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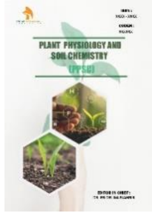

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REVIEW ARTICLE

A REVIEW ON DROUGHT TOLERANCE AND EFFECTS IN MAIZE

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ABSTRACT

Drought is a situation that occurs when there is a prolonged period of exceptionally low rainfall, resulting in water scarcity. It is one of the most significant factors contributing to serious crop output deficits in developing countries. Tiny, broad branches, tiny tassels, elevated leaves, delayed senescence, low root biomass, and a deep root system all seem to be characteristics of this plant. with a small lateral root are all features that seem to be likely selected in maize breeding for enhanced drought tolerance. Tolerant genotypes should have strong spikelet and kernel growth, as well as adequate osmotic adjustment to help retain water in cells under drought, during the cell division, and expansion-growth stages. This does not completely stifle root and ear growth, and leaf survival is better despite the lack of water. As a consequence of comprehensive dissections of drought tolerance features in maize over the last century, numerous QTLs linked to drought tolerance in maize have been revealed(Ribaut et al., 2009).Drought-related yield reduction in maize (Zea mays L.) arise anticipated to boost when temperatures rise and rainfall distribution changes as a result of global climate change in popular traditional producing areas. The effectiveness of traditional crop development for drought tolerance has served as a benchmark against which new genetic approaches must be measured for the past 50 years. Resulting in higher yield potential and kernel set, faster silk effort, and less barrenness, selection based on performance in multi-environment trials (MET) has increased grain output under drought, though at a slower rate than under optimal conditions.

KEYWORDS

drought, tolerance, stress, root, maize

1. Introduction

More than 4.5 billion people in 94 impoverished nations rely on maize (Zea mays L.), wheat, and rice for at least 30% of their daily caloric, where one-third of children are malnourished. When compared to current levels, maize demand in emerging nations will nearly triple by 2050 (Campos et al., 2004). Drought, on the other hand, is predicted to reduce maize grain output by 15% to 20% per year, with losses likely to rise if droughts become more common and severe as a result of climate change. Many farmers do not have access to irrigation, and the potential for irrigation expansion in emerging countries is limited (Maazou et al., 2016). Maize is one of the 3rd most significant food grain crop among the developing countries. By 2020, maize demand in developing nations is predicted to outpace wheat and rice consumption, resulting in a global annual maize demand rise of 837 Mt. (Rosegrant et al., 2001). Domestic supply will be required to meet a large percentage of this rising demand and boosting production on currently available arable land would help in achieving that ambition (Rosegrant and Cline 2003).

Rainfall is the primary source of water for tropical maize, and irrigation is rarely used to alleviate water stress. Maize varieties with better yields are being produced in response to rising competition for water, the global rate of warming, as well as the possibility of more intense regional and seasonal climate differences in particular areas (Ribaut et al., 2009). Drought tolerance selection is difficult due to intricate interactions between genotypes and the environment, as well as a lack of understanding of how tolerance mechanisms work and what they do. Number of approaches have been used in several study to investigate biological variations in drought tolerance. The ability to distinguish genotypes that have a desirable and similar yield in stress and non-stress situations from other groups, according to The best indices for drought selection have a substantial association with kernel yield in both situations (Fernandez, 1992). There are numerous genotype selection criteria based on performance in stress and non-stress circumstances. When watered consistently, the hybrid yield has a lower stress tolerance index (STI), according to the hybrid yield with regular irrigation has a lower stress tolerance index (STI). and drought conditions are near to each other, or the plant is drought resistant (Rosielle and Hamblin, 1981; Naghavi et al., 2013).

2. Methodology

Method of classifying data collection simply into: primary and secondary data collection. Several procedures under the secondary method were followed to ensure a high-quality review of the literature. In identifying sources for this literature review, multiple databases were used. The most popular destination for citing research data was Google Scholar. Journal papers published from 2000 to 2022 were given major priority in this study.

