Approaches for Nutrient Management in degraded soils

Leaching:

Salt affected soils can be reclaimed by removing the salts from the root zone area of plants either with heavy irrigation or with the drainage. Salt affected soils can be reclaimed as well as managed by irrigating the soil with plenty of good quality water. We can determine the reclamation rate by knowing the amount of water that reaches out of root zone after passing through soil referring as leaching fraction while leaching fraction is directly related to the drainage capacity of soil. Reclamation process initiates by drainage of salts and reducing the water table. There are some cases when reducing water table will no longer be beneficial but this problem can be solved by the utilization of land for crop cultivation. Brackish water used for irrigation purposes due to shortage of good quality water is the major cause of salinity problem. Salt affected soils can be reclaimed by leaching down the salts along with irrigation sources of good quality water rather using the poor quality water. 1.5 times of the EC of the irrigation water salts can be removed from the soil while adopting the good management activities. Thus if EC of the leaching water is high we need huge quantity of water to eliminate the salts from the salt affected soils. It is general recommendation that EC can be reduced up to half with every 6 in. good quality water that can pass through the soil along with salts. That's why if we have to remove the salts 30 in. downward having EC 1.5 dS/m we need 6 in. water that will move up to the 30 in. within the soil that will EC lower the EC to 0.75 dS/m. It is proved that organic matter improves the soil properties thus with the application of the organic matter drainage capacity of the soil will be enhanced that will reduce the problem of salinity. To enhance the organic matter into the soil vegetation is very important. Growing of maximum trees can act as the buffer of the soil against the generation of the salt affected soil. Addition of salts will lower down the free energy of the water by rising the osmotic potential or solute potential. Resultantly plants feel difficulty in the uptake of the water and growth and development of the plants become less. Now it is the need of the hour to reclaim the salt affected soil to get the maximum yield as food security and sustainability are becoming major problem of the world.

Irrigation Method

It is very important that how are we irrigating the soil to check down the high concentration of the salt in the root zone. It is reported that application of the large amount of water for the irrigation purposes plays supportive role for the adequate uptake of water by plants. Sprinkler

irrigation is one of the best methods for irrigation especially when water shortage and salinity are the major problem.

Sprinkler irrigation ranks high in efficiency as compared to the flooding. It is reported that requirement of water becomes 3 times more in flood irrigation when compared with the sprinkler irrigation for lowering the same amount of the salts. It is also beneficial that land leveling is not required for the uniform application of the water which is the basic necessity in the flooding irrigation. Similarly drip irrigation which is sometimes also called trickle irrigation is the best method of irrigation for the perennial crops and seasonal row crops. As it supply the water the water at one point only problem of salinity become minimized. Salt concentration will become less by this method by keeping the water table low. When water table will be low risk of salinity development reduces up to great extent.

Mulching

Salts come at the surface of the soil when process of the evaporation becomes faster that application of water. Even the leached down salts can come at the surface along with water with capillary rise process when irrigation will not be applied for long time especially during the fallowing of the land. Soil salinity is the major problem when water table is shallow along with the high EC of the irrigation water. But the problem salinity can be reduced by lowering the evaporation process. Evaporation become limited when soil remain covered with vegetation. It is recommended that the salinity problem become less when process of evaporation will be lowered by mulching or covering the soil Thus after the fallowing of land mulching will be helpful in controlling the salinity problem.

Management of Sodic Soils

Excess Na + on the cation exchange sites causes clay particles to disperse or swell, and as a consequence these soils have poor structure, low aggregate stability, and reduced water infiltration Overall, sodic soils are a poor rooting medium for plant growth and provide lowered or insufficient nutrients. Sodic soils also have reduced biological activity and function due to the limited availability of C substrates that are likely the result of lowered net primary productivity in these soils remediating the effects of excess Na^+ in sodic soils can be accomplished with soil amendments and land management. Calcium amendments have been shown to reduce the effects of sodicity. Calcium flocculates cl,ay particles leading to improvements in soil structure. Calcium also replaces Na^+ on soil exchange sites and is frequently correlated with increases in

