GROWTH RATES OF PARKIA *biglobosa* JACQ. SEEDLINGS (AFRICAN LOCUST BEAN TREE) AS INFLUENCED BY TWO INORGANIC MANURES

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ABSTRACT

One of the prominent fruit trees in the savanna ecosystem is Parkia biglobosa Jacq. (African Locust Bean Tree). Apart from being a nitrogen fixing tree, the seeds from its matured pods are often processed and used as soup condiment in some African countries most especially Nigeria. The population density of this plant species is low, its growth rate is slow and the processed seeds are not abundantly available and therefore costly. Thus, the influence of two inorganic manures/fertilizers (Urea and N. P. K.) on the growth rate of the seedlings of this species was investigated to pave way for massive production. The experimental design employed was completely randomized design (CRD) comprising 3 treatments and 4 replicates (treatments A (sandy loam + Parkia biglobosa seeds + N.P.K), B (sandy loam + Parkia biglobosa seeds + Urea) and C (sandy loam + Parkia biglobosa seeds as control). Seedlings' emergence rates/percentages and morphological growth indices /parameters (plant height, leaf count, number of branches, collar girth and leaf area) were evaluated. Application of inorganic manures commenced at the 6th week after germination/seedling emergence. Results from statistical data analyses (SPSS 21.0) indicated significant differences (at $P \leq 0.05$) among the treatments. Seedlings in Urea + sandy loam (treatment B) had the highest mean values/fastest growth rate followed by treatment A and treatment C was the least. Incontrovertibly, faster growth rate of this important tree species could be achieved by employing Urea and relatively, N.P.K fertilizer could also be used.

Keywords: Parkia biglobosa, inorganic manures, seedlings, growth rate, morphological indices.

1. INTRODUCTION

Parkia biglobosa Jacq. (African Locust Bean Tree) is a wild fruit tree in the savanna ecosystem especially in Africa. It is a perennial and nitrogen fixing tree legume which belongs to the family Fabaceae and subfamily Mimosoideae. Its origin had been traced to South America and due to its economic significance it had attracted more recognition (Joshi and Joshi, 2009; Laperia *et al*, 2014). It helps in ensuring geo-ecological sustainability such as soil fertility improvement, erosion control and environmental air or atmosphere balance (Abebe *et al*., 2008). As earlier observed by Ademola, *et al*. (2011), *P. biglobosa* seeds are processed into a condiment called 'iru' (in Yoruba – Western Nigeria) or 'dawadawa' (in Hausa – Northern Nigeria), which is a very good source of protein in Nigeria and other west African countries (e. g. Ghana). In fact, this wild fruit tree has numerous benefits and it is a blessing to Africa (Cemanskay, 2015). Thus, it is imperative to conduct reasonable research on how to ensure faster growth rate of this important wild fruit tree and subsequently its yield. Eventually when its seedlings are planted on large scale especially under alley cropping system (a type of agro-forestry system) adequate soil conservation will be ensured on sustainable basis (Kareem and Ojo, 2019) and the seeds from the matured fruits will be abundantly available at lower cost.

The objective of this study is to investigate the influence of two inorganic manures (chemical fertilizers) on the growth rate of *Parkia biglobosa* seedlings.

2. MATERIALS AND METHODS

The experiment was carried out in the screen house of the Department of Plant Science and Biotechnology, Adekunle Ajasin University, Akungba -Akoko, Ondo State Nigeria. The area (Ondo State in Nigeria) is characterized by two climatic seasons (the rainy and dry seasons) and is on latitude of $7^{o}28^{1}$N and longitude of $50^{o}44^{1}$ (Odjugo, 2010). Experimental materials used include African locust bean (*Parkia biglobosa*) seeds, plastic buckets (perforated at the bottom), N.P.K. 15:15:15, Urea fertilizers (procured from Ikare market in Ondo State) and sandy loam/top soil (gotten from the University premises). Other items used in collecting data on morphological indices include meter rule, thread, simple calculator, camera etc. The design of the experiment was completely randomized design (CRD) consisting of three (3) treatments and four (4) replicates Table 1 below shows the experimental plot layout.

