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Effect of Drought Stresses on Plant Growth and Development

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SUMMARY

Plants faces a combination of different abiotic stresses under field conditions whichare lethal to plant growth and production. Simultaneous occurrence of drought stresses in plants due to the drastic and rapid global climate changes can alter the morphological, physiological and molecular responses. Drought stresses adversely affect the plant growth and yields due to physical damages, physiological and biochemical disruptions, and molecular changes. Drought stresses resulting in the non-normal physiological processes that influence one or a combination of biological and environmental factors. Drought stresses has occurred as a result of an abnormal metabolism and may reduce growth, plant death or the death of the plant develops. Production is limited by environmental stresses, according to different scholar estimates, only 10 percent of the world's arable land is free from Stress. In general, it is a major factor in the difference between yield and potential performance, environmental stresses. Drought is risk to successful production of crops worldwide and occurs when a combination of physical and environmental factors causing stress in plants and thus it reduces production. Many plants have improved their resistance mechanisms to tolerate drought stress, but these mechanisms are varied and depend on the plant species. Typically, mechanisms involved in plant tolerance to drought follow a general plan; maintaining cell homeostasis in water deficit situations. Which is possible by increasing the water inlet to the cells drought avoidance is other common drought resistance mechanism in annual plants.

INTRODUCTION

Drought stress in plants is characterized by reduced leaf water potential and turgor pressure, stomatal closure, and decreased cell growth and enlargement (Farooq *et al*., 2009). Drought stress reduces the plant growth by influencing various physiological as well as biochemical functions such as photosynthesis, chlorophyll synthesis, nutrient metabolism, ion uptake and translocation, respiration, and carbohydrates metabolism (Jaleel *et al*., 2008; Farooq et al., 2009; Li *et al*., 2011). Nevertheless, plants experience water deficit not only duringdrought, but low temperature may also cause turgor stress at cellular level (Thomashow, 1994). Drought stress is among the most destructive abiotic stresses that increased in intensity over the past decades affecting world's food security. Drought stress may range from moderate to short to extremely severe and prolonged duration, restricting the crop yields. (Austin, 1989, Pereira and Chaves, 1993).Drought is one of the major constraints on agricultural productivity worldwide and is likely to further increase. Several adaptations and mitigations strategies are required to cope with drought stress.Drought severity is changeable as it depends on numerous factors like soil structure and it's water reserve capacity, average of rainfall, and transpiration rate.Plants have various responses for acclimatisation and survive under drought conditions through induction of morphological, biochemical, physiological responses; also, there is a molecular mechanism in the plant under water deficit conditions. Progress of plants tolerant to drought stress might be a promising approach.However, plant adaptations for drought stress could be divided into three strategies which involves- Drought escape, Drought avoidance and Drought tolerance. Generally, drought-tolerant plants are able to survive dehydration through osmotic adjustment and production of molecules that stabilize proteins.This work is aimed to understand plants adapting drought conditions and explain main mechanisms and some practice to reduce drought effects to improve plant growth and total yield.

Drought Escape

Escape from drought allowed production of new seeds before the harsh environment conditions end the life cycle of the plant. In these conditions, plants develop rapidly and reduce vegetative growth period. Also, early flowering is an important mechanism plant use to adapt with drought. Therefore, short life cycle considered a proper technique to escape from climatic stresses.

Drought Avoidance

In previous researches drought avoidance has been referred to as dehydration avoidance, avoidance mechanisms and depends on the decrease water loss from plants by control transpiration, and increase water use efficiency. At the same time, the root system plays a vital role in avoiding drought mechanism and the root system characters change (it becomes deeper and thicker) to adsorbing water from extra depths to contribute to producing yield under drought conditions. Plant reserve water uptake through prolific root system,in this condition plants reducing transpiration, limiting vegetative growth, or increasing root growth, and avoid dehydration during transient periods of drought stress.

Drought Tolerance

Drought tolerance is defined as the ability to grow, flower and display economic yield under sub-optimal water supply. The plant ability to preserve leaf area and growth under extended vegetative stage are considered as other definition for stress tolerance. Also, drought tolerance evaluated as amplify cell membrane stability under water shortage conditions. The root system is the main plant organ for adaptation of drought stress conditions. The main basis of variation appears to be constitutive, therefore, root system architecture that allows reserve of more water quantity are the most important tool for drought tolerance. Drought stress alone inhibited plant growth in term of reducing shoot length and fresh weight of the hypocotyls. The drought, tolerant plants initiate defence mechanisms against water deficit, plants use different mechanisms of drought tolerance at different levels of aridity. Some of this is morphological mechanism such as escape from drought, drought avoidance and phenotypic flexibility. Also, there are physiological mechanisms to avoid negative effects of drought on plant growth**.**

Mechanisms of Resistance to Drought Stresses

Drought Resistance in fact, the ability of species or cultivars for growth and production in droughtconditions. By a long dry period on the physiological and morphological effects on yield and ultimate effect on yield depends on many factors. This is not only depends on the time of drought on the life cycle of plants and water holding capacity of the soil in the root zone It also depends on plant characteristics. To prevent water losses, crop should close the stomatal, reducing absorption or decreased sweating, or a combination of all three levels will reduce the amount of transpiration. One of drought tolerance in crop plants through water conservation and sustaining water absorption. The important feature is that this requires one to have deep roots and branches and a low resistance to flow of water inside the plant (Zareian, 2004).Maintaining inflammation in the leaves while they are growing shortage of water can maintain the physiological activity. Maintaining inflammation in conditions of reduced leaf water potential can be fully or partially by setting the osmotic conditions, increase or decrease the size of the cell elasticity acquired. Many plants have improved their resistance mechanisms to tolerate drought stress, but these mechanisms are varied and depend on the plant species. Typically, mechanisms involved in plant tolerance to drought follow a general plan; maintaining cell homeostasis in water deficit situations, which is possible by increasing the water inlet to the cells. Drought avoidances is other common drought resistance mechanism in annual plants, with this mechanism escape from stress conditions is the main strategy for plant growth under drought conditions. Some of physiological mechanisms are cell and tissue water preservation, Cell membrane stability and endogenously produced growth regulator. However, the deficit of plant cellular water occurs under dry soil conditions considered as molecular mechanisms.

