International Journal of Research in Agriculture and Forestry
Volume 4, Issue 5, 2017, PP 15-21
ISSN 2394-5907 (Print) & ISSN 2394-5915 (Online)

Effect of NPK and Cowdung Rates on the Growth of Parkia biglobosa (Jacq.) and Moringa oliefera (Lam) in Semi-Arid Environment of Nigeria

Igbokwe G. O[2], Bello, A. G[1] and Umar, I[3].

[1,2] Department of Forestry and Environment, Usmanu Danfodiyo University, Sokoto, Nigeria
[3]Department of Forestry, Fisheries and Wildlife. Kebbi State University, Alero, Nigeria

***Corresponding Author:** Igbokwe G. O, Department of Forestry and Environment, Usmanu Danfodiyo University, Sokoto, Nigeria*

Received Date: 02-08-2017 ***Accepted Date: 08-08-2017*** ***Published Date: 29-08-2017***

ABSTRACT

A study on the effect of inorganic fertilizer (NPK) and cowdung manure (CDM) rates on the growth of Parkiabiglobosa (Jacq.) and Moringaoleifera (Lam) was carried out for a period of fourteen (14) weeks. A control was set up for this study. Growth indices of P.biglobosa and M.oleifera to which CDM and NPK fertilizers were applied showed no significant difference (P>0.05) between treatments. ButParkiabiglobosatreated with 2.5tonsCDMha-1showedhigher numerical values instem heights (8.40) and total heights (17.83) than the control, 5tonsCDMha-1, 7.5tonsCDMha-1, and NPK fertilizer treatmentswhile Moringaoleiferatreated with 7.5tonsCDMha-1showed higher numerical values in stem heights (13.0) and total heights (23.0) but 100kgNPKha-1 showed higher values in number of leaves (93.33) produced 14WAT. The study recommended that cow dung manure (CDM) can be used in the absence of N.P.K fertilizer considering the cost and associated environmental effect of the later.

Keywords: *Inorganic fertilizer, N.P.K, Cow Dung Manure CDM, growth.*

INTRODUCTION

Fertilization has been a major component of cultural practices in forestry and agricultural crop production for over a century in Nigeria, since most of the arable lands are under continuous cultivation. Shifting cultivation as a land-use practice (where it exists) and the slash and burn system of land preparation practiced by the local farmers greatly deplete soil fertility. The savanna soils of Northern Nigeria are more or less completely weathered and possess few mineral resources. They are low in organic matter and need manuring if significant production is to be maintained (Okali and Nwoboshi, 1979). Constraints and the problem of soil nutrients have caused yield below potential levels (Adepetu, 1986). The best way of preventing soil from becoming poor is to put back into it what plant has taken out and one of the ways to do this is through fertilizer application (Roberts and Andrew, 1989). Cooke (1972) reported that the major nutrients required by the crop are Nitrogen (N), Phosphorus (P) and Potassium (K). Inadequate supply of any of these nutrients during crop growth is known to have negative impact on the reproductive capability, growth and yield of the plant (Vine, 1953; Solubo, 1972) and supplementary amount of nutrients can be added to soil in form of inorganic fertilizer to correct inadequate supply of nutrients to the crop (Dirk and Hogarth1984).

Parkia biglobosa also known as 'African locust bean tree' is widely distributed throughout the Guinea, Sudan and Sahel Savannah of Nigeria (Hutchinson and Dalziel, 1963). It is said to be named after the 18th century explorer Mungo Park (Keay, *et. al.*, 1964). It has been classified as a distinguished member of the family Mimosacea (Geerling, 1987). *Parkia biglobosa* is a tree with crooked and short bole of about 20 – 30 meters tall. The leaves are bipinnately compound, the tree has red club-shaped flower heads (about 5cm in diameter) and numerous pods with a characteristic leather brown colour when ripe. Other species in the family are *Parkia filicoidea* and *Parkia bicolor*.

