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Proceedings of the

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of the

Soil Science Society of Nigeria

MARCH 7 – 11, 2011

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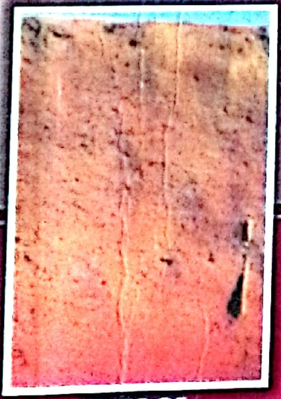

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FEDERAL UNIVERSITY OF TECHNOLOGY,
Minna, Niger State, Nigeria.

SOIL RESOURCES MANAGEMENT, GLOBAL CLIMATE CHANGE AND FOOD SECURITY

PROCEEDINGS OF THE

35TH ANNUAL CONFERENCE

OF THE

SOIL SCIENCE SOCIETY OF NIGERIA

"MINNA 2011"

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MARCH 7TH – 11TH, 2011

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FOREWORD

The 35th Annual Conference of the Soil Science Society of Nigeria (SSSN) was held at the Fe University of Technology (FUT), Minna, Niger State, Nigeria, from 7th – 11th March, 2011. The the the Conference was " Soil Resources Management, Global Climate Change and Food Security. Conference was attended by over four hundred (400) registered participant, comprising of emine Scientists from within and outside Nigeria, including, Prof. S. Norcliff, Chairman of Budget and Fi International Union of Soil Science (IUSS). Ninety-six (96) papers were presented and after they peer reviewed, eleven (11) papers were selected for publication in Journal and fifty-one (51 published in this book of Proceedings.

In recent times, there has been growing societal concern about the deleterious impact of cli change in the achievement of food security in the developing countries. The increasing dema food is leading to environmental degradation, thereby exacerbating factors such as increasing ca dioxide concentration in the atmosphere, in part, responsible for climate change. This is fu undermining the food systems upon which food security is based. Soils represent an impo terrestrial stock of carbon in the form of soil organic matter and contain approximately two to three t as much as terrestrial vegetation and atmosphere respectively. Thus, the dynamics of soil org carbon as affected by agroecosystem, to a large extent, affects the carbon dioxide concentration in atmosphere, as well as global climate change. The theme of the Conference is therefore apt and tim in order to discuss soil management strategies to reduce carbon dioxide concentration in atmosphere, through increasing terrestrial stock of carbon as well as improving soil fertility.

The sub themes on which papers were presented, addressed the various areas of soil science tha not only help to manage the soil to mitigate the impact of climate change, but improve the fertility o soil for optimum and sustainable productivity. These sub themes were:

- Integrated Nutrient Management and Food Security.
- Biological Interactions in the Soil and Food Security.
- Organic Agriculture and Climate Change.
- Soil Genesis, Classification and Land Evaluation.
- Land Use Systems and Climate Change.
- Tillage and Soil Conservation for Enhanced Food Security.
- Irrigation Management, Climate Change and Food Security.
- Environmental Management and Climate Change.
- Socio-economic Implications of Climate Change on Soil Resources Management.

Agricultural activities are partly responsible for changing the world's climate and giving rise to ot environmental changes, including carbon and nitrogen cycling. The achievement of food secur Millennium Development Goals (MDGs), Poverty/Hunger Alleviation, Environmental Protection a New Partnership for Africa Development (NEPAD) sectoral priorities of Agriculture and Environme remains a major challenge for Nigeria. Thus, coming up with this theme, at this time, was not o propitious, but afforded eminent soil scientists from both within and outside the country, to collective discuss their experiences, findings and proffer soil management strategies to mitigate the negat effects of climate change on food security and the environment. This edition of our Conferen proceedings, therefore contain very valuable information for the attainment of food security, there alleviating poverty and hunger, and on environmental protection for sustainable biological producti and environmental quality. I, therefore recommend the publication, for the use of environmen management experts, scientists, policy makers, industrialists and business investors.

