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EFFECT OF INORGANIC FERTILIZER APPLICATION ON GROWTH AND YIELD OF *THEVETIA PERUVIANA* (PERS) SCHUM. (YELLOW OLEANDER) IN THE SOUTHERN GUINEA SAVANNAH OF NIGERIA

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ABSTRACT

Growth and yield parameters of Thevetia peruviana (Pers) Schum. were evaluated under in-organic fertilizer in 2009, 2010 and 2011 rainy seasons at the Research farms of the Biofuel and Alternate Renewable Energy Ltd, Edidi, Kwara State in the southern Guinea savannah of Nigeria. The objective of the study was to determine the influence of different rates of N and P fertilizers on the vegetative growth and yield of T. peruviana. The experiment was laid out in a RCBD in a factorial arrangement with three replications. The factors includes: 3 levels of N (0, 30 and 60 kg ha^{-1}) and 3 levels of P (0, 30 and 60kg ha^{-1}) which were combined factorially. The results indicated that application of 0 kg N ha^{-1} and 30 kg P_2O_5 ha^{-1} resulted in increased plant height, number of primary branches, stem girth, number and weight of harvested seeds. It was also observed that application of 60 N kg ha^{-1} and 0 kg P_2O_5 kg ha^{-1} delayed number of days to both first and 50% flowering. Based on the result of this study it is recommended to apply only 30 kg P_2O_5 ha^{-1} because the native nitrogen in the soil was enough for both the growth and yield performance of T. peruviana in the study area.

Keywords: - *Thevetia periviana*, Growth, Yield, Nitrogen and Phosphorus fertilizers.

INTRODUCTION

Thevetia peruviana (Pers) Schum. is native to tropical America; especially Mexico, Brazil and West Indies and has naturalized in tropical regions worldwide (Daniel, 1937). It is commonly known as Yellow oleander (nerium), Lucky nut, Be-still tree, gum bush, bush milk, exile tree in India, and Olomi-ojo by the Yorubas in Nigeria. Its fruit is green in colour when unripe and changes from brown to black as it ripens. It encases a large dicotyledonous seed which is capsule-like, hard, angled, up to 1 inch in diameter and may remain viable after one year of proper storage. In its native countries, the plant has been known for more than 2000 years (Balusamy and Manrappan, 2007). In the wild the plant flowers after about one and half years and blooms thrice a year (Balusamy and Manrappan, 2007). *T. peruviana* produces between 400-800 fruits yearly depending on the rainfall and plant age (Ibiyemi *et al*., 2002). The number of kernels per fruit and the oil yield varied significantly among geographical locations. The plant has annual seed yield of 52.5 tonnes ha^{-1} at maturity (i.e. after 4 years old) and about 1,750 litres of oil can be obtained from an hectare of waste land where the plant is growing (Balusamy and Manrappan, 2007).

In the last ten years, chemists have revealed the potentials and prospects of some plants (*Jatropha curcas* and *T. peruviana*) which are not food crops and do not compete with the human food chain and they are viable sources of bio-oils. Recent research by Ibiyemi *et al*. (1995) revealed that *T. peruviana* has superior oils in terms of quality and quantity than *J. Curcas.* The seed contains 60 – 65% oil and the cake comprise of 30 – 37% protein. Despite the fact that there is high level of oil and protein in the seed, it remains non – edible because of the presence of cardiac glycoside (toxins). According to Atteh *et al*. (1995) and Oluwaniyi *et al*. (2007), the crude protein content of the defatted seed ranges from 42.79 – 47.50/100 g of the seed cake while crude lipid ranges from 4.40 to 4.80/100 g.

It is obvious that the world has shifted sourcing protein for animal diets and oils for industrial raw material to oil seeds. Notable among the oil seeds are *J. curcas*, *J. gosipifolia*, neem seed, and rape seed. Usman *et al*. (2009) therefore concluded that the plant can thus be used as an alternative protein source in animal feed formulation. If well processed, it would reduce competition between man and livestock for the conventional sources of proteins. The oil could also be useful in the production of oleochemicals such as liquid soap, shampoos, alkyd resin, and biodiesel. Thus, African countries are encouraged to invest in the cultivation of this potentially rich plant in order to reduce over-dependence on the currently limited sources of protein and oil.