Moringa oleifera commonly known as "Moringa or Drumstick tree [E], Zogali [Ha]" is the only genus in the family Moringaceae. It is a

fast-growing, drought -resistant tree, native to the southern foothills of the Himalayas in northwestern India, and widely cultivated in tropical and subtropical areas including Central America, South America, Africa, Southeast Asia, Caribbean and Oceania (Leone, *et. al*., 2015; USDA, 2013). Moringa tree is grown mainly in semiarid, tropical, and subtropical areas. It tolerates a wide range of soil conditions, but prefers a neutral to slightly acidic (pH 6.3 to 7.0), well-drained sandy or loamy soil. In waterlogged soil, the roots have a tendency to rot (Leone, *et. al*., 2015). Moringa is a sun- and heat-loving plant, thus does not tolerate freezing or frost. Moringa is particularly suitable for dry regions, as it can be grown using rainwater without expensive irrigation techniques. *M. oleifera* can reach a height of 10–12 m, with a trunk of about 45cm in diameter. The bark has a whitish-grey colour and is surrounded by thick cork. Young shoots have purplish or greenish-white, hairy bark. The tree has an open crown of drooping, fragile branches and the leaves build up a feathery foliage of tripinnate leaves (Parotta, 1993; Encychlopedia Britannica; *M. oleifera*, 2013).

Cattle manure, or Cowdung manure (CDM) application is a method of increasing soil fertility popularly practiced in many rural areas. It is basically made up of digested grass and grain. CDM is high in organic materials and rich in nutrients. It contains about 3 percent nitrogen, 2 percent phosphorus, and 1 percent potassium (3-2-1 NPK) (Parker and Javier 1981). Composted CDM can provide numerous benefits to the soil. CDM contains large amounts of organic matter, by mixing this into the soil; the moisture-holding capacity is improved. This helps to reduce frequent watering, as the roots of plants can use the additional water and nutrients whenever needed. Additionally, it will improve aeration, helping to break up compacted soils. CDM also contains beneficial bacteria, which convert nutrients into easily accessible forms so they can be slowly released to tender plant roots. It also produces about a third less greenhouse gases, making it environmentally friendly. Where fertilizers are not used or rarely used as a result of being expensive, manure from cattle and other small ruminants, known as dung has make very important contribution to maintenance of soil fertility on any Land-use practice.

Research information is fast accumulating for managing both woody perennials and agricultural crops on the same unit of land (Oyenuga, 1968). However, no research on agroforestry in semi-arid environment has been undertaken using indigenous tree species, with appropriate rates of fertilizer application (Bello *et. al*., 2014). There is no record of quantified rates of manuring in agricultural land and tree crop plantations in the semi-arid region of Nigeria. This research is intended to determine the appropriate rates of NPK and CDM on *Parkiabiglobosa* and *Moringaoleifera* in an agroforestry system in semi-arid environment.

MATERIALS AND METHODS

The study was carried out as pot experiment in the nursery. The study was conducted in 2015/2016 cropping season in northwestern Nigeria at Forestry department nursery, Usmanu Danfodiyo University, Sokoto. The area is located between latitude 11.6°N and 13.93°N and longitude 3.75°E and 6.9°E(Bashir, 1989). It is characterized by low rainfall usually less than 700mm, annually (Kowal and Knabe, 1972). Mean maximum temperatures range from 35°C and 37°C while relative humidity can be less than 5% during the harmattan season (Bashir, 1989). The soils are predominantly ferruginous tropical soils, texturally sandy and freely draining (Bashir, 1989). The pH of the soil ranges from 6-7 and this is maintained by low level of production and the return to the soil of some residues as well as lack of fertilizer application (Kowal and Knabe, 1972). It is located in semi-arid region where grass cover is more or less continuously interspersed by short trees and shrubs, intensive cultivation together with overgrazing and bush burning continued to degrade the sparse vegetation.

Pot Experiment

Seeds of a *Parkia biglobosa* and *Moringa oleifera* collected from good mother trees were sown in nursery and later transplanted into pots 2 weeks after planting at the rate of one plant per pot. Sterilized River sand was mixed thoroughly with NPK and Cowdung manure (CDM). The treatment consisted of 3 levels of chemical fertilizer (NPK 15:15:15) applied at the rate of 50, 100 and 150 kg/hectare, (CDM) applied at the rate of 2.5, 5.0 and 7.5 tons/hectare. Sterilized river sand was used as control. A total of one hundred and forty seven pots were used, and arranged in Completely Randomized Design (RCBD) with 3 replicates. Each pot contained 3kg of the mixture. The amount of NPK applied for the above rates were

calculated as 0.6, 1.2 and 1.8 g/pot and (CDM) applied at the rate of 3.8, 7.5 and 11.3 g/pot respectively. Weeds and pests were controlled manually and the crops were maintained to the end of experimental period (14 weeks). Data on stem height, leaf number and total height were collected and subjected to one way analysis of variance (ANOVA). The means where significant were separated using Duncan Multiple Range Test (DMRT) at P = 0.05.

