## Chapter 11:

## Crop adaptation and distribution

**Crop adaptation** essentially refers to the relationships between the principal environmental factors and the growth response of **crop** plants. Largely ecological in character, this branch of plant science can be considered a synthesis of important elements of geography, physiology, genetics, meteorology and agronomy.

Adaptability is **defined** as the ability of a **crop** (or variety) to respond positively to changes in agricultural conditions.

**Ecology and ecosystem:** Ecology and ecosystem influences adaption and distribution of crops. As such basic knowledge of ecology and ecosystem is necessary to understand adaptation and distribution of crops for maximum economic yields through efficient use of natural and applied inputs.

Plants growing in different types of soil exhibit variations in their physiological and morphological features.

### Morphological, anatomical and physiological adaptations hydrophytes

### Morphological adaptations

1. Root system is poorly developed.
2. Roots of floating hydrophytes show very poor development of root hairs, absence of true root caps, with root pockets to protect their tips from injuries. (e.g. ***Eichhornia***)
3. Rooted hydrophytes like ***Hydrilla, Vallisnera, Elodia*** derive their nourishment through their body surfaces. More plants partly depend on their roots for the absorption of minerals from the soil. Roots are totally absent in ***Ceratophyllum, Salvinia, Azolla, Utricularia*** etc.,
4. In free floating hydrophytes, the stem is thick and short, floating on the surface of water (e.g.) ***Eichhornia***.
5. In floating plants of ***Eichhornia, Trapa*** etc., the petioles become characteristically swollen and become spongy, providing buoyancy.

### Anatomical adaptations

1. The root and shoot systems show common features such as cuticle which is very thin or absent.
2. Epidermis is usually a single layer of thin walled cells, not protective in function.
3. Cortex is well developed. It has numerous air chambers. It helps in buoyancy and rapid gaseous exchange.
4. Epidermal cells of Phloem leaves contain chloroplasts and they can function as photosynthetic tissue, especially where the leaves and stems are very thin. eg. Hydrilla

5. Stomata are totally absent in submerged, but in floating leaves, stomata are confined only to the upper surface. In amphibious plants stomata may be scattered on all the aerial parts.
6. In submerged leaves, air chambers are filled with respiratory and other gases and moisture.

**Physiological Adaptations:**

Petioles of floating- leaved hydrophytes have a great capacity for renewed growth, which is perhaps regulated by auxins (phytohormones). In lotus, the long petioles seem to adapt themselves the depth of water, thus keeping the leaf lamina on the surface of water.

## Morphological, anatomical and physiological adaptations of Xerophytes

### Morphological Adaptations

1.The root system is very well developed with root hairs and root caps. e.g. ***Calotropis.***
2. The roots are fasciculated as in ***Asparagus***.
3. In ***Opuntia*** phylloclade is covered with spines.
4. Stem is covered with dense hairs as in ***Calotropis***.
5. Stems may be modified into a cladodes e.g. ***Asparagus.***
6. Leaves are very much reduced, small scale-like, sometimes modified into spines or scales as in ***Casuarina, Asparagus***.
7. Lamina may be narrow or needle like as in ***Pinus*** or divided into many leaflets as in ***Acacia*** or succulents as in ***Aloe***.
8. In ***Euphorbia*** and ***Zizyphus jujuba*** stipules become modified into spines.
9. Xerophytes like ***Calotropis*** have hairy covering on the leaves and stems to check transpiration.

### Anatomical Adaptations of Xerophytes

1. Root hairs and root caps are well developed in ***Opuntia***.
2. Roots may become fleshy to store water as in ***Asparagus***
3. In succulent xerophytes, stems possess a water storage region (thin walled parenchyma cells)
4. Stems of non-succulent xerophytes show a very thick cuticle, well developed epidermis with thickened cell wall, several layered and sclerenchymatous hypodermis e.g. ***Casuarina***.
5. The stems have sunken stomata and well developed vascular and mechanical tissues.

6. Leaves show well developed cuticle, succulent leaves in ***Aloe***, sclerenchymatous and several layered hypodermis in ***Pinus***.
7. Mesophyll is well differentiated and vascular tissues and mechanical tissues are well developed.

**Physiological Adaptations**

1. The stomata of these plants open during night hours and remain closed during the day. This unusual feature is associated with metabolic activities of these plants.
2. In xerophytes, the chemical compounds of cell sap are converted into wall forming compounds (eg) Cellulose, Suberin etc.
3. Some enzymes, such as catalases, perioxidases are more active in xerophytes than in mesophytes.
4. The capacity of xerophytes to survive in long period of drought is due to the resistance of the hardened protoplasm to heat and desiccation.

**Morphological, anatomical and physiological adaptations Mesophytes**

Mesophytes are common land plants which grow in situations that are neither too wet nor too dry. They do not need any extreme adaptations.

1. The roots of mesophytes are well developed and are provided with root caps.
2. The stem is generally straight and branched.
3. The leaves are generally broad and thin.
4. The presence of waxy cuticle in leaves traps the moisture and lessens water loss.
5. Leaves have stomata which close in extreme heat and wind to prevent transpiration.

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| Oxylophytes | - | Plants growing in acid soils |
| Halophytes | - | Plants growing in saline soils |
| Psammophytes | - | Plants growing in sand |
| Lithophytes | - | Plants growing on rocks |
| Chasmophytes | - | Plants growing on rock crevices |

**Crop distribution:** Basic principles and concepts relating to natural distribution of plants are useful in studying the plant adaptations. The plant geographer mainly studies the spatial relationship of plants both in past and present. He attempts to explain origin, development and distribution of plants.

**The plant geographer Good (1953) formulated the basic principles of plant**

**distribution. They are**

i. Plant distribution is primarily controlled by the distribution of climatic conditions like light, temperature, moisture, wind *etc.*

ii. Plant distribution is secondarily controlled by distribution of edaphic factors like soil, parent material, physiography *etc.* these factors considered secondary because they are greatly influenced by climate.

iii. Great movement of flora have been taken place in the past and are still continuing.

iv. The plant migration is brought about by the transport of individual plants during their mobile dispersal phase.

v. Great variation and oscillation in climate especially at higher latitude during the geographical history of angiosperms. Ex. Global warming – Extinction of organisms.

vi. Considerable variation has occurred in the relative distribution and outline (Border) of land and sea in the history of angiosperm and it exerts a high degree of control over distribution of flora.