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E-mail: *jrfwe2019@gmail.com*; *jfewr@yahoo.com*
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ASSESSMENT OF CHANGES IN NUTRIENT STATUS OF TROPICAL LOWLAND SOIL AMENDED WITH LEAF BIOMASS OF SOME AGROFORESTRY TREE SPECIES

Adesokan F.B[1], Odetola E.F[2], Jemiwa O.R[3], Isienyi N.C[4], Agbeje A.M.[5] and Olaifa K.A[6],

[13456]Forestry Research Institute of Nigeria, Jericho Hill Ibadan Oyo State, Adekunle Ajasin[2]University AkungbaAkoko, Ondo State, Nigeria

***Corresponding author:** *odetolasenior@gmail.com*, 08051373500

ABSTRACT

This research was aimed at assessing the nutrient status of tropical lowland soil; through the application of leaf biomass of some selected tree species evaluate the effect of the leaf biomass on soil nutrient status and also determine the changes in nutrient status in the past decades. Leaves from Anogeissus leiocarpus, Enterolobium cyclocarpum, Gliricidia sepium, Leuceana lucocephala and Treculia Africana at the rate of 5 tons per hectare (5t ha⁻¹) were assessed. Soil samples were collected at the forest nursery of federation university of agriculture Abeokuta at 2, 4, 6, 8 and10 weeks after application of, organic carbon, total N, P, K, Ca, Mg and Na were analyzed in a split plot experimental design with the main plots being the time of soil sampling and the sub-plots mulch type means were separated. Leuceana lucocephala was observed to have the highest nutrient release capacity given its value for the following nutrients; total nitrogen 0.019, calcium 41.07 and sodium 139.0 Control plot has the highest organic carbon 3.12 content followed by Enterolobium cyclocarpum, 3.05 as well as highest pH value 6.45 The highest phosphorous content was recorded in Treculia africana 466.6 plot followed by Leuceana lucocephala 3.05. Enterolobium cyclocarpum however recorded the highest potassium 90.0 and magnesium 152.5 content. *The rapid decomposition of **Leuceana lucocephala** and its nitrogen fixing ability is an indication that it is a good replacement to fixing soil nutrient in lowland soil**.***

Keyword: assessment change, nutrient, tropical lowland, leaf biomass

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INTRODUCTION

Most soils in the tropics are deficient in soil nitrogen (N), phosphorus (P), or both (Cardoso and Kuyper, 2006). The same can also be said for carbon (C). Many of these soils are acidic, infertile, and cannot support sustainable crop production without external inputs or fertilizers. Even some soils which were once fertile have become depleted of nutrients and can no longer sustain crop production (Steiner *et al.*,2007). Such fertilizers are not readily available to farmers and sometimes where available, are on sale at exorbitant prices, leading to higher pricing where food is concerned.

Available lands for forestry and agriculture have been converted to other uses such as industrialization, mining activities, resulting in land hunger and by extension food shortage owing to the rapid population growth surpassing growth in all other ramifications specifically food production in this case (Awopetu *et al.*,2020). Soil organic residues represent materials accumulated above and belowground falling from living organisms, such as leaves, twigs, reproductive parts, bark, and wood, including decomposing roots and root exudates and dead bodies and exudates from living animals that live in and around the soil (Rahmonov *et al.*,2021). How residues decompose, accumulate, and release its components (i.e., nutrients) in the system conforms to the nutrient cycle, a process which is considered to be similar in tropical natural forests and forest plantations (Fuke*et al.*,2021).

Another way of improving soil fertility is the introduction of biomass transfer (Mafongoya et al., 2006). The use of biomass also helps in the preservation of the ecosystem's balance and reduce the use of foreign chemicals which can burn the plant, can be retained in the consumable parts of the plant, or can be leached down to the water table to contaminate drinking water for both man and animals and this of course is detrimental to human and animal health (Reicosky and Forcella, 1998). However, the research is aimed to increase the nutrient status of a tropical soil by the application of leaf biomass of selected tree species, and evaluate the effect of leaf biomass of selected tree species on soil nutrient status, and to determine the changes in nutrient status overtime. This research encourages leaf biomass transfer method because the trees from which leaf biomass can be harvested can be found around the environment at no cost and it can be practiced in home gardens and the leaf biomass can be gotten from yard trees to support national food security and the individual and household nutritional requirements

