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Effect of Drought Stress on Plants Growth

Kana Ram Kumawat* and N. K. Sharma
Department of Plant Breeding and Genetics, Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan, 334006, India
***Email of corresponding author: kanaramkumawat8@gmail.com**

Agricultural drought is the lack of ample moisture required for normal plant growth and development to complete the life cycle. Scarcity of water is a severe environmental constraint to plant productivity. Drought-induced loss in crop yield probably exceeds losses from all other causes, since both the severity and duration of the stress are critical. In this popular article, we have simply mentioned the effects of drought stress that a plant faces during the growth. The main consequences of drought in crop plants are reduced rate of cell division and expansion, leaf size, stem elongation and root proliferation, and disturbed stomatal oscillations, plant water and nutrient relations with diminished crop productivity, and water use efficiency.

Introduction

A continuous shortfall in precipitation coupled with higher evapotranspiration demand leads to agricultural drought. Crop plants are exposed to several environmental stresses, all affecting plant growth and development, which consequently hampers the productivity of crop plants. Drought is considered the single most devastating environmental stress, which decreases crop productivity more than any other environmental stress. Drought severely affects plant growth and development with substantial reductions in crop growth rate and biomass accumulation. The main consequences of drought in crop plants are reduced rate of cell division and expansion, leaf size, stem elongation and root proliferation, and disturbed stomatal oscillations, plant water and nutrient relations with diminished crop productivity, and water use efficiency. The rate of photosynthesis is reduced mainly by stomatal closure, membrane damage, and disturbed activity of various enzymes, especially those involved in ATP synthesis. Plants display a range of mechanisms to withstand drought, such as reduced water loss by increased diffusive resistance, increased water uptake with prolific and deep root systems, and smaller and succulent leaves to reduce transpirational loss. Plant drought stress can be managed by adopting strategies such as mass screening and breeding, marker-assisted selection, and exogenous application of hormones and osmoprotectants to seeds or growing plants, as well as engineering for drought resistance.

Sign of Drought in Plants

Plant roots can sign (warning) that they are under water stress and they experience it before the leaves' stomata are closed. The sign is abscisic acid (ABA) hormone that is produced as a result of stress in the root tip. In this respect, there is general agreement that the most important plant hormone, abscisic acid is a major role in the life cycle of plants and many important physiological processes.

Effects of Drought Stress

Shortage of water supply at any growth stage poses detrimental effects on crop growth and development in general but varies depending on the severity of stress and the crop growth stage. According to Ghatak *et al.* (2017) the main effects of water stress on plant activities are given below in Figure 1.

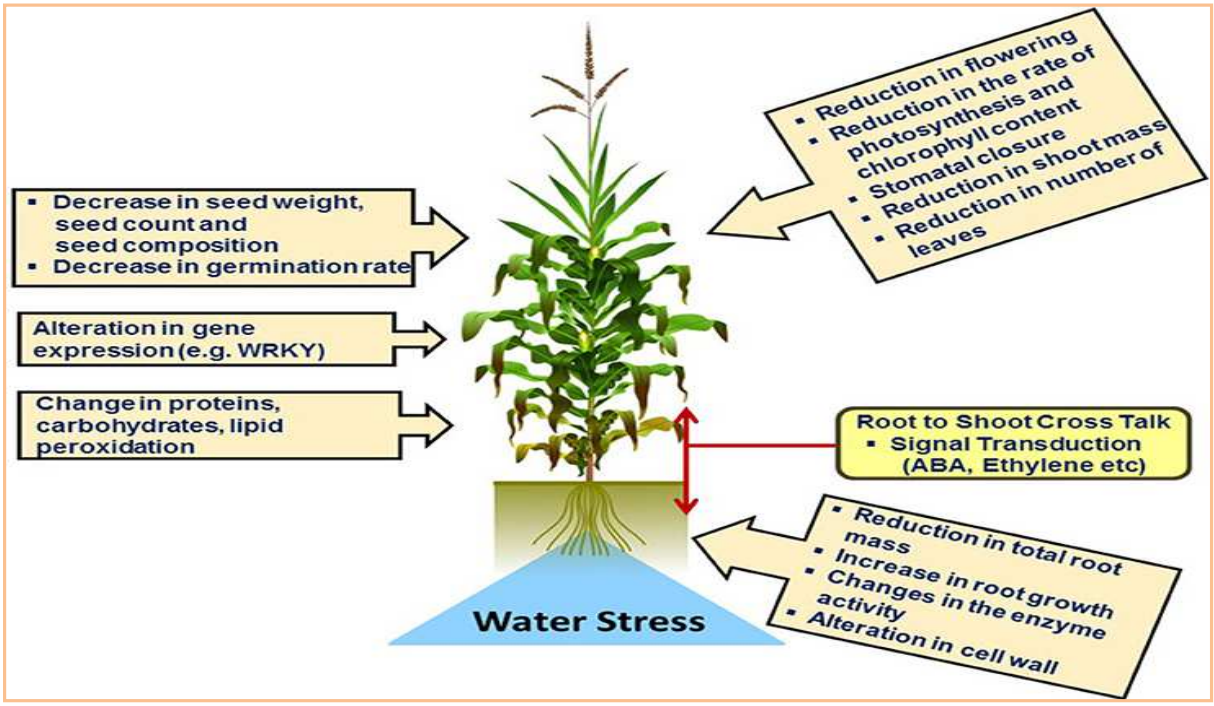

Figure 1: Various effects of water stress on plant activities

Various other effects of drought stress on morphological, physiological, and biochemical processes in plants are discussed below:

- Early season drought severely reduces germination and stand establishment principally due to reduced water uptake during the imbibition phase of germination. It also reduces energy supply and impaired enzyme activities during early seedling stages.
- Cell division and cell enlargement are affected under drought owing to impaired enzyme activities, loss of turgor, and decreased energy supply.
- Under drought stress, reduced dry matter accumulation occurs in all plant organs, although different organs manifest varying degrees of reduction.
- Drought also decreases leaf area owing to loss of turgor and reduced leaf numbers.
- Drought decreases leaf area index (LAI) in crop plants which is the ratio of leaf area to ground area, which denotes the extent of assimilatory power of crops under field conditions.
- Drought also suppresses leaf expansion and tillering and reduces leaf area due to early senescence.
- All these factors contribute to reduced dry matter accumulation and grain yield under drought.
- Drought strongly affects crop phenology by shortening the crop growth cycle with a few exceptions. It is the study of different growth and developmental events in crop plants with respect to time.
- Limited water supply triggers a signal to cause an early switching of plant development from the vegetative to reproductive stages. The effect of drought is phase specific in most cases.

- Drought occurs during the vegetative period of crop growth may substantially decreases economic yield.
- Drought stress during reproductive and grain filling phases are more devastating. Drought at flowering stage increases the rate of ear abortion due to a decline in assimilate supply to developing ears.
- Relative water contents, leaf water potential, osmotic potential, pressure potential, and transpiration rate are the major attributes of plant water relations which significantly affects under water deficit.
- The increase in drought conditions, accumulation of salts and ions in the upper layers of the soil around the root cause osmotic stress and ion toxicity.

Conclusion

Water deficit reduces plant growth and development, leading to the production of smaller organs, and hampered flower production and grain filling. A diminution in grain filling occurs due to a decrease in the accumulation of sucrose and starch synthesis enzymes. Timing, duration, severity and speed of development undoubtedly have pivotal roles in determining how a plant responds to water deficit. Being very complex, the drought tolerance mechanism involves a number of physiological and biochemical processes at cell, tissue, organ and whole-plant levels, when activated at different stages of plant development.

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