RESULTS

The results obtained from the experiments are presented in Table 1, 3 and 4.

Growth in *P. biglobosa* at 2.5tonsCDMha^{-1} performed better than the control, performed better than in the control, 5 and 7.5tonsCDMha^{-1} with average stem height, total height and leaf number differences of 8.40cm, 17.83cm and 15.3 respectively at 14WAT. Similarly 150kgNPKha^{-1} performed better than 50 and 100 kgNPKha^{-1} with stem height, total height and leaf number of (7.17; 14.67 and 12.33cm) at 14WAT. The result showed that there were high significant difference in stem height, total height and leaf number of *P. biglobosa* treated with CDM compared with control and 2.5 tons CDMha^{-1} performed better (Table 3).There were mild differences in total height and leaf number between the treatments of NPK compared with control (Table 4).Seedling streated with 50kg NPKha^{-1} and 150kg NPKha^{-1}performed better than 100kg NPKha^{-1}. Growth decline in 100kg NPKha^{-1} could have resulted from plant burn due to toxicity. There were significant differences observed in plant growth measured WAT with in treatments of CDM and NPK. The lowest growth was obtained from100kgNPKha^{-1}.

Table1. *Growth of Parkia biglobosa as influenced by treatments across WAT*

	Cowdung manure			NPK Fertilizer			Control
	2.5 ton/ha	5.0 ton/ha	7.5 ton/ha	50kg/ha	100kg/ha	150kg/ha	
StemHeight							
2WAT	3.67^{b}	2.90^{c}	2.57	4.00	1.73^{b}	2.83^{c}	3.00
4WAT	4.50^{b}	3.67^{c}	3.37	4.40	2.27^{b}	3.13^{c}	3.45
6WAT	5.50^{ab}	4.20^{c}	4.00	4.77	2.67^{b}	3.73^{c}	3.76
8WAT	6.67^{ab}	4.83^{c}	4.63	5.03	3.00^{b}	4.40^{c}	4.16
10WAT	7.50^{a}	5.47^{bc}	5.07	5.50	3.30^{ab}	5.23^{c}	4.53
12WAT	8.40^{a}	6.17^{a}	5.63	5.97	3.67^{a}	5.97^{b}	4.95
14WAT	8.40^{a}	6.17^{a}	5.63	7.00	4.17^{a}	7.17^{a}	5.16
Sig.	*	*	NS	NS	*	*	NS
TotalHeight							
2WAT	6.00^{b}	6.00	4.33^{b}	7.50	3.83^{c}	5.33	6.20
4WAT	9.00^{b}	7.00	6.90^{b}	8.00	4.47^{bc}	6.40	6.98
6WAT	11.07^{ab}	8.20	8.00^{ab}	8.73	5.10^{b}	7.50	7.76
8WAT	13.40^{ab}	9.23	9.17^{a}	9.07	5.80^{ab}	8.83	8.41
10WAT	15.83^{a}	11.30	9.73^{a}	9.83	6.30^{ab}	10.33	9.15
12WAT	17.83^{a}	12.47	10.67^{a}	11.17	7.10^{ab}	11.57	9.86
14WAT	17.83^{a}	12.47	10.67^{a}	13.97	8.17^{a}	14.67	10.25
Sig.	*	NS	*	NS	*		NS
NumberofLeaflets							
2WAT	6.33^{c}	3.67^{b}	4.33^{c}	7.00	3.67^{c}	5.00	4.66
4WAT	8.00^{b}	5.00^{b}	6.33^{ab}	7.33	5.00^{c}	5.67	5.33
6WAT	9.33^{b}	6.00^{b}	7.33^{bc}	8.33	5.67^{bc}	7.00	5.83
8WAT	10.67^{ab}	6.67^{a}	8.33^{ab}	8.67	6.33^{bc}	8.33	6.65
10WAT	12.67^{ab}	8.33^{a}	9.00^{a}	9.33	6.67^{b}	9.33	7.50
12WAT	15.33^{a}	10.00^{a}	9.67^{a}	10.67	7.33^{b}	10.67	8.16
14WAT	15.33^{a}	10.00^{a}	9.67^{a}	12.33	8.33^{a}	12.33	8.50
Sig.	*	*	*	NS	*	NS	NS

WAT = Weeks After Treatment

Growth in *M. oleifera* at 2.5tonsCDMha^{-1}showed higher growth than in the control, 5 and 7.5tonsCDMha^{-1} with average stem height, total height and leaf number differences of 13.00cm,

23.00cm and 77.7 respectively. Similarly 100kgNPKha^{-1}showed higher growth than 50 and 150 kg NPKha^{-1} with stem height, total height and leaf number of (10.50; 20.83 and 93.33cm). The result shows that plants treated with CDM performed better than NPK fertilizer. There were significant differences within the treatment observed in growth of total height and leaf number of CDM treated seedlings measured 14WAT (Table 2, 5 and 6).

