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EFFECT OF LEAFLITTERS OF SELECTED NITROGEN FIXING ACACIA TREES ON THE GROWTH OF *Vitellaria paradoxa* C. F GAERTN

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ABSTRACT

Inadequacy of quantified information on the growth response of *V. paradoxa* to organic manure from plant has limited its propagation. In an attempt to improve the slow growth of *V.paradoxa*, investigation was conducted to assess the effect of leaf litters of some nitrogen fixing acacia trees on the growth of *V. paradoxa* seedlings. The experiment adopted a Completely Randomised Design (CRD) with seven treatments replicated five times. The treatments consisted of leaflitters of selected nitrogen fixing acacia trees (*Acacia tortilis*, *Acacia senegal*, *Acacia nilotica*, *Acacia seyal*, *Acacia leucophloea*, *Acacia albida*) and control on the growth of *V.paradoxa*. A total of thirty five (35) seedlings were involved in the experiment. A-year old *V.paradoxa*seedlings were transplanted into pots with and without 100 g of leaflitters of nitrogen fixing acacia trees and subjected to 200 ml of water twice daily.The plant growth parameters were evaluated.Data was subjected to oneway Analysis of Variance (ANOVA). The leaflitters of selected nitrogen fixing acacia trees significantly ($P<0.05$) enhanced the growth of *V.paradoxa*. Tallest plant (33.34cm), widest girth(3.60cm)., highest number of leaves (18), widest leaf area ($264.63cm^2$), highest leaf area index (2.78), highest total fresh weight (12.05g) and total dry weight(6.10g) were recorded from seedlings planted in the soil enhanced with leaf litters of *A. leucophloea*. Highest nitrogen (3.6%) and phosphorus (458mg/100g) were recorded from leaflitter of *A. leucophloea*. Planting of *V. paradoxa* in the soil influenced with leaflitters of *A. leucophloea* enhanced its seedling growth.

Keywords: Manure, Nitrogen fixing trees, Growth, Leaflitters, Soil amendment.

Introduction

It is globally agreed that continuous existence of many societies and their livelihoods rest on the sustainability of the biodiversity of their forests as this ensures the availability of more goods and services(Oboho *et al.*,2015). Oboho *et al.* (2015) stated that deforestation is threatening the survival and health of natural forests with man being at risk of losing his resources and benefits too. Lapido (2010) puts the deforestation rate in Nigeria at about 3.5%, translating to a loss of about350,000 to 400,000 hectares of forest land per year.Anthropogenic activities (deforestation includes removal of forest to make way for urbanization, infrastructural development, agriculture (especially plantation agriculture), logging and in recent times fires and wars depletes the population of forest resources (Oboho, 2014).

Many forest fruit trees of great socio-economic value to the people are among the NTFPS. One of these valuable priority fruit trees includes *Vitellaria paradoxa*. The *Vitellaria paradoxa* is an indigenous fruit tree of Sudano - Sahelian African which belongs to the family Sapotaceae (Okullo *et al.*, 2004a, b). Its natural habitat stretches over Africa south of the savannah, from the Eastern part of Senegal to the North of Uganda. It is called Monkade, kareje, Chammal, Orioyo, Okeruma and Kirite in Hausa, Fulani, Tiv, Yoruba, Igbo and French, respectively (Adeoye, 2011). It has multi-purpose values in medicine, cosmetic and pharmaceutical industries (Odebiyi*et al.*, 2004; Bonkoungou, 2005).As a deciduous woody perennial species, *V. paradoxa* plays a major role in nutrients restoration through the decay of its leaves and fine roots on the soil surface (Bayala *et al.*, 2005). The West African annual production of its nut in years of good crops is estimated at about 600,000 metric tons of dry nuts, while Nigeria accounts for 50% of its production (Adeoye, 2011). Adeoye (2011) reported that the Nigeria production level was 373,000 metric tons for its dry nuts in 1991.

Vitellaria paradoxa tree is a main component of the tree stratum in traditional parklands systems, which are farm lands with scattered trees forming an open permanent over storey of associated crops (Bounkoungou, 1992). The wild populations of the species result from natural regeneration as well as protected and scattered trees on cultivated land (Aderounmu and Olajuyigbe, 2019).The naturally occurring individual *Vitellaria paradoxa* trees that are protected by farmers during fields clearing form parkland system which has been degraded both in vegetation cover as well as in soil fertility (Boffa *et al.* (1996; Quedraogo, 2006).

This trend suggests the need to use artificial regeneration to promote this species in farmer's field. Regeneration is the act of renewing the forest by establishing young trees naturally or through planting out (Oboho *et al.*, 2015). Oboho *et al.* (2015) stated that production practice for sustainable use can be achieved through regeneration. The slow growth of *V. paradoxa* is a threat to regeneration. There is the need for the use of affordable, available and environmentally friendly organic fertilizer, to enhance its growth to meet population demand of its benefits. Organic amendments help to improve soil fertility and sustainability by improving biological activity, nutrient mineralization and immobilization (Albiach *et al.*, 2000). Leaflitters of nitrogen fixing trees is an organic amendment.