MATERIALS AND METHODS

Study Area

The experimental site was the forest Nursery of the Federal University of Agriculture, Abeokuta is located close to Ogun-Osun River Basin Development Authority (OORBDA), along Alabata Abeokuta road, It located within the humid lowland rain forest region with two distinctive seasons. The soil is under laid by the pre-cambium metamorphic rocks of the basement complex with bedrock consisting predominantly of gentle gneisses, bounded biotite hornblende gneisses, quartzite and quartz schists. It has fertile sandy loam, very dark at the top surface and grayish brown in the subsoil with occasional areas of loamy soil. The area has a tropical climate with a binomial distribution of rainfall. It lies within the humid lowland region with two distinct seasons. The wet season extends from April to October, while the dry season extends from November to March. The mean annual rainfall is 1113.1mm. The bimodal distribution of rainfall has its peak in July and September and breaks in August. Generally, the rainfall could be heavy and sometimes accompanied by lightning and thunderstorms at the beginning and end of the season. Surface soil (0-15cm) samples were collected at three auger points in. The three auger points were taken in each micro-plot on which the same treatment have been administered and bulked then homogenized. Composite soil samples of two replicates each was taken to the laboratory for analysis. The soil samples were taken at 2, 4, 6, 8 and 12 weeks after treatment have been applied. Nevertheless, soil pH was measured with an electronic pH meter in a 1:2.5 soil/water suspension. Soil organic carbon was determined by wet oxidation. Total nitrogen in the soil was determined using semi microKjeldahl method. Soil samples were leached with ammonium acetate solution to obtain the extracts used in the determination of exchangeable cations. Calcium and magnesium in the leachate were determined by Ethylene Tetra-acetic Acid (EDTA) titration while potassium was determined by flame photometry following the procedure

Experimental Design: The experimental design used is a split plot experimental design with the main plots being the time of soil sampling and the sub-plots, mulch type

Experimental site is the forest nursery.

Plot of 10m×10m was partitioned into 24 micro-plots of 1.5m×1.5m in dimension. Adjacent micro-plots were separated by a buffer of 0.25m wide. Five (5) treatments were applied to the plots at random and treatments were replicated four (4) times with a control experiment. The leaves of the following tree species in Table 1were used for the study.

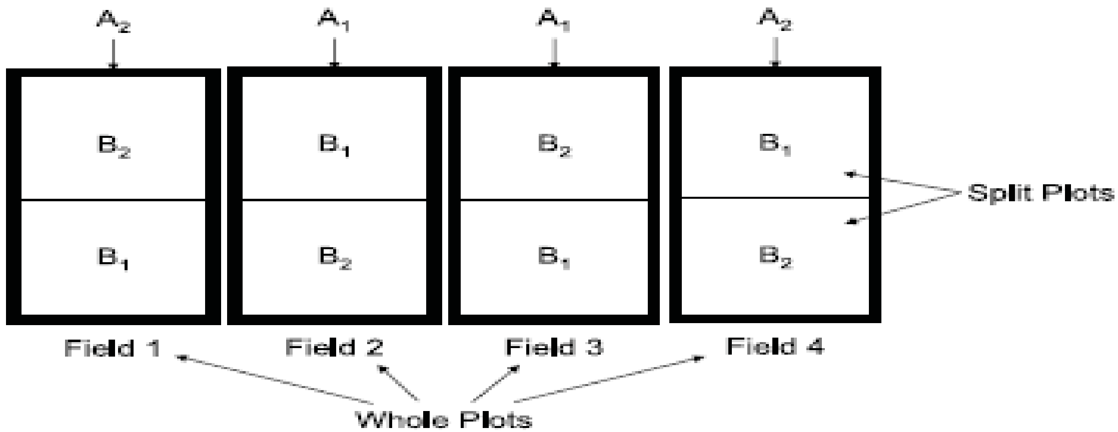

Table 1: Concentration of carbon and nitrogen in the leaves of the selected agroforestry tree species.