Table 1: Experimental Plot Layout

A	B	C
B	C	A
C	A	B
B	C	A

Legend:

Treatment A – Sandy loam + *Parkia biglobosa* seeds + NPK
Treatment B – Sandy loam+ *Parkia biglobosa* seeds + Urea
Treatment C – Sandy loam+ *Parkia biglobosa* seeds (control)

Pertaining to the procedure, the perforated buckets (at the bottom) were filled with 3kg sandy loam after proper identification and arranged in line with the design of the experiment which was completely randomized design (CRD) comprising 3 treatments and replicated 4 times, each of the replicates consisted of two units (seedlings) and was later thinned to one. The soil used was taken to the laboratory for physico - chemical analysis to assess both the physical and chemical properties. The physical properties include the percentage sand, silt and clay while the chemical properties assessed include pH (H_20), organic carbon, total nitrogen, available phosphorus, exchangeable bases (potassium, sodium, calcium, magnesium, aluminum, copper, manganese, zinc), exchangeable acidity and effective cation exchange capacity (ECEC).

The seeds of *Parkia biglobosa* were extracted from matured/ripe fruits (in form of dry pods) washed and air dried for a week. Two seeds were sown at a depth of 2cm in each bucket (with 3kg sandy loam) and all plastic buckets used were perforated at 5 points at the bottom to avoid water logging/flooding and ensure that the soil remained at field capacity. The seedlings were later thinned to one (with better vigor) per bucket at the 3rd week after germination/seedling emergence (SE) to avoid competition for nutrients. Watering was done twice daily (morning and evening). Germination/seedling emergence (SE) rates were taken daily and ended at 14^{th} day after sowing. The germination/SE percentages were calculated by dividing the number of seedlings that emerged by the total number of seeds sown and then multiplied by 100.

Morphological parameters such as plant height (measured with meter rule), number of leaves (by visual counting), collar girth (by placing thread round the basal part of the stem 2cm from the ground level and later placed (the thread) on the meter rule to record the value), number of branches (by visual counting) and the leaf area (measured by multiplying the length of each leaf by the mean breadth of the particular leaf at 3 points, then the average/mean area of 3 leaves on a seedling was used to multiply the total number of leaves on that particular seedling to obtain the area (length x breadth) of all the leaves on that seedling – in the absence of leaf area meter). After 6 weeks of SE, 1.8g of N.P.K 15:15:15 and Urea were applied using ring application method about 3cm away from the seedlings at 2cm depth and watered thrice a week. Data were collected on soil physicochemical properties (by employing standard laboratory procedures), seedlings' emergence rates and percentages and morphological parameters/indices (leaf count, collar girth, plant height, number of branches and leaf area). Collection of data continued till the end of the experiment (12 weeks).The data were analyzed by employing Analysis of Variance (ANOVA) technique (SPSS version 21.0).

3.0 Results

The analyzed soil sample (sandy loam) indicated that the soil consisted of three major physical components (Table 1 below) which are clay (20.20%), sand (61.80%) and silt (18.00%).

Table 2: The physical properties of the sandy loam used before sowing

S/N	Parameters	Values
1	Clay	20.20%
2	Sand	61.80%
3	Silt	18.00%

With regard to the chemical properties (Table 2 below) the soil used consisted of total Nitrogen (TN) of 4.35%, P^H (H_20) 6.10, Organic matter (42.60%), available phosphorus of (36.67ppm), exchangeable potassium (0.41kg^{-1}), exchangeable calcium (0.29mg/kg), exchangeable Sodium of (0.52kg^{-1}), exchangeable magnesium (2.16kg^{-1}), copper is (7.20kg^{-1}), exchangeable acidity (0.79kg^{-1}) and 11.37kg^{-1} for effective cation exchange capacity (ECEC).

