Introduction ...

Soil salinity is world wide problem in crop production. Every year more and more land is becoming non-productive due to this problem. It is estimated that more than 25% of the earth's surface is considered to be saline to produce sufficient yields of crops. This problem is more serious particularly in arid and semi-arid regions of the world. In India this problem is more severe as more than one third of the land is arid or semi-arid and the rainfall is scanty, seasonal and irregular. It is estimated that about 12 million hectares of land in our country is affected by salinity as well as alkalinity (Sharma and Gupta, 1986).

Saline habitats are characterised by an excess of inorganic salts and salts accumulated in the upper soil layer. This accumulation usually results from evapotranspiration causing a rise in ground water which contains salts. The effect is particularly marked where the ground water is near the surface as it occurs in depression or low lying sites. Two major soil types of salt affected or halomorphic soils may be distinguished; the saline soils and the alkali soils. Saline soils contain an excess of neutral salts such as chlorides and sulphates of Na^+ and Mg^{2+}. Some times even NO_3^- accumulates.

A saline environment may expose the plants to three types of stress - (1) the high osmotic pressure of the environment could lead to an "induced water stress", (2) specific ion toxicities could arise from the high concentration of ions such as Na^+ and Cl^-, SO_4^{2-}, Mg^{2+} etc. and (3) ionic imbalance could be caused by the high levels of these ions e.g. K^+ uptake or distribution could be impaired by excess Na^+ or high Cl^- could influence nitrate or phosphate uptake or utilisation.

Salinity profoundly influences growth, yield and even existence of plants. Plants suffering from salt stress are typically stunted with small and dull bluish green leaves. The other changes brought about by salinity include anatomical, morphological and metabolic changes. These may be considered as adaptive features or signs of damage caused by salinity. Glycophytes, which are sensitive to salinity show drastic changes under saline conditions while halophytes show a better growth under saline conditions (Strogonov, 1964). Salinity also affects several nutritional or metabolic activities. The major nutritional effects of salinity are those associated with cation nutrition. The regulation of ion concentration is relevant to salt tolerance of vascular plants. The consequence of the change in ionic balance in salt stressed plants is the shift in ionic interaction with the enzymes and intermediates of metabolism at several levels. Salinity is also known to affect metabolic processes such as CO_2 assimilation, protein synthesis, respiration or phytohormone turnover.

It has been found that the plants differ greatly in their tolerance to salinity. Recently Greenway and Munns (1980), have categorised plants for their salt tolerance into (1) salt tolerant, (2) moderately salt tolerant, and (3) sensitive species. Several mechanisms have been put forth for salinity tolerance in plants. Osmotic adjustment by accumulation of excess of ions, selective absorption of balancing cations like K & P, accumulation of or synthesis of osmotica such as proline, carbohydrates, glycinebetaine and such other compounds. Even some plant species have the mechanism at the absorptional level only by which they are able to avoid or exclude the absorption of toxic ions. In spite of several studies the exact nature of mechanism of salt tolerance in plants, however, is yet not clear.

According to Epstein et al. (1980), besides an engineering approach, the development of crops tolerant to salinity is a better strategy for meeting the challenge of salinity problem. They have suggested that there is a very great need to breed economic crops which are salt tolerant. They argue that by generating strains of crops capable of coping with salinity that, "what is now a problem could become a vast apportunity for crop production by tapping the immense wealth of water and mineral nutrients of the oceans without the energy - costly process of industrial de-salination." In view of the enormous expanses of saline soil and the necessary increase in crop production to meet the world's expanding population such a breeding programme may well be proved to be of extreme importance.

To meet this challenge, to cope with salinity problem, it is highly essential to understand the basic nature of crop species. In other words one should know the metabolic aspects of a crop species. For this, it is essential to screen the present day crop species for their salt tolerance and to study the physiology of such plants for the mechanism of their salt tolerance. This can be achieved well through the study of physiology of plants differing in their nature of salt tolerance.

"Millets" is a group of small seeded cereals and forage grasses used for food, feed and forage, especially cultivated in tropical and sub-tropical regions of the world. They have got remarkable drought and temperature tolerance. Besides these qualities millets possess good nutritive value, especially protein quality is better than other cereals. They are also rich in minerals. They show a wide range of adaptibility to the environmental conditions. Even though millets possess such important qualities they have received very little attention by the scientific community as regards their improvements and physiological aspects leading to general tolerance especially salt tolerance.

Among the millets, ragi (*Eleusine coracana*), bajra (*Pennisetum typhoides*) and *Panicum* have been investigated to some extent for their basic physiology and physiology of salt tolerance. *Setaria*, another important member of millets, has also been investigated for its basic physiology particularly its photosynthesis. There is almost no work on the physiology of salt tolerance in Setaria. Hence in the present investigation an attempt has been made to study physiology of salt tolerance in two cultivars of *Setaria italica* (SIC-1 and CO-5) differing in salt tolerance, which have been selected through the screening programme of millets for their salt tolerance at the seedling stage. In the present investigation more emphasis is given on nitrogen metabolism of these cultivars under different levels of salinity. Besides, seed germination, seedling growth and changes in some organic constituents under saline conditions have also been studied.

The seeds of the cultivars were germinated in petri plates at different levels of sodium chloride salt. The germination was continued for 120 hours. From the experiment, germination percentage, biomass of the seedlings and activity of enzymes nitrate reductase and nitrite reductase are determined. Nitrate-nitrogen as well as nitrite-nitrogen are also estimated from the seedlings. In the second set of experiment the plants were raised from seeds in soil culture in earthen pots. Plants were grown under different levels of salinity. At the end, plants were analysed for biomass production, organic constituents such as chlorophylls, carotenoids, polyphenols, different fractions of nitrogen and the activity of different enzyme systems such as nitrate reductase, nitrite reductase, glutamate oxaloacetate transaminase, alanine amino transferase, glutamine synthatase and glutamate dehydrogenase in different parts of salt treated and control plants. For this study recent and advanced methods have been followed. UV-spectrophotometry has also been used.

For convenience and presentation, the thesis has been divided in different parts. To know the basic problem a brief review of salt tolerance studies of plants and some aspects of physiology of millets, Setaria italica in particular has been given in Chapter-I of the thesis. Chapter-II describes the material obtained, the methodology adopted for culture and plant analysis. The important findings of the investigation have been statistically analysed and discussed critically in the light of recent literature collected in the form of reprints of research articles, research papers, monographs and books. This part has been included in Chapter-III of the thesis. The problem, perspectives and significant findings of the investigation have been summarised briefly in the Chapter-IV of the thesis. The research papers, research articles, monographs and books used extensively for discussion have been listed in "Bibliography", the last part of the thesis.