Species	C (%)	N (%)	C/N
Leuceana leucocphala	10	16	0.63
Treculia africana	-	-	-
Enterolobium cyclocarpum	-	-	-
Anogeissu sleocarpus	47.80	1.85	25.84
Gliricidia sepium	10	20	0.5

There was careful selection of mature but not senescent leaves of the woody species collected as mulch for this study. The treatment was applied at the rate of 5 tons per hectare (5t ha^{-1}) of which its equivalent of 0.5kg of the desired species was applied to each 1.5m×1.5m micro-plot assigned to the species which was picked at random however the soil samples were throughout the period of wet season.

Soil Sampling

Surface soil (0-15cm) samples were collected from FUNAAB forest Nursery at three auger points in. The three auger points were taken in each micro-plot on which the same treatment have been administered and bulked then homogenized. Composite soil samples of two replicates each was taken to the laboratory for analysis. Soil samples were taken at 2, 4, 6, 8 and 12 weeks after treatment have been applied. Soil pH was measured with an electronic pH meter ina 1:2.5 soil/water suspension. Soil organic carbon was determined by wet oxidation

Experimental design

The experimental design used is a split plot experimental design with the main plots being the time of soil sampling and the sub-plots, mulch type.

Statistical analysis

Data collected were analysed using the general Linear Model of SAS software (SAS Institute, Inc.1989). Two-way ANOVA and Duncan's multiple range test was used to separate the means (p=0.05). Correlation analysis was also carried out to examine if a relationship existed between species as mulch and soil nutrient status.

RESULT

Nutrient content pattern with species

Results from the nutrient content analysis are presented in table 2. There was a noticeable change in nutrient status as well as pH following

the application of the leaf biomass of the chosen agroforestry tree species.
pH value varies with species. Control (6.45) was significantly different from others. However, there was no significant difference between species *Anogeissus leocarpus* (6.37) and *Enterolobium cyclocarpum* (6.34) as similar trend was observed between *Gliricidia sepium* (6.23) and *Treculia africana* (6.26). *Gliricidia sepium* (6.23) has the least pH value.

Organic carbon content varies also with species; control (3.12) is more significant and has the highest value. There however is a significant difference among *Leuceana lucocephala* (3.05), *Anogeissus leocarpus* (3.04), *Treculia africana* (2.96), *Enterolobium cyclocarpum* (2.93) and *Gliricidia sepium* (2.70).

Total nitrogen content also varies with species. *Leuceana lucocephala* (0.019) is highly significant from the others. However, there is no significant difference among *Anogeissus leocarpus* (0.015), *Enterolobium cyclocarpum* (0.015) and *Gliricidia sepium* (0.016). Control (0.013) has the least Nitrogen content value.

Phosphorous content was not significantly difference between all the species as well as the control. However Phosphorous content was highest in *Treculia africana*(466.6) and the least was recorded in *Enterolobium cyclocarpum* (47.4).

Potassium content varies with species. *Enterolobium cyclocarpum* (94.0) was significantly different from the others. Species *Gliricidia sepium* (63.0), *Leuceana lucocephala* (58.0) and *Treculia africana* (58.0) were not significantly different. *Anogeissus leocarpus* (53.0) was significantly different from Control (40.0).

Calcium content also varies with species. *Leuceana lucocephala* (41.07) was significantly different from the others. However, there was no significant difference among *Anogeissus leocarpus* (30.30), *Treculia africana* (34.30) and*Gliricidia sepium* (28.60). Similar trend was observed between *Enterolobium cyclocarpum* (25.20) and control (23.80).

Magnesium content also varies with species with *Enterolobium cyclocarpum* (152.50) more significant than the others, there however is no significant difference among *Anogeissus leocarpus* (88.70), *Leuceana lucocephala* (95.50), *Gliricidia sepium* (111.30), *Treculia africana* (105.20) and control (101.40). Sodium content in the soil also varies with species. There is no significant difference between *Leuceana lucocephala* (139.0) and control (132.0). *Anogeissus leocarpus* (80.0) and *Gliricidia sepium* (82.0) is not significantly different. There is a similar trend between *Treculia africana* (73.0) and *Enterolobium cyclocarpum* (62.0).