Table 3: The chemical properties of the sandy loam used before sowing

S/N	Parameters	Values
1	pH ($H_2$0)	6.10
2	Organic matter	42.60%
3	Total Nitrogen	4.35%
4	Available Phosphorus	36.67ppm
5	Exchangeable potassium	0.41kg^{-1}
6	Exchangeable calcium	0.29kg^{-1}
7	Exchangeable magnesium	2.16kg^{-1}
8	Copper	7.20kg^{-1}
9	Exchangeable sodium	0.52kg^{-1}
10	Exchangeable acidity	0.79kg^{-1}
11	Effective Cation Exchange Capacity (ECEC)	11.37kg^{-1}

Pertaining to the SE rate and percentages, a total number of 48 seeds (scarified *Parkia biglobosa* seeds) were sown in sandy loam. Seedlings' emergence (SE) commenced on the 9th day and ended at 14th day after sowing. The Table below shows the seedlings' emergence rates and percentages.

Table 4: Germination/seedlings' emergence rates and percentages

DAS	No. of seeds sown	No. of seedlings that emerged	Percentages
9	48	30	62.50%
10	48	37	77.08%
11	48	42	87.50%
12	48	44	91.67%

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13	48	44	91.67%
14	48	44	91.67%

Legend: DAS = Day after sowing

Table 5: Mean values of plant height after fertilizer application from weeks 6-12

Treatment	PH6	PH8	PH10	PH12
A	9.05 ± 1.31[a]	10.18 ± 1.02[b]	11.75 ± 1.04[ab]	12.63 ± 1.[33b]
B	11.56 ± 1.40[b]	12.88 ± 1.27[b]	14.94 ± 0.96[c]	16.19 ± 0.97[c]
C	9.63 ± 1.68[a]	10.25 ± 1.62[b]	11.84 ± 1.91 [ab]	12.46 ± 1.40[ab]
GM	10.08 ± 1.74	11.10± 1.78	12.84 ± 1.99	13.76 ± 2.12

Legend: PH= Plant heightA (Sandy loam +*Parkia biglobosa* seeds + N.P.K.), B (Sandy loam +*Parkia biglobosa* seeds + Urea), C (sandy loam +*Parkia biglobosa* seeds). In the Table above, values that have the same alphabets as superscript are not significantly different (at P≤0.05) and values that have different alphabets as superscript are significantly different. Also values that have two different alphabets as superscript (X^{ab}) were different but not at any level of significance.

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Plate1: *Parkia biglobosa* seedling

Analysis of variance revealed that there were significant differences in leaf count. The observed maximum mean leaf count was recorded in treatment B (20.25) followed by C (18.50) and A had the minimum mean value. Also treatment B had the highest mean leaf count at weeks 8 and 10, followed by C but A had the least mean value. However, at week 12 the highest mean value was recorded in treatment B (35.63) followed by A (28.25) and C (27.75) had the least mean value (Table 6 below).

Table 6: Mean values of leaf count after fertilizer application from weeks 6-12

Treatment	LC6	LC8	LC10	LC12
A	16.75 ± 0.29[a]	20.00 ± 2.86[a]	27.13 ± 6.79[a]	28.25 ± 5.98[a]
B	20.25 ± 0.96[b]	24.88 ± 3.42[b]	34.50 ± 1.78[b]	35.63 ± 1.79[b]
C	18.50±2.79[ab]	21.50 ± 3.29[a]	27.25 ± 5.39 [a]	27.75 ± 4.73[a]
GM	18.50 ± 2.15	22.13± 3.59	29.63 ± 5.98	30.54 ± 5.56

Legend: LC= Leave count**,** A (Sandy loam + *Parkia biglobosa* seeds + N.P.K.)**,** B (Sandy loam + *Parkia biglobosa* seeds + Urea), C (Sandy loam + *Parkia biglobosa* seeds)

Significant differences (at P≤0.05) were observed among the treatments regarding number of branches. At weeks 6 and 8 the maximum number of branches were recorded in treatment B (5.25) followed by C (4.88) and A (4.38) had the least and also the same trend was observed at week 8 (B: 6.63, C: 6.25, A: 6.00). However, at weeks 10 and 12, B had the highest mean value followed by A and C was the least (7.25, 6.88, 6.75 and 7.88, 7.13 and 7.00 respectively, Table 7)

Table 7: Mean values of number of branches after fertilizer application from weeks 6-12

