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Composition study of the liming materials to know the efficiency and effectiveness in soil and plant

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Abstract
A laboratory experiment was conducted to study the "Composition study of the liming materials to know the efficiency and effectiveness in soil and plant". In the experiment three different sources of liming materials were used i.e industrial source paper mill sludge and calcium silicate and natural source Stromatolite. Results indicated that the highest neutralizing value (80%) was observed in the Stromatolite which contain some amount of Mg (10.5%) and S (0.04%) also. So the reactivity of Stromatolite was more compare to the other liming materials. The highest quantity of micronutrients was observed in the paper mill sludge. The highest Cr content was observed in the calcium silicate (290%), Cd in paper mill sludge (7%) and Pb in Stromatolite (13.2%). The only Si was one present in the calcium silicate not in paper mill sludge and Stromatolite.

Keywords: Neutralizing value, macronutrients, micronutrients and heavy metals etc.

Introduction
Acid soils are widespread in Cameroon and cover about 75% of agricultural lands in the country (Sieffermann, 1973) [15]. Acid soils are generally highly weathered, but very different in their mineralogical, physical and chemical properties (Keng and Uehara, 1974) [7]. Soil acidity is common in all regions where precipitation is high enough to leach appreciable amounts of exchangeable bases from the surface of the soil. Acid soils are prevalent in areas experiencing high annual rainfall of about 1500 mm or more (Conyers, 1986) [4]. These soils, especially the ultisols and oxisols usually have problems associated with Al toxicity, low nutrient status, nutrient imbalance and multiple nutrient deficiencies (Sanchez, 1987; Adiloğlu and Adiloğlu, 2004) [14, 1]. Under pH 4 or less, most macronutrients become limited to the plant and a toxic form of Al (Al^{3+}) increases its availability and can be a major limiting factor of plant growth and production in acid soils (Kochian, 1995; Matsumoto, 2000) [8, 9]. Causes of soil acidity have been attributed to inorganic fertilizer application and biological nitrogen fixation (Bolan *et al*., 1991) [3] and acid rain (Raij, 1991) [13]. Conventional lime still remains the major means of ameliorating soil acidity but must farmers still find it difficult to purchase it coupled with the subsoil acidity associated with inadequate liming practice.
Agricultural liming has increased with agricultural intensification and periodic use has become necessary to counteract acidification of cultivated soils (Helyar and Porter, 1989; Fisher *et al*., 2003) [6, 5]. The benefits of liming include increased soil pH, calcium and magnesium saturation, neutralisation of toxic concentrations of Al, increase in phosphorus, improved nutrient uptake by plants and increased crop yield (Nicholaides *et al*., 1983; Oguntoyinbo *et al*., 1996; Oluwayinbo *et al*., 2005; Anetor and Akinrinde, 2006) [10-12, 2]. Agricultural lime refers to all limestone-derived materials used to neutralize acid soils, including ground limestone (calcium carbonate$CaCO_3$), hydrated lime (calcium hydroxide-$Ca(OH)_2$), or burned lime (calcium oxide-CaO), with or without additions of magnesium carbonate ($MgCO_3$), magnesium hydroxide (Mg(OH)2), or magnesium oxide (MgO). The main objective of the study is composition study of the liming materials to know the efficiency and effectiveness in soil and plant.

Materials and Methods
The industrial and natural source liming materials were collected from different sources. The paper mill sludge was local source collected from Rayagada district, Stromatolite was natural source collected from nabarangpur district and calcium silicate was industrial waste collected from jajpur district of Odisha. The neutralizing value of the liming materials were analysed by the following standard procedure. One gram sample was taken in a 250 ml conical flask. Added 20 ml nitric acid to each flask and kept overnight. Then heat on the hot plate added with 50 ml digestion mixture till white colour liquid observed. Then samples were filtrated in a

100 ml volumetric flack and volume make up. From this volumetric flasks samples were taken and analysed for silicon, macronutrients, micronutrients and heavy metals etc.

Results and Discussion

The neutralizing value of Paper mill sludge was 60 per cent where as in Stromatolite 80 per cent and Calcium silicate 80 per cent. The neutralizing value of PMS was low compare to the Stromatolite & calcium silicate. Stromatolite and calcium silicate has same percentage of neutralizing value but the reactivity was more in Stromatolite compare to the calcium silicate (table-1).

