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Effect of NPK Fertilizer on Growth Performance of African Locust Bean (*Parkia biglobosa*) *(Benth*) and Tamarind (*Tamarindus indica*) (*Linn*) seedlings in Sudan Savannah of Nigeria.

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Abstract

The study was conducted at the Arboratum site of the Department of Forestry and Environmental Management Technology, Hussaini Adamu Federal Polytechnic, Kazaure, to evaluate the effect of fertilizer (NPK) application on growth performance of Parkia biglobosa and Tamarindus indica seedlings. Three levels of NPK fertilizer (0, 3, 5, and 7 g) and no fertilizer were used. The soil test was conducted to test the CEC (Organic carbon, pH and soil texture) of the site before applying fertilizers to the plants for growth, in which the pH is between 6.0 - 7.0 and the soil texture is sandy loam and Organic carbon is 0.45. The fertilizer was applied by ring method after dig round the stem of the planted seedlings at three centi meter deep (3cm). All the treatments were set in a Randomized Complete Block Design (RCBD) with three replications. Data were analysed using Analysis of Variance (ANOVA), while Duncan Multiple Range Test was used for means separation among the parameters measured. The result showed no significant (P>0.05) difference in stem height and collar diameter, number of leaflets and Number of Branches compared to control. Data on growth parameters was taken at three weeks' interval. T. indicates applied with 5g of NPK fertilizer had significantly higher value than the control while 7g was found to be of highest value in Parkia b. It is evident from the results of this study that, the two tree species responded to NPK fertilizer application. It is recommended that the farmers should be enlighten on the accurate dose of NPK fertilizer to be used on the growth performance of these tropical trees planted on the farms and plantation site.

Keywords: Effect, Savannah zone, Performance, NPK fertilizer, Parkia b.* and *Tamarindus indica

Introduction

Trees are central to our lives. The best friend on earth, we eat food and fruits from trees, we use paper made from wood pulp, tools with wooden handles, and medicine extracted from tree parts (Hannah, 1999). We rest in their shade and we breathe fresh air which serves as air conditioner to supply to an extended family. Trees are an integral part of agricultural sector and generate income for rural house hold. Indigenous tree species are endowed with features that give them the potential of ecosystem stabilization and anti-desertification control in arid and

semi-arid areas because they are highly adapted to the environmental conditions (Rabi'u and Rabi'u, 2013). Consequently, basic information on nutrient requirements of important indigenous tree species is not readily available, leading to lack of practical fertilizer prescription (Muhammad *et al*., 2009). Fertilizer is one of the most significant cultural practices in modern tree production. Application of fertilizer enhances seedlings growth (Zubairu, 2014). Considering the importance of this indigenous tree species to the populace, livestock, and the environment, there is a need to encourage their easiest way of propagation, since over-utilization rendered most of the species threatened. The study was justifiable in providing information on the response of the indigenous tree species on NPK fertilizer. Inadequate supply of any of these nutrients during growth is known to have negative impact on the seedlings growth (Nafiu, *et al*., 2011 and Maharazu *et a*l., 2013).

Nutrient deficiencies, especially low soil nitrogen (N), phosphorus (P) and potassium (K) constitute the most important soil limiting factors for trees growth throughout the Sudan savannah environment (Hussein, *et al*. (2000)). NPK fertilizers contain balanced amount of Nitrogen, phosphorous and potassium to feed plants and to foster growth and also to evaluate equal application of nutrients to tree legumes (Nader, *et al*., 2014). Multipurpose trees respond positively to the fertilizer application, the dose depend on the soil type, climate and system of planting (Atiku, *et al*., 2020). The NPK fertilizers is the most important and costly input to enhance seedlings growth (Upadhyaya and Thupan, 2014). The practice of applying NPK fertilizers separately was due to low fertilization efficiency which is incorporated in association into the soil (Emylia and Lucretia, 2017). According to Davidson (2004) pointed out that, fertilizers application plays a vital role in increasing growth of indigenous tree species at the seedlings stage.

