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EFFECT OF FERTILIZERS ON YIELD AND PROFITABILITY OF *HIBISCUS CANNABINUS* L. IN RAIN FOREST-SAVANNA TRANSITION AGRO ECOLOGY OF NIGERIA

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ABSTRACT

Appropriate use of fertilizer is crucial to crop productivity and soil management. This study was carried out to determine the most appropriate and profitable rate of nitrogen fertilizers for optimal growth and yield of kenaf. Organic fertiliser (OF) was applied at the rates of 0, 6.36, 9.09, 11.82 and 14.55 kg per plot and thoroughly mixed with the soil two weeks before sowing. At two weeks after sowing, NPK 20-10-10 fertilizer was applied at rates 0, 0.42, 0.60, 0.78 and 0.96 kg per plot to the plots designated for inorganic fertiliser (IF). Both organic and inorganic fertilizers applied were expected to release 0, 70, 100, 130 and 160 kg N/ha. The field trial was arranged in randomized complete block design (RCBD) replicated three times. Data on growth performance and yield obtained were subjected to analysis of variance (ANOVA), Duncan multiple range test 0.05 level of probability and gross margin analysis. Results showed that treatments OF× 130 kg and IF× 130 kg N/ha had significantly highest values for bast fiber (1.37 t/ha) and seed yield (1.55 t/ha), respectively. The net benefit ₦2,974,100 and ₦3,041,600 derived from core and bast fibers were obtained in plot with 130 kg N/ha organic and inorganic, respectively.

Nitrogen fertilizer use at the rate of 130 kg ha^{-1} was thereby recommended for use due to its high potential growth with increased yield and economic value of high marginal benefit.

Keywords: Growth, inorganic and Organic fertilizer Kenaf, Profitability and Yield

INTRODUCTION

Kenaf (*Hibiscus cannabinus* L.) is a fibre plant native to East-Central Africa where it has been grown for several thousand years for food, seed and fibre (Danalatos and Archontoulis, 2010). The crop is a common wild plant of tropical and sub-tropical Africa and Asia and the existence of semi-wild kenaf in Africa (especially Kenya and Tanzania) indicates that the crop originated from Africa (Oguniyan, 2016). Also, kenaf plant is a warm-season short-day annual herbaceous plant cultivated for its bast fibre and belongs to the family Malvaceae (Danalatos and Archontoulis, 2010). To produce enough biomass of high quality which can be converted to fibre, animal feed, ethyl alcohol and other chemicals, there is the need to identify kenaf varieties with potentials for high biomass yield and specific quality traits. The best economically viable management practice for growing such kenaf variety must also be developed. This is necessary for farmers and industrialists to benefit from the recent innovative use of kenaf as a bio-renewable energy resource. Kenaf plant is known for both its economic and horticultural importance which is closely related to cotton and okra. It has a wider range of adaptation to climate and soils than any other fibre crop grown for commercial uses (Agbaje *et al.*, 2011). Kenaf cultivation in Africa has been limited to small plot with low yield per unit land area, hence as low as 2.9% of the global production is being produced in Africa. This may be connected with the fact that most African soils are poor in nutrient contents and there is need to supplement the deficient nutrients with high rate of organic or inorganic fertilizers especially in kenaf production (Agbaje *et al.*, 2008; Adeniyan *et al.*, 2014). However, the detrimental effect of mineral fertilizer on the environment and its high cost calls for the use of organic fertilizer which are more locally available and had been adjudged to have environmental benefits. Olanipekun *et al.* (2016) reported that organic fertilizer could be applied at higher rate to improve growth and yield of kenaf. It also has the capacity to improve soil structure.

A lot of studies have been conducted on other factors directly related to the growth and yield of kenaf, such as the plant density, spacing, time of planting, method of planting and other cultural practices which include the tillage operation (land preparation). The production of kenaf in Nigeria would compare favourably in international market if backed up by good management practices, use of farm mechanization for commercial production, replenishing of soil nutrients with organic or inorganic fertilizers and availability of modern processing equipment (Ajijola *et al.*, 2011).