There is paucity of research based information on the efficacy leaflitters of nitrogen fixing acacia tree species on the growth of our economic indigenous fruit tree species as *V. paradoxa*. The use of plant based organic fertilizer to enhance the growth of *V. paradoxa* need to be addressed through research.In this light, this investigation was conducted to assess the effect of leaf litters of selected nitrogen fixing acacia trees on the growth of *V. paradoxa* with a view to enhance its growth to meet the population demand of its associated benefits and to increase biodiversity conservation of it in Nigeria.

Materials and method

Experimental site

The research was conducted in the screen house of Federal College Forestry Mechanization, Afaka, Kaduna. The College is located in the Northern Guinea Savannah ecological zones of Nigeria. It is situated in Chikun Local Government Area of Kaduna State, Nigeria. It lies between Latitude 10^{o}35'and 10^{o}34'and Longitude 7^{o}21'and 7^{o}20' (Adelani, 2015). The mean annual rainfall is approximately 1000mm. The vegetation is open woodland with tall broad leave trees (Otegbeye *et al.,* 2001).

Experimental Materials

The fruits were collected from mother tree in Niger State. The seeds were extracted and washed. The seeds were air dried for 30 minutes. The biomass transfer method which involved the collection of wet leaves of nitrogen fixing trees from different location was used. The nitrogen fixing acacia trees are not in the same location. The samples of the different leaves of nitrogen fixing acacia trees were air dried and pulverized. The river sand was collected from the floor of the college dam and allowed to pass through 2mm sieve. The sieved sand was sterilized at 160^{o}C for 24hours.

Effect of selected leaf litters of nitrogen fixing acacia trees on the growth of *V. paradoxa*

The experimental design adopted for investigation on the effect of leaf litters of selected nitrogen fixing acacia trees (*Acacia tortilis*, *Acacia senegal*, *Acacia nilotica*, *Acacia seyal*, *Acacia leucophloea*, *Acacia albida*) *and* control on the growth of *V. paradoxa* was a Completely Randomized Design with five replicates. A year old seedling was carefully transplanted into a potting mixture packed in larger poly pots of $25x20x15cm^3$ dimensions. The potting mixture contained samples of sterilized sand thoroughly mixed with each leaves of nitrogen fixing acacia trees at same quantity of 100g. Each sample of pulverized leaves of nitrogen fixing trees was analyzed chemically for nitrogen, phosphorus and potassium (NPK).The sand without the addition of leaf litters was analyzed for nutrient content under untreated soil (control). The 200ml of distilled water per seedling was used to water the seedlings twice daily.

Growth parameters were monitored every month for 6 months.Growth parameters assessed include; Seedling height (using meter rule); girth (using venier caliper); the number of leaves were counted manually and Leaf area was obtained by linear measurement leaf length and leaf width as described by as described by Ugese *et al.* (2008).

$$LA = 4.41 + 1.14LW$$

Where:

LA = leaf area

LW = Production of linear dimension of the length and width at the broadest part of the leaf

Leaf Area Index was calculated by using the formula: leaf area/land area

The fresh and dry weight were determined by the use of Mettler Top Loading Weighing Balance, but dry weight was taken after oven dried the seedlings at 70 ^{o}C for 72 hours (Umar and Gwaram, 2006).

Data analysis

The data on the effect of leaf litters of selected nitrogen fixing acacia trees on the growth of *V. paradoxa* seedlings were subjected to one way analysis of variance (ANOVA) using SAS (2003). Comparison of significant means was accomplished using Fishers Least Significant Difference (LSD) at 5% level of significance.

Result

Effect of leaflitters of selected nitrogen fixing acacia trees on the height of *V. paradoxa*

Tallest plant of33.34cm was recorded from seedlings planted in the soil influenced with leaflitters of *A .leucophloea* at 24 weeks after transplanting, WAT. The least height of 6.60cm was recorded from seedlings planted in soil without the influence of leaflitters (control) at 4 WAT.

Table 1: Effect of leaflitters of selected nitrogen fixing acacia trees on the height (cm) of *V. paradoxa*

NFAT		Weeks	After	Transplanting		
	4	8	12	16	20	24
A.tortilis	16.28^{b}	17.82^{ab}	18.82^{ab}	20.14^{ab}	21.20^{ab}	22.32^{a}
A.senegal	12.60^{b}	13.68^{b}	17.54^{ab}	18.10^{ab}	19.38^{ab}	20.10^{a}
A.nilotica	15.40^{a}	17.90^{a}	18.10^{b}	18.60^{b}	23.38^{a}	24.40^{a}
A.seyal	17.24^{b}	18.10^{b}	18.60^{b}	23.38^{a}	24.40^{a}	25.00^{a}
A.leucophloea	17.10^{c}	20.90^{bc}	25.40^{b}	28.00^{a}	31.60^{a}	33.34^{a}
A.albida	19.90^{b}	23.46^{b}	26.54^{ab}	28.05^{a}	30.00^{a}	30.80^{a}
Control	6.60^{a}	7.72^{a}	8.54^{a}	9.98^{a}	10.24^{a}	10.42^{a}
SE	2.66	2.86	2.90	2.94	3.01	3.00