Despite its contributions to the local economies, the two study trees remain undomesticated due to lack of tradition to plant indigenous tree species (Bayala, *et al*., 2006). This trend suggests the need to use artificial regeneration method to promote the growth of these tree species on the farmlands. *Tamarindus indica* belongs to the family Fabaceae and subfamily Caesalpinioideae with a common name Tamarind, Tsamiya in Hausa dilec in the Kingdom Plantae (Muhammad and Musa, 2003). The seeds have a high forage value, it is a tree that provides good firewood and produces excellent charcoal (Ajiboye, 2010). It is a multipurpose and also as a resistant tree and have specific uses for medicinal, shelter, food, as well as wind break purpose (Yakubu, *et al*., 2013). The tree is native to tropical Africa; and it grows wild throughout the Sudan and was introduced to India where it later

became naturalized. The seedlings of this valuable tree species need inorganic fertilizer application at formative stage of growth (Daldoum and Ghassan (2014)).

Parkia biglobosa is known as African locust bean, Dorowa in Hausa and is a perennial deciduous tree of the family *Fabaceae*. *P. biglobosa* hitherto denoted by different scientific name *P. roxburghii, P. javanica, P. timoriana* is a tree distributed in India in north eastern region where people of Manipur consume its food products and substantially (Saidu, *et al*., 2019). The tree is a multipurpose that provided domestic products and income for many rural populaces especially women. According to Burkill, (2004) revealed that, the major income generating products from the fermented seeds. *P. biglobosa* has a high protein content (Kronborg, *et al*., 2013). The tree has a capacity to withstand drought condition due to its deep taproot system and an ability to restrict transpiration. The tree is also known to provide an ingredient that is used in treating leprosy and hypertension (Okunomo, 2010). The fermented seeds of *P. biglobosa* are used in all parts of Nigeria and indeed the west coast of Africa for seasoning traditional soups (Gernah, *et al*., 2007). The seeds contained amino acid and used as a coffee substitute, and contains 29% crude protein, 60% saccharose, and Vitamin C, (Emrah, *et al*., 2010). The trees occur on a wide range of Natural and semi natural communities (woodland and open savannah). The trees prefer well drained, deep and cultivated soils, stony ridges or sandstone hills (GNONLONFIN, *et al*., 2018).

Methodology

Study area

This study was conducted in Kazaure (Hussaini Adamu Federal Polytechnic Arboratum site) of Jigawa state, Nigeria. It lies between latitude 12’65’10 N and longitude 8^0 41’ 94 E and Temperature between 32 ^OC to 43 ^OC The area is among the large agricultural part of the state and the habitants are mostly Hausa and Fulani. Rainfall ranges between 800 to 1000mm (Field Survey, 2023).

Sampling Location

Arboratum site of the Department of Forestry and Environmental Management Technology School of Agriculture Hussaini Adamu Federal Polytechnic, Kazaure Jigawa state, Nigeria.

Selected physical properties before embark of planting

Soil was low in total Nitrogen in both top and bottom with the Organic carbon (0.42% - 0.50%) respectively. The soil pH is basic and Neutral respectively. The soil belongs to the textural class of Sandy loam for both. The soil CEC (cation exchange capacity) follows order Ca>Mg>Na>K in both top soil and bottom soil.

Field Experimental procedures

Seedlings quality

Quality of *P. biglobosa* and *T. indica* planting stock were improved greatly within four months. These improvements have been prompted by benefits of large planting stock (Rose and Ketchum, 2003). The target seedlings concept which link morphological and physiological trait with field performance, has improve method of plantation establishment on the Arboratum site. **Planting Techniques**

Four Line planting of seedling densities of 50 each of (6 x 6m^2) spacing were used. The seedlings grow to 35cm high of *T. indica* and 30cm high for *P. biglobosa*, before transplanting and implanted in to the soil at a depth of 30cm simply with a shovel large enough to accommodate the roots system. Place the root system in the hole, spread out as much as possible and backfill only up to the root collar. However, utmost care was taken while transplanting as the tap roots are tender and tend to get affected. Only graded seedlings were lifted to the Arboratum site for planting operation. Four seedlings per line planting were randomly sampled and tagged the seedling which was used for the research. Average values for the growth parameters (Total height, collar diameter, number of leaflets and Branches) were done. The stands were fully watered to maintain the moisture content of the soils to field capacity. Manual weeding was done regularly throughout the period of the research. Total height, collar diameter, leaflets number and Number of Branches were taken at every three weeks' interval for a period of 15 weeks were the experiments terminated.

