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Effect of Diferent Lime Materials as an Amendment on the Ph of Potting Soil for Maize (*Zea mays*) Nursery Production

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Abstract: *A screen house experiment conducted in Rivers state university teaching and research farm and crop/soil science laboratory, to evaluate the effect of different organic lime materials as an amendment for an acid potting soil for maize (Zea mays) nursery. The lime materials used were egg shell, snail shell, oyster shell, wood ash. Calcium carbonate was used as a basis for comparison and no lime was used as control for all the limes. Results showed that all the different lime materials used appreciably raised the soil pH. Application of the different lime materials showed no significant different among the lime materials but with no lime having the lowest pH value OF 6.2, when compared to the of value pH of the other treatments. The lime materials positively affected all the plant parameters measured. Result showed that white maize variety had the highest percentage germination (89.6%), when compared to the two improved varieties (oba 98 and oba super6); 85.4%, with the yellow local variety having the least % germination of 66.7%. Generally, the combined effect of the different lime materials and maize varieties, showed significant differences (P< 0.05) among plant parameters measured; across the four weeks. Results also showed the effect of the liming varied with both the type of liming materials and the crop variety.*

Key words: *Lime materials, Amendment, Soil pH, Potting soil.*

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I. Introduction

Potting soil is a weed –free, packaged soil mix that is formulated for maximum result for most plant. It is also a medium in which to grow plants, herbs pots or otherdurable container. Liming is the application of mineral calcium and magnesium compounds, mainly carbonates, oxides, hydroxides, or a mixture of them and more rarely, silicates into acid soils to decrease the concentration of protons (Filipek, 2011). In acid soils, these materials react as a base and neutralize soil acidity and thereby increase soil pH. The role of liming is to ameliorate the effect of acidity in soil, thus ensuring that acidity is not the cause of reduced plant performance(Orji and Onunwa, 2018). This often improves plant growth and increases the activity of soil bacteria, but over supply may result in harm to plant life. However, liming is not a common practice in the traditional subsistence farming system due to lack of lime and unavailability of products at critical period. Also, lime sources of sufficientfineness and purity is major challenge in the country (Effiong, *et al*,2009). These commercial limes which can be used in soil amendment are expensive to be purchased by local farmers. There is therefore need to look for alternative and cheap sources of liming materials which can reduce soil acidity and bring about increased yield of crops and that are also environmentally friendly.

II. Materials And Methods

This research was carried out in the Screen house of the Teaching and Research Farm of the Rivers State university Port Harcourt (4.5^{o}N, 7.0^{O}E) on an elevation of 18m above sea level, with mean annual rainfall of 3,000mm to 4,500mm and annual temperature of 22^{o}C to29^{o}C.

The treatments consisted of 6 lime materials (egg shell, snail shell, calcium carbonate, oyster shell, wood ash and no lime),2 local cultivars (white maize and yellow) and 2 hybrid (oba 98 and oba super 6) of maize; giving a total of 24 treatments replicated four times and fitted into a completely randomized design. The liming materials were sundried, ground into powder and applied at the rate of12tonsha^{-1} to 0.5litres volume of disposable cups perforated underneath for drainage.A uniform application of poultry manure at the rate of 60kgha^{-1} was done to all treatment to boast the fertility status of the soil.

Two seeds of maize were sown directly into the cups and thinned to one seedling 1 week after germination. Weeding was done by hand picking. Watering was done daily to the soil field capacity.

Germination percentages were recordedfrom 3 to 7DAP. Plant height and number of leaveswere measured weekly for 4 weeks and above ground biomass (fresh and dry weight) at the end of the experiment. The data collected were subjected to analysis of variance using Minitab 19.1 software.

