Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.5, No.18, 2015

Effect of Different Rates of Liming Materials on the Production of Groundnut (*Arachis Hypogeae*) In Owerri Southeastern Nigeria

Jaja, E. T[1] and I.I. Ibeawuchi [2]
(1) Department of Applied Environmental Biology, Rivers State University of Science and Technology, Nkpoh, Port Harcourt
(2)Department of Crop Science and Technology, Federal University of Technology PMB1526, Owerri Imo State, Nigeria

ABSTRACT

This work evaluated liming effects on the production of groundnut. The field work was laid out in randomized complete block design (RCBD).Three lime materials (Calcium oxide, wood ash and palm bunch ash) were used at three rates (2,4,6tons ha- 1) and the control (Otonha-1) to give a total of 10 treatments. The treatments were replicated three times. Plant growth parameters collected at 2,4 and 8 week after planting includes% emergence at 2WAP; leaf area, plant height and number of leaves per stand at 4 and 8 WAP. Pod yield parameters per hectare. Data collected were subjected to statistical analysis of (ANOVA). Results of the analysis showed significant difference at 5% probability level except for number of leaves at 4WAP which manifested at 8WAP. Soils of Owerri are acidic in nature and this could be as a result of parent materials, land use and climate. However, results of the post planting physiochemical analysis were promising at it showed considerable improvement in the soli system and the effective distribution and uptake of nutrient is an indication of the response of the crop due to liming. Highest performance of the crop was obtained from treated with 2 tons ha-1 of wood ash followed by palm bunch ash at 4tons ha -1 . The least performance was obtained from the control experiment.

Key word: Lime and liming materials, groundnut production, soils of Owerri, Nigeria

INTRODUCTION

Groundnut,(*Arachis hypogeae L.)* belongs to the family leguminoceae. It is an important legume grown for human consumption and livestock feed. West African countries like Nigeria, Senegal, and the Gambia are amongst the leading producers of groundnut and Nigeria is the third largest producer in the world and the largest world exporter of the crop (Ngoka 1997). Groundnut is a valuable cash crop for millions of resource poor farmers in the semi-arid tropics and thus generates employment on the farm and in the transportation, processing and marketing of the crop. It is the 1th most important food crop of the world and the word's 4th most important source of edible oil and third most important source of vegetable protein (Weiss 1983). The peanut plant hides its fruits in the ground for what reason nobody seems to know and therefore has been given name that refer to this strange event (Verdcourt 1970). Groundnut is a widely used common name and the Azetec called this plant "tlalcacahuatl' or ground cacas' Linnaeus named the specie hypogeae which under earth (Anikwe et al 2005). *Arachis hypogeae i*s not known to occur in the wild. According to cobley and steels (1976) groundnut has spread through the tropics and sub- tropics to latitude 40^{o} N and S of the equator, where rainfall during the growing season is greater than 500mm ripen. It is an annual herb with variations in its growth habit: there are now open, spreading compact and dense bunch types. It grows to a height of not more than 60cm. the free branching stems hold the pale flowers and after fertilization the stems of the flower grows downwards towards the soil taking the developing seeds with it to a depth of about 2.5-6cm (David and Admas 1985). Soils of Owerri are characterized as Ultisols formed from coastal plain sands and are low in mineral reserves and fertility (Eshett 1993).

The are inherently infertile (Babalola 2002) and are high in acidity, low cation exchange capacity, low base saturation and low fertility status, usually suffering from multiple nutrient deficiency. Thus, liming is necessary for acid soils (ultisols) Owerri so as to keep the p^{H} at levels required for maximum performance of

groundnut. Various liming materials are used in treating acid soil. Orthodox liming materials also called inorganic lime and non-orthodox also known as organic lime are two category of lime generally used. Gillman (1989) recommended the use of inorganic lime in ameliorating soil acidity. Inorganic liming materials include gympsum, C_aCO_3, Ca $(OH)_2$, MgO, dolomitic lime stone. Ash has been considered a waste product instead of a lime resource. Wood ash, palm bunch as, saw dust ash, cocoa husk ash, egg shell ash and many other forms of ash has been used recently in buffering the soil and also to improve the soil system. Liming with wood ash has been seen to have between 8-90% of the total neutralizing power of lime and can increase plant growth up to 45% over traditional lime (Giller *et al.* 1997). Ibeawuchi et al (2009) reported that increase application of palm bunch ash increases soil p^H and percentage carbon. Cocoa husk ash plant source liming has been found to contain high amount of plant nutrient especially potassium as reported by Odedian et al. (2003). He also compared coca husk ash and wood ash and observed that the cocoa husk ash improved the soil fertility better than wood ash. Ash in general is a good source of potassium, phosphorus, magnesium and aluminum. However, rich well-drained sand loan soils are best for groundnut, though the crop grows on both light and heavy clay soils. There is a slight preference for slightly acid soils but groundnut tolerates a wide range of acidity and alkalinity. Hence, liming is required for optimum production of Arachis hypogeal in the area and it is for this reason that this study has been proposed to determine the optimum lime requirement and best liming materials for the production of groundnut in the area, ascertain the efficacy of the various liming materials used in this study and evaluate the groundnut yields and nutrient balance or fertility status under lime application.

