AGRONOMY

Reclamation of Saline & Sodic Soils

Saline and/or sodic soil is caused by four separate conditions: ❶ high salt in the parent material and low rainfall (low leaching); ❷ high rainfall with poor internal drainage; ❸ a high water table that carries salt to the soil surface, and ❹ a high amount of salt being applied (e.g., manure, poor quality irrigation water). Before a reclamation system can be established, the factors causing salt accumulation must be eliminated.

Drainage

When deciding whether corrective action for saline and sodic soils will be effective, it is of primary importance to consider the drainage conditions. The ability to leach water is dependent upon drainage, and the overall effectiveness of your reclamation system is dependent upon leaching. Drainage carries the salts down through the soil profile and out of the rooting zone. Without drainage, salts will accumulate regardless of any applied soil amendments.

Tile drainage and open-trench drainage are two options for carrying away leached salts. If possible, it is important to eliminate any impermeable zones above the artificial drains before leaching is attempted. Drainage is an expensive operation requiring technical knowledge and should be performed only after consultation with agricultural irrigation drainage experts.

Leaching and Reclaiming Saline Soil

Saline soils are relatively easy to reclaim for crop production if adequate amounts of low-salt irrigation water are available and if internal and surface drainage are feasible. Saline soils cannot be reclaimed by any chemical amendment, conditioner, or fertilizer. Reclamation of these soils consists of simply applying enough high-quality water to leach the soil thoroughly. The water applied should be low in sodium but can be fairly saline (1,500 to 2,000 ppm total salt), as this helps to keep the soil permeable during the leaching process. Several applications of water are recommended, which allows time for the soil to leach and drain well after each application. Generally, about 12 inches of water are required to remove 70 to 80 percent of the salt for each foot of soil.

After reclamation, only good quality water should be used for irrigation. To ensure that salinity does not reoccur, an excess amount of water must be added so that the amount of salt added is equal to the amount of salt leaving the root zone. Excess water can create extra management problems due to the threat of high water tables, increased irrigation water expense, and difficulty in maintaining adequate levels of soil nitrate for crop growth.

Reclaiming Sodic and Saline and Sodic Soils

In sodic soils, the exchangeable sodium may be so great that the resulting dispersed soil is almost impervious to water. Sodium soil is treated by replacing the absorbed sodium with a soluble source of calcium. Calcium may be supplied by native gypsum already in the soil, calcium in irrigation water, or commercial amendments. In fact, the use of amendments is the only real difference between treating saline soil versus sodic and saline/sodic soil.

Amendments should be used only when needed and/or when past results justify their use. They may be useful where soil permeability is low due to low salinity, excess sodium, or high carbonate/bicarbonate in the water. However, they will not be useful if poor permeability exists due to problems with soil texture, soil compaction, restrictive layers (hardpans, claypans), or high water tables.

Amendments for soil and water and their relative effectiveness in supplying calcium are shown in **Table 1**.

Table 1. Effectiveness of Calcium Supplying Amendments

Amendment	Suitable For	Tons Equivalent to 1 ton of 100% Gypsum
Gypsum	soil/water	1.00
Sulfur	soil	0.19
Sulfuric Acid	soil/water	0.61
Ferric Sulfate	soil	1.09
Lime Sulfur	soil/water	0.78
Calcium Chloride	soil/water	0.86
Calcium Nitrate	soil/water	1.06

In order to reclaim soil to a depth of one foot, gypsum recommendations are as follows: tons of gypsum per acre = 1.7 × (meq Na/100g) - (CEC × 5%)

If sodic soils contain no source of calcium (gypsum or free carbonates), then gypsum or a soluble calcium source should be applied. If the soils contain lime, then acid or acid-forming materials can be used. Examples of acid or acid-forming materials include sulfuric acid, elemental sulfur, ferric sulfate, and lime sulfur. Sulfuric acid reacts immediately with soil lime. One advantage of using sulfuric acid is that the gypsum formed is in very fine particles. The fine gypsum particles react more quickly to replace sodium because they are more soluble than the coarse gypsum usually applied. Elemental sulfur takes several years to completely oxidize into sulfates, and gypsum is the slowest of all amendments.

However, the reclamation process is not complete until most of the sodium is removed from the soil to at least a depth of three to five feet. Even then, more time is required for restoration of good soil productivity. Once the soil structure is completely destroyed, it is slow to return to a desirable condition.

Conclusion

Correcting saline and sodic soils requires salt to be leached out of the soil profile. This requires good quality water, good soil permeability, and good drainage. Amendments that supply soluble calcium are needed to correct sodic soils.