Soil sample of the top soil used were collected for analysis before treatment application. The soil was air-dried, crushed and sieved to pass through 2mm sieve and analyzed for some physico-chemical properties. Particlesize analysis was done using the hydrometer method and pH in a soil water ratio of 1: 2.5 using pH meter with a glass electrode. Exchangeable cations (Ca, Mg, K, Na) were extracted from the soil with 1N ammonium acetate solution. Na and K were measured with a flame photometer while Mgand Ca by EDTA titration. Organic carbon was determined by Walkey and Black method, Total nitrogen by micro-kjedahl method, available P was determined by spectrometer method and exchangeable acidity by titration method. The lime materials used were analyzed for Ca, Mg, and pH.pH of the lime materials were analyzed in 1:2.5 ratio of water to lime materials. Ca and Mg content of the soils were extracted with distilled water to obtain the extract, then used for EDTA titration. Wood ash was determined by dry ashing, extract was used to determined Ca and Mg by EDTA titration method. Bulk soil sample were collected at the end of the experiment, air-dried, crushed to pass through a 2mm sieve and analyzed for pHin soil water ratio of 1:2.5 by pH meter using glass electrode.

III. Results And Discussions

Physico-Chemical Properties of the Experimental Materials and Top Soil Used

Some physical and chemical properties are as shown on table 1. The soil is a sandy loam with a pH of 4.43. It is low in total nitrogen and moderate in percentage organic matter (4.49%).

Chemical Properties of Lime Materials Used

The lime materials used were analyzed for Ca, Mg and pH is as shown on table 2. Egg shell and oyster shell were higher in calcium content and this is similar to the work done by (Effiong *et. al* 2009.) that shells are found to contain high percentage of $CaCo_3$which is the active agent of lime materials. In this study it is higher in magnesium content as compared to calcium; this may be due to the age of the snail shell. The pH of the lime materials ranges from moderately alkaline to very strongly alkaline (8.4-10.3) which signifies that they are effective lime materials and this agrees with the work done by (Kingori 2011) that shells contain calcium that raises or neutralized the pH level of overly acidic soil.

Table 4.1: Chemical Properties of Experimental Soil

Particle Size Distribution (%)			Texture Class	pH	Org. Carbon (gkg^{-1})	% Organic Matter	Avail . P ($mgkg^{-1}$)	Total N (gkg^{-1})	Exchangeable Base Cmolkg^{-1}			
Sand	Silt	Clay							Ca^{2+}	Mg^{2+}	K^{+}	Na^{+}
78.0	8.0	14.0	Loamy Sand	4.4	1.4	2.5	0.4	0.3	8.0	3.2	0.2	0.1

Table 4.2: Chemical Properties of Lime Materials

Liming Materials	Ca^{2+} (cmol/kg)	Mg^{2+} (cmol/kg)	pH (H_20 1:2.5)
Eggshell	1.2	1.0	8.8
Snail shell	0.6	0.8	8.4
Oyster shell	1.8	0.2	8.6
Wood ash	7.0	19.8	10.3

Soil pH asAffected by Liming Materials

The effect of pH as affected by liming materials is shown on fig.1.The application of the different liming materials increased the soil pH as compared to control at the end of the experiment. Wood ash increase the soil pH to 6.5 as compared to control and this result agrees with the findings of (Iren et. al,2016) that ash materials contain exchangeable cations, which are known to increase pH. And also, to the work done by Olivia, 2018 that wood ash is more soluble and reactive than ground limestone and brings about a change in soil pH more than lime. Snail shell also increase the soil pH to 6.5 followed by oyster shell and calcium carbonate with pH value of 6.4, followed by eggshell by eggshell which also increased the soil pH value to 6.3 and control with least pH value. This result is in accordance with the findings of (Peter, 2017) that lime significantly increased soil pH.

