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STRATEGIZING TO IMPROVE AGRICULTURAL FERTILIZATION SYSTEM USING LOCAL MATERIALS IN SOUTHEASTERN NIGERIA

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Abstract

Organic fertilizers were produced using legumes, poultry manure, rice husk and swine dung; and its potentials in crop production evaluated at Umudike, Nigeria. Three plots of six leguminous species were established to generate vegetal matter for the fertilizer production. Soil samples were collected from the plots at 0-30cm auger depth and analyzed. The plots were cleared manually, ploughed and harrowed with a tractor mounted disc plough. Each plot was divided into 3 blocks and the legumes raised by direct seeding at 40cm x 40cm in a randomized complete block design in three replications. The vegetal matters were harvested at 50% flowering and the yield-per-specie determined. Samples of legumes matter, rice husk, poultry manure and swine dung were analyzed for mineral composition. Each legume matter with rice husk, poultry droppings and swine dung in the ratio 5:4:4:4 were mixed and heaped for composting in a Randomized Complete Block Design with three replicates. Heaps were turned every 2 months for six (6) months. Manufactured fertilizer samples were analyzed for mineral composition. Data collected were subjected to analysis of variance using SPSS 17 at $p \leq 0.05$. Results show that poultry manure, rice husk and swine dung varied in nutrient composition. Poultry manure had highest N (25.20%) and K (24.50 %) content; rice husk contains highest organic matter (306%) and organic carbon. Vegetal matter yield and the nutrient composition of legumes varied significantly. Consequently, the compounded composts varied in nutrient composition. *L. purpureus* compost had highest N (33.60g/kg), while *C. mucunoides* had highest K (8g/kg), organic C (347.70g/kg) and organic matter (590.90g/kg). The organic fertilizers were generally rich in nutrients, with potentials for enhancing crop production system.

Keywords: Organic fertilizers, legumes, rice husk, poultry manure, swine dung, composting, and crop production

Introduction

Climate change has introduced new uncertainties, added new risks and changed already existing risks (FAO, 2012). Among the uncertainties and impact of climate change in Nigeria is poor agricultural output occasioned by progressive decline in soil productivity from soil flooding and erosion. In the southeastern States in particular, soil erosion and poor agricultural practices have increased the severity of poor quality soil which has now become a major constraint to crop production (Nwosu *et al.*, 2011; Louisa and Taguiling, 2013; Olorunfemi, 2013). The practice of shifting cultivation which helped in the past to restore soil fertility is no more practicable because of population growth and increased demand for land. Among the efforts put in place by government at different levels to boost crop production and improve food security in Nigeria is the provision of needed farm inputs such as fertilizer. There has been a tremendous increase in terms of quantity of fertilizer used in both crop and tree husbandry in recent decades following intensification of production processes. The use of inorganic fertilizers (single and compound fertilizers) have taken over other fertilization techniques since early 80's because of the subsidy introduced by the Nigerian government, and the ready advantages associated inorganic fertilization (Okalebo *et al*., 2006). However, besides growing scarcity and high cost, there are serious challenges posed by the continuous application of inorganic fertilizers which includes eutrophication of nearby water bodies, soil acidification, and reduction in quality of arable lands (Nwosu *et al.,* 2011; Uka *et al*., 2013). Moreover, some of the disadvantages can worsen with climate change (FAO, 2012). Thus, the use of organic fertilizers both in agricultural and forestry practices is increasingly gaining global attention.

Prior to the introduction of mineral fertilizer in Nigeria, organic manure was the only source of nutrient to crop. Soil structure and fertility were maintained or enhanced by the use of animal manure, compost, farm wastes and green manure (Mapfumo *et al.*, 2001; Omotayo and Chukwuka, 2009). The application of organic manure not only replenishes depleted nutrients but also improves the physical, chemical and biological properties of such soils (Omotayo and Chukwuka, 2009). However, the use of organic manure has its own shortcomings (Okalebo *et al.*, 2006; Ngome *et al.,* 2011), one of which is their their large bulk in relation to the nutrients contained in them (Roy *et al.*, 2006, Ngome *et al.,* 2011). According to Louisa and Taguiling (2013), key among challenges with organic manures is the difficulty of compounding all the needed nutrients in a single medium and rapid release of the nutrient. However, concentrated organic manures are comparatively richer in NPK (Roy *et al.,* 2006).

