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Effect of Poultry Manure Application on the Growth and Fibre Yield of three Kenaf (*Hibiscus cannabinus* L.) Varieties in the Northern Guinea and Sudan Savanna of Nigeria

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Abstract

Field trials were conducted during the 2017 wet season at the Research farms of the Institute for Agricultural Research, Samaru and Kadawa to study the fibre yield response of three Kenaf (Hibiscus cannabinus L.) varieties (Ifeken 400, Ifeken D1 400 and Girin danani) under four rate of poultry manure (0, 2, 4 and 6 t ha^{-1}) factorially combined and laid in a Randomized Complete Block Design and replicated three times. Plots supplied with 6 t ha^{-1} poultry manure significantly produced ($p<$ 0.05) taller plants with more leaves, higher shoot dry weight and fibre yield. Although no statistical difference was observed among varieties during the growth stages (plant height, number of leaf and shoot dry weight) across sampling periods except in Samaru, at 3 and 6 weeks after sowing(plant height), where Girin danani produced significantly taller plants than other varieties. The interactions between varieties and poultry manure was significant on shoot dry weight in Samaru. However Girin danani variety significantly produced ($p <0.05$) higher fibre yield of (148.1 and 152.5 kg ha^{-1}) in both locations, compared with Ifeken 400 and Ifeken D1 400 varieties. Based on the results obtained from this trail, the application of 6 t ha^{-1} poultry manure and Girin danani variety resulted in higher growth and fibre yield in both locations.Therefore, the use of Girin danani variety and 6 t ha^{-1} poultry manure can be adopted by farmers in the Northern guinea and Sudan Savanna agro ecological zones to enhanced the growth and fibre yield of kenaf.

Keywords: Growth, Fibre Yield, Poultry manure, Kenaf and Varieties.

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Introduction

Kenaf (*Hibiscus cannabinus* L.) is a fast growing annual crop of the malvaceae family known for both its economic and nutritional importance. Kenaf is believed to have its origin in Africa (Western Sudan), occurring as early as 4000BC, where diversified forms of its species are widely grown (Mostofa *et al.*,2013; Dempsey, 1975; Kobayashi *et al.*, 2003 and Cheng *et al.*, 2004).It is an erect annual shrub 1-4 meters height, with well-developed tap roots, straight and slender stems. It has cream-colored, large flowers characterized by a reddish purple throat. The seeds are cylindrical or kidney-shaped pubescent, grey in colour and ranged between 35,000 to 40,000 per kg. (Purseglove, 1974 and Dempsey, 1975). Kenaf is the most economically important fiber crop after cotton and jute. Kenaf is traditionally grown in East Central Africa, western Asia and in several southern states of America for fibre and seed oil production. It is also an excellent forage crop (Muchow and Wood, 1980) containing 18-30% crude leaf protein and stalk protein 5.8-12.1% (Ogbonnaya *et al.*, 1997). Kenaf fiber is comparable to jute in luster, although it is coarse, less supple and resistant to rottening. The cordage fiber is used in sacks, mats, carpets, ropes roofing and canvass. The stalk is used as paper pulp and the seeds contain about 20% oil which is extracted and used as lubricant and for illumination, soaps, paints varnishes (Purseglove, 1968).The leaf contains about 25% crude protein (Killinger,1965) and is used in human diets and animal feeds. Investigation has indicated that Nigerian savannah soils are largely deficient in major essential nutrients like nitrogen, phosphorus and potassium. Making it necessary to supply and enrich the soil with applied nutrients using inorganic and organic sources such as poultry, cow and goat manure. The use of inorganic fertilizer is constrained by factors, such as unavailability of the right type at the right time, and at affordable cost, as well as inadequate credit facilities for the farm inputs (Chude, 1999). Hence organic manure is a better alternative and a necessary option for improved crop production especially in the Northern Guinea and Sudan Savannah of Nigeria. Poultry manure is relatively cheap, readily available to small holder farmers and improve soil physical properties compared to inorganic fertilizers, similarly the increasing demand for poultry manure was due to its health benefits and risk-free characteristics especially in vegetables and fruits production. Poultry manure has been found to have higher nutrients concentration (Iken and Amusa, 2004). Although in Nigeria research work on poultry manure recommendation for kenaf production is not available, however improve and high yielding kenaf varieties have been developed such as Ifeken 400 and Ifeken D1 400. Based on this, the present study was conducted to determine the appropriate rate of poultry manure and suitable variety in growing kenaf for fibre in the Northern guinea and Sudan savannah agroecological zones of Nigeria.

