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Effect of mineralized nitrogen through decomposition of plant residues on the uptake of maize (*Zea mays* L.) in sudan savannah ecological zone of Nigeria

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INFO

Keywords
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ABSTRACT

A field experiment was designed to determine the effect of mineralized nitrogen (N) through the decomposition of leafy biomass of agroforestry tree species as residues to underscore its uptake by maize under Sudan savannah conditions. The experiment was laid out as 3 x 4 x 2 factorial in a split-split plot design with three replicates for two cropping seasons. The factors considered include: control, biomass species (*Albizia lebbeck* and *Parkia biglobosa*) as main plots, four levels of nitrogen fertilizer (0, 40, 80, 120 kg N ha^{-1}) as sub-plots, and two maize varieties (DMR-ESR-7 and 2009 EVAT) as sub-sub plots. Data were analysed using Analysis of Variance (ANOVA). Chemical composition of *A. lebbeck* biomass had higher average contents of N (32.4 g kg^{-1}) and C (186.4 g kg^{-1}) and lower average C: N ratio (57.5) than *P. biglobosa* and this affected their decomposition rates, hence, *A. lebbeck* decomposed faster than *P. biglobosa*. 56 % of N in the litter bags were released within the first 2 weeks of biomass incorporation and progressively increased up to 10 weeks after planting (WAP). Total N uptake by maize was lowest (2.8 kg N ha^{-1}) in *P. biglobosa* and was highest (8.6 kg N ha^{-1}) in *A. lebbeck* amended plots. It is then concluded that total N uptake by maize crop increased rapidly between 4-6 WAP, and the impact was obvious in plots amended with *A. lebbeck* biomass than in *P. biglobosa* plots during the two cropping seasons.

RESUMO

Palavras-chaves
resíduos vegetais
decomposição
mineralização
absorção

*Efeito do nitrogênio mineralizado através da decomposição de resíduos vegetais na absorção de milho (*Zea mays *L.) na zona ecológica da savana sudanesa da Nigéria.* Um experimento de campo foi projetado para determinar o efeito do nitrogênio mineralizado (N) através da decomposição da biomassa foliar de espécies de árvores agroflorestais como resíduos para destacar sua absorção pelo milho em condições de savana do Sudão. O experimento foi estabelecido como fatorial 3 x 4 x 2 em um delineamento de parcelas subdivididas com três repetições para duas safras. Os fatores considera-dos incluem: controle, espécies de biomassa (*Albizia lebbeck e Parkia biglobosa*) como parcelas principais, quatro níveis de fertilizante nitrogenado (0, 40, 80, 120 kg N ha^{-1}) como subparcelas e duas variedades de milho (DMR -ESR-7 e EVAT 2009) como sub-subparcelas. Os dados foram analisados por meio de Análise de Variância (ANOVA). A composição química da biomassa de *A. lebbeck* apresentou maiores teores médios de N (32,4 g kg^{-1}) e C (186,4 g kg^{-1}) e menor relação C:N média (57,5) do que *P. biglobosa* e isso afetou suas taxas de decomposição, portanto, *A. lebbeck* se decompôs mais rápido que *P. biglobosa*. 56% do N nos sacos de lixo foram liberados nas primeiras 2 semanas de incorporação da biomassa e aumentaram progressivamente até 10 semanas após o plantio (WAP). A absorção total de N pelo milho foi menor (2,8 kg N ha-1) em *P. biglobosa* e maior (8,6 kg N ha^{-1}) em parcelas corrigidas de *A. lebbeck*. Conclui-se então que a absorção total de N pela cultura do milho aumentou rapidamente entre 4-6 WAP, e o impacto foi óbvio em parcelas alteradas com biomassa de *A. lebbeck* do que em parcelas de *P. biglobosa* durante as duas safras.

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INTRODUCTION

Maize (*Zea mays* L.) has been relatively a major staple food and is useful in human diet and animal feeds across Africa. It has been the most widely adapted and accepted cereal in the world with production of 872.8 million metric tonnes in 2012, followed by rice and wheat (FAO, 2014). Nigeria happens to be second in Africa after South Africa to produce maize of about 9.4 metric tonnes which represent 1.1 % of the world's total maize production in 2012. Considering world total cereal in 2012, it was discovered that, maize was the first most vital cereal in Nigeria followed by sorghum and millet (FAO, 2014).

