

Acid Soils & Their Management

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Abstract

Acid soils are widespread and limit plant production all over the world. Acid soils occupy almost 92.3Mha of land and constitute 28.3% of total geographical area in India. Soil acidity is a severe soil degradation problem that can greatly reduce the production potential of crops and pastures.

Keywords: Acid soil, Lime, Parent materials, Hydrogen ions

Introduction

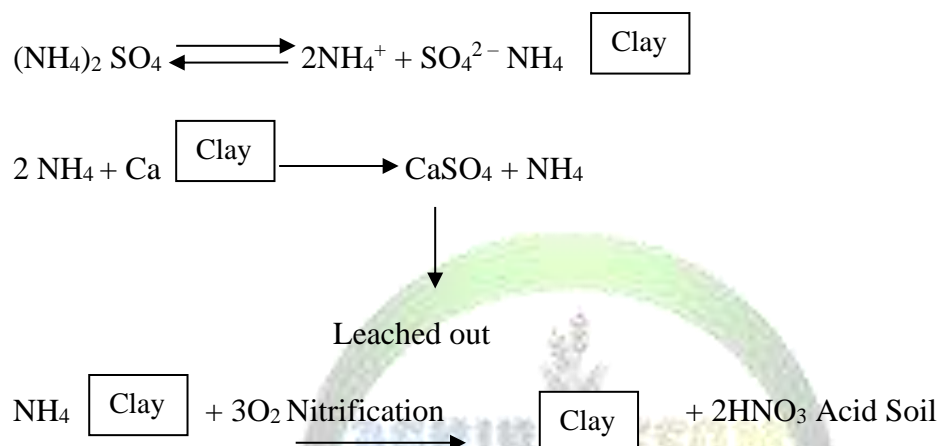
An acid soil is a base unsaturated soil containing of absorbed hydrogen ions and probably aluminium ions so as to give it a pH lower than 7. Acid is a substance that tends to give up protons (hydrogen ions) some other substances. Conversely, a base in any substance that tends to accept protons (hydrogen ions).

Source of soil acidity: Acid soil is a base unsaturated soil which has got enough adsorbed exchangeable hydrogen ions so that to give soil lower than 7.

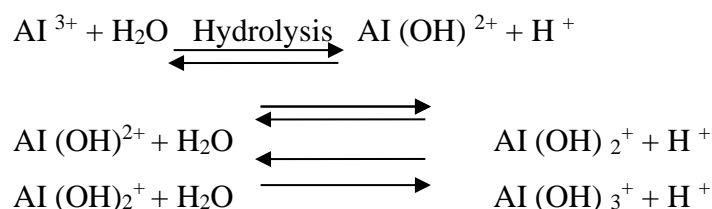
- 1. Leaching due to heavy rainfall:** Generally acid soil is common in all regions where rainfall or precipitation is high enough to leach appreciable amounts of exchangeable bases from the surface soils and selectively insoluble compounds of Al & Fe remains in soil. The natures of these compounds are acidic and oxides and hydroxides react with water and release H⁺ ions in soil solution and soil become acidic.
- 2. Acidic Parent Material:** Some soils have developed from parent material which one acid, such as quartzite and that may contribute to some extent of soil acidity. Major acid soil forming minerals are quartz, feldspar and muscovite, mica etc. Feldspar and mica which are aluminosilicates of K undergo hydrolysis in weathering producing Al⁺. But the water charged with, CO₂ (Forming

H₂CO₃), nitric acid and sulphuric acid ionize strongly. The acidulated water of rainfall reaches the soil and the H⁺ ions displace the metallic cat ions and get themselves adsorbed.

3. **Acid forming fertilizers and soluble salts:** The use of ammonium sulphate (NH₄)₂ SO₄ and NH₄NO₃ increases soil acidity. Ammonium ions form (NH₄⁺) ions from (NH₄)₂ SO₄ when applied to the soil replace calcium (Ca²⁺) ions form the exchange complex and CaSO₄ is formed and finely leached out.



4. **Humus and other organic acid:** Organic matter or humus material in soils occur as a result of microbiological decomposition of organic matter and contain different functional groups like carboxylic (-COOH), Phenolic (-OH) etc. which are capable of attracting and dissociating hydrogen (H⁺) ions.
5. **Aluminosilicate Mineral:** At low pH most of the aluminium (Al) is present as the hydrated aluminium ions (Al³⁺) which undergoes hydrolysis and releases hydrogen (H⁺) in the soil solution.



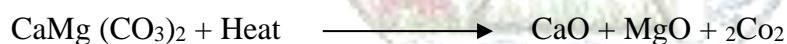
Degree of Soil acidity: Theoretically any soil having a pH < 7.0 should be called an acid soil, but for practical purposes, related to plant growth, the pH ranges for a neutral soil and different intensities of acidity have been fixed as follows.

Soil Reaction	pH Range
Neutral Soil	6.7 – 7.3
Slightly acid	6.1- 6.6
Moderately acid	5.6 - 6.0
Strongly acid	5.1 - 5.5
Very strongly acid	4.6 – 5.0
Extremely acid	4.5 and lower

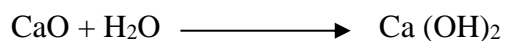
Use of liming to improve soil quality in acid soils.

Kinds of Liming materials There are various kind of liming materials that are used for correction of soil acidity.

1. **Oxides of Lime:** it is normally called burned lime or quick lime. Oxides of lime is more caustic than limestone burned lime is produced by heating lime stone and dolomite.



2. **Hydroxide of Lime:** It can be produced by adding water to burn lime and is called slaked lime.



3. **Carbonates of Lime:** There are the byproduct of certain industries and the content of calcium & magnesium varies two important minerals are found in this group calcite (CaCO_3 & dolomite ($\text{CaMg}(\text{CO}_3)_2$).

4. **Other liming materials:** Basic slag, coral shell, chalks, wood ash, pressmud, by product materials of paper mills liming material and also used for the amelioration of soil acidity.



Neutralizing value of some liming materials

Liming Materials	Neutralizing Value or CCE (%)
Calcium oxide (CaO)	179
Calcium Hydroxide (Ca (OH) ₂)	136
Dolomite CaMg (CO ₃) ₂	108.7
Calcite (CaCO ₃)	100
Baric slag (Ca SiO ₃)	86

Liming Benefits

Liming will provide the following benefits:

- Reduces the possibility of Mn²⁺ and Al³⁺ toxicity;
- Improves microbial activity;
- Improves physical condition (better structure);
- Improves symbiotic nitrogen fixation by legumes;
- Improves palatability of forages;
- Provides an inexpensive source for Ca²⁺ and Mg²⁺ when these nutrients are deficient at lower pH
- Improves nutrient availability (availability of P and Mo increases as pH increases at 6.0 – 7.0, however, other micronutrients availability increases as pH decreases).