SOIL SCIENCE SOCIETY OF NIGERIA

PROCEEDINGS OF THE 38TH ANNUAL CONFERENCE

NIGERIAN AGRICULTURAL TRANSFORMATION AGENDA

SOIL AS A KEY TO NATIONAL DEVELOPMENT

DATE: March 10 - 14, 2014

HOST: Department of Soil Science and Land Resources Management, University of Uyo, Uyo, Nigeria

EDITED BY:

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FORWARD

The University of Uyo in Akwa Ibom State hosted the 38th Annual Conference of the Soil Science Society of Nigeria between the 10th and14th of March 2014. The theme of the Conference was Nigerian Agricultural Transformation Agenda: Soil as Key to National Development. The representative of the Vice Chancellor (Professor Comfort Ekpo) of University of Uyo, Professor Okon Ansa (Deputy Vice Chancellor Administration) presented the Welcome address as the Chairman at the Opening Ceremony. The Speaker of Akwa Ibom State House of Assembly (AKHA), Rt. Honourable Elder Sam Ikon presented the first guest lecture, while Prof. (Mrs)Atim B. Antai (Commissioner for Education) the representative of His Excellency, The Governor of Akwa Ibom State Chief (Dr.)Godswill Obot Akpabio CON, delivered the Special guest lecture and declared the Conference open.

Eminent scholars that presented lead and guest papers included Prof. David N. Sasseville, Lincoln University, Missouri, USA, Dr. Markus G. Walsh, Columbia Global Centre, Nairobi Kenya, Prof. Imoh Ukpong, University of Uyo, Nigeria and Prof. S. O. Ojeniyi, Federal University of Technology Akure., Nigeria. Over four hundred and fifty Soil Scientists, Environmentalists, Farmers, Policy Makers, the organized private sector and students attended the Conference. Participants discussed major challenges originating from inadequate knowledge, utilization and management of soil and land resources and consequences on National Development and the Agricultural Transformation Agenda of the Government of Federal Republic of Nigeria.

More than 300 papers were presented under the main or following Sub-themes (i) Sustainable Nutrient Management and Agricultural Development; (ii) Soil Genesis, Classification and Land Evaluation; (iii) Biological Systems, Soils and Agriculture; (iv) Soil Management and Conservation; (v) Water Resources and Irrigation Management; (vi) Land, Environment and Climate Change; (vii) Socio-economic Issues in Agricultural Transformation, and (viii) Legislative Issues on Soils, Land Resources and Agriculture.

The focus of the papers was diverse, but major observations were adverse effects of erosion, land degradation, desertification, deforestation, massive nutrient mining, ill-planned development projects, lack of appropriate legislation and gully erosion. Progressive shrinkage of agricultural land as a result of population pressure leading to over-exploitation of hillsides, mangroves ecosystems and other marginal lands, loose watersheds, deforestation and loss of biodiversity and resultant implications to global warming and climate change. Pragmatic paradigms were nutrient management, erosion control, environmental reclamation programmes and the use of soil information system for appropriate soil and land resources utilization and management. Need for land use Policy to serve as guide for proper utilization and management of land and soil resources and appropriate legislation for the regulation and practice of landuse /utilization and management.

The papers are rich in content and could serve useful purposes for researchers, policy makers, legislators, land and soil resources use practitioners, students, other peripheral and ancillary individuals.

Jude C. Obi (PhD)
Editor-In-Chief
30th October 2014

ACKNOWLEDGMENTS

The Editors most humbly express immense gratitude to the Vice Chancellor of University of Uyo,Professor Comfort Ekpo for hosting the 38th Annual Conference of the Soil Science Society of Nigeria (SSSN) and provision of various facilities which made planning relatively easy and the Conference successful.

The contributions and sacrifices of LOC Chairman, sub-Committee Chairmen and the entire Local Organising Committee were immeasurable and responsible for the unequalled, record breaking and **landmark** success of 'Promise 2014'. Your names are written in gold in the book of history. Those sacrifices are not in vain.

