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POTENTIALS OF LATERITE SOIL FOR THE PRODUCTION OF ELEPHANT GRASS (*Pennisetum purpureum*) IN NIGERIA

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Abstract: **The experiment was conducted at the teaching and research farm of the Department of Agriculture, Ignatius Ajuru University of Education, Ndele Campus to evaluate the potentials of lateritic soils as an alternative for the production of elephant grass for biofuel and fodder. The performance of elephant grass was assessed on the normal loamy soil, laterite soil and sandy soil. Thus, the soil types were the treatment replicated 10 times to give 30 experimental units arranged in a completely randomized design. Data taken were plant height, number of leaves, number of tillers, leaf length, leaf area, plant fresh weight and dry weight. The study revealed that loamy soil had best values in all parameters. While the values in all measured parameters were most different between loamy soil and sandy soil, there was no significant difference in initial plant height, in the number of leaves, number of tillers, plant fresh and dry weights. Therefore, elephant grass can be alternatively cultivated on lateritic soils for both biofuel production and the cut and feed (zero grazing) cattle production in Nigeria.**

Keywords: **Elephant grass, Soil types, Forage, Feedstock, Ethanol production, Nigeria.**

I. INTRODUCTION

Lateritic soils are prevalent in tropical areas and subtropical climatic areas and they are known for their unique characteristic red hue which make them different and special among other soil types. They also have lower cation exchange capacity, poor fertility, high clay content, poor percolation and poor aeration. Lateritic soils also have huge quantity of iron and aluminum oxides (Shaw, 2001). Laterite soils are highly weathered mineral, rich in secondary oxides of iron, aluminum or both. Laterites result from leaching of parent sedimentary rocks which leave insoluble ions commonly iron and aluminum (Adekoya, 2003). These characteristics has classed lateritic soil as having very low potential for arable and economic crop production.

Elephant grass (*Pennisetum purpureum*) is a monocot belonging to the family Poaceae (grass family). It is very diverse consisting of a heterogeneous group of about 12, 000 species (Woodard *et al.*, 2005). Elephant grass though a forage crop is a narrowed leafed grass weed infesting secondary crops in over 20 countries (Holm et al., 2007) and has the ability to grow with low input, and thus is suited for sustainable production (Tsai, 2009) and on soil considered of low potential for crop production. Elephant grass has for long been used as vital forage crop in the tropics because of its high yields and nutrient value. Napier grass (elephant grass) is known for their associative relationship with nitrogen fixing bacteria and because of this reason has the capability and capacity to grow without the addition of nitrogen (James and Olivares, 2007). Elephant grass has drawn particular attention for nitrogen – sustainability because of the discovery of the presence in the plant of the same nitrogen-fixing endophytic bacteria, that has been found to contribute reasonable quantities of Nitrogen to sugarcane (Döbereiner, 2008).

Another important beneficial use of elephant grass is its suitability as feedstock for ethanol production. Environmentally clean energy can be obtained from plant biomass, a source of energy in the form of biofuels (solid, liquid and gaseous biofuels) that is fast replacing energy from fossil. Ethanol an example of a liquid biofuel is fast replacing current transportation liquid fuels. Industrially degradable plant biomass is fermented to manufacture ethanol or bioethanol (Keith, 2009). However, the use of sugar in ethanol production is expensive, making the use of a cheaper and easily available alternative, lignocellulosic biomass from plants as feedstock in the manufacture of ethanol is more realistic and viable (Stanley et al., 2017). Elephant grass has prolific growth rate and high biomass yield that can be harvested about 3 to 4 times annually and thus an important source of lignocellulosic material, with further composition of about 30-40% cellulose and 25-30% hemicellulose (Santos et al., 2001; Inter Press Service, 2007).

In Nigeria there is an increasing awareness, which has led to increasing demand and industrial production of ethanal and biofuels. According to Elijah (2010), the annual demand or utilization of ethanol in Nigeria is 5140 million litres; while the industrial production capacity is 133.9 million Litres/year.

For two important reasons of (i) need for large tonnage of lignocellulosic material as feedstock for ethanol production and (ii) forage needed for cattle production for both field grazing and the now becoming popular cut and feed or zero grazing intensive cattle production there is need for intensive production of elephant grass on fields that will not compete with arable crop production.

The aim of the study was therefore to compare growth and yield of elephant grass grown of loam soil with lateritic soil and sandy soil.

II. MATERIALS AND METHODS

A. Description of Experimental Site

The experiment was conducted at the Teaching and Research Farm of the Department of Agriculture, Ignatius Ajuru University of Education (IAUE), Ndele Campus, Rivers State, Nigeria with latitude 4° 58 N and longitude 6° 48 N. Ndele Campus is one of the campuses of Ignatius Ajuru University of Education and is located in Emohua Local Government Area of Rivers State, which is in the rainforest agro-ecological zone of Nigeria, known for high annual rainfall.

B. Experimental Procedure

Forest topsoil was dug from the upper 10 cm and filled into 10 polybags with dimension, 30 cm width and height 28 cm. The polybags were filled to give a soil depth of 25 cm. The laterite soil was dug from sub- surface soil from a depth of 50 cm below the surface, while the sandy soil was obtained from a farm site. Particle size analysis was carried out to determine the soil texture. Ten polybags each were also filled with sandy and laterite soils in the same manner as the topsoil.