MATERIALS AND METHOD

This experiment was conducted in 2001 and repeated in 2012 at the Federal University of Technology Teaching and Research farm located on Lat. 5^0 27' 50"N of the equator and Long. 7^0.2'49"E of the Greenwich meridian and at an elevation of 58m above sea level (Hand held global positioning system). Owerri has a rainforest ecological characteristic. Its annual rainfall, mean annual temperature and mean relative humidity are 250mm,22-32^0 and 89%93 respectively. The soils of Owerri belong to the soil mapping unit number 431-Amakoya-Orji-Oguta soil associated (FDALR1985). The study are was cleared manually during the early rains and the debris packed to avoid altering the effect of the various lime treatments to be used. No burning was done in the experimental plots used for this experiment. Weeding was done at 4 weeks interval after planting three liming materials were used at three rates including the control. The treatments and their rate of application were as follows:

Control …….0tons/ha
(Cao) …….2tons/ha
(Cao) ……..4tons/ha
(Ca0) ……..6tons/ha
Palm bunch ash……..2tons/ha
Palm bunch ash ……4tons/ha
Palm bunch ash ……6tons/ha
Wood ash ……2tons/ha
Wood ash ……4tons/ha
Wood ash…… 6tons/ha

Key:
Cao… calcium oxide
PBA… palm bunch ash
WA… wood ash

This experiment was laid out in a 'Randomized complete Block Design' (RCBD) and replicated three times. A 6cmx60cm planting distance between and within rows was used on a 3mx 2m plot site to obtain a population size of 16-stands per plot. The cultivar of groundnut use was obtained from the department of crop science and technology germplasm collection, federal university of technology, owerri (FUTO). The cultivar used was the

spreading bunch type. Growth parameter were observe and measured at intervals (2WAP, 4and 8 WAP) to ascertain the effects for the various treatment.

$$\frac{\text{Number of seedling emergence}}{\text{Number of stands per plot}} \times \frac{100}{1}$$

Leaf area was obtained graphically by tracing the leaf on a graph and counting the number of boxes inside the sketched edge of the leaf at 4 and 8 weeks after planting leaves traced were obtained from the top and bottom of the plant. Five plants were used as observational unit. Plant height was obtained by measuring vertical heights of the plants using a meter rule at 4 weeks and 8 weeks after planting respectively and number of leaves per stand was obtain by counting the number of leaves per stand on each plot at 4 and weeks after planting pod yield was obtained by counting the number of seeds produced per pod, number of pods produced per stand and the pod weight per hectare for each of the experimental plot. Seeds were collected from the observational units and the average was taken and used to represent the average number of seeds per pod. The number of pods per plant were obtained after harvesting of the number of pods per plant. Consequently, the pod weight after harvesting, drying and weighing of the pods obtained from a plot were converted to weight in tons per hectare (tons ha^{-1}).

$$\text{Weight (tons ha}^{-1}) = \frac{\text{plot weigh} \times 10000\text{m}^2}{6\text{m}^2}$$

Soil physio- chemical analysis was carried out on the soils of the study area before and after planting. The soil samples analyzed before plaiting were collected randomly from the experimental site and bulked together to form a composite sample. the soil samples plot. Samples were collected at depth of 0-20cm using a soil auger. The samples were collected in a black polyethene bag and labeled appropriately. The samples were air dried in the soil handling room for three days and then passed through a 2mm sieve after which the were subjected to physio-chemicla analysis. Partical size analysis was carried out by hydrometer method as recommended by Bouyocous (1951). The soil p^H was determined in distilled water in the ration of 1:25 using a Bahman model p^H meter. The organic carbon content of the soil was estimated using the Walkey an Black (wet oxidation method) as outlined by Allison (1996) while percentage nitrogen was determined by the modified Kjehdahl method as used by Bremmer and Mulvarey (1982), percentage organic matter was obtained by multiplying the percentage organic carbon by 1.724. available phosphorus was determined by Bray method 2 while exchangeable cations were estimated by neutral ammonium acetate displacement procedure (Jackson 1962). Exchangeable acidity was determine by 1 N KCL extraction procedure as outline by Mclean (1965). The data collected above were separated using the least significant difference (LSD)

