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Role of Anti-Transpirants in Agriculture

Ekta Kamboj[1] and Vijeta Gupta[2]
[1]PhD Scholar, Department of Agronomy, [2]PhD Scholar, Department of Genetics and Plant Breeding, College of Agriculture, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana

SUMMARY

The two main sources of water loss from vegetated fields are transpiration from plants and evaporation from the soil surface. However, in arid climates where soil moisture levels are crucial, water loss from sandy soils after the top layer has dried may be little. In recent studies, increasing emphasis has been placed on examining the possibility of using chemicals to reduce plant transpiration. These anti-transpirants work by films the leaf surface or regulating the stomatal aperture to control transpiration.

INTRODUCTION

Anti-transpirants are compounds or chemicals that reduce the size and number of stomata on plant leaves, minimizing water loss. Transpiration wastes nearly all of the water that the plant absorbs. Anti-transpirants are chemical substances whose purpose is to train plants to become more resistant to stress as a way to mitigate the effects of drought caused by salinity. Reduced transpiration can help in this regard by avoiding the wasteful loss of water to the atmosphere through stomata. Anti-transpirant materials have recently been developed as a result of research into compounds that, when applied to plants, inhibit transpiration. Because both transpiration and photosynthesis rely on the flow of water vapour and carbon dioxide through the stomata, both processes may be harmed if the stomata are restricted or limited by anti-transpirants. Anti-transpirants are compounds that are given to plants to reduce transpiration (water loss) without interfering with other plant activities like photosynthesis and growth. They've had some success in the horticulture sector, particularly in the ornamental market.

Anti-transpirants may reduce transpiration in three different ways:

- By lowering solar energy absorption and, as a result, leaf temperatures and transpiration rates.
- By creating thin transparent layers that prevent water vapour from escaping from the leaves.
- By increasing stomatal closure (by influencing the guard cells surrounding the stomatal pore), the loss of water vapour from the leaf is reduced.

Types of Anti-Transpirants

Stomatal Closing Type

- These antitranspirants slow down the closure of stomata and hence diminish transpiration.
- The rate of CO_2 diffusion into the leaf is likewise reduced as the stomata are induced to shut, resulting in poor photosynthetic rates.
- For instance, Phenyl Mercuric Acetate (PMA), Abscisic Acid (ABA), and high CO_2 levels.
- CO_2 is an effective anti-transpirant, and a small increase in CO_2 concentration from 0.03 percent to 0.05 percent causes partial stomatal closure.
- Its higher dosage cannot be employed because it causes total stomatal closure, which has a negative impact on photosynthesis and respiration.
- PMA is a widely utilized stomatal closure chemical. Although it has the power to close stomata, it has the drawback of being toxic to fruits and vegetables. This molecule also prevents phosphorylation, which harms the foliage by preventing photosynthesis.
- Herbicides such as triazine, atrazine, and simazine are ETC inhibitors at QA and QB sites, but they can also be utilized as anti-transpirants at lower concentrations.

Film forming type:

This type generates a thin film covering on the leaf's surface that prevents water vapour from escaping. They do, however, allow CO_2 to enter the leaf through the lower epidermis. For e.g. waxes, plastic films, and silicone oils.

Advantages: Affects only at low temperatures, not at high temperatures; obstructs gas exchange; creates a mechanical barrier for stomatal movement.

Reflectance type:

- The idea behind applying these chemicals is to enhance the amount of light reflected by the leaves, lowering the leaf temperature or head load.
- The amount of water lost is lowered without reducing CO_2 absorption. Kaolinite (Kaolin), for example, and lime water (Lime wash)
- When kaoline is applied, it forms a thin white layer. It is usually sprayed at a concentration of 2-5 percent and forms a thin coating on the leaf.

Function: Radiation falling on the leaf is reflected, reducing the heat burden on the leaf. When the heat load is reduced, the amount of water required to maintain the temperature is reduced as well. As a result, water conservation takes place. Kaoline does not obstruct metabolic function in any way.

Growth Retardant:

These compounds inhibit shoot growth while promoting root growth, allowing plants to withstand drought. Stomatal closure may also be induced. Cycocel is beneficial to the plant's water status. Anti-transpirants are also helpful in preventing transplant shock in nursery plants.

Anti-transpirants have the following advantages:

- Toxicity-free
- Damage to the stomata mechanism should not be permanent.
- Effects only guard cells and not on other cells.
- The stomatal effect should last at least one week.
- Chemicals and materials should be inexpensive and easily accessible.

Role of Anti-Transpirants in Annual Field Crops

Field crops, in general, rely heavily on current photosynthesis for growth and final production. As a result, it's doubtful that a currently available anti-transpirant will boost an annual crop's yield unless the crop is stressed by a lack of water or a high evaporative demand, especially at a moisture-sensitive stage of development. Fuahring (1973) observed that spraying stomata blocking or film creating anti-transpirants on field grown sorghum under limited watering conditions increased grain yield by 5 to 17 percent, and that spraying anti-transpirants right before the boot stage was more effective than later treatments.

CONCLUSION

Anti-transpirants, or transpiration suppressant agents, not only reduced the rate of transpiration, but they also improved a variety of physiological attributes such as several vegetative and reproductive parameters, conferred disease resistance, improved qualitative characters, and, most importantly, greatly increased the yield and yield contributing traits in cereal crops.

Anti-transpirants such as stomatal closing (PMA 100-750 uM, potassium chloride 1 percent), film forming (chitosan 250 ppm, Nu-film 1 percent), reflectance type (Kaolin 3 and 6 percent), and growth retardant (cycocel 1000 ppm) have been found to improve various growth, qualitative, and quantitative characteristics.

REFERENCES

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