*Means on the same rows with the same alphabet are not significantly different at (P<0.05)

Key: NFAT=Nitrogen fixing acacia trees

WAT= Weeks After Transplanting

Effect of leaflitters of selected nitrogen fixing acacia trees on the girth of *V.paradoxa* seedlings

Widest girthof 3.60cm was recorded from seedlings planted in the soil enhanced with leaflitters of *A. leucophloea* at 24 WAT. The least value of 0.72cm was recorded from seedlings planted in the soil without amendment of leaflitters (control) at 4 WAT.

Table 2: Effect of leaflitters of selected nitrogen fixing acacia trees on the girth (cm) of *V. paradoxa* seedlings

NFAT		Weeks	After	Transplanting		
	4	8	12	16	20	24
A. tortilis	1.84^{b}	1.98^{b}	2.10^{ab}	2.42^{ab}	2.48^{a}	2.56^{a}
A. senegal	1.52^{a}	1.60^{a}	1.78^{a}	1.96^{a}	1.98^{a}	2.06^{a}
A. nilotica	2.10^{b}	2.20^{b}	2.46^{ab}	2.66^{ab}	2.68^{a}	2.78^{a}

A. seyal	1.78^{a}	1.88^{a}	2.02^{a}	2.12^{a}	2.14^{a}	2.24^{a}
A.leucophloea	2.32^{b}	2.48^{b}	2.88^{ab}	3.40^{a}	3.40^{a}	3.60^{a}
A. albida	1.58^{b}	1.76^{b}	2.02^{ab}	2.20^{ab}	2.24^{a}	2.34^{a}
Control	0.72^{a}	0.88^{a}	0.92^{a}	0.92^{a}	0.96^{a}	0.96^{a}
SE	0.22	0.23	0.24	0.23	0.23	0.25

*Means on the same rows with the same alphabet are not significantly different at (P<0.05)

Key: NFAT=Nitrogen fixing acacia trees

WAT= Weeks After Transplanting

Effect of leaflitters of nitrogen fixing acacia trees on the number of leaves of *V. paradoxa* seedlings

Highestnumber of leaves of 18 was recorded from seedlings planted in the soil improved with leaflitters of *A. leucophloea* at 24WAT, while the least value of 2.60 numbers of leaves was recorded from seedlings planted in unamended soil (control) at 4WAT.

Table 3: Effect of leaflitters of nitrogen fixing acacia trees on the number of leaves of *V.paradoxa* seedlings

NFAT	Weeks	After	Transplanting			
	4	8	12	16	20	24
A.tortilis	6.00^{a}	7.00^{a}	7.00^{a}	7.40^{a}	7.80^{a}	8.40^{a}
A.senegal	7.40^{a}	7.40^{a}	8.00^{a}	8.00^{a}	8.40^{a}	9.60^{a}
A.nilotica	6.00^{a}	6.60^{a}	7.00^{a}	7.40^{a}	8.00^{a}	8.20^{a}
A.seyal	6.60^{b}	7.80^{b}	7.80^{b}	8.00^{b}	8.20^{b}	10.60^{a}
A.leucophloea	4.80^{c}	5.40^{c}	9.00^{b}	14.20^{a}	16.20^{a}	18.00^{a}
A.albida	6.20^{b}	6.60^{ab}	7.00^{a}	8.20^{a}	9.20^{a}	9.60^{a}
Control	2.60^{a}	2.60^{a}	3.40^{a}	3.40^{a}	3.40^{a}	3.40^{a}
SE	0.78	0.77	0.90	0.95	1.09	1.21

*Means on the same rows with the same alphabet are not significantly different at (P<0.05)

Key: NFAT=Nitrogen fixing acacia trees

WAT= Weeks After Transplanting

Effect of leaflitters of selected nitrogen fixing acacia trees on the leaf area of *V. paradoxa* seedlings

Widest leaf area of 264.63cm^2 was recorded from seedlings enhanced with leaflitters of *A. leucophloea* at 24 WAT. The least value of 31.62cm^2 was recorded from seedlings planted in the soil not influenced with leaflitters of nitrogen fixing acacia trees (control) at 8 WAT.