RESULTS AND DISCUSSION

RESULTS

Table I Shows the pre- planting and post-planting physiochemical properties of the soil p^H was low indicating high acidity accompanied by low exchangeable cations and mean nutrients. However, the post planting physiochemical properties indicate improved soil p^H, exchangeable cations, P,K, MG% N and *O.M.*

TABLE 1: Soil Preplanting and post planting physio-chemical properties

Treatment	%sand	%silt	%clay	Textural class	p^H	Pmg/kg	%N	%OC	%OM	Ca	Mg	K Cmol.kg^{-1}	Na	EA	ECEC	%BS
Pre-planting	75.80	13.14	10.80	Sandy-loam	4.94	35.40	0.138	1.60	2.76	2.20	1.35	0.09	0.37	1.52	5.53	72.51
Control	75.80	13.40	10.8	Sandy-loam	5.64	35.38	0.140	1.69	2.91	2.00	1.20	0.09	0.37	1.52	5.18	70.
Calcium oxide 2tons	79.80	11.40	8.80	Sandy-loan	6.98	34.05	0.154	1.83	3.15	11.20	2.00	0.08	0.37	0.48	14.13	96.60
Calcium oxide 4tons	83.80	7. 40	8.80	Loamy-sand	7.8	15.40	0.070	1.17	2.02	12.80	4.80	0.06	0.37	0.32	18.35	98.26
Calcium oxide 6tons	85.80	5. 40	8.80	Loamy-sand	8.80	21.60	0.098	1.69	2.91	22.40	6.0	0.06	0.37	0.16	28.99	99.45
Palm bunch ash 2tons	81.80	7. 40	10.80	Loamy-sand	5.98	33.16	0.154	1.59	2.74	2.80	1.60	0.08	0.41	1.04	5.93	82.46
Palm bunch ash 4tons	79.80	11.40	8.80	Sandy-loam	6.06	37.50	0.168	2.00	3.45	3.60	1.60	0.15	0.41	1.20	6.96	82.76
Palm bunch ash 6tons	75.80	13.40	10.80	Sandy-loam	6.76	27.85	0126	1.69	2.91	4.00	1.60	0.26	0.46	0.96	7.28	86.81
Wood ash 2tons	79.80	11.40	8.80	Sandy-loam	6.04	35.80	0.098	1.622	2.80	4.00	1.60	0.09	0.36	0.88	6.93	87.30
Wood ash 4tons	77.80	11.40	10.80	Sandy-loam	6.58	30.95	0.140	1.52	2.62	4.00	1.609	0.14	0.40	0.72	6.86	89.50
Wood ash 6tons	75.80	15.40	8.80	Sandy-loam	6.30	44.20	0.168	2.04	3.51	8.80	3.60	0.12	0.37	0.72	13.61	94.71

TABEL2: The result of the percentage seedling emergence indicates significant effect of the various treatment. These effects are due to the efficacy of the treatments as there is a significant difference between the treatments. However, the control experiment recorded the lowest percentage emergence. Plant heights of groundnut at 4 and 8 WAP showed that there were significant differences ($P \leq 0.05$) between the various treatments at 4 and 8 WAP. The tallest heights of 17.99 and 30.32cm were obtained from 2tons of wood ash at 4 and 8 weeks respectively. Leaf area at 4 and 8 WAP there was significant difference ($p \leq 0.05$) in the leaf area across the various treatments at 4 and 8WAP respectively with the control plot having the lowest. The broadest leaf area of 49cm ^{2} and 98.01cm^2 was obtained from wood ash 2tons at 4 and 8 weeks after planting respectively. At 4WAP, there was no significant difference (NS), between the various treatments. However the treatment effects manifested later showing significant difference ($p \leq 0.05$) at 8 weeks where highest number of leaves occurred at 2tons of wood ash.

Table: Plant Growth Parameters.