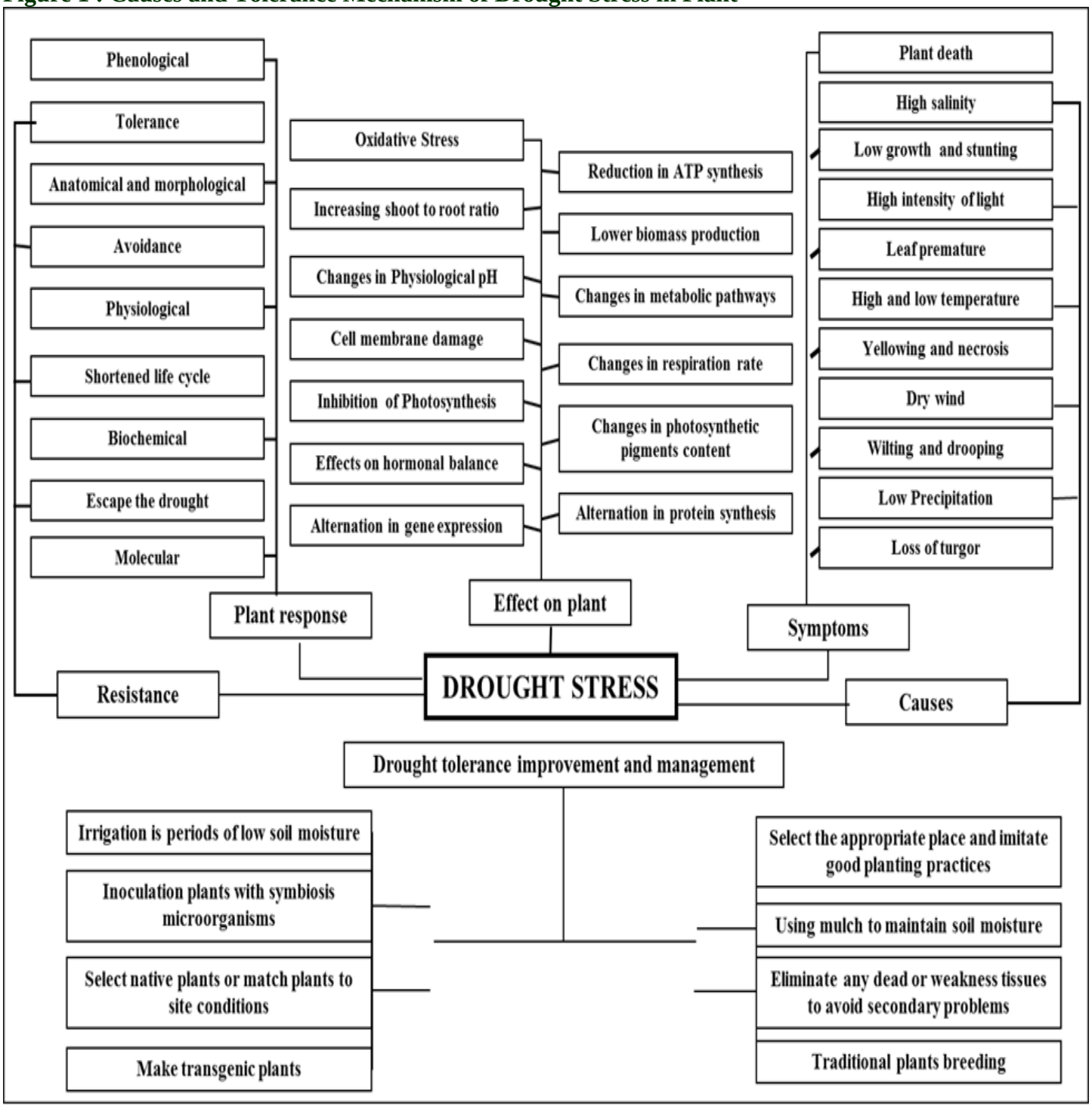
Some Agricultural Practice to Increase Drought Tolerance

Usage of potassium fertilization under drought stress increased the drought tolerance, due to implement cell membrane stability. Also, seedlings hardening increased drought tolerance primarily by reducing osmotic potential and stomatal regulation, improved new root growth capacity and enhanced cell membrane stability,nevertheless, exogenous application of indole-3-yl-acetic acid enhanced net photosynthesis and stomatal conductance in cotton Indole-3-butyric acid is naturally occurring auxins (Abobatta, 2019)

CONCLUSION

Drought stress is one of the most serious threats to world food security. There are various negative effects on plant growth and total yield occurs under drought conditions, therefore, plants have different responses for adapted and survive with drought conditions such as morphological, biochemical, physiological responses, and a molecular mechanism. Plants acclimatise with drought stress through use various strategies which include drought escape, drought avoidance and drought tolerance. Plant breeders using biotechnology and classical breeding techniques for improving plant drought tolerance, from another side, using of exogenous plant growth regulators could improve plant tolerant for drought stress

Figure 1 : Causes and Tolerance Mechanism of Drought Stress in Plant



(Salehi-Lisar and Bakhshayeshan-A, 2016)

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