Stress tolerant plants

The stress may be immediately made out in the plant or plants may become resistant when exposed to stress conditions. Extreme environmental conditions such as drought, salinity and freezing temperature cause adverse effect on the growth and productivity of crop plants. The temperature (heat, chilling and freezing), drought and salinity stress together represent abiotic stress. Exposure of plants in general to these abiotic stresses is inevitable in nature.

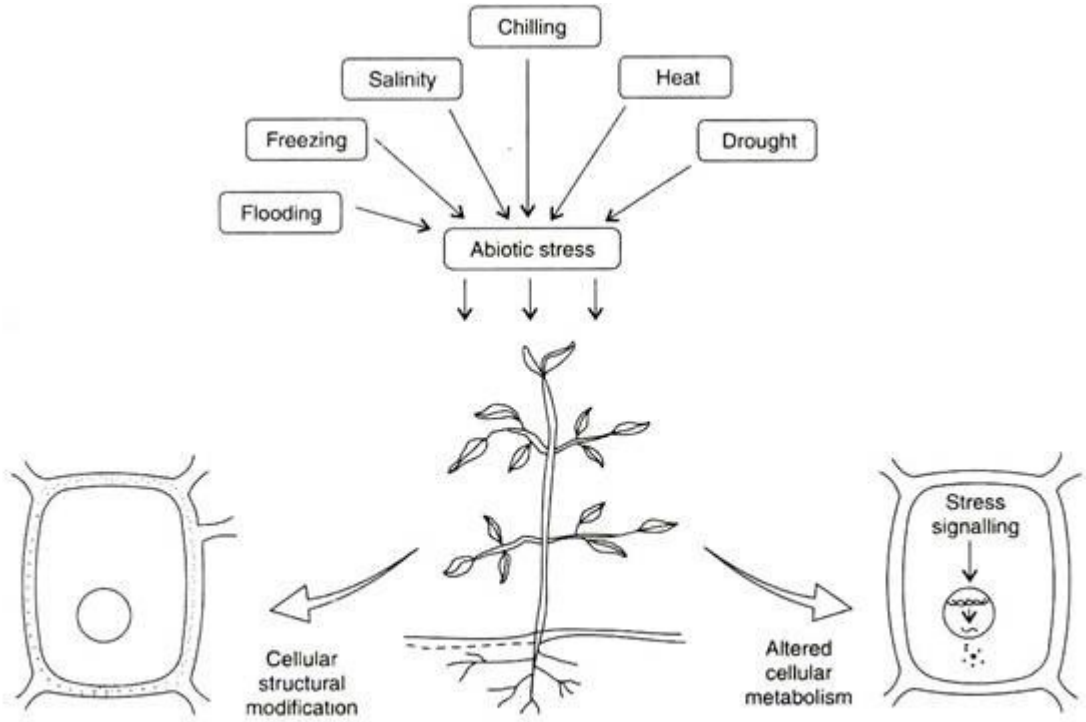

Fig. 15.1 Types of abiotic stress

Several plants, however, respond to abiotic stresses at molecular, cellular and physiological level. Several stress inducible genes have been characterized and are implicated in the protection of plants. Many of these gene products not only enhance stress tolerance but also are involved in the regulation of gene expression and signal transduction.

Abiotic stress triggers secondary effect in plants by producing excess of reactive oxygen species (ROS), which have greater impact on plant's survival. In stressed plants, the most useful oxygen molecule turns to be lethal and inflicts severe damage to the cell.

Due to the increase in human population, there is more demand for food and hence agricultural practice must feed more people. This increasing demand must combat with new strategies that are to be enforced to enhance crop productivity.

Salt Resistance:

Salt resistance is the ability of plants to tolerate excess salt in their habitat without any significant impairment of their vital functions. It is a complex combination of various mechanisms, not a single process or adaptation, and therefore not controlled by a single gene. Plants can achieve resistance to salt stress either by tolerating the stress or by avoiding it.

Tolerance to salt stress is the ability to tolerate toxic as well as osmotic effects of salt ions, like Na^+ and Cl^- ions in the cytoplasm. High concentrations of salt ions have been found in the cytosol of salt-exposed plants. Under such conditions, the cytoplasmic enzymes have to function in presence of salt ions.

This was investigated with the enzyme PEP carboxylase from halophytes Suaeda monoica and Chiorisgayana. It is the key enzyme for CO_2 fixation in plant leaves. Addition of substrate PEP to the extraction and storage medium helps to stabilize the enzyme. At low PEP levels of the assay medium, the enzyme is inhibited by NaCl but at high PEP levels the enzyme was activated by NaCl.

Cold:

Cold stress as abiotic stress has proved to be the main abiotic stresses that decrease productivity of agricultural crops by affecting the quality of crops and their post-harvest life. Plants being immobile in nature are always busy to modify their mechanisms in order to prevent themselves from such stresses. In temperate conditions plants are encountered by chilling and freezing conditions that are very harmful to plants as stress. In order to adopt themselves, plants acquire chilling and freezing tolerance against such lethal cold stresses by a process called as acclimation. Several signal transduction pathways are there by which these cold stresses are transduced like components of ROS, protein kinase, protein phosphate, ABA and Ca^{2+}, etc. and among these ABA proves to be best.

Drought:

Drought is one of the most severe environmental stresses affecting almost all plant functions. A severe water deficient condition arises in drought stressed plants. Both drought and freezing temperature creates water deficiency in plants. It is a situation in which the demands exceed the supply of water. Water deficit in plants is due to scanty rainfall condition called drought.

After drought is imposed on crop plants growth arrest is the first response subjected on the plants. Plants reduce their growth of shoots under drought conditions and reduce their metabolic demands. After that protective compounds are synthesized by plants under drought by mobilizing metabolites required for their osmotic adjustment. The phytohormone—abscisic acid—acts as a central regulator in the response and adaptation of plants to drought conditions. The various physiological reactions regulated by ABA, including stomatal closure, accumulation of osmoprotectants, changes in gene expression, and other phytohormones have been characterized at the molecular level

Heat:

Increase in temperature throughout the globe has become a great concern, which not only affect the growth of plants but their productivity as well especially in agricultural crops plants. When plants encounter heat stress the percentage of seed germination, photosynthetic efficiency and yield declines. Under heat stress, during the reproductive growth period, the function of tapetal cells is lost, and the anther is dysplastic.