Francois *et al.* (1992) had reported a net income of ₦310,000 per hectare from kenaf products which make it to be more profitable than any other food crops. However, Ajijola *et al.* (2011) reported a net return of ₦268,343.33 per hectare from kenaf fibre products and internal rate of returns (IRR) of 67.6%, which indicates that kenaf production in Nigeria is feasible and viable for enhancing foreign income earnings vis a vis improved the gross domestic products (GDP) in Nigeria.

Therefore, the objectives of the study were to evaluate the effects of different rates of organic and inorganic fertilizers on the growth and productivity of kenaf and determine the economic values of these fertilizers on the performance of kenaf.

MATERIALS AND METHODS

Study Area and Description of the Site

The study was carried out on the Experimental Farm of the Institute of Agricultural Research and Training, Ibadan, located on Latitude 07^o 38'N, Longitude 03^o 84'E and altitude of 182 m above sea level. The site is located within the rainforest-savanna transition agro ecological zone of Nigeria. The ecology is characterized by bimodal rainfall distribution with distinct dry and wet seasons. Annual rainfall ranges between 1084 to 1315 mm for the period of the study (Oguniyan, 2016). The dry season runs through early November to the end of March, and the wet season is from early April to October annually, while annual temperature ranges from 21 to 36 ^{o}C.

Land preparation and experimental design and soil analysis

Field trials were conducted in 2014 and 2015 to evaluate the response of kenaf to fertiliser types and rates. The whole field measured 34 m × 19 m was divided into main plot of 19 m

× 4 m leaving 2 m space between two main plots. Sub-plot measured 3 m x 4 m each with 1 m gap between two sub plots. The main plots were for the two fertiliser types while subplots were for five fertiliser rates and were laid side by side in each replicate. The experiment was arranged in a randomized complete block design (RCBD) with three replicates.

Soil samples were randomly taken within 0-15 cm depth, bulked and sub samples were taken for soil analysis before the experiment start in each year. The samples were air-dried and passed through a 2.0 mm mesh sieve and another part with 0.5 mm mesh sieve (for organic carbon). The samples were analyzed for pH (H_2O), organic carbon, total nitrogen, available phosphorus (P), exchangeable bases; Ca, Mg K, and Na following the standard procedure. Organic fertiliser (OF) were applied as: 0, 6.36, 9.09, 11.82 and 14.55 kg per plot and thoroughly mixed with the soil two weeks before sowing. At two weeks after sowing, the following quantity of NPK 20-10-10: 0, 0.42, 0.60, 0.78 and 0.96 kg per plot were applied to the plots designated for inorganic fertiliser (IF). Both organic and inorganic fertiliser applied were expected to release 0, 70, 100, 130 and 160 kg N/ha.

Planting and field management

Four seeds of Ifeken 100 variety of kenaf were planted at 0 - 0.5 cm depth with spacing of 50 cm × 20 cm on the 24 May, 2014. The plants were thinned to two plants per stand at 2 WAS, resulting in a plant density of 240,000 plant ha^{-1}. Hoe weeding was done at 3 and 6 WAS, while insect pests were controlled at 4 and 8 WAS using Laraforce (Lambda halothrin 2.5% E.C) insecticide at the rate of 1L ha^{-1} with dilution factor of 2.5 ml/litre.

Data collection

Ten plants were randomly selected from the middle of each plot and these were tagged for data collection on crop performance. Plant height (cm), stem diameter (cm) and number of leaves were obtained from the tagged plants. Plant height was measured from the soil surface to the tip of the stem using a meter rule graduated in centimeter. Stem diameter was measured using Vernier caliper at the base of each plant, 10 cm above the soil surface. Number of leaves per plant was counted while leaf area per plant was measured using SHY- 150 leaf area meter with accuracy of ± 2%.

