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**FACULTY OF AGRICULTURAL SCIENCES & ALLIED INDUSTRIES**

# Rainfed Agriculture and Watershed Management

## Lecture -6

### Effects of drought on crop production

#### Water relations:

Alters the water status by its influence on absorption, translocation and transpiration. The lag in absorption behind transpiration results in loss of turgor as a result of increase in the atmospheric dryness. As moisture stress increases, turgidity of guard cells decreases. Due to water deficit leaf and canopy temperatures of plant increases. To reduce the temperature in plant stomata starts closing during day time.

#### Photosynthesis:

Photosynthesis is reduced by moisture stress due to reduction in Photosynthetic rate, chlorophyll content, leaf area and increase in assimilates saturation in leaves (due to lack of translocation). Due to water deficit leaf and canopy temperatures of plant increases. To reduce the temperature in plant, stomata start closing during day time. As a consequence, the entry of CO<sub>2</sub> into plant reduces.

#### Respiration:

Respiration increases with mild stress. If water deficit becomes severe, respiration decreases. More severe drought lowers water content and respiration.

#### Anatomical changes:

Decrease in size of the cells and inter cellular spaces, thicker cell wall greater development of mechanical tissue. Stomata per unit leaf tend to increase under moisture stress.

#### Metabolic reaction:

All most all metabolic reactions are affected by water deficits. Severe water deficits cause decrease in enzymatic activity. Accumulation of sugars and amino acids takes place under moisture stress. **Proline**, an amino acid accumulates whenever there is moisture stress.

#### Hormonal Relationships:

The activity of growth promoting hormones like cytokinin, gibberlic acid and indole acetic acid decreases and growth regulating hormone like abscisic acid, ethylene, etc., increases due to moisture stress. **Abscisic acid** acts as water deficit sensor to minimize the loss of tissue water potential. Ethylene production induced by moisture stress is considered to be the cause for leaf and tissue water potential. **Ethylene production** induced by moisture stress is considered to be the cause for leaf and fruit drop. **Betain** is another hormone produced by the moisture stressed plants and it is used as an indicator of moisture stress.

#### Nutrition:

The fixation, uptake and assimilation of nitrogen is affected. Nitrogen fixation by leguminous plants is reduced by moisture stress due to reduction in leghaemoglobin in nodules, specific

nodules activity and number of nodules. Since dry matter production is considerably reduced the uptake of NPK is reduced.

### **Growth and Development:**

The expansion of cells and cell division are reduced due to moisture stress resulting in decrease in growth of leaves, stems and fruits. Moisture stress affects germination, leaf area, leaf expansion and root development. Maturity is delayed if drought occurs before flowering while it advances if drought occurs after flowering.

Development: In general, moisture stress delays maturity. If stress occurs before flowering, the duration of crop increases and when it occurs after flowering, the duration decreases.

### **Reproduction and grain growth:**

Drought at flowering and grain development determines the number of fruits and individual grain weight, respectively. Panicle initiation in cereals is critical while drought at anthesis may lead to drying of pollen. Drought at grain development reduces yield while vegetative and grain filling stages are less sensitive to moisture stress.

Pod abortion takes place due to drought in several legumes including in soybean. Drought decreases photosynthetic rate and water potential in leaves, flowers and pods. Drought decreases leaf sucrose and starch concentrations but increased hexose (Glucose + Fructose) concentrations.

### **Yield:**

The effect on yield depends hugely on what proportion of the total dry matter is considered as useful material to be harvested. If it is aerial and underground parts, effect of drought is as sensitive as total growth. When the yield consists of seeds as in cereals, moisture stress at flowering is detrimental. When the yield is fibre or chemicals where economic product is a small fraction of total dry matter moderate stress on growth does not have adverse effect on yields.