Table2. *Growth of Moringa oliefera as influenced by treatments across WAT*

	Cowdung manure			NPK Fertilizer			Control
StemHeight							
	2.50 ton/ha	5.0 ton/ha	7.5 ton/ha	50kg/ha	100kg/ha	150kg/ha	
2WAT	4.33	5.33	5.00	4.10^{d}	4.67^{d}	3.10	3.00^{c}
4WAT	7.00	7.00	6.83	5.17^{d}	6.10^{d}	4.83	4.63^{c}
6WAT	7.50	8.23	8.30	6.43^{d}	7.23^{d}	5.83	5.73^{bc}
8WAT	9.00	9.00	9.17	7.17^{c}	8.00^{c}	6.53	6.80^{b}
10WAT	9.83	10.00	9.93	7.83^{bc}	8.83^{b}	7.33	7.70^{ab}
12WAT	10.9	10.7	11.0	8.83^{ab}	9.67^{b}	8.00	8.50^{a}
14WAT	11.8	12.2	13.0	9.83^{a}	10.50^{a}	8.33	9.50^{a}
Sig.	*	*	*	*	*	*	*
TotalHeight							
2WAT	8.67	8.33	7.67	7.67^{e}	10.33	7.00	9.67^{c}
4WAT	12.0	13.8	13.6	9.67^{d}	12.67	8.67	10.50^{c}
6WAT	13.7	15.2	15.2	13.43^{c}	15.17	11.50	11.93^{c}
8WAT	14.8	16.2	16.1	14.33^{bc}	16.67	15.00	14.00^{bc}
10WAT	15.8	17.3	18.0	15.50^{b}	17.93	15.83	15.53^{ab}
12WAT	17.0	19.7	20.7	16.60^{a}	19.10	16.93	17.00^{a}
14WAT	17.9	21.7	23.0	17.50^{a}	20.83	18.00	18.17^{a}
Sig.	*	*	*	*	*	*	*
NumberofLeaflets							
2WAT	15.0	16.7	18.7	24.33^{c}	42.33	34.67	18.00^{d}
4WAT	23.0	26.3	35.7	32.67^{c}	50.67	54.67	27.00^{d}
6WAT	31.7	34.0	45.0	55.67^{c}	65.67	64.00	45.00^{cd}
8WAT	46.0	43.7	53.7	62.33^{c}	73.00	69.00	50.33^{c}
10WAT	59.7	53.7	54.0	68.33^{abc}	79.00	75.33	57.00^{bc}
12WAT	68.0	63.7	64.3	72.67^{a}	85.00	81.00	65.00^{b}
14WAT	77.7	70.0	68.3	82.00^{a}	93.33	92.33	77.00^{a}
Sig.	*	*	*	*		*	*

WAT = Weeks After Treatment

The lowest growth was obtained from100kgNPKha^{-1}. There were no statistical differences in stem height, total height and leaf number between the treatments. However, 2.5tonsCDMha^{-1} showed a better growth performance compared to other treatments and control.

DISCUSSION

The study, recorded higher growth (stem height and total height) in CDM fertilized soil than with NPK fertilized soils as clearly indicated in Tables 3, 4, 5 and 6 with statistical differences, this is similar to the result obtained by Wisdom *et. al.* (2012) who worked on the comparative study of the effect of organic manure (cowdung) and inorganic fertilizer (NPK) on the growth rate of maize. However, Tanimu *et. al.* (2013) working on the effect of cowdung and development of maize crop reported that NPK fertilized soil showed higher growth. Schaffer (1938) working on maize reported that heavy demand on potash (K) is significant in the maintenance of normal physiological functioning of the cell and stem growth. Deficiency of potash he observed results in retarded plant growth.The temperature and pH in CDM organic fertilizer might invite large number of microbes which obviously facilitates the easier degradation of wastes thereby releasing and enriching soil properties faster than NPK. The leaf number of NPK fertilized soil performed better than CDM fertilized soil.

