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Effect of Some Tree Species in Nutrient Enrichment of Semi-Arid Soil and Their Influence on Growth and Yield of Potted Maize in Borno State, Nigeria

Hajara Ibrahim Mustapha[1], Ali Abba Gana Benisheikh[2]

[1]Sir Kashim Ibrahim College of Education Maiduguri, Borno State, Nigeria
[2]North East Zonal Biotechnology Centre of Excellence, University of Maiduguri, Borno State, Nigeria

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ABSTRACT

The effect of *Balanites aegyptiaca, Faidherbia albida*, and *Tamarindus indica* in nutrient enrichment of semi- arid soil and their influence on growth and yield of potted maize was investigated in university of Maiduguri campus with the objectives of evaluating the impact of the tree species on soil fertility and the distance at which the trees could supply nutrients to the soil. An experiment was conducted to test the influence of the trees on potted maize growth and yield. A total of 63 soil samples were collected before and after rainy season at varying distances of 30 cm, 60 cm, and 90 cm and at a depth of 15 cm. The first set of twenty-seven samples were collected in May 2014 before rainy season and were compared with soil after rainy season. The second set of 36 samples were collected under and outside tree canopies in October 2014 after rainy season. The collected samples were analysed for pH, N, EC, P, K, Na, Ca, Mg, and CEC following standard laboratory techniques. Potted maize experiment was conducted in completely randomized block design for eighteen weeks. The result showed that organic matter, nitrogen, potassium, phosphorus, calcium, sodium was significant at ($p<0.05$) at all distances before and after rainy season. Soil pH were found to be significant across the distance and are mainly neutral both before and after rainy season. The soil textural class were also significant at ($p<0.01$) between species and across the distances. Soil under and outside canopy showed that *F.albida* had the highest value of nitrogen 0.31g/kg and lower value of 0.15g/kg with control treatment at distance of 30 cm. At distance 0f 60 cm *F.albida* had the higher value of N 0.32g/kg and lower value 0.16g/kg with control treatment. Phosphorus was significantly higher under *B.aegyptiaca* 14.5g/kg at distance of 30cm, lower value of 3.73g/kg under *T.indica*. At distance of 60 cm *T.* Indica had the higher value of P 6.30g/kg, lower value 4.39g/kg with control treatment. *F.albida* had the higher value of potassium 5.09cmol/kg, lower value 0.68cmol/kg with control treatment at distance of 30 cm.*T.indica* had higher value of 2.34cmol/kg, lower value 0.60cmol/kg under control treatment at distance of 60 cm and *B.aegyptiaca* had 0.52cmol/kg, lower under *T.indica* 0.38cmol/kg at 90 cm distance. Calcium were significant at ($p<0.01$) across the distances and between species. Maize crop grown in soil under *F.albida* had higher grain yield of 161.2g and control treatment had lower value of 19.97g. Maize crop grown in soil under *F. albida* and *T.indica* had better growth and yield. The result suggest that *F.albida* and *T.indica* are important agroforestry resource to sustain soil fertility and subsequently crop yield. *F.lbida* and *T. indica* could be the best choice to integrate into farming system in semi-arid zone.

KEYWORDS: *semi-arid, influence on growth, yield of potted maize, effects of some tree species, Borno state, nutrient enrichment*