Fibre yield determination

At 10 WAS, plants within 1 m^2 were cut at height of 10 cm from plant base within the inner row of each plot in each replicate to avoid border effects. The leaves were removed and whole stems were subjected to water retting. The plants were soaked in water for 14 days. After the 14th day, the plants were removed from water and the bast was separated from the core. The bast and core were thereafter washed with clean water and sun dried. Dried bast and core yield were determined by weighing using Mettler PM 4000 weighing balance.

Determination of seed yield and yield components

At 20 WAS (when more than 80% of the capsules were already dried but before the seed started to shatter), the plants were cut at about 1 m above ground level. Five plants were selected from each plot to determine: number of capsule per plant and number of seed per capsule through visual counting. Weight of 100-seed and the total seed weight per plot were also determined using top load weighing balance.

Statistical analysis

Data on plant height, stem diameter, number of leaves, leaf area, fibre yield and seed yield were subjected to ANOVA using SAS statistical package (SAS, 2007) and the mean comparisons were performed by Duncan's multiple range test (DMRT) at $P \leq 0.05$

Profitability Analysis:

In determining the most economically acceptable (treatment) practice, partial budget analysis was carried out to estimate the gross value of the fibre and seed yield of kenaf using the adjusted fibre yield and seed at the prevailing market price for kenaf fibre, seed and inputs used following Saka *et al.* (2007). The prevailing wage rates paid to farm labourers at the location were used to estimate the labour cost that varies. All other production costs were adjudged with the prevailing prices of the inputs. The accruing marginal net benefit and the costs that vary were then compared in dominance analysis based on the criterion that any treatment that had net benefit equal to or lower than that of another treatment with lower cost is dominated and as such would not be considered for investment by the farmer.

$$GM = GR – TVC$$

Where, GM = Gross Margin (₦)

GR = Gross Revenue

TVC = Total Variable Cost

The Net Farm Income was calculated as;

$$NFI = GR – TC$$

Where;

NFI = Net Farm Income

GR = Gross Margin

TC = Total Cost (TVC + TFC)

TVC = Total Variable Cost

TFC = Total Fixed Cost

However, the values of the Total Fixed Cost items used in this study were obtained by depreciating all fixed items using straight line depreciation method. That is, the purchasing price divided by the life span (useful life) of the fixed items, and it is assumed that the salvage value of the fixed items is zero.

RESULTS AND DISCUSSION

Kenaf plant height, bast fiber and seed yield were significantly influenced by varying fertiliser rates applied (Table 1). The study corroborate the findings of Mohd Hadi *et al* (2013) that kenaf stem height varies with type and rate of fertilisers applied. The least plant height (177.52±4,13 cm) was obtained from plot without fertiliser. This value was not significantly different from what was obtained in plots with rates 70, 100 and 130 kg N/ha they were however higher than control. This is similar to the findings of Danalatos and Archontoulis (2010) who reported that kenaf plant heights obtained under different N rates of 50, 100 and 150 kg N/ha were not significantly different from one another. Islam *et al.* (2011) stated that organic and chemical fertilisers significantly affected the growth and yield of kenaf stem which supports the findings of this result.

Bast fiber yield followed same trend with the highest bast obtained from plot with 160 kg N/ha and the least from control. Bast fiber yields of 1.27±0.98 t/ha from plot with 160 kg N/ha and 1.17±0.59 t/ha from plot with 130 kg N/ha were the highest, contrary to Hossain *et al.* (2011) who reported that fiber yield of kenaf varieties were significantly influenced by fertilizer level in a paper titled growth, yield and fiber morphology of kenaf grown on sandy bris soil as influenced by different levels of carbon. Bast fibre yield (0.80±0.54 t/ha) was least in plot without fertiliser applied. Seed yield values obtained from plots with rate 160 kg N/ha (3.39±0.22 t/ha) and 130 kg N/ha (3.09±0.17 t/ha) were not significantly different from each other but they were both significantly higher than the seed yield (2.66±0.14 t/ha and 2.58±0.14 t/ha) from plots with rate 100 kg N/ha and 70 kg N/ha, respectively. The least seed yield (2.24±0.16 t/ha) was from plot without fertiliser.

