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Saline Soil Reclamation

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Abstract

The distinguishing characteristic of saline soils contains sufficient neutral soluble salts to adversely affect the growth of most of the crop plants. Saline soils are those which have an electrical conductivity of more than 4 dS/m at 25 °C. Different ways of saline soil reclamation practices were followed to alleviate the saline soil problem and the practices encompasses namely, scraping, flushing and leaching, agronomic practices, crop rotation, selected crop cultivation, different irrigation practices, drainage of soil, gypsum application and biological methods of saline soil removal by applying manures, green manures and bulky organic manures, etc.

Introduction

The distinguishing characteristic of saline soils contains sufficient neutral soluble salts to adversely affect the growth of most of the crop plants. Saline soils are those which have an electrical conductivity of more than 4 dS/m at 25 °C. Soluble salts most commonly present are the chlorides and sulphates of sodium, calcium and magnesium. Nitrates may be present in appreciable quantities. Sodium and chloride are by far the most dominant ions, particularly in highly saline soils, although calcium and magnesium are usually present in sufficient quantities to meet the nutritional needs of the crops. Many saline soils contain appreciable quantities of gypsum ($CaSO_4$, $2H_2O$) in the profile. Soluble carbonates are always absent. The pH value of the saturated soil paste is always less than 8.2 and more often near neutrality.

Physical Method of Saline Soil Reclamation

• **Scraping:** The salts accumulated on the surface can be removed by mechanical means. This is the simplest & most economical way to reclaim saline soils if the area is very small e.g. small garden lawn or a patch in a field. This improves plant growth only temporarily as the salts accumulate again & again.

• **Flushing:** Washing of surface salts by flushing water. This is especially practicable for soils having a crust & low permeability. However this is not sound method of practice.

• **Leaching:** Leaching with good quality water, irrigation or rain is the only practical way to remove excess salts from the soil. It is effective if drainage facilities are available, as this will lower the water table & remove the salts by draining the salt rich effluent.

• **Leaching requirement:** The amount of water needed to remove the excess soluble salts from the saline soils is called leaching requirement or the fraction of the irrigation water that must be leached through the root zone or soil profile to control soil salinity at any specific level (Salt balance).

Leaching Requirement (LR) = $\frac{EC_{iw}}{EC_{dw}}$ 100 or $\frac{D_{dw}}{D_{iw}}$ × 100

Where,

EC = Electrical Conductivity in dSm^{-1};
iw = EC of Irrigation water in dSm^{-1};
dw = EC of Drainage water in dSm^{-1};
D_{dw} = Depth of drainage water in inches;
D_{iw} = Depth of irrigation water in inches.

Agronomic and Cultural Methods of Saline Soil Reclamation

In areas where only saline irrigation water is available or when shallow saline water table prevails and soil permeability is low, the following cultural practices are adopted.

1. Selection of Crops and Crop Rotations

On the basis of crop tolerance to quality of irrigation water or soil salinity the crops can be classified in four groups viz.,

Highly tolerant crops: Barley, Sugar beet, datepalm.

Tolerant: Tapioca, mustard, coconut, spinach, amaranthus, pomegranate, guava, ber.

Semi-tolerant: Ashguard, bitterguard, brinjal, cabbage, cluster bean, Pea, lady's finger, muskmelon, onion, potato, dolichos, sweet potato, tomato, turnip, water melon.

Sensitive: Radish, carrot, Coriander, Cumin, Mint, Grape, sweet orange.

2. Method of Raising Plants

• Crop should be raised by transplanting seedlings (especially vegetables, flowers, fruit trees) than germinating the seeds.

• Wild root stocks grafted with a good quality but salinity sensitive scion (Mango, citrus, Guava and ornamental plants like rose).

3. Irrigation Practices

• Method of water application- follow furrow or drip irrigation, sub surface irrigation systems and sprinkler irrigation.

• Frequency of irrigation- irrigation more often (frequent) can maintain better water availability & decrease the salinity should not too much irrigations.

