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Potential Role of Anti-Transpirants in Fruit Crop Production

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SUMMARY

Scarcity of water is a severe environmental constraint and being accepted as a major limitation in farming system. While, crop production is strongly associated with fresh-water resources for irrigation purpose thereby enormous pressure has been put on fresh-water because of increased demand and limited availability. The severity of drought is unpredictable as it depends on many factors such as occurrence and distribution of rainfall, evaporative demands and moisture storing capacity of soils. Therefore exploring a new strategy to minimize the excess loss of water from plants during drought conditions without reduction in crop growth and yield is of significant importance. One such strategy is utility of anti-transpirants in fruit crops.

INTRODUCTION

Anti-transpirants are the chemicals or minerals which decrease the evaporative water loss from the leaves by reducing the number and size of stomata. It can act as either physical or physiological barriers to water loss.

Mechanism of Anti-Transpirants in Reducing Transpiration Loss

- By reducing the absorption of solar energy and thereby reducing leaf temperatures and transpiration rates.
- By forming thin transparent films which hinder the escape of water vapours from the leaves.
- By promoting closure of stomata (by affecting the guard cells around the stomatal pore), thus decreasing the loss of water vapours from the leaf.

Types of Anti-Transpirants

Stomatal closing type

Most of the transpirantion occurs through the stomata on the leaf surface. These type of anti-transpirants induce the closure of stomata and reduce the rate of transpiration,a partial closure of stomata for 2 weeks. Since the stomata are made to close, the rate of CO_2 diffusion into the leaf is also reduced leading to low photosynthetic rates. Ex: Phenyl Mercuric Acetate (PMA) (Ahmed and Ahmed, 2014).

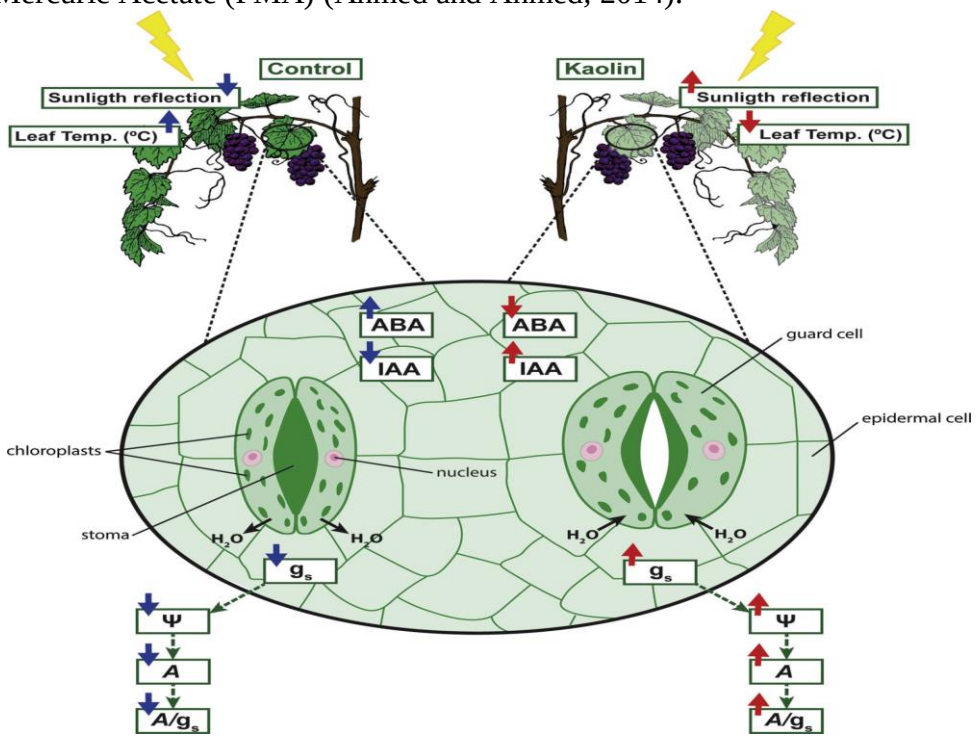

Fig. 1. Schematic representation of kaolin treated plant on stomata mechanism in grapevine (*Vitis vinifera*) .