The success of the Conference was not without the financial support of numerous donors including University of Uyo, Exxon Mobil Nigeria Unlimited, Niger Delta Development Commission, Raw Material Research and Development Council, Niger Pet Structures, and Akwa Ibom State Local Government Commission, Some Ministries in Akwa Ibom State (including Agriculture and Natural Resources, Environment and Mineral Resources, Local Government and Chieftaincy Affairs, Rural Development, Women affairs and Social Welfare, Science and Technology). The financial contributions of some individuals are clearly outstanding including Sir (Elder) Barr. Bassey Dan Abia, two Members of House of Representatives, Federal Republic of Nigeria including Hon. (Dr) Akpan M. Umoh and Rt. Hon. (Sir) Emmanuel Ekpenyong. You are our pride in the organization of the Conference and your rewards will surely come.

The address from the Vice Chancellor of University of Uyo (Professor Comfort Ekpo) represented by Professor Okon Ansa, Guest Speaker, Rt. Hon Elder Sam Ikon (Speaker AKHA) and distinguished Guest lecturer Chief (Dr) Godswill Akpabio (Governor of Akwa Ibom State), represented by Prof. (Mrs)Atim B. Antai (Commissioner for Education) added glamour to the Conference. While the presentations from Lead and other Guest Speakers including Prof. David N. Sasseville, Dr. Markus G. Walsh, Prof. ImohUkpong, and Prof. S. O. Ojeniyi gave authority and impetus. The contributions of Chairmen and Rapporteurs of various Sessions were indispensible. You made the efforts, sacrifices and dedications of the Executive Committee of SSSN, Local Organizing Committee and Members of SSSN including other attendees of "Promise 2014" worthy. We are immensely grateful and are proud to be associated with you.

The reviewers of the manuscripts including Prof. Trenchard O. Ibia, Dr. Peter I. Ogban, Dr. Gregory S. Effiong, and Dr. Godwin U. Akpan made the publication of the Conference Proceedings (without which the Conference itself is meaningless) possible. You will live to attend many more Conferences, Thank you.

J. C. Obi (PhD)
For the Editors
30th October 2014.

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GROWTH AND NODULATION OF GROUNDNUT FERTILIZED WITH INORGANIC N AND P ON DIFFERENT PEDONS IN MINNA, NIGERIA

*Afolabi, S. G., Hassan, M. F., Uzoma, A. O., Lawal, B. A., Adeboye, M. K. A. and Bala, A.

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ABSRTACT

Growth and Nodulation of groundnut fertilized with inorganic N and P was evaluated on different pedons of the Teaching and Research Farm of the School of Agriculture and Agricultural Technology, Gidan Kwano campus, Minna in the month of March, 2013. There are 4 treatments as follows: control, 25kg N ha^{-1}, 60 kg P ha^{-1} and 25 kg N ha^{-1} + 60kg P ha^{-1}. There were also 4 locations as pedon one, pedon two, pedon three and pedon four. The pot experiment was arranged in a Complete Randomized Design (CRD) replicated 3 times. Result revealed that the effect due to the interaction between fertilizer and location was not significant. However location significantly affected plant height, nodule number and nodule weight. Fertilizer only affected leaf number. Planting groundnut (SAMNUT 22) in pedon 3 support good growth and nodulation.

INTRODUCTION

Groundnut (*Arachis hypogaea L.)* is an important cash and food grain legume crop grown for its edible oil and protein-rich kernels in Sudan Savanna and Northern Guinea Savanna of Nigeria. It is one of the most popular and crops cultivated in more than 100 countries in six Continents (Nwokolo, 1996). It is grown in 25.2 million hectares with a total production of 35.9 million metric tons (FAO, 2006). It is sometimes grown as a sole crop in rotation with cereals to reduce striga infestation and improve soil fertility. Phosphorus (P) deficiency is the most frequent nutrient stress for growth and development of grain legumes including groundnut in the Nigerian Savanna (Kamara *et al.,* 2008). It is one of the most popular commercial crops in Nigeria and accounted for 70% of the total Nigeria export earning between 1956 and 1967 but declined, to almost half of the existing level of 1.7 million hectares (Larinde, 1999), between 1956 and mid 1980s due to combined effect of drought and disease (Misari *et al.,* 1980), and production was at 23,390,000 metric tons in 2002 (Larinde, 1999). Groundnut is a safe, cheap and renewable nitrogen source for crops not capable of fixing N_2 and therefore good for agriculture as well as the environment (Vance, 2001). Application of nitrogenous fertilizer is not required but that lower doses of nitrogen would be sufficient to raise a good crop. However, soil physico-chemical constraints, among other problems, pose an important barrier to actualizing optimum utilization of the benefits of N_2-fixation (Graham and Vance, 2003). It is an important annual legume in the World and it is mainly grown for oilseed, food, and animal feed (Pande *et al.,* 2003). It is the chief crop rotation component in many Sub-Saharan Countries. Groundnut does best in sandy-loam and loamy soils, and in black soils with good drainage. Heavy and sticky clays are not suitable for groundnut cultivation because the pod development is hampered in these soils. The objective of the study is to evaluate the growth and nodulation characteristics of groundnut (SAMNUT 22) as affected by application of inorganic N and P in different pedons of the Teaching and Research Farm of Federal University of Technology, Minna.

