table 1.Anovaresult on effect of seeds source and manure types on growth variables of *Khaya senegalensis* seedlings sourced from different location in Bauchi State, Nigeria

Manure types	Seeds source		
	Toro	**Bauchi**	**Alkaleri**
Mean height (cm)			
Inorganic manure	12±0.37^{b}	14±0.43^{b}	14±0.40^{b}
Cow dung	14±0.37^{a}	17±0.49^{a}	15±0.38^{a}
Poultry dung	15±037^{a}	17±0.47^{a}	16±0.42^{a}
Control	13±0.63^{ab}	15±0.67^{b}	14±0.60^{ab}
P-Value	<0.02	<0.02	<0.02
Number of Leaves			
Inorganic manure	6.71±0.26^{b}	7.64±0.30^{b}	6.94±0.29^{c}
Cow dung	8.52±0.26^{a}	9.33±0.32^{a}	8.78±0.29^{ab}
Poultry manure	8.54±0.21^{a}	8.56±0.25^{a}	9.50±0.34^{a}
Control	6.66±0.32^{b}	8.26±0.47^{ab}	8.10±0.37^{bc}
P-Value	<0.01	<0.01	<0.01
Collar diameter (cm)			
Inorganic manure	3.04±0.08^{b}	3.13±0.08^{a}	3.37±0.09^{c}
Cow dung	3.42±0.10^{a}	3.82±0.10^{a}	4.02±0.24^{a}
Poultry dung	3.47±0.10^{a}	3.69±0.09^{a}	3.85±0.09^{ab}
Control	3.47±0.17^{a}	3.66±0.17^{a}	3.27±0.14^{c}
P-Value	<0.01	<0.01	<0.01

Means on the same column with different superscript are statistically significant ($p<0.05$), ns = not significant

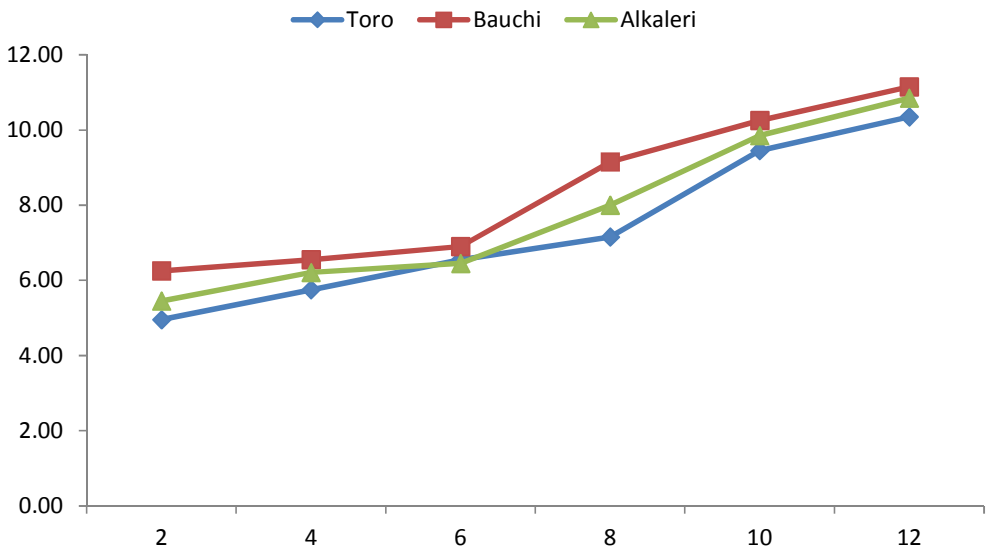

Fig. 2. Effect of manure type on the leaf length of *K. senegalensis* seedlings in Bauchi State, Nigeria

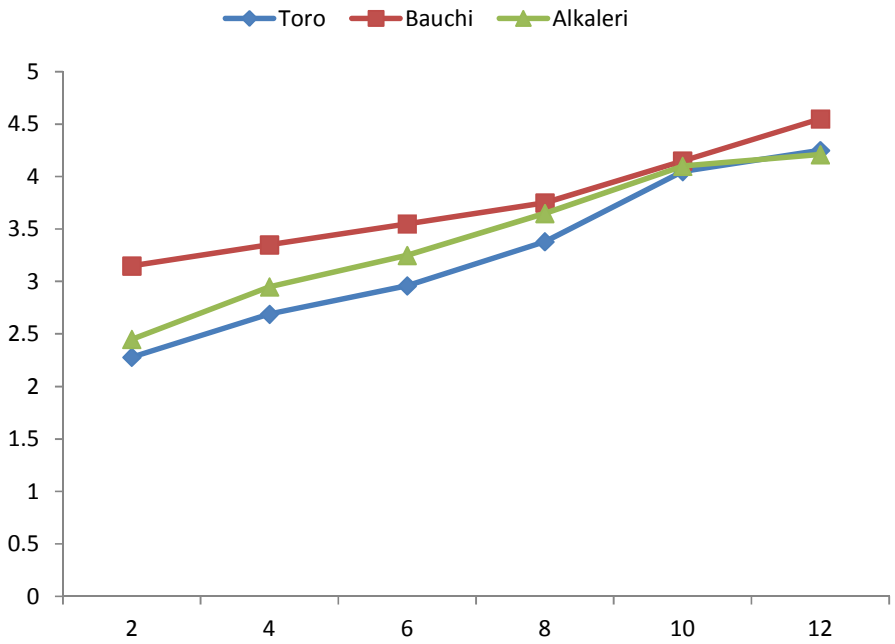

Fig. 3. Effect of manure type on the leaf width of *K. senegalensis* seedlings in Bauchi State, Nigeria