Although, many organic waste products can be added directly into the soil, most of them have a better soil-improving effect after their decomposition through the composting process. Composting describes a biological process in which organic materials are decomposed by aerobic micro-organisms, thereby lowering the Carbon to Nitrogen (C/N) ratio of the organic materials. It can be defined as the controlled aerobic conversion of mixed organic materials into a form that is suitable for addition to soil (Hubbe *et al*., 2010). This breakdown of the cellulosic and lignin components of the composted material into nitrogen-rich compost helps to address solid waste problems and provides a sustainable way to enhance soil fertility. There are many variations in composting practices, yet certain steps are broadly shared. In general, the process starts with gathering together of biomass components, the optimal reduction of size of some of the materials, mixing (or optional layering) of the components, and formation into pile (Hubbe *et al*., 2010). Some other essential ingredients are water, sufficient air, and a sufficiently large mass so that self-insolation and the decay process results in a strong increase in temperature, which can be taken as evidence of the oxidation process inherent in composting. Suitably prepared compost can provide multiple benefits to soils (Hubbe *et al.*, *ibid*).

The demand for compost as an alternative to inorganic fertilizers has increased in order to sustain intensive agriculture (Adamu *et al*., 2014). Compost is said to be of more importance than inorganic fertilizers because it consists of the relatively stable decomposed materials resulting from accelerated biological degradation of organic matter under controlled, aerobic conditions (Adamu *et al*., *ibid*). Dougherty (1998) divided the main kinds of compost piles into four categories: open static piles, turned windrows and piles, aerated static piles, and in-vessel systems. However, compost should be rich in available plant nutrients, contain readily decomposable material and relatively stable humic substances, and have a crumbly structure, similar to humus-rich topsoil (Roy *et al*., 2006). Literatures on plant nutrient sources and soil amendment reveal that legumes vegetal matter, rice husk (also commonly known as rice mill waste), poultry droppings and swine dung are suitable sources of plant nutrients. Leguminous plants species have high crude protein content, in addition to serving as useful grazing material or fodder for livestock, and as cover crop protecting the soil against erosion. Legumes contribute to soil fertility by fixing highly needed nitrogen into the soil through the activities of microorganisms inhabiting their root nodules and their litter decomposition. Legumes therefore can play a complimentary or alternative role as sources of organic fertilizer in farming systems incorporating inorganic fertilizers (Mapfumo *et al.,* 2001; Ngome *et al.,* 2011). Organic composts formed by leguminous plant matter are rich in mineral elements, and when supplemented with other nutrients sources will be very effective as organic fertilizer (Louisa and Taguiling, 2013). Some common indigenous legumes found growing wild include: *Centrosema pubescens* Benth., *Mucuna pruriens* (Linn.) DC*, Calopogonium mucunoides* Desv.*, Stylosanthes capitata* Vogel*, Lablab purpurues* L. (Sweet)*, and Mucuna bracteater* DC.

Rice husk is one of the waste materials from rice production in Nigeria because it has not been utilized effectively. In rice producing belts like Abia, Ebonyi and Niger States, mountains of rice husk are commonly seen around mills. Though proposals have been made to use rice husk in developing thermal electricity projects, this has not come into fruition. It is also being studied for possible use in the manufacture of cement (Ajiwe *et al*., 2000). Rice husk is reported to have high organic carbon content and have been recommended for soil amendment (Mbah *et al*., 2012; Omenihu *et al*., 2011). Omenihu *et al*. (*ibid*) reported that the application of rice mill waste fortified with inorganic NPK fertilizer significantly increased grain yield, biomass yield, tissue N content and N uptake of maize relative to the absolute control (no rice mill waste and no fertilizer) and optimum NPK fertilizer applied alone. According to the authors, it increased maize yield by as much as 89% relative to the optimum NPK fertilizer application. Mbah *et al*. (2012) observed that burn and unburnt rice mill waste improved soil physical and chemical properties, and increased crop production.

