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LECTURE NO. 7

CROP ADAPTATIONS ON DROUGHT



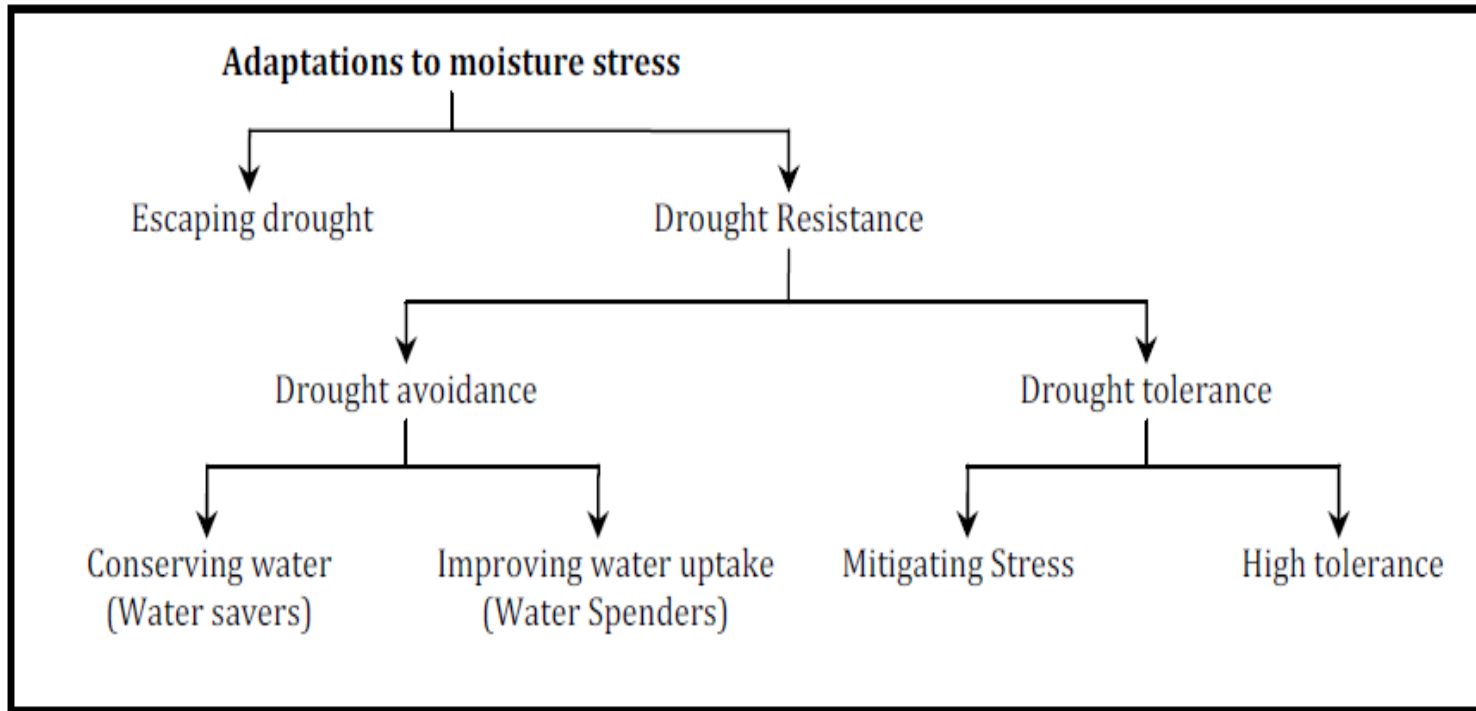


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7.1 Crop Adaptations

The ability of crop to grow satisfactorily under water stress is called drought adaptation. Adaptation is structural or functional modification in plants to survive and reproduce in a particular environment.

Crops survive and grow under moisture stress conditions mainly by two ways: (i) escaping drought and (ii) drought resistance



7.1 Flow chart showing different mechanisms for overcoming moisture stress



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7.2 Escaping Drought

Escaping the drought period is the simplest means of adaptation of the plants under dry soil conditions.

Many desert plants, **Ephemerals** have an extremely short life period (5 to 6 weeks). So they germinate at the beginning of the rainy season and completes its lifecycle by the end of rainy period.

These are not drought resistant.

In cultivated crops, the ability of a cultivar to mature before the soil dries is the main adaptation to growth in dry regions. Ex: Certain varieties of pearl millet mature within 60 days after sowing, Short duration pulses like cowpea, greengram, blackgram can be included in this category.



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7.3 Drought Resistance

The ability of a crop species or variety to grow and yield satisfactorily in areas subjected to periodic water deficits is termed as drought resistance

Plants can adopt to drought either by avoiding stress or by tolerating stress due to different mechanisms. These mechanisms provide drought resistance.



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7.4 Avoiding Stress

- Stress avoidance is the ability to maintain a favourable water balance and turgidity even when exposed to drought conditions, thereby avoiding stress and its consequences.
- A favourable water balance under drought conditions can be achieved either by:
 1. Conserving water by restricting transpiration before or as soon as stress is experienced
 2. Accelerating water uptake sufficiently so as to replenish the lost water



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7.4.1 Conserving water:

- By closing stomata we can reduce the transpiration (stomata will be closed due to increase in ABA concentration, thereby reducing water loss).
- These (CAM) plants store enough water in their tissues. They open stomata at night. They have thick leaves and possess modifications (such as phyllodes and phylloclades) under water stress conditions. They fix carbon during day time with the help of malic acid and CO_2 , which is released internally during respiration.
- By developing smaller leaves with thick cuticle



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- By increasing photosynthetic efficiency.
- Having sunken stomata with hairs (pubescence) to reflect light and to reduce the transpiration eg. Soybean, Nerium
- Shedding their leaves during summer to avoid excess water loss
- Dehydration of protoplasm
- Reducing enzyme activity
- By developing awns, thorns in some crops.
- By deposition of lipids on the leaf surface to reflect light. Ex: Sorghum, Sugarcane etc.
- Favoring the syntheses of ABA (stress hormone) and Ethylene (senescence hormone)



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7.4.2 Water uptake:

- The plants try to uptake more water whenever water is available and act as a water conservers in the future for the growth and development of the crop. Water uptake is done by either more development of roots, root- shoot length.
- Development of adventitious roots helps the plant to absorb more water and keeps the plant for survival.
- The crops selecting should have high root length instead of shoot length. Because if more shoot length and less root length is there means less absorption of water and more transpiration will be there.



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- ❖ If more root than shoot means vice versa will be there and conserves moisture in the metabolism of the plant.
- ❖ Hydraulic conductance of plants (increasing either the diameter of xylem vessels or their numbers).

6.5 Drought tolerance with low tissue water potential: The ability of the plant to endure periods without significant rainfall and to endure low tissue water potential. Ability to produce flowers with a minimum of vegetative structure enables them to produce seeds on a limited water supply.



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7.5.1 Mitigating stress:

An important aspect of developmental plasticity is the ability of plants to transfer assimilates accumulated prior to seed-filling to the grain during the seed filling stage. It was also suggested that when sufficient water supply is there the food materials stored will be supplied to the grain from the stems and roots in small amounts, but when stress occurs in the seed filling stage, an increased proportion of the prior assimilate is transferred to the seed.

7.5.2 Desiccation Tolerance

Based on the desiccation tolerance of the protoplasm, plants can be classified as poikilohydric or homohydric plants.



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THANK YOU