Table 4: Effect of leaflitters of selected nitrogen fixing acacia trees on the leaf area (cm^2) of *V. paradoxa* seedlings

NFAT	Weeks	After	Transplanting			
	4	8	12	16	20	24

A.tortilis	211.31[a]	107.92[b]	182.37[a]	181.27[a]	189.47[a]	192.61[a]
A.senegal	94.48[a]	117.00[a]	68.58[a]	72.75[a]	88.05[a]	91.39[a]
A.nilotica	111.17[a]	117.33[a]	102.29[a]	100.78[a]	107.16[a]	113.60[a]
A.seyal	105.97[a]	89.27[a]	66.66[a]	73.42[a]	77.38[a]	80.32[a]
A.leucophloea	99.51[d]	103.02[d]	156.00[c]	209.35[bc]	210.55[b]	264.63[a]
A.albida	74.43[a]	77.84[a]	67.63[a]	71.45[a]	74.07[a]	76.75[a]
Control	32.60[a]	31.62[a]	57.84[a]	37.18[a]	42.33[a]	49.26[a]
SE	14.76	18.51	20.12	20.54	31.35	22.24

*Means on the same rows with the same alphabet are not significantly different at (P<0.05)

Key: NFAT=Nitrogen fixing acacia trees

WAT= Weeks After Transplanting

Effect of leaflitters of selected nitrogen fixing acacia trees on the leaf area index of *V. paradoxa* seedlings

Widest leaf area index of 2.78 was recorded from seedlings planted in the soil influenced with leaflitters of *A. leucophloea* at 24 WAT. The least value of 0.32 leaf area index was recorded from seedlings planted in the soil not amended with leaflitters of nitrogen fixing acacia trees at 20 WAT.

Table 5: Effect of leaflitters of selected nitrogen fixing acacia trees on the leaf area index of *V. paradoxa* seedlings

NFAT		Weeks	After	Transplanting		
	4	8	12	16	20	24
A.tortilis	2.20[a]	1.12[b]	1.90[a]	1.89[a]	1.97[a]	2.01[a]
A.senegal	0.98[a]	1.22[a]	0.71[a]	0.76[a]	0.92[a]	0.95[a]
A.nilotica	1.16[a]	1.22[a]	1.07[a]	1.05[a]	1.12[a]	1.18[a]
A.seyal	1.10[a]	0.93[a]	0.69[a]	0.76[a]	0.81[a]	0.89[a]
A.leucophloea	1.04[c]	1.09[c]	1.66[bc]	2.18[b]	2.56[a]	2.78[a]
A.albida	0.78[a]	0.81[a]	0.70[a]	0.75[a]	0.77[a]	0.80[a]
Control	0.34[a]	0.33[a]	0.36[a]	0.38[a]	0.32[a]	0.51[a]
SE	0.16	0.19	0.20	0.19	0.24	0.37

*Means on the same rows with the same alphabet are not significantly different at (P<0.05)

Key: NFAT=Nitrogen fixing acacia trees

WAT= Weeks After Transplanting

Effect of leaflitters of selected nitrogen fixing acacia trees on the fresh and dry weight of *V. paradoxa* seedlings

Highest fresh root weight (9.20g) and dry root weight (4.75g) were recorded from seedlings planted in the soil amended with leaflitters of *A. leucophloea*. Highest total fresh weight (12.05g) and dry weight(6.10g) were recorded from seedlings planted in the soil influenced with leaflitters of *A. leucophloea*. The least values of 0.20g and 0.01g were recorded from fresh leaf weight and dry shoot weight of seedlings planted in the soil without the

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amendment of leaflitters of nitrogen fixing acacia trees (control).

Table 6: Effect of leaflitters of selected nitrogen fixing acacia trees on the fresh and dry weight(g) of *V. paradoxa* seedlings

NFAT	FW			TFW	DW			TDW
	L	S	R		L	S	R	
A. tortilis	2.25[a]	0.45[b]	2.70[a]	3.60[b]	0.85[b]	0.60[b]	4.60[a]	6.05[a]
A. senegal	1.05[b]	0.50[b]	5.40[a]	6.95[ab]	0.20[b]	0.90[b]	3.95[a]	5.10[a]
A. nilotica	0.80[b]	0.40[b]	7.60[a]	8.80[ab]	0.35[b]	0.05[b]	3.90[a]	4.30[ab]
A. seyal	1.70[b]	0.75[b]	8.00[a]	10.45[a]	0.80[b]	0.40[b]	3.80[a]	5.00[a]
A.leucophloea	1.60[b]	1.25[b]	9.20[a]	12.05[a]	0.80[b]	0.55[b]	4.75[a]	6.10[a]
A. albida	0.40[b]	0.65[b]	5.95[a]	7.00[ab]	0.15[b]	0.20[b]	3.00[a]	3.35[ab]
Control	0.20[b]	0.45[a]	2.60[a]	3.25[b]	0.10[a]	0.01[a]	0.65[a]	1.80[b]
SE	1.20	0.93	3.59	5.73	0.55	0.38	2.32	3.25

*Means on the same rows with the same alphabet are not significantly different at (P<0.05) for fresh weight and dry weight

*Means on the same columns with the same alphabet are not significantly different at (P<0.05) for total fresh weight and total dry weight

Key: NFAT=Nitrogen fixing acacia trees

Nutrient composition of leaf litters of selected nitrogen fixing acacia trees

Highest nitrogen (3.69%), phosphorus (458mg/100g) and potassium (22.49mg/100g) were recorded from leaf litters of *A. leucophloea*, *A. leucophloea* and *A. albida* respectively. The least values of nitrogen (0.05%), phosphorus (0.02mg/100g) and potassium (0.07mg/100g) were recorded for control treatment.