Poultry manure has been described as one of the most viable of all manures produced by livestock and *an excellent source of nutrients which can be incorporated into most fertilizer programs* (*Zublena, 1993;* Mitchell and Tyson, 2001*)*. It supplies some important micro and macro elements to the soil, and has beneficial effects on soil properties and on crop yield. Poultry manure is used directly or indirectly for several purposes in agriculture because of its high nitrogen and energy value. It has historically been used as a source of plant nutrient and for soil amendments. Poultry manure application is reported to have over 53% increase in N level of the soil; from 0.09% to 0.14 %, and exchangeable cations increase (Boateng *et al*., 2006). However, the nutrient composition of poultry manure varies with the type of bird, feed ration, proportion of litter to droppings, manure handling system, and type of litter (*Zublena, 1993,* Hochmuth *et al*., 2013*)*. To get the best result in terms of economic value from the use of poultry manure, while also protecting our water bodies from the nutrient runoff or leaching, poultry manure; with other organic manures should be applied to match the nutrient needs of crop.

Swine manure have been reported to be effective in increasing the yields of cereals, legumes, oilseeds, vegetables and pastures, and increasing plant nutrient concentration; especially N, P, K, Mg, Fe, Cu, and Zn (Jun *et al*., 2003; Agbogidi and Avwevughware, 2011). The efficient use of swine manure can be an agronomically and economically viable management practice for sustainable crop production in temperate regions (Choudhary *et al.*, 1996; Adeniyan *et a*l., 2011). Swine manure application have resulted in higher crop and pasture yields than inorganic fertilizers (Sutton *et al*., 1982; Choudhary *et al.*, 1996), although, the rate of manure was higher than inorganic fertilizers due to limited availability of N from manure at the time of application. Swine manure has been shown to increase crop quality by increasing plant nutrient concentration not only in the year of application but also in succeeding years. In other studies, liquid swine manure was reported to increase leaf or seed N, P and K concentrations in grains or N, P and K content of forages compared with inorganic fertilizers (Sutton *et al*. 1982; Choudhary *et al.*, 1996).

Since the agricultural sector in Nigeria is vulnerable to climate change impacts with threat of poor yield because of depleting soil fertility (Nwajiobi *et al*., 2013), adaptation mechanism through adoption of organic fertilizers is an approach which hold prospects for enhanced resilience of the sector. In order to effectively serve as an agricultural resilience strategy, organic fertilizers should be able to supply most of the needed nutrients adequately (Roy *et al*., 2006). This study evaluated the nutritional value of locally available organic materials and strategized on strengthening their capacity as fertilizers using compost technology for boosting growth and yield of agricultural and forest crops.

Materials and Methods

Study area

The study was conducted in Umudike, (Lat. $50^0 30'$N, Long.$70^0 31'$E, altitude 122m), Abia State, Nigeria. Umudike is situated within the rainforest zone where climate is essentially humid tropical. There are two distinct seasons: the rainy season covering March/April to October/November, while the dry season starts in November and ends in March (Nwosu *et al*., 2011). The area has a bimodal pattern of rainfall which peaks in June and September with a short spell in August. Annual precipitation is an average of 2,163mm. Maximum and minimum annual mean temperatures are 28^0C and 21^0C respectively, and through the year insolation is high. The soil which is derived from coastal plain sediments is classified as ultisol and haplic acrisol (Nwosu *et al*., 2011). The main occupation of the people is subsistence farming.

