www.sciencevision.org

Research Forum

Sci Vis Vol 13 Issue No 2
April-June 2013
ISSN (print) 0975-6175
ISSN (online) 2229-6026

Studies on types of acidity in soils of Kolasib agriculture, Kolasib district, Mizoram, India

B. K . Mallik[1*] and Bharat Rai[2]

[1]*Department of Chemistry,* [2]*Department of Botany, Government Kolasib College, Kolasib 796 081, India*

Received 16 February 2013 | Revised 24 April 2013 | Accepted 3 May 2013

Abstract

The study was made on assessment of the soil quality of Kolasib, Agriculture district of Mizoram. 20 soils samples were selected from various localities of the study out of 200 samples and were found to have their pH fall under five classes of soil acidity. Total acidity in the soils was estimated by following standard method based on the technique of by Sokolov and Soroken. The soil samples were found to be acidic and exhibited increased concentration of Al^{+3} with the decrease of pH. Upon the different forms of acidity detected in Kolasib, soils can be arranged in decreasing manner as – total acidity > non- exchangeable acidity > active acidity.

Key words: Acidity; agriculture; ionisation; hydrolysis; toxicity; soil .

Introduction

Kolasib is the youngest district of Mizoram with an average area of 1382.51 sq km located in between 24°80' to 24°00' N latitude and 92°30' to 92°45' E longitude. Its altitude ranges from 85 to 1,500 m asl with hills and valleys. Annual rain fall varies from 2,576 to 3,650 mm from southwest monsoon. There is primary and secondary forest cover of tropical and subtropical type in this region. The life pattern and economy of the people are influenced by the agricultural activities. Jhuming on the spur of the hills and traces of wet agriculture in the valleys is a common feature in this district.

The pH of the soil is the most important characteristic in determining fertility of the soil. Soil reaction (pH) affects various pHysical, chemical and biological properties of soils. Acid soil is an H^+ - Al^{3+} system. As soil acidity increases, concentration of H^+ ions. The degree of ionization of H^+ and Al^{3+} from the exchange complex and into soil solution determines the nature of soil acidity on strongly acidic soils. Hydrolysis reactions Al^{3+} produces H^+ ions and its toxicity comprise one of the main detrimental effects of soil acidity.

Corresponding author: Mallik
Phone:
E-mail: bijay.mallik08@gmail.com

The degree of soil acidity is known to exert an adverse effect on crop growth by influencing nutrient availability and microbial activity.[1] Soil acidity also has effect on the survival and growth of important microbes such as *Rhizobium* bacteria. Aluminium toxicity restricts roots growth and reduces the yield of crops grown on acid soils.

The sum of all types of acidity is the total acidity of a soil. Total acidity also termed as hydrolytic acidity or titratable acidity is present in measurable quantities in soil. Measurement of soil pH alone is not a true representation of soil acidity. It is in this background that the present study was aimed to find out the types of soil acidity in some selected soils of Kolasib, Agriculture district.

Materials and Methods

200 soil samples (from 0–15 cm depth) were collected from various parts of Kolasib, Agriculture district of Mizoram. The soil samples were dried and processed. The soils were sieved with a 2 mm sieve. Soil pH was determined with the help of a pH meter in 1: 2:: Soil : meter suspension following the method of Jackson (1978).[3] Electrical conductivity was determined in the soil suspension in which pH was again measured following the method of Jackson.

On the basis of soil pH, soils were categorised in to five different classes

Extremely acidic—having pH < 4.5
Very strongly—having pH between 4.5 – 5
Strongly acidic—having pH between 5 -5.5
Medium acidic—having pH between 5.5 – 6
Slightly acidic—having pH between 6 – 6.5

20 soils samples were selected out of these two hundred samples based their pH falling under above classes of soil acidity. Total acidity in the soils was estimated by following standard method. Exchangeable acidity was determined by the method suggested by Sokolov and Soroken (1993).[5] Exchangeable Al^{3+} was extracted by 4% NaF in the titrated solution of exchangeable with $BaCl_2$ - TEA reagent using that of Peech *et al.* (1962).[4] Non–exchangeable acidity was determined by different by methods. Active acidity was determined by taking the negative logarithm of H^+ ion concentration.