Table 7: Nutrient composition of leaflitters of selected nitrogen fixing acacia trees

NFAT	N%	P mg/100g	K mg/100g
A.seyal	3.22	353.27	21.49
A.tortilis	2.67	415.80	18.78
A.albida	2.84	380.22	22.49
A.nilotica	2.93	406.34	16.45
A.senegal	2.34	362.49	14.32
A.leucophloea	3.69	458.98	20.65
Control	0.05	0.02	0.07

Discussion

The excellent growth performance recorded from seedlings planted in the soil influenced with *A. leucophloea* could be traceable to its better release of nitrogen compared to others investigated species. Similar observation has been made by Gaisie *et al.* (2016) who stated that nitrogen released from *Albizia lebbeck* was significantly greater than that of *Senna siamea*. This findings is consonance with that of Iloyanomon and Ogunlade (2011) who reported highest nitrogen release from leaflitters of *Cola nitida* under plantation A relative to others. In the same trend, Mahmood *et al.* (2009) documented that *Eucalyptus camaldulensis* leaflitters released highest nitrogen compared to other species studied.

The leaflitter of *A.leucophloea* released highest percentage of nitrogen that is essential for plant growth. Nitrogen has been called the growth element because it is a vital part of protoplasm. Protoplasm is the seat of cell division (Abod and Siddiqui, 2002). Sinfield *et al.* (2010) stated that nitrogen is part of various enzymatic proteins that catalyses and regulates plant-growth process.The contribution of nitrogen to plant growth is 40%–50%. Nitrogen is an important component of proteins, nucleic acids, chlorophyll and some growth hormones in plants, andhas an important effect on photosynthetic rate (Güsewell 2004., Ogunlela *et al.*, 2005; Luo *et al.*, 2013, Zhang *et al.*, 2014; Anderson, 2015; Ginindza *et al.*, 2015). Cai *et al.*(2017) reported that nitrogen addition significantly increased *Arabidopsis thaliana* stem diameter, cortical thickness, flower ring radius, midrib thickness, and leaf and stem vascular size.

The superior performance of *V. paradoxa* seedlings planted in *A.leucophloea* over other treatment combinations is traceable to highest phosphorus content of *A.leucophloea*. Phosphorus is considered a primary nutrient for plant growth (Hinsinger, 2001) and needed to sustain optimum plant production and quality (Zapata and Zaharah, 2002). Adelani *et al.* (2017) stated that phosphorus has been reported for its enhancement of growth of tree seedlings. Phosphorus improves the germination of seeds as well as seedling growth of trees and arable crops (Mengel and Kirkby; 2001, Smith, 2014; Adelani *et al.*, 2014). The growth-promoting role of P application has been reported previously (Williamson *et al.*, 2001, Pandey *et al.*, 2006, Waraich *et al.*, 2015). This is in consonance with the reports of Hudai *et al.* (2007) and Cicek *et al.* (2010). Cai *et al.* (2017) stated that phosphorus addition significantly increased the stem xylem thickness of *Arabidopsis thaliana*.Epstein and Bloom (2004) stated that the P element is essential for cell division, reproduction, and plant metabolism; moreover, its role is related to the acquisition, storage, and use of energy.

Ogunlela *et al.* (2005) and Ginindza *et al.*(2015) stated thatphosphorus contributes to root, flower and fruit development of plant.Phosphorus is an indispensable element in the synthesis ofnuclear proteins, lecithin,andso on,and can also promote cell division and energy transport and accelerateboth aerial and underground growthof plant(Dos Santos *et al.*, 2006., Burman, *et al.*, 2009; Gan *et al.*,2016). In addition, phosphorus plays an important role in lateral root morphology (Williamson *et al.*, 2001) and root branching (Lopez-Bucio *et al.*, 2003) influencing not only root development, but also the availability of nutrients to plants

(Jin *et al.*, 2005). Therefore, plants have developed various strategies for obtaining optimum P from soils, including increases in root surface area, specific root length (SRL), and root-shoot ratio (Tang *et al.*, 2009; Xu *et al.*, 2012). The present study also confirmed the results of Jin *et al*. (2005) who reported that P application increases total root length and average root diameter of *Glycine max*. In most species, P-deficiency results in decreased average root diameter (Hill *et al.*, 2006) however, some species, such as *Arabidopsis thaliana*, develops larger roots in P-deficient conditions (Ma *et al.*, 2001).

Seedlings planted in the soil influenced with leaflitters of acacia trees gave better growth parameters compared to control. Similar observation has been reported by Sohail (2008) who stated that plants were shortest when grown in topsoil without fertilizer and tallest when grown in coco coir or topsoil with fertilizer. This is in consonance with the report of Adejobi *et al.* (2014) who obtained good responses in leaf nutrient content and growth measurements of cocoa seedlings after applying cocoa husk ash. The ability of leaflitters of acacia trees to influence seedling growth relative to control is an indication that plant based organic manure or green manure enhances the growth of tree seedlings.Similar observation has been made by Agbede *et al*. (2018)who revealed that green manure has potential to improve soil properties, tomato yield and quality, being an alternative for cropping management.