Treatments (tons ha^{-1}		Seedling emergence 2WAP	Plant height 4WAP (cm)	Plant height 4WAP (cm)	Leaf area (cm^2) 4 WAP	Leaf area (cm^2) 8WAP	Number of leaves 4WAP	Number of leaves 8WAP
Calcium Oxide	2tons	86.11	16.13	25.22	36.26	72.59	58.24	175.00
Calcium oxide	4tons	83.33	14.16	23.51	37.32	73.61	123.97	193.73
Calcium oxide	6tons	91.97	13.68	20.17	31.16	66.96	102.86	193.85
Palm bunch ash	2tons	74.99	14.41	21.64	32.73	63.14	97.23	180.53
Palm bunch ash	4tons	72.22	14.70	26.03	43.23	87.05	110.72	233.33
Palm bunch ash	6tons	69.44	15.54	23.41	34.42	67.82	92.17	176.67
Wood ash	2tons	91.97	17.99	30.32	49.00	98.01	108.59	209.67
Wood ash	4tons	88.89	16.05	24.15	37.59	72.86	92.80	196.87
Wood ash	6tons	77.78	15.23	28.76	38.40	82.40	112.60	212.00
Control	0tons	58.33	10.42	12.50	29.64	61.69	93.99	149.07
LSD (P ≤0.05)		21.06	3.50	6.27	10.36	18.31	NS	28.14

TATBLE 3: Pod yield parameters depicting performance of groundnut in response to the various treatments. There was significant difference ($p \leq 0.05$) in the number of seeds per pod and the number of pods per plant. Consequently, pod weight showed significant difference ($p \leq 0.05$) and the highest yield occurred at 2tons/ha wood ash.

TABLE 3: Pod Yield Parameters

Treatments		Number of seeds per pod	Number of pod per plant	Pod weight (tons ha^{-1}
Calcium oxide	2tons	2.70	70.09	0.42
Calcium oxide	4tons	3.05	74.64	0.54
Calcium oxide	6tons	2.74	63.32	0.48
Palm bunch ash	2tons	2.09	62.78	0.49
Palm bunch ash	4tons	3.24	87.92	0.57
Palm bunch ash	6tons	2.69	67.57	0.45
Wood ash	2tons	3.41	93.82	0.72
Wood ash	4tons	3.21	72.74	0.63
Wood ash	6tons	2.97	81.74	0.51
Control	0tons	2.02	57.72	0.41
LSD (P≤0.05)		0.54	3.95	0.08

DISCUSSION

The results of the pre- planting physico-chemical analysis of the soil of the study area show acidic, low nitrogen content and low exchangeable cations. This is in line with earlier work reported by Ohiri (1992) that soil of Imo, Akwa Ibom, Abia and Rivers are characterized by low pH, low organic carbon and low exchangeable cations which further confirms that soil acidity which occurs in southeastern Nigeria is due to weathering of the parent material and heavy leaching (Owolabi et al. 2003), gives rise to low soil p^H, nutrient deficiency and a preponderance of aluminum in the soil (Onwuka et al. 2007). The post- planting physio-chemical analysis revealed that there was an improvement in the soil physio-chemical properties which indicates the considerable effect of the various treatments used and also confirms that the soil now has profound effect on the nutrient availability and dis-equivalen in soil acidity (Thompson and Troech 1973). Liming reduces exchangeable aluminum and aluminum in the soil solution when calcium and or magnesium from the liming material replace

aluminum on the colloidal complex (Brady and Weil 2004). Liming also increases P uptake and root- surface area.

Based on the plant growth parameters obtained from the study area, the percentage seedling emergence at 2weeks after planting was affected by the various treatments. Calcium oxide at 6 tons and wood ash at 2 tons gave the highest percentage emergence of 91.67% respectively with the control coming way behind with 58.33%. This can be attributed to the improved soil conditions due to liming. Leaf area at 4 WAP and 8WAP showed significant difference and is highest as WA 2tons followed by PBA 4tons and WA 6tons with 49.00, 43.23

REFERENCES

Agboola A. A., G.O. Obigbesan and A.A. Fayemi (1975) interrelations Organic and mineral fertilizer in the tropical forest of Western Nigeria FAO soil bulletin NO: 27,325-337.

Allison L.E. (1965). Organic carbon in C.A. Black (ed). Method of analysis: Chemical and microbiological properties. Parts 2, Agro, Madison, Wisconsin pp. 1367-1378.

Anikwe, M. A. N.,, V. N. Onyia, O.E. Ngwu and C.N. Mba (2005): Ecophysiology and cultivation practice of Arable crops. New generation books, Enugu, Nigeria. Pp 260.

