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Reclamation and Management of Usar Lands : Sodic

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ABSTRACT

Land and soil are precious natural resources and are Nature's gift to the mankind. The prosperity of a country depends on the richness of these resources. The land resource is limited as the total geographical area is fixed. Under these conditions, every part of the land is important for us and for the nation. Out of the several problems that limit the economic utilization of land resources in India, the problem of usar lands (Sodic and Saline) - the so called salt - affected soils is of great concern. Usar land is defined as that land where the vaste patches of white efflorescence salt called 'Reh'. Such type of lands need special attention because they are quite different in nature from other type of lands.

Usar lands required different approaches for their better management and reclamation. Gypsum application followed by leaching and improved cultural practices is the main technology for the reclamation of sodic usar lands. Besides gypsum, several other materials have been used for the reclamation. These are gypsum containing material (phosphogypsum), organic waste material (pressmud, molasses, FYM, green manure and rice husk), and saline water. The cropping pattern to be followed for the management of sodic soils should be: Leaching (dhaincha)/ rice (dhaincha)/ barley (wheat) during first year, dhaincha/ rice/ wheat (barley, raya, barseem) during second year and dhaincha (fallow, cowpeas, maize) /rice/wheat (barley,raya, barseem) during third year.

Keywords: Reclamation, Management, Usar lands, Reh.

INTRODUCTION

Land is the basic and most important resource to the mankind. All agricultural, animal and forestry production depend on the productivity of the land. The land resource is limited as the total geographical area is fixed. The amount of land and land-based resources is, then finite. Land is therefore, scarce in supply. Under these conditions, every part of the land is important for us and for the nation. Out of the several problems that limit the economic utilization of land resources in India, the problem of usar lands (Sodic and Saline) - the so called salt -affected soils is of great concern. In India alone, about 7 million ha of the cultivated land are affected by sodicity and salinity. Nearly 35 per cent (2.5 million ha) of usar lands are sodic, occurring in parts of the Indo-Gangetic plains. In Haryana, it is about 0.50 million ha. Nearly 65 per cent (0.33 million ha) of the usar lands are sodic, occurring in the Indo-Gangetic plains with mean annual rainfall of 550-1000 mm.

Usar land is defined as that land where the vaste patches of white efflorescence salt called 'Reh'. Such type of lands need special attention because they are quite different in nature from other type of lands. Usar lands required different approaches for their better management and reclamation. Establishing a good crop stand in the usar land is a challenging task. Hence the urgent need of the present time is not only to increase agricultural production in the land, which is already under cultivation by using all sorts of scientific techniques. But we will have to adopt recent reclamation and management techniques for sodic usar lands.

RECLAMATION

The reclamation of sodic soils basically requires that the excess sodium in the exchange complex should be replaced with calcium and exchanged sodium be leached out of the root zone. Different aspect of the reclamation technology of these soils is presented below:

Gypsum Application followed by Leaching

These soils can be brought successfully under cultivation by adoption of reclamation and management technology. The key to success is the availability of good quality water and a cheap source of gypsum. The main features of the technology are:

- The leaching of excess salts from the soil surface layers.
- The supply of adequate quantities of soluble calcium (like gypsum) to improve the soil chemically and physically.

Other Amendments

Besides gypsum, several other materials have been used or recommended for the reclamation of sodic soils. These are gypsum containing material (phosphogypsum), organic waste material (pressmud, molasses, FYM, green manure and rice husk), and saline water.

Gypsum Containing Materials

Phosphogypsum, a by-product of the fertilizer industry, is available in large quantities for use as amendment. In field experiments (Mehta and Yadav, 1977), it has been found as effective as gypsum. The material is, however, likely to contain a considerable amount of fluorine. Fluorine poses fears of toxicity in soil-plant-animal-system. The studies (Singh *et al*., 1980; Chhabra *et al.*, 1980) have, however, shown that the solubility and the availability of fluorine reduction with reaction in soil ESP and pH. Therefore, the application of a moderate quantity of phosphogypsum is not likely to increase fluorine uptake by crops like rice and wheat.

Organic Material

The application of organic materials (pressmud-a by product of sugar industry, FYM, green manures, rice husk, saw dust, charcoal dust, molasses), either alone or in combination with other amendments, has also proved beneficial at several places (Anonymous, 1986). Besides being a source of plant nutrients, these materials, when decay, liberate large amounts of carbon dioxide and organic acids which react with the native calcium carbonate to form soluble calcium salts and consequently decrease the soil ESP and pH. Secondly, a heavy dressing of organic materials improves soil intake rate and its permeability. However, these ameliorative effects of the organic materials are temporary unless the dressings are renewed regularly.

Use of Saline Water as a Source of Calcium

Another development in the reclamation of sodic soils is the high salt dilution method in which the soil is leached with saline water in successive dilutions. A divalent (Ca and Mg): total salt ratio of 0.3 in the water being use for leaching is considered to be sufficient for a successful and rapid reclamation. Dubey (1987) used saline (EC=4 dS/m, SAR=10) water for the reclamation of a sodic soil in the presence of rice followed by wheat. Saline water alone or in combination with other amendments (gypsum, FYM and pyrite) did significantly better than the non-saline good quality water. Although the method is promising one without any extra amendment, the only serious problem is that the saline waters exist mostly in areas suffering from salinity. In areas having sodicity, the ground water is mostly of a fairly good quality.