Result and Discussion

Classes of soil acidity

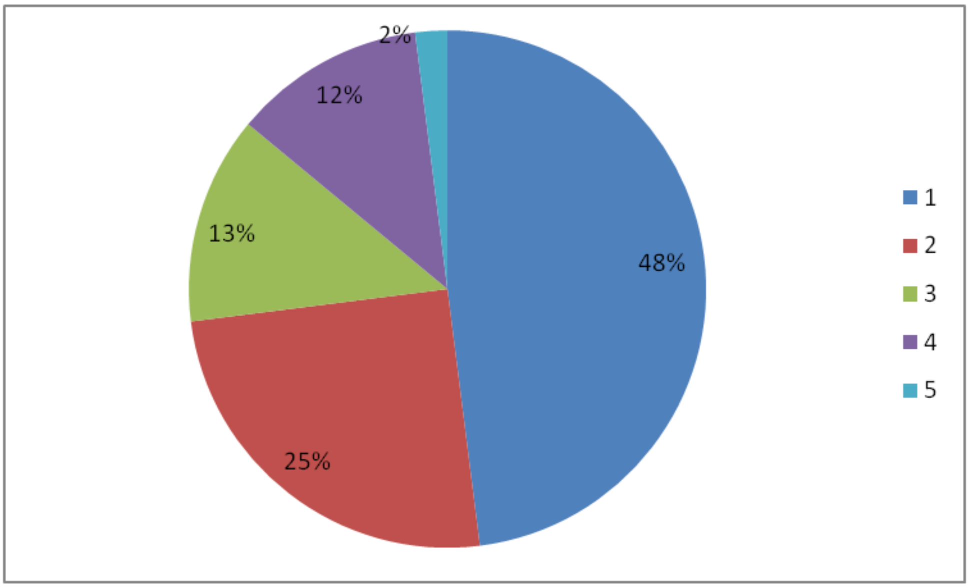
All the soil samples varied in the pH levels based on their categorisation in to different acidity groups, majority of soils of Kolasib were found strongly acidic. Twenty five percent of sampled soils were medium in acidity, 12% slightly acidic and 13% soils were very acidic. Only 2% soils were extremely acidic.

Total acidity

Total acidity constituted the largest value for all the soils (Table 1). The values of total acidity ranged from 8.7 meq /100g in soil sample number -3 to 4.12 meq /100 g in soil sample number 18. The values of non-exchangeable acidity were second highest and next only to total acidity. This form of acidity arise only after the precipitation of the soluble Al^{3+} as $Al(OH)_3$. The non-exchangeable or potential acidity is much higher requiring much larger doses of lime to neutralize than what is needed for neutralisation of active acidity.

Exchangeable acidity values ranged from 2.75 meq /100 g in soil sample number 7 to 0.110 meq /100 g in soil sample number 18. As the pH increased from 5.70 (in soil sample number 13) onwards, the values of exchangeable acidity decreased. As the pH is due to the fact that in strongly acidic soil, the concentrations of exchangeable Al^{3+} and H^+ ions contribute to exchangeable acidity. The acidity developed in such soils is due to absorbed H^+ and Al^{3+} ions on soil colloids. However, exchangeable Al^{3+} and H^+ were negligible in moderately to slightly acidic soils.

Sample No	pH	EC (dS/m)	Total acidity (meq/100 g)	Non exchangeable acidity (meq/100 g)	Exchangeable acidity (meq/100 g)	Active acidity (meq/100 g)
1	4.09	0.83	6.87	5.4	1.5	8.28×10^{-4}
2	4.44	0.35	5.37	4.0	1.37	3.98×10^{-4}
3	4.69	0.79	8.7	6.7	2.0	2.04×10^{-4}
4	4.69	0.98	5.5	5.3	0.25	2.04×10^{-4}
5	4.78	0.96	4.37	3.1	1.25	1.66×10^{-4}
6	4.80	0.94	4.7	3.0	1.75	1.58×10^{-4}
7	4.91	0.66	6.05	3.3	2.75	1.23×10^{-4}
8	5.03	0.51	4.25	2.2	2.05	9.33×10^{-5}
9	5.05	0.26	5.95	4.0	2.00	8.92×10^{-5}
10	5.32	0.83	6.12	3.6	2.5	4.78×10^{-5}
11	5.38	0.81	5.56	3.5	2.12	4.16×10^{-5}
12	5.53	0.06	6.62	4.1	2.5	2.95×10^{-5}
13	5.70	0.79	5.9	4.7	1.25	1.99×10^{-5}
14	5.79	0.89	5.65	5.4	0.25	1.62×10^{-5}
15	5.79	0.57	6.8	4.8	2.00	1.62×10^{-5}
16	6.15	0.66	4.55	3.1	1.5	7.07×10^{-5}
17	6.21	0.64	4.75	4.6	0.12	6.16×10^{-5}
18	6.31	0.88	4.12	4.1	0.11	4.89×10^{-5}
19	6.35	0.89	5.0	4.9	0.12	4.46×10^{-5}
20	6.38	0.89	6.0	5.8	0.17	4.16×10^{-5}