The search for alternative sources of energy to supplement or replace fossil fuels so as to fetch their increasing demands, uncertain availability and to reduce the associated pollution problems of their combustion has drawn attention towards fuels of biological origin (Marchenko and Semenov, 2001), which provides a regenerable feedstock. As the plant is undergoing development in its various utilisation potentials, it is pertinent that factors that facilitate its large production such as soil nutrient and age of plant be investigated. Thus, this study tends to determine the influence of different rates of N and P fertilizers on the vegetative growth and the effect of years of establishment on the yield of *Thevetia* peruviana.

MATERIALS AND METHODS

Study area

The research work was carried out at the Research Farm of the Bio-fuel and Alternate Renewable Energ**y** Ltd, Edidi, Kwara State in the southern Guinea savannah of Nigeria between June 2009 and June 2012.

Soil sampling

Pre-cropping soil samples were randomly taken from six spots using the soil auger at 0-30cm soil depth from the experimental field. The samples collected were bulked to obtain composite sample for routine soil analysis in the laboratory to determine physico-chemical properties of the experimental site.

Sampling design

The experiment was laid out in a RCBD in a factorial arrangement with three replications. The factors includes: 3 levels of N (0, 30 and 60kg ha^{-1}) and 3 levels of P (0, 30 and 60kg ha^{-1}) which were combined factorially.

Planting technique

The land was ploughed once and harrowed twice to give a well pulverized soil. The size of each plot in the experiment was 10.0m x 4.0m. The plants were transplanted at 2.0m by 2.0m spacing to give a total population of 10 plants per plot. There were nine plots in each of the replicate giving a total population of 90 plants per replicate. Mature seeds were manually picked under a five year old plant after which it was cleaned, sorted for viability and pre-germinated in plastic bags for 6 weeks before they were transplanted on a flat field at a spacing of 2m by 2 meters with a plant population of 2,500 plants ha^{-1}.

Fertilizer application

Nitrogen fertilizer in form of Urea (46% N) was applied at the rate of 0 kg N ha^{-1}, 30 kg N ha^{-1} and 60 kg N ha^{-1} while phosphorus fertilizer in the form of single superphosphate (18% P) was applied at the rate of 0 $kgP_20_5ha^{-1}$, 30 $kgP_20_5ha^{-1}$and 60 $kgP_20_5ha^{-1}$. Phosphorus fertilizer was applied once at transplanting while nitrogen fertilizer was applied in two split doses, the first half of nitrogen was applied at 2 weeks after transplanting (WAT) while the second half was applied at 6 weeks after transplanting. Fertilizer application was done only in the first year of the experiment.

Harvesting

The first, second and third year harvests were terminated when the plants were exactly one, two and three years old respectively.

Herbicide Application

In the first and second year of the experiment, glyphosate was used at the rate of 2.5kg a.i ha^{-1} to control both annual and perennial weeds at intervals of ten and fifteen weeks respectively while in the third year, the canopy was fully covered to naturally control weeds.

Data collection and analysis

Vegetative growth parameters- plant height, number of primary branches, stem girth were determined at 8, 16 and 24 WAT and number of days to first and 50% flower appearance were taken only in the first year of the experiment while the yield parameters- number of harvested seeds and weight of harvested seeds were taken at both the first, second and third year of the experiment. The data collected was subjected to analysis of variance (ANOVA) using Statistical Analysis Software (SAS) and the significant means were separated using the Least Significant Difference (LSD) at 5% level of probability ($p \leq 0.05$).

RESULTS

The pre-cropping soil sample characteristics indicated that the soil of the experimental site was sandy loam that was moderately acidic (Table 1). The organic matter and total nitrogen were moderate while the phosphorus level was low.

Table 1: Physico-Chemical properties of the soil of the experimental sites during 2009 and 2011 rainy seasons.

Soil characteristics	Soil Depth 2009 0-30cm	2011 0-30cm
Physical characteristics %		
Clay	236	236
Silt	40	80
Sand	724	684
Textural class	Sandy loam	Sandy loam
Chemical characteristics		
pH1:1 in H_2O	6.20	5.60
Organic Carbon g/kg	1.51	1.10
Organic matter g/kg	2.82	2.30
Total Nitrogen g/kg	2.15	1.62
Available Phosphorus m/kg	1.48	1.12
Exchangeable bases (cmol kg^{-1})		
K	1.44	1.43
Na	1.92	1.63
Ca	0.90	0.68
Mg	0.36	0.32
CEC	4.62	4.06

Nitrogen rates significantly affected the height of *T.peruviana* except at 8 WAT whereas plant height was significantly influenced by the levels of phosphorus fertilizer except at 8 WAT (Table 2). Where significant differences were observed, plots with no nitrogen fertilizer had significantly tall plants compared to plots where 60 kg N ha^{-1} was applied. Significantly taller plants were observed on plots that had 30 and 60 kg P ha^{-1} compared plots with no phosphorus fertilizer.

