CHAPTER - I

REVIEW OF LITERATURE

A. **SOIL SALINITY :**

The normal soil contains salts of various kinds essential for the growth of plants. Additional salts are usually carried to the soil through water from river and wells. Some part of the irrigation water is taken up by the plants while the remaining gets evoprated and most of the salt accumulate in the soil. Similarly residues of the excessive fertilizers also get accumulated in the soil. Where large areas of land are under irrigation, usually part of it becomes water logged. Additional water may come from seepage from ditches, canals and reservoirs or from nearby areas with excess irrigation. As ground water accumulates and leaching of salts is restricted the soil becomes a problem soil. It is estimated that about 122 million hectors or half of the world's irrigated land has developed drainage and salinity problems. The solution to these extensive problems includes the shaping of the land surface and the installation of drains and the maintenance of low water tables. So crops can root effectively. The solution also involves removal of excess soluble salts by leaching and proper irrigation water management to maintain a favourable salt balance in the soil root zone. The problem soils are those which owing to land or soil characteristic can not be economically used for the cultivation of crops without adopting proper reclaimation measures. Acid, saline and alkali soils constitute an important set of problem soils.

In the case of which acidity, soluble salts and exchangeable sodium limit, the scope of cultivation. In many arid and semi arid areas of India, crop production is limited because of salinity or alkalinity or both. It is estimated that more than 10 million hectors in the country have either gone out of cultivation or produce low yields of crops (Table 1).

Soil salintiy has long been a bit problem for agriculture. In modern times the development of medical science and social care have resulted in a tremendous growth of population accompained by problems of food supply with the development of soil science and the extended use of modern agricultural technology man must meet the challenge of increasing food production and of using for agriculture areas and sources of water formerly considered unsuitable for the purpose. Much has been achieved due to the development of various agrotechnogical practices attempts are also being made to develop salt tolerant varieties of various crops. To succeed in this it is necessary to understand what is the actually damage to the plants caused by soil salinity and what are the mechanisms by which individual plants, certain cultivars or plant communities withstand the damage by salinity and develop normally.

TABLE 1 : GROUPING OF THE ESTIMATED SALT AFFECTED AREAS IN INDIA ON TENTATIVE BASIS

	STATE	MILLION HA.
INDO-GANTETIC ALLUVIAL PLAINS	UP,HARIYANA,DELHI, PUNJAB,BIHAR AND PART OF RAJASTHAN	4.0
MEDIUM AND DEEP BLACK SOIL	MP, RAJASTHAN,GUJA -RATH,KARNATAKA,AP	4.0
ARID AND SEMI-ARID TRACTS	RAJASTHANA AND GUJARATH	1.0
COASTAL ALLUVIAL	GUJARATH,W.BENGAL ORISSA,KERALA, TAMILNADU,AP, MAHARASHTRA	3.0

(AFTER SHARMA AND GUPTA, 1986)

B. SALINTIY AND PLANT GROWTH :

1. GROWTH :

Salt tolerance of plants is their ability to tolerate high concentrations of soluble salts in the root medium. Plant species differ greatly in their tolerance to salinity. The exact adaptive mechanism of a plant to the adverse effects of salts is still unknown. The damage caused to the plants by salinity can be osmotic, toxic or nutrtional (Bernstein,1964; Strogonov, 1964). The work on the salinity for the last several decades has laid to the formation of two different schools of thoughts regarding the nature of salt injuries. The scientitist of osmotic school claim that most of the adverse effects of salinity are related with the decreased osmotic potential of saline root media (Bernstein and Hayard,1958). On the other hand the scientists of specific ion schools proposed that the adverse effects of salinity are caused by the specific effects of individual toxic ions (Eaton, 1942; Strogonov,1964). According to Maas and Nieman, 1978 such specific ion effects seem limited to certain susceptible plant species and rarely are the major cause of growth of suppression.

Salinity affects the plants at all stages of development and for some crops sensitivity varies from one growth stage to the other (Maas and Halfman, 1977). Several studies show that rice is tolerant during germination becomes very sensitive during early seedling growth, and then becomes increasingly more tolerant with maturation (Pearson et.al,1966). Significant inhibition of germination of ground nut has been reported by Iyengar et.al., (1968)and Gujarathi et.al. (1981). Francois et.al.,(1984), observed tghat maximum plant height of two cultivars of sorghum at maturity is significantly reduced with increasing salinity.

There are some reports of stimulation of growth by low salt concentrations. A growth stimulation by salts has been observed in case of halophyte Atriplex confertifola by Kelinkopf et.al.,(1975). In case of glycophytes also there are some reports of plant growth stimulation by lower salt regimes. Nieman (1962) studied the salt tolerance of 12 crops and found a stimulation of growth in a garden beat and spinach by NaCl. According to Bernstein (1964), the economically important salt tolerant species are burmonda grass, barley, sugar beet and cotton. The crops like alfa-alfa, soyabean, rice and tomato belong to the class of moderate salt tolerant types.

Epstein (1977), demonstrated that when resources of germplasma in barley and wheat are screened on adequate scale, much intraspecific diversity with restrict to salt tolerance exists, so much as to make it possible to select and breed strains adapted to sea water culture. According to

Maas and Nieman (1978), such studies help in selection and breeding of crop plants for salt tolerance.