Treatment	**NB 6**	**NF B 8**	**NB 10**	**NF B 12**
A	4.38 ± 0.25^{a}	6.00 ± 0.41^{a}	27.13 ± 6.79^{a}	7.13 ± 0.85^{b}
B	5.25 ± 0.29^{b}	6.63 ± O.48^{a}	34.50 ± 1.78^{a}	7.88 ± 0.63^{c}
C	4.88 ±0.48^{ab}	6.25 ± O.65^{a}	27.25 ± 5.39^{a}	7.00 ± 0.41^{a}
GM	4.83 ± 0	6.29± 0.54	6.96 ± 0.58	7.33 ± 0.72

Legend: N B = Number of branches, A (Sandy loam + *Parkia biglobosa* seeds + N.P.K.) B (Sandy loam + *Parkia biglobosa* seeds + Urea) C (Sandy loam + *Parkia biglobosa* seeds)**.** In the table above, values that have different alphabets as superscripts are significantly different and values that have two different alphabets as superscript (X^{ab}) were different but not significant different. Also values that have same alphabets as superscript are not significantly (P<0.05).

The maximum and minimum mean leaf area values were recorded in treatments B (179.78) and A (111.55) respectively at weeks 6 and 8, while treatment B had the highest mean value followed by A and C (the least mean value) at weeks 10 and 12 with 434.73, 240, 58 and 228.03 and 532.98, 294.94 and 261.61 respectively (Table 8 below- values in cm^2).

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Table 8: Mean leaf area after inorganic fertilizer application from weeks 6-12

Treatment	LA 6	LA 8	LA10	LA12
A	111.55 ± 21.62^{a}	150.73 ± 47.02^{a}	240.58 ± 96.93^{a}	294.94 ± 78.71^{a}
B	179.78 ± 51.00^{b}	274.33 ± 100.^{72b}	434.73 ± 163.^{41b}	532.98 ± 183.25^{b}
C	135.04 ±40.25^{ab}	169.35 ± 64.01^{ab}	228.03 ± 101.^{70ab}	261.61 ± 120.64^{ab}
GM	142.13 ± 46.39	198.14± 87.85	301.11 ± 149.78	363.18 ± 175.35

Legend: LA= Leave AreaA (Sandy loam +*Parkia biglobosa* seeds + N.P.K.)**,** B (Sandy loam + *Parkia biglobosa* seeds + Urea), C (Sandy loam + *Parkia biglobosa* s

Analysis of variance revealed that there were significant differences in the collar girth among the treatments. The maximum mean values were observed in treatment B followed by C while A had the least collar girth mean values at week 6 (1.56, 1.51, 1.41 respectively: in cm) and week 8 (1.47, 1.60, 1.50 respectively: in cm). However, at weeks 10 and 12 the highest mean values were recorded in treatment B followed by A and C had the least collar girth mean values, 1.94, 1.63, 1.61 and 2.03, 1.71 and 1.70 respectively, Table 9 below - values in cm).

Table 9: Mean values of collar girth after inorganic fertilizer application from weeks 6-12

Treatment	C G 6	C G 8	C G 10	C G 12
A	1.41± 0.15^{a}	1.50 ± 0.19^{a}	1.63± 0.18^{a}	1.71 ± 0.15^{a}
B	1.56 ± 0.75^{a}	1.74 ± 0.09^{a}	1.94 ± 0.13^{b}	2.03 ± 0.06^{b}
C	1.51 ±0.95^{a}	1.60 ± 0.14^{a}	1.64 ± 0.17^{a}	1.70 ± 0.15^{a}

GM	1.49 ± 0.12	1.61± 0.17	1.73 ± 0.21	1.81 ± 0.19

Legend: CG= Collar Girth, A (Sandy loam + *Parkia biglobosa* seeds + N.P.K.)**,** B (Sandy loam + *Parkia biglobosa* seeds + Urea) , C (Sandy loam + *Parkia biglobosa* seeds)

4. DISCUSSION

This study showed a profound effect of the chemical fertilizers applied on the growth of *Parkia biglobosa* seedlings. It improved the nutrient status of the growth media with significant differences (Urea was better than NPK and control). It is also an established fact that soil with reasonable nutrient status is very essential to the growth, development and yield of crop plants. Seedlings' emergence took place at the 9th and ended at the 14th day after sowing. Early emergence observed was possibly due to removal of seed coat which has been eaten up by mechanical scarification or due to rasping of the seed hard coat which has eaten deeper into the epicarp or cotyledon which actually sped up the emergence or germination of the seeds. This phenomenon had been confirmed by Agboola (2002) and in the same vein, Tomlison *et al*. (2002) also reported that seed dormancy resulting from an impermeable seed coat could be overcome by peeling off the seed coat to pave way for water imbibition through the micropyle (micropile). Several pre-sowing treatments such as scarification, hot water and acid treatment had been used and proven successful to overcome seed coat-imposed dormancy (Tekekay, 1996).