Dr. M.K.A. Adeboye
18th January, 2012

ACKNOWLEDGEMENTS

The Editors wish to express their profound gratitude and appreciation to the Vice-Chancellor, Federal University of Technology (FUT), Minna, Prof. M.S. Audu, for accepting to host the 35th Annual Conference of the Soil Science Society of Nigeria (SSSN) and approving the use of the various facilities of the University, for the successful hosting of the Conference. The University administration provided accommodation and transportation for SSSN officials and invited guests, in addition to a sumptuous cocktail party. We are particularly grateful to the Deputy Vice-Chancellor (Administration), Prof. M.A.T. Suleiman, for his assistance in raising fund for the Conference. Our profound appreciation also goes to the Dean, School of Agriculture and Agricultural Technology, Prof. K.M. Baba, who was the host Dean, for his contributions towards the successful hosting of the Conference.

We are grateful to the Chairmen and members of the various sub-committees of the Local Organizing Committee (LOC), for their hard work, dedication and commitment, that made the hosting of the Conference possible and successful.

The Editors thank both staff and students of the School of Agriculture and Agricultural Technology, FUT, Minna, for their support and sacrifice, right from the beginning of preparations to the end of the Conference.

The Conference was held with donations from various individuals and Corporate organizations, already listed in this book, without which our ability to host the Conference would have been doubtful. Let us acknowledge here, our special donors:
Prof. Sheikh Abdallah (former Honorable Minister of Agriculture and Rural Development).
International Fertilizer Development Center (IFDC).
We appreciate all your financial contributions.
The Editors express their thanks to the Chairmen of the Plenary and Technical Sessions, Prof. V.O. Chude, Prof. I.E. Esu, Prof. O.O. Agbede, Prof. S.O. Ojeniyi, Prof. P. Nnabude and Prof. J.O. Ogunwole, who saw to the smooth running of the Sessions.

Finally, the Editors are sincerely appreciative of the unflinching support of the National Executive of the SSSN in the articulation of the Conference Theme and Sub-themes and for their moral and logistics support. We particularly express our profound gratitude to the President and Fellow of the SSSN, Prof. V.O. Chude, for his untiring, selfless and persistent encouragement, right from the day we got the hosting right, to the end of the Conference and the production of this Book of Proceedings.
God bless you all.

Editors
18th January, 2012.

TABLE OF CONTENTS

SOIL FERTILITY, CHEMISTRY AND MICROBIOLOGY

AGROFORESTRY AND OTHERS

VARIETAL PERFORMANCE OF GROUNDNUT (*Arachis hypogaea*) UNDER TWO PHOSPHORUS LEVELS ON AN ALFISOL IN MINNA, SOUTHERN GUINEA SAVANNAH OF NIGERIA

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ABSTRACT

Growth, nodulation and yield responses of groundnut varieties to phosphorus application was evaluated in a field experiment at the Teaching and Research Farm of the Federal University of Technology, Minna during the 2010 cropping season. The aim of the study was to select lines of groundnut varieties that exhibit good growth and yield characteristics with minimal input requirement. The experiment consisted of five groundnut varieties (Samnut 22, RMP 12, Samnut 23, Ex Dakar and a local variety) at two phosphorus levels (0kg P ha^{-1} and 30kg P ha^{-1}) in a 2x5 factorial experiment arranged in a randomed complete block design with three replicates. Results revealed that phosphorus significantly ($p \leq 0.05$) increased plant height, leaf number, days of 50% flowering and yield. With the exception of percent germination and nodule weight, varietal difference significantly ($p<0.05$) affected the measured parameters. On the average, 30kg P ha^{-1} application gave higher percentage germination than 0kg P ha^{-1}. Similarly, plants receiving 30kg P ha^{-1} were taller than those supplied with 0kg P ha^{-1}. Regardless of P application, Samnut 22 and RMP 12 recorded the best heights followed by Samnut 23, Ex Dakar and local variety in that order. Application of 0kg P ha^{-1} gave a higher shoot biomass but plants supplied with P flowered earlier by one day, produced heavier pods and nodules per plant, and had greater grain yield than those plants without fertilizer P. Results showed that Samnut 22 and Samnut 23 had the earliest flowering dates and highest grain yields regardless of P treatment, thus suggesting better adaptation by these varieties than the others.

