Direct Research Journals

Vol.3 (12), pp. 232-235, December 201 5
ISSN 2354-4147
International Standard Journal Number (ISJN) e-ISJN: A4372-2604
Article Number: DRJA209158136

Direct Research Journal of Agriculture and Food Science
http://directresearchpublisher.org/aboutjournal/drjafs

Research Paper

Response of Kenaf (*Hibiscus cannabinus L.*) to NPK doses on lateritic soil in Southern rainforest of Nigeria

Ansa, Joseph Etim Okon

Department of Agricultural Science, Ignatius Ajuru University of Education, Rivers State, Nigeria.
E-mail: joseph.ansa@iaue.edu.ng.

Received 2 November 2015; Accepted 13 December, 2015

Pot experiment was conducted in the teaching and research farm of the department of Agricultural Science Ignatius Ajuru University of Education, Port Harcourt to determine the effect of NPK 15:15:15 doses on the performance of Kenaf. The experiment was arranged in a completely randomized designed with NPK levels (0 g, 3 g, 6 g, 9 g, 12 g, per pot) as treatment repeated 12 times to produce 60 experimental units. Data collected were weekly plant height, stalk (stem) fresh weight, stem thickness (girth size), number of leaves, leaf area (LA) and leaf area index (LAI); Total dry matter (DM), stalk dry weight, core dry weight and bark (bast) dry weight. Reproductive Parameters measured were, number of flowers, number of pods, number of days to fruiting, average number of seeds per pot/treatment, total seed number per treatment. Results indicate that plant height increased with NPK rates. Girth, LA and LAI were significantly influenced by NPK doses; 9 g NPK rate produced kenaf plants that were 40% taller, 2 times wider girth, and a ratio 10:1 LAI over the control plants. Stalk, core and bark dry weights were all due to NPK levels (Fcal 0.75*, 1.85*, and 0.80* respectively) at P<0.5. Control Plants did not produce flowers or sett seed. Number of flowers, pod and seed varied positively with NPK application. In all parameters measures, there was positive and increasing influence of NPK rate from 0 to 9 g per seedling, after which response began to decline. 9 g NPK equivalent to about 51 kg/ha is recommended for Kenaf production on lateritic soil in southern rainforest zone.

Key words: Kenaf, Laterite soil, Fertilizer, Growth, Fiber crop

INTRODUCTION

Lateritic soilS or latosol are highly weathered tropical rainforest soils with enormous quantities of sesquioxides ion, that is iron and aluminum oxides (Basu, 2007; Delvaux and Brahy, 2014). It is acidic with low in nutrient status and exchangeable bases making it less suitable for arable crop production that requires fertile loamy soil. Kenaf (*Hibiscus cannabinus* L), an indigenous African crop is an annual crop gaining world prominence because of its fiber which can be utilized as raw material in the pulp and paper industry and also in the sack manufacturing and cordage industries (Humphrey, 2004 , Pentri et el 1994).

Kenaf produces two types of fibers; the bark produces long fiber strands “bast” fiber while the inner core exhibit the “core” fiber. Both fiber have been shown to be valuable raw material in the production of ropes, twine, fiberboard and pulp and paper (Webber and Bledsoe, 1993; Yu and Yu, 2007).

Other non-fiber usage of kenaf include production of particle board (Webber et al., 1999), as an absorbent (Goforth, 1994), in poultry litter and animal bedding (Tilmon et al., 1988); as a potting amendment (Webber et al, 1999) and in soil fertility restoration (Seller et al., 1993).

Kenaf is also fast growing, reaching a height of 2-4 metres in 3 months (Dempsey, 1975) and capable of adapting to various range of soil (Abdul –Hamid et al., 2009). This fast growing ability give it an edge over other pulp crop plant such as *Eucalyptus* spp, *Gmelina arborea* and *Acacia mangium* which take longer duration to mature.

As a result of its versatility of usage, various agronomic studies have carried out on kenaf but little research has been conducted on its adaptability to lateritic soil. Investigation into suitability of kenaf production on lateritic soil is critical so that it will not compete with arable crops for the nutrient rich fertile dark loamy soils. Lateritic soils are of low potential for arable crop production because they have low levels of desirable nutrients hence this study attempts to investigate kenaf response to NPK amendments on laterite soil.

MATERIALS AND METHODS

The experiment was carried out in the Teaching and research farm of the department of Agricultural Science, Ignatius Ajuru University of Education,(Ndele campus) Port Harcourt, Rivers State, Southern Rain Forest zone of Nigeria, to determine the NPK 15:15:15 rates on growth yield and seed production of kenaf on lateritic soil. The underlying laterite soils were dug out from overlying loamy soil. Kenaf seeds were obtained from Institute of Agricultural Research and Training, Moor plantation, Ibadan. Polythene bags with depth 25 cm and diameter 15 cm were purchased from an horticultural garden in port Harcourt.