Table 2: Nutrient contents of soil varying with species

SPECIES	ANLE	ENCY	GLSE	LELA	TRAF	CONTROL
Ph	6.37±0.035^{b}	6.34±0.029^{b}	6.23±0.042^{c}	6.25±0.046^{c}	6.26±0.04^{c}	6.45±0.029^{a}
Organic C	3.04±0.047^{c}	2.93±0.027^{e}	2.70±0.067^{f}	3.05±0.123^{b}	2.96±0.023^{d}	3.12±0.067^{a}
Total N	0.015±0.000^{b}	0.015±0.002^{b}	0.016±0.002^{b}	0.019±0.002^{a}	0.015±0.0004^{b}	0.013±0.001^{c}
P (mg kg^{-1})	116.5±22.01^{a}	47.4±1.58^{a}	89.5±11.37^{a}	88.4±16.63^{a}	466.6±383.40^{a}	168.5±28.57^{a}
K (ppm)	53.0±4.75^{c}	94.0±4.79^{a}	63.0±3.44^{b}	58.0±4.57^{bc}	56.0±2.40b^{c}	40.0±2.63^{d}
Ca (ppm)	30.30±4.53^{bc}	25.20±2.81^{c}	28.60±3.14^{bc}	41.07±3.75^{a}	34.30±2.70^{b}	23.80±2.51^{c}
Mg (ppm)	88.70±17.495^{b}	152.50±24.575^{a}	111.30±13.405^{ab}	95.50±17.373^{b}	105.20±20.19^{ab}	101.40±19.578^{ab}
Na (ppm)	80.0±2.845^{abc}	62.0±4.409^{c}	82.0±3.000^{abc}	139.0±36.927^{a}	73.0±3.039^{bc}	132.0±45.695^{ab}

Legend: ANLE- *Anogeissus leocarpus; LELA- Leuceanaleucecophala; ENCY- Enterolobium cyclocarpum; TRAF-Treculia africana GLSE- Gliricidia sepium*

Soil nutrient contents with varying days of collection

Soil nutrient contents with varying days of collection are presented in table 3. pH value varies with days. Day84 (6.43) was significantly different from other days. There is no significant difference between day 28 (6.32) and day 56 (6.37). Similarly, no significant difference is observed between day 14 (6.24) and day 42 (6.22). Organic carbon content varies with days of collection; there were significant difference among the various days of collection. Organic carbon content was higher in day 28 (3.13) and followed by day 84 (3.11) and the least was day 42 (2.78).

Total nitrogen content varies with days. There was no significant difference between day 28 (0.016) and day 42 (0.016), also similarly for day14 (0.015), day56 (0.014) and day84 (0. 015) follow a similar trend with no significant difference among them. Phosphorous content was not significantly different among the various days of collection. Day 42 (437.7) has the highest value followed by day 14 (114.3) and the least was day 28 (82.0). Potassium content varies with days. There was no significant difference between day 14 (71.67) and day 42 (67.50). Day 28 (60.83), day 56 (57.50) and day 84 (45.83) were also not significantly different.

For calcium, day 42 (37.75) is significantly different from others while there is no significant difference among day 14 (26.92), day 28 (26.33), day 56 (37.75) and day 84 (36.06±). Magnesium content was not significantly different among the various days of collection. Day 42 (127.92) has the highest value followed by day 56 (120.17) and the least was day 84 (84.75). Sodium content varies with days. Day 42 (130.83) is the most significantly different. There is no significant difference among day 14 (119.17), day 28 (75.83), day 84 (70.00).

Table 3: Nutrient contents of soil varying with day (14, 28, 42, 56, 84)

DAY	**14**	**28**	**42**	**56**	**84**
pH	6.24 ± 0.035^{c}	6.32 ± 0.038^{b}	6.22 ± 0.034^{c}	6.37 ± 0.023^{ab}	6.43 ± 0.037^{a}
Organic C	2.95 ± 0.029^{c}	3.13 ± 0.024^{a}	2.78 ± 0.064^{e}	2.85 ± 0.05^{d}	3.11 ± 0.090^{b}
Total N	0.015 ± 0.001^{ab}	0.016 ± 0.002^{a}	0.016 ± 0.001^{a}	0.014 ± 0.001^{b}	0.015 ± 0.001^{ab}
P (mg kg^{-1})	114.3 ± 19.88^{a}	82.0 ± 11.86^{a}	437.7 ± 318.5^{a}	93.4 ± 93.43^{a}	86.6 ± 86.63^{a}
K (ppm)	71.67 ± 5.54^{a}	60.83 ± 5.31^{b}	67.50 ± 4.88^{a}	57.50 ± 4.03^{b}	45.83 ± 4.47^{b}
Ca (ppm)	26.92 ± 3.22^{b}	26.33 ± 3.72^{b}	37.75 ± 1.84^{a}	29.67 ± 3.65^{b}	36.06 ± 3.04^{ab}
Mg (ppm)	119.08 ± 16.93^{a}	93.85 ± 16.14^{a}	127.92 ± 21.48^{a}	120.17 ± 17.24^{a}	84.75 ± 15.33^{a}
Na (ppm)	119.17 ± 31.83^{ab}	75.83 ± 2.78^{ab}	130.83 ± 37.70^{a}	77.50 ± 3.36^{ab}	70.00 ± 3.66^{b}