3. Literature Review

3.1 Effects of Drought in Maize

Drought stress impacts all stages of maize development, including

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seedling establishment, vegetative growth and development, and reproductive growth, from germination to harvest maturity. The impacts of drought on maize at various phases of growth and organizational levels are depicted in the diagram below (Showstack, 2005).

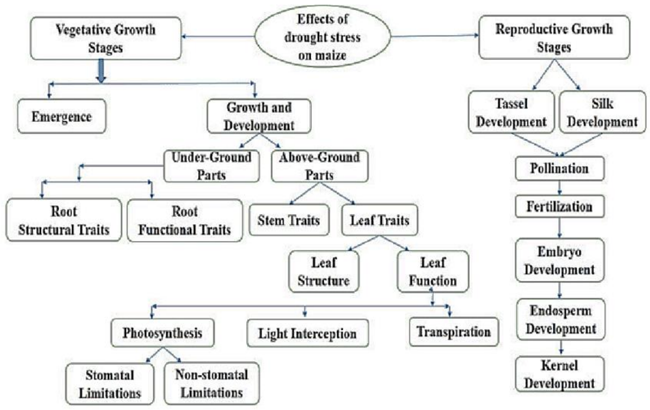

Figure 1: Vegetative and Reproductive Growth Stages Effects in Drought Stress of Maize

3.1.1 Physiological Effects of Arbuscular Mycorrhizal in Drought Maize

The water intake and outflow rates of host plants are frequently regulated by fungi, influencing tissue moisture content and leaf physiology. Variations in stomatal conductance and transpiration, which are often higher and often unmodified or larger during drought stress, are one of the most visible aspects of AM symbiosis. The AM symbiosis modulates plant metabolism by regulating carbon distribution and metabolite concentrations in both shoot and root tissues. Because of the higher carbohydrate content, AM colonization raises foliar soluble glucose and chlorophyll concentrations, resulting in increased photosynthetic activity. Amino acid and nitrogenous component accumulation is very often enhanced or reduced in colonizing plants in addition to accumulate more amino acids and nitrogenous substances in drought stressed plants (Boomsma and Vyn, 2008).

3.1.2 Response to Maize in Drought Condition

According to a meta-analysis of all known evidence, maize yield response to drought varied greatly. When water was cut by a similar amount, maize yields dropped by 39%. (About 40 percent). The most important C4 cereal species with the highest sensitivity is maize (91.7 percent of worldwide C4 grain production in 2013). As a result, maize is regarded to be less resistant to drought than other crops. Drought sensitivities in maize are most likely attributable to changes in drought-related plant characteristics. The three forms of plant responses to drought are drought escape, which means a short life cycle, drought avoidance, which means maintaining a good water status during drought by diverse mechanisms such as stomatal closure, and drought tolerance. Because male (tassels) rather than female (ears) inflorescences (ears) develops more readily in maize, cultivars with small tassels have proven to be efficient. Smaller tassels are correlated with increased output, which could be due to decreased transpiration or less shadow and greater light interception by the upper leaves (Daryanto et al., 2016).

3.2 Effects of Drought in Maize on Glutathione Biosynthesis

The effect of variations in glutathione pool redox state on total glutathione concentrations and the glutathione synthesis pathway was studied in greater depth. Water deficit caused only minor changes in the levels of glycine and glutamate in roots and leaves, according to the study. Not only was the steady-state glutathione level in drought-stressed maize leaves reduced by nearly half, and so were the steady-state levels of the precursors EC and cysteine stress-induced which were reduced by 60% and 75%, respectively. The roots of the control plant have nearly half of the glutathione concentration of the leaves. Total glutathione levels in the roots increased 1.8- and 2.3-times during water stress compared to controls, reaching levels similar to non-stressed maize leaves (Ahmad et al., 2016).

4. Conclusion

From the above findings with the help of different articles, we were able to find that Maize is an important C4 crop that can tolerate mostly the drought condition than any other crop. And in the drought condition there are different effects shown by maize in all stages of maize development, including seedling establishment, vegetative growth and development, and reproductive growth, from germination to harvest maturity and more clearly shown on above figure 1 with consisting different stages. Drought sensitivities in maize are most likely attributable to changes in drought-related plant characteristics.

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