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The Myth of Antitranspirants

"Antitranspirants prevent drought stress, especially in newly installed trees and shrubs"

The Myth

"Product X dries on plants to form a clear, glossy film that reduces water loss on plants while at the same time allowing them to breathe normally. Product X beautifies plants by polishing leaf surfaces."

"Product Y locks moisture and protects against winter kill, wind burn, and drought."

"Product Z is an antitranspirant and surfactant, which has been proved to minimise the impact ofdrought. Product Z is a balanced combination of amino acids, peptides and low molecular weight oligopeptides impregnated in a herbal based fatty alcohol series along with surfactants and biostimulant. Product Z imparts drought tolerance by reducing the rate of transpiration by regulating stomatal movements and increasing the rate of photosynthesis and carbohydrate reserves in roots. Proteins and peptides are complex structures playing a fundamental role in plant physiology. They function as growth activators in enzymatic systems and accelerate all the metabolic processes in the nutrient transformation."

Here are but three examples of products that promise to reduce water use and increase survival of landscape plants. (We're going to ignore the ludicrous claim that amino acids applied to leaves do anything but feed bacteria.) Antitranspirants are recommended for avoiding drought conditions induced by wind, high temperatures, or cold temperatures. They are extolled as effective disease controllers and aids to plant propagation. They are used to preserve cut flowers and Christmas trees. What's not to like?

The Reality

Antitranspirants can act as either physical or physiological barriers to water loss. The most popularly used antitranspirants are spray emulsions of latex, wax, or acrylic that form a film over the leaf surface and reduce water loss. Other physical barriers are solar reflectants, which reduce internal leaf temperature and thereby depress evapotranspiration. Physiological barriers are those chemicals that act as plant growth regulators and may close stomata or inhibit plant growth.

Applying these substances to plant leaves can have a significant impact on normal physiological function. Film-forming antitranspirants prevent evaporation by covering and clogging leaf stomata – the tiny pores on leaf surfaces. These pores have two functions: they create a gradient for water movement throughout the plant and they allow gas exchange between the plant and the atmosphere. Each of these physiological functions is vital to a plant's survival. The transpiration stream not only transports water through the plant, but root-produced growth regulators and soil minerals as well. Furthermore, water transpiration from the leaf surface aids in evaporative cooling of the leaves. Interfering with this normal and necessary process is harmful to the plant; the increase in internal leaf temperature has been documented to kill some plants.

The second vital function performed by stomates is gas exchange. In the daytime, carbon dioxide enters the leaf and oxygen exits; in the evening, the reverse occurs. This is erroneously referred to as "breathing" but the mental image of the effect on the plant is useful. Without carbon dioxide uptake, photosynthetic rate is depressed. Regardless of what advertisers claim, it is impossible to prevent water vapor movement through the stomates without impairing gas exchange.

The scientific literature on antitranspirants is robust; numerous antitranspirants have been tested for their effect upon desiccation, disease control, fruit production, transplant establishment, and weed control. Research has been conducted in the lab, greenhouse, nursery, and field on a variety of plants ranging from vegetable crops to house plants to fruit and timber species. Briefly, this is what recent research in the peer-reviewed literature has shown:

- **Disease control**: Antitranspirants had decreased or had no effect on bacterial and fungal diseases; helped reduce insect pests.
- **Fruit production**: Antitranspirants increased, decreased, or did not affect fruit splitting; decreased or did not affect marketable yield; increased water loss from fruit.
- **Heat or cold-induced desiccation**: Antitranspirants had no effect.
- **Root/tuber production**: Antitranspirants delayed or had no effect on growth of cuttings, improved accumulation of calcium in roots and tubers.
- **Transplant stress**: Antitranspirants increased, decreased, or had no effect on survival; increased, decreased, or had no effect on transpiration; increased, decreased, or had no effect on leaf water content; reduced growth rate; decreased height; increased or decreased fresh and dry weight; delayed leaf unfolding increased leaf drop; had no effect on root regeneration; decreased evaporative cooling and increased leaf temperature; depressed chlorophyll content.
- **Weed Control**: Antitranspirants decreased transpiration, increased leaf temperature, and thereby increased weed mortality.

Plants vary significantly in their abilities to control leaf water loss: cuticle thickness, leaf pubescence, cell wall thickness, stomatal conductance, stomatal density, stomatal location (upper, lower, or both leaf surfaces), and leaf angle are species specific and will influence water loss. Furthermore, environmental conditions vary significantly between controlled laboratory settings, greenhouses, and field situations. It's not surprising that research results have been contradictory.

Plants have survived the so-called "photosynthesis-transpiration compromise" for millions of years. Each species is adapted to the environmental conditions under which it evolved. If a plant suffers from extreme drought stress, it's likely that site conditions aren't optimal for that species. Interfering with the plant's ability to manufacture food by blocking stomates is only going to increase the stress load, which could be lethal to plants already shocked from transplanting or other environmental perturbations.

The Bottom Line

- There are no "miracle" antitranspirants; prevention of stomatal water loss increases heat load, inhibits gas exchange, and decreases photosynthesis
- Choose site-appropriate plants; know the water needs of selected species and plant accordingly
- Species with large thin leaves are more sensitive to water stress than those with small thick leaves or needles
- A little water stress is a good thing; it will help acclimate the plant to future drought
- There is no substitute for adequate soil water conditions
- Maintain adequate soil moisture in newly installed landscapes through mulching and other sustainable practices
- Maintain optimal soil temperatures through mulching; cooler soils have less evaporation

For more information, please visit Dr. Chalker-Scott's web page at http://www.theinformedgardener.com.