Seedlings Fertilization

Seedlings fertilization is being considered as a technique for accelerating juvenile growth of tropical trees. Slow release products have been developed that can be combined with the soil medium placed directly in to the planting hole. Rose and Ketchum, (2002). Observed that fertilization of tropical trees resulted in increased growth only on sites having adequate soil water. The growth increased associated with fertilization were larger and more transient than competing vegetation. Fertilization can supplement depleted soil and enhance the foliage colour of tropical trees. It is good to conduct a soil test for a large area to be sure fertilization is necessary and if so the correct

nutrient ratio and application rates of fertilizer were used. The NPK fertilizer rate of 3g, 5g, and 7g was apply by ring method one week after planting the seedlings by hole method in the Arboratum site for growth and development. The frequent fertilizer application was done every three weeks. Nutrients loading is a new concept for plantation fertilization regime, in which fertilizers is applied at an exponentially increasing rate of seedlings nutrient content (Rose and Rosner, 2004). This research was to test the tree growth responses to fertilization in the Sudan Savannah Environment of Nigeria (Saidu, *et al*., 2019).

The trees have a good deep root system, such plants tend to be sensitive to drought and winds. All treatments were set in a Randomized Complete Block Design (RCBD).

Data collection

Data on the following variables were taken after fertilizer was applied, as described thus:

- Collar diameter (mm): The diameter of each sampled seedling was measured at the root collar with the aid of veneer caliper.

- Total height (cm): The height of each seedling was measured from the surface of the soil to the tip of the leaf using meter ruler.

- Number of leaflets: this is done by physical count.

- Number of Branches by physical count.

Data Analysis

Data were subjected to Analysis of variance (ANOVA) using SPSS (version 22) to test the significant difference of NPK fertilizer on the growth performance of the seedlings.

Result

The height of the plants before fertilizer application is presented in in Table 1. The seedlings were graded to be of the same sizes before embark on lifting to the field to indicate any changes in the stages of growth after fertilizer application.

Table 1: Total height of Planted seedlings before embark on Fertilizer application

Treatments	Weeks before Fertilizer application	
	T. i	*P. b*
NPK (g)		
0	35	30

3g	35	30
5g	35	30
7g	35	30

Table 2 presented the effect of NPK fertilizer on Seedlings growth on stem height (cm) of *P. biglobosa and T. indica*. It is revealed that, there was no significant (P> 0.05) difference among the values but there was slight increase between the rates (WAFA) of fertilizer on stem height for *P. biglobosa* with the highest of 97.46 cm and lowest of 81.47 cm for control. The result indicated that, the application of 7g of NPK to *P. biglobosa* in week 3, 9 and 15 gave the highest stem height than the other treatments.

For *T. indica*, there was no significant (P>0.05) difference at 3 and 9 WAFA, but significantly difference at 6, 12 and 15 WAFA. The application of 5g of NPK to *P. biglobosa* seedlings was found to have more number of branches at 13.80cm. All the values were better than the control.

Table 2, Effect of NPK fertilizer on Seedlings growth on stem height (cm) of *P. biglobosa* and *T. indica*