Nutrient contents of soil varying with days and species

pH varies with day and species. Day 84 Control (6.62) is the most significantly different. There is no significant difference among day 14 *Treculia africana* (6.27), 28 *Enterolobium cyclocarpum* (6.31), 28 *Treculia africana* (6.26), 42 *Anogeissus leocarpus* (6.28) and 42 *Enterolobium cyclocarpum* (6.27), and 56 *Treculia africana* (6.35).

Organic carbon varies with day and species. Day 84 *Leuceana lucocephala* (3.91) is more significantly different from the others. Day 14 *Anogeissus leocarpus* (3.11) and day28 *Leuceana lucocephala* (3.11) are not significantly different. Between day 14 *Treculia africana* (3.07) and day 56 *Anogeissus leocarpus* (3.07), no significant difference was observed as well as between 28 *Treculia africana* (3.13), 56 control (3.13) and 84 control (3.13).

Total nitrogen content varies with day and species. However, there is no significant difference between 28 *Leuceana lucocephala* (0.028) and 42 *Enterolobium cyclocarpum* (0.028). No significant difference was observed between 14 *Gliricidia sepium* (0.023 ± 0.000^{b}) and 28*Gliricidia sepium* (0.025). Day 28 *Treculia africana* (0.014), day 56 *Treculia africana* (0.014), day 56 CONTROL (0.016) and day 84 control (0.014) were not significantly different.

For phosphorous, 42 *Treculia africana* (1983.2) is significantly different from others. No significant difference is observed among all other day/species value. Potassium content varies with day and species. There is no significant difference among day 14 *Enterolobium cyclocarpum* (115.00), 28*Enterolobium cyclocarpum* (100.00) 42 *Enterolobium cyclocarpum* (100.00) and 56 *Enterolobium cyclocarpum* (85.00).

Calcium content varies with day and species. There is no significant difference among 14 *Enterolobium cyclocarpum* (35.5), 28 *Leuceana lucocephala* (54.0), 42 *Anogeissus leocarpus* (42.0), 42 *Gliricidia sepium* (40.5), 42 *Leuceana lucocephala* (42.0), 42 *Treculia africana* (42.0), 56 *Gliricidia sepium* (44.5), 56 *Leuceana lucocephala* (46.0), 84 *Enterolobium cyclocarpum* (50.5) and 84 *Leuceana lucocephala* (38.3).

No significant difference was observed among the value of other day/species. Magnesium content varies with day and species. 28 *Enterolobium cyclocarpum* (219.50) is significantly different from others. There also is no significant difference among day 14 *Anogeissus leocarpus* (92.5), 28 *Gliricidia sepium* (94.0) and 84 *Treculia africana* (121.0). Sodium content varies with day and species. There is no significant difference between 14 *Leuceana lucocephala* (355.0) and 42 control (380.0). However no significant difference was observed among the value