Maize is a multi-purpose crop that can be utilized as food, livestock feed and fuel, and for manufacturing starch, flakes, alcohol, salad oil, soap, varnish paint, and painting and similar products (Biswas et al., 2009). The demand for maize is rapidly increasing day by day worldwide. It is expected to be increased further with the establishment of maize-based food industries, poultry, dairy and fish farms. But, its production is still low due to declining in soil fertility, especially nitrogen (N) couple with some other environmental factors (Oyebamiji et al., 2020).

Soil infertility has been the major challenge for small holder farmers in terms of maize production in any semi-arid zones (Osuji et al., 2010), and this has invariably increased poverty and food insecurity too. Meanwhile, legume tree based agroforestry trees has the capacity to improve soil quality (Osuji et al., 2010; Oyebamiji et al., 2017c), improve nutrient cycling, support microbial N_2 fixation, increase soil N availability, improve soil fertility, crop yields, and also support long-term nutrient balance in semi-arid lands (Jama and Zeila, 2005; Rosenstock et al., 2014).

Fertilizer agroforestry trees improve soil for better productivity of maize yield and it components due to N_2 fixation and recovery of leached nutrients (Akinnifesi et al., 2008). Plant residues equally have other beneficial effects on crop yield as they can improve availability and uptake of nutrients such as phosphorus. Application of plant biomass or residues from fertiliser trees as green manure also contribute to P availability, either directly by releasing tissue P during decomposition and mineralisation or indirectly by acting on chemical processes that regulate P adsorption-desorption reactions (Mweta et al., 2007).

Chemical fertilizers have been reported to increase cereal rooting depth and root proliferation. However, few small holder farmers cannot afford chemical or mineral fertilizers, and those who can afford hardly use the recommended rates (Mugwe et al., 2009). Moreover, the little fertilizer available when added to the soil is often utilised with poor efficiency (Vanlauwe et al., 2010) due to environmental or soil-related factors (e.g. P fixation by sesquioxides, leaching and volatilization of N etc.) as well as management factors (e.g., poor timing or placement of fertilizer). In the opposite, the use of locally available manure is also limited by its low quality and quantity (Bationo and Waswa, 2011).

The uptake of nutrients and their distribution to various parts of maize plants have been noted to be influenced by factors like fertility of the native soil, application of chemical fertilizers, the growth stage of the plant and the environmental conditions Hussaini *et al.* (2008). Decomposition of plant material is key process in the control of nutrient cycling and formation of soil organic matter (Oyebamiji et al., 2018). Nutrient release during decomposition of litters or residues increases plant available nutrients (Koorem et al., 2011). Plant litter input also constitutes the main resource of energy and matter for the community of soil organisms (Hattenschwiler et al., 2005) that improve nutrient cycling process.

MATERIALS AND METHODS

Study area

The study area is Makera, a village in Dutsinma Local Government Area of Katsina State, having an area of 527 km², altitude of 605 m and a population of 169, 671 and is found within Latitude 12^{0}27'18" N and Longitude 07^{0}29'29" E. It is also found in the basement complex derived soils of Katsina State (Oyebamiji et al., 2018). The area receive an annual rainfall of 700 mm, which is spread from May to September. The mean annual temperatures range from 29-31^0 C. the high temperature normally occurs in April/May and the lowest in December through February (Tukur et al., 2013).

Experimental design

The experiment was laid in split-split plot design in 3 x 4 x 2 factorials with three replicates. The plot dimension was 4 m x 3 m. Leafy biomass of *Albizia lebbeck* and *Parkia biglobosa* were pruned and incorporated fresh into the soil at the rate of 6 kg for each of each species biomass plots (B_1 and B_2 for *A. lebbeck* and *P. biglobosa* respectively). There are plots without incorporation of leafy biomass (B_0), referred to as control. The leafy biomass was incorporated into the soil for two planting seasons (2014 and 2015).