Key words: Adaptation, Alfisol, groundnut varieties, performance, phosphorus levels

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an annual legume which is also known as peanut, earthnut, monkey nut and goobers. It is the 13th most important food crop and 4th most important oil seed crop of the world (Weiss, 2000). Groundnut seeds (Kernels) contain 40 – 50 % fat, 20 – 50% carbohydrate. Groundnut seeds are a nutritional source of vitamin E, niacin, falacin, calcium, phosphorus, magnesium, zinc, iron, riboflavin, thiamine and potassium. Groundnut kernels are consumed directly as raw, roasted or boiled kernels; oil extracted from the kernel is used as culinary oil. It is also used as animal feed (oil pressings, seeds, green material and straw) and industrial raw material (oil cakes and fertilizer). These multiple uses of groundnut plant make it an excellent cash crop for domestic markets as well as for foreign trade in several developing and developed countries.

Groundnut is one of the most popular and universal 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). Major groundnut growing countries are India (26%), China (19%) and Nigeria (11%). Its cultivation is mostly confined to the tropical countries ranging from 40°N to 40° S. Major groundnut-producing areas in Nigeria are located in the Sudan and northern Guinea savanna ecological zones where the soil and agro-climatological conditions are favorable (Misari *et al.*, 1990). Sudan savanna zone receives adequate rainfall for groundnut production. The crop is grown usually as a component of variety of crop mixtures including sorghum, millet, cowpea and maize (Misari *et al.*, 1998).

As to production constraints, the groundnut production in Nigeria faces problems that are many and complex. The drought coupled with rosette epidemic in 1975 resulted in decline in groundnut production. This has resulted in a southward shift of the suitable climatic zone for groundnut production. Diseases such as the groundnut rosette, early leaf spot, late leaf spot, and rust have been on the increase. Leaf spot attack severally reduces the yield.

Groundnut is an energy-rich crop but it is grown under energy – starved conditions. An average crop of groundnut removes about 112kg N, 27kg P_2O_5 and 34kg K_2O from 1 ha of land. It has great affinity for phosphorus; the nutritional needs of groundnut must be satisfied to attain maximum yields. Groundnut being a leguminous crop is capable of fixing atmospheric nitrogen by the root nodule bacterial. Application of nitrogenous fertilizer is not required but that lower doses of nitrogen would be sufficient to raise a good crop. Also application of phosphorus and potassium become more essential and these needs to be supplied in adequate quantities for obtaining higher yields. The efficient use of P applied however, depends on genetic variation within crop species, even between cultivars within a crop species, form and type of fertilizer, soil characteristics and their interactions with crop grown, and the production environment that includes technological, agro ecological, and economic factors. In view of this, a field experiment was carried out in Minna, the Southern Guinea Savanna Zone of Nigeria. The aim was to evaluate the response of five varieties namely Samnut 22, Samnut 23, Ex- Dakar, RMP 12 and a local check to Single super phosphate in order to recommend varieties with highest nodulation and yield potentials for farmer's use.

MATERIALS AND METHOD

Study area

The research was carried out at the Teaching and Research Farm of School of Agriculture and Agricultural Technology, Federal University of Technology permanent site situated at kilometer (16km) along Minna-Bida road from the month of July to November 2010. Minna lies within the Southern Guinea Savanna of Nigeria (Lat 9^0 49^1N and Long 6^0 30^1E)

Soil sampling and analysis

Twenty core samples collected from the surface soil (0 – 15 cm depth) using auger was bulked and mixed. A sub – sample was then air dried and passed through a 2mm sieve in preparation for physico-chemical analysis using procedure described by Juo (1979) as follows; Total Nitrogen was determined by micro – Kjeldahl method and available P by Bray 1 procedure. Effective CEC (ECEC) by the summation of the exchangeable cations and exchangeable acidity expressed in C mol kg^{-1} soil. The particle size was analyzed by the hydrometer method, pH in water (Soil: water ratio of 1:2) and in 0.01M $CaCl_2$ by electrometric method, Organic carbon by Walkey-black method, Exchangeable Ca^{2+} and Mg^{2+} by Na – EDTA method, K^+ and Na^+ by flame photometric method..

Land Preparation, experimental design and treatments

A hectare of land was cleared, ploughed, harrowed and ridged after which about 0.05ha was reserved for groundnut varietal trial. The land reserved was further divided into six i.e. two blocks representing one replicate. Each block was further divided into plots of size 4.5m 3m. The experiment was a 2 5 factorial experiment arranged in randomized complete block design i.e. two phosphorus levels (0 kg P ha^{-1} and 30kg P ha^{-1})) and five varieties of groundnut (SAMNUT 22, RMP 12, SAMNUT 23, EX – DAKAR, and Local Variety) to give ten treatments which were replicated three times.