Materials and Methods

Experimental Site

The experiment was conducted at the Institute for Agricultural Research (I.A.R) Farm, Samaru, (Latitude 11^0 11N Longitude 07′ 38 E, 686m) above sea level in Kaduna State and at Kadawa, (Latitude 11^0 39 N Longitude 08′ 27 E, 500m) above sea level in Kano State, in the northern Guinea and Sudan savannah ecological zones of Nigeria, respectively during the 2017 wet season (Kowal and Knabe, 1972).

Treatments, Experimental Design and Plot Size

The treatments consisted of four rate of poultry manure (0, 2, 4 and 6 tons ha^{-1}) and three varieties of kenaf (Ifeken 400, Ifeken D1 400, and Girin danani). The treatments were factorially combined and laid out in a Randomized Complete Block Design (RCBD) and replicated three times. The gross plot size was 4m x 3 ($12m^2$) while the net plot was 2 x 3 ($6m^2$).

Land preparation and fertilizer application
The experimental field was cleared and harrowed twice, and raised seed beds were constructed according to plot size above. The poultry manure was applied 7 days before planting by mixing the manure thoroughly with the soil with a hoe in each plot as per treatment basis.

Sowing
Seeds were sown manually on 26th July, and 2nd August, 2017 wet season at the rate of 3 seeds per hole, at an intra-row spacing of 25cm and inter-row spacing of 50cm. Sowing was done on flat land after harrowing and the plants were thinned to 2 plants per stand at 3 weeks after sowing.

Harvesting
Kenaf was harvested for fibre when 50% of the plants had flowered and it was done four times at three weeks intervals. Harvesting was done by cutting the plant stalk at ground level and tied in bundles, the bundles were left on the field for 5 days to allow for complete defoliation before retting and the fibre is extracted from the wood by retting. Retting is done by immersing the bundles of the whole stalk in stagnant water for 10 days after defoliation is completed, then the fibre is separated from the wood and mass embedding it(NAERLS, 1993).

Data Collection
Growth parameters were assessed through random sampling of five plants from each net plot that were tagged. Observation and measurement of growth characters were done at intervals of three weeks beginning from 3weeks after sowing and terminating at 12 WAS. Parameters measured include;

Plant height (cm)
Heights of five randomly tagged plants per plot were determined by measuring the height from the ground level to the main shoot apex of the plant using a meter rule, and the average thereafter recorded.

Number of leaf
The number of leaf was counted per plant from the five tagged plants from each plot and the average per plot was determined and recorded.

Shoot dry weight (g)
Samples were oven dried to a constant temperature of 70^o C. A Metler balance (Metler Toledo, model SB16001) was then used for weight determination and the average was computed and recorded as per treatment.

Yield parameter

Fibre yield per hectare
Fibre yield was determined by weighing the fibre obtained from the retted kenaf stalk per net plot and computed on per hectare basis.

Statistical Analysis

The data collected were subjected to statistical analysis of variance (F-test) as described by (Snedecor and Cochran, 1967) to test significance of treatment effects. The treatment means were compared using Duncan's Multiple Range Test (DMRT) (Duncan, 1955).

Results

The effects of varieties and poultry manure rate on the mean height of kenaf during the 2017 wet season at Samaru and Kadawa is presented in Table 1. A significant difference between varieties at 3 and 6 WAS in Samaru. At 3 WAS, Girin danani significantly produced taller plants, than Ifeken D1 400 and Ifeken 400 which were statistically similar. At 6 WAS the production of tall plants by Ifeken 400 was significant, while Girin danani significantly produced taller plants than Ifeken D1 400. At Kadawa, no significant difference was observed between varieties on plant height of kenaf at all sampling periods. Application of poultry manure significantly influenced the height of kenaf at 3 and 6 WAS in Samaru and 3-12 WAS at Kadawa. Where the application of 6 t ha^{-1} poultry manure produced taller plants than other rates. The interactions between varieties and poultry manure rate on the mean height of kenaf was not significant throughout the period of study.

Table 1: Effects of varieties and poultry manure rate on the mean height of kenaf at Samaru and Kadawa during the 2017 wet season.

