Introduction

Soil salinity is the threatening problem to the modern agriculture, which causes great losses by lowering the yields of various crops in many parts of the world. About 25% of earth's surface can be considered as 'Saline'. Millions of hectares of cultivated land in our country has become saline due to mismanagement in fertilization and irrigation. In India, the states where this problem is very serious are U.P., Haryana, Gujrath and Rajsthan, estimating about 12 million hectares of land (Sharma and Gupta, 1986). In Maharashtra also several hundreds of hectares of land under sugarcane cultivation is becoming saline.

A saline soil is the one, which contains excess of soluble salts or excess of exchangeable sodium which adversely affects the plant growth. The electrical conductivity of the saturation extract of such soil is greater than 4 $mScm^{-1}$ and the exchangeable sodium percentage (ESP) is less than 15. The pH of saline soil is usually less than 8.5. However, such a soil can be made productive either after reclaimation or by growing the salt tolerant plant species. But the reclaimation practice is costly and causes to increase the production cost of a crop.

When a plant is growing under such conditions, it is probably exposed to a variety of stresses. There are two contraversial views which describe the mechanisms of salt stress. According to the osmotic effect view, the adverse effect of salinity is related to the decreased osmotic potential of the saline soil, while according to the specific ion effect view, the adverse effect of salinity is caused mostly by the specific effect of individual ions. Soil salinity puts various problems to the plants either at the population, organismal, physiological or even at the molecular level. The overall effect of these, results in the reduction of growth. Stunted growth of plants under saline conditions is the visible symptom of salinity effect. The development of succulence in halophytic plants, under saline conditions, is considered to be an adaptive feature. Due to succulence, the internal concentration of salts is minimised. Salinity also induces numerous structural changes such as changes in number and size of stomata, thickening of the cuticles, extensive development of tylosis, inhibition of differentiation and earlier occurence of the lignification.

Salinity also affects the uptake and distribution of mineral nutrients. It causes increased uptake of Na^+ and Cl^- which accumulate upto the toxic level in a plant disturbing the normal activities of plant body. Increased uptake of

K^+ under saline conditions in halophytes is an adaptive feature. Salinity also affects the uptake of Ca^{2+}, Mg^{2+}, P^{5+}, Mn^{2+} and other micronutrients from the surrounding medium.

Under saline conditions, the organic solutes such as soluble sugars, organic acids, amino acids like proline, glycine betaine, keto acids etc. serve as a compactible osmotica within the protoplast of the cells. For the synthesis of such organic solutes, large amount of energy is utilized and which ultimately results in the growth reduction. Salinity, not only influences the efficiency of photosynthesis, but even its pattern is considerably altered. Salinity changes the free structure of chloroplast which ultimately results in the reduction in photosynthetic rate. According to Strogonov <u>et al</u>. (1970) salinity affects the strength of the forces binding the complex of pigment protein-lipid in chloroplast structure and the balance of photosynthetic pigments is upset. A reduction in photosynthetic rate under saline condition is also due to the reduction in the efficiency of RuBP-case and PEP-case enzymes. The changes in photosynthetic pathways from C_3 to C_4 or CAM and C_4 to CAM due to salt stress have also been recorded (Winter and Willert, 1972; Shomer-Ilan and Waisel, 1973; Joshi and Karadge, 1979; Hegde and Patil, 1982). Salinity also affects the nitrogen metabolism in plants. It causes reduction in the number of nodules in legumes and the uptake of N_2 from the growth medium which disturbs the overall nitrogen metabolism. The enzymes of nitrogen metabolism are affected by salinity in most of the glycophytes. According to Strogonov (1964) the nitrogen metabolism is the main site of salt injury in plants. It is also reported that protein synthesis and nucleic acid metabolism are disturbed at the higher salinity levels. The accumulation of ammonia, amides, free amino acids and quaternary ammonium compounds are considered as an adaptive feature in salt tolerance. These and many other minor effects of salinity synergize and produce the devastating effects on the crop yields.

There are quite a few number of crop species, however, which can grow successfully in such saline soils and the degree of salt tolerance in these species differs from species to species and even from cultivar to cultivar. Thus the plants can be categorised as salt sensitive, moderately salt tolerant and salt tolerant. Most of the crop plants, however, are glykic in nature and hence are either moderately tolerant or salt sensitive.

To overcome this severe problem, two main approaches have been suggested, one, an engineering approach and the other, biological approach. The biological approach seems to be practicable in the countries like ours. This approach deals with the screening of crop species or cultivars for salt tolerance and their utilization, further, in the soil reclamation and breeding programmes for the salt tolerant varieties.

To achieve this and to throw some light on the mechanism(s) of salt tolerance in leguminous plants, we have selected two crop species as C.juncea and S.grandiflora. Both the plants have a great economic importance, as C.juncea is grown as a green manure crop in different parts of the world and also for its good fibre production in manufacturing papers etc. Because of its high crude protein percentage (36%) in the leaves, tender pods and giant flowers, S.grandiflora is a favourite Asian vegetable used in curries and soups. It is also used as a paper pulp source for tropical regions, an excellent green manmure and for forage in different parts. The seeds of S.grandiflora are among those richest in protein with more than 40% by weight of all legume seeds. The gum of S.grandiflora has been used as a substitute for gum arabic in foods and adhesives.

As both the plants are legumes, the nitrogen metabolism is an important physiological process in them. The physiological studies in Crotalaria and Sesbania species in relation to salinity tolerance have also indicated that Sesbania species are more salt tolerant than Crotalaria species. Therefore, in the present investigation an attempt has been made to study the effect of NaCl salinity on growth parameters like plant height, shoot length, root length, biomass production (fresh and dry wt), number of leaves per plant, number of nodules per plant, leaf area per plant etc. and photosynthetic pigments like chlorophylls and carotenoids, proline content, total nitrogen content and different nitrogen fractions of *C. juncea* and *S. grandiflora*. The effect of salinity on important enzyme systems of nitrogen metabolism has also been investigated. It was thought that the study will help for understanding the mechanism of salt tolerance in these legumes through nitrogen metabolism.

For convenience and presentation, the Thesis has been divided into different parts. The Chapter-I, "Review of Literature", of this Thesis deals with a brief review of literature on the salt tolerance studies in plants, general outlines of nitrogen metabolism in higher plants, details of the scope of present investigation, work done in our laboratory and some economic values and physiological studies of these plant species. The material obtained and the methods followed for this investigation have been described in Chapter-II, "Materials and Methods". The important findings of the investigation have been critically discussed in the light of the most recent literature in the form of research articles, reviews, books etc. in Chapter-III, "Results and Discussion". Finally the significant findings of the investigation have been summarised briefly in the last Chapter, (Chapter-IV), "Summary and Conclusions", of the Thesis. The last part of the Thesis includes the references (research papers, books, reviews and monographs) used for discussion which have been listed alphabeticaly and chronologically, in "Bibliography".

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