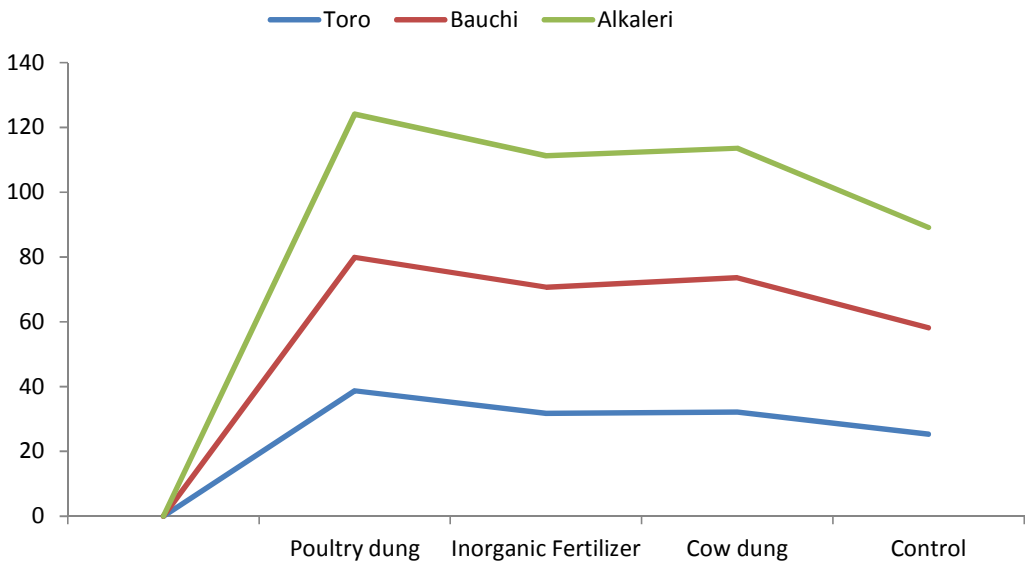

Fig. 4. Effect of manure type on leaf area of *K. senegalensis* seedlings in Bauchi State, Nigeria

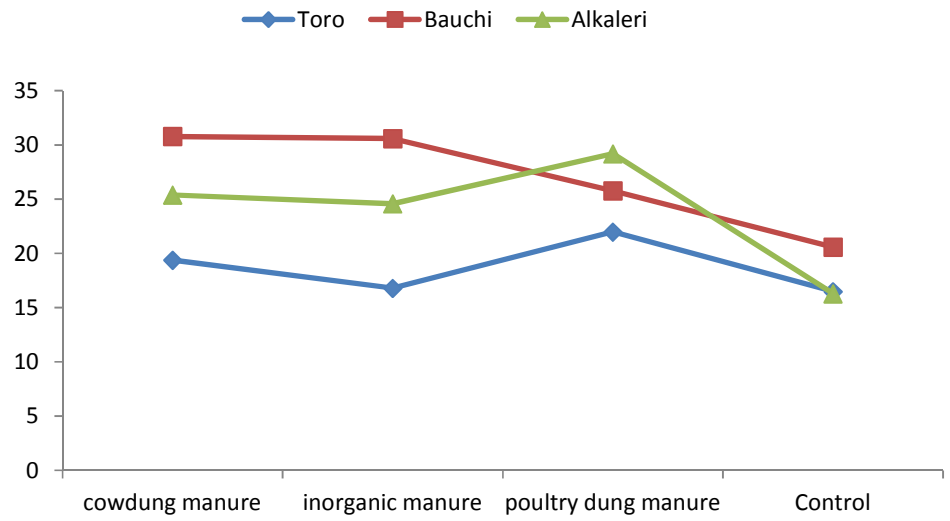

Fig. 5. Effects of manure type application on the fresh weight of *K. senegalensis* seedlings from different locations in Bauchi State, Nigeria