Conclusion

To forestall threats of extinction, regeneration through improving the seedling growth of economic tree species by subjecting it to appropriate fertilizer from leaflitters of nitrogen fixing treesofacaciaspeciesis vital for biodiversity conservation of indigenous priority fruit tree species. Nutrients from leaflitters of nitrogen fixing acacia tree species helps to restore and maintain soil fertility for sustainable productivity of crop and tree integration. Investigation into effect of selected leaflitters of nitrogen fixing acacia trees revealed that leaflitters of *A.leucophloea* enhances the growth of *V.paradoxa* seedlings. Overcoming the early growth constraint of *V.paradoxa* helps to meet the population demand and increase biodiversity conservation of this indigenous valuable species.

References

Abod, S.A andSiddiqui, M.T. (2002).Growth response of teak (*Tectonagrandis*L.F.) seedlings to nitrogen, phosphorus and potassium fertilizers.*Pertanika Journal of Tropical Agricultural Science*, 25(2):107-113.

Adejobi, K B., Akanbi., O S., Ugioro, O andNduka, I.(2014).Comparative effects of NPK fertilizer, cowpea pod husk and some tree crops wastes on soil, leaf chemical properties and growth performance of cocoa (*Theobroma cacao* L.).*African Journal of Plant Science*, 8(2):103-107

Adelani, D.O., Suleiman, R.A., Aduradola, M. A and Akesode, H.A. (2014). Assessment of leaf litters of some tree species on the growth of *Zea mays* (L) in the Northern Guinea Savanna ecology. *Journal of Organic Agriculture and Environment*, 2:117-130.

Adelani, D.O. (2015). Effects of pre-germination treatments and sowing depths on early growth of sesban (*Sesbaniasesban*). *Applied Tropical Agriculture* 20(1): 31-36

Adelani, D.O., Amos, O.S and Maikano, S. (2017). Effect of botanical pelletings and storage periods on the germination of African star apple (*Chrysophyllumalbidum* G. Don). *Journal of Agricultural Science and Environment* 17(2): 37-49.*journal.unaab.edu.ng › index.php › JAgSE › article › view*

Adeoye G.O (2011). Shea butter production and utilization in Nigeria Organic Agriculture prospective, *Seminar Paper Presented by Nigeria Organic Agriculture Network* (NOAN), held in Abuja. 5pp

Aderounmu, A. F. and Olajuyigbe S.O (2019). The effects of organic and inorganic fertilizers on the early growth and development of *Vitellariaparadoxa* C. F. Gaertn. *Applied Tropical Agriculture*, 24(2): 132-140.

Agbede, T.M, Adekiya, A. O., Monday , O. A ., Eifediyi, E. K and Olatunji, C. A. (2018). Effects of green manures and NPK fertilizer on soil properties, tomato yield and quality in the forest-savanna ecology of Nigeria.*Experimental Agriculture*, 55(3):793 – 806.

Albiach, R., Canet, R., Pomares, F and Ingelmo, F. (2000).Microbial biomass content and enzymatic activities after the application of organic amendments to a horticultural soil.*Bioresource Technology*, 75: 43-48.

Anderson, P. (2015). N.P.K and Fe, what are they good for ?www.LimbwalkerTree Service 1(1):1-4. Accessed on 1/16/2015.

Bayala, J., Mando, A., Teklehaimanot, Z and Ovedraoga, S. J (2005). Nutrient release from decomposing leaf mulches of karite (*Vitellariaparadoxa*) and nere (*Parkiabiglobosa*) under semi – arid conditions in Burkinafaso, West African. *Soil Biology and Biochemistry*, 37: 533 – 539.

Boffa, J.M., Yameogo, G. Nikiemap and Knudson D. M. (1996) – Shea nut (*Vitellariaparadoxa)* production and collection in agroforestry parklands of Burkina Faso. *http://hubrural.org/IMG/pdf/etudekaritebu rkina.pdf.Accessed on 11/01/2021.Pp 13*

Bonkoungou, E. G (1992). Socio cultural and economic functions of *Acacia albida in West Africa*.http://apps.worldagroforestry.org/Units/Library/Books/Book%2085/faidherbia%20albida/html/sociocultural.htm?n=8. Accessed on 11/01/2021. PP 5

Bonkoungou, E. G. (2005): The Shea Tree (*Vitellariaparadoxa*) and African Shea Parklands. Proceedings of the International Workshop on Processing and Marketing of Shea Products in Africa, Sénégal, 4-6 March 2002. *CFC Technical paper* No 21. *Food and Agriculture Organization, Rome*pp226.

Burman, U.; Garg, B.K. and Kathju, S. (2009). Effect of phosphorus application on clusterbean under different intensitiesof water stress.*Journal of Plant Nutrition*, 32: 668–680.

