Biological approach for saline agriculture

Intshar-ul-Haq Javed

Salinity is a problem of arid region where artificial irrigation results into addition of more salts to the soil than are leached down. When leaching is poor and evaporation exceeds the precipitation, there is movement of solutes towards the upper soil profile leading to the accumulation of salts in the root zone with sodium (Na+) as the major cation.

This phenomenon is called primary salinisation and may start from the very beginning of soil formation. Advent of canal irrigation system in the last quarter of 19th century in Pakistan accelerated the pace of secondary salinisation, the main factors being the poor drainage, increased utilisation of underground brackish water and inappropriate irrigation practices accelerate the pace of salinisation. In nutshell, salinity - sodicity and waterlogging emerged as the agricultural productivity, reducing yield by up to 25 per cent.

Salinisation of soils is posing a serious threat to agriculture around the globe. Current estimates indicate that 1 billion hectares land out of 13 billion hectares total land on earth are salt affected and therefore, exhibit restricted crop productivity. In some agricultural systems of the world, as much as 50 per cent of the irrigated land is salinised. In Pakistan there is an estimated salt affected area of about 5.8 million hectare, with an annual increase of about 0.04 million hectare. The salt affected area in Pakistan in 42 per cent of cultivated area. Despite the advanced technologies available today, salinisation of millions of hectare of land continues to reduce crop productivity worldwide. This entails an economic loss of over 140 million US $ per year. At present, Pakistan is experiencing a huge loss in terms of agricultural pro-

'Salinisation of soils is posing a serious threat to agriculture around the globe'

modify the soil according to plant requirement. Scrapping of slat layer, land leveling, deep ploughing, sub-soiling, sanding, quality and quantity of water, method of irrigation help in improving solid conditions as physical measures. Chemical amendments are also helpful to restore the soil productivity.

The reclamation approaches are costly and long time taking while the cultural approach is easy, cheap and highly rewarding in short span of time. So the 2nd approach is being focus to bring the salt affected lands under cultivation. The cultural approaches in four ways (A) Screening of salt tolerant varieties (B) Identification of specific traits/genes responsible for salt tolerance (C) Breeding programmes by hybridisation (D) Search for economic coloniser other than crop plant.

Salinity tolerance in plants is a difficult and complex phenomena of great potential significance to agriculture in arid and semiarid countries. On the basis of their responses to salinity plants are classified, as the plants that grow in high salt soils are known as halophytes. The most tolerant halophytes will continue to grow at concentrations of NaCI in the 200 to 500 millmoles range. Some halophytes are known as salt regulators, do not absorb salt, but actively exclude it from their roots. Other salt regulators take up the salt by excrete large quantities through specialised salt glands in the leaves. Excreted salt crystallises on the leaf surface where it is no longer harmful. Excretion through salt glands is highly specific. Salt accumulators, on the other hand, rely on high ion uptake to maintain cell turgor

Pakistan is experiencing a huge loss in terms of agricultural productivity due to this factor only.

The magnitude, severity and damage due to salinity are multiplying daily with no immediate solution in sight. The efforts needed to overcome this problem have been partially effective so far, but surely, there is a growing need to tackle it actively. Saline soils are not only rampart in Pakistan, but also occurs in many arid and semiarid parts of the world. For a country like Pakistan, which relies heavily on agriculture for it sustenance, this is of particular significance. Ever increasing demand of food, fodder and fuel wood is pushing agriculture to marginal lands, thus increasing the need of finding ways to utilise them, this is possible by improving salt condition and or finding plants, which could tolerate these stresses.

Reclamation is the major way to tors, on the other hand, rely on high ion uptake to maintain cell turgor under conditions of low soil water potential.

At the other extreme are sensitive non-halophytes called glycophytes. Many agriculturally significant species such as beans, soybeans, rice and maize are glycophytes. Glycophytes can tolerate very little salt and may suffer irreparable damage at concentration of NaCI less than 50 millmole.

Plant scientists are being engaged in this field to developed some salt tolerant crops to cope with this ever-increasing problem. Important programme in this regard is going on, on pearl millet in Department of Botany University of Agriculture Faisalabad.

Pearl millet (Bajra) is one of the multipurpose and commercially important cereals (grain and for-

See page 15

Biological approach

From page 13

age) crop of Pakistan. It is mainly endemic to rain-fed areas. In chemical composition it contains water 12.4 per cent, protein 11.6 per cent, fats 5.00 per cent, fiber 1.2 per cent and ash 2.7 per cent. The nutritive value is comparable to those in rice and wheat; preliminary research work revealed that some varieties, together with drought tolerance, have potential to tolerate high salinity conditions. However, the understanding of salinity tolerance mechanism (s), particularly under irrigated area have not been fully understood.

The study entailed the screening in terms of growth, yield and exploration of salinity mechanism (s) at seedling, tillering and grain filling stages of growth. For this purpose ten high yielding varieties recommended for cultivation in whole of Punjab Province were selected on the basis of some morphological characteristics of seed and plant.

During the studies it was revealed that some varieties have developed specific physiological and anatomical features at cell, tissue, organ and whole plant levels which enable them to sustain growth under 100, 150 and 200 mill moles levels of salinity. Being cross-pollinated crop every line of pearl millet is highly variable for this exploitation, from available pearl millet germplasm through standard screening techniques, salt tolerant line, ToGO is evolved, that can tolerate even the salinity level of 200mill moles of NaCI salinity.

It is also concluded that behaviour of pearl millet lines differed greatly with the age and growth stage of the plant. I want to inculcate may thinking regarding this discovery that the farmers of salt affected and arid region may pay their attention to it so that they may get more and more advantage from it. The scientists should also pay their heed on it and utilise their potential talents, nature gifted them, and do more work on this assignment. In coming days, this study will provide a base line information for improvement and introduction of this and other ignored non-traditional crops in saline soils for their profitable use.