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**RECLAMATION OF ACIDIC SOILS:**

**Important factors which produce acidity in soil are as follows:**

(1) Continuous removal of lime and other base elements by crops and accumulation of acids contained in the manures.

(2) Application of acid forming fertilizers in the soil.

(3) Microbial action.

(4) Formation of soil on the acidic rocks.

In India acid soils occur in the high rainfall areas covering about 25 million hectares of land with a pH below 5.5 and 23 million hectares of land with a pH between 5.6 and 6.5. These estimates are calculated by Bhaumik, H.D. and Donahue, Roy, L., 1964 (Reference: Soil acidity and the use of lime in India. Farm Information unit. Directorate of Extension, Ministry of Food and Agriculture, Government of India).

 In India, acid soils occur in Assam, Meghalaya, Arunachal Pradesh, Mizoram, Nagaland, NEFA, Manipur, Tripura, West Bengal, Bihar Uttar Pradesh, Himachal Pradesh, Jammu and Kashmir, M.P., Maharashtra, Kerala, Karnataka, Tamil Nadu and Andhra Pradesh. Punjab, Haryana, Rajasthan and Gujarat are the only states in India where acid soils do not occur.

Very few plants can grow well in strong acid soils. Soil acidity below pH value 5.5 is generally injurious to plants. Plant roots are badly affected if the pH value exceed limits of tolerance for particular crops. High degree of soil acidity (pH 5 to 6.5) decreases the availability of plant nutrients particularly phosphorus, calcium, magnesium, molybdenum, iron, manganese, potassium sulphur nitrogen, boron, copper and zinc. It also affects adversely the important microbiological processes, such as nitrogen fixation by Azotobacter, Clostridium and nodule inhabiting bacteria (Rhizobia) of leguminous plants.

 Acid soils are highly leached, generally poor in fertility and water holding capacity with pH value of less than 5.5. Such soils are having production potential but due to severe deficiencies of phosphorus, calcium, magnesium, molybdenum and toxicities of aluminum & iron, soil productivity decreases over the years.

 **Recommended package of practices includes following measures:-**

a) Field bunding, land shaping, construction of field channels/water harvesting structures, etc.;

b) Application of soil amendment (lime), at the rate of 2 to 4 quintals per ha. in furrows depending on extent of acidity along with growing crops suiting to such soils to enhance productivity;

 c) Green manuring & its mulching into soil for increasing organic carbon in the soil along with use of F.Y.M;

d) Growing of suitable crops (Pigeon pea, Soya bean, Groundnut, Lentil, Gram, Pea, Cotton, Maize, Sorghum, Wheat, Linseed and Mustard etc.) /horticultural/agro-forestry species including fuel & fodder plantation depending upon soil capabilities and slope conditions; and

e) Skill development for adoption of recommended package of practices on continuous basis to prevent recurrence of acidity in the soil.

**Reclamation of Acid Soils or Correction of Soil Acidity:**

Acidity of soil is due to predominance of H+ ions over OH– ions, the bulk of H+ ions being held in close association with clay-organic colloid complex. Strong acid soils are not much productive. The soils which are less productive owing to high degree of acidity can be made more productive by liming (application lime).

When lime is added to moist soil, the soil solution becomes charged with cations and the exchangeable hydrogen and aluminium ions on clay-organic colloid complex as well as the H+ ions in soil solution are displaced by calcium ions. Hydrogen combines with OH– to form neutral water or with CO3 or HCO3– to form unstable H2CO3, which readily dissociates to form CO2 and water.

Acidity of soil can also be corrected by adding exchangeable Mg++ to exchange complex But addition of or Mg++ or both to the soil will not necessarily solve the problem of soil acidity.

**The important points to be considered in liming are:**

(i) The salts of these elements which are going to supply these ions (Ca++ or Mg++) and

(ii) The overall reactions of salts in the soils Salts of strong acids as gypsum (CaSO4) or calcium chloride (CaCl2) can be applied to supply calcium 10ns to the soils but it is worth considering what will be the effects of these salts on soil acidity. The application of these salts will indeed increase the acidity in the soil, instead of decreasing it. Therefore, it is suggested that calcium salts of strong acids must not be applied for correcting the acidity of soils.