Analysis of variance (ANOVA) which indicated significant differences ($P<0.05$) for all the morphological parameters (plant height, leaf count, number of branches, collar girth and leaf area) was due to the level of different nutrient/fertility statuses among the growth media. For instance, treatment B with Urea in terms nitrogen was above others. This result was similar to that of Ashraf & Rehman (1999) who reported that increasing supply of Urea (nitrogenous fertilizer) improved growth of corn and Ashraf *et al*. (2002) while assessing the effect of sub and supra-optimal nitrogen regimes on wheat. Robson and Deason (1978) and Gastal & Saugier (1986) submitted that Urea application increases the leaf count of plants and canopies to greater extent. Khalid *et al*. (2003) with regard to rice reported that plant growth was improved when nitrogen (N), Potassium (K) and Phosphorus (P) fertilizers were employed. Also, Kareem (2018) reported positive effects of NPK fertilizer on the growth and yield of *Glycine max* (soya bean).

Inorganic fertilizer application had been a major component of culture for over a century in Nigeria, since most of the arable lands are under continuous cultivation. Shifting cultivation as a land - use practice is no more practicable as result of pressure on land (owing to increasing population) and the slash and burn system of land preparation practiced by the local farmers had greatly depleted soil fertility. The best way of preventing soil from becoming poor is to put back into it what had been taken out and one of the ways of achieving this is through chemical (inorganic) fertilizer application (Robert and Andrew, 1989). Application (of appropriate chemical fertilizer) should be at recommended rates to avoid some deleterious effects on crops and the consumers. The major nutrients required by crops are nitrogen, phosphorus and potassium, inadequate supply of any of these nutrients during crop growth often leads to negative impact on the reproductive capacity, growth and yield of crops (Cooke, 1972; Vine, 1953: Solobo, 1972; Kareem and Adegoke, 2015) and supplementary amount of nutrients can be added to soil in form of inorganic fertilizer to correct inadequate supply of nutrient to crops after soil nutrient status assessment.

5. CONCLUSION

Growth of the *Parkia biglobosa* seedlings was enhanced positively during the period of study by the application of Urea, N.P.K. and even the sandy loam (Control). It could be vividly inferred that seeds of *Parkia biglobosa* that were mechanically scarified, sown in sandy loam and received application of urea fertilizer (6 weeks after germination/seedling emergence)was the most suitable for improving the growth rate of *Parkia biglobosa* seedlings. Thus, sandy loam could be used in sowing the seeds of *Parkia biglobosa* in order to achieve high germination/seedling emergence percentage and application of inorganic fertilizer (Urea) could be used to reasonably improve the growth rate of the seedlings though NPK can also be employed. This can enhance the domestication and cultivation of this valuable plant in our environment on a very large scale for its edible seeds and soil improvement qualities (nitrogen fixing activities). In a bid to achieving faster growth rate of the seedlings after planting out (on large scale plantations or alley cropping farms), inorganic fertilizer application could continue at reasonable intervals and rates prior to attainment of young tree stage when well - established root system would be formed which will eventually pave for higher level of nitrogen fixation activities. Also, soil nutrient augmentation will be ensured at full-tree stage due to the deciduous nature of this plant (*Parkia biglobosa*) owing to decomposition /mineralization (especially in raining season) of the leaves shed in the dry season.

REFERENCES

Abebe, M.; Oosting, S.; Fernandez, A.J; Vander, Z. (2008). Multipurpose fodder trees in the Ethiopian Highlands: farmers' preference and relationship of indigenous knowledge of feed value with laboratory indicators. *Agric, Syst.* 9, 184-194.