Planting and crop management

Two seeds of each variety were dibbled into the soil at intra and inter row spacing of 25cm 75cm $plot^{-1}$ on the month of July, 2010. A week after emergence, phosphorus treatment was applied. Two manual weedings were carried out 3WAP and 6WAP.

Harvesting and tissue sampling

Shoot biomass of groundnut sampled at 50% podding for Biological Nitrogen Fixation (BNF) assessment and nodule collection for a set of plots. About four plants were destructively sampled from the two inner ridges. Harvesting was done at maturity with the aid of hoes and hand pulling.

Data collection and statistical analysis

The yield data were taken at harvest. Plant height, shoot biomass, leaf number and nodulation were taken at 50% podding. The statistical package SAS 2002 was used to subject data collected to two way analysis of variance (ANOVA) to determine treatment effect at 5% level of significance. Duncan multiple tests were used to separate means.

Table 1: Some physico-chemical properties of the soil at the experimental farm prior to planting of groundnut

Parameters	Value
Sand (%)	66.40
Silt (%)	7.00
Clay (%)	26.60
Textural class	Sand clay loam
pH in $CaCl_2$	5.42
pH in H_20 (1:2:5)	6.33
%N	0.154
Available P (g Kg^{-1})	6.30
Organic C (g kg^{-1})	0.184
Exchangeable cations (cmol kg^{-1})	
Mg^{2+}	1.70
Ca^{2+}	2.30
K^+	0.92
Na^+	1.56
Exchangeable acidity (cmol kg^{-1})	
$AL^{3+} + H^+$	6.2

RESULTS AND DISCUSSION

Soil texture, reaction and exchangeable bases

The results of the physico-chemical properties of the soil at 0-20cm (Table 1) revealed that the soil was sandy clay loam, slightly acidic in water and $CaCl_2$ respectively and also low in organic carbon and total N. A low available P content of 6.3g kg^{-1} justifies the reason for screening groundnut varieties for better adaptation to low soil P content. Johnson *et al.*, (1994) have reported that species of crops have the capacity to significantly modify the environment of their root system particularly under stress condition which can increase their absorption of P several folds.

Growth, nodulation and yield parameters of groundnut

Groundnut varieties differed in their response to P application (Table 2). Regardless of P application, samnut 23 had the highest germination percentage, followed by samnut 22, RMP 12, local and Ex – Dakar in that order probably because of inherent ability to be adapted to the environment (Ahmad Mohammad Ulas, 2007). The higher percentage germination of 89% recorded by groundnut varieties when supplied with 30 kg P ha^{-1} emphasises the role P plays in plant growth.

Contrary to the report of Cheema *et al.*, (2001), the results of this study (Table 3) showed that plant height had a strong positive correlation with yield, leaf number and weight of pods per plant. Podding correlated positively with grain yield just as observed by Miri, (2007). The varieties which produced heavier pods per plant also produced higher grain yield. Result has also shown that plants that did not receive any P application (0 kg P ha^{-1}) were the shortest, while Samnut 22 and RMP 12 plants were the tallest plants regardless of P application. The significant effect of 30kg P ha^{-1} application on leaf number compared to shoot biomass suggest that 30kg P was more effective in increasing numbers of leaves than their weight. The higher shoot biomass accumulation of local variety, Samnut 22 and RMP12 regardless of phosphorous application suggest a form of genetic variability in P uptake. This agrees with the report of Miri, 2007 that biomass accumulation is greatly influenced by crop variety. Regardless of P application, local variety recorded the highest shoot biomass followed by Samnut 22, RMP 12, Samnut 23, Ex Dakar in that order. On the average, groundnut varieties recorded higher shoot biomass of 26g $plant^{-1}$ when 0 kg P ha^{-1} of phosphorus was applied suggesting that they were averagely P efficient.