Gypsum Solubility in Sodic Soils

Hira *et al*. (1980) observed that the solubility of gypsum mixed in a sodic soil was much more than its solubility in pure water. The solubility further increases with increase in soil ESP. Owing to this fact, the quantity of water required for reclamation was much less than the quantity calculated on the basis of the solubility of gypsum in water.

Gypsum Application Method

For sodic soils containing soluble carbonates, the mixing of the limited quantities of gypsum to a shallower depth was much more beneficial in improving soil properties and crop yield than its mixing to a deeper depth. Moreover, when gypsum was mixed to a greater depth, it got diluted, resulting in only a small decrease in the ESP throughout the depth. Also, when mixed to a greater depth, a larger fraction of the gypsum is used up in neutralizing the soluble carbonates with only a little left for replacing exchangeable sodium. In laboratory studies, Abrol *et al.* (1975) showed that a surface applied gypsum caused a greater reduction in the ESP and gave a higher final hydraulic conductivity than when it was mixed. For the same reason, it is recommended that gypsum should be surface-broadcast and be mixed with 10 or 15cm surface soil only.

Time of Commencement of Reclamation

The best time to apply gypsum is the last week of March, Provided the farmer has got a sufficient amount of good quality water at his disposal. After a continuous leaching for 30 days, sesbania should be sown in the first week of April. When it is 50-60 days old, it should be green manured and rice should be transplanted in the first week of July. Alternatively, if sufficient water is not available in summer months, gypsum can be applied in the last week of May after a heavy irrigation. After leaching for 30 days, rice should be transplanted in the first week of July.

MANAGEMENT

The adoption of the best suited cultural and crop management practices is essential for maximum returns from the inputs to the sodic soils.

Cropping Sequence

The cropping sequence to be followed in the sodic soils as given in Table 1. In case of highly sodic soils, rice, because of its shallow rooting system, its high tolerance to flooding conditions and its ameliorative effects should be the first crop during rainy season. After rice the field should not be left fellow. The field should therefore, be continuously cropped. Following rice, wheat or barely is a better crop in rotation for the winter season. If market is available berseem can also be grown after rice. Among oil seeds, raya is also a better-suited crop. As winter vegetables turnip, spinach, radish, muskmelon, watermelon, etc. are also suitable for such soils. In summar, sesbania should be grown for green manuring.

Table 1: Cropping sequence to be followed in sodic soils

Season	1st year	2nd year	3rd year
Summer	Leaching/Sesbania	Sesbania	Sesbania/Fallow/Cowpeas/Maize
Rainy	Rice/Sesbania	Rice	Rice
Winter	Barley/Wheat	Wheat/Barley/Raya/Berseem	Wheat/Barley/Raya/Berseem

Irrigation

For crop other than rice, their irrigation presents the major difficulty in obtaining their optimum yields from sodic soils. The low infiltration rates and the low hydraulic conductivity of these soils result in a reduced water storage in the profile. The root penetration in these soils is restricted due to a dense and high ESP sub-soil. Further, the movement of stored sub-surface water to the root zone is slow, resulting in the rapid drying of the surface soil layer. Furthermore, the crusting of sodic soils causes, failure in the emergence of seedlings. These limitations require that the crops should be irrigated more frequently and with smaller quantities of water at each irrigation, unlike for the crops grown under non-sodic conditions.

Fertilization

The low organic matter content and the high pH impart poor fertility to the sodic soils. Due to low levels of nitrogenous in these soils, the application of nitrogen in these soils, the application of nitrogenous fertilizers is particularly important. A number of studies have shown that crops grown in sodic soils respond more to the higher levels of applied nitrogen than crops grown in non-sodic soils (Anonymous, 1979). Among the different sources, ammonium sulphate proved to be a better source of nitrogen than urea. In view of these and other studies, it is recommended that the crops grown in sodic soils should be fertilized at least with 20 per cent more nitrogen than the recommended rates for the non-sodic soils.

Among the micronutrients, the zinc deficiency is the most common in sodic soils. Several studies have attempted to define the optimum zinc fertilization needs of crops in these soils. These studies have clearly established the need for applying zinc in the initial years of reclamation for obtaining optimum yields.

RECOMMENDATIONS

The sodic usar lands can be brought to high productivity by vigorous adoption of reclamation technology. The following technological steps and management practices are to be followed:

- Level the land first and, then, divide it into various blocks and plots by making strong and high bunds. This should be done in the months of April, May or June, depending upon the availability of water.
- Plough the plots to a normal depth and irrigate them with 5 to 7 cm water.
- After 1 or 2 days, spread gypsum on the soil surface. Gypsum is to be added only once.
- Do not mix gypsum to more than 15cm depth. If mixed deeper, it will be less effective due to its dilution in the soil mass and its reaction with soluble carbonate.
- Leach the soil with about 50 cm of water to make the surface up to 30 to 45 cm depth relatively salt-free. Do subsequent leaching while growing the rice crop.
- Depending upon the time of the year and the availability of water, grow rice or sesbania (green manuring) after leaching.
- Do not keep the land fallow in the following winter and summer seasons.
- In such partially reclaimed soils, pudding and deep ploughing should not be done.
- High plant population of rice (4-6 plants per hill) and higher seed rate for other crops to compensate for lower tillering result in higher yields.
- Among nitrogen fertilizers, ammonium sulphate should be preferred during first few years. While nitrogen is to be applied, 10 to 15% extra above the recommended dose.
- Zinc sulphate at the rate of 25 kg/ha should be added.

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