Table 1: Mean square values of growth and yield parameters of four kenaf varieties grown under different fertilizer types and levels

Source of variation	df	Plant Height (cm)	Stem diameter (cm)	Number of leaves	Fiber Yield (t/ha)		Seed Yield (t/ha)
					Core	Bast	
Replicate	2	770.43	0.69	1060.06	3.01	3.25	5.31
FT	1	3223.31	0.37	75.02	1.58	1.29	1.49
FR	4	4332.15*	0.46	582.40	1.65	0.89*	4.92*
FT*FR	10	502.61	0.25	865.29	2.26	0.49	4.14
Error	16	589.39	0.26	431.64	4.85	1.72	11.11

(*) – Significant at Pr < 0.05
FT=Fertilizer Type, FR= Fertilizer rate

Table 2: Effect of fertilizer types and varying levels on growth and yield of kenaf varieties

Source	Plant height (cm)	Stem Diameter (cm)	Number of leaves	Fiber Yield (t/ha) Core	Bast	Seed Yield (t/ha)
Fertilizer Type						
NPK	194.75±2.80	1.87±0.05	62.60±1.92	1.7±0.78	1.03±0.48	2.76±0.13
Org	205.12±3.04	1.98±0.05	64.18±2.13	1.8±0.78	1.02±0.47	2.83±0.11
Fertilizer Rate (kg N/ha)						
Control	177.52±4.13[b]	1.70±0.07	55.23±3.63	1.4±0.10	0.80±0.54[c]	2.24±0.16[c]
70	200.51±4.47[a]	1.96±0.09	67.40±3.31	1.6±0.89	0.95±0.56[bc]	2.58±0.14[b]
100	203.02±4.18[a]	2.05±0.07	66.01±2.84	1.72±0.11	0.93±0.57[abc]	2.66±0.14[b]
130	205.22±3.64[a]	2.02±0.07	62.37±3.09	1.92±0.11	1.17±0.59[ab]	3.09±0.17[a]
160	213.42±4.03[a]	1.90±0.08	65.95±2.61	2.11±0.15	1.27±0.98[a]	3.39±0.22[a]

The economic analysis of Kenaf cultivation using varying N rates is presented in Table 3. The partial budget for Kenaf fibre and seed using different N rates of organic and inorganic fertilizer treatments are presented in Tables 3 and 4. The highest net benefits of ₦2,974,100 and ₦3,041,600 derived from fibre (core and bast) were realized under the rate of 130 kg N/ha organic and inorganic fertilized field respectively. In the case of Kenaf seed, the highest net benefit of ₦2,559,100 was realized under organic rate 160 kg N/ha but with marginal net benefit of ₦768,000 under 100 kg N/ha. However, highest net benefit of ₦2,827,600 and marginal net benefit of ₦733,500 was realized from inorganically fertilized field at 130 kg N/ha.

Table 3: Partial budget of Kenaf fiber yield as influenced by organic and inorganic fertilizer