Cai, Qiong.,Ji, Chengjun., Yan, Zhengbing., Jiang, Xingxing and Fang, Jingyun (2017). Anatomical responses of leaf and stem of *Arabidopsis thaliana* to nitrogen and phosphorus addition.*Journal of Plant Research*, 130(6): 1035–1045.

Cicek, E., Yilmaz, F and Yilmaz, M. (2010).Effect of N and N P K fertilizers on early field performance of narrow-leaved ash, *Fraxinusangustifolia*. *Journal of Environmental Biology*, 31(1–2):109–114.

Dos Santos, M.G.; Ribeiro, R.V.; de Oliveira, R.F.; Machado, E.C and Pimentel, C.

(2006).The role of inorganic phosphateon photosynthesis recovery of common bean after a mild water deficit.*Plant Science*, 170: 659–664.

Epstein, E and Bloom, A. J. (2004).*Mineral Nutrition of plants: Principles and Perspectives* (Second Edition). Sunderland, M.A: Sinauer Associates, Inc. 402p.

Gaisie, E., Sadick, A., Agyeman, K., Adjei-Gyapong, T and Quansah, G.(2016). Leaf decomposition and the nutrients release from multipurpose trees for crop production. *International Journal of Scientific Research in Science, Engineering and Technology*,(*ijsrset.com*) 2(1): 345-352.

Gan, H.; Jiao, Y.; Jia, J.; Wang, X.; Li, H.; Shi, W.; Peng, C.; Polle, A andLuo, Z.B. (2016).Phosphorus and nitrogenphysiology of two contrasting poplar genotypes when exposed to phosphorus and/or nitrogen starvation.*Tree Physiology*,36: 22–38.

Ginindza, T. K., Masarirambi, M. T., Wahome,P. K and Oseni, T. O.(2015). Effects of different concentrations of NPK fertilisers on growth and development of wild okra (*Corchorusolitorius*).*Agriculture and Biology Journal of North America*,6(3): 74-80.

Güsewell, S. N. (2004). P ratios in terrestrial plants: Variation and functional significance.*New Phytologist*, 164: 243–266.

Hill, J.O., Simpson, R. J, Moore, A. D and Chapman, D. F. (2006). Morphology and response of roots of pasture species to phosphorus and nitrogen nutrition. *Plant and Soil*, 286(1–2):7–19.

Hinsinger, P. (2001). Bioavailability of soil inorganic P in the rhizosphere as affected by root-induced chemical changes: a review. *Plant and Soil*, 237(2):173–195.

Hudai, S. M, Sujauddin, M., Shafinat, S and Uddin, M. S. (2007). Effects of phosphorus and potassium addition on growth and nodulation of *Dalbergiasissoo* in the nursery.*Journal of Forestry Research*, 18(4):279–282.

Iloyanomon, C.I andOgunlade, M.O. (2011). Soil nutrient dynamics and leaflitter fall under Kola (*Cola nitida*) plantations in Ibadan, Nigeria. *International Journal of Science and Nature*, 2(4): 832-836.

Jin, J., Wang, G. H., Liu, X., Pan, X and Herbert, S. J. (2005). Phosphorus application affects the soybean root response to water deficit at the initial flowering and full pod stages. *Soil Science and Plant Nutrition*, 51(7): 953–960.

Lapido,D .(2010). The State of Nigeria forest in conserving endangered species in Nigeria. Nigerian Field Society 80th Anniversary, IITA, Ibadan p. 4.

López-Bucio, J., Cruz-Ramírez, A and Herrera-Estella, L. (2003).The role of nutrient availability in regulating root architecture.*Current Opinion in Plant Biology*, 6(3):280–287.

Luo, J.; Qin, J.; He, F.; Li, H.; Liu, T.; Polle, A.; Peng, C andLuo, Z.B. (2013).Net fluxes of ammonium and nitrate inassociation with h+ fluxes in fine roots of *Populuspopularis*.*Planta*, 237: 919–931.

Ma, Z., Bielenberg, D. G., Brown, K. M and Lynch, J. P. (2001). Regulation of root hair density by phosphorus availability in *Arabidopsis thaliana. Plant, Cell and Environment.*,24 (4):459–467.

Mahmood, H., Limon, S.H., Rahman, M.S., Azad, A. K., Islam, M.S and Khairuzzaman, M.(2009). Nutrients (N, P and K) dynamics associated with the leaf litter of two agroforestry tree species of Bangladesh. *iForest -Biogeosciences and Forestry*, 2(5): 183-186.

Mengel, K and Kirkby, E. A. (2001).*Principles of Plant Nutrition*. Kluwer Academic Publishers, Dordrecht, The Netherlands. p. 833.

Pandey, S.T., Singh, P and Pandey, P. (2006).Site specific nutrient management for *Withaniasomnifera* at subtropical belt of Uttaranchal.*International Journal of Agricultural Sciences*, 2:626–628.

