INFLUENCE OF SOME LEGUMES ON SELECTED SOIL PROPERTIES IN OWERRI AREA, SOUTHEASTERN NIGERIA.

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Abstract
This study investigated the effect of some legumes on selected soil properties in Owerri Area of Imo State, Nigeria. Auger and core soil samples were collected, and used for routine laboratory analyses. Maize was used as a test crop in an experiment involving 4 treatments. To (zero treatment), T_1 (4t/ha of Mucuna leaves), T_2 (4t/ha of Pigeon pea leaves) and T_3 (4 t/ha of soybean leaves) and these were arranged in a randomized complete block design (RCBD) and replicated 4 times. At the end of the experiment, bulk soil samples were collected and analyzed for some properties. Data were analyzed using Analysis of Variance and means were separated using Least Significant Difference at 5% level of probability. There were significant differences in bulk density, ranging from 1.23mg/m^3, 1.16mg/m^3, 1.18mg/m^3 to 1/19mg/m^3. Organic matter components, soil organic carbon (SOC) and total nitrogen (TN) varied significantly at 5% level of significance. These changes influenced maize performance as significant ($P \leq 0.05$) differences were recorded in maize height and grain yield. Further studies involving other test crops and more parameters are recommended.
Keywords: Biofertilizer, Legume, Edaphic properties, Soil fertility, Yield

Introduction
Legumes play great roles in enhancing physicochemical properties of soils. These effects including nitrogen effect (Chalk, 1998) and break-crop effect (Robson *et al*., 2002) contribute to sustained use of soils. Legumes improve soil structure (Jensen et al., 2011) and break up soil hardpans (Peoples *et al*., 1990);and legumes contribute to high soil organic matter content (Dong and Layzell, 2001). Some legumes solubilize phosphates in the soil system (Nuruzzaman et al., 2005). Soybean-maize intercrop led to enhanced yield (Bichel, 2013) possibly due to increased N-fixation (Giller, 2001).

Soils in Owerri area and indeed entire Southeastern Nigeria are dominated by sandy textures, and are highly erodible leading to low nutrient status. In these soils, soil nitrogen tend to be easily lost via soil erosion, leaching and denitrification in wetland areas. Yet, this area is one of the densest locations in Nigeria in addition to serving as headquarters of administration in Imo State. It becomes necessary to investigate other ways of improving soil fertility especially as the area is experiencing shortened fallow periods-while cost of inorganic fertilizer is unaffordable to many farmers who belong to low-income group of the population. Therefore, the major objective of the study was to study the effect of some legumes, namely mucuna, pigeon pea and soybean on some soil properties in Owerri area of Southeastern Nigeria.

Materials and Method
The study was conducted at Owerri area lying between Latitudes 5 ^{o} 30 ^{1} and 5 ^{o} 50^{1} N and Longitudes 7 ^{o} 20^{1} and 7^{o}40^{1} E with an elevation below 90m above sea level. Soils are derived from coastal plain sand while its land surface is generally flat. It lies within the humid tropics with an annual rainfall of about 2500mm and rainfall pattern is bimodal (Onweremadu,2009). Owerri has a rain forest vegetation though depleted by human activities. Agriculture is a major socioeconomic activity.

Experiment
The experiment was conducted at FUTO outreach farm at Eziobodo in Owerri. Four treatments were To (zero treatment), T_1 (mucuna 4 t/ha), T_2 (pigeon pea, 4 t/ha) and T_3 (soybean 4 t/ha). The experiment was a factorial fitted into a randomized complete block design (RCBD). The leaves of these legumes were incorporated into the soils two weeks before planting the test crop.

Sampling
Soil samples were collected at 0 – 15 cm soil depth before and after planting the legumes. Soil samples were air dried and sieved using 2-mm aperture. Particle size distribution was determined by hydrometer method (Rayment and Higginson (1992). Soil pH was measured potentiometrically in 1:2.5 soil liquid ratio. Soil organic carbonwas measured using the procedure of Udo *et al*., (2009). Total nitrogen was determined by micro-kjeldahl digestion method, while available phosphorus was estimated by molybdenum blue colorimetry. Exchangeable Calcium and Magnesium were obtained by atomic absorption spectrophotometer while exchangeable potassium was determined using flame photometer. Catio exchange capacity was obtained according to Soil Survey Staff (2003) procedure. Base saturation was got by computation involving basic cations and cation exchange capacity. Bulk density was measured by core method. Height of maize was measured by tape while grain yield was weighed with weighing balance.