Treatments	Weeks after Fertilizer application									
	3		6		9		12		15	
	P. b	*T. indi*	*P. b*	*T. indi*	*P. b*	*T. indi*	*P. b*	*T. indi*	*P. b*	*T. indi*
NPK (g)										
0	33.13	39.50^{b}	41.13^{b}	44.20^{b}	50.51^{b}	49.60^{b}	62.53^{b}	54.97^{b}	81.47^{c}	60.00^{b}
3g	37.3	40.33^{b}	45.42^{b}	50.80^{ab}	6050^{b}	60.60^{ab}	73.33^{b}	74.50^{b}	93.47^{bc}	82.33^{b}
5g	37.23	42.33^{a}	49.34^{a}	56.33^{a}	65.25^{a}	64.87^{a}	80.63^{a}	78.70^{a}	96.00^{ab}	99.00^{ab}
7g	39.3	42.30^{b}	48.60^{a}	54.13^{a}	66.42^{a}	63.20^{a}	79.19^{a}	60.30^{ab}	97.46^{a}	73.80^{ab}
SEM	1.3	0.8	1.6	1.35	1.81	2.41	2.29	2.97	2.4	3.9

Key: P.b= *P. biglobosa* , T. indi =*T. indica.* Means with no letter are not significantly different at 0.05 level using Duncan Multiple range test

Table 3 revealed the effect of NPK fertilizer on seedlings growth on Collar diameter (mm) of *P. biglobosa* and *T. indica.*

There was a significantly differences (at P<0.05) with respect to fertilizer (NPK) application on Collar diameter of *P. biglobosa*. However, all the levels were better than the control.

Table 3: Effect of NPK fertilizer on seedlings growth on Collar diameter (mm) of *P. biglobosa* and *T. indica*

Treatments	Weeks after Fertilizer application									
	3		6		9		12		15	
	P. b	*T. indi*	*P. b*	*T. indi*	*P. b*	*T. indi*	*P. b*	*T. indi*	*P. b*	*T. indi*

NPK (g)										
0	2.80^{c}	2.5	3.20^{b}	3.10^{c}	3.60^{b}	3.40^{b}	4.97^{b}	3.97^{b}	5.40^{c}	4.30^{c}
3g	3.33^{b}	3.33	3.80^{b}	3.85^{b}	4.60^{b}	4.10^{b}	5.50^{b}	5.20^{b}	6.33^{bc}	5.40^{bc}
5g	3.43^{a}	3.43	4.03^{a}	4.40^{a}	4.87^{a}	4.70^{a}	5.00^{a}	5.40^{a}	7.00^{a}	5.90^{ab}
7g	3.70^{b}	3.3	4.13^{ab}	4.13^{a}	5.20^{b}	4.20^{a}	6.30^{b}	5.30^{ab}	7.80^{b}	5.80^{a}
SEM	0.27	0.27	0.29	0.29	0.41	0.32	0.57	0.37	0.7	0.48

Key: P.b= *P. biglobosa* , T. indi =*T. indica.* Means with no letter are not significantly different at 0.05 level using Duncan Multiple range test

Table 4, shows the effect of NPK fertilizer on seedlings growth on Number of Leaflets of *P. biglobosa* and *T. indica*. There was no significant (P>0.05) difference at 3 and 9 WAFA, but significantly difference across all weeks WAFA. The application of 5g of NPK to *P. biglobosa* seedlings was found to have more number of leaflets at 15 weeks (89.80cm).

There was no significant (P>0.05) effect on the Leaflets number at 6 WAFA for *T. indica*. The result showed that application of 5g of NPK fertilizers gave highest number of Leaflets across the weeks (89.00) and lowest of (42.00). Therefore, all the levels were better than the control

Table 4, Effect of NPK fertilizer on seedlings growth on Number of Leaflets of *P. biglobosa* and *T. indica*

Treatments	Weeks after Fertilizer application									
	3		6		9		12		15	
	P. b	*T. indi*	*P. b*	*T. indi*	*P. b*	*T. indi*	*P. b*	*T. indi*	*P. b*	*T. indi*
NPK (g)										
0	10.50^{b}	10.5	18.20^{b}	16.20^{d}	27.60^{b}	27.60^{b}	35.97^{b}	35.97^{b}	52.00^{c}	42.00^{c}
3g	11.33^{b}	12.33	25.80^{b}	20.80^{b}	37.60^{b}	37.60^{b}	48.50^{bc}	58.50^{b}	61.33^{bc}	71.33^{bc}
5g	21.33^{a}	16.33	26.33^{a}	36.33^{a}	40.87^{a}	44.87^{a}	48.30^{a}	68.00^{a}	63.00^{a}	89.00^{ab}
7g	21.50^{b}	15.3	29.13^{b}	34.13^{a}	47.20^{b}	42.20^{a}	58.30^{ab}	50.30^{a}	89.80^{ab}	73.80^{a}
SEM	1.4	1.4	1.85	1.85	2.41	2.41	2.97	3.97	3.67	4.9