INTRODUCTION

Traditional form of land use such as fallow rotation and shifting cultivation are no longer able to meet the increasing demand for food production due to ever increasing population especially in the poorer nations of Africa (Abdulhameed *et al.,* 2004). Nutrients are critical elements for crop production and it is important to supply them to the soil and make them available for crops. The use of fertilizer sources for improving nutrients and increasing crop production on sustainable basis has become imperative as the cost of inorganic fertilizer is high (Desta, 2015). Nutrients are essential for plant growth and development. The three main elements needed for plant growth and development are nitrogen (N), phosphorus (P), and potassium (K) and together they make up the trio known as NPK. Other important nutrients are calcium, magnesium and sulfur. Plants also need small quantities of iron, manganese, zinc, copper, boron and molybdenum known as trace elements (Line, 2004). Plants that are deprived of any one of these nutrients suffers from deficiency or may cease to exist. Knowing the nutrient required to grow plants is only one aspect of successful crop production. Soil fertility is fundamental in determining the potentials of all cropping systems and is most commonly defined in terms of the ability of soils to supply nutrients for plants growth (Swift and Palm, 2000). Soil nutrients are continuously removed by crops in addition to leaching and erosion. When lands are cropped continuously even highly fertile soils gets exhausted of the reserve nutrients, thus nutrients removed from the soil by crops must be restored. Poor cultivation practice results to decreased soil fertility and farm productivity (Amede, 2003). According to Oyetunji and Ekanakaye (2001), low soil fertility leads to low agricultural productivity since agricultural development is fundamentally affected by productivity status of land resources. Healthy soil is fundamental to the food production system, therefore, maintaining a healthy soil demands effort from the farmers. Farming system disturbs soil processes including the nutrient cycle and nutrient exchange between organic matters. Water and soil are essential indices to soil fertility and there is need for the two to be maintained for sustainable crop production. Where the soil is explored for crop production without restoring nutrient content, the nutrient cycle is broken down and the balance in the agro ecological system is destroyed. Villa *et al.* (2003) reported the effect of tree cover in improving soil nutrient while UNESCO (1979) reported depletion of soil fertility and structure in areas with less or non- vegetation cover. (Abdulhameed *et al.*2001; 2004) reported soil nutrient status under canopies of savanna trees to be higher than non-tree areas which could have been due to the uptake of nutrients from deeper zones in the soil or enrichment through stem fall and subsequent decomposition. Soil are an integral component of agriculture and serve as medium for eco-biological, chemical and physical processes. Over burdening of soils as a natural resource have always been serious issues. The need to effectively manage soil (store house of nutrients) in order to achieve optimum productivity and enhance agricultural productivity to support increasing population is necessary. The challenge of producing enough food for ever increasing population has been one of the many issues facing mankind for a long time (Yakubu, 2010). Semi-arid region of Nigeria, especially areas around Borno, are known for their low soil fertility and degradation mostly influenced by erosion and desertification (Abdu, 2013). Socio economic problem especially poverty is a key issue in the region where rural farmer in the area lack the capacity to tackle the problem of low soil fertility.

MATERIALS AND METHODS

The Stu**dy Area:** The soil samples were collected in May 2014, from the University of Maiduguri campus Borno State Nigeria which is geographically located between latitude 11^{o} -46' N and longitudes 13^{o} 14' E. The seeding experiment was conducted at the Botanical Garden of Kashim Ibrahim College of Education Maiduguri, Borno State which lies between latitude 11^{o} 50' N and Longitudes 13^{o} 07'E. The climate of Borno state is characterized by three seasons: The cool dry harmattan, Hot dry season and Rainy season.

Selection of Study Tree Species

The tree species *Balanites aegyptiaca, Fadherbiaalbida* and *Tamarindus indica* were randomly selected because of their availability in campus. All tree species sampled for this study were located between gate 2 and 3 and behind Centre for Research and Documentation in Trans-Saharan Studies.

Seed Collection and Pot Preparation

Maize seed was purchased from the Maiduguri Monday Market and was tested for viability by flotation method (kimsey, 2012). A total of sixty-four (64) containers with some drainage hole at the bottom were used to allow excess water drain out of the soil to avoid rotting of plant root. The forty-eight (48) containers were filled with soil collected under study tree species and sixteen (16) were filled with soil from open grassland which served as control.

Experimental Design and Treatment

The experimental design was laid out in randomized complete block design and replicated four times. The treatment consisted of the following:

T1 Soil collected from *Balanites aegyptiaca* under canopy
T2 Soil collected from *Fadherbia albida* under canopy
T3 Soil collected from *Tamaridus indica* under canopy
T4 Soil collected from open area (control).

The containers were separated from each other by a space of 1m each and maize seeds were sown on the 26 June, 2014 at the rate of two seeds per pot and at a depth of 5cm. Watering was done twice daily (morning and Evening) using a watering can. The temperature ranged between 32^{o}C – 34^{o}C throughout the experiment period. Two weeks after seedling emergence, 16 plants were tagged for measurement of growth and yield parameter. The experiment was terminated at eighteen (18) weeks after sowing (WAS). Weeds were controlled by hand picking at6, 10 and14 weeks after.