This agrees with Wisdom *et. al.* (2012) and Tanimu *et. al.*, (2013). This may be due to the high percentage of the nutrients (N) needed for growth at this stage. This also agrees with Vignesh *et. al.* (2012) who reported that nitrogen is a constituent part of chlorophyll molecules which is found in the leaf. Jedidi *et. al.*, (2004) reported that organic fertilizers feed and sustain beneficial microorganisms that live in the soil, while chemical products from NPK often destroy microorganisms due to increasing acid levels in soil.

Table3. *ANOVA of Treatments Comparison within CDM in Parkia biglobosa*

WAT	2.5tons/ha	5.0tons/ha	7.5tons/ha	Control	Sig
Stem Height					
2	3.67	2.90	2.57	2.50	NS
14	8.40[a]	6.17[b]	5.63[b]	4.90[b]	*
Total height					
2	6.00	6.00	4.33	5.75	NS
14	17.83[a]	12.47[b]	10.67[c]	9.00[c]	***
Leaf Number					
2	6.33	3.67	7.00	4.50	NS
14	15.33[a]	10.0[b]	9.67[b]	8.00[b]	***

Table4. *ANOVA of Treatments Comparison within NPK fertilizer in Parkia biglobosa*

WAT	50kg/ha	100kg/ha	150kg/ha	Control	Sig
Stem Height					
2	4.0	1.73	2.83	3.00	NS
14	7.00	4.17	7.17	5.10	NS
Total height					
2	3.83	5.33	6.20	6.20	NS
14	13.97[a]	8.17[b]	14.67[a]	10.25[b]	*
Leaf Number					
2	3.67	5.00	4.66	4.50	NS
14	12.33[a]	8.33[b]	12.33[a]	8.50[b]	*

Table5. *ANOVA of Treatments Compared within CDM in Moringa oleifera*

WAT	2.5tons/ha	5.0tons/ha	7.5tons/ha	Control	Sig
Stem Height					
2	4.33[ab]	5.33[a]	5.00[a]	3.00[b]	*
14	11.80[ab]	12.2[a]	13.0[a]	9.50[b]	*
Total height					
2	8.67	8.33	7.67	9.63	NS
14	17.9[b]	21.7[a]	23.0[a]	18.17[b]	*
Leaf Number					
2	15.0	16.7	18.7	18.0	NS
14	77.7[a]	70.7[b]	68.3[c]	77.0[a]	**

Table6. *ANOVA of Treatments Compared within NPK fertilizer in Moringa oleifera*

WAT	50kg/ha	100kg/ha	150kg/ha	Control	Sig
	Stem Height				
2	4.10	4.67	3.10	3.00	NS
14	9.83	10.50	8.33	9.50	NS
Total height					
2	7.67	10.33	7.50	9.63	NS
14	17.50	20.83	18.0	18.17	NS
Leaf Number					
2	24.33[c]	42.33[a]	34.67[b]	18.0[c]	***
14	82.00[b]	92.33[a]	92.33[a]	77.0[b]	***

CONCLUSION

Growth of the two trees at seedling stage was enhanced positively during the period of study by the application of CDMand NPK. 2.5tonsCDMha^{-1}seems adequate for optimum stem height and leaf number production, while application of NPK (15:15:15) fertilizer at the rate of 100kgNPKha^{-1} favoured better growth and production in *M. oleifera*. Under the prevailing poor climatic and soil conditions, fertilization at 2.5tonsCDMha^{-1}or 100Kg NPKha^{-1} (15:15:15) is adequate for optimum growth and development of *P. biglobosa* and *Moringaoleifera*. However, further studies may be needed with other levels of treatments to determine their roles in replenishing and maintaining soil fertility, minimizing disease incidence while keeping the yields as high as possible.

REFERENCES

[1] Adepetu, J. A (1986). Soil fertility and fertilizer requirements in Oyo, Ogun and Ondo States, FDALR, Federal Ministry of Agriculture and Water Resources, (Publ) Lagos.

[2] Bello, A. G. Abba, S. B. and G. O. Igbokwe (2014). Effects of NPK and Cow dung rates on Locust bean tree, Millet and Cowpea in Agroforestry System in Semi-arid Environment. *International Conference of Plant Sciences, Forestry and Biology (ICPSFB)*Dubai. November, 2014. Pp 105-110. www.scie.org.au

[3] Cooke, G. W (1972). *Fertilizer for maximum yield.* Great Britain: Granada Publishing Limited. pp. 465.