	Organic fertiliser					Inorganic fertiliser				
N kg/ha	0	70	100	130	160	0	70	100	130	160
Average fibre yield										
Core kg/ha	540	1700	1830	1990	2050	550	1650	1680	1960	1680
Bast kg/ha	340	810	980	1370	1220	350	960	990	1210	1030
Gross field benefit (N/ha)										
Core (N 500 / kg)	270,000	850,000	915,000	995,000	1,025,000	275,000	825,000	840,000	980,000	840,000
Bast (N 2000 / kg)	680,000	1,620,000	1,960,000	2,740,000	2,440,000	700,000	1,920,000	1,980,000	2,420,000	2,060,000
Total gross benefit	950,000	2,470,000	2,875,000	3,735,000	3,465,000	975,000	2,745,000	2,820,000	3,400,000	2,900,000
Cost of Input/Labour (N/ha)										
Land preparation	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
Seed (N 1,800 / kg)	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000
Planting (N 1,500 / md)	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
Weeding (N 1,500 / md)	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Organic fertiliser (N 2,500/bag)	0	250,000	400,000	500,000	600,000	0	0	0	0	0
Inorganic fertiliser (N 7,500 / bag)	0	0	0	0	0	0	52,500	75,000	97,500	120,000
Fertiliser application (N 1,500/md)	0	7,500	7,500	7,500	7,500	0	7,500	7,500	7,500	7,500
Insecticide /application	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900
Harvesting (N 1,500 / md)	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Processing fibre	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000
Transportation	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Total cost that vary	253,400	510,900	660,900	760,900	860,900	253,400	313,400	335,900	358,400	380,900
Net benefit	696,600	1,959,100	2,214,100	2,974,100	2,604,100	721,600	2,431,600	2,484,100	3,041,600	2,519,100
Marginal Net benefit		1,262,500	255,000	760,000	-370,000		1,710,000	52,500	557,500	-522,500

1. Gross field benefits: Field price/kg * average yield (kg/ha). Where field price is market value of 1 kg of the crop.
2. Costs that vary: Include only those cost that are affected by alternative treatments being considered.
3. Net benefit: This is calculated by subtracting the total costs that vary from the total benefits.
4. Md: Man day

Table 4: Partial budget of Kenaf seed yield as influenced by organic and inorganic fertilizer

	Organic fertilizer					Inorganic fertiliser				
N kg/ha	0	70	100	130	160	0	70	100	130	160
Average Seed yield kg/ha	510	720	1230	1650	1900	490	1260	1350	1770	1550
Gross field benefit (N/ha)										
Seed (N 1,800/ kg)	918,000	1,296,000	2,214,000	2,970,000	3,420,000	882,000	2,268,000	2,430,000	3,186,000	2,790,000
Cost of Input/Labour (N/ha)										
Land preparation	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
Seed (N 1,800 / kg)	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000
Planting (N 1,500 / md)	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
Weeding (N 1,500 / md)	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Organic fertiliser (N 2,500/bag)	0	250,000	400,000	500,000	600,000	0	0	0	0	0
Inorganic fertiliser (N7,500 / bag)	0	0	0	0	0	0	52,500	75,000	97,500	120,000
Fertiliser application (N 1,500/ md)	0	7,500	7,500	7,500	7,500	0	7,500	7,500	7,500	7,500
Insecticide/application	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900
cost of harvesting (N 1,500/md)	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
cost of processing seed	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000
cost of transportation	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Total cost that vary	253,400	510,900	660,900	760,900	860,900	253,400	313,400	335,900	358,400	380,900
Net benefit	664,600	785,100	1,553,100	2,209,100	2,559,100	628,600	1,954,600	2,094,100	2,827,600	2,409,100
Marginal Net benefit		120,500	768,000	656,000	350,000		1,326,000	139,500	733,500	-418,500

1. Gross field benefits: market value of 1kg of the crop
2. Costs that vary: Include only those that are affected by alternative treatments being considered.
3. Net benefit: This is calculated by subtracting the total cost that vary from the total gross benefit
4. Md: Manday

Table 5: Partial budget of Kenaf fibre yield as influenced by residual organic and inorganic fertiliser