Data Collection

Data were collected on growth and yield parameters. The growth parameter measured included plant height which was measured using a meter rule at two weeks' interval starting from 14 days to 12 WAS in cm. The number of leaves per tagged plant was determined by counting, starting from 14days after sowing (DAS) until 8 WAS. The yield was determined at harvest by measuring the dry weight of cobs. The dry weight of shoot, root weight was also determined by carefully uprooting the plant. The roots were thoroughly washed under running tap water until all the adhering soil particles were removed. The plants were separated into shoots and roots and sun dried, enveloped and labeled, and were taken to the Department of Biological Sciences Laboratory for weighing. The plant specimens were weighed on an electronic precision balance (model P1210) after which the mean weight of roots, shoots and cobs were calculated from the replications.

Data Analysis

Data were analyzed using SPSS version 16. Data on soil properties before and after rainy season were analyzed using T-test. Data on soil chemical properties were analyzed using one-way ANOVA. Data on plant height, number of leaves and dry weight of shoot, root and yield were also analyzed using one-way analysis of variance and means were compared using LSD.

RESULTS AND DISCUSSION

Soil pH and Electrical Conductivity (EC)at 0-15 Depth Before and After Rainy Season.

Table1. presents soil pH under tree canopy before and after rainy season. The result showed that at distance of 30cm soil pH under *Balanites aegyptiaca* and *Faidherbia albida* recorded a decrease while *Tamarindus indica* recorded an

increase at same distance. At 60cm. *B. aegyptiaca* recorded an increase of 3.5% while *T. indica* recorded a decrease of 3.6% and F.*albida* recorded no significant difference before and after rainy season. *B. aegyptiaca and T.indica* showed no significant difference in soil pH before and after rainy season at distance of 90cm. *F.albida* recorded an increase of 13% at same distance. Electrical conductivity (EC) (Table 1) was also significant. At distance of 30cm and 90cm all the treatments recorded an increase in EC after rainy season. At distance of 30cm *B. aegyptiaca* recorded 84% increase and at distance of 90cm 36%. *F. albida* recorded 2.1% at distance of 30cm and 100% at distance of 90cm.*T. indica*recorded of 200% at distance of 30cm and 55% at distance of 90cm.At distance of 60cm all the treatments recorded a decrease in EC after rainy season for *B. aegyptiaca* 71%, *F. albida* 37% and *T. indica* 55% respectively.

Table1 Soil pH and electrical conductivity at 0-15 depth before and after rainy season

Distance	Treatment	Ph			EC dS/m		
		B	A	%V	B	A	%V
30cm	*B.aegyptiaca*	6.93±0.01	5.32*±0.01	-23	0.07±0.01	0.45**±0.01	84
	F.albida	6.97±0.01	6.28*±0.01	-11	0.12±0.01	0.37**±0.01	2.1
	T.indica	6.82±0.01	6.92**±0.01	1.5	0.24±0.01	0.72**±0.01	200
60cm	*B.aegyptiaca*	6.58±0.01	6.81**±0.01	3.5	0.35±0.01	0.10**±0.01	-71
	F.albida	6.82±0.01	6.82^{NS}±0.01	0	0.23±0.01	0.12**±0.01	-37
	T.indica	7.03±0.01	6.78**±0.01	-3.6	0.47±0.01	0.21**±0.01	-55
90cm	*B.aegyptiaca*	6.14±0.01	6.14^{NSs}±0.01	0	0.09±0.01	0.42**±0.01	367
	F.albida	5.60±0.01	6.43*±0.01	13	0.21±0.01	0.42*±0.01	100
	T.indica	6.34±0.01	6.34^{NS}±0.01	0	0.22±0.01	0.34*±0.01	55

NS= not significant, **= P<0.01and * = P<0.05 Significant.
Key: B= before rainy season, A= after rainy season, % V= percentage variation over B
EC= Electrical conductivity; dS/m = decisiemens

Soil Organic Matter, Nitrogen and Phosphorus at 0-15 Depth Before and After Rainy Season

The result from table 2 indicated that organic matter was significant. At all distances OM recorded a decrease after rainy season,except under *Balanites aegyptiaca* at 30cmdistance, it recorded an increase 164%, at distance of 60cm recorded a decrease of 1.2%, at 90cm 19% for *Faidherbia albida* at distance 30cm 42%, at 60cm 0.3%, at 90cm 33% and for *Tamarindus indica* at distance of 30cm 38%, at distance of 60cm 0.4%, at 90cm 25% respectively. Nitrogen was also significant at (P<0.01 and P<0.05) across the distances. Phosphorus was also significant across the distance and between the treatments.