Babalola, O. (2002). Nigeria Agriculture: Basis for hope, hurdles against hope, hope for Tomorrow University lecturers, university of Ibadan.

Bouyoucous, G.H. (1957): a Recalibration of Hydrometer for making mechanical analysis of soils. Agronomy journal 43: pp 434-438.

Brady, N.C., and Weil, R.R. (2004): Elements of the Nature and properties of soils. Second edition, PEARSON prentice hall, upper saddle River, New jersey pp-80.

Bray R.H, and Kurtz, L.T. (1984): Determination of total organic N and available from of P in soil Sci, 59:39-43.

Bremmer J. M. and Mulvancy, C.S. (1982). Total Nitrogen in page A.C. Miller, R.H. and Keeney D.R. (eds). Methods of soil analysis parts II America Soc. Of Agron., Madison Wisconsin-pp 595-624.

Cobley, L.S. and Steele, W.M. (1976). The grain legumes, introduction to botany of tropical crops. 2nd Edition Longman group limited pp. 79-85.

David Gibbon and Adam pain (1985): Crops of the Drier Regions of the tropical.

Esshet, E.T. (1993): Wetland and Ecotones studies on land-water. National institute of ecology. New Delhi and international scientific publication, new Delhi. Pp 232-234.

Federal department of agriculture and land Resource (1985).

Giller, K. E.G., Cardiseh, C. Ehaliots, E. Adams, W.D. Sakala and P.I. Mafongeya (1997): building soil nitrogen capital in Africa soil science 164:671-678.

Gillman, G.P.,J. Shamshuddin and L.C. Bell (1989): Soil chemical parameters and organic matter soil management and small holder development in pacific islands ISBRAM, No. 8 Thailand pp. 141-153.

Ibeawuchi, I. I., J.C. Obiefuna E.U. Onweremadu (2009): Effect of oil palm bunch refuse as rates on the Ultisols of Owerri, Imo State, Southeastern Nigeria, proceedings of the international conference on Globalfood Crisis, April 19-24, 2009 pp. 190-193.

Ibeawuchi, I.I. (2008) SOIL Amendments for enhanced filed establishment of Gnetum Africanum (Okazi) plantlets in Owerri, Southeastern Nigeria. Centre for Agricultural research. FUTO.

IITA (1990): Annual report for 1990.

Jackson M. I, (1962): Soil chemical analysis prentice hall, new York.

Lekwa G. and E.P. White soils (1986): Coastal plane sand of South Eastern Nigeria. Soil sci J. 50:154-196.

Mclean, E. O. (1965): Aluminum in C.A. Black 9 (ed). Methods of soil analysis Agron No. 9 part 2. American Soc. Of Agronomy. Madison, Wisconsin. Pp. 978-998.

Ngoka D.A. (1997). Groundnut crop growing production in the tropics Alphabet Nigeria publishers pp. 118-120.

Odedina, S.A., Odedina, J.N. Ayeni, S.O. Arowojulu, S.A.A, Adeyeye S.D. and Ojeniyi S.O. (2003): effect of types of ash on soil fertility, nutrient availability and yield of tomato and pepper, Nigeria journal soil science 13:61-69.

Ohiri, H.C. (1992) soil and fertilizer use on maize in Southeastern State, Nigeria. An update proceeding 3rd National fertilizer workshop Ibadan April 22-24, 1992.

Onwuka M.I.,V.E. Osodeke and N.A. Okolo (2007): amelioration of soil acidity using cocoa husk for maize production in Umikike area of South-eastern, Nigeria, Department of soil science and Agro climatology, Michael Opara University of Agriculture. Short note, tropical and subtropical ecosystem (2007): 41-45.

Owolabi, O., A. Adeyeye, B.T. Oladejo and S.O. Ojeniyi (2003): effect of wood ash on soil fertility an crop yield South West Nigeria. Nig. Jour. Soil sci. 13:55-60.

Thompson, L.M. and F.R. Troech (1973): soils and soil fertility, 3rd edition, Macmilliam publishing Company New York.

Verdocourt, B. (1970): Studies in the Leguminosae-Papilionoideae for 'Flora of tropical east Africa' Kew Bul 24:507-569.

Wahua T.A.T. (1999): Applied statistics for scientific analysis African link books, Ab, Nigeria.

Weiss, E.A. (1983): Oilseeds crops Longman, London.