MATERIALS AND METHODS

Study area

The study was carried out at the glass house of School of Agriculture and Agricultural Technology Federal University of Technology, Gidan Kwano, Minna (latitude 09° 31′ 59.5″ N and longitude 006° 27′ 11.4″ E, 251.6 m above the sea level), in the Southern Guinea Savanna of Nigeria. The physical features around Minna consist of gently undulating high plains

developed on basement complex rocks made up of granites, migmatites, gneisses and schists. Inselbergs of "Older Granites" and low hills of schists rise conspicuously above the plains. Beneath the plains, bedrock is deeply weathered and constitutes the major soil parent material (saprolites) (Ojanuga, 2006). Climate of Minna is sub – humid with mean annual rainfall of about 1284 mm and a distinct dry season of about 5 months duration occurring from November to March. The mean maximum temperature remains high throughout (about 33.5°C) particularly in March and June (Ojanuga, 2006).

Soil sampling and analysis

The soil samples were collected from the depth of 0 – 15 cm from four pedons of the Teaching and Research Farm of the Federal University of Technology, Gidan Kwano, Minna. Pedon 1 is located at longitude 6^0 26′ 5.29″E and latitude $9^0$31′ 34.40″N, 253 m above sea level, Pedon 2 has a longitude of 06^0 25′00.94″E and latitude of 9^0 32′03.50″ N, 217 m above sea level, pedon 3 is located at longitude 6^0 26′49.10″E and latitude 9^0 30′ 39 46″N, 205 m above sea level. Pedon 4 is located at longitude 6^0 26′ 24″ E and latitude $9^0$30′ 47.7″N, 195 m above sea level. The samples were bulked according to the n, sieved using 2 mm sieve, then 4kg of soil was collected in 12 sampling bags for each pedon. All 48 pots were arranged at the glass house while a representative sample was collected for physico-chemical properties. The soil samples were air-dried, sieved and analysed for the following: Soil particles size analysis by hydrometer method. pH was determined by using pH meter in both water and 0.01M CaCl (Soil solution ratio 1:2). Total nitrogen was estimated by Kjedhal method. Organic carbon was determined by Walkley Black method. Available phosphorous was determined colorimetrically after Bray-1 extraction. Exchangeable bases were extracted with neutral 1N NH_4OAC. Sodium and potassium were measured by using flame photometer. Calcium and Magnesium by Na EDTA titration. Exchangeable acidity was extracted with 1N KCl (Agbenin, 1995).

Treatment and experimental design

4 kg of soil was filled in a pot, 12 pots for each pedon, making a total of 48 pots for the 4 pedon. The experiment was 4 x 4 factorial experiment filted to Complete Randomized Design (CRD) with three replications. The factors are; control, 25 kg N ha^{-1}, 60 kg P ha^{-1}, 25 kg N ha^{-1} + 60 kg P ha^{-1} and four pedon.

Agronomics practices

The pots filled arranged in the glass house were watered for three days before planting. The groundnut seed (Samnut 22) were selected and planted on the 3rd of May, 2013 at four (4) seeds per pot. The plants were thinned to two plants per pot at 2 weeks after planting (WAP) and fertilizer was applied the same day. Weeding was done manually at 2 and 5 WAP. Water application was on daily bases (as the plant required). Plants were harvested 8 WAP. Shoots were cut at soil level, roots were also washed, nodules were collected, counted and weighed. The plant height was taken at harvesting, biomass fresh weight, number of leaf at physiological maturity, dry biomass weight and dry nodules weight, were taken.

Statistical analysis

Growth and Nodulation data were subjected to analysis of variance (ANOVA) and the least significance difference (LSD) were used to separate significantly different means at 5% probability level.