Experimental design and layout

Sixty polybags were filled with dugout laterite soil up to a height of 23 cm and arranged in 5 columns of 12, all pots were sown with 3 seeds each of kenaf same day and watered. The germinated seedlings were thinned to one seedling per pot two weeks after planting (WAP). NPK fertilization was the only factor of the study and the doses (0, 3, 6, 9, and 12 g) are treatments replicated 12 times to give 60 experimental pots. The treatments were allotted randomly in a randomized complete block design using replicates as blocks. Fertilization with the NPK rate was down at 3WAP and weekly data were taken from 4WAP. Parameters measured were plant height, girth circumference, number of leaves, leaf area LA, Leaf Area Index LAI, stalk or stem fresh weight, stalk dry weight, core dry weight, bark dry weight and total dry matter accumulation. Reproductive potential was estimated using number of flower, number of pods, seed per pod and total number of seeds. Sample of the laterite soil was obtained from the dugout soil before pot filling and sent to the laboratory for analysis.

RESULTS

The soil was slightly acidic with low levels of organic matter, nitrogen, exchangeable K, Ca and Mg. Available phosphorus was moderate (Table 1).

Table 1. Physio-chemical properties of the lateritic soil.

Soil variable	Soil content
Sand %	65
Salt %	6
Clay %	29
Soil texture	Sandy clay
Moisture content %	1.52
CEC (cmol/kg)	4.79
Organic carbon %	0.55 (0.95% of om)
Total nitrogen %	0.11
Available phosphorus	15.03
Exchangeable k^+ (cmol/kg)	0.08
Exchangeable Na^+(cmol/kg)	0.50
Exchangeable Ca^{2+} (cmol/kg)	3.02
Exchangeable Mg^{2+} (cmol/kg)	0.84

The growth and vegetative development of kenaf consequent to NPK doses on lateritic soil is displayed in the (Table 2). The effect of NPK amendment on the lateritic soil did not produce significant effect on growth rate of kenaf. However, plants that received NPK doses grew taller than those that did not receive NPK. Plant that receive 3g NPK were 1.5 time taller than the control plants, while those that received 9 g NPK were 40% taller than those that had no NPK. Plants fertilized with 9 g NPK produced the tallest plants. Stem Girth, Fresh Stem Weight, Number of Leaves, Leaf Area (LA) Leaf Area Index (LAI) also produced similar trend with plant height growth rate but in their case, the effect was significantly due to the different rate applied NPK.

Table 3 highlights dry matter yield (DM), core dry weight (wt), bark, dry weight and stem, dry weight Yield of kenaf influence by NPK levels on lateritic soil. DM, stalk, dry weight, core weight and bark dry weight, produced weight variations which were due to the different rates of NPK fertilization (Fcal= 0.75*, 1.88*, and 0.80* respectively; significant at $p \geq 0.5$). Highest dry weight was achieved in plants that were fertilized with 9 g NPK while least weight was obtained in the zero fertilizer treatment.

Table 4 shows the reproductive potential of NPK amendment lateritic soil grown with kenaf plants. Soils that were not amended with NPK, produced plants that did not complete their life cycle. Application of 9 g NPK was promising for production of propagule for the next generation or plant, as they produced the highest number of flowers, reached maturity fastest and produced the largest number of seeds.

Table 2. Growth and vegetative response of kenaf to N.P.K 15:15:15 ratio grown on lateritic soil.

NPK Rates	Plant Height (cm)	Girth (cm)	Fresh stem weight (g)	No. of Leaf	Leaf area (cm^3)	Total Leaf Area (cm^3)	LAI
0	58.6^d	2.1^d	7.8^d	11.6^c	36	417.6	1.3
3 g	86.7^c	3.8^c	32.5^c	28.5^d	68	1938	6.2^d
6 g	94.0^b	4.6^b	49.2^b	42.5^b	83	3527.7	11.2^b
9 g	98.0^a	5.1^a	79.6^a	47.9^a	87	41673	13.3^a
12 g	89	4.5^b	50.7^b	37.0^c	71	2627	8.4^o
SE	6.93	52	11.79	6.34			2.07
SD	15.54	1.17	26.37	14.19			4.64
F_{cal} P $\geq$0.05	NS	*	*	*	*	*	*

* = Significant, NS = Non-significant, Means with different alphabets in same column are significant different.

Table 3. Influence of NPK rates on dry matter content and fiber yield in kenaf grown on laterite soil.

NKP Rates	Steam Dry Weight (g)	Dry Matter Accumulation (g)	Core Dry Weight (g)	Bark Dry Weight (g)
0	1.7^d	2.68^d	0.87^d	0.77^d
3	8.5^c	11.37^c	4.8^c	3.67^c
6	11.1^{bc}	14.60^{bc}	6.87^{bc}	4.22^b
9	23.0^a	28.15^a	13.92^a	8.77^a
12	15^b	19.40^b	9.92^b	5.07^b
SE	3.54	4.18	2.22	1.29
SD	7.90	9.35	4.96	2.88
F_{cal}	*	*	*	*

* = Significant, NS = Non-significant, Means with different alphabets in same column are significant different.

Table 4: Reproductive Potential of Kenaf fertilized with NPK Rates on Laterite Soil.