soluble Na^+ .Rates of gypsum application can be calculated by taking into account soil cation exchange capacity, target SAR, and current SAR values (Ashworth et al. 1999). After chemical treatment subsurface tile drainage may be used to remove excess sodium from the rooting zone Subsurface drainage can also prevent salt accumulation due to fluctuations in water table depth, capillary rise, and evaporation In order to provide advice to growers with respect to whether their management strategies have begun to bring about the changes they anticipated, a tool capable of detecting short term improvements is needed. Successful remediation of sodicity may take years and can be costly Soil health is referred as ability of soil to perform within ecosystems and use of land to sustain high yield, good environmental quality and improve plant, animal, and human health. Soil health can be determined by the use of different indicators such as a proxy for shifts in nutrient cycling resulting from land use change, amendment application and tile drainage installation will aid in the early detection of effective remediation strategies, potentially reducing the cost and environmental impact of remediation Additionally identifying soil health indicators and monitoring changes in these soil properties will aid landowners in ensuring the long–term productivity of the land. Currently, biological soil health indicators are not widely used to assess remediation progress. Reclamation of the sodic soil is very difficult and mostly expenses become high than income. By following the above procedures reclamation of the sodic soil is possible but it took many years to completely reclaim this problem while following the good crop management practices.

Drainage

Soil sodicity problem can be controlled by removing the high concentration of sodium from the root zone by good drainage practice. Low water table is helpful in reducing this problem. By the development of the tile drains and by changing the topography sodic soils can be reclaimed up to the great extent. Plantation of trees especially deep rooted is also beneficial when we want to low down the problem of sodicity. Sealing of canals or lining of canals become supportive for controlling the seepage which resultantly control the problem of the sodicity. Thus good drainage property of the soil is very important in controlling the problem of the sodicity.

Tillage and Amendments

Tillage practice is considered as the physical practice in reclaiming the problem of sodicity. Tillage cause the fragmentation of the big soil colloids having the high concentration of the sodium and amendments will become the part of the soil and reclaiming process become faster.

Large organic matter which has the property of slow decomposition like straw, cornstalks, sawdust, or wood shavings used for animal bedding is reported beneficial for improving soil structure and infiltration properties of soil along with the other reclamation activities.

Supplying Calcium to Improve Water Infiltration: Refining water infiltration property of soil requires lowering of the exchangeable sodium percentage (ESP) along with raising the electrical conductivity (EC) up to more than 4 dS/m (4 mmhos/cm). It can be determined by the soil texture and irrigation method that how much exchangeable sodium percentage (ESP) is required to make the better infiltration. Sandy textured soils have the capacity to bear the exchangeable sodium percentage (ESP) up to the 12 while still having good infiltration and percolation. Surface irrigation similarly can retain good infiltration and percolation with high exchangeable sodium percentage (ESP) as compared to the sprinkler irrigation. Calcium is basic need in the reclamation process of the sodic soils as it can replace the sodium and that lowering the ESP as well as SAR.

Irrigation Water Management

Irrigation water that comes from the deep wells has great concentration of bicarbonate and thus high sodium concentration as compared to the calcium and magnesium. Irrigation with such type of water for long time creates the problem of sodicity. EC and SAR are used to evaluate the infiltration problems by the application of the irrigation water.

Management of Saline-Sodic Soils

To reclaim the saline-sodic soils it is the important to first reclaim the sodic soil with the use of calcium to resolve the problem of high concentration of the sodium. After reclaiming the problem of the high concentration of sodium (sodicity) problem of the high concentration of salts (salinity) can be resolved simply by the application of the high amount of irrigation water. It is the basic requirement of saline-sodic soil reclamation that to solubilize the sodium first before the leaching of all other salts. The reason behind it is that if we'll not make the sodium soluble before removing all salts from root zone problem of sodicity will left over after treating the soil for salinity problem. Thus soil structure will be deteriorated that will make infiltration process either completely stop or lower down. After this destruction remediation becomes very difficult. Therefore it is necessary to determine that how much sodium problem still remaining before applying good quality irrigation water to leach salts. High EC of irrigation water and soil supports for improving soil structure, increasing water infiltration and resist sodium from

accumulation into the soil. Except this positive effect of high EC (salt) irrigation water about soil structure it is not good for crop production.