***Table 2:* Growth, nodulation and yield performance of groundnut varieties as affected by P application**

Treatment	% germination	height (cm)	Shoot Biom. (g plt^{-1})	leaf no. (plant^{-1})	Days 50% flowering	pod Weight (g plant^{-1})	Nodule (g plant^{-1})	Yield (kg ha^{-1})
P Level								
0 kg P ha^{-1}	87^{a}	31^{b}	26^{a}	254^{b}	35^{a}	3^{a}	0.2^{a}	272^{b}
30 kg P ha^{-1}	89^{a}	35^{a}	25^{a}	284^{a}	34^{a}	4^{a}	0.3^{a}	424^{a}
Variety								
Samnut 22	89^{a}	35^{a}	32^{ab}	298^{a}	32^{b}	6^{a}	0.3^{a}	569^{a}
RMP 12	89^{a}	35^{a}	27^{abc}	246^{ab}	32^{b}	3^{ab}	0.3^{a}	375^{a}
Samnut 23	90^{a}	34^{a}	18^{bc}	267^{a}	32^{b}	4^{ab}	0.2^{a}	480^{a}
Ex – Dakar	86^{a}	30^{ab}	14^{c}	197^{b}	40^{a}	2^{b}	0.3^{a}	157^{a}
Local	88^{a}	28^{b}	36^{a}	238^{ab}	38^{a}	3^{ab}	0.2^{a}	161^{a}
P*V	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns

NS: not significantly different
Means with the same letters indicated in columns are not significantly different ($P \leq 0.05$). Means with the same letters indicated in columns are not significantly different ($P \leq 0.05$).

Table 3: Correlation Coefficient between the pairs of Growth, Nodulation and Yield Parameters

	Plant Hght cm). (plant^{-1})	Leaf no. (plant^{-1})	F50	% germination	Shoot biomass (g plant^{-1}	Pod Wt (g plant^{-1})	Nodule wt (g plant^{-1})	Yield (kg ha^{-1})
Plant Hght (cm)	-							
No. Leaf (Plant^{-1}	0.71**	-						
F50	-0.44*	-0.41*	-					
% Germination	0.36*	0.35^{-ns}	-0.29^{-}	-				
Shoot biomass (plant^{-1})	0.41*	0.31^{-ns}	-0.01^{-ns}	0.30^{-ns}	-			
Pod (g plant^{-1})	0.37*	0.26^{-ns}	0.40*	0.25^{-ns}	0.41*	-		
Nodule wt (plant^{-1})	0.10^{-ns}	0.10^{-ns}	0.16^{-ns}	0.07^{-ns}	0.41^{-ns}	-0.06^{-ns}	-	
Yield (kg ha -1)	0.70**	0.64**	-0.66*	0.31^{-ns}	0.25^{-ns}	0.51**	0.91^{-ns}	-

p≥ 0.05 not significant *P< 0.05 significant **P< 0.001 F50 days to 50% flowering

Consistent with this report is the findings of Gahoonia *et al.* 2000 and Shenoy and Kalagudi, 2005 who maintained that phosphorus mobilizing process may differ with plant species and even cultivars in some cases making them successful in low P soils. The nodule weights of groundnut varieties were improved by the application of 30kg P ha^{-1} phosphorus suggesting that their nodules were good sinks for P storage (Conradie *et al.*, 1989). In this result, yield of groundnut varieties also responded to P application as reported by Azizi *et al.* (2006). Regardless of varietal difference, groundnut plants produced higher yield at 30kg P ha^{-1}. Although the groundnut varieties were earlier identified to be P efficient, this probably did not translate to better yield at 0 kg P ha^{-1} (Table 2). Consistent with the report of Aziz *et al.*, 2006, our results have revealed that 30 kg P ha^{-1} reduced days to 50% flowering of groundnut varieties by one day though not significantly. The highest yield of 569 kg ha^{-1} recorded by Samnut 22 is comparable to the yield of groundnut observed in the Southern Guinea Savannah of Nigeria.

Conclusion

Our results have proven that agricultural productivity in the Southern Guinea Savannah of Nigeria can be increased by efficient management of phosphorus. The extent of response to phosphorus application will however be determined by the choice of crop varieties. Regardless of varietal differences, 30kg P ha^{-1} phosphorus application averagely produced the best growth, nodulation and yield response of Groundnut varieties. Samnut 22, Samnut 23 and RMP 12 gave the best responses averagely suggesting that they were better adapted to our low P soils than the rest varieties and may be useful to our resource-poor local farmers. The focus for further research will be to verify their responses to various P source and levels under varying management practices and prevailing environmental conditions.

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