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Effect of Drought Stress and Mineral Nutrition in Plant Growth and Development

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A B S T R A C T

Drought is most important abiotic factor which cause significant loss in crop production, declines the economy of a crop. Decreasing the climate change will leads to increasing the drought, so food production also decreases in agriculture. During seed development drought stress reduces the photosynthetic rate of lead and chlorophyll content. Drought shows the drastic effect on mineral nutrition in plants. It reduces the uptake of nutrients from root to the shoot by reducing the rate of transpiration. The aim of essential nutrients are not only for better plant growth and development, also helps to improve from drought stress. Reducing harmful influences on drought stress can be reached by better nutrient achievement.

Introduction

Vitamins Drought stress is the most predominant environmental factor limiting crop productivity. Among all abiotic stresses like temperature, light, chilling, freezing, salinity. Drought makes more economic damage to crops. Drought is a prolonged period of lacking moisture results extensive damage to agricultural crops and substantial yield loss. Decreasing the climate change will leads to increasing the drought on globe, therefore decreasing the food production in agriculture (Deepesh, 2018). Duration of drought decreases the precipitation on earth, this would be experienced by many of regions on globe. Though, most of the human beings are depending on the vegetation, increasing the drought leads to increases starvation. When plant growth decreases due to lack of moisture present in the plant body, simultaneously decreases the phenological development. Usually, before depletion of soil water the rapid phenological development involves speedy plant growth. Once complete depletion of water occurs in the soil body, the level of moisture content in plant body and soil will decreases which leads to decrease the metabolic activity of the plant growth and development (Supratim Basu, 2016).

Drought stress during seed development reduces the leaf photosynthetic rate and chlorophyll content, changes in metabolism of carbohydrates, proteins, amino acids and enzyme activities, decreases the

flower and fruit development and results the serious reduction in yield and yield traits. The effect of drought stress during fruiting period on seed quality may differs within and amongst species. The drought stress reduces the plant biomass and leaf area and methods of computing certain parameters that describe growth *viz.*, leaf area index, leaf area ratio, leaf area duration, specific leaf weight, net assimilation rate, relative growth rate, crop growth rate, translocation percentage, light transmission ratio and harvest index. Approximately 70 % of yield was reduced by drought stress in several crops (Akram *et al.*, 2013). Different morphological activities such as seed germination, root growth, leaf area, leaf rolling and plant height are disturbed under drought stress.

Drought shows the drastic effect on mineral nutrition in plants. It reduces the uptake of nutrients from root to the shoot by reducing the rate of transpiration. Some studies saying that the role of mineral nutrition can be increase or decrease the drought stress in plants, but it still inadequate and indefinable. Although if plant grows on rich fertile soil, nutrient deficiency can be caused by drought stress because the impact of soil physiochemical properties and henceforth reduces the movement and uptake of mineral nutrients by the plant (Singh and Sale, 2000).

Effects of drought on plants

The effect of drought stress ranges to various level such as morphological, physiological, biochemical and molecular levels. An account of various drought stress effects and their level is elaborate as crop growth and yield, water relations, nutrient relations, photosynthesis, respiration and oxidative damage.

Effect on plant morphology

For germination of seeds, it requires minimum amount of water. If all environmental conditions are favorable, inability to imbibe and germinate under water deficit conditions. In most of the legumes have shown poor germination of seed under drought condition. Reduction in seed germination and growth establishment is the first signs of drought at early crop growth stages. A healthy root systems performs well to helps the plants to strengthen as well as uptake of water and nutrient from soil. Under trivial drought conditions root growth is severely affected. Significantly, the dry weight of roots also decreases in plants. Leaf area also affect the plant growth by closing the stomata and photosynthesis process affects when water quality decreases by reducing the leaf expansion. Substantially, plant height also affected by drought stress. A decline in plant height can be leads to reduction cell expansion. Plant height is mainly associated with cell enlargement and leaf senescence (Sadam *et al.*, 2019).Water deficit shows the result of poor germination, affects the root growth, reduces the leaf area, decline in plant height and declining the growth establishment in various crops. Henceforth, maximum moisture supply is mandatory for early growth to the various crops.

