CHAPTER V

SUMMARY AND CONCLUSIONS

The normal growth and yield are grately affected when crop plants are subjected to environmental stresses. Water and salt stress are of prime importance in these stresses. Salinity has become one of the serious problems in modern agriculture. Millions of hectares of land throughout the world is too saline to produce economic yields of crop plants and more land is becoming nonproductive each year as a result of poor soil management which results in salt accumulation. In India about 11 million hectares of saline soil affects the grain production. In Maharashtra also several hundreds of hectares of land under sugarcane cultivation has become saline.

It is well known that most of the crops do not show optimum growth under saline conditions. Salinity is known to affect several facets of metabolism of plant and thereby induces changes in morphology as well as anatomy. Salinity influences metabolic activities of different processes like mineral nutrition, nitrogen uptake, carbohydrate metabolism and photosynthesis. The disturbed metabolism culminates finally in the stunted growth of plants and impairement of productivity. Plant species differ grately in their tolerance to salinity. However, most of the crop species are rather salt sensitive. To cope with this problem then it is essential to screen crop species and varieties for their salt tolerance. It is also necessary to know the mechanism of salt tolerance in plants. This biological approach as the solution of this salinity problem has been suggested as a better strategy than that of engineering. To understand the mechanism of salt tolerance then it is important to study the physiology of both salt tolerant and salt sensitive species under saline conditions.

Several investigations have been devoted to such studies in salt tolerance of plants. However, most of the studies are limited to one or two species either tolerant or sensitive and those growing even under different sets of environmental conditions. Therefore, it is of worth to study the physiology of plant species differing in their salt tolerance under identical saline conditions and the species being almost belonging to the same group of plants. Such type of study will definitely throw some light on the mechanism of salt tolerance in plants.

Keeping this view in mind in the present investigation an attempt has been made to study the influence of NaCl salinity on some physiological aspects of leguminous species differing in salt tolerance. For the present study, therefore, groundnut, an important oil yielding leguminous crop and Sesbania grandiflora also belonging to the same group of plants (Leguminosaea), an important protein source, which differ in their salt tolerance, (groundnut being salt sensitive species while *S.grandiflora*, salt tolerant one) are selected. The effect of salinity on growth, uptake and distribution of inorganic nutrients in different parts of plant, organic constituents and some enzyme systems have been investigated by growing the plants in sand culture with nutrient media at different salinity levels. Organic and inorganic constituents were estimated from both fresh as well as oven dried powdered plant material while enzyme systems were studied from the fresh plant material. For analytical purposes the standard methods were followed. The techniques include the spectrophotometry and flame photometry etc.

The organic constituents include the chlorophylls, polyphenols, carbohydrates, acidity status, total nitrogen and proline, while the following inorganic constituents were determined; Na, K, Ca, Cl, mg, P, Fe. The investigation also includes the root anatomy.

Some of the significant findings of the investigation are listed as follows :

1. Sodium chloride salinity has caused a considerable reduction in overall growth of both the plants. However, growth of groundnut is affected relatively more due to salt concentration of 100 mM. 200 mM NaCl concentration in the medium was found to be highly toxic to the groundnut. This

caused burning of plant parts and finally death of groundnut even after two to three salt treatments. This clearly indicated the salt sensitivity of groundnut Var. SB-11.

2. It is found that sodium uptake is relatively more than that of chloride in groundnut and it accumulates more in roots and stem. On the other hand sodium accumulation trend is almost the same in all parts of Sesbania when grown under saline conditions. However, chloride remains accumulated in stem part of this plant. Thus basically groundnut and Sesbania seem to be different with respect to uptake and distribution of sodium and chloride. Probably the differential uptake and distribution mechanism plays a role in salt tolerance in these plants.

3. Potassium content of almost all parts of Sesbania is always higher than that in groundnut. Uptake and translocation of this cation seems to be more in groundnut growing under salt stress. This observation warrents to suggest that role of potassium in salt tolerance of the species investigated is not decisive.