**Liming materials:**

More than 90 per cent of the lime used in agriculture for reclamation of acid soils IS generally in the form of calcium carbonate, some in calcium and magnesium carbonates, and much smaller quantity in the form of calcium oxide or calcium hydroxide. To a chemist lime is calcium oxide but to a farmer, agronomist or soil scientist lime usually means calcium carbonate or calcium carbonate equivalents.

**The common liming materials used for reclamation of acid soils are as follows:**

(1) Calcic limestone (CaCO3) which is ground limestone.

(2) Dolomite (CaCO3. MgCO3).

(3) Quick lime (CaO) which is burnt limestone.

(4) Hydrated (slaked) lime [Ca (OH)2].

(5) Coral shell lime.

(6) Marl or chalk (CaCO3).

(7) Slags Obtained as by-products from iron and steel plants, slags are used in agriculture for reclaiming acid soils.

**The slags are of three types:**

(i) Blast furnace slags,

(ii) Basic slag and

(iii) Electric furnace slag.

These slags are rich in phosphorus and mixture of CaO and CaCOH)2. Besides, Ca, Mg, Al, silicates are also present in them.

(8) Press-mud. It is obtained from carbonation plants of sugar mills. Press mud and some other matters containing calcium are used to decrease acidity in the soils.

(9) Miscellaneous sources of lime, such as, wood ash, ground oyster shells, by-product lime resulting from paper mills, tanneries, water softening plants, and by product CaCO3 form fertilizer factories using gypsum process (such as Sindri Fertilizer Factory, Bihar, India).

**The rate of lime application should always be determined after soil testing. When excessive amount of lime is applied to sandy soils low in humus, injury to plants may be caused which may be attributed to one or more of reasons listed below:**

(1) Boron deficiency.

(2) Iron, manganese and zinc deficiency.

(3) Reduced availability of phosphorus to a critically low level.

(4) Reduced potassium uptake.

Such injurious effects may be reduced by application of large amount of compost manure, green manure crops, phosphorus fertilizers, boron or a mixture of minor elements.

**While applying liming agents of acid soils, the following points must be taken into consideration:**

(i) The liming agents should be used in highly powdered state. The smaller the particles of liming agents the greater will be their effectiveness in correcting the soil acidity.

(ii) Liming materials should be in direct contact with clay Organic exchange complex so that H+ ions of exchange complex may be easily displaced by Ca++ ions.

(iii) Liming agents should be applied to soils at least one month before sowing the crops or they should be applied thoroughly mixed with soils just after harvesting the crops.

**Important Roles of Liming Agents in Soils:**

(1) Liming agents reduce soil acidity and stabilize pH of the soils.

Acid-clay + Ca(OH)2 → Ca-clay + H2O

(2) Lime makes phosphorus easily available. This is true mainly because in acid soils phosphorus is fixed by soluble iron and aluminium. Liming reduces the solubility of iron and aluminium and therefore less phosphorus is held in these insoluble and unavailable forms.

(3) Lime makes potassium more efficient in plant nutrition. When K is in sufficient amount in soil plants absorb more potassium than is actually needed but at the same time when lime is available in plenty, plants take up more calcium and less potassium. Economically liming is more desirable because plants absorb more cheap Ca. than expensive potassium.

(4) Lime enhances the decomposition of organic matter, thereby increases the availability of nitrogen and other nutrients locked up in complex forms to plants.

(5) Lime promotes beneficial activities of soil bacteria.

(6) Liming programme extended over a period of years improves the physical conditions of the soil by causing granulation of soil particles, decreasing its bulk density, and increasing its infiltration rate.

(7) Ca and Mg found in liming agents, particularly in Dolomite act as essential elements in the nutrition of plants.

(8) Lime converts toxic elements such as aluminium, Mn, Fe of the soil in insoluble and harmless compounds.