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Four levels of N fertilizers were split applied as: N_0, 0 kg N ha^{-1} (control); N_1, 40 kg N ha^{-1}; N_2, 80 kg N ha^{-1}; N_3, 120 kg N ha^{-1} and half were applied at 2 weeks after planting (WAP). The remaining quantity was applied 5 WAP. The two varieties of maize used (DMR- ESR- 7 (Yellow Maize) and 2009 EVAT (White Maize) were obtained from Katsina State Agricultural and Rural Development Authority (KTARDA). The two maize varieties were planted; two maize seeds were planted per hole, at equal depth and it was later thinned to one 2 WAP by conventional spacing of 75 cm x 25 cm two weeks after the incorporation of leafy biomass of *A. lebbeck* and *P. biglobosa* into the soil, to make the total plant population of 64 stands per plot.

Plant tissue analysis of the agroforestry tree species

Samples of pruned leaves of *A. lebbeck* and *P. biglobosa* were air dried at a room temperature and ground to be analysed for their initial contents of N, C, lignin and polyphenols. Total N was analysed by Macro-Kjeldahl digestion, followed by distillation and titration (Brandstreet, 1965; Anderson and Ingram, 1993). Lignin was determined by the Acid Detergent Fibre (ADF) method as outlined in (Anderson and Ingram, 1993). The polyphenol was extracted in hot (80^0 C) 50 % aqueous methanol and determined calorimetrically with tannic acid as a standard measurement (Hagerman, 1988; Anderson and Ingram, 1993).

Leaf biomass decomposition

Fifty grammes of the tree-leafy biomass from all the treatments that received biomass application was placed in 1-mm mesh size litter bags and buried into the soil at a depth of about 15 cm at the time of maize planting (beginning of the season). One bag per replicate containing residues from each species was randomly removed from the soil in each plot at 2, 4, 6, 8 and 10 weeks after planting (WAP). The contents in the bags were cleaned with water, oven dried at 65^0 C to constant weight, and dry weights were recorded.

Estimation of leaf biomass decomposition and N mineralization rate were carried out as follows:

$$Y = e{-}kt,$$

where

Y is the percent remaining of initial weight of material at time

t in weeks

k is the rate of decomposition/N release per week (rate constant).

The k values were estimated using ANOVA in SAS (2003). Nitrogen released (RLS) over time were calculated following the formula by Giashuddin et al. (1993):

% N RLS = 100 – % of original N content remaining (No) where,

$$No = \frac{(\%\ N\ a\ time\ t) \times \%\ of\ original\ weight\ remaining}{(\%\ N\ at\ time\ 0)}$$

Maize crop N uptake

Destructive random maize sampling was done at 4, 6, 8, and 10 weeks after planting (WAP) maize to determine N concentration in the plant tissue. Sampling was done outside of the net plots. The total dry matter weight per plant of the harvested plants was used to determine N uptake by maize crop growth.

The cob was not included in the plant materials that were used for the analysis. The samples were cleaned with water (where necessary) and oven dried at 65^0 C to constant weight after which they were ground to first pass through a 2-mm and finally through a 0.5 mm sieve. The resulting powder was then kept in plastic air tight bottle sand stored in a cool dry place awaiting chemical analysis. Nitrogen concentration in the samples was analyzed following the methods outlined by Parkinson and Allan (1975). Nitrogen uptake was there after calculated by this equation:

$Y = A \times B$

Where Y = percentage nitrogen uptake by maize

A = dry matter yield of maize

B = N concentration

Data collection method

Five maize plants were randomly selected within each of the net plots of 4 m x 1.5 m (6 m^2) with a tag for periodic observations at 4, 6, 8 and 10 WAP during the crop growth cycle for both pre and post- harvest data collection.