NKP Rates	No. of Flowers	No. of Pods	Average no. of seeds per pod	Total no. of Seeds
0	-	-	-	-
3	12	79	10	790
6	38	94	17	1598
9	58	174	102	17
12	56	157	15	2355
SE	10.25	52	3.30	
SD	22.92	69.28	7.38	
F_{cal} P $\geq$0.05	*	*	*	

* = Significant, NS = Non-significant, Means with different alphabets in same column are significant different.

DISCUSSION

There was positive response of growth and vegetative development to NPK amendment of the lateritic soil. The soil analysis of the lateritic soil show low levels of nitrogen, phosphorus and potassium which are vital in the development of crops, confirming the report of Basu, (2007) on groundnut productivity on soil amendment of acid lateritic soils. Similar response was observed by Santiago et al. (2012) on tropical tree seedlings. Crop growth rates, plant height, stem diameter, leaf number, leaf area and biomass were all positively affected by kenaf grown on BRIS soil amended with NPK 12:12:16 + 2 MgO + micronutrient (Abdul- Hamid et al., 2009). These positive responses were also observed in this study.

In the study, stem dry weight, total dry matter, core dry weight and back dry weight all increased with increasing NPK levels. This was similar to Hossain et al. (2010) in kenaf fertilized with different rate of nitrogen, phosphorus and potassium in polypropylene trays containing Hoagland situation. They reported that stem dry weight and total dry weight increased with increasing levels of N, P and K rates. The study observed that kenaf plants that were not fertilized with NPK did not enter into the reproductive stage, hence did not produce flowers or seeds. This shows that the quantities of NPK in the lateritic soil were in deficient amounts hence the plants grown on it without fertilizer addition could not complete their life cycle. The result of the study show that kenaf responded to increasing levels of NPK from 3 g to 9 g. Increasing NPK rate beyond 9 g resulted in a decline in all parameters measured. Similar trend was observed by Hossain et al. (2010) in kenaf in culture solution.

Conclusion

The study was conducted to investigate the possibility of cultivating kenaf on lateritic soils amended with different rates of NPK. Growth and fiber yield increased with NPK doses from 3 g to 9 g. Increasing NPK rates beyond 9 g resulted in decline of all parameters measured. Though plants that received zero NPK had some form of growth and development, they did not produce seed for the next planting. The Implication of this is that, in order to obtain propagule for next generation of planting, kenaf grown on lateritic soils have to be fertilized and the quantity needed for optimum development and reproduction on lateritic soil is 9 g per plant. Nine grammes of NPK or approximately 51 kg/ha of NPK is recommended for optimum growth, fiber yield and seed production in kenaf.

REFERENCES

Abdul – Hamid H, Yusuf M, Ab – Shukor N, Zainal B, Musa M (2009). Effect of different Fertilizer Application levels on Growth and Physiology of *Hibiscus cannabinus* L. (Kenaf) Planted on BRIS Soil. J. Agric. Sci. 1 (1):121 – 131.

Basu M, Bhadoria PBS, Mahapatra SC (2007). Role of Soil Amendments in Improving Groundnut Productivity of Acid Laterite Soils, International Journal of Agricultural Research 2(1) 87-91.

Delvaux B, Brahy V (2014). Mineral Soils conditioned by a wet (sub) tropical climate. FAO Corporate Document Repository: lecture notes on the major soils of the world. http://www.fao.org/docrep/003/y1899e/y1899e08ahtm

Dempsey JM (1975) Fiber Crops. University of Florida press. Gainesvilla FL.

Goforth CE (1994). The Evaluation of Kenaf as oil Sorbent. In: GoForth CE and Fuller MJ (Ed). A summary of Kenaf Production and Product development research. Mississippi State University Bullet 1011.

Hossain MD, Hanati MM, Talib J and Jol, H (2010). Growth, yield and fibre morphology of Kenaf (Hibiscus cannabinus L) grown on Sandy bris soil.

Humphrey M (2004). Fabric Reference 3rd Edition Pearson Education Inc. Upper Saddle River, New Jersey pp 30 – 31

Santiago LS, Wright SJ, Harms KE, Yavitt CK, Garcia MN, Turner BL (20012) Journal of Ecology vol: 100, pp309-316.

Seller T, Miller GD, Fuller MJ (1993). Kenaf core a board raw material. Forestry Product Journal 43: 69 – 71.

Tilmon HD, Taylor R and Malone G (1988). Kenaf: an alternate crop for Delaware. In: Janick J and Simon JE (ed). Advances in new crops. Timber Press, Portland.

Webber CL, Bledsoe RE (1993). Kenaf production, harvesting and Products. In Janick J and Simon JE (ed) New crops, Wiley, New York USA pp 416 – 421.

Webber CL, Whitworth J and Dole J. (1999) kenaf (Hibiscus cannabinus) core as a containerized growth medium component. Ind. Crop Prod. 10: 97 – 105.

Yu H, Yu C (2007). Study on microbe retting of kenaf fibre. Enzyme Microb Technol. 40: 1806 – 1809.