Data analysis

Soil and maize data were subjected to analysis of variance, while mean was separated using least significant difference at 5% level of probability**.**

Results and Discussion

Pre-planting soil data are shown in Table 1, indicating sandy and acidic soils in the sampled site. Organic fractions were generally low with soil organic carbon having a value of 4.3 g/kg and total nitrogen recording 0.6 g/kg. Base saturation was very low (14.6%) using some standards (FDALR, 1985).

Table1 Preplanting soil properties at 0 – 15 cm depth

Soil	Property	Unit	Value
BD			
Sand		g/kgmg^3	1.24
Silt		g/kg	850
Clay		g/kg	50
Texture			
Soc	3	g/kg	4.3
TN	6	g/kg	0.6
Av.P		mg/kg	11.4
Exchange	Ca	cmol/kg	1.1
Exchange	Mg	cmol/kg	0.6
Exchange	K	cmol/kg	0.1
Exchange	Na	cmol/kg	0.01
CEC		cmol/kg	12.32
BSat		cmol/kg	14.60
pH		%	5.29

Legumes had non-significant effect on particle size fractions as texture is an inherent property of soils (Table 2). However, there was significant (P = 0.05) difference in the distribution of bulk density across treatments (Table 2) suggesting that rooting activities of legumes and the rapidity at which their leaves decay may have influenced aggregation. Peoples *et al.* (1990) observed that roots of legumes break up hardpans making water and air entry easy into the soil system.

Table 2: Effect of legumes on physical properties at 0 – 15cm depth

Treatment	Sand	Silt	Clay	Tex	BD
		g/kg			mg/m^3
T_0	850	48	102		1.23
T_1	848	50	102		1.16
T_2	852	50	98		1.18
T_3	852	51	97		1.19
$SD_{0.05}$	NS	NS	NS		0.03

T_0 = zero treatment, T_1 = mucuna, T_2 = pigeon pea, T_3 =Soybean

Soil chemical properties were significantly affected (P = 0.05) by legume cropping (Table 3). Soil organic carbon differed among treatments @ 5% level of significance (Table 3). Similar significant effect was recorded by total nitrogen at 5% level of significance. Increase in organic carbon could be attributed to luxuriant vegetal growth which engendered high foliage among legumes and their consequent shedding and decomposition. Similar findings were made by Chalk (1998) while increased fixation raised total nitrogen level of soils (Giller, 2001). Phosphorus became more available in soils and differed significantly (P = 0.05) among legumes (Table 3). The results (Table 3) show that legumes differed significantly (P = 0.05) in their capacity to generate the organic fractions.

Table 3: Effect of legumes on chemical properties at 0 – 15cm depth

Treatment	Soc	TN	Av.P	Ca	Mg	K	Na	CEC	B_5	pH
	g/kg	g/kg	mg/kg			cmol			%	
T_0	3.70	0.80	23.98	1.6	0.9	0.02	0.01	5.68		5.31
T_1	9.80	0.97	29.9	2.26	1.7	0.10	0.01	6.70		5.40
T_2	16.00	1.14	34.10	2.9	1.8	0.16	0.02	8.72		5.41
T_3	19.82	1.42	36.01	3.1	2.5	0.20	0.01	8.92		5.51
$LSD_{0.05}$	0.15	0.011	1.63	1.43	0.18	0.06		1.63		NS

T_0 = zero treatment, T_1 = mucuna, T_2 = pigeon pea, T_3 =Soybean

Higher values of organic carbon, total nitrogen and available phosphorus when compared with values obtained at preplanting suggests the need to use these legumes for soil fertility enhancement. Nuruzzaman *et al.*(2005) reported high uptake of available phosphorus by grain legumes and enhanced performance of wheat. However, greater foliage holds a great promise in using legumes in mitigating climate change as earlier suggested by Jensen *et al.*(2011).

Table 4: Effect of legumes on Maize performance

Treatment	Height	Grain Yield (t/ha)
T_0	46.39	0.40
T_1	50.63	1.23
T_2	54.65	1.38
T_3	57.93	2.02
$LSD_{0.05}$	0.06	0.26

Performance of maize improved significantly (P=0.05) in its height. Values were less those reports of Bello and Adekunle (2013) at Igbowa on maize when urea was mixed with animal manures. However, higher yield 1.23 to 2.02 t/ha were obtained compared to 0.204, 0.189, 0.260 and 0.200 t/ha obtained by Bello and Adekunle (2013) on maize in Western part of Nigeria. Differences in performance could be due to varietal and agroecological differences.

Conclusion

Legumes influence soil properties. Soil chemical properties particularly SOC, TN and Av. P were affected by legumes. There was significant (P=0.05) in the yield of maize resulting from the interaction between soil and legumes.

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