Table 1: Neutralising value and silicon content of the liming materials

Parameter	Neutralising Value (%)	Silicon (%)
Paper mill sludge	60	-
Stromatolite	80	-
Calcium silicate	80	24.7

The Silica content of Calcium silicate was 24.7 per cent but there is no silicon present in paper mill sludge and Stromatolite (Table-1). When calcium silicate applied to the soil the mono silicic acid complexes with toxic Al^{3+} and Al hydroxy species from non toxicalumino silicate and hydroxy amino silicate compounds, which precipitate at root zone.

Table 2: Macronutrients content in the liming materials

Parameter	Paper mill sludge	Stromatolite	Calcium silicate
	(%)		
Ca	22	17.3	34.5
Mg	2.8	10.5	-
Na	0.34	-	-
K	0.04	-	-
S	-	0.04	-

The Ca content in the paper mill sludge was 22 per cent where as in Stromatolite 17.3 per cent and calcium silicate 34.5 per cent. The Ca content was more in calcium silicate than Stromatolite than the paper mill sludge (Table-2). The Mg content in the paper mill sludge was 2.8 per cent where as in Stromatolite 10.5 per cent and there is no Mg present in the calcium silicate. Stromatolite contain higher Mg than paper mill sludge (Table-2). The Na content in the paper mill sludge was 0.34 per cent and there was no Na present in the Stromatolite and calcium silicate. Similarly the K content in the paper mill sludge was 0.04 per cent where there is no K present in the Stromatolite and calcium silicate. The S content in the Stromatolite was 0.04% where there is no S present in the PMS and CS (Table-2).

Table 3: Micronutrients content in the liming materials

Parameter	Paper mill sludge	Stromatolite	Calcium silicate
	(%)		
Fe	275	259	252
Mn	41	38	17
Cu	8.5	1.5	4.3
Zn	10.8	9.9	10.1

The Fe content of the paper mill sludge was 275 per cent where was in Stromatolite 259 per cent and calcium silicate 252 per cent. The Fe was more in paper mill sludge than Stromatolite than the calcium silicate (Table-3). The Mn content of the PMS was 41 per cent where was in Stromatolite 38 per cent and calcium silicate 17 per cent. The Mn content was more in paper mill sludge than Stromatolite than the calcium silicate (Table-3). The Cu content of the paper mill sludge was 8.5 per cent where was in Stromatolite 1.5 per cent and calcium silicate 4.3 per cent. The Cu content was more in paper mill sludge than calcium silicate than the Stromatolite (Table-3). The Zn content of the paper mill sludge was 10.8 percent where was in Stromatolite 9.9 per cent and calcium silicate 10.1 per cent. The Zn content was more in paper mill sludge than calcium silicate than the Stromatolite. The result indicated that the highest content of micronutrients was observed in the paper mill sludge than the Stromatolite and calcium silicate.

Table 4: Heavy metals content in the liming materials

Parameter	Paper mill sludge	Stromatolite	Calcium silicate
	(%)		
Cr	16.3	10.3	290
Cd	7.0	5.0	3.2
Pb	12.1	13.2	9.2

The Cr content in paper mill sludge was 16.3 per cent where was in Stromatolite 10.3 per cent and calcium silicate 290 per cent. The much more quantity of Cr was content in the calcium silicate than paper mill sludge than the Stromatolite. The Cd content in paper mill sludge was 7.0 per cent where was in Stromatolite 5.0 per cent and calcium silicate 3.2 per cent. The more Cd was observed in paper mill sludge than Stromatolite than the calcium silicate. The Pb content in paper mill sludge was 12.1 per cent where was in Stromatolite was 13.2 per cent and calcium silicate was 9.2 per cent. The more Pb was observed in Stromatolite than paper mill sludge than the calcium silicate (Table-4).

Conclusion

The highest neutralizing value (80%) was observed in the Stromatolite which contain some amount of Mg (10.5%) and S (0.04%) also. So the reactivity of Stromatolite was more compare to the other liming materials. The highest quantity of micronutrients was observed in the paper mill sludge. The highest Cr content was observed in the calcium silicate (290%), Cd in paper mill sludge (7%) and Pb in Stromatolite (13.2%). The only Si was one present in the calcium silicate not in paper mill sludge and Stromatolite.

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