Drought stress reduction with nutrient inputs

For every living organism, proper nutrition is the basic need. Plant requires 17 essential elements for their growth and development (Waraich *et al.*, 2011). Essential plant nutrients are divided into two groups, micronutrients and macronutrients. Among these C, H and O are three essential nutrients most plants requires. Nutrients Fe, Zn, Mn, Cu, B, Mo and Cl are micronutrients that are in lesser quantity 0.1 to 100 mg per kg of plant dry matter (Singh, 2008). The nutrients N, P, K, Ca, Mg and S are considered as macronutrients, because they are in greater quantity (1 to 150 g per kg of plant dry matter). Some nutrients like Si, Na, Ni and Co are not essential elements to all plants, but it is considered as a beneficial plant nutrients. The aim essential nutrients are not only for better plant growth and development, also helps to improve from drought stress. Plants maintain a resistance mechanisms to ensure survival under different environmental stress conditions. Sometimes in plants stress occurs not only by drought, also due to deficiency of mineral nutrients.

Decreasing water availability under drought, results in limited uptake of total nutrient. Moisture stress induces an increase in N and decline in P and no definite effects on K (Farooq *et al.*, 2008). Influence of drought on plant nutrition may also be related to less availability of energy for assimilation of NO_3^- and NH_4^+ they may converted in energy dependent process before the ions can be used for growth and development of plants (Grossman and Takahashi, 2001). As water and nutrient requirements are closely related, by utilizing available water fertilizer application is probable to increase the efficiency of crops. It indicates the significant contact between soil moisture deficits and nutrient attainment (Garg, 2003). Likewise, other nutrient contents in the plant tissues diminished under drought, because of low nutrient mobility results of low moisture availability. Drought can be managed by the following cultivation practices like sowing time, plant density and soil management. Application of plant growth regulators as foliar spray in both natural and synthetic way has proved to improving growth against a variety of abiotic stress. Partly gibberrelic acid increased the water status of the seedlings and partially sustained protein synthesis. Drought stress unaided inhabited increases in length and fresh weight of the hypocotyl, if gibberrelic acid apply on this it shows reverse effect (Taiz and Zeiger, 2006).

Worldwide, drought stress is a major drawback to the agricultural productivity. Drought stress frequently results in loss of growth and yield of agricultural crops. Managing the plant mineral nutrients is vigorous for the development of drought tolerance because mineral nutrients play a vital role in determining plant resistance to drought. Also affects the growth and physiology of plants and their functions like photosynthesis, respiration, protein synthesis.