RESULTS AND DISCUSSION

The physico-chemical properties of the four pedons

The physico-chemical properties of the four pedons were shown in Table 1. The textural classes of the soils were sandy clay loam. The pH in H_2O were slightly acidic. It implies that some plant nutrients may be readily available in the soil. Brandy and weil (2010) reported that release of some plant nutrients fall between pH 5.5 – 7.0. The available phosphorous was rated medium in pedon 1, 2 and 4 but high in pedon 3. The organic carbon and total nitrogen were low in all pedon. The low organic contents of the soils are characteristics of the savanna due partly to rapid decomposition and mineralization of organic matter and to poor management (i.e sometimes burning of crop residues by farmer). Calcium was low in pedon 1, 3 and 4 but medium in pedon 2.

Magnesium was medium in pedon 3 and 4 but high in pedon 1 and 2. Potassium was low in pedon 1 and 3 but medium in pedon 2 and 4. Sodium was medium in all the pedons. The dominance of calcium on the exchange site may be attributed to calcium being the least easily lost from the soil exchange complex. It has being said to be the most abundant cation in exchange complex of nearly all soils that are not as acidic as to have high aluminium saturation (Brandy and Weil, 2010).

Growth and nodulation characteristics of groundnut as affected by fertilizer treatment under four pedons

Growth and nodulation characteristics of groundnut as affected by fertilizer treatment on different four pedons were shown in Table 2. Plant height (cm) of groundnut was significantly affected ($P < 0.05$) by pedon but not by fertilizer treatment. Pedon 3 produced the tallest plants (17.2cm). The shortest plants were observed at pedon 4. The difference in height of plants in pedon 1 and 2 were not statistically different ($P > 0.05$). Shoot biomass (g plant^{-1}) was also significantly affected ($P < 0.05$) by pedons but not by fertilizer treatment. Pedon 2 however produced the heaviest plants (6.08 g plant^{-1}) followed by pedon 3, 4 and 1. There was however no significant difference between the shoot weight of the plants of pedon 2 and 3 and also between the shoot weight of plants at pedon 1 and 4. Leaf number per plant was significantly affected ($P < 0.05$) by fertilizer treatment but not by pedon. A combination of 25 kg N ha^{-1} and 60 kg P N ha^{-1} produced more leaves compared with the control and with sole N and P application. 25 kg N ha^{-1} application gave a leaf number of 128 while 60 kg P N ha^{-1} produced a leaf number of 114. Nodule number (plant^{-1}) was significantly affected ($P < 0.05$) by pedons but not significantly affected by fertilizer treatments. The highest nodule number of 87 was however produced plants supplied with a combination of 25 kg N ha^{-1} and 60 kg P N ha^{-1}. The least nodule number was produced by control plants. Pedon 3 produced the highest nodule number of 107 followed by pedon 2, 1 and 4 in their sequence. Nodule weight (g plant^{-1}) was not significantly affected by fertilizer treatment or pedon ($P > 0.05$). However, plants supplied with 25 kg N ha^{-1} produced the heaviest nodules of 0.13 g followed by receiving a combination of 25 kg N ha^{-1} and 60 kg P N ha^{-1} with 0.1 g plant^{-1}. The control plants and plants receiving 60 kg P N ha^{-1} produced the lightest nodules (0.08 and 0.07 g plant^{-1} respectively). Pedon 3 plants produced the heaviest nodule weight (0.14 g plant^{-1}), followed by pedon 2, 1 and 4 in that order. There was a significant difference between the nodule weights of plants grown on Pedons 3 and 4.

Plant height and shoot biomass plant^{-1} was not significantly affected by fertilizer treatments suggesting that the inherent soil fertility status were probably sufficient. This is similar to the finding of Ahmed *et al.*, 2007 which observed that groundnut is adaptable to environment to low fertility status. It also suggests that SAMNUT 22 is nutrient efficient and may not need an exogenous supply of N and P fertilizers. Applying a combination of 25 kg N ha^{-1} and 60 kg P ha^{-1} depressed the height of plant compared with the control. Although the sole applications of 25 kg N ha^{-1} and 60 kg P N ha^{-1} respectively produced the taller and heavier plants, the difference compared with the control was not statistical ($P > 0.05$). Leaf number of plants followed a similar trend except that it was significantly affected by fertilizer treatments ($P < 0.05$) suggesting that nutrient supply determine the number of leaves produced by SAMNUT 22. It will however be needless to supply a combination of 25 kg N ha^{-1} and 60 kg ha^{-1} when sole application can give leaf number that are statistically as high as those produced when N and P are combined.