Plant Height (cm)	**Samaru**				**Kadawa**			
Treatment	**3WAS**	**6WAS**	**9WAS**	**12WAS**	**3WAS**	**6WAS**	**9WAS**	**12WAS**
Variety (V)								
Ifeken 400	41.47b	138.73ab	168.05	180.02	48.28	151.59	174.92	201.02
Ifeken D1 400	41.56b	137.12b	164.15	178.40	45.92	151.91	176.52	202.72
Girindanani	43.78a	140.41a	162.88	175.55	45.03	152.71	174.68	198.11
SE±	0.681	0.980	3.375	4.490	1.231	3.983	3.888	4.463
Poultry manure (t ha^{-1})								
0	36.57b	132.82c	160.42	172.80	39.31c	141.92b	162.73c	178.24b
2	43.87a	138.18b	161.73	174.00	45.62b	156.81a	171.22bc	186.08b
4	43.82a	140.45ab	165.42	177.74	47.97b	154.37ab	182.11ab	216.86a
6	44.82a	143.56a	172.53	187.39	52.74a	155.17ab	185.44a	221.28a
SE±	0.787	1.132	3.897	5.185	1.422	4.599	4.490	5.154
Interaction								
V x M	NS	NS	NS	NS	NS	NS	NS	NS

Means in a column of any set of treatment followed by different letter (s) are significantly different at 5% level using DMRT.
WAS = Weeks after sowing NS = Not significant ** = significant at 1%

The effects of varieties and poultry manure rate on the mean number of leaf of kenaf during the 2017 wet season at Samaru and Kadawa is presented in Table 2. Crop variety influenced leaf numbers at 3 WAS in Samaru only, whereas Ifeken D1 400 and Girin danani significantly produced higher number of leaf than Ifeken 400.Application of poultry manure had significant effect on the number of leaf of kenaf at 3 and 6 WAS in Samaru and 12 WAS in Kadawa. At 3 WAS in Samaru, application of 4 and 6 t ha^{-1} poultry manure produced similar and higher number of leaf than the lower rates, which were also similar. At 6 WAS in this location, the application of 4t ha^{-1} poultry manure significantly produced higher number of leaf than lower rate, but was statistically at par with the application of 6 t ha^{-1}. At 12 WAS in Kadawa, application of 6t ha^{-1} poultry manure produced higher number of leaf than 2 t ha^{-1}, but was statistically at par with application of 4 and 0 t ha^{-1}, while the least number of leaf was by 2 t ha^{-1} and was statistically at par with 0 t ha^{-1}.

Table 2: Effects of varieties and poultry manure rate on the mean number of leaf of kenaf at Samaru and Kadawa during the 2017 wet season

	Number of Leaf							
	Samaru				Kadawa			
Treatment	**3WAS**	**6WAS**	**9WAS**	**12WAS**	**3WAS**	**6WAS**	**9WAS**	**12WAS**
Variety (V)								
Ifeken 400	18.76	23.01	26.58	30.55	18.75	22.99	27.10	31.38
Ifeken D1 400	20.97	23.17	26.28	30.78	19.20	23.09	27.25	31.48
Girindanani	20.06	22.67	25.85	30.75	18.64	23.51	26.65	30.87
SE±	0.393	0.467	0.518	0.676	0.573	0.611	0.677	0.707
Poultry manure(tha^{1})								
0	18.69b	22.47b	26.34	30.65	17.96	22.69	26.49	30.31ab
2	19.18b	21.86b	25.01	29.31	18.91	22.54	25.69	29.87b
4	20.84a	24.13a	26.90	31.67	18.69	23.35	27.73	32.05ab
6	21.03a	23.33ab	26.70	31.16	19.91	24.21	28.11	32.73a
SE±	0.456	0.540	0.599	0.781	0.661	0.705	0.782	0.817
Interaction								
V x M	NS	NS	NS	NS	NS	NS	NS	NS

Means in a column of any set of treatment followed by different letter (s) are significantly different at 5% level using DMRT.
WAS = Weeks after SowingNS = Not significant