Ademola, I. T; Baiyewu, R.A; Adekunle, E. A; Omidiran, M. B. (2011). An assessment into the physical and proximate analysis of processed locust bean (*P. biglobosa*) preserved with common salt. *Pakistain Journal of Nutrition* 10 (5): 405-408.

Agboola, O. O; Basaranoglu, Z., Yilmaz M., Bugutekin A., Full, M. Z. (2001). Physiochemical attributes of wine produced from the yellow pulp of *Parkia biglobosa* using traditional juice extraction techniques. *Big. Food J.* 19: 76-79.

Ashraf, M. Y; Ashraf, M., & Ozturk, M. (2018). Underutilized vegetables: A tool to address nutritional issues, poverty reduction and food security. M. Ozturk K. Hakeem M. Ashraf & M. Ahmad, In *Global perspectives on underutilized crops* (pp. 1–23). New York, NY: Springer. *P. biglobosa*. A Monograph - School of Agricultural and Forest Sciences, University of Wales, Bangor, U.K.

Ashraf, M; Mustaq, M. A.; Missed A. (2002). Effect of sub and Supa-optimal nitrogen regimes on nutrient relation in two spring wheat cultivate differing in salinity tolerance. *Floral*, 197:126-133.

Ashraf M., Rahman H. (1999). Interaction effects of nitrate and long term water logging on growth, water relations, and exchange properties of Maisie (Zea mays L) Plant Science. 144:35-43.

Cemansky, R. (2015). Africa's indigenous fruit trees: A blessing in decline. *National Institute of Environmental Health Sciences*, *123*(12), A291–A296.

Cooke, G.W (1972). Fertilizer for maximum yield. Great Britain: Granada publishing Limited. 465pp.

Joshi, A. R and Joshi, K. (2009). Plant Diversity and Ethno-botanical notes on tree species of Syabru Village, Langtang National park, Nepal. *Ethno botanical leaflets* 13: 651-64.

Kareem, I.A. and Adegoke, A. O. (2015). Response of *Glycine max* (Soya Bean) to different levels of NPK fertilizer and Soil types. *International Journal of Agric. Research and Review.* 3(7): pp. 401-405.Spring Journals.

Kareem, I. A. (2018). Influence of Soil Manures (Organic and Inorganic) on the growth and yield of bell pepper (*Capsicum annuum Linn*.). *Indian Journal of Applied Research.* 8(9): pp. 11-13.

Kareem, I. A. and Ojo, M. O. (2019). Soil fertility status and crop yield as influenced by *Albizia lebbeck* Benth (ratle tree) in alley cropping system. *International Journal of Agric., Environment and Bioresearch.*

Khalid M, Chaudhry FM, and H. (2003). Effect of different levels of N. P. K.On the yield and quality of Rice CV. IR-6 .*J. Red.Science*. 14:11-15.

Lapeña, I., Turdieva, M., Noriega, I.L. and Ayad, W.G. (2014). Conservation of fruit tree diversity in Central Asia: Policy Options and Challenges. Bioversity Inter-national, Rome, p. 251.

Odjugo, P. A. O. (2010). General overview of climate change impacts in Nigeria. Journal of Human Ecology 29 (1): 47-55.

Robert, K. M and J. W. Andrew, (1989). An introduction to crop physiology. New York: Longman scientific and technical, Willey, 340.

Robson, M. J, Deacon MJ (1978), Nitrogen deficiency in small closed Communities of S24 rye grass. 11 changes in the weight and chemical Composition of single leaves during their growth and dealth. Ann Bot. 42:1199-1213.

Tekekay, D. (1996). Germination ecology of twelve indigenous species from Ethiopia. Forest ecology management 80: 209-223.

Tomlinson H, Ng'andwe M, Nikiema A. (2000). Field and in-vitro method of propagation of the African locust bean tree (*Parkia biglobosa* (Jacq). *Journal of. Horticultural Science and Biotechnol*ogy. 75: 42-49.

Vine, H. (1953). Experiments in the maintenance of soil fertility in Ibadan, Nigeria. *Empirical Journal of Experimental Agriculture*.21:65-71.