2. SALINITY AND METABOLISM :

In fact, the influence of salinity on growth and development is the reflection of changes in metabolic activities of a plant. The excess of salt in the medium modifies the metabolism of a plant by several ways. Ionic imbalance is the first and the most important event in the plants growing under saline conditions, which probably influences the organic metabolism. The excess of salt in the medium may affect the synthesis of enzymes or exert an alosteric effect on the proteins. It is well known that salinity also exerts a profound influences on photosynthesis and respiration in plants.

a. Organic Constituent :

Gupta and Kaur (1970), observed that in pea varieties some how the hydrogenase activities are closely linked with salt tolerance. Probably dehydrogenase helps to main protein synthesis which otherwise is known to decrease under saline conditions. The change in ionic balance in salt stressed plants is the shift in ionic interactions with the enzymes and intermediates of metabolism at several levels. Effect of salt stress on enzyhme activity have been studied by several workers (Weimberg,1970; Waisel, 1972). ATPase can be have differentially in halophyties and glycophytes. According to

Flowers (1978), a comparatmentalisation of enzymes at a distance from salts in halophyhtic cells may help in keeping normal enzyme activity under saline condition.

A decrease in net photosynthetic rate due to salinity has been reported by number of workers Sankhala and Huber (1974), studied the effect of NaCl salinity on $^{14}CO_2$ fixation in seedling of Pennisetum typhoides. They found that high concentration of NaCl increased $^{14}CO_2$ incorporation in organic acids but less radio activity was detected in amino acid fraction.

In case of higher plants accumulation of organic compounds due to stress has been linked primarily to maintain turgor pressure of cells (Kauss,1977). Osmond,(1976), suggested that among these organic acids L-proline is prominent. he found that free proline has been involved in osmoregulation. The idea of proline as an important cytoplasmic osmoticum is favoured strongly by Voetberg and Sterwart, (1983). They observed a ,ositive correlation between Na and K concentration and proline in salt stressed barley leaves.

In view of Strogonov (1964), nitrogen metabolism is the major site of salinity damage in plants. Salinity has been shown to interfere with the uptake of inorganic nitrogen into barley plants (Hellal et.al.,1976) whereas icorporation of nitrogen into protein was not affected or was even stimulated. On the other hand, slinity was shown to inhibit the uptake of externally supplied amino acids and incorporation into protein (Poljakoff Mayber,1979).

b. Mineral Nutrition :

Soil salinity produces imbalanced nutritional medium which decreases plant growth and yield of crops as the excessive salts modify the uptake and distribution of inorganic ions. The affected mineral metabolism either results in mineral deficiency of some element or excessive accumulation of other elements which can be toxic for plants.

According to Bernstein and Hayward 1957,increased level of salts in the rooting medium increases osmotic pressure outside the root, which in turn decreases the osmotic potential of the root cells producing the artificial water stress situation. Wieneke and Lauchli (1980) noted that at 66.5 mM NaCl the Na contents increased more in the leaves of salt sensitive soyabean variety than in tolerant one. They have further suggested that insufficient control of Cl transport along with increasing accumulation of Na in the leaves at higher salinity levels and the varietally independent depression of Ca uptake and translocation may enhance the development of leaf necrosis.

According to Khalid and Malik (1987), accumulation of ions against a concentration gradient, selective K uptake, and partioning of excess salts in the leaf seem attributable to the high salt tolerance of the Atriplex species. Larsen (1967), proved that the capacity to increase K uptake under saline conditions is the main factor for the capacity of salt tolerance in brine bacteria.

Higher Na/K ratio in tolerant variety "Vijay" than susceptible one of barley was observed by Gill and Dutt (1982). According to them the higher salt tolerance in Vijay at early growth stage in the presence of higher Na might be due to its higher genetic potential of Ca uptke which might be helpful to maintain its cell wall integrity. Increase in calcium content of plant parts due to salinity is noticed by Joolka et.al.,(1977), Ayoub (1977), and Mareinez et.al.,(1987). The adverse effects of salinity on phosphorus uptake have been reported by Strogonov (1964). An increase in phosphorus content due to salt stress has been observed by Gates et.al.,(1966), Ansari (1972), Chavan and Karadge (1980), Lal and Bharadwaj (1984) and Murumkar (1986).

Slow absorption of magnesium as compared to other cations as a result of NaCl salinity has been reported by Overstreet and Jacobson (1952). Similar observations of dedcrease in Mg content in the plant parts due to salinity have been made in Desert Holly (Atriplex hymenelytra). According to Bernstein (1957), tghe salt tolerance capacity of a species is reflected by its ability to absorb nutritionally adequate levels of Ca and Mg from the soil. An increase in Mg uptake under salinity stess has been reported in sorghum by Sinha et.al.,(1986).

Very little attention has been paid to the effect of salinity on uptake and distribution of micronutrients. A decrease in iron content due to NaCl salinity has been reported by Deshpande (1981) in gram. Iron was found to be accumulated more in the roots of salt stressed Sesbania aculeata (Karadge and Chavan,1983).