Turf Response to Water Deficit

In order to reduce water loss, an early response by plants to internal water deficit is stomatal closure. This normally occurs during peak water demand periods. After these environmental stresses subside, stomata usually reopen. Under extreme conditions, stomata may close for extensive periods, which in turn affects further plant functions.

Stomata are major vapor-gas exchange sites from the leaf to the atmosphere. If closed from water deficit, carbon dioxide exchange from plants and the atmosphere is inhibited, as is the diffusion of water vapor. This, in turn, reduces photosynthesis and eventually retards leaf growth and emergence. Over time, turf density will decline from this reduction in leaf growth, emergence, and tillering.

Water stress has less immediate effects on root growth. Plants tend to have continued root growth relative to shoot growth during periods of water stress. This results in an increase in the root-to-shoot ratio and is an important mechanism for avoiding drought stress. Turf managers should maximize root systems by lengthening the interval between irrigations. Excessive soil pH, salinity, nitrogen levels, potassium deficiency, or improper mowing height and frequency can limit root growth and can decrease plant tolerance to increasing moisture stress.

Environmental Influence on Evapotranspiration

Environmental parameters are the controlling influence of plant ET. These include relative humidity, temperature, and wind. Of these, solar radiation is the driving force for evaporative demand by stimulating stomata opening. Cloudiness can decrease ET by blocking incoming radiation.

Atmospheric relative humidity and wind velocity also influence ET rates. As air becomes more saturated at higher humidities, the vapor pressure gradient between leaves and air is reduced, resulting in less ET. Under calm air conditions, the existing vapor pressure tends to form an external layer adjacent to the leaf called the *boundary layer*. The boundary layer, if not disturbed, acts as an insulator by protecting the leaf from sudden vapor pressure changes, and thus reduces ET. However, with increasing wind, the boundary layer decreases and ET increases. As a result, ET rates tend to increase with higher temperatures, light, and wind, but tend to decrease with higher atmospheric relative humidity and cloud cover. Minimal ET rates occur when there are dark, cloudy days with high relative humidity, low temperatures and little wind. Conversely, highest ET rates occur on bright sunny days with low relative humidity, high temperatures, and moderate to high winds.

TURFGRASS EVAPOTRANSPIRATION RATES

Many studies have been performed comparing the relative ET rates of various turfgrasses. Warm-season turf water use rates typically range from 0.1 to 0.25 inches per day, with maximum values reported as high as 0.47 inches per day under exceptionally high evaporative demand. Table 1 summarizes the reported summer mean ET rates by turfgrass species. In general, the major considerations contributing to low water-use rate by a turfgrass are its ability to maintain a dense shoot coverage, slow vertical leaf growth rate, narrow leaf width, horizontal leaf orientation, and color. As discussed, cultural practices and environmental parameters also have considerable influence on each of these contributing factors. It is interesting to note that on a similar leaf index area, turfgrasses generally are no different on their ET rates than other plants used in Florida, such as citrus or forests, and may be less than others, such as sawgrass. Again, it bears repeating that climate conditions control ET and not always the plant species, provided there is a continuous canopy or coverage of the soil surface and water is readily available.

Table 1. Generalized mean summer evapotranspiration rates of turfgrasses.

Turfgrass	ET Rates	
	In/wk	**mm/day**
Bahiagrass	1.7	6.2
Bermudagrass	1.0-2.0	4.0-8.7
Buffalograss	1.5-2.0	5.3-7.3
Centipedegrass	1.5-2.3	5.5-8.5
Creeping bentgrass	1.3-2.7	5.0-9.7
Kentucky bluegrass	1.1-1.8	4.1-6.6
Perennial ryegrass	1.8-3.1	6.6-11.2
Seashore paspalum	1.7-2.2	6.2-8.1
St. Augustinegrass	1.7-2.6	6.3-9.6
Tall fescue	2.0-3.5	7.2-12.6
Zoysiagrass	1.3-2.1	4.8-7.6

Cool-season turfgrasses have the C_3 pathway of carbon fixation or photosynthesis while warm-season grasses utilize the C_4 pathway. Cool-season turfgrasses thus have a higher CO_2 compensation point.