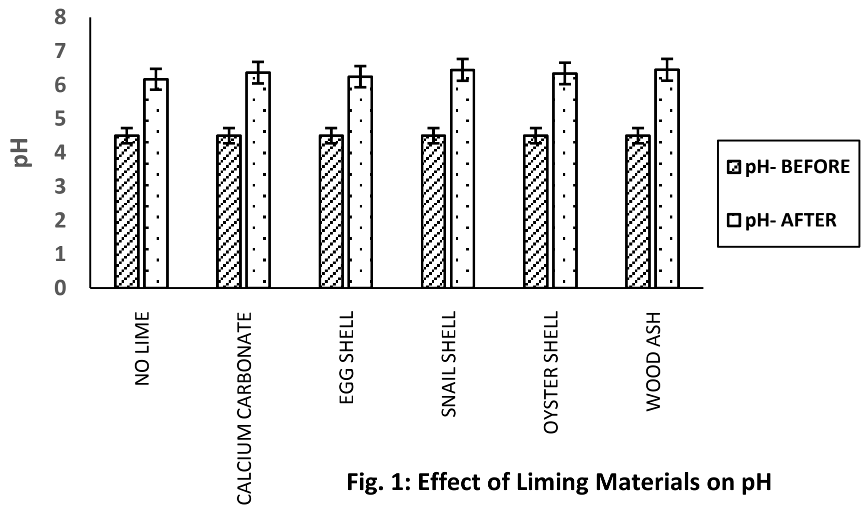

Fig. 1: Effect of Liming Materials on pH

Effect of The Different Lime Materials on the Performance of Maize

Generally, liming negatively affectedmaize seed germination (Fig. 2). However, the various liming materials affected the various maize varieties differently. The germination of the local maize varieties were more depressed in germination by calcium carbonate (white corn-50% and yellow corn-38%). The germination of the oba 98 and oba super 6 were significantly reduced by snail shell and wood ash, respectively.

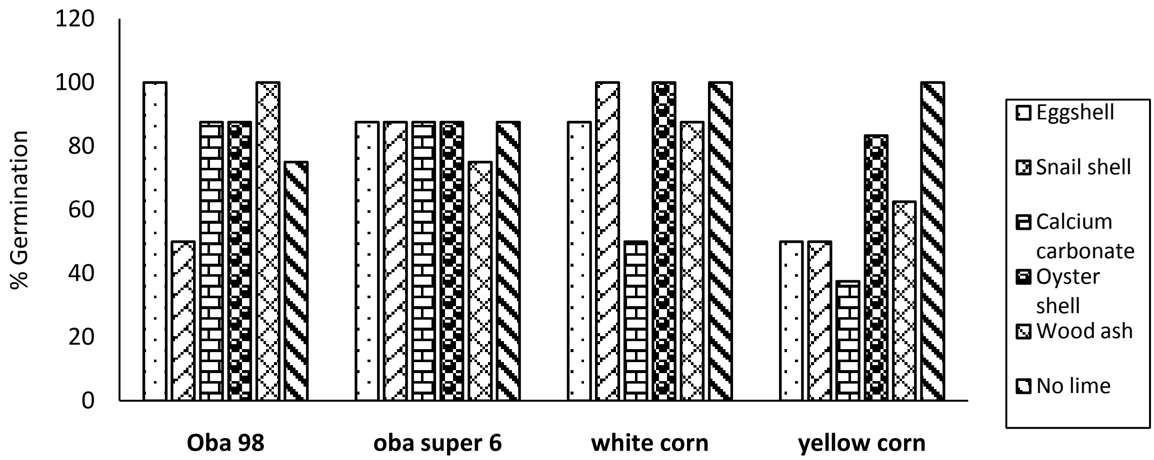

Fig.2: Effect of Lime Materials on the Percentage Germination of Maize

The effects of the liming materials on the Plant height and number of leaves of the various maize varieties is as shown on tables 3 and 4.At the 4th week, there were significant differences among the treatments for the two parameters, when compared to no lime treatment. Plant height ranged between 54.4cm for yellow corn and 88.9cm for oba 98. The trend was the same for number of leaves, ranging between 5.8 for yellow corn and 9.0 for oba 98 and white corn. This suggests that the hybrid varieties responded better to liming when compared to the local varieties; especially the yellow corn. This is similar to the findings of Yuan, et al,. (2018).