Table 2: Effect of rates of nitrogen and phosphorus fertilizers on plant height (cm) of *Thevetia peruviana*.

Treatment	Sampling Periods (WAT) 8	16	24
Nitrogen (N) rate $Kgha^{-1}$			
0	42.47	74.73a	93.98a
30	41.38	72.36ab	90.38ab
60	40.93	70.00b	87.40b
LSD (0.05)	N.S	3.79	5.73
Phosphorus (P) rate $Kgha^{-1}$			
0	40.13b	71.40	89.49
30	41.12a	72.04	90.07
60	43.52a	73.64	92.07
LSD (0.05)	2.93	N.S	N.S
Interaction			
N*P	N.S	N.S	N.S

Means in a column under any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD).
N.S = Not significant

The number of primary branches significantly decrease and increase gradually with an increased in application of nitrogen and phosphorus fertilizers respectively (Table 3).

Table 3: Effect of Rates of Nitrogen and Phosphorus Fertilizers on Number of Primary Branches of *Thevetia peruviana*.

Treatment	Sampling Periods (WAT)		
	8	16	24
Nitrogen (N) rate Kgha^{-1}			
0	10.47a	25.47a	33.04a
30	10.04a	25.80a	32.82a
60	8.24b	22.87b	29.20b
LSD (0.05)	1.29	2.54	3.20
Phosphorus (P) rate Kgha^{-1}			
0	8.87b	22.76b	29.67b
30	9.93ab	24.67b	31.80b
60	10.69a	27.71a	35.60a
LSD (0.05)	1.29	2.54	3.20
Interaction			
N*P	N.S	N.S	N.S

Means in a column under any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD).
N.S = Not significant

While the stem girth was not affected by application of nitrogen and phosphorus fertilizers except phosphorus at 8 WAT (Table 4), the Interaction between nitrogen and phosphorus fertilizers was significant at 8 WAT. Plots with no application of phosphorus fertilizer had significantly lower stem girth and this plots were similar to plots that 0 kg P ha^{-1} were combined with 60 kg N ha^{-1}. Other plots had relatively similar stem girth (Table 5)

Table 4: Effect of Rates of Nitrogen and Phosphorus Fertilizers on Stem Girth (cm) of *Thevetia peruviana*.

Treatment	Sampling Periods (WAT)		
	8	16	24
Nitrogen (N) rate $Kgha^{-1}$			
0	0.97	1.78	2.11
30	0.99	1.81	2.09
60	0.93	1.71	1.97
LSD (0.05)	N.S	N.S	N.S
Phosphorus (P) rate $Kgha^{-1}$			
0	0.90b	1.78	2.09
30	1.02a	1.79	2.08
60	0.98a	1.73	2.01
LSD (0.05)	0.02	N.S	N.S
Interaction			
N*P	*	N.S	N.S

Means within a column followed by the same letter do not differ significantly at 0.05 level of probability according to Duncan Multiple Range Test (DMRT)

* = Significant at 5% level of probability

N.S = Not significant

Table 5: Interaction of Rates of Nitrogen and Phosphorus Fertilizers on Stem Girth of *Thevetia peruviana* at 8 WAT.

	Phosphorus fertilizer rates		
	0	30	60
Nitrogen fertilizer rates			
0	0.83e	1.02a-c	1.04ab
30	0.97a-d	1.05a	0.94b-d
60	0.90de	0.98a-d	0.92c-e
LSD (0.05)		0.02	

Means followed by the same letter (s) do not differ statistically at 0.05 level of probability according to Duncan Multiple Range Test (DMRT). N.S =Not significant.

Increase in N level from 30 to 60 kg N/ha significantly increased days to first and 50 % flowering of *T. Peruviana* whereas application of P significantly reduced days to first and 50 % flowering of *T. Peruviana* (Table 6).

