

⇒ Concept of stress & stressful environments:

1) "External factor that exerts disadvantageous influence on the plant."

Stresses

- 2) External factors (living or non-living) that suppress growth, development, or productivity of crops.
- 3) A change in any environmental factor that causes biochemical and physiological changes in plants, which may sometimes lead to damage or injury.
 - In general, the stressful situations cause a number of physiological changes in the plant to counteract these situations that are meant for maintaining the plant's fundamental functions. *or survival*

— "Stress tolerance is the plant's fitness to cope with an unfavorable environment."

— "Acclimation" is the increase in the stress tolerance as a result of exposure to prior stress."

— "Adaptation" is the genetically determined level of resistance acquired by a process of selection over many generations."

⇒ Types of Stresses

- **Biotic** - caused by living organisms
- **Abiotic** - due to an excess or deficiency in the physical or chemical environment

Different Stress Sources

(A) Stress factors caused by weather conditions

- (i) **Heat stress:** Exposure to high temperatures causes damages to tissues and cells, due to inactivation of a number of key enzymes and protein denaturalization. This in turn causes an increase in cellular membrane fluidity, thereby affecting membrane permeability. *Enzyme activity increased,* that also alters gas exchange capacity of the plant to ultimately affect photosynthesis, which may adversely affect growth and development.
- (ii) **Low temperature and Freezing:** they cause alteration in protoplasmic streaming and also affect cell membrane permeability. *enzyme activity.*
- (iii) **Humidity:** Relative humidity (RH) directly affects the water relations of plant and indirectly affects leaf growth, photosynthesis, pollination, occurrence of diseases and finally economic yield.

Continued

- (iv) **Light:** High or low light intensity adversely affects photosynthesis. Stomata of most plants (particularly of C_3 plants) close under high light intensity and rate of photorespiration (a destructive phenomenon) increases.
- (v) **Hydric stress:** It can be due to both scarcity of water (drought) and excess of it (**radicular asphyxia**). The former causes loss of cell turgor thereby causing cell dehydration, stomatal closure and decreased photosynthetic capacity, whereas the latter causes anaerobiosis.
- (vi) **Wind or Hail:** They cause rupturing of the entire plant or some of its parts.

2 B) Stress factors associated with soil

- **Salinity:** Excessive amount of neutral soluble salts in soil
- **Mineral nutrients:** Excess or deficiency of essential mineral elements

3 C) Stress factors associated with crop management

Common agronomic practices applied to agricultural fields to attain optimum crop yield can harm plants and its environment when practiced improperly. For example, the use of unwise and untimely pesticides can cause phytotoxicity problems for the crop.

4 D Stress factors caused by phenological stages

From seed germination to maturity, the plant experiences a series of physiological and metabolic changes, which allow plant growth and differentiation of its various structures, depending on the phenological stage. Plant response to a stressful agent generally differs at various phenological stages. For example, early growth stages such as germination and seedling are considered more sensitive to a stress compared with the later growth stages such as vegetative and adult stages. In fact, the varying response of a plant at different growth stages is genetically determined and it also depends on the nature and intensity of a climatic factor.

5 E Stress factors caused by pathogens

- Insects: sap-sucking insects, shoot chewing insects, ground-digging insects, germ carriers, etc.
- Nematodes: They live in soil and plant tissues and feed on plants. The soil inhabitants attack roots, causing deformation and galls, but their symptoms are very visible in the aerial part of the plant: perishing, yellowing, vigour loss and specially rot.
- Fungi: cause a variety of plant diseases.
- Viruses and Bacteria:

6 F Stress factors caused by weeds:

Environmental factors/conditions that can cause stress

- Drought
- High or low temperatures
- Soil and water salinity
- Excess or low minerals in the soil
- Light of high or low density
- Waterlogging
- Humidity
- Gases
- Metals
- Sound/noise