Establishment of Plots of Legumes for Harvesting Vegetal Matter

Plots of six leguminous species (*Stylosanthes capitata, Mucuna. bracteata, Lablab purpureus, Calapagonium. mucunoides Centrosema. pubescens, Mucuna pruriens*) were established for production of adequate vegetal matters, which were harvested for compost production. The research plots were established in three locations with 2 of the plots located in Micheal Okpara University of Agriculture, Umudike, while the third was in Abia State University, Umudike Campus. Details of the plots are as given thus:

Plot A: Land measuring 27x14m (378m^2), located at Nursery Unit of Department of Forestry and Environmental Management (FOREM), Michael Okpara University of Agriculture, Umudike (MOUAU).

Plot B: Land measuring 27x25m (675m^2), located at Teaching and Research Farm of the College of Natural Resources and Environmental Management (CNREM), MOUAU.

Plot C: Land measuring 26x45m (1170m^2), located at Teaching and Research Farm of the Faculty of Agriculture, Abia State University (ABSU), Umudike Campus.

The experiments were laid out in a Randomized Complete Block Design in three replications with the legume species as treatments. Planting spacing was 40x40cm, and an open-space boarder 40cm between blocks. The plots were maintained for 18weeks and the harvesting of the vegetal matters was conducted at 50% flowering of the legumes.

Soli Analysis: Soil samples were collected randomly from six locations on each plot using soil auger at 0-30cm depth. The soil samples were bulked, mixed properly to ensure uniformity and sieved to remove large particles, roots and debris. The composites sample were collected and analyzed for soil physicochemical properties (Table 1) at the soil laboratory of the National Root Crops Research Institute (NRCRI), Umudike, using conventional methods for soil analysis as described by Udo *et al.* (2001).

Table 1: Physico-chemical properties of soil of experimental plots

		Experimental Plots (Location)		
		Plot A	Plot B	Plot C
S/N	Soil Properties	FOREM Nursery	CNREM Farm	ABSU Farm
1	Sand (%)	46.40	32.40	46.40
2	Silt (%)	19.40	37.40	7.40
3	Clay (%)	34.20	30.20	16.20
4	Texture	SCL	CL	SL
5	pH	4.40	4.60	4.20
6	P (mg/kg)	20.80	17.50	26.30
7	N (%)	0.156	0.08	0.056
8	OC (%)	1.88	0.10	0.77
9	OM (%)	3.25	1.71	1.32
10	Ca (cmol kg-^{1})	2.60	3.60	2.40
11	Mg (cmol kg-^{1})	1.00	2.40	1.60
12	K (cmol kg-^{1})	0.08	0.04	0.05
13	Na (cmol kg-^{1})	0.23	0.26	0.29
14	EA (cmol kg-^{1})	1.60	1.52	1.12
15	ECEC (cmol kg-^{1})	5.52	7.824	4.34
16	BS (%)	71.00	80.57	74.19

SCL = sandy clay loam, CL = clay loam, SL = sandy-loam

Collection of Rice Husk, Poultry Droppings and Swine Dung to Supplement the Compost

Four hundred kilograms (400kg) of rice husk was collected in bags from Rice mill at Uzoakoli in Bende LGA Abia State, and taken to the University where it was further air dried (Plate 1). The poultry droppings and swine dungs were collected from the Livestock Section of Michael Okpara University of Agriculture Umudike (Plate 2).

Plate 1: Livestock waste collection from MOUAU Livestock farms

Plate 2: Rice Husks collected from Uzuakoli Rice mill

Laboratory Analysis of the Organic Materials for Compost Making

Samples of each of the six legume species (*Stylosanthes capitata, Mucuna bracteata, Lablab purpureus, Calapagonium. Mucunoides. Centrosema. pubescens, Mucuna pruriens*) and samples of the rice husk, poultry and swine dungs were collected, taken to the laboratory of the National Root Crops Research Institute (NRCRI), Umudike, and analyzed for mineral elements composition. The analysis was conducted using standard laboratory methods as described by Udo *et al.* (2001). The mineral compositions of the legumes vegetal matter; rice husk, poultry droppings and swine dung were determined (Table 2).