Table 2 Soil OM, N and P at 0-15 depth before and after rainy season

Distance	Treatment	OM g/kg			N g/kg			P g/kg		
		B	A	%V	B	A	%V	B	A	%V
30cm	*B.aegyptiaca*	0.42±0.01	1.11**±0.01	164	0.08±0.01	0.15**±0.01	88	14.1±0.01	11.1*±0.01	-21
	F.albida	0.64±0.01	0.37**±0.01	-42	0.08±0.01	0.07^{NS}±0.01	-13	11.8±0.01	2.45**±0.01	-79
	T. indica	0.65±0.01	0.41**±0.01	-38	0.12±0.01	0.04**±0.01	-67	4.12±0.01	1.40**±0.01	-66
60cm	*B.aegyptiaca*	0.82±0.01	0.81^{NS}±0.01	-1.2	0.12±0.01	0.13^{NSs}±0.01	8.3	7.04±0.01	5.97*±0.01	-15
	F.albida	0.72±0.01	0.91**±0.01	0.3	0.07±0.01	0.23**±0.01	-229	4.90±0.01	3.85**±0.01	-21
	T. indica	0.81±0.01	0.47**±0.01	-0.4	0.11±0.01	0.07**±0.01	-36	5.94±0.01	6.32*±0.01	6.4
90cm	*B.aegyptiaca*	0.44±0.01	0.36*±0.01	-19	0.08±0.01	0.03**±0.01	-63	3.50±0.01	1.40*±0.01	-60
	F.albida	0.54±0.01	0.36*±0.01	-33	0.08±0.01	0.03*±0.01	-63	3.50±0.01	1.40**±0.01	-60
	T. indica	0.48±0.01	0.36^{NS}±0.01	-25	0.07±0.01	0.03±0.01	-57	3.01±0.01	1.40*±0.01	-54

NS- not significant, **= P<0.01 and *= P<0.05 Significant, % V = percentage variation over B
Key OM – organic matter, N = Nitrogen, P = Phosphorus b = Before rainy season

Potassium, Sodium and Calcium at 0-15Depth Before and After Rainy Season

The result from table 3 indicated that there was significant difference in potassium, sodium and calcium at (P< 0.01 and P< 0.05). *Balanites aegyptiaca* recorded an increase in potassium at distance of 30cm 21% and at 90cm 11% and a decrease of 9% at 60cm after rainy season *Faidherbia albida* recoded an increase at 30cm 51%, at distance 60cm 8% and at distance 90cm 2.3% after rainy season respectively. *Tamarindus indica* recorded a decrease of 4.8% at distance 30cm and at 60cm 1.4% and 90cm 6% increase was observed after rainy season. *B. aegyptiaca* recorded an increase in sodium at distance of 30cm 38% and at 90cm 15% while at 60cm a decrease of 27% was observed. *F. albida* recorded an increase in sodium at distance of 30cm 110% and atdistance 90cm 12% whereas at 60cm a decrease of 36% was observed. *T. indica* showed an increase in sodium at distance 30cm and 90cm after rainy season. At 30cm 27% at 90cm 43% and a decrease of 43% was observed after rainy season. Calcium was also significant. *B. aegyptiaca* recorded a decrease in calcium across the distance after rainy season, 85% decrease at 30cm at 60cm 2.1% and at 90cm 34%. *F. albida* also recorded a decrease across the distance in calcium after rainy season. At 30cm 86%, at 60cm 318% and at 90cm 65%. *T. indica* recorded 79% at distance of 30cm and at 60cm 103% increases in calcium was observed and at distance of 90cm no significant difference was observed in calcium before and after rainy season.