Soil sample collections

Soil sample collections from the depth of 0-30 cm which were randomly taken in each plot in 2014, were analyzed as described below. Soil pH was determined in 0.01M $CaCl_2$ by using a soil

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solution ratio of 1: 2.5 by means of a Philip analogue pH meter. The soil was determined using the pH meter (Black, 1965). The organic carbon content of soil was determined by the wet oxidation method of Walkley-Black as described by Allison (1965). The total nitrogen content of the soil was determined by Micro Kjeldahl procedure Bremner (1965). C: N was computed as ratio of N to C. Available phosphorus (P) was extracted by the Bray 1 method. The P concentration in the extract was determined colorimetrically by using the Spectronic 20 and absorption was read-off as described by Bray and Kurtz (1945) and modified by Murphy and Riley (1962). Exchangeable K, Ca and Mg were extracted using ammonium acetate. K was determined on flame photometer and Ca and Mg by Atomic Absorption Spectrophotometer (AAS).

Statistical analysis

Data were analysed using Analysis of Variance using Statistical Analysis System (SAS, 2003) computer package at 5 % level of significance to determine differences in the treatment and interaction effects. The Duncan's Multiple Range Test (Duncan, 1955) was used to separate means of significant differences among the treatments.

RESULTS

Selected soil physical and chemical properties before planting

The physical and chemical analysis of the top soil (0-30 cm depth) of the experimental site before planting in 2014 and 2015 as determined by standard procedures showed that, the soil was sandy loam with the following properties: pH (0.01M $CaCl_2$), 4.1, 4.2; organic carbon, 5.3 g kg^{-1}, 5.46 g kg^{-1}; total nitrogen, 0.4 g kg^{-1}, 0.45 g kg^{-1}; ammonia-nitrogen, 23.99 mg kg^{-1}, 24.68 mg kg^{-1}; nitrate-nitrogen, 26.38 mg kg^{-1}, 27.79 mg kg^{-1}, available phosphorus, 7.94 mg kg^{-1}, 7.96 mg kg^{-1}; and exchangeable cations (c mol kg^{-1}) of Ca^{2+}, 6.25, 6.36; Mg^{2+}, 1.01, 1.11; K^{+}, 0.2, 0.32; Na^{+}, 0.35, 0.41; and CEC, 7.96, 8.34 c mol kg^{-1} (Table 1).

Table 1 - Soil physical and chemical properties before establishment of the experiment at the study site

Soil properties	**2014**	**2015**
Particle size (g kg^{-1})		
Sand	88.60	85.75
Silt	4.00	3.89
Clay	7.40	7.33
Textural class	Sandy loam	Sandy loam
Chemical properties		
pH (0.01M $CaCl_2$)	4.10	4.20
Organic carbon (g kg^{-1})	5.30	5.46
Total nitrogen (g kg^{-1})	0.40	0.45
NH_4^+N (mg kg^{-1})	23.99	24.68
NO_3^-N (mg kg^{-1})	26.38	27.79
Available phosphorus (mg kg^{-1})	7.94	7.96
Exchangeable cations (c mol kg^{-1})		
Ca	6.25	6.36
Mg	1.01	1.11
K	0.20	0.32
Na	0.35	0.41
CEC	7.96	8.34

NH_4^+N: Ammonia-nitrogen, NO_3^-N: Nitrate-nitrogen. Ca: Calcium, Mg: Magnesium, K: Potassium, Na: Sodium, CEC: Cation Exchange Capacity.

Chemical composition of leafy biomass of the two agroforestry species

The leaves of *A. lebbeck* contained more N (leading to lower C: N ratio) than *P. biglobosa*. *A. lebbeck* had the highest concentration of lignin with mean value of 110.6 g kg^{-1}, while, *P. biglobosa* had highest concentration of C: N ratios with mean value of 63.0. The result showed that *P. biglobosa* had low N and C contents (Table 2).

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Table 2 - Initial chemical composition of the biomass of *A. lebbeck* and *P. biglobosa* plant species

Component	N(g kg^{-1})	C (g kg^{-1})	Lignin (g kg^{-1})	Polyphenol (g kg^{-1})	C: N
Albizia lebbeck					
2014	33.2a	186.2a	113.7a	6.5b	56.0b
2015	31.6a	186.5a	107.4a	4.8b	59.0b
Means	32.4a	186.4a	110.6a	5.7b	57.5b
Parkia biglobosa					
2014	28.5b	178.1b	83.5b	8.7a	62.0a
2015	24.4b	155.2b	81.3b	6.3a	64.0a
Means	26.5b	166.7b	82.4b	7.5a	63.0a

N= Nitrogen; C= Carbon; C: N= Carbon/N ratio
Means followed by the same letter(s) within the same column and treatment are not significantly different (p > 0.05).