Developing Compost from the Legumes and other organic materials

Compost heaps/piles were made of the six (6) legumes species respectively with the other organic materials. Each compost heap was made of 50kg legume species, 40kg Poultry droppings, 40kg Swine dung, and 40kg Rice husk, using the open static compost making method (Dougherty, 1998). A total of eighteen compost heaps were made consisting three replications of each of the six legumes species as treatments laid out in a randomized complete block design (Plate 3). The heaps were turned every two (2) months and maintained for a period of six months. Samples were collected from the produced composts and analyzed in laboratory, while the manufactured fertilizers were collected into bags and weighed (Plate 4).

Plate 3: The six legumes compost heaps in 3 replications

Plate 4: Weighing of the compounded composts produced

Data analysis

Data collected from the experiments were analyzed using SPSS version 17. Mean separations were done using the Duncan Multiple Range Test (DMRT) at 95% probability.

Results and Discussion

Vegetal matter yield of the legumes (t/ha)

All the legumes recorded over 1.5t/ha dry matter yields (DMY) (Table 1). *L. purpureus* gave significantly the highest DMY (2.55t/ha) than the other legume species except *M. bracteater* (2.16t/ha), while the DMY of *S. capitata* had the least value of 1.44t/ha. The findings agree with reports of several authors on the legume species. Tarawali (1994) and Iwuafor and Odunze (1999) reported that *Stylosanthes species* do not generally do well in the establishment year. Amole *et al*. (2013) reported high herbage yield of *L. purpureus,* and noted that the plant can provide up to 6t of dry matter per hectare. Lukiwati (2007) reported a low dry matter production of *Cenrtosema pubescens.*

Table 1: Vegetal dry matter yield of the legumes species (t/ha)

Legume Spp.	Quantity (t/ha)
C. pubescens	I.83^{bc}±2.01
M. pruriens	1.81^{bc}±1.72
C. mucunoides	1.77^{bc}±1.33
L. purpureus	2.50^{a} ± 3.04
M. bracteater	2.16^{ab}± 2.21
S. capitate	1.64^{bc}±3.44

Values are mean±SE. Mean values followed by the same letters in the column are not significantly different (P < 0.05)

Nutrient composition of the legumes species

The nutrient content of the legume species varied significantly (Table 2). However, except for *S. capitata* with N content of 2.82%, all the legumes recorded N content of at least 3%. *C. mucunoides* has highest percentage N content (3.90%), followed by *L. purpurues* (3.86%). Though, N content of the legumes were higher than other nutrient elements. The result agree with McKey (1994) who reported rich nitrogen content of legumes matter and noted that leguminous crops can add up to 500kg of nitrogen to the soil per ha per year. *Stylosanthes capitata* recorded highest value for P (0.868%), *L. purpurues for K* (1.60%) and Na (0.635%), *M. bracteata* for Ca (3.81%), *C. pubescens* for Mg (1.46%), and *C. mucunoides* for Organic carbon (18.46%) and organic matter (31.83%). The high organic matter content of the legumes suggests huge prospects for soil amendment as soil organic matter is known to perform diverse functionary roles in improving the physical, chemical and biological composition of the soil (Omotayo and Chukwuka, 2009; Nwosu *et al*., 2011). This is essentially for soil amendment in the southeastern Nigeria, where low activity clay (LAC) has made organic matter the hub around which soil fertility revolves (Omenihu *et al*., 2011). The result supported use of leguminous plants for improving soil fertility (McKey, 1994; Rao and Mathuva, 2000; Nwosu *et al*., 2011; Adamu *et al*., 2014). Nwosu *et al*. (2011) noted that besides direct fixation of nitrogen, leguminous cover crops add organic matter to the soil through leaf litter fall, which decomposes and improves soil organic matter, physical and chemical properties. Soils in which legumes and farm yard manure (FYM) are either grown or incorporated contain enough suitable nitrogen, phosphoric, acid, potash and lime (Rao and Mathuva, 2000). Thus legume integration into farming systems have become an important component of integrated soil fertility management (ISFM) options for increasing soil fertility and agronomic efficiency of applied inputs (Vanlauwe *et al*., 2010; Khaledian *et al*., 2014).