Table 3 Potassium, Calcium and Sodium at 0-15 depth before and after rainy season

Distance	Treatments	K(cmol/kg)		Nacmol/kg		Cacmol/Kg	
		B	A %V	B	A %V	B	A %V
30cm	*B.aegyptiaca*	0.63±0.01	0.76**±0.01 21	0.32±0.01	0.44**±0.01 38	4.20±0.01	0.62**±0.01 -85
	F. albida	0.69±0.01	1.04**±0.01 51	0.42±0.01	0.88**±0.01 110	4.41±0.01	0.61**±0.01 -86
	T. indica	0.63±0.01	0.60*±0.01 -4.8	0.33±0.01	0.42**±0.01 27	1.00±0.01	0.21**±0.01 -79
60cm	*B.aegyptiaca*	0.57±0.01	0.52*±0.01 -9.8	0.48±0.01	0.35**±0.01 -27	1.01±0.01	0.80**±0.01 -21
	F. albida	0.51±0.01	0.55**±0.01 8	0.66±0.01	0.42**±0.01 -36	1.01±0.01	4.22**±0.01 318
	T. indica	0.54±0.01	0.63*±0.01 14	0.40±0.01	0.32**±0.01 -43	0.80±0.01	1.62**±0.01 103
90cm	*B.aegyptiaca*	0.18±0.01	0.20*±0.01 11	0.34±0.01	0.39*±0.01 15	1.21±0.01	0.80**±0.01 -34
	F. albida	0.35±0.01	0.36^{NS}±0.01 2.9	0.42±0.01	0.47**±0.01 12	1.61±0.00	0.80*±0.41 -65
	T. indica	0.70±0.01	0.73*±0.01 6	0.37±0.01	0.53**±0.01 43	1.41±0.01	1.41^{NS}±0.010

NS- not significant, **= P<0.01 and *= P<0.05 Significant, % V = percentage variation over B
Key = cmol/kg = centimoles

Magnesium and Cation Exchange Capacity at 0-15 DepthBefore and After Rainy Season

The result from table 4 indicated a significant difference at (P<0.01 and P< 0.05). *Balanites aegyptiaca* recorded an increase in magnesium 98% at distance of 30cm, 102% at 60cm and a decrease of 33% at 90cm. *Faidherbia albida* recoded a decrease across the distance after rainy season44% at distance 30cm, 25% at 60cm and 100% at 90cm. *Tamarindus indica* recoded a decrease of 83% at distance of 30cm whereas at 60cm an increase in magnesium 681% and at 90cm an increase of 43% was observed after rainy season. Cation exchange capacity (CEC) was significant at (P<0.01 and P< 0.05). *B. aegyptiaca* recorded a decrease in CEC of 47% at distance of 30cm, 8.1% at 60cm and at 90cm recorded an increase of 88% after rainy season. *F. albida* showed no significant difference in CEC at 30cm while at distance of 60cm recoded an increase of 94% and at 90cm a decrease of 23%. *T. indica* recorded a decrease of 58% in CEC and 168% at distance of 60cm and at distance of 90cm 111% respectively after rainy season.

Table 4 Magnesium and CEC at 0-15cm depth before and after rainy season

Mg cmol/kgCEC cmol/kg							
Distance	Treatment	B	A	%V	B	A	%V
30cm	*B.aegyptiaca*	0.61 ±0.01	1.21**±0.01	98	5.74±0.01	3.02**±0.01	-47
	F.albida	2.20 ±0.01	1.22**±0.01	-44	5.73±0.01	5.73^{NS}±0.01	0
	T.indica	4.79 ±0.01	0.81**±0.01	-83	6.75±0.01	2.63**±0.01	-56
60cm	*B.aegyptiaca*	0.60 ±0.01	1.21**±0.01	102	2.63±0.01	2.87**±0.01	8.1
	F.albida	0.81 ±0.01	0.61**±0.01	-25	2.97±0.01	5.76 ±0.01	94
	T.indica	0.41±0.01	3.20**±0.01	681	2.14±0.01	5.74**±0.01	168
90cm	*B.aegyptiaca*	0.60±0.01	0.40*±0.01	-33	1.31±0.01	1.80*±0.01	88
	F.albida	0.40±0.01	0.80**±0.00	100	3.18±0.01	2.46**±0.01	-23
	T.indica	1.20±0.0	1.61**±0.01	34	3.86±0.01	4.26**±0.00	11

NS- not significant, **= P<0.01 and *= P<0.05 Significant, % V = percentage variation over B.Key:B= before rainy season A= after rainy season. CEC= cation exchange capacity.