Decomposition patterns of plant residues

Generally, there was a rapid loss of mass from the litter bags during the first two weeks after planting (2 WAP) for the two species (Figure 1) in this order *A. lebbeck* (38.2 g) < *P. biglobosa* (28.16 g) compared to initial weight of 50 g. At four weeks after planting (4 WAP), *A. lebbeck* had lost 42.19 g of its initial weight, while, 30.04 g of *P. biglobosa* had been decomposed. At 6 WAP, the rate of mass loss due to decomposition declined in both species. Though, *A. lebbeck* continued to decompose faster than *P. biglobosa*. The rate of decomposition increased with increase in the number of weeks after planting.

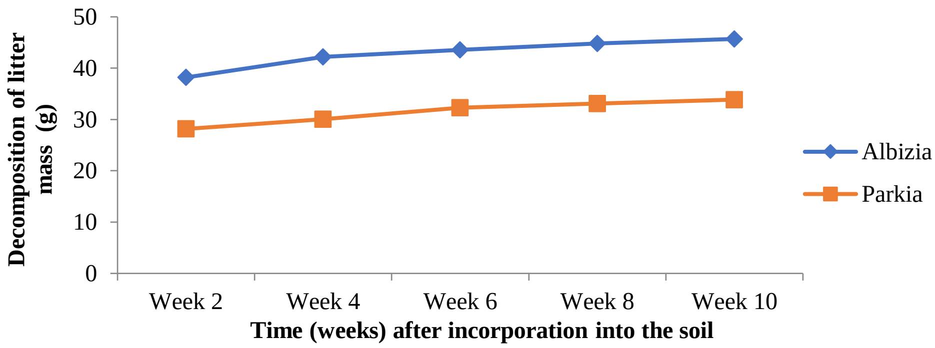

Figure 1 - Loss weight of *A. lebbeck* and *P. biglobosa* leafy biomass over a period of 10 weeks

Decomposition factors of plant residues

The plant materials investigated showed variations in their rate and pattern of decomposition during 2014 and 2015 cropping seasons. The leaves of *A. lebbeck* contained significantly ($p < 0.05$) higher N (leading to lower C: N ratio) than *P. biglobosa*. *P. biglobosa* leaves had significantly ($p < 0.05$) lower concentration of lignin (LG) and lignin plus polyphenol (PP): nitrogen (N) (LG+PP: N) ratio in 2014 compared with *A. lebbeck*, but *A. lebbeck* and *P. biglobosa* had similar values in 2015. Also, *P. biglobosa* had higher concentration of PP: N ratio than *A. lebbeck*. On the other hand, *A. lebbeck* had the significantly ($p < 0.05$) higher concentration of LG, while, *P. biglobosa* had higher concentration of C: N ratios. *A. lebbeck* had higher rates of (LG+PP): N in 2014 and was constant in 2015. However, *A. lebbeck* and *P. biglobosa* had similar concentrations of LG: N in 2014, but the value for *A. lebbeck* was significantly ($p < 0.05$) higher than that of *P. biglobosa* in 2015 (Table 3).

Table 3 - Decomposition rate patterns of *A. lebbeck* and *P. biglobosa* leafy biomass during the maize growing seasons of 2014 and 2015

Season	Residue	N	C	LG	PP	C:N	LG:N	PP:N	(LG+PP):N
					g kg^{-1}				
2014	*Albizia*	33.20a	186.20a	113.70a	6.54b	56.00b	30.00a	2.00b	40.00a
	Parkia	28.50b	178.10b	83.50b	8.67^{a}	62.00a	30.00a	3.00a	30.00b
2015	*Albizia*	31.60a	186.50a	107.40a	4.84b	59.00b	34.00a	2.00b	36.00a
	Parkia	24.40b	155.20b	81.30b	6.38^{a}	64.00a	33.00b	3.00a	36.00a

Abbreviation: LG = lignin; PP = polyphenol; N = nitrogen; C = organic carbon
Means followed by the same letter within a column in a particular season are not significantly different at 5 % level of probability.