Film-forming materials

This material provide a coating on leaf surface with wax, gel or plastics impeding excess water loss from leaves, and thus improving plant water status and increased growth under water stress condition. They allow CO_2 to pass into the leaf through lower epidermis (Saleh *et al.*, 2006).

The desirable characteristics of film forming type of anti-transpirants are:

- They should form a thin layer.
- They should be more resistant to the passage of water vapour than carbon dioxide and the film should maintain continuity and should not break.

Reflecting materials

Material such as kaolin, clay and chitosan, decrease leaf temperature by increasing leaf reflectivity, resulting in lower transpiration and higher water use efficiency. The water loss is reduced without affecting the CO2 assimilation. Eg: Kaolin, clay and chitosan (El Khawaga, 2013).

Growth retardant type

These reduce the shoot growth and increase the root growth and enable the plants to resist drought. They may also induce stomatal closure. Eg: Cycocel and ABA

Functions of reflecting anti-transpirants

- Reflects radiation falling on the leaf.
- Reduces heat load on leaf. - When heat load is reduced amount of water to maintain temperature is also reduced. Therefore water conservation occurs. Kaoline doesn't come in the way of any metabolic activity.

Classification of Anti-Tiranspirants

Materials causing stomatal closure

Herbicides like 2, 4 – D, Phosphon D and Atrazine

Fungicides like Phenyl Mercuric Acetate (PMA)

Metabolic inhibitors like hydroxy sulfonates, potassium metabisulphite etc.

Reflectant Types: Calcium carbonate, magnesium carbonate, zinc sulphate, kaoline, china clay, calcium bicarbonate and lime water etc.

Thin-forming chemicals: Paclobutrazol, brassinolide and resorcinol

Method of Applications

Foliar sprays

This type of application forms a thin film coating on the surface of leaf and inhibits the loss of water vapour from the leaf.

Soil drenching or application

When applied around the root zone of the plant as a soil application, it will conditioned the plant to raise its own natural abscisic acid (ABA) level, thus closing the stomata and putting the plant into a state of temporary drought resistance.

Features of Ideal Anti-Transpirants

- Non-toxicity.
- Non-permanent damage to stomata mechanism.
- Specific effect to guard cells and not to other cells.
- Effect on stomata should persist atleast for one week.
- Chemical or material should be cheap, readily available and eco-friendly.
- Should avoid from cold stress and heat stress

Role of Anti-Transpirants in Water Conservative Strategy

- Assured better crop growth and yield when no yields are expected under severe drought.
- Getting normal and better sized fruits.

- Saving the crop with marginal crop productivity under drought.
- Minimizing irrigation frequency and saving water through drip irrigation.
- Monitoring or managing drought.
- Very useful for farmers with minimum irrigation facilities.

Role of Anti-Transpirants in Fruit Crops

- Improves light scatter within the plant canopy, hence, increases the light absorption by the canopy.
- Increases the leaf area and other vegetative attribute thus, increasing the photosynthetic efficiency in fruit crops (Abd-El-Kader *et al*., 2006).
- Enhances the fruit size, fruit weight, yield and overall productivity of fruit crops Improves the fruit quality in terms of colour and biochemical parameters.
- Provides resistance towards fruit cracking, fruit sunburn and other physiological disorders.
- Reduces the water loss within the plants in arid and semi-arid regions.
- Enhances the drought tolerance by reducing transpiration water loss in fruit crops.

Trade name of anti-transpirants available in the market

Wilt-Pruf, Moisturin, Root-zone, Stasis, Vaporguard, Sunshield, Cryoshield and transfilm

CONCLUSION

Anti-transpirants not only reduce the rate of transpiration but alongside they plays an immense role in improving the various physiological attributes which involved several vegetative and reproductive parameters, impart disease resistance, improves tolerances towards abiotic and biotic stress, improve qualitative characters and most importantly tremendously enhanced the yield and yield contributing traits in fruit crops. Therefore, anti-transpirants could be one of the best approach to enhance crop productivity and quality fruits in an eco-friendly way. Hence, these will be of great boon to farmer to get more profit in fruit production.

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