Table 2: Nutrient composition of the legumes species

Legumes	Mineral elements (%)							
Species	N	P	K	Ca	Mg	Na	Org. C	Org. M
C. pubescens	3.82ab	0.412bc	1.078bc	3.41ab	1.46a	0.550b	17.54b	30.25b
M. pruriens	3.45bc	0.342c	1.520ab	3.01ab	1.16bc	0.450bc	16.52bc	29.79bc
C. mucunoides,	3.90a	0.44bc	1.140bc	2.20c	0.851c	0.160d	18.46a	31.83a
L. purpureus,	3.86a	0. 508b	1.600a	3.61a	1.22bc	0.635a	17.54b	30.25b
M. bracteata	3.28ab	0.381c	0.850c	3.81a	1.34ab	0.275cd	17.75b	30.60ab
S. capitata,	2.82c	0.868a	1.560ab	2.410bc	1.09bc	0.250d	17.50b	28.21c

Mean values followed by the same letters in the column are not significantly different (P < 0.05) by DMRT. Figures in parenthesis are the percentage compositions

Mineral nutrient composition of rice husk, poultry manure and swine dung (%)

Rice husk had significantly high percentage organic carbon (17.75%) and organic matter (30.60%) than swine dung (9.08%) and poultry droppings (21.81%). The findings agree with Mbah *et al*. (2012) and Omenihu *et al*. (2011) on high organic carbon content of rice mill waste and its recommendation for soil amendment. Swine dung contains higher Ca (7.62%) relative to poultry droppings (6.81%) and rice husk (1.80 %). This agrees with Choudhary *et al.* (1996) that swine waste contain essential plant nutrients and is suitable as soil amendment for crop production. Although the composition and effectiveness of swine manure as a source of plant nutrient will vary from place to place, because this will depend on several factors; including type of ration fed, housing system, method of manure collection, storage and handling (Choudhary *et al.,* 1996).

Poultry droppings have higher percentage N (2.52%), P (1.40%) and Mg (3.16%). This agrees with McCall (1980) and Hochmuth *et al*. (2013) who reported high content of mineral elements in poultry droppings. This is perhaps the reason it has been described as one of the most viable of all manures produced by livestock and *an excellent source of nutrients which can be incorporated into most fertilizer programs* (*Zublena, 1993;* Mitchell and Tyson, 2001*)*. The nature of variations in the nutrient compositions of the organic materials suggests that they will be complementary when compounded and yield fortified compost. More so, as the value of organic manure is attributed to its high organic matter content and relatively higher content of major nutrient compounds (Roy *et al*., 2006).

Table 3: Mineral nutrient composition of rice husk, poultry manure and swine dung(%)

	Mineral Compositions (%)							
Material	**N**	**P**	**K**	**Ca**	**Mg**	**Na**	**Org c**	**Org M**
Rice husk (RH)	4.20	8.24	10.00	18.00	6.10	1.55	177.50	306.00
Swine Dung	12.60	14.40	10.00	76.20	28.00	2.75	90.80	156.56
Poultry Dropping	25.20	14.00	24.50	68.10	31.60	1.50	126.50	218.10

Mineral nutrient composition of compounded composts manufactured

Laboratory analysis of the compounded composts shows that the various composts are rich in mineral nutrient elements (Table 4). This should be expected and agrees with several authors that composts contain high amount of nutrients that enhance crop growth (Roy *et al*., 2006; Hubbe *et al*., 2010; Adamu *et al.,* 2014). However, the nutrient compositions of the compounded composts significantly varied with legume species used in the compost. Compounded compost made with *L. purpureus* contain the highest nitrogen (33.60g/kg), followed by *M. pruriens* (32.20g/kg) and *C. pubescens* (30.80g/kg). The nitrogen content of the compounded compost of *S. capitata* was least (2.31%), followed by *M. bracteater* (2.870%). The result supported Ngome *et al*. (2011) and Nwosu *et al*. (2011) who reported differential capacity of leguminous crops to enhance soil fertility and crop productivity. This could be due to differences in the rates of the legume materials decomposition (Mathews, 1998), and therefore suggests that *L. purpureus* decomposed faster, while *S. capitata* and *M. bracteater* decomposed slowly than the other legumes. Thus, the result agrees with Mathews (1998) who reported that *M. bracteata* litter decomposes slowly. The findings support Rao and Mathuva (2000), who reported that soils in which legumes and farm yard manure (FYM) are either grown or incorporated contain enough suitable nitrogen, phosphoric acid, potash and lime. The high organic matter and mineral elements contents of the compounded composts also follows the findings of Hubbe *et al.* (2010) that suitably prepared compost can provide multiple benefits to soils.