4. Calcium accumulates more in young leaves of both the plants and it is withdrawn from the mature leaves due to salinity in groundnut. However, it is significantly accumulated

more in the mature leaves of Sesbania due to 200 mM salt concentration. Low level of this divalent cation in roots of salt affected Sesbania indicates easy translocation of this cation in this plant. Translocation of calcium from stem to other parts is affected due to salinity in groundnut and thus resulting in calcium deficiency in salt affected groundnut plants. Uptake and distribution of phosphorus is found to be vigorous in groundnut under saline conditions while there is a little influence of salinity on uptake and distribution of this cation in Sesbania.

5. Mg content of all parts of groundnut except mature leaves increases markedly under saline conditions. However, except young leaves it is affected in all parts of Sesbania due to salinity. Thus groundnut and Sesbania respond differently to Mg metabolism under saline conditions.

6. Iron content of young and mature leaves of groundnut decreases due to salt stress. Root Fe in this plant, however, remains unaffected. Contrary to this Fe accumulates in the leaves of Sesbania under salt stress. It is found that in this respect the two plants investigated differ markedly when grown under saline conditions.

7. It is observed that more "free" space in root system for sodium is made available in groundnut under saline condi-

tions. This is indicative of high rate at absorption of sodium by groundnut under saline conditions.

8. Root system in groundnut is poorly developed under saline conditions. The number of secondary as well as tertiary roots is very low in case of root system affected by salinity. The length and diameter of main root is relatively much less in this plant Nodule formation is also affected in both the plants due to salinity. However, it is relatively more in groundnut.

9. In groundnut it is found that the diameter of fully developed root is considerably reduced due to salinity at 100 mM NaCl concentration. It is also found that the development of pitted cells in between the medullary rays is almost absent in 100 mM NaCl treated groundnut roots. It appears that the salinity affects the formation of water conducting cells as the number and size of vessel is markedly reduced due to salinity. Contrary to this there is only a slight influence of salinity on the anatomical features of *Sesbania* roots.

10. It is observed that *Sesbania* has well developed capacity to produce more acids under saline conditions. Those acids may play a role in osmotic adjustment thereby showing a mecha-

nism of adaptation. Groundnut, however, seems to be salt sensitive in this respect.

11. Salinity exerts an adverse effect, probably on chlorophyll synthesis in both the plants. Chlorophyll a : b ratio is slightly affected in groundnut while it is on increase in Sesbania due to salinity. This change is found to be due to strong inhibitory effect of salinity on the synthesis of chlorophyll 'b'. This is in case of young leaves. However, regarding mature leaves it appears that it is the capacity to retain the chlorophylls and sometimes their synthesis which is the characteristic of salt tolerant species like Sesbania.

12. Polyphenol content of young and mature leaves of groundnut decreases due to salinity. However, it is slightly an increase in the young leaves of salt treated Sesbania. Contrary to this it is strongly affected in the mature leaves of Sesbania. It appears that Sesbania has the mechanism to stimulate the synthesis of phenolic compounds under saline conditions which may be an adaptive feature of salt tolerance in this plant.

13. Groundnut and Sesbania differ in their response shown by young and mature leaves to salinity with respect to soluble sugar content. It is observed that the rate of increase

of soluble sugars in different parts of *Sesbania* as a response to salinity is relatively much higher than that in groundnut. It appears that soluble sugars may play some role in salt tolerance mechanism of the plant.

14. Proline level of all parts of groundnut increases due to salt treatment. Contrary to this free proline content significantly increases only in mature leaves and stem of *Sesbania*. It appears that proline plays a key role in groundnut while a minor role in *Sesbania* towards salt tolerance.

15. Groundnut peroxidase seems to be more sensitive than that of *Sesbania*.

16. Activity of catalase is increased in both young and mature leaves of groudnut due to salt stress, the significant increase being in the mature leaves. The response shown by young and mature leaves of *Sesbania*, however, is exactly opposite. Response of catalase from the roots of both the plants differ considerably.

17. An increase in Acid phosphatase activity in all parts of *Sesbania* subjected to salt stress is indicative of an increase in metabolic activities and rapid turnover of phosphate compounds leading to availability of energy for the

metabolic activities which may be considered as an adaptive feature of *Sesbania* which is probably not observed in groundnut.

18. Root NR in groundnut is affected more than that in *Sesbania* due to salinity which indicates relatively more salt tolerance of *Sesbania*.