TURFGRASSES
AND
WATER CONSERVATION ISSUES

In recent national headlines, there have been allegations that turfgrass culture has a major role in adversely increasing water use. It is important to address these allegations and to identify those that can be supported by sound scientific data in order to make the adjustments needed to eliminate or minimize any potential problems. At the same time it is necessary to nullify those unfounded allegations that are based on speculative pseudo-scientific information.

Conservation of water has become an issue, not only in the arid regions of the world, but also in many densely populated urban areas that do not have adequate reservoir supplies as a contingency when extended droughts occur. Considering all uses for water in the USA, the average person directly or indirectly uses between 1,800 and 2,000 gallons per day (6813 and 7570 L d^{-1}) (Rossillion, 1985). To put this in perspective, this is more than applying 1-inch (25 mm) of water across a 1000 sq. ft. (92.9 m^{-2}) lawn each day for a year. Industry accounts for 43% of the water use, agricultural irrigation for 47%, and domestic use in cooking, bathing, sanitation, drinking, and landscape irrigation for the remaining 10%. Decisions concerning the most effective programs to reduce water use should consider these data. A primary concern that is seldom mentioned is the actual water leakage loss rate of municipal water distribution systems.

Zeriscape Concept Validity?

The original xeriscape group and others have actively promoted the reduction of turfgrass areas and their replacement with trees and shrubs as an urban water conservation measure (Beard, 1993). Statements have been made in widely distributed nonscientific publications such as all turfgrasses are higher water users than trees and shrubs. There are no published scientific data available to support this allegation. In fact, the limited experimental data available suggest the opposite position. What then is known?

Comparative Evapotranspiration Rates

Very few of the many hundreds of tree and shrub species-cultivars have actually been quantitatively assessed for their evapotranspiration (ET) rates. In contrast, a major portion of the turfgrass species-cultivars have been assessed for their evapotranspiration rates. There are bermudagrass (*Cynodon* spp.) cultivars with evapotranspiration rates of < 0.1 inch per day (3 mm d^{-1}), whose evapotranspiration rates are 50% lower during dry-down periods between irrigations or rain (Beard, 1990). If one compares the few evapotranspiration studies that are available, typically trees and shrubs are found to be higher water users than turfgrasses on a per unit land area basis (D. Devitt, 1993), personal communication). This is based on the sound premise that the evapotranspiration rate increases with leaf area when under a positive water balance (Johns, Beard and van Bavel, 1983; Kim and Beard, 1987). Note that the major grasslands of the world are located in the semiarid regions, whereas the major forests of the world are located in high rainfall areas.

Much confusion has arisen from the "low water use landscape plant lists" from the xeriscape groups that have been widely distributed. The lists are based on the incorrect assumption that those plants capable of surviving in arid regions are low water users, when these plants typically are only drought resistant. When these species are placed in an urban landscape with drip or other forms of irrigation, many become high water users. This occurs because the physiological mechanisms controlling evapotranspiration and drought resistance are distinctly different and can not be directly correlated within a plant species or cultivar (Beard, 1989).

It also should be noted that when turfed areas are irrigated, the adjacent trees and shrubs also are being irrigated as a result of the multitude of shallow tree and shrub roots that concentrate under the irrigated turf area. Thus, when a home owner is irrigating the lawn, most of the adjacent trees and shrubs also are being irrigated.

Comparative Dehydration Avoidance and Drought Resistance

For unirrigated landscape sites, detailed assessments have been conducted of drought resistance and dehydration avoidance for many turfgrass species and cultivars (Sifers, Beard and Hall, 1990). The results have shown that a number of turfgrass genotypes possess superior dehydration avoidance and can remain green for more than 158 days in a high-sand root zone without irrigation under the hot summer conditions in College Station, Texas. Comparable detailed studies of dehydration avoidance and drought resistance among tree and shrub species are lacking.

Numerous turfgrass species are capable of ceasing growth, entering dormancy, and turning brown during summer drought stress, but they readily recover once rainfall occurs (Sifers, Beard and Hall, 1990). Some people incorrectly assume that turfgrasses must be kept green throughout the summer period to survive, and thus will irrigate. Many trees drop their leaves during summer drought stress or during the winter period when only brown bark remains. What then is wrong with a tan to golden-brown, dormant turf during summer droughts, if one chooses not to irrigate? If water conservation is the goal, then a dormant turf uses little water.

Mulching Fallacies. Zeriscape advocates propose the replacement of turfgrasses with a mulch cover and then planting landscape shrubs within the mulched area as a water conservation measure. Some mulches do reduce evaporation of moisture from the soil. However, the presence of a mulch increases the radiant energy load on the under side of deciduous shrubs and trees, which have a majority of their stomata on the undersides of the leaves. This in turn substantially increases the evpotranspiration rate. For example, detailed studies revealed that crape myrtle (*Lagerstroemia indica* L.) grown on a mulched surface used 0.63 to 1.25 kg m^{-2} per day more water than those located in a bare soil, and 0.83 to 1.09 kg m^{-2} per day more water than crape myrtle located in a bermudagrass (*Cynodon* spp.) turf (Zajicek and Heilman, 1991). Further, crape myrtle located on bare soil used 0.2 kg m^{-2} per day more water than when growing in a bermudagrass turf. Sensible heat and long wave radiation from the mulched area increased plant temperatures and thus the leaf air vapor pressure deficit and associated transpiration rate. Thus, replacing turfs with a mulch-shrub landscape can actually increase water use.

In summary.

There is no valid scientific basis for water conservation strategies or legislation requiring extensive use of trees and shrubs in lieu of turfgrasses. Rather the proper strategy based on good science is (a) the use of appropriate low-water-use turfgrasses, trees, and shrubs for moderate-to-low irrigated landscapes and similarly (b) to select appropriate dehydration-avoidant and drought-resistant turfgrasses, trees, and shrubs for nonirrigated landscape areas.

The main cause for excessive landscape water use in most situations is the human factor. The waste of water results from improper irrigation practices and poor landscape designs, rather than any one major group of landscape plant materials.

What is the future?

Great natural genetic diversity exists among turfgrass genotypes in terms of both low evapotranspiration rates and superior dehydration avoidance/drought resistance (Beard, 1989). Applying appropriate breeding techniques should achieve even lower water use rates among the currently used turfgrass species and cultivars. Unfortunately, efforts by turfgrass breeders in addressing these water conservation issues have been very limited.

Avoid Single Issue Approach

There is one caution as we strive for low evapotranspiration rates. One must avoid a narrow, single-issue emphasis that ignores the potential effects of a lowered evapotranspiration rate on the total urban ecosystem. Urban areas already suffer from substantially higher temperatures of 10 to 12°F (6-7°C) when compared to adjacent rural areas. Lowering the evapotranspiration rate through plant material selection and judicious irrigation will reduce transpiration cooling, and increase the heat loads on residences and buildings, thereby increasing energy requirements for interior mechanical cooling. Depending on the relative costs and availability of water versus energy, it may be wise in certain urban areas not to strive for the lowest possible water-using landscapes. Here again, detailed scientific investigations will be required to develop appropriate definitive strategies that take into consideration the total effects on all components within the urban ecosystem.

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