Table 3: Effect of Lime Material on the Plant Height of the various varieties of maize

Treatment	Plant Height (cm)			
	Week 1	Week 2	Week 3	Week 4
Eggshell + white corn	26.1a	53.1a	64.7a	77.3b
Eggshell + Oba super 6	17.9b	40.0b	51.3b	67.7c
Eggshell + Oba 98	24.5ab	52.8a	63.3a	80.6a
Eggshell +Yellow corn	23.3ab	48.7b	60.6a	80.2a
Snail shell + white corn	22.2ab	48.0b	60.6a	75.3b
Snail shell + Oba super 6	23.4ab	44.5b	57.0b	66.2c
Snail shell + Oba 98	25.1ab	48.4b	56.1b	75.7b
Snail shell + Yellow corn	21.2ab	44.7b	53.7b	75.8b
Calcium carbonate + white corn	24.6ab	58.3a	68.6a	83.9a
Calcium carbonate + Oba super 6	23.3ab	52.2a	64.0a	83.9a
Calcium carbonate + Oba 98	21.6ab	48.2a	60.3a	77.0b
Calcium carbonate + Yellow corn	16.8b	34.9c	44.0c	50.7d
Oyster shell + white corn	25.3a	52.7a	64.0a	79.3ab
Oyster shell + Oba super 6	17.9b	37.9c	46.9c	61.3c
Oyster shell + Oba 98	23.2ab	54.9a	63.6a	75.2b
Oyster shell + Yellow corn	11.7b	37.8c	47.5c	61.5c
Wood ash + White corn	23.8ab	46.2b	59.7b	74.5b
Wood ash + Oba super 6	21.6ab	45.0b	59.4b	75.3b
Wood ash + Oba 98	21.1ab	60.3a	63.7a	88.9a
Wood ash + Yellow corn	10.9c	30.9c	40.7c	54.4d
No lime + White corn	21.0ab	46.7b	58.7b	73.0a
No lime + Oba super 6	22.7ab	51.5a	61.6a	77.4b
No lime + Oba 98	23.5ab	48.1b	59.1b	76.2b
No lime + Yellow corn	15.4b	36.7c	48.2c	60.9c

Means that do not share the same letter are significantly different at $P < 0.05$

Table 4: Effect of Lime Material on the number of leaves of the various varieties of maize

Treatment	Number of Leaves			
	Week 1	Week 2	Week 3	Week 4
Eggshell + white corn	3.0a	5.0a	6.8ab	8.3a
Eggshell + Oba 98	3.0a	5.0a	6.5ab	8.5a
Eggshell + Oba super 6	3.0a	4.8a	6.3ab	8.3a
Eggshell +Yellow corn	3.0a	5.0a	7.0a	8.0a
Snail shell + white corn	3.0a	5.0a	7.0a	9.0a
Snail shell + Oba 98	3.0a	5.0a	6.7ab	8.7a
Snail shell + Oba super 6	2.8a	4.8a	6.5ab	8.0a
Snail shell + Yellow corn	2.3	3.0a	6.0ab	5.3c
Calcium carbonate + white corn	3.0a	5.0a	7.0a	9.0a
Calcium carbonate + Oba 98	3.0a	5.0a	6.8ab	8.5a
Calcium carbonate + Oba super 6	3.0a	5.3a	6.8ab	8.8a
Calcium carbonate + Yellow corn	2.5a	3.8a	4.5c	5.8c
Oyster shell + white corn	3.0a	5.0a	7.3a	9.0a
Oyster shell + Oba 98	3.0a	5.0a	6.3ab	8.3a
Oyster shell + Oba super 6	2.8a	4.5a	5.8ab	7.3b
Oyster shell + Yellow corn	2.0a	5.0a	6.0ab	8.3a
Wood ash + White corn	3.3a	5.0a	7.0a	9.0a
Wood ash + Oba 98	3.0a	5.0a	7.0a	9.0a
Wood ash + Oba super 6	3.0a	5.0a	6.8ab	8.9a
Wood ash + Yellow corn	2.5a	4.3a	5.5b	6.8b
No lime + White corn	3.0a	5.0a	6.8ab	8.5a
No lime + Oba 98	3.0a	4.8a	6.7ab	8.3a
No lime + Oba super 6	3.0a	5.0a	6.8ab	8.5a
No lime + Yellow corn	2.5a	4.5a	6.5ab	8.0a

Means that do not share the same letter are significantly different at $P < 0.05$

IV. Conclusion

These results have shown that local organic sources of lime materials, like snail shell, egg shell, oyster shell and wood ash are effective in neutralizing acidity in acid soils. This suggests that these can be used in place of Calcium carbonate, considering their other beneficial effects to soils as organic materials.