The effects of varieties and poultry manure rate on the mean shoot dry weight of kenaf during the 2017 wet season at Samaru and Kadawa is presented in Table 3. No significant difference between varieties was recorded at all sampling periodsin alllocations. Application of poultry manure significantly influenced shoot dry weight of kenaf at 9 WAS in Samaru where the application of 4 t ha^{-1} poultry manure produced a significantly higher shoot dry weight than at 0 t ha^{-1}; but statistically at par with plots applied with 2 and 6 t ha^{-1}. The least shoot dry weight was recorded on plots with 0 t ha^{-1}poultry manure application. There was a significant difference on the application of poultry manure on the shoot dry weight of kenaf at all sampling periods in Kadawa. At 3WAS, the application of 2 t ha^{-1} poultry manure produced significantly higher shoot dry weight than plots with 0 t ha^{-1}; but statistically at par with plots applied that had 4 and 6 tha^{-1} poultry manure application. However at 6, 9 and 12 WAS, shoot dry weight of kenaf generally increased with increasing rate of poultry manure from 0 to 6 t ha^{-1}. Shoot dry weight was significantly higher in plots with 6 t ha^{-1} poultry manure than on those with 0 t ha^{-1}. There was no significant difference on shoot dry weight from plots with 6 t ha^{-1}of poultry manure application and those applied with 2 and 4 t ha^{-1}. The lowest shoot dry weight was recorded on plots with 0 t ha^{-1}.

Table 3: Effects of varieties and poultry manure rate on the mean shoot dry weight of kenaf at Samaru and Kadawa during the 2017 wet season

	Shoot dry weight (g)							
	Samaru				Kadawa			
Treatment	**3WAS**	**6WAS**	**9WAS**	**12WAS**	**3WAS**	**6WAS**	**9WAS**	**12WAS**
Variety								
Ifeken 400	11.24	15.95	23.94	25.68	11.48	14.99	18.96	23.69
Ifeken D1 400	11.56	16.12	20.99	24.43	11.30	15.24	18.21	22.63
Girindanani	10.98	16.82	23.25	25.58	11.30	14.75	18.78	23.69
SE±	0.549	0.859	0.698	0.815	0.168	0.427	0.474	0.993
Poultry manure(t ha^{-1})								
0	10.87	14.82	20.35b	23.89	10.94b	12.47c	15.33c	20.37b
2	11.14	17.20	23.29a	26.86	11.61a	14.11bc	18.97b	22.85ab
4	11.84	17.03	23.35a	26.12	11.39ab	15.29b	19.52ab	24.38a
6	11.19	16.13	22.51ab	23.97	11.51ab	18.11a	20.72a	25.81a
SE±	0.634	0.992	0.806	0.942	0.194	0.569	0.548	1.147
Interaction								
V x M	NS	NS	**	**	NS	NS	NS	NS

Means in a column of any set of treatment followed by different letter (s) are significantly different at 5% level using DMRT.
WAS = Weeks after Sowing
** = significant at 1%
NS = Not significant

The interactions between varieties and poultry manure rate on the mean shoot dry weight of Kenaf was significant at 9 and 12 WAS in Samaru is presented in Table 4. At 9 WAS, the combination of poultry manure rate and varieties had a significantly higher shoot dry weight with Ifeken 400 and 2 t ha^{-1} poultry manure; and was statistically similar with the variety Girin danani applied with poultry manure at 2 and 4 t ha^{-1}.The lowest shoot dry weight was recorded with Ifeken D1 400 which had 2 t ha^{-1} poultry manure. At 12 WAS, Ifeken 400 applied with 2 t ha^{-1} poultry manure applicationproduced the highest shoot dry weight; but was statistically at par with Girin danani which had poultry manure at 2 and 4 t ha^{-1}poultry manure applicationand Ifeken D1 400 at 0 t ha^{-1}. The lowest shoot dry weight was recorded with Ifeken 400 at 0 t ha^{-1}.

Table 4: Interaction between varieties and poultry manure rate on the mean shoot dry weight of kenaf at 9 and 12 WAS in Samaru during the 2017 wet season

	9 WAS			
Treatment	**Poultry manure (t ha^{-1})**			
Variety (V)	0	2	4	6
Ifeken 400	19.41cd	27.35a	22.87bc	22.84bc
Ifeken D1 400	22.33bc	15.97d	23.37bc	22.29bc
Girindanani	19.31cd	26.45ab	23.92a-c	22.42bc
SE± 1.398				

	12 WAS			
Treatment	**Poultry Manure (t ha^{-1})**			
Variety (V)	0	2	4	6
Ifeken 400	21.39d	31.63a	26.86bc	23.59b-d
Ifeken D1 400	26.93a-c	21.92cd	25.31b-d	23.58b-d
Girindanani	23.34b-d	27.20ab	26.98ab	24.76b-d
SE± 1.631				

Means followed by the same letters do not differ significantly at 5% level of probability according to Duncan Multiple Range Test (DMRT)

The effects of varieties and poultry manure rate on the mean fibre yield per hectare of kenaf at Samaru and Kadawa during the 2017 wet season is presented in Table 5. A significant difference was observed between varietiesat both locations,in which Girin Danani produced higher fibre yield ha^{-1} than other varieties that were tested. Application of poultry manure significantly influenced fibre yield at both locations. The application of 6 t ha^{-1} poultry manure significantly showed the highest fibre yield against other treatments.