Table 4: Nutrient contents of soil varying with days and species

DAY/SPECIES	PH	Organic C	Total N	P (mg kg^{-1})	K (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)
14ANLE	6.34±0.064^{bcdef}	3.11±0.000^{f}	0.018±0.000^{de}	277.3±0.07^{b}	55.00±8.66^{efg}	14.0±2.89^{i}	92.5±11.258^{abcde}	80.0±0.000^{b}
14ENCY	6.24±0.012^{defgh}	2.91±0.000^{m}	0.011±0.000^{gh}	49.9±2.83^{b}	115.00±2.89^{a}	35.5±7.22^{abcdefg}	92.5±44.167^{abcde}	65.0±2.887^{b}
14GLSE	6.17±0.052^{efgh}	2.77±0.000^{r}	0.023±0.001^{bc}	116.0±36.96^{b}	70.00±5.77^{cde}	18.5±1.44^{i}	118.0±43.301^{abcde}	85.0±2.887^{b}
14LELA	6.05±0.139^{h}	2.87±0.000^{o}	0.014±0.000^{efg}	48.0±2.03^{b}	70.00±11.55^{cde}	27.0±4.04^{cdefghi}	148.5±59.756^{abcd}	355.0±152.998^{a}
14TRAF	6.27±0.000^{cdefg}	3.070.000^{g}	0.014±0.000^{efg}	123.2±15.16^{b}	70.00±0.00^{cde}	46.0±0.58^{ab}	114.0±21.362^{abcde}	80.0±5.774^{b}
14CONTROL	6.38±0.043^{bcd}	2.99±0.035^{k}	0.012±0.001^{fg}	71.5±0.59^{b}	50.00±0.00^{fgh}	16.5±3.75^{i}	149±71.014^{abcd}	70.0±11.547^{b}
28ANLE	6.52±0.015^{ab}	3.31±0.000^{b}	0.014±0.000e^{fg}	62.0±5.94^{b}	55.00±2.89^{efg}	24.0±8.66^{efghi}	44.0±14.434^{cde}	85.0±2.887^{b}
28ENCY	6.31±0.012^{cdefg}	3.01±0.000^{j}	0.007±0.000^{h}	43.1±0.03^{b}	100.00±5.77^{ab}	22.5±4.33^{fghi}	219.50±32.620^{a}	75.0±2.887^{b}
28GLSE	6.06±0.066^{h}	3.05±0.000^{h}	0.025±0.000^{b}	59.0±7.30^{b}	45.00±2.89^{fghi}	17.5±2.60^{i}	94.0±2.309^{abcde}	70.0±0.000^{b}
28LELA	6.40±0.012^{bcd}	3.11±0.000^{f}	0.028±0.000^{a}	73.1±0.63^{b}	75.00±2.89^{cd}	54.0±i.73^{a}	72.5±34.930^{bcde}	90.0±0.000^{b}
28TRAF	6.26±0.046^{cdefg}	3.13±0.000^{e}	0.014±0.000^{efg}	88.1±26.13^{b}	55.00±2.89^{efg}	26.0±9.24^{defghi}	29.5±22.805^{bcde}	65.0±2.887^{b}
28CONTROL	6.39±0.069^{bcd}	3.19±0.000^{c}	0.011±0.000^{gh}	167.0±38.84^{b}	35.00±2.89^{hi}	14.0±2.89^{i}	72.0±8.660^{bcde}	70.0±11.547^{b}
42ANLE	6.28±0.038^{cdefg}	2.83±0.000^{p}	0.014±0.000^{efg}	69.1±13.05^{b}	80.00±5.77^{c}	42.0±5.77^{abcd}	153±6.928^{abcd}	95.0±2.887^{b}
42ENCY	6.27±0.012^{cdefg}	2.95±0.000^{l}	0.028±0.000^{a}	56.3±0.25b	100.00±5.77^{ab}	24.5±3.18^{defghi}	186.5±101.902^{ab}	45.0±8.660^{b}