Table 1: Physico-chemical properties of the soils of each pedon collected from the Teaching and Research Farm

Parameter	Pedon	1	2	3	4
Sand (g kg?¹)		675	665	685	705
Silt (g kg?¹)		103	133	113	93
Clay (g kg?¹)		222	202	202	202
Texture class		Sandy clay loam			
pH in $CaCl_2$		4.61	4.52	4.57	4.47
pH in H_2O (1:2.5)		6.27	5.47	5.15	5.80
Available P (mg kg?¹)		16.00	12.00	21.00	17.00
Total Nitrogen (g kg?¹)		0.62	0.71	0.40	0.60
Organic Carbon (g kg?¹)		4.60	5.90	4.10	4.50
Exchangeable Cations (cmol kg?¹)					
Mg²?	1.12	1.12	0.80	0.56	
Ca²?	1.28	2.24	1.60	1.68	
K?	0.13	0.23	0.11	0.20	
Na?	0.15	0.22	0.12	0.15	
Exchangeable Acidity (cmol kg?¹)					
Al³? + H?		2.5	2.5	2.5	2.5
ECEC		5.18	6.31	5.13	5.09

Table 2 Growth and nodulation characteristics of groundnut as affected by fertilizer treatment under four pedons

Treatment	Plant height (cm)	Leaf number (plant $^{-1}$)	Shoot biomass	Nodule number g plant^{-1}	Nodule weight
Fertilizer (F)					
Control	15.17	91.00	4.39	74.00	0.08
25 kg N ha^{-1}	15.58	128.00	4.91	78.00	0.13
60 k g Pha^{-1}	16.33	114.00	5.46	76.00	0.07
25 kg N ha^{-1} + 60 k g Pha^{-1}	15.00	133.00	5.41	87.00	0.10
LSD (p<0.05)	NS	32.18	NS	NS	NS
SE±	1.74	22.34	1.11	18.88	0.04
Pedon (P)					
1	15.67	118.00	3:10	77.00	0.08
2	15.33	118.00	6.08	79.00	0.09
3	17.17	128.00	5.74	107.00	0.14
4	13.92	101.00	3.25	53.75	0.06
LSD (p < 0.05)	2.51	NS	1.60	27.19	0.06
SE±	1.74	22.34	1.11	18.88	0.04
F*P	NS	NS	NS	NS	NS

Researches conducted in the Southern Guinea Savanna have shown that phosphorus is very important in shoot biomass production because it affects dry matter production and accumulation. Nitrogen has also been demonstrated to increase carbohydrate and protein synthesis (Yusuf *et al.*, 2003). These explained that plants supplied with 25 kg N ha^{-1} were taller, heavier and vigorous in growth compared with the control (Table 2). Pedons affected plant height and shoot biomass plant^{-1} significantly ($P < 0.05$) and not leaf number. Pedon 3 averagely produced the highest values of growths parameter observed, followed by Pedon 2, 1 and 4 in that sequence. Averagely Pedon 3 soils are the poorest in nutrient status (Table 1) and support the fact that SAMNUT 22 is nutrient efficient and very adaptable to poor soils of the pedon. Nodulation characteristics assessed as nodule number and weight plant^{-1} was significantly affected by ($P < 0.05$) pedon but not by fertilizer treatments. The highest nodule number of 87 plants was produced by plants supplied with combination of N and P while sole N and P produced 78 and 76 nodule per plant respectively. These values were higher than that produced by the control but the difference was not statistical ($P < 0.05$) suggest the fertilizer

application may not be necessary. A similar trend was observed for nodule weight except that 60 kg P ha^{-1} surprisingly depressed nodule weight compared with the control. Pedon 3 produced the highest values of nodule number and weight, followed by pedon 2, 1 and 4 in that sequence. The reason might be that SAMNUT 22 is nutrient efficient and very adaptable to the poor soils of the pedons of the Teaching and Research Farm.

CONCLUSION

This study revealed that growing groundnut (SAMNUT 22) in pedon 3 of the Teaching and Research Farm Federal University of Technology support good growth and nodulation, although application of fertilizer treatments 25 kg N ha^{-1} + 60 kg P ha^{-1} and 25 kg N ha^{-1} increased leaf number in the area. No significant interaction between fertilizer and pedons suggest that planting groundnut (SAMNUT 22) without fertilizer treatment can still be encouraged in the study area.

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