4. Use of mulching materials to prevent evaporation losses like straws, plastic sheets etc.

Drainage Method of Saline Soil Reclamation

Drainage means removal of excess of water and along with it the salts from lands. In general drainage can be of two types viz.,

Surface Drainage

Surface drainage is the collection and removal of water from the surface of the soil. Two conditions favouring the use of surface drainage are low areas that receive water from surrounding higher land and impermeable soils that have insufficient capacity of dispose of the excess water by movement downward through the soil profile.

Subsurface Drainage

In subsurface drainage ditches can be quickly and inexpensively made to remove gravitational water. Drainage ditches, however, require periodic cleaning and are inconvenient for die use of machinery. Both these drainage systems have their values and limitations according to particular local situations.

Contributing Factors for Subsurface Drainage

• The natural hydrological conditions of the area;

• The magnitude of seepage through canal irrigation and other sources that may augment the ground water recharge; and

• The additional leaching requirement for hydro technical soil improvement.

Biological Method of Saline Soil Reclamation

It is well known that the decomposition of cattle manures and plant residues, in the soil, liberates carbon dioxide and organic acids which help to dissolve any insoluble calcium salts in the soil solution and also neutralize the alkali present. Decomposing organic matter improves soil permeability and increases water-stable aggregates.

Organic Amendments for Improvement of Saline Soil

Soil amendments namely, farmyard manure, molasses, sugar factory press-mud, green manures, crop residues and different weeds etc., may be incorporated in the salinity affected soil to make improvement and reclamation process over a period of time and the amendment practices are as follows.

Green Manuring and Crop Residues

The common crops used for green manuring are dhaicha or Jantar (*Sesbania aculeata*), Sunnhemps (*Crotalaria juncea*), barseem (*Trifolium alexandrieutn*), sengi (*Melioletus parviflora*) and cowpea (*Vigna sinensis*) etc. They serve on decomposition as sources of readily available nutrients besides acting as solubilizing agent for calcium and neutralizing high pH of alkali soils. Consequent improvement in soil permeability and also increased biological activity help

in slowly regenerating the soil. Of all the plants used as green manure, *Sesbania aculeata* has been found most successful on saline soils.

The important characteristics of green manuring crops are:

• Legume crops can neutralize alkalinity.

• Highest calcium content on ash basis.

• Thrive well under moderately saline conditions.

The application of 5-0 tonnes per hectare of Sesbania green manure has been quite effective in gelling higher yields of paddy on saline soils of the mm coast in Andhra Pradesh.

Afforestation

The plant species like *Acacia arabica*, *Melia azadirachta*, *Prosopis juliflora*, *Butea monosperma*, *Tamarix articulata* and *Albizzia lebbeck* can grow within certain limits on the salt affected soils. Some species like *Capparis aphylla*, *Capparis horrida*, *Salvadora oleoides* and *Zizyphus* can be grown or even occur naturally on certain types of salty lands.

The forest growth exerts ameliorative effect on the soil by loosening the subsoil and improving permeability through the action of the root system. Organic matter is added by the leaf litter and root residues. Carbonic acid produced through root activity and decay of organic material, mobilizes calcium for replacement of exchangeable sodium. Besides, there is a general soil and ecological improvement through microbial activity and moderation of the micro-climate.

Bulky Organic Manures

Farm manures has been successfully tried in the treatment of saline-alkaline soils in Haryana and Punjab. The application of 10 tonnes of farmyard manure with 15 tonnes of Sesbania green leaves proved almost as beneficial as 30 tonnes per hectare of Sesbania green manuring, in increasing the yield of paddy.

Chemical Amelioration

Chemical amendments for the purpose of reclamation are either soluble calcium salts like calcium chloride and gypsum or relatively less soluble ground limestone and pressmud from sugar factories and slag from iron factories or acid and acid formers which work as calcium mobilizers like sulphuric acid, sulphur, iron sulphate, aluminium sulphate, lime sulphur etc.

Gypsum

The 0.59 mm fineness of gypsum was more effective in reclamation of saline and alkaline soils. It is safe, less costly and the supply of calcium for decreasing exchangeable sodium percentage of soils results in increased permeability of water to soil. It also helps in reducing the salts from root zone depth by the smooth flow of water in the soil profile.

Conclusion

The saline soil should be remediated by adopting different methods of reclamation technologies namely, Physical, Chemical and biological. The above methods can be implemented for saline soil reclamation and the scientist should create awareness among people through trainings.

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