They have also been shown to positively enhance crop performance, particularly maize. However, these effects are both variety and organic lime type specific.

Reference

[1]. Anderson, N.P, Hart, J.M, Sullivan, D.M. Christensen, N.W, Horneck, D.A. and Pirelli, G.J. (2013). Applying lime to raise Soil pH for crop production. Extension Service Oregun State University 2013: 1-21.

[2]. Beuked, B.J, Mapumulo, T.C, Fyfield, T.P &Jezile, G.G. (2012). Effects of liming and inorganic fertilizer application on soil properties and maize growth and yield in rural agriculture in the Mbizana area, Eastern Cape province. South African Journal of Plant and Soil 21(3-4): 127-133.

[3]. Effiong, G.S, Ibia, T.O, Ogban, P.I and Inyang N.D. (2009) Evaluation of locally-sourced liming materials for acid soils in Akwa-Ibom State, Southeastern Nigeria. American-Eurasian Journal of Agronomy 2(3): 14-151.

[4]. Hossner, L. R. (1996). Dissolution for Total Methods of Soil Analysis Elemental Analysis, Third edition. In Methods of Soil Analysis Part 3 Chemical Methods SSSA and America Society of Agronomy, Madison WI, 44-64.

[5]. https://www.smart-fertilizer.com>articles.

[6]. Ibitoye, A.A., (2008). Laboratory manual on bases soil analysis (3rd edition). Nigeria; Foldave Nigeria Limited, Akure, Ondo State.

[7]. Iren, O. B, Udoh, D. J, Ufot, U. O, Chukwuemeka, J. N, (2016). Influence of local lime materials and organo mineral fertilizer on fluted pumpkin (Telfairiaoccidentalis) performance in an ultisol of Southeastern Nigeria. InternationalJournal of sciences 5.

[8]. King'ori A.M. (2011). A review of the uses of poultry Eggshells and shell membranes. International Journal of Poultry Science 10(11): 908-912.

[9]. Orji, O. A. and Onunwa, A. O. (2018). Estimating LimeRequirement and Lime Buffering Capacity of Acid

[10]. Soils of Zaakpon and Kpean, Khana Local Government Area, Rivers State. Delta Agriculturist, 10 (2): 11- 21.
[11]. Peter, A., opala, (20110. Comparative effects of limes and organic materials on selected soil chemical properties and nutrient uptake by maize in an acid soil. Scholars research library Archives of Applied Science Research, 3(1): 96-107.
[12]. Roger Lalande, Bernard Gagnon and Isabelle Royer (2019) Impact of natural or industrial liming materials on soil properties and microbial activity. Canadian Journal of Soil Science 89(2): 209-222.
[13]. Ubi, M.W, Ubi, W. and Godwin MichealUbi (2017). Effect of lime application on soil physiochemical characteristics and plant nutrient contents of three soybean cultivars (Glycine Mase (L) Merril) in coastal plain sands of Nigeria. Direct Research Journal vol. 5, 96-106.
[14]. Udo E.J. Ibia, T.O. Ogunwale, J,A.Ano., A.O and Esu I.E (2009). Manual or Soil Plant and Water Analysis Nigeria.Sibom Book Limited.
[15]. Walkley, A & Black I.A (1934) An Examination of Different methods of Determining soil organic chromic acid titration method, soil science, 37, 29, 37.
[16]. Yuan, Li. Song Cui. Scott x. Chang. Qingping Zhang (2018). Liming effects on soil pH and Crop yield depend on lime materials type, application method and rate, and crop species: a global meta-analysis.