DISCUSSION

The result of the soil properties under tree canopy before and after rainy season indicated that soil pH was significant at (**= P<0.01 and*=P< 0.05). At distance of 30cm under *Balanites aegyptiaca* and *Faidherbia albida* soil pH recorded a decrease of 23% and 11% after rainy season and *Tamarindus indica* recorded an increase of 1.5%. (Table 1). The soil pH is mainly natural to slightly alkaline and the pH range for most agricultural crops is in the range 6.0 to 7.5 (Brady and Weil 2002). This indicates that the pH in the study area is within the optimal range of most crop requirement. The increase or decrease in soil pH before and after rainy season might be due to litter fall, which on decomposition is known to produce week acid. Electrical conductivity (EC) was significant across distances under all the treatments. However, at distance of 30cm and 90cm EC was significantly higher after rainy season. (Table 1). This might be due to higher level of soluble salt of the soil. This might be attributed to the nature of the soil, or the root pumping effect and leaching of soluble salt deep into the soil or it might be attributed to the availability of old leaves. (Hailemariam *et al,* 2010). Organic matter was significant at (P< 0.01 and P<0.05) before and after rainy season across distance under all the tree species. The higher level of organic matter can be attributed to leaf and fruit fall and decomposition of dead root from the trees and cycling of nutrients or might be due to favorable soil temperature and moisture of the soil. (Abebe *et al,* 2009). The maximum amount of organic matter was observed under *B. aegyptiaca* at distance of 30cm and at 60cm under *F.albida* after rainy season (Table 2). The result also showed that nitrogen was significant between all the treatments and across distance. However, nitrogen was significantly higher under *B.aegyptiaca* at distance of 30cm and 60cm. At distance of 90cm nitrogen was higher under *B.aegyptiaca* and *F. albida* before rainy season (Table 2). The reason behind higher nitrogen might be due to greater volume of leaf and litter fall. *F. albida* fix nitrogen and also return other nutrients to the soil. The result also indicated that phosphorus was significant under all the treatment and across distances. Higher available phosphorus was observed at distance of 30cm under *B. aegyptiaca*, and at 60cm under *T. indica* after rainy season (Table 2). The reason behind higher level of phosphorus could be attributed to the parent material of the soil and to the input from leaf litter decomposition and release at mineralization. (Tanga *et al,* 2014). The result also indicated significant difference in exchangeable cations viz potassium, sodium, magnesium, calcium. However, higher level of potassium was observed under *F.albida* at distance of 30cm after rainy season. Similarly, at distance of 60cm and 90cm potassium was higher under *T.indica* after rainy season (Table 3). This might be due to substantial amount of leaf and pod litter fall to the soil mass. (Tambari, 2000). Sodium was significantly higher under *F.albida* after rainy season at distance of 60cm. This might be due to deeper root system of the trees which could absorb the nutrient at some depth and deposits at the surface. (Berhe and Tian, 2004) No significant difference was found in the value of calcium and magnesium. However, Ca was significantly higher under *F.albida* at distance of 60cm after rainy season (Table 3). This might be attributed to calcium addition by wind from adjoining trees or might be due higher organic matter content under *F.albida.* Magnesium was also significant. However, higher value of Mg was observed under *T.indica*at distance of 60cm and 90cm after rainy season (Table 4). Many studies have shown that soils under trees are richer in nutrients (Sharma, 2003). The reason behind high Mg might be due to protection of the soil from the impact of rain drop and nutrient cycling through litter fall and protection from erosion. The result also indicated that cation exchange capacity was significant. CEC was higher under *F. albida* at distance of30cm and 60cm after rainy season. At distance of 90cm higher value was observed under *T. indica*after rainy season (Table 4). The reason behind higher CEC might be due to higher organic matter content the greater the cation exchange capacity of the soil. (Ameha, 2006). Gachene and Kimaru (2003), reported that soil with CEC of <16cmol/kg are considered not fertile and such soil are highly weathered while fertile soils have a CEC of > 24cmol/kg.