Oboho, E. G. (2014). *Silviculture for Beginners*.Uniben Press, EkehuanCampus, Benin City, Nigeria. p. 263.

Oboho, E. G, Ogedegbe, S. A and Taiwo, O. P.(2015). Effect of fruit ripeness status and netting on the germination and early growth of *Dennettiatripetala* G. Baker seedlings.*Journal of Agricultural and Crop Research*, 3 (8):123-129.

Odebiyi, J. A., Bada, S. O., Awodoyin, R. O., Oni, P. I. and Omoloye, A. A. (2004). Population structure of *Vitellariaparadoxa*Gaertn. Fand *Parkiabiglobosa* (Jacq.) Benth inAgroforestry parklands of Nigeria humid savanna. *West African Journal of Applied Ecology*, 5: 31-39.

Ogunlela, V., Masarirambi, M.T and Makuza, S.M. (2005).Effects of cattle manure application on pod yield of okra (*Abelmoschusesculentus*) in a semi-arid Subtropical environment. *Journal of Agriculture Food and Environment*, 3 (1):125-129.

Okullo J.B.L., Hall J.B., and Obua, J. (2004a). Leafing, flowering and fruiting of *Vitellariaparadoxa* subsp. *nilotica* in savanna parklands in Uganda. *Agroforestry Systems*, 60: 77–91.

Okullo, J. B. L., Obua, J and Okello, G. (2004b). Use of indigenous knowledge in predicting fruit production of shea butter tree in agroforestry parklands of north-eastern Uganda.*Uganda Journal of Agricultural Sciences*, 9:360-366.

Otegbeye, G.O., Owonubi, J. J and Oviasauyi, P. K. (2001). Interspecific variation growth of Eucalyptus growing in northern Nigeria. *In*: Popoola, L, Abu J.E and Oni, P.I (Eds). *Proceedings of 27th Annual Conference of the Forestry Association of Nigeria*, pp 12 – 16.

Ouedraogo, I. (2006). Land use dynamics in Bieha district, Sissili Province; southern Burkina Faso, West Africa. Umoja: *Bulletin of the African and African American Studies*, 1: 18–34.

SAS (2003).*Statistical analysis system*. SAS release 9. 1 for windows, SAS Institute Inc. cary, NC, USA

Sinfield, J.V., Fagerman, D and Colic, O. (2010).Evaluation of sensing technologies for on-the-go detection of macro-nutrients in cultivated soil.*Computers and Electronic in Agriculture*, 70:1-18.

Smith, R.A. (2014). *Plant Nutrients*. 1(1): 1-4. http//www/plant nutrient.htm. Accessed on 10/03/2015.

Sohail, L. (2008). *Effect of Organic Fertilizer on Plant Performance in Greenhouse Vegetable Production*. A Thesis Submitted to the Faculty of Graduate Studies through Biological Sciences in Partial Fulfillment of the Requirements for the Degree of Master of Science at the University of Windsor, Windsor, Ontario, Canada. pp 104.

Tang, C., Han, X. Z., Qiao, Y. F and Zheng, S. J. (2009). Phosphorus deficiency does not enhance proton release by roots of soybean [*Glycine max* (L.) Murr.].*Environmental and Experimental Botany*, 67(1):228–234.

Ugese, F. D., Baiyeri, K. P and Mbah, B. N. (2008). Leaf area determination of sheabutter tree (*Vitellariaparadoxa* C.F Gaernt). *International Agrophysics*, 22:167-170.

Umar, T and Gwaram, A. B. (2006). Foliar nutrient contents of four indigenous trees of the
Sudan savanna. In: Popoola, L. (Eds). *Proceedings of 31st Annual Conference of Forestry Association of Nigeria*.pp131-139.

Xu, B.C., Niu, F.R., Duan, D. P, Xu, W. Z and Huang, J. (2012). Root morphological characteristics of *Lespedeza davurica* (L.) intercropped with *Bothriochloaischaemum* (L.) Keng under water stress and P application conditions.*Pakistan Journal of Botany*, 44 (6):1857–1864.

Waraich, E.A, Ahmad, Z, Ahmad, R., Saifullah, M and Ashraf, M.Y. (2015). Foliar applied phosphorous enhanced growth, chlorophyll contents, gas exchange attributes and PUE in wheat (*TriticumaestivumL.*). *Journal of Plant Nutrition*, 38(12):1929–1943.

Williamson, L., Ribrioux, S., Fitter, A and Leyser, O. (2001). Phosphate availability regulates root system architecture in Arabidopsis. *Plant Physiology*, 126 (2):875–882.

Zapata, F and Zaharah, A. R. (2002).Phosphate availability from phosphate rock and sewage sludge as influenced by addition of water soluble phosphate fertilizers.*Nutrient Cycling in Agroecosystems*, 63 (1):43–48.

Zhang, S.; Jiang, H.; Zhao, H.; Korpelainen, H and Li, C. (2014).Sexually different physiological responses of*Populuscathayana*to nitrogen and phosphorus deficiencies. *Tree Physiology*,34: 343–354.