1: 6-6.5, 2: 5.5-6, 3: 5-5.5, 4: 4.5-5, 5: 4.4.5

Figure 1. Classes of acidity in Kolasib soils.

Table 2. Effect of pH on exchangeable Al^{3+} and H^+ in Kolasib soils.

Sample No	pH	EC (dS/m) (meq/100 g)	Exchangeable Al^{3+} (mg/100 g)	Exchangeable Al^{3+} (meq/100 g)	Exchangeable H^+
1	4.09	0.83	5.5	49.5	8.5
2	4.44	0.35	4.75	42.0	7.2
3	4.69	0.79	4.37	39.3	11.6
4	4.69	0.98	3.50	31.5	16.8
5	4.78	0.96	2.37	21.3	12.2
6	4.80	0.94	2.75	24.8	19.38
7	4.91	0.66	1.75	15.8	10.8
8	5.03	0.51	1.75	15.8	18.2
9	5.05	0.26	1.5	13.5	10.0
10	5.32	0.83	1.5	13.5	4.8
11	5.38	0.81	1.25	11.3	16.0
12	5.53	0.06	1.0	9.0	18.8
13	5.70	0.79	1.0	9.0	18.4
14	5.79	0.89	0.75	6.8	15.6
15	5.79	0.57	0.75	6.8	17.2
16	6.15	0.66	0.5	4.5	6.8
17	6.21	0.64	0.25	2.3	16.6
18	6.31	0.88	0.25	2.3	5.0
19	6.35	0.89	0.15	1.21	16.8
20	6.38	0.89	0.05	0.5	7.0

Effect of pH on Al^{3+} in solution

Exchangeable Al^{3+} concentration varied from 0.5 meq /100 g to 5.5 meq /100 g or 0.5 mg Al^{3+}/ 100 g soil to 49.5 mg Al^{3+} /100 g soil (Table 2) the concentration of Al^{3+} in the soil solution was related to pH of the soil. At a pH 4.09 (soil number 1) the concentration of exchangeab-leAl^{3+} ion was highest 5.5 meq /100 g or 49.5 mg Al^{3+} /100 g soil. However, the concentration of exchangeable Al $^{3+}$ was very low (0.05 meq/ 100 g or 0.5 mg /100 g) pH 6.38 (soil sample number 20). This showed that Al^{3+} concentration increased as the pH dropped from 5.70 and decreased appreciably as the increased from 5.70 (Figure 2).

Active acidity

This form of acidity is the actual H^+ ion concentration in soil solution measured by a pH meter. The concentration of active acidity varied as decrease of one unit of pH is equal to 10 times increase H^+ ion concentration in the soil solution. The pH decreased from 6 to 5, H^+ ion concentration increased from 10 times and as pH decreased from 6.4, H^+ ion concentration increased from 100 times . In the present study, active acidity varied from 7.07 X 10^{-6} meq/100 g in soil sample number 17 to 8.28 X 10^{-4} meq /100 g in soil sample number 1.

In general, the different forms of acidity detected in Kolasib, soils can be arranged in decreasing manner as – total acidity > non- exchangeable acidity > active acidity.

Conclusion

To facilitate better suggestions for the agriculture either to enrich the soil or introduce suitable crops, the studies on types of soil acidity of Kolasib are furnished here. The government and the NGO's keen interest in the aspect of agriculture and research would surely help agricultural revolution in the district.

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