5. CONCLUSION

The findings of this study showed that seed locations and manure types had significant effects on the mean heights growth (cm), number of leaves, collar diameter, leaf area (cm²), leaf width (cm), leaf lengths (cm) and fresh weights (g) of *K. senegalensis* seedlings in the study

area. Thus, for conservation and genetic heredity *of K. senegalensis* species, seeds sourced from Bauchi eco-zones were the best with poultry manure as the best performed manure for the raising of *K. senegalensis* seedlings in the study area. Therefore, for successful plantation establishment of *K. senegalensis* in the study area, the seeds of the species should be collected from Bauchi eco-zone; and can be best grown with the application of poultry manure. It is recommended that similar studies should be carry out in the other two eco-zones i.e. Alkaleriand Toro to re-examine or attest the performance of seeds sourced from Bauchi eco-zone.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kubmarawa D, Khan ME, Punah AM, Hassan M. Phytochemical screening and antimicrobial efficacy of extracts from *Khaya senegalensis* against human pathogenic bacteria. African Journal of Biotechnology. 2008;7(24).
2. Sondarva RL, Prajapat VM, Mehta ND, Bhusara J, Bhatt BK. Effect of various growing media on early seedling growth in *Khaya senegalensis* (Desr.) A. Juss. International Journal of Current Micro-biology Applied Science. 2017;6(12):3290-3294.
3. Michael A. Trees, shrubs and lianas of West Africa dry zones. (CIRAD Muggraf Publishers GMBH. MNHN. 2004;355.
4. Nikiema A, Pasternak D. *Khaya senegalensis* (A. Juss). In: Louppe D, Oteng-Amoako AA, Brink M. (Eds.). Plant resources of Tropical Africa. PROTA Foundation, Wageningen. 2008;7:339-344.
5. Zaccheus Tunde Egbewole, Odunayo James Rotowa, Emmanuel DaudaKuje, Oluwasola Abiodun Ogundana, Hassan Haladu Mairafi, Ibrahim Yohanna. Early germination, growth and establishment of *Khaya senegalensis* (DESR.) A. Jussin middle-belt zone of Nigeria. Journal of Energy and Natural Resources. 2018;7(3): 75-82.
6. Saka MG, Amadi DCA, Olaniyi WA. Effects of different soil potting mixture on the early growth of Mahogany (*Khaya senegalensis*) A. Juss; FUTOJNLS. 2016;2(2):35–42.
7. UNEP-WCMC. *Khaya senegalensis*; In: Contribution to an evaluation of tree species using the new CITES listing criteria “Profiles of tree species: Africa. United Nations Environment Program Convention on International Trade in Endangered Species; 2002.
   Available:http://www.unep-wcmc.org/species/tree
8. Dau JH, Elisha A. Survey on non-timber forest products in Bauchi South Senatorial Districts, Bauchi State, Nigeria. Journal of Research in Forestry, Wildlife and Environmental. 2013;6(1).
9. National Bureau of Statistics. Archived from the original on 1st May, 2010. Retrieved; 2010.
10. National Population Commission. National Population Commission; Bauchi State; 2006.
11. Ufere N. Uka, Kanayo S. Chukwuka, Mary Iwuagwu. Relative effects of organic and inorganic fertilizers on the growth of Okra. Journal of Agricultural Sciences. 2013; 58(3):159-166.
12. Imoro AWM, Sackey I, Abubakari AH. Preliminary study on the effects of two different sources of organic manure on the growth performance of *Moringa oleifera* seedlings. Journal of Biology, Agriculture and Healthcare. 2012;2(10):147-158.
13. Aluko OA, Olanipekun TO, Olasoji JO, Abiola IO, Adeniyan ON, Olanipekun SO, Omenna EC, Kareem KO, Douglas AI. Effect of organic and inorganic fertilizer on the yield and nutrient composition of jute mallow. Global Journal of Agriculture Research. Published by European Centre for Research Training and Development UK. 2014;2(3):1-9.
   Available:www.eajournals.org
14. SPSS. (Statistical Package for Social Sciences): Procedure and Facilities for release, Mc Graw-Hill Book Co. New York, USA, IBM SPSS Statistics. 2012;Version 21.
15. Mahhoub S. Studies of physiological, environmental and of some forest tree species. Ph.D. Thesis, U. K; 2002.
16. Robertson B, Reilly D. Growing African Mahogany in Northern Australia; 2012.
17. Algunaid FH, Ibrahim AM, Zahran BB. *K. senegalensis* seeds polymorphism and dormancy breaking, Seeds collected from different localities in Sudan. International

Journal of Scientific and Research Publications. 2013;3.
Available:www.ijsrp.org

18. Ajari O, Tsado E, Oladiran J, Salako E. Plant height and fruit yield of okra as affected by field application of fertilizer and benlate in Bida, Nigeria. Nigeria Agricultural Journal; 2004.
DOI: 10.4314/naj.v34i1.3173
19. Carl JR, Peter MB. The effects of manure on the soil using manure and compost nutrient sources for fruit and vegetable crops, University of Minnesota; 2014.
20. Swiader MJ, Ware W, McCollum JP. Producing vegetables vero media Inc: 4th edition. 1992;105.
21. Ogunwale JA, Olaniyan JO, Aduloju MO. Morphological, physio-chemical and CLA mineralogical properties of soil overlaying basement complex rocks in Ilorin East, Nigeria. Moor Journal of Agriculture Resources. 2002;3(2):147-154.

Peer-review history:
The peer review history for this paper can be accessed here:
https://sdiarticle4.com/review-history/48847