	Organic fertiliser					Inorganic fertiliser				
N kg/ha	0	70	100	130	160	0	70	100	130	160
Average fibre yield										
Core kg/ha	490	850	910	1210	1650	450	450	450	460	470
Bast kg/ha	250	620	700	950	1020	230	220	230	240	230
Gross field benefit (N/ha)										
Core (N 500 / kg)	245,000	425,000	455,000	605,000	825,000	225,000	225,000	225,000	230,000	235,000
Bast (N 2000 / kg)	500,000	1,240,000	1,400,000	1,900,000	2,040,000	460,000	440,000	460,000	480,000	460,000
Total gross benefit	745,000	1,665,000	1,855,000	2,505,000	2,865,000	685,000	665,000	685,000	710,000	695,000
Cost of Input/Labour (N/ha)										
Land preparation	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
cost of seed (N 1,800 / kg)	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000
Planting (N 1,500 /md)	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
Weeding (N 1,500 / md)	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Insecticide /application	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900
Harvesting (N 1,500 / md)	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
cost of processing fibre	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000
cost of transportation	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Total cost of input	228,400	228,400	228,400	228,400	228,400	228,400	228,400	228,400	228,400	228,400
Net benefit	516,600	1,436,600	1,626,600	2,276,600	2,636,600	456,600	436,600	456,600	481,600	466,600
Marginal Net benefit		920,000	190,000	650,000	360,000		-20,000	20,000	25,000	-15,000

1. Gross field benefits: market value of 1kg of the crop
2. Net benefit: This is calculated by subtracting the total cost of input from the total gross benefit
3. Md: Man day

Table 6: Partial budget of Kenaf seed yield as influenced by residual organic and inorganic fertiliser

	Organic fertilizer					Inorganic fertiliser				
N kg/ha	0	70	100	130	160	0	70	100	130	160
Average Seed yield kg/ha	340	510	820	900	1010	330	340	330	320	320
Gross field benefit (N/ha)										
Seed (N 1,800/ kg)	612,000	918,000	1,476,000	1,620,000	1,818,000	594,000	612,000	594,000	576,000	576,000
Cost of Input/Labour (N/ ha)										
Land preparation	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Seed (N 1,800 / kg)	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000
Planting (N 1,500 / md)	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
Weeding (N 1,500 /md)	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Insecticide/application	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900
Harvesting (N 1,500 / md)	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Processing seed	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000	80,000
Transportation	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Total cost of input	228,400	228,400	228,400	228,400	228,400	228,400	228,400	228,400	228,400	228,400
Net benefit	383,600	689,600	1,247,600	1,391,600	1,589,600	365,600	383,600	365,600	347,600	347,600
Marginal Net benefit		306,000	558,000	144,000	198,000		18,000	-18,000	-18,000	0

1. Gross field benefits: Field price/kg * average yield (kg/ha). Where field price is market value of 1 kg of the crop.
2. Net benefit: This is calculated by subtracting the total costs of input from the total benefits.
3. Md: Man day

The net benefit and marginal net benefit from the residual effects of fertilizer applied on kenaf fibre and seed are presented in Tables 5 and 6. The highest net benefit of ₦2,636,600 was attained at 160 kg N/ha while the highest marginal net benefit of ₦ 650,000 was at 130 kg N/ha under organic fertilizer treated field. Both net and marginal net benefits of ₦481,600 and ₦25,000, respectively were obtained at 130 kg N/ha under inorganic fertilized field for fibre yield. For seed, both net benefit and marginal net benefit of ₦1,589,600 and ₦198,000, respectively were at 160 kg N/ha under organic fertilized field. This result corroborated the findings of Agbaje *et al*. (2008) that net benefit from kenaf fibre varied with increase in use of the external inputs while the lowest net benefit was from plot without external input.

The economic analysis of the cost of N in the kenaf cultivation indicated that farmers make extra investment by applying organic fertiliser but in return, they obtain extra benefit due to higher yield in first and following year. Also, the marginal net benefit ranged from ₦ 255,000 to ₦ 760,000 in the first year and ₦ 190,000 to ₦ 650,000 in the second year from organic fertilized field for fibre, while the marginal net benefit for seed under organic fertiliser ranged from ₦ 120,500 to ₦ 768, 000 in the first year and ₦ 306,000 to ₦558, 000 in the second year. It was recommended that higher rate above 130 kg N/ha of inorganic application is considered a waste since it did not translate to higher yield of kenaf.