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Effect of nitrogen uptake on maize

The combined mean of 2014 and 2015 cropping seasons revealed that, N uptake was comparable among the treatments across the periods of experiments. At 4-8 WAP, there was progressive and significant increase of N uptake by maize and declined at 10 WAP in some treatments. At 4 WAP, treatment 12 (*A. lebbeck* plots and 120 kg N ha^{-1} with DMR-ESR-7 maize variety (B1N3V1) had significantly higher value (0.5 kg N ha^{-1}) than *P. biglobosa* (0.4 kg N ha^{-1}) and control (0.2 kg N ha^{-1}). At 6 WAP, treatment 16 (*A. lebbeck* plots and 120 kg N ha^{-1} with 2009 EVAT maize variety (B1N3V2) had significantly higher value (2.5 kg N ha^{-1}) uptake of maize than control and *Parkia*. At 8 WAP treatments 8 and 11 (plots without biomass and 120 kg N ha^{-1} with 2009 EVAT maize variety (B0N3V2 and *A. lebbeck* plots and 80 kg N ha^{-1} with DMR-ESR-7 maize variety (B1N2V1) had significantly higher value (3.4 kg N ha^{-1}) of N uptake in maize than *P. biglobosa* (1.1 kg N ha^{-1}). At 10 WAP, treatment 8 (plots without biomass and 80 kg N ha^{-1} with DMR-ESR-7 (B0N2V1) produced significantly ($p < 0.05$) higher value (3.1 kg N ha^{-1}) than *A. lebbeck* (2.6 kg N ha^{-1}) and *P. biglobosa* (1.8 kg N ha^{-1}). Total N uptake was comparable in many treatments, however, treatment 8 (plots without biomass and 120 kg N ha^{-1} with 2009 EVAT maize variety (B0N3V2) had significantly ($p < 0.05$) higher value (9.2 kg N ha^{-1}) of N uptake in maize than *A. lebbeck* (8.6 kg N ha^{-1}) and *P. biglobosa* (2.8 kg N ha^{-1}). However, the values of N uptake ranged from 2.8 kg N ha^{-1} to 8.6 kg N ha^{-1} that is, in P. *biglobosa* and *A. lebbeck* respectively (Table 4).

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Table 4 - Nitrogen taken up by maize at different sampling periods during 2014/2015 growing seasons at Makera in combined means

	Treatment	Uptake (kg N ha^{-1}) at different sampling period (WAP)				
		4	6	8	10	Total
1	B0 N0 V1	0.1ef	0.9fg	1.4efg	1.4ab	3.9fgh
2	B0 N1 V1	0.1def	0.8g	1.1fg	1.5ab	3.6fgh
3	B0 N2 V1	0.3a-f	1.7b-f	2.2b-g	2.8ab	7.0a-e
4	B0 N3 V1	0.2a-f	1.4c-g	2.2b-g	2.2ab	6.0b-g
5	B0 N0 V2	0.2b-f	1.2efg	2.0b-g	2.0ab	5.4c-g
6	B0 N1 V2	0.3a-f	1.4c-g	2.2b-e	2.3ab	6.2a-f
7	B0 N2 V2	0.3a-f	1.3d-g	1.7d-g	2.6ab	5.9b-h
8	B0 N3 V2	0.3a-f	2.4ab	3.4ª	3.1a	9.2a
9	B1 N0 V1	0.2c-f	0.9f-g	1.1g	1.3ab	3.5fgh
10	B1 N1 V1	0.2b-f	1.4c-g	1.8d-g	1.4ab	4.7d-h
11	B1 N2 V1	0.4abc	2.3ab	3.4ª	2.4ab	8.5abc
12	B1 N3 V1	0.5a	2.4ab	2.6a-e	2.4ab	7.8a-d
13	B1 N0 V2	0.3a-e	2.1abc	2.5a-e	2.4ab	7.4a-e
14	B1 N1 V2	0.3a-f	2.0a-e	2.7a-d	2.4ab	7.4a-e
15	B1 N2 V2	0.4a-d	2.1a-d	2.9abc	2.5ab	7.8a-d
16	B1 N3 V2	0.3a-d	2.5a	3.1ab	2.6ab	8.6ab
17	B2 N0 V1	0.2b-f	0.8g	1.1g	0.9b	3.0gh
18	B2 N1 V1	0.2b-f	1.4c-g	1.9c-g	1.4ab	4.9d-h
19	B2 N2 V1	0.2b-f	0.8g	1.1g	1.2ab	3.3fgh
20	B2 N3 V1	0.4ab	2.1a-d	2.5a-e	2.0ab	7.0a-e
21	B2 N0 V2	0.3a-f	1.4c-g	1.9c-g	2.1ab	5.7b-h
22	B2 N1 V2	0.2a-f	1.0fg	1.1g	1.2ab	3.6fgh
23	B2 N2 V2	0.1f	0.6g	1.1g	1.0b	2.8h
24	B2 N3 V2	0.2b-f	0.9f-g	1.5efg	1.8ab	4.4e-h