Table 6: Effects of rates of nitrogen and phosphorus fertilizers on number of days to first and 50% flowering of *Thevetia peruviana*

Treatments	Days to first flowering (DAT)	Days to 50% flowering (DAT)
Nitrogen rate (Kg N ha^{-1})		
0	237.78a	271.94a
30	236.67a	272.83a
60	245.78b	276.67b
LSD (0.05)	7.03	3.55
Phosphorus rate (Kg P_2O_5 ha^{-1})		
0	241.78b	288.67b
30	239.28a	267.39a
60	239.17a	265.39a
LSD (0.05)	2.09	18.24
Interaction		
N x P	N.S	N.S

Means in a column under any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD). N.S = Not significant
DAT= Days after transplanting

Application of 0 and 30 kg N ha^{-1} significantly increased both the number and weight of harvested seeds while application of 30 and 60 kg P_2O_5 ha^{-1} gave a significantly higher number and weight of harvested seeds which was statistically similar (Tables 7 and 8).

Table 7: Effect of rates of nitrogen and phosphorus fertilizers on number of harvested mature seeds per plot (ha^{-1}) of *Thevetia peruviana*

Treatment	Number of Harvested Seeds		
	1 year old	2 years old	3years old
Nitrogen (N) rate Kgha^{-1}			
0	5,000a	36,500a	370, 450a
30	3,444b	35,500a	371, 650a
60	2,944b	29,750b	306, 800b
LSD (0.05)	660.65	5,000	63, 585
Phosphorus (P) rate Kgha^{-1}			
0	1,972b	30,750b	317, 675b
30	3,722a	37,250a	386, 175a
60	4,294a	35,900a	381, 975a
LSD (0 .05)	660.65	5,000	63, 585
Interaction			
N*P	N.S	N.S	N.S

Means in a column under any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)
N.S = Not significant

Table 8: Effect of rates of nitrogen and phosphorus fertilizers on weight of harvested mature seeds per plot (kg ha^{-1}) of *Thevetia peruviana*

Treatment	Weight of Harvested Seeds		
	1 year old	2 years old	3years old
Nitrogen (N) rate Kgha^{-1}			
0	22.07a	1,094a	11,103.35a
30	20.88a	1,195a	12,510.47a
60	12.20b	898b	9,260.72b
LSD	8.50	191.0	2,429
Phosphorus (P) rate Kgha^{-1}			
0	10.04b	923b	9,035.42b
30	21.22a	1,115a	11,559.33a
60	23.88a	1,223a	13,012.69a
LSD	8.50	191.0	2,429
Interaction			
N*P	N.S	N.S	N.S

Means in a column under any given treatment followed by the same letter(s) do not differ significantly at 0.05 level of probability using the Least Significant Difference (LSD)

N.S = Not significant

DISCUSSION

The result obtained from this study revealed that application of 60 kg N ha^{-1} significantly reduced plant height and number of primary branches of *T peruviana* while plots with no N had significantly higher plant height and number of branches. This means that 2.15 N g/kg obtained from the pre-cultivation soil analysis was sufficient to aid the growth of the plants and the reduction in growth as the nitrogen level increases could be attributed to the burning effect of excess nitrogen fertilizer on plants.

Youssefi *et al*. (2000) reported that trees appear to have a finite capacity to use available soil N and demonstrate the capacity to self-regulate net N uptake once that capacity has been met. The yield of *T. Peruviana* from this experiment was also observed to be suppressed with increasing nitrogen fertilizer. This could be as a result of reduction in the vegetative growth of the plant at the early stage of development. Achten *et al*., (2008) observed that optimal fertilization can increase the seed and oil yield, but high fertilization can result in low seed production.

Application of phosphorus fertilizer increased both plant height and number of primary branches. This result indicated that phosphorus is essential for the general health and vigour of thevetia plants and the effect of phosphorus on growth have been reported in several investigations. Das *et al*. (1991) found an increase in black cumin (*Nigella sativa*) height, number of branches and fresh weight and dry weight of shoots and roots with increasing phosphorus concentration from 20 to 40 kg/ ha. This was also supported by Munshi *et al*. (1990) who reported an increase in plant height and number of branches of *Carum carvi* grown from root tubers when phosphorus was applied at the rate of 40 kg/ ha. Rathore *et al*., (1992) also observed that adequate amount of phosphorus in soils favours rapid plant growth, early fruiting / maturity and improve the quality of the produce.

The results of this study also reveal that application of phosphorus fertilizer significantly increased the yield (number and weight of harvested seeds). This showed that phosphorus fertilizer improved seed production. Scheffel, (1999) documented that some specific growth factors that have been associated with phosphorus are: stimulated root development, increased stalk and stem strength, improved flower formation and seed production.

CONCLUSSION

The result of this study suggests that, the native N (2.15 N g/kg) in the soil and application of 30 kg P_2O_5 ha^{-1} was enough to improve both the vegetative and yield performance of the plant in the study area in all the affected years.

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