CONCLUSION AND RECOMMENDATION

Kenaf growth and yield could be improved through the use of external input such as fertilisers. However, rate above 130 kg N/ha could amount to a waste as this does not translate to economic benefits. Hence application of 130 kg N/ha was found profitable for kenaf fibre and seed production**.**

REFERENCES

Adeniyan, O.N., Aluko, O.A., Olanipekun, S.O., Olasoji, J.O., Adetunmbi, J.A., Alake, C.O., and Adenekan, M.O. (2014). Genotype × environment interaction and stability analysis in kenaf (*Hibiscus cannabinus* L.) for growth and yield performances in Southwest Nigeria. *Journal of Agricultural Science*, 6. 8: 1-7.

Agbaje, G. O., Saka, J. O., Adegbite, A. A and Adeyeye, O. O. (2008): Influence of Agronomic Practices on Yield and Profitability in Kenaf (*Hibiscus cannabinus* L.) Fibre Cultivation *African Journal of Biotechnology*. Vol 7 (5), pp. 565-574,

Agbaje, G.O, Aluko O.A and Olasoji. J.O. (2011). Effect of plant spacing on seed yield and yield components in kenaf (*Hibiscus cannabinus*) variety, Ifeken 400. *African Journal of plant Science,* 5. 12: 718-721.

Ajijola S., G.O. Agbaje and B.A. Ogunbodede (2011): Economic Feasibility of Kenaf (*Hibiscus cannabinus*) Powder Production in Southwestern Nigeria. *Moor Journal of Agricultural Research* 12 (2): 116 – 122.

Danalatos, N.G., and Archontoulis, S.V. (2010). Growth and biomass productivity of kenaf (*Hibiscus cannabinus* L.) under different agricultural input and management practices in central Greece: *Industrial Crops Products*, 32: 231-240

Francois, L.E., Donovan, T.J., and E.V. Maas. (1992). Yields, vegetative growth and fibre length of kenaf grown on saline soils. *Agronomic Journal* 84.4: 592- 598.

Islam, M. M, A.J.M.S., Karim, M. Jahiruddin, N.M Majid and M.G. Miah (2011). Effects of organic manure and chemical fertilisers on crops in the radish-stem amaranth-Indian spinach cropping pattern in homestead are. *Australia Journal of Crop Science,* 5: 1370-1378.

Hossain M.D, Hanafi M.M, Jol H. Hazandy A.H. (2011); Growth, yield and fiber morphology of kenaf (Hibiscus cannabinus L) grown on sandy bris soil as influenced by different levels of carbon. *African Journal of Biotechnology,* 10(50): 10087-10094.

Mohd Hadi, A. B., Arifin, A., Shamshiddin, J., Osumanu, H. A., Hazandy, A. H., Mohd, A. K., Baharom, Z., Abdual, L. S and Nasima, J. (2013). Effects of mixed organic and inorganic fertilisers application on soil properties and the growth of Kenaf (*Hibiscus cannabinus* L) cultivated on bris soils. *American Journal of Applied Science*, 10.12: 1586-1597

Ogunniyan, D.J. (2016). Assessment of genetic divergence in kenaf (*Hibiscus cannabinus* L) genotypes using agro-botanical characteristics and multivariate analysis. SABRAO *Journal of Breeding and Genetics*, 48. 1: 61-71.

Saka J.O., O.N. Adeniyan, S.R. Akande and M.O. Balogun (2007): An Economic Evaluation of Intercropping African Yam Bean, Kenaf and Maize in the Rain Forest Zone of Nigeria. *Middle-East Journal of Scientific Research* 2 (1): 01-08

SAS (2007). SAS/STAT Software. Version 9.2. SAS Institute Inc., Cary, NC,USA.