4, 6, 8 and 10 WAP = Weeks after planting, B0= without biomass incorporation, B1= *Albizia lebbeck* biomass incorporation, B2= *Parkia biglobosa* biomass incorporation, N0= 0 Kg N ha^{-1}, N1= 40 Kg N ha^{-1}, N2= 80 Kg N ha^{-1}, N3= 120 Kg N ha^{-1} and V1= DMR-ESR-7, V2 = 2009 EVAT.
Means followed by the same letter within a column are not significantly different at $p > 0.05$.

DISCUSSION

The soil of the study area is basically sandy loam and acidic with pH of 4.1, 4.2 before the experiment commenced as observed by Oyebamiji et al. (2017b). Plots amended with *A. lebbeck* biomass performed better as it contain higher average N and C contents and lower average C: N which aided its decomposition than *P. biglobosa* as confirmed by Oyebamiji et al. (2017a). Over 56

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% of N in the litter bags were decomposed during the first two weeks of incubation for the two biomass species. Thereafter, the N release in the remaining undecomposed litter generally increased with time for the two biomass.

The differences in decomposition and N release between biomass of *A. lebbeck* and *P. biglobosa* tree species could be interpreted to be caused by the amount of initial N concentration and C: N ratios contained in the tissue of these plant materials. Meanwhile, *A. lebbeck* leafy biomass that had significantly higher N concentration and lower C: N ratio than *P. biglobosa* decomposed and released N faster than *P. biglobosa* over the entire 10 weeks of research investigation and aligned with the results of other researchers that N content and C: N ratio serve as relevant bases for decomposition and N release study (Santonja et al., 2015).

It was noted that *P. biglobosa* contained higher level of polyphenol which have been confirmed and reported by other researchers to inhibit microbial activities, thereby slowing down the rate of decomposition and N release (Mafongoya et al., 1998). Therefore, it is important to note that decomposition and nutrient release are governed by the chemical composition of the plant materials. The total N uptake in maize had better performance in *A. lebbeck* amended plots than in *P. biglobosa* plots, this was possible as result of its ability to decompose and mineralize faster based on mineral contents inherent in the leafy biomass (Bisht et al., 2014; Oyebamiji et al., 2017a).

CONCLUSIONS

This study revealed the appreciable N released from decomposed biomass of both *A. lebbeck* and *P. biglobosa* tree species. The differences in decomposition and nitrogen release patterns between *A. lebbeck* and *P. biglobosa* biomass was determined by the amount of initial N concentration and C: N ratios which are contained in the leaves of these plant materials. *A. lebbeck* leafy biomass decomposed and released nitrogen faster and was significantly higher in N and lower C: N ratio than *P. biglobosa*. It was also noted that *P. biglobosa* contained high level of polyphenol compared with *A. lebbeck*, hence, slower rate of decomposition and N release. The total N uptake by maize crop increased rapidly between 4-6 WAP, and the impact was obvious in plots amended with *A. lebbeck* biomass compare to *P. biglobosa* amended plots.

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