Key: P.b= *P. biglobosa* , T. indi =*T. indica.* Means with no letter are not significantly different at 0.05 level using Duncan Multiple range test

Discussion

Growth parameters enhanced by continuous application of NPK fertilizer to the planted seedlings on soil with low CEC. The Stem height was found to increase significantly with increasing level of NPK fertilizer. The Use a balanced fertilizer with equal parts Nitrogen (N) Phosphorus (P) and Potassium (K) (NPK fertilizer 15: 15: 15) to the planted seedlings of Sudan Savannah trees provided a great enhancement and increased growth parameters

across the seedlings, this is because young seedlings, require liquid and water soluble fertilizers which are more effective than granular fertilizers applied by ring method. Similarly, the result of this research discovered that, NPK fertilizer at 7g for *P. biglobosa* and 5g to *T. indica* seedlings increased stem height with increment of atleast10cm high at three weeks' interval of the parameters measured. The result agreed with the finding of Daldoum and Ghassan (2014) who said that, NPK fertilizer increase shoot height growth of *Mangifera indica, A. nilotica* as well as *Khaya ivorensis* with increment of 15 cm at first application. This concurred with the findings of Saidu, *et al*. (2019) that showed a significant enhancement in stem height with increase fertilizer application on weekly basis under varying level (0.5, 1.0 and 1.5g) of NPK 15: 15: 15 applied in the potted seedlings in which 1.0g performed better than the others. The was changes in collar diameter experienced as NPK fertilizer was applied at different rate with difference of minimum 10 cm at every three week intervals. The result of this research disagreed with the findings of Upadhyaya and Thupan (2014) who revealed that, NPK fertilizer application had negative response on the growth of indigenous trees in the savannah Environment. These come across with the findings of Emrah *et al*. (2010) who said that, NPK fertilizer had a large and positive effect on stem height and diameter growth.

This is in line with Zubairu (2014) who reported that, increase in stem height, Collar diameter and number of leaves of Acacia senegal was due to frequent NPK fertilizer application to the seedlings. *T. indica* at 5g of NPK produced 99.00cm and collar diameter 5.90mm. This is in accordance with the findings of Ahmed *et al*. (2007) that, different levels of nitrogen were found to be highly significant in the growth of Beta vulgaris and the collar diameter of A. Senegal treated with 5g NPK was significantly higher.

Fertilizing the plantation provide opportunity to produce healthy seedlings that of high potential. Healthy seedlings were observed to grown efficiently on field to form larger one. Application of NPK fertilizer to *T. indica* seedlings makes it to grow faster, this is almost related to the finding of Hussein and Bhuiyan, *et al*. (2000) expressed that, NPK fertilizer increase plant height, number of leaves, diameter growth as well as number of branches of savannah trees.

Conclusion and Recommendation

Fertilizers are the components that increase plant productivity, development and helps the soil increases its fertility thereby promoting growth. The seedlings of savannah Environment (*P. biglobosa*) responded positive to 5g for the parameters measured and 7g were found to be active nutrients to the *Tamarindus indica* seedlings for

both the height and Collar diameter measured. The seedlings were fertilized one week after planting. Fertilizer enhances natural fertility of the soil or replace chemical elements taken from the soil by previous plants. Seedlings utilized the synthetic fertilizer (NPK 15:15:15) as it contained the salts that can affect the ability of the seedlings to absorb water.

It is recommended that, increasing proportion of the fertilizer from 5g to 10g for *P. biglobosa* and from 7g to 14g can markedly promote the rapid growth and thrive new shoots sprouting of rootstock. When the fertilizers were applied to soil or plants tissue to supply plant nutrients missing beneath the soil.

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