CHPATER-4

CHAPTER-IV

SUMMARY AND CONCLUSION

Groundnut (Arachis hypogaea L.) is one of the important legume crops of both the tropical and temperate regions of the world. Groundnut is an economically important major oil seed crop. It fixes about 60-170 Kg N/Ha and thus helps in maintaining fertility of the soil. The groundnut seeds yield edible oil which is used for culinary purposes. The seeds are rich in protein content and they are used for preparation of sweets and butter. The oil cakes serve as good cattle feed and manure being rich in nitrogen content. Thus this crop is a multiple benefit crop.

Groundnut occupies about 77% of the total area of semi-arid tropics contributing 65% of the total oil seed production. The major groundnut growing countries in the world are India, China, France, West Africa, Nigeria and U.S.A. India ranks first in area and 10th in production in semi-arid tropical countries. India has a credit to contribute world's 37% produce. Groundnut cultivation in India is mainly confined to ten states. Some of the popular groundnut cultivars in Maharashtra are JL-24, SB-11, Karad-4-11, Kopergaon-1, TMV-10, TG-1, TG-17. Groundnut is cultivated in both Kharif and Rabbi seasons. In Kharif season about 92% of the groundnut is grown under rainfed conditions. Since groundnut is a dominant oil seed legumes of India, there are continuous efforts to increase

the yield and productivity of this crop and mainly they are made by plant breeders. Physiological studies have been reported to offer such an opportunity in many other crops like rice and wheat. The review of literature indicates that groundnut gives very good response to various growth regulators. One of the major constraints on groundnut production in the semi-arid tropics is the drought. Drought is a hazard to successful crop production throughout the world. Drought occurs when there is creation of internal water stress in crop plants due to various environmental factors which reduces productivity of crop plants. This reduction of crop productivity is brought about by a delay or prevention of crop establishment, weakening or destruction of established crops, alteration of physiological and biochemical metabolism in plants and alteration of the quality of grain, forage, fibre, oil etc. (Larson and Eastin, 1971). Drought is often a factor in yield reduction even when damage is not apparent. Constant efforts are made to lessen this damage and the work of Russian workers has indicated that remedy can be sought in biological methods which induce drought resistance in plants. One such fruitful remedy is of presowing soaking treatment or seed hardening treatment. It is documented in several studies that such treatment induces drought resistance and increases plant yield. However, the exact physiological principles underlying this treatment have not been worked out. In the present

investigation an effort has been made in this direction. Thus an attempt is made to find out influence of presowing soaking treatment with growth retardant CCC and growth promoter kinetin on some physiological parameters associated with drought resistance. The pretreatments are given both in aqueous medium and organic solvent acetone to find out effectivity of the method of application. Some of the significant findings of the present investigation can be summarised as follows :

A) Influence of presowing soaking treatment on inorganic constituents :

The mineral elements play a vital role in plant metabolism. The inorganic analysis of different parts of groundnut plants grown under irrigated conditions and water stress conditions revealed that in most of the cases the pretreatment with CCC and kinetin were effective in raising phosphorus status of the normally irrigated groundnut plants. However, under stress conditions these treatments were not found effective and the phosphorus nutrition was affected to almost similar degree in the untreated as well as pretreated plants due to water stress. The potassium content in all parts of groundnut plants raised from seeds pretreated with CCC (in acetone) was significantly increased. The increase in potassium content may help in inducing drought resistance in these plants. Calcium status of leaf tissue increased under the conditions of drought in

plants pretreated with CCC (in acetone and water) and kinetin (in water). Calcium status of stem tissue was increased due to pretreatment with CCC (in acetone and water). The calcium content of root tissue was increased under water stress conditions in plants raised from the seeds pretreated with CCC (in acetone) and kinetin. The elevation in calcium content in water stressed plants due to pretreatment can be helpful in preventing water stress induced membrane damage. There was elevation of leaf magnesium content as compared to control (untreated) plants due to pretreatment with CCC and kinetin. There was increase in magnesium content of stem and root tissue of plants grown from seeds pretreated with both CCC and kinetin as compared to control (untreated) plants under water stress conditions. The accumulation of magnesium in leaf tissue may be helpful in maintaining stability of chlorophylls and photosynthetic apparatus. According to Pitman (1981) the plants of arid zone have adapted to low water potential by acquiring ability to make use of magnesium as osmotica or to store sugars in vacuoles and other organic solutes in the cytoplasm. Thus accumulation of magnesium in leaf, root and stem tissue may be regarded as adaptive feature to overcome drought conditions. The seed pretreatment with CCC and kinetin has caused elevation in manganese content of leaf tissue of groundnut plants under water stress conditions. Increase in manganese content in leaf and root tissue of groundnut plants due to pretreatments

may be helpful in maintaining normal metabolism under stress conditions. In general there was elevation in root iron content as compared to control (untreated) plants due to pretreatment with kinetin and CCC (in acetone). The seed pretreatment with aqueous solutions of CCC and kinetin caused increase in iron content in the leaf tissue as compared to respective control plants. Although iron increase in roots may not be of any metabolic advantage to the plants, the elevation of this element in leaf tissue will be of great help under water stress conditions. In general there was elevation of leaf sodium content as compared to control (untreated) plants due to pretreatment with kinetin and CCC. According to Lawlor and Milford (1973) sodium can increase the drought resistance of water stressed sugarbeet by altering the leaf water balance. Similar situation may prevail in groundnut plants raised from pretreated seeds.