Table 5: Effects of varieties and poultry manure rate on mean fibre yield per hectare of Kenaf at Samaru and Kadawa during the 2017 wet season.

	Fibre yield per hectare (kg ha^{-1})	
Treatment	**Samaru**	**Kadawa**
Variety (v)		
Ifeken 400	136.9c	140.6c
Ifeken D1 400	140.9b	146.5b
Girindanani	148.1a	152.5a
SE±	2.242	1.671
Poultry manure(t ha^{-1})		
0	121.3d	121.3d
2	136.5c	139.6c
4	145.8b	154.6b
6	164.3a	170.7a
SE±	2.589	1.929
Interaction		
V x M	NS	NS

Means in a column of any set of treatment followed by different letter (s) are significantly different at 5% level using DMRT.
NS= Not significant

Discussion

The positive response of growth components such as (plant height, number of leaves and shoot dry weight) to poultry manure application from 2 to 6 t ha^{-1} at both locations could be attributed to the beneficial role of manure in providing soil nitrogen, phosphorus, potassium and other essential nutrients, which in turn improved growth and development of the plants during the trial. This is in consonance with the findings of Adekunle *et al*.(2014) who reported that the application of manure from 10-20 t ha^{-1} significantly increased the growth attributes of kenaf. The interaction between varieties and poultry manure was significant on shoot dry weight, where the combination of Ifeken 400 and 2 t ha^{-1} poultry manure produced higher shoot dry weight in Samaru. This could be probably due to the morphology of the variety and its ability to utilize the nutrients supplied by the poultry manure for rapid growth and development. This is in agreement with the findings of Mubarak (2014b) who reported that higher shoot dry weight was obtained in clemson spineless variety of okra as a result of the morphology of this variety which was taller than Ex Samaru 4 and it contributes to the weight of the variety (clemson spineless).

Fibre yield ha^{-1} was observed to increase significantly with the application of 6 t ha^{-1} of poultry manure at both locations. This could be due to the appreciable amount of essential nutrients in the poultry manure (N,P,K,Ca and Mg) and the favourable weather conditions during the 2017 wet season that favored the quick decomposition of the manure. This result conforms to earlier findings by Atif *et al*. (2015) who reported a higher yield of jute mallow when poultry manure was applied. The significant differences recorded among the three kenaf varieties in terms of their growth and yield such as plant height, number of leaves, shoot dry weight and fibre yield of kenaf is attributed to differences in the genetic composition of the varieties used. This is in line with the study of Akinfasoye *et al*. (1997) who reported that the differences in yield parameters of crops are attributed to the cultivars grown and their genetic make-up.

Girin danani produced higher fibre yield than Ifeken 400 and Ifeken D1 400 at both locations. Apart from the genetic composition of the variety which plays an important role in the potential yield of the crop, the differences in the rate of nutrient absorption and utilization among the three varieties and environmental variations could greatly influence the yield of kenaf. This result agrees with the finding of Williams (2004) who observed differences in yield of kenaf varieties due to different genetic make-up of these varieties.

Conclusion

In accordance with the findings of this study, it is concluded that the application of 6 t ha^{-1} poultry manure and Girin danani variety resulted in higher growth and fibre yield in both locations as a result of the appreciable amount of essential nutrients in the poultry manure (N,P,K,Ca and Mg) release in the soil, which improve the growth and development of the crop and the genetic composition of the variety which plays an important role in the potential fibre yield of the crop, ability to adapt to different environmental and climatic conditions of the experimental sites, and ability to absorb and utilize the nutrients supplied by the poultry manure .Therefore, the use of Girin danani variety and 6 t ha^{-1} poultry manure can be adopted by farmers in the Northern guinea and Sudan Savanna agro ecological zones to enhanced the growth and fibre yield of kenaf.

References

Adekunle, A.F., Olanipekun, S.O., Kayode, C.O., and Ogunleti, D.O. (2014). Evaluation of time of compost Application of the growth, nutrient uptake and seed yield of kenaf (*hibiscus cannabinus* L.). *Greener Journal of Soil Science and Plant Nutrition* VOI,1(1):7-15.