Fig.1 Mechanism of growth reduction

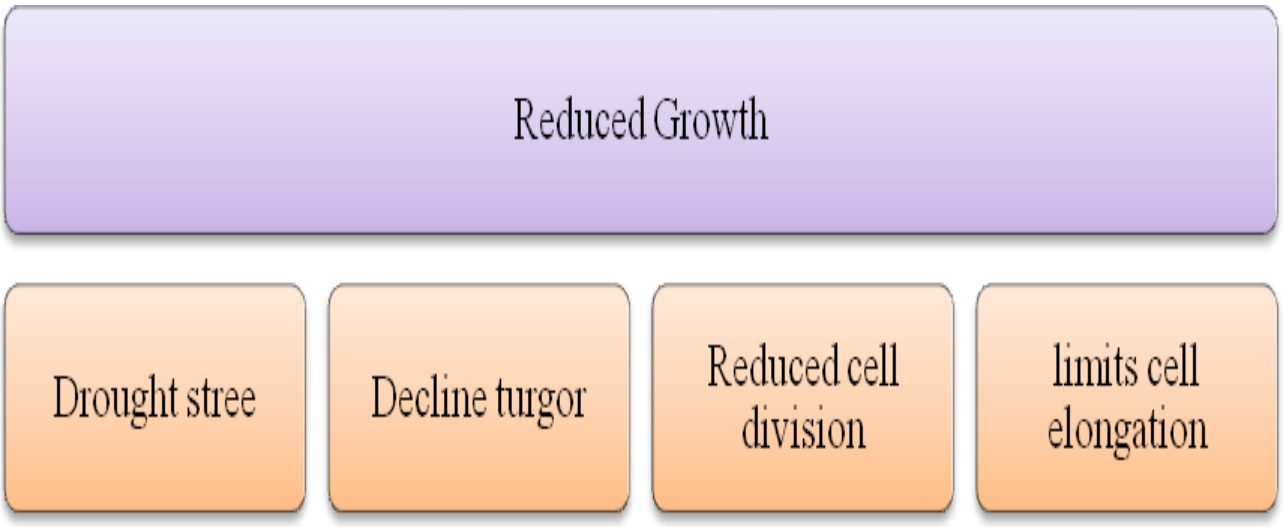
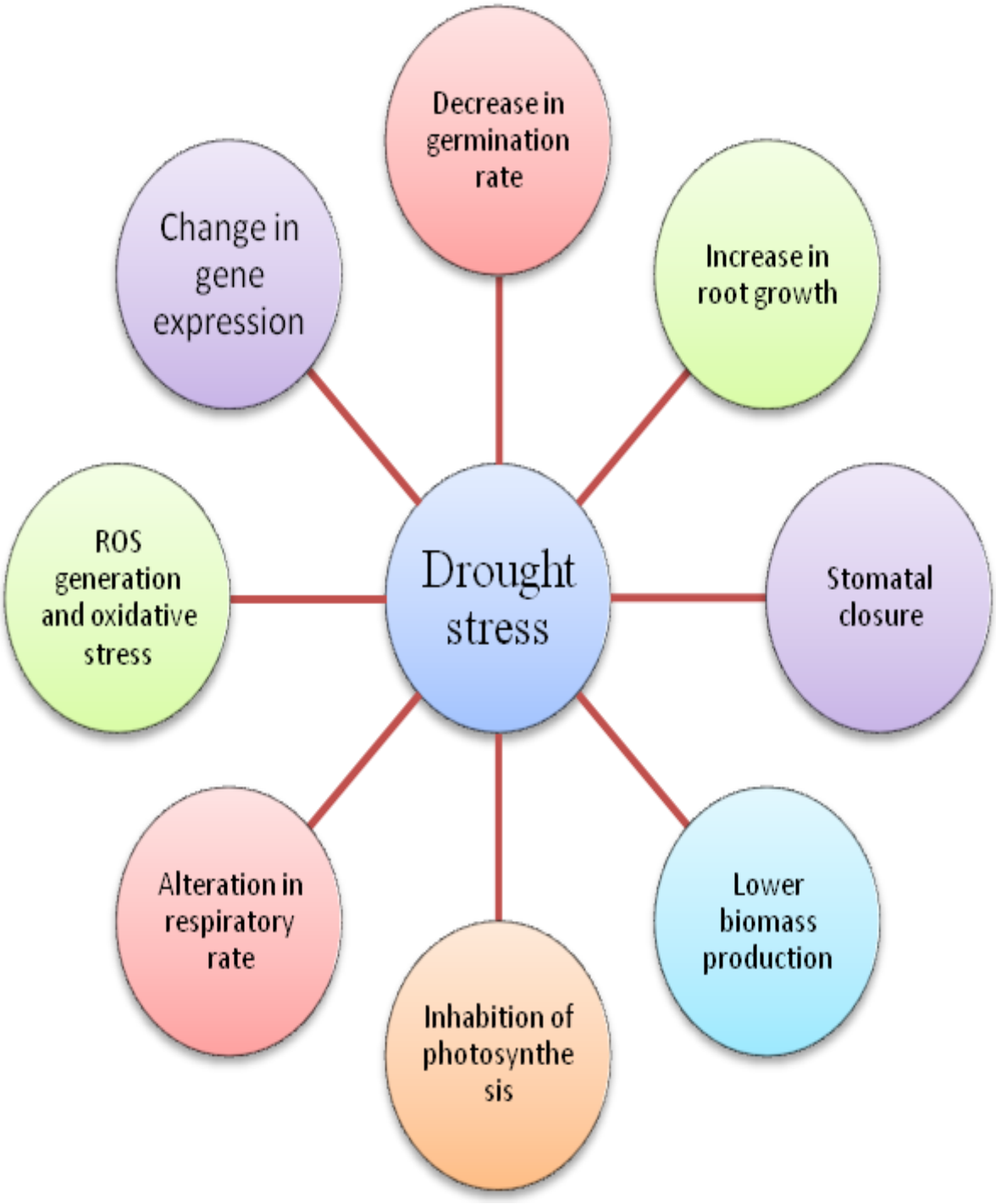


Fig.2 Drought stress effect on plant growth and development



Improper application of nutrients leads to stunted growth. Drought stress cause interference in nutrient acquisition even if nutrients are available in sufficient quantities. The use of micronutrients like Zn, Si and Mg improves antioxidants and promotes plant drought resistance. The nutrients P, K and Mg supports to develop root, improves water absorption. Reducing lethal impacts on drought stress can be

achieved by better nutrient achievement. In future, focusing on developing the drought resistance varieties shows the better strategies on agricultural crops.

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