42GLSE	6.13±0.035^{gh}	2.33±0.000^{v}	0.011±0.000^{gh}	97.7±17.94^{b}	70.00±0.00^{cde}	40.5±0.29^{abcde}	175.5±31.466^{abc}	95.0±2.887^{b}
42LELA	6.16±0.056^{fgh}	2.61±0.000^{t}	0.016±0.003^{ef}	58.1±5.55^{b}	50.00±5.77^{fgh}	42.0±3.46^{abcdef}	78.5±19.341^{bcde}	85.0±8.660^{b}
42TRAF	6.05±0.017^{h}	2.81±0.000^{q}	0.018±0.000^{de}	1983.2±1924.90^{a}	60.00±0.00^{def}	42.0±1.73^{abcd}	39.5±6.640^{de}	85.0±8.660^{b}
42CONTROL	6.46±0.035^{abc}	3.17±0.000^{d}	0.012±0.001^{fg}	361.6±3.3^{b}	45.00±8.66^{fghi}	37.5±1.44^{abcdefgh}	1134.5±58.024^{abcde}	380.0±184.752^{a}
56ANLE	6.35±0.026^{bcdef}	3.07±0.000^{g}	0.016±0.001^{ef}	87.8±3.77^{b}	45.00±2.89^{fghi}	21.0±10.39^{hi}	143.0±52.539^{abcde}	75.0±2.887^{b}
56ENCY	6.45±0.066^{abc}	2.75±0.000^{s}	0.014±0.000^{efg}	47.3±1.99^{b}	85.00±2.89^{bc}	16.0±4.62^{i}	80.5±6.640^{bcde}	60.0±0.000^{b}
56GLSE	6.40±0.012^{bcd}	2.53±0.000^{u}	0.011±0.000^{gh}	131.1±4.0^{b}	70.00±0.00^{cde}	44.5±2.02^{abc}	99.0±12.702^{abcde}	90.0±0.000^{b}
56LELA	6.23±0.012^{defgh}	2.75±0.000^{s}	0.014±0.000^{efg}	68.5±6.64^{b}	60.00±5.77^{def}	46.0±11.37^{ab}	112.5±45.889^{abcde}	90.0±11.547^{b}
56TRAF	6.35±0.081^{bcdef}	2.89±0.000^{n}	0.014±0.000^{efg}	68.7±6.95^{b}	45.00±2.89^{fghi}	28.0±1.15^{cdefghi}	192.0±63.509^{ab}	65.0±2.887^{b}
56CONTROL	6.43±0.032^{bcd}	3.13±0.000^{e}	0.016±0.005^{ef}	157.2±5.83^{b}	40.00±0.00^{ghi}	22.5±3.75^{fghi}	94.0±42.724^{abcde}	85.0±2.887^{b}
84ANLE	6.35±0.141^{bcdef}	2.87±0.000^{o}	0.014±0.000^{efg}	86.0±17.74^{b}	30.00±0.00^{i}	50.5±4.91^{a}	11.0±1.732^{e}	65.0±2.887^{b}
84ENCY	6.45±0.066^{abc}	3.03±0.000^{i}	0.013±0.001^{fg}	40.5±0.49^{b}	70.00±11.55^{cde}	23.5±4.91^{efghi}	183.5±0.289^{ab}	65.0±8.660^{b}
84GLSE	6.39±0.058^{bcd}	2.83±0.000^{p}	0.011±0.000^{gh}	43.7±1.85^{b}	60.00±11.55^{def}	22.0±1.15^{ghi}	70.0±9.815^{bcde}	70.0±5.774^{b}
84LELA	6.24±0.046^{bcd}	3.91±0.000^{a}	0.021±0.000^{cd}	194.2±49.18^{b}	35.00±2.89^{hi}	38.3±11.46^{abcdefgh}	65.5±29.734^{bcde}	95.0±8.660^{b}
84TRAF	6.37±0.118^{bcde}	2.89±0.000^{n}	0.018±0.000^{de}	69.9±1.85^{b}	50.00±0.00^{fgh}	29.5±1.44^{bcdefghi}	121.0±45.611^{abcde}	70.0±5.774^{b}
84CONTROL	6.62±0.040^{a}	3.13±0.000^{e}	0.014±0.000^{efg}	85.4±10.93^{b}	30.00±5.77^{i}	28.5±1.44^{bcdefghi}	57.5±1.443^{bcde}	55.0±2.887^{b}