[4] Dirk, A. T and Hargarty, M (eds.) (1984). Soil and Plant Analysis. Guide for Agricultural Laboratory Directors and Technologists in Tropical Region, pp. 147.

[5] Encyclopedia Britannica."Horseradish tree". Retrieved 2015-04-25.

[6] Geerling, C. (1987). Cropping in the humid and sub-humid tropics. State of the Art and Recommendations. International Institute of Tropical Agriculture and International Development Research Centre Agroforestry Project, Progress Report, October, 1980.

[7] Hutchinson, J. and J. M. Dalziel (1963). Flora of Tropical West Africa. Vol II. Crown Agents, Millbank, London 544pp.

[8] Jedidi, N. A. Hassen, O. van Cleemput and A. M'Hiri, (2004). Microbial biomass in a soil amended with different types of organic wastes. Waste Manage. Res., 22: 93-99.

[9] Keay, R. W. J., C. F. A. Onochie and D. P. Stanfield, (1964). Nigeria trees volume II. Department of Forestry Research, (Forestry Resource Institute of Nigeria) Ibadan Pp.495.

[10] Robert, K. M and J.W. Andrew, (1989). *An Introduction to crop physiology.* New York: Longman scientific and technical, Willey, 340 pp.

[11] Leone A., A. Spada,A. Battezzati, A. Schiraldi, J. Aristil andS. Bertoli. (2015). Cultivation, Genetic, Ethnopharmacology, Phytochemistry and Pharmacology of Moringa oleifera Leaves: An Overview. *International Journal of Molecular Science* 16 (**6**): 12791–835. doi: 10.3390/ijms160612791 . PMID 26057747.

[12] Moringa oleifera (Lam). Plant Resources of Tropical Africa. Retrieved2013-11-20.

[13] Okali, D.U.U. and L. C. Nwoboshi (1979). Preliminary study of the performance of Maize Planted among coppice teak. (Unpublished manuscripts) Department of Forest Research Management, University of Ibadan, Nigeria. Pp. 8.

[14] Oyenuga, V. A. (1968). Nigeria's food and feeding stuffs; their chemistry and nutritive value. IbadanUniversity Press. Pp.99.

[15] Parker, F.P and C.Z. Javier (1981). Available nitrogen fromanimal manures.California Agriculture, July-August 1981

[16] Parotta, John A. (1993). "Moringa oleifera Lam. Reseda, horseradish tree. Moringaceae. Horseradish tree family." (PDF). USDA Forest Service, International Institute of Tropical Forestry. Retrieved 2013-11-20.

[17] Schaffer S. (1938). Fertilizer and manure. *Science Journal*. 5: pp. 83-84.

[18] Solubo, R. A (1972). Studies on white yam (*Discorea rotundata*) II. Changes in Nutrient content with Age. *Experimental agriculture* 8: 107-115.

[19] Tanimu, J., E.O. Uyovbisere, S.W.J. Lyocks and Y. Tanimu (2013). Effects of Cow Dung on the Growth and Developmentof Maize Crop. *Greener Journal of Agricultural Sciences* Vol. 3 **(5)**, pp. 371-383.

[20] United States Department of Agriculture (USDA) GRIN Taxonomy.Retrieved 2015-06-25.

[21] Vignesh. R., N.R. Venkatesh, B. Meenakshisundaram and R. Jayapradha, (2012). Novel Instant Organic Fertilizer and Analysis of its Growth Effects on Spinach.*Journal of Biological Sciences*, 12: 105-110.DOI: 10.3923/jbs.2012.105.110

[22] Vine, H (1953). Experiments on the Maintenance of soil Fertility in Ibadan, Nigeria.*Empirical Journal of Experimental Agriculture.*21: 65-71.

[23] Wisdom S. G.O., R.W. Ndana and Y. Abdulrahim (2012). The Comparative study of the effect of organic manurecow dung and inorganic fertilizer N.P.K on the growthrate of maize (*Zea Mays* L)*International Research Journal of Agricultural Science and Soil Science* Vol. 2(12) pp. 516-519. Available online http://www.interesjournals.org/IRJAS

Citation: *G. Igbokwe, A. Bello and I. Umar, "Effect of NPK and Cowdung Rates on the Growth of Parkia biglobosa (Jacq.) and Moringa oliefera (Lam) in Semi-Arid Environment of Nigeria", International Journal of Research in Agriculture and Forestry, vol. 4, no. 5, pp. 15-21, 2017.*