The elephant grass propagules were 25 cm cut stems with two nodes and planting was such that a node was buried in the soils leaving the other appearing above ground. Planting was done in 3rd June 2017 while harvesting took place on the 1st of September 2017.

C. Experimental design

The treatment were the three soil types in 10 replicates each and arranged in a completely randomized design to give a total of 30 experimental units

D. Data Collected

The parameters assessed were plant height taken at 4, 8 and 12 weeks after planting (WAP). The vegetative parameters of number of leaves, leaf area, number of tillers and leaf length were taken at 10 WAP. The yield parameters (fresh biomass weight, and dry weight) were taken 12 WAP.

III. RESULTS

The influence of soil type on *Pennisetum* plant height is presented in Table 1. Irrespective of soil type there was growth in terms of height increment. Loamy soil had plants that were twice the height of those planted on sandy soil. The grasses grown on the laterite soil did not initially express appreciable differences in plant height as those planted on loamy soil, but by 12 WAP, there was clear difference between grasses plant on the two soil types with those grown on loamy soils been taller.

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Table 1: Plant Height (cm) Response of Elephant Grass (*Pennisetum purpureum*) to Soil Types

Soil types	4 WAP	8 WAP	12 WAP
Loamy	50^a	95.3^a	122^a
Laterite	44^a	90.3^a	113^b
Sandy	25^b	55.0^b	64^c
SE ±	1.66	1.22	1.58

Means followed by same letter in each column are not significantly different at P < .05 by Duncan multiple range test.

Table 2: Effect of Soil Type on Vegetative Characteristics of Elephant Grass *(Pennisetum purpureum)*

Soil Type	Number of Leaves	Leaf Length (cm^2)	Leaf Area (cm^2)	Number of Tillers
Loamy	29^a	56.5^a	1638.5^a	5.0^a
Laterite	26^a	43.8^b	1138.8^b	4.5^a
Sandy	12^b	23.0^c	171.6^c	3.3^b
SE±	.793	1.698	1.347	.430

Means followed by same letter in each column are not significantly different at P < 05 by Duncan multiple range test.

The vegetative response of elephant grass to the different soil types in Table 2 indicate that there was no difference in leaf production between grasses that were cultivated on both laterite soil and loamy soil hence the number of tillers and number of leaves were statistically the same for grasses grown on both soil types. However, there was notable difference in the length of leaves and leaf area. Grasses planted on loamy soil had plants that produced highest leaf area and leaf length. In all the vegetative parameters measured, sandy soil had the least values. For instance, while the number of leaves produced by grasses grown on loamy soil were just a faction higher than those grown on laterite soil, those planted on sandy soil were 2.4 times less than those grown on loamy soil. Similarly, while the leaf area of grasses grown on loamy soil was only about 30% higher than those grown on laterite soil, they were almost 90% higher than those planted on sandy soil.

Table 3: Effect of Soil Type on biomass of Elephant Grass *(Pennistum purpereum)*

Soil Type	Fresh Weight (g)	Dry Weight (g)
Loamy	98.7^a	45.7^a
Laterite	95.7^a	43.9^a
Sandy	60.0^b	10.7^b
SE±	1.991	1.333

Means followed by same letter in each column are not significantly different at P < .05 by Duncan multiple range test.

The effect of soil type on biomass of elephant grass is displayed in Table 3. The result indicates similar fresh weight yield in grasses grown on both loamy and laterite soils but those grown on sandy soil were obviously lower than those planted in loamy and laterite soils.

The dry weight yield of grasses grown on loamy soil showed significant different weight from those grown on sandy soils but not with those grown on laterite soil. Though loamy soil had difference in biomass yield from those grown on both laterite and sandy soils, values were most different between those grown on loamy soil and sandy soil

IV. DISCUSSION

The study observed that plant height increment, number of leaves, leaf length, leaf area, number of tillers, fresh weight and dry weight yield were markedly higher in elephant grasses grown on loamy soil compared with the laterite and sandy soils. The same performance was observed by Mohammed *et al.* (2017) in Napier-4 fodder which had better growth, development and yield on loamy soils compared with sandy soils. Among loamy, laterite and sandy soils, plant height, vegetative production and yield were most different between loamy and sandy soil. This probably may be because of the presence of organic matter in loamy soil (Mclean, 2012) and higher moisture retention in both loamy and laterite soils

(Amin et al., 2016). In all parameters taken and recorded laterite soil produced grasses that had statistically similar or with little difference from those planted on loamy soil. This shows that production of elephant grass may not be adversely affected if grown on lateritic soils. Patil and Sheelavanter (2000) revealed that laterite soil could be used in the production of crop.

V. CONCLUSION AND RECOMMENDATION

The study showed that the growth and yield values of elephant grass grown on laterite soil were favourable comparable to the grasses grown on loamy soil. Sandy soil recorded the least values in all parameter determined. Loamy soil did not record grasses that where obviously different in measurement than the ones planted on lateritic soils. Laterite soil can therefore support the production of elephant grass *(Pennistum purpureum)*.

This study suggests and recommends that elephant grass production can be alternatively and intensively cultivated on lateritic soils for both biofuel production and the cut and feed (zero grazing) cattle production in Nigeria.

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