Correlation matrix of soil nutrients

Correlation coefficients between paired nutrients variables are presented in Table 5. There was generally high and significant correlation. Highest correlation was recorded among the nutrients, while the lowest correlation was between organic carbon and phosphorous. There was also significant correlation between pH and all other nutrients (R ranged from 0.06 to 0.37). There is positive correlation between pH and organic carbon. However, pH was negatively correlated with other nutrients.

Table 5: Correlation matrix of nutrients

Parameter	pH	Organic C (%)	Total N (%)	P (mg kg⁻¹)	K (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)
Ph	1.00							
Organic C (%)	0.37	1.00						
Total N (%)	-0.12	0.23	1.00					
P (mg kg⁻¹)	-0.15	-0.02	0.04	1.00				
K (ppm)	-0.18	-0.33	-0.03	-0.04	1.00			
Ca (ppm)	-0.08	-0.16	0.02	0.09	0.07	1.00		
Mg (ppm)	-0.05	-0.15	-0.04	-0.10	0.30	-0.19	1.00	
Na (ppm)	0.05	0.04	-0.12	0.03	0.07	0.10	0.06	1.00

DISCUSSION

This research has investigated the change in nutrient status following the application of leaf biomass of *Anogeissus leocarpus, Enterolobium cyclocarpum, Gliricidia sepium, Leuceana lucocephala* and *Treculia africana.* Control (6.45) and *Anogeissus leocarpus* (6.37) mulch plot recorded higher pH value than the other mulch plots. This could be due to effect of the chopped herbaceous mulch and shrub which tend to improve on soil exchangeable bases while reducing exchangeable acidity thereby reducing soil acidity, likewise the availability of seed bank component of the soil similar results was also observed by (Egbe *et al.* 2012; Awopegba, 2017).

Also, Control (3.12) and *Leuceana lucocephala* (3.05) recorded higher organic content value. This might be attributed to the organic carbon accumulation in the herbaceous mulch treatment as a result of balance from subtraction by decomposition process and additions from synthesized humus from shrubs and herbaceous *Leuceana lucocephala* plot recorded highest nitrogen content due the fact that it is known as a legume which is established as nitrogen fixer. *Treculia africana* has the highest phosphorous content followed by *Leuceana lucocephala*. *Enterolobium cyclocarpum* has the highest potassium content. This could be due to its ability as a legume. Leaf/ plant mulch conserve soil moisture, increase soil organic matter and improves soil properties and microbial activity thereby supporting mineralization rate and release of nutrient such as N, P and K into the soil, organic carbon was determined by wet oxidation. Total nitrogen in the soil was determined using semi microKjeldahl method. Soil samples were leached with ammonium acetate solution to obtain the extracts used in the determination of exchangeable cations. Calcium and magnesium in the leachate was determined by Ethylene Tetra-acetic Acid (EDTA) titration while potassium was determined by flame photometry following the procedure (Panneerselvam *et al.*, 2020).

Leuceana lucocephala mulch plot was observed to have the highest calcium content when compared to others. While *Enterolobium cyclocarpum* plot recorded the highest magnesium level in reference to *Gliricidia sepium*, *Treculia africana*, Control, *Leuceana lucocephala* and *Anogeissus leocarpus* respectively during the study period. pH increases steadily from day 14 (6.24) through day 84 (6.43). However, there was a fall in pH value at day 42 (6.22). According to Hailin Zhang (2013) and (Oladoye *et al*, .2012). factors causing rise in soil pH value include acidic parent material, Organic matter decay, harvest of high yielding crops, nitrification of ammonium, rainfall and leaching.

Organic carbon was at its highest content in the soil at day 28 after which it presented irregular fluctuating values which can be attributed to rainfall pattern causing it to be leached as they are released by the leguminous mulch species *Leuceana lucocephala* and *Enterolobium cyclocarpum* were observed to decompose rapidly.Total nitrogen was observed to be highest in day 28 (0.016) and 42 (0.016) while it is lowest on day 56 (0.014) and then picks up on day 84 (0.015). Nitrogen and make it available as a biological source of nitrogen in a mulched plot. Phosphorous content was highest on day 42 (437.7), followed by day 14 (114.3), and least on day 28 (82.0). This fluctuation may be due to rainfall pattern in relation to P release

CONCLUSION

The study inferred that leaf biomass of agroforestry species increases the nutrient status of a tropical lowland soil. The pattern of leaf biomass in days and species observed and assessed in this research implies that leaf biomass use has the potential to improve the soil nutrient status.-Application of leaf biomass of these agro forestry species in this study showed that *Leuceana lucocephala, Anogeissus leocarpus, Enterolobium cyclocarpum, and Treculia africana* applied as mulch in a recommended dosage/proportion or composition can serve as an alternative to N.P.K. The rapid decomposition capacity of *Leuceana lucocephala* and its nitrogen fixing ability is an indication that it can be a better replacement to fixing soil nutrient in lowland soil and can then be recommended to small scale farmers and foresters for improving soil properties and optimum on tropical land

Recommendation

Reculia africana, Enterolobium cyclocarpum should be administered in the case of potassium and magnesium deficiency.

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