



Drought Tolerance Mechanisms for EMPIRE Turf™

EMPIRE Turf™ is a *Zoysia japonica* (Steud) bred and developed in Brazil, and introduced in the United States in the late 90s. EMPIRE Turf is a fast growing Zoysia and it was selected because it has wide leaf blades, thick stolons, strong rhizomes and deep roots.

EMPIRE Turf was also selected due to its great ability to survive long periods of drought or keep an acceptable color and quality with minimum water supply. EMPIRE Turf demands much less water compared to other turfgrass varieties.

Described below are some of the “built in” physiologic mechanisms that allow EMPIRE Turf to perform well during dry periods, using less water and coming back when normal water supply is restored after long drought periods.

Deep root system – Roots are the main engine for meeting transpirational demand, and play an important role in controlling plant water status to avoid drought injury. EMPIRE Turf is deep rooting, which facilitates the extraction of water from deep soil where such moisture is available. It also has the ability to shift the respiration rate and the carbon allocation from its roots close to the drying soil surface during drought to its roots in deeper and wetter soil. This adjustment helps sustain deep root growth, which in turn helps to maintain water uptake and prolong turf growth under drying conditions.



Roots are also important sites for the synthesis of abscisic acid (ABA). EMPIRE Turf’s deep roots produce plenty of ABA, which is transported to shoots and initiates a signal cascade in guard cells that alters the membrane transport of several ions. As a result, guard cells lose their turgescence and stomata close. Stomatas are leaf structures that have a “door” function. When stomata are open, the plant breathes normally and uses water; when stomata are closed, the plant breathes much less and uses much less water. EMPIRE Turf stomata respond quickly to dry conditions, closing and inducing the grass to demand less water to survive.

Leaf blades – EMPIRE Turf has leaves which roll under dry conditions, exposing less leaf surface to be in contact with dry air. This conserves moisture inside the plant more efficiently than many other grasses. Under continuing drought stress the leaves will turn brown and loose

their ability to produce carbohydrates through photosynthesis, inducing the plant to a dormant stage. It is what we call the EMPIRE Turf self-defense mechanism against drought. EMPIRE Turf will enter a dormant stage to protect itself against further damage, keeping alive only the essential structures: deep roots, rhizomes and stolons. This will provide re-growth and new leaf structures when water is supplied again.

Osmotic adjustment – One of the important mechanisms of drought tolerance is osmotic adjustment. When water deficit develops, various solutes accumulate in cells and subsequently tissue osmotic potential is reduced, which is defined as osmotic adjustment. EMPIRE Turf has an outstanding osmotic adjustment, playing an important role in plant tolerance to drought stress. Osmotic adjustment helps to maintain cellular turgescence, which delays wilting of the leaves to sustain growth and productivity at lower plant water status. The accumulated solutes EMPIRE Turf produces protect cellular protein, various enzymes, cellular organelles and cellular membranes against desiccation injury. The osmotic adjustment produced by EMPIRE Turf is crucial for maintaining the meristem viability under desiccation towards the recovery of its functions upon rehydration.

Drought-induced proteins – The alteration of protein synthesis is one of the fundamental metabolic processes that can influence drought tolerance. EMPIRE Turf shows a high accumulation of drought-induced proteins and many physiological adaptations to water limitation. Dehydrin proteins are a group of drought-induced proteins that accumulates under dehydration stress. They are hydrophilic and stable in the heat, protect other proteins and help maintain physiological integrity of cells during drought stresses.

EMPIRE Turf's deep root system allows it to seek available water under greater soil depths. Its "self-defense" mechanism against drought puts EMPIRE Turf in a protective dormant stage. Its osmotic adjustment, along with the drought-induced proteins, help maintain the cell integrity, providing the basis for a fast recovery after the drought period is over. These improved physiological characteristics help EMPIRE Turf to reduce water needs under drought stress and to recover quickly after normal water supply is made available.

EMPIRE Turf is a great water saver, coming back much quicker after extended drought periods when compared to other grasses.

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