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Antitranspirant: A Novel Emerging Approach to Combat Drought Stress in Maize (*Zea mays L.*)

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Abstract

Drought stress occurring more frequently and severely because of the climatic change, and it threatens to food security of the world. Maize crop is intensely affected by biotic and abiotic stresses. Antitranspirants are the compounds that are applied to the leaves for reducing the water losses. Film forming type, growth retardant, reflecting type and stomatal closing type are the four categories of antitranspirants. Antitranspirants can; lessen water stress, enhance chlorophyll content, photosynthetic rate and improve the grain yield of maize. In this article we emphasize on the responses of maize to antitranspirants under drought conditions.

Introduction

Drought is one of the environmental factors and natural climatic sense that happens frequently in most parts of the world. Maize (*Zea mays* L.), the main cereal crop is cultivated across the widespread agro-ecological zones due to better adaptability. It is the crop that is significantly affected by biotic and abiotic stresses. In maize drought stress at the physiological level, commonly known for reduction of plant synthetic activities, stimulate stomatal closure through addition of abscisic acid (ABA) and hydraulic signaling. The chemical control of growth and stomatal behavior acts as a major part in the regulation of growth and development in dry soil and water deficit conditions. Foliar application of the antitranspirant, Biobest, on maize exposed to different levels of water stress had mitigated the effect of moisture stress on plants (Dai, 2012). The material and chemical compound that favors the decline in rate of transpiration from leaves by reducing the size and number of stomata and gradually stabilizing them to stress, is basically termed as antitranspirants.

Response of Antitranspirants on Maize under Water Deficit Condition

Approximately, 95-98 % of the water absorbed by the plant vanishes in transpiration. Antitranspirant may help in maintenance of favorable water balance if transpiration is controlled; they reduce photosynthesis in crop plants. The application of antitranspirant material by exogenous spray can significantly decrease the damage caused by water deficit conditions in maize. Antitranspirants are typically made up of emSulsions of wax or latex that creates a thin film over the surface of the plant, and kaolin clay or chitosan which supports as a reflective type material. Responses of antitranspirants on maize under drought condition is shown in the Figure 1 and discussed as follow:

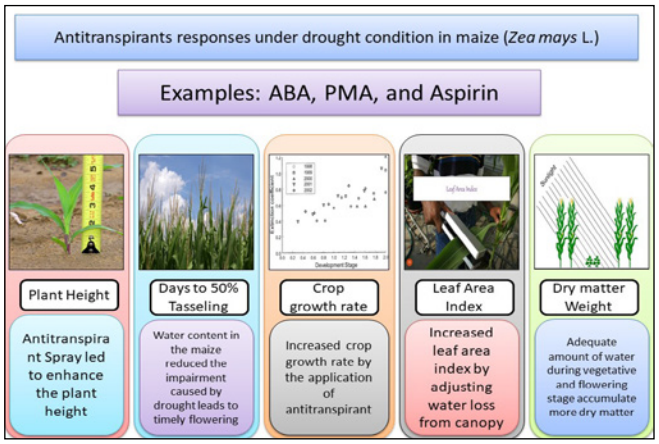

Figure 1: Antitranspirants responses in maize (*Zea mays L.*) under drought condition

1. Number of Days till 50% of Tasseling

The water scarcity accompanied by high temperature, an increase in wind speed and a decrease in relative humidity enhanced the speediness of physiological processes in maize, as a result of increase in the temperature of plants, stimulating them to influence the flowering stage quickly. The number of days before tasseling was shortened as irrigation water decreased. The anti-transpiration plays a key role in conserving the water content in the plant that decreased the impairment caused by water shortage and then it significantly pushed the plant to continue the growth instead of initial tasseling and complete its life cycle early.

2. Plant Height

The reduction in the plant height was recognized to the condensed period, from planting till the stage of 50% of tasseling, throughout which the stem elongation occurred. Under the drought conditions shortage of water declined each of cell division, cell elongation, and cell widening therefore lowering the water potential. Moreover, reducing the number and area of the leaves affected over reduction to the plant canopy which manipulates the plant height undesirably by hindering the oxygen as a result of photo radiation in maize (Ulameer and Ahmed, 2018). Spraying the anti-transpiration led to an increase in the plant height. Moreover, applying the anti-transpiration as a foliar application contributed to the establishment of a thick layer on the surface of the leaves. There is significant reduction in the water loss from the cells that resulted in cell elongation and expansion.

3. Leaf Area Index

The decline in the leaf area index in maize crop under water stress is attributed to decrease in the leaf area. The non-availability of water reduced the leaf area of maize, therefore this reduction reflected adversely on the leaf area index. There was a major increase in the leaf area index by using the foliar application of antitranspirants as a result plants close their stomata apparatus and modify their leaf area, and thereby adjust the loss of water from the canopy.

4. Dry Matter Weight (g)

Reduction in the dry weight might be attributed to influence the water stress on growth attributes for instance plant height, leaf area and leaf area index. Therefore, it affected the aptitude of maize plants to produce and collect the dry matter. Water deficit conditions in maize crop led to decrease in absorbing water and nutrients, exclusively those that play key roles in the practices of growth and dry matter accumulation. Through the foliar application of antitranspirants, the water condition of plants may be better during the vegetative and flowering stage. This makes the cells turgid with water, thus increasing the absorption of nutrients from the soil and further providing the plant, the possibility of absorption of more volume of nutrients and increasing their concentrations in dry matter.

5. Crop Growth Rate (g/day)

The crop growth rates reduced with increase in moisture stress in maize because of the shortening of the period from planting to tasseling by 50% resulting in the reduction in photosynthesis that reflected undesirably on accumulating dry matter as a result there is decline in plant height and number of leaves. The crop growth and development mainly depend upon the growth of plant parts and their formation. Crop growth rates vary according to the age, growth, and stress level in plants. Antitranspirants treatment achieve some equilibrium in the internal physiological regulation of maize plant which is reduced when exposed to water stress, so these treatments have maintained level of water within the plant resulting in the rise of plant growth rate (Mphande *et al.,* 2020).

Conclusion

Drought condition in maize plant causes reduction in the maize growth which ultimately reduces the grain yield. Antitranspirants such as ABA, PMA, aspirin, alachlor etc., are the chemical compounds that help us to reduce the water losses caused by the drought condition in maize. From the above discussion, it can be concluded that antitranspirants not only reduces water losses, they also play an important role in improving the various physiological parameters that include reproductive and vegetative attributes.

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