Adeniyan, O.N., Aluko, O.A., and Olanipekun, S.O. (2014).Genotype x environment Interaction and stability analysis in kenaf (*Hibiscus cannabinus* L.) for growth and yield performances in southwest Nigeria. *Journal of Agricultural science*; Vol. 6, No. 8; 2014.

Atif, H.N., kwthar, M. A., and Faisal, E. A. (2015).Effects of chicken manure on Growth and yield of Jute Mallow (*corchorus olitorius* L.) under Rain-Fed Conditions of Sudan. Open Access library Journal, 2:e2042.http://dx.do i.org/10.4236/oalib.1102042.

Akinfasoye, J.A., Olufolaji, A.O., Tauru, F.M., and Adenawoola, R.A. (1997). Effects of different phosphorus levels on the yield of four varieties of rained tomato (*Lycopersicon esculentum). Proceedings of the 15th Hortson Conference Nihort*, Ago-Iwoye, pp:65-66.

Cheng, Z., Lu, B., Sameshima, K., Fu, D., and Chen, J.(2004). Identification and genetic relationship of kenaf (*Hibiscus cannabinus* L.) germplasm. *Journal of Crop Science.*231:114-126.

Chude, V.O. (1999) Perspectives on fertilizer use in the 21stcentury. Book of abstract of the with Annual Conference of the Soil Science Society of Nigeria held at prestigious Palm Hotel Benin, from 21st-25th November, 1999.

Dademel, A.A. Dangale, J.H. Mhaskar, N.V. (2004). Effect of manures and fertilizers content and uptake of nutrients of garden egg (*S.gilo* L.) Varieties. *Journal of Tropical Science.* 5 (2005) pp 38-48.

Dempsey, J.M.(1975). Fibre crops. The university press of Florida, Gainesville. Pp.203-304.

Duncan, D.B. (1955). Multiple Range and Multiple F-test. *Biometrics*. 11: pp 1-42.

Iken, J.E., and Amusa, N.A. (2004). Maize research and production in Nigeria, *African Journal of Bio-tech*, 3, 302-307.

Killinger,G.B.(1965). Kenaf (*hibiscus cannabinus* L.):A multi-use use crop. *Agronomy Journal* 61: 734-736.

Kowal, J.M. and Knabe, D.I. (1972). An Agro-climatological atlas of northern states of Nigeria. Ahmadu Bello University, Zaria pp 111.

Kobayashi, Y., Otsuka, K., Taniwaki, K., Sugimoto, M., and Koboyashi, K. (2003). Development of kenaf harvesting technology using a modified sugarcane harvester. *Japan Agricultural Research quarterly.* 37:65-69.

Mostofa, M.G., Rahaman, L., and Ghosh, R.K. (2013). Genetic analysis of some important seed yield related traits in kenaf (*Hibiscus cannabinus* L.). *Journal of Natural Science*. 47:155-165.

Mubarak, Z.I. (2014b). Response of common okra (*Abelmoschus esculentus* L. Moench) varieties to NPK fertilizers and poultry manure in Northern Guinea Savannah, Nigeria. Unpublished MSC thesis Submitted to the Postgraduate School Ahmadu Bello university, Zaria, Nigeria .p.69.

Muchow, R.C., Wood, I.M., (1980). Yield and Growth Responses of Kenaf (Hibiscus cannabinus L.) in a Semi-Arid Tropical Environment to Irrigation Regimes Based on Leaf Water Potential. Irrig. Sci. 1: 209-222.

NAERLS,(1993).*Production of kenaf in Nigeria*.Extension bulletin no 66. National Agricultural Extension and Research Liaison Services(NAERLS) Zaria, Nigeria.

Ogbonnaya, C.I., Roy-Macauley, H., Nwalozie, M.C., Annerose, D.J.M. (1997).The Physical and Histochemical Properties of Kenaf (Hibiscus cannabinus L.)Grown Under Water Deficit on a Sandy Soil. Indus. Crops and Products, 7: 9-18.

Purseglove, J.W. (1968). *Tropical crops: dicotyledon 1st edition longman London*,pp719.

Purseglove,J.W.(1974).*Tropicalcrops:dicotyledonsThirdedition.Longmanpress:London*,pp.719.

Snedecor, G.W., and Cochran, W.G. (1967). *Statistical method 6th edition* pp. 465. Iowa state university press USA.

Williams, J.H. (2004). Influence of row spacing and nitrogen levels on dry matter yield of kenaf (*Hibiscus cannabinus* L.) *Agronomy Journal* 58:166-168.