Reference

[1] Abdul, E. B. (2013). Fuelwood Consuption and Desertification in Nigeria. *International Journal of Science and Tecchnology* (3) 1

[2] Abdulhameed, A., Nura, T., Ahmed, B. I., & Lawan, H. M. (2004). The potentials of *Tamarindus indica*as a source of soil Nutrient in the Northern Guinea Savanna of Nigeria. *Nigerian Journal of Botany*. **17:** 68 -73.

[3] Abebe,Y., Fisseha,I., &Olisson M. (2009). Scattered trees as modifies of Agricultural land scapes:The role of *Waddeesu cordia african* (lam) trees in Bako area, Oromia, Ethiopia. *Afri. Jour.Ecol*. **47:**78-83.

[4] Amede, T. (2003). Opportunities and challenges in Reversing Land degradation. The Regional Experience. Natural resource and Environmental concerns

[5] Ameha, T. (2006). Impact of *prosopis Juliflora* (SW. DC): invasion of plant biodiversity and soil properties in the middle Awash, rift valley, Ethiopia. M. Sc. Thesis, Havassa University, Ethiopia.

[6] Brady N. C. & Weil, R. R. (2002). *The Nature and properties of soil* (13th Ed.) New York: USA. 960.

[7] Buresh, R. J. & Tian, G. (2004). Soil improvement by trees in Sub-Saharan Africa. *Agro forestry System*. **3:** 51 – 76.

[8] Desta, H.A. (2015). Effect of organic and inorganic fertilizer on selected soil properties after Harvesting maize at Antra catchment, Northwestern Ethiopia. *International Invention Journal of Agric and Soil Sciences* **3 (5):** 68-78.

[9] Gachene, C. K. & Kimaru, G. (2003). Soil fertility and Land productivity; A guide for extensive workers in the Eastern Africa region Nairobi, Kenya. 146pp.

[10] Hailemariam,K., Kindeya, G. & Charles, Y. (2010). *Balanites aegyptiaca* a potential tree for parkland agro forestry system with sorghum in Northern Ethiopia. *Journal of Soil Science. and Environmental Management***6:** 107 – 114.

[11] Kimsey, P. (2012). The Quickie Seed Viability Test for Seed Savers and Traders. Retrieved *from http://nerdy.millennial.seed.savers.2436html*

[12] Line, K. R. (2004). *Plant Nutrition in the soil*. Retrieved on 26th Feb. 2013 from http; llwww.dpi.nsw.gov.au/agriculture/resource/soil/impr oment/plant-nutrients.

[13] Oyetunji, O. I. & Ekanakaye, J. J. (2001). Influence of yam fungi on cassava –maize inter crop in an alley cropping system. *Proceeding of African crop science conference Uganda*,**5,** 179- 183.

[14] Sharma, B. M. (2005). Productivity of grain legumes in agri silviculture systems under hot arid conditions. (*in*) *Advances in Arid Legume Research,* pp 279. Scientific Publishers, Jodhpur.

[15] Swift, M. J. and Palm, C. A. (2000). Soil fertility as an ecosystem concept: A Paradigm lost or regained? *Accomplishment and Changing Paradigm* toward the 21st century: 112-116 pp.

[16] Tambari, U. (2007). Nutrient levels in the leaves of four indigenous trees in Sudan Savanna of North Western Nigeria. M. Sc. Thesis School of postgraduate studiesUsmanu Danfodiyo University Sokoto. Unpublished.57 -69.

[17] Tanga, A.A., Erenso, T.F.& Lemma, B. (2014). Effect of three tree species on microclimate and soil Amelioration in the central rift valley of Ethopia. *Journal of Soil Science and Environmental Management***5 (5),**62-71

[18] UNESCO (1979). United Nations Educational Scientific and Cultural Organization. *Tropical Grazing Land Ecosystem state of knowledge Report* ll 10.13 wwf (1987) world wild life fund project **36,** 1 – 6.

[19] Yakubu, I. (2010). Climate change impact on the density of *Faidherbia albida* on small holder farms in the degraded lands of Kano, Northern Nigeria. *Environmentalist*, **30:** 330-332.