Table 4: Mineral nutrient composition of Compounded composts Produced

	Mineral Composition of compost of legumes in g/Kg							
Compounded Compost	**N**	**P**	**K**	**Ca**	**Mg**	**Na**	**Org C**	**Org M**
RMW, PW, SW,	29.40b	9.99bc	7.75a	32.10b	10.34c	3.25bc	306.00b	527.50b
+ *C. pubescens*	(2.94)	(0.99)	(0.775)	(3.210)	(1.034)	(3.25)	(30.60)	(52.75)
RMW, PW, SW,	23.10c	8.81c	7.00ab	24.10d	12.20b	2.76c	265.20cd	457.20cd
+ *M. pruriens*	(2.310)	(0.881)	(0.70)	(2.410)	(1.220)	(0.276)	(26.52)	(45.72)
RMW, PW, SW,	30.80ab	10.30abc	8.00a	38.20ab	10.94c	3.50b	347.70a	590.90a
+ *C. mucunoides*	(3.08)	(1.03)	(0.800)	(3.820)	(1.094)	(0.35)	(34.770)	(59.090)
RMW, PW, SW,	33.60a	11.20a	4.50c	30.10bc	12.20b	4.00a	289.70c	499.40bc
+ *L. purpurens*	(3.360)	(1.120)	(0.45)	(3.010)	(1.220)	(0.40)	(28.970)	(49.940)
RMW, PW, SW,	32.20a	11.70a	4.25d	40.20a	17.60a	1.75d	306.00b	528.00b
+ *M. bracteata*	(3.220)	(1.170)	(0.425)	(4.020)	(1.760)	(0.175)	(30.600)	(52.80)
RMW, PW, SW,	28.70b	10.50ab	4.00	28.10c	11.60bc	3.25bc	240.70d	415.00d
+ *S. capitate*	(2.870)	(1.050)	(0.4)cd	(2.810)	(1.160)	(0.325)	(24.070)	(41.50)

Mean values followed by the same letters in the same column are not significantly different ($P < 0.05$) by DMRT. Figures in parenthesis are percentage compositions

Conclusion

Leguminous species are increasingly appreciated for their roles especially in animal nutrition, soil amendment and soil fertility enhancement. Nigeria is endowed with numerous legume species, mainly growing in the wild, and some species being utilized as cover crops and for green manuring in improved fallow technologies, Rice husk, on the other hand, is one of the waste materials from rice production in Nigeria, which is not being utilized effectively. The use of these relatively abundant organic materials for compounded compost formulation has potentials for biodiversity conservation and enhancing stability in agro-ecosystems of Africa in this climate change regime. Leguminous cover crops are important for direct fixation of atmospheric nitrogen to soils, and they also have nutrient rich biomass suitable for compost manufacture. The vegetal matter of the various leguminous species vary in their nutrient elements composition, and consequently in their potentials for yielding a nutrient rich compost of their biomass. When properly fortified with other organic materials of complimentary plant nutrients, compounded fertilizers could effectively improve soil fertility and crop yield. As sustainable management of natural resources and ecosystem restoration are the starting point to building resilience to climate change (FAO, 2012), compounded composts have potentials to restore soil and improve crop productivity, building resilience in agro-ecological systems vulnerable to climate change.

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