B) Influence of presowing soaking treatment on organic constituents :

The leaves of groundnut plants raised from untreated seeds were almost collapsed, dry and rolled and their moisture percentage was declined to 9% when subjected to water stress. However, the pretreatment with CCC (in acetone) brought about retention of moisture percentage upto 51.62% in groundnut leaves under water stress conditions. The seed pretreatment with CCC (in water) and kinetin (in water and acetone) were

also able to maintain the leaf tissue water content higher than that of untreated plants under drought conditions. Thus it is evident that the presowing soaking treatment with CCC and kinetin may be causing more efficient water absorption and retention of the absorbed water under drought conditions.

Relative water content has been recognized as one of the most reliable criteria for assessing the water status of the tissue and maintenance of higher relative water content is helpful in creating optimum water balance in the leaf tissue. This was greatly achieved in groundnut by CCC pretreatment. In this respect growth retardant was found to be effective while the growth promoter kinetin was totally ineffective.

Sugar content in water stressed groundnut leaves was not increased due to pretreatment with CCC and kinetin. Thus the pretreatments are not probably effective in enhancing the role of sugars in osmotic adjustment in water stressed leaves. At the same time the starch content in water stressed leaves was increased due to pretreatment with CCC and kinetin. Thus it is probable that the starch degradation which prevails in leaves during drought was slightly lowered due to seed pretreatment.

RNA is an important macromolecule associated with protein biosynthesis. The presowing soaking treatment with CC

and kinetin (in acetone) were effective in increasing RNA content in leaf tissue of groundnut plants under water stress conditions. The maintenance of higher levels of RNA may be of great significance in stabilizing protein synthesizing machinery under drought conditions.

Proline is a cyclic amino acid of glutamate family. Accumulation of proline is clearly an adaptive response of plants towards drought. Presowing soaking treatment of groundnut seeds with CCC and kinetin increased the intensity of this response. The extensive accumulation of proline in the roots of water stressed.plants raised from the pretreated seeds may be of great help in restoring plant metabolism during post stress period.

The presowing soaking treatments with CCC and kinetin were found to cause very minor changes in organic acid status of the groundnut leaves.

Excellent work of Chinoy and co-workers (1969) has highlighted the key role of ascorbic acid (Vitamin C) as a plant growth regulator in number of physiological processes such as germination, flowering and stress tolerance. Findings of present investigation revealed that the water stress induced accumulation of ascorbic acid in leaves of groundnut plants raised from untreated seeds, seeds pretreated with CCC and kinetin (in acetone). The maximum increase in ascorbic

acid content was observed in case of seed pretreatment with CCC (in acetone). Accumulation of ascorbic acid in leaf tissue may be an adaptive feature of overcome drought conditions as indicated by Chinoy et al. (1969).

C) Influence of presowing soaking treatment on enzyme and -SH content :

Nitrate reductase is an important enzyme of nitrogen metabolism. It reduces nitrate to nitrite with the help of NADH. A decline in nitrate reductase activity under water stress conditions was evident in number of earlier experiments and present investigation. The NR activity has been increased due to pretreatment with CCC and kinetin under water stress conditions in groundnut leaves as compared to water stressed control (untreated) plants. The CCC pretreatment was more effective in increasing NR activity under water stress conditions than kinetin. The increase in NR activity under water stress conditions may help in providing nitrogen pool to metabolic reactions which lead to the synthesis of amino acids.

The -SH group occurs in plant protoplasm mainly as a component of proteins, an essential amino acid (Cysteine or CSH) and a peptide (Glutathione or GSH). In our experiments, pretreatments with CCC and kinetin were found to be effective in increasing -SH content in leaf tissue. This may be regarded

as an adaptive feature in the light of hypothesis of Levitt (1980) that the protection of -SH groups in proteins from the formation of disulfide bridges is of great importance for providing cellular resistance to dehydration caused by drought and heat.

D) Influence of presowing soaking seed treatment on photosynthetic pigments and stomatal behaviour :

Chlorophylls are main light harvesting molecules usually present in the chloroplast. The chlorophyll content and their stability have direct bearing on photosynthetic efficiency. Carotenoids are accessory pigments which take part in harvesting of solar energy and help the main photosynthetic pigments in trapping and transferring solar energy.

The stability of chlorophylls under the conditions of water stress has been regarded as one of the important criteria for assessment of drought resistance (Kushinirenko et al., 1971; Tadzieva, 1980). The presowing soaking treatment with both CCC and kinetin were helpful in increasing the stability of chlorophylls in groundnut leaves under drought conditions. At the same time it was noticed that seed pretreatments were not effective in increasing the level of accessory and protective pigments carotenoids under the conditions of water stress. The favourable influence of presowing soaking treatments on photosynthetic process was also

noticed in stomatal functioning. The autoporometric studies indicated favourable influence of pretreatments on stomatal behaviour in leaves of water stressed plants.

It is evident from foregoing account that chlorocholine chloride (CCC) when applied to groundnut in the form of pre-sowing seed soaking medium, brings about number of metabolic changes in groundnut plants which improve the drought resistance capacity of the plant. This in turn may also lead to increase in yield. Thus this growth retardant is equally effective like standard growth promoter kinetin in elliciting positive response. It has been reported by Nawata et al. (1985) that CCC causes accumulation of cytokinins in the root tissue. This observation can at least partially explain the positive influence of CCC pretreatment on groundnut physiology.