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Turfgrass Shade Adaptation

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The sun is the energy source that supports life on earth, including turfgrasses. The radiant energy is converted to chemical energy in green plants by photosynthesis. In the case of mowed turfgrasses, they are capable of absorbing and converting to chemical energy only 1 to 2% of the total incident solar radiation. Thus, a major portion of the incident radiant energy is absorbed and reradiated at longer wavelengths with the release of heat.

Shade. Studies in a number of states reveal that home owners rank shade as the number one problem in growing turfgrasses. It is estimated that between 20 and 25% of the lawn turfs in the United States are grown under some degree of tree or structural shade stress. Obviously, the problem becomes more severe in older residential areas as the trees grow and mature. Another shade stress aspect is an increase in the construction of tall, erect stadia and partially-roofed, fully-roofed, or retractable-roofed stadia, where turfgrasses are to be propagated.

Radiation Assessment. In the past, light intensity has been used when referring to plant requirements. However, **the more appropriate terminology for the receipt of radiation on the surface of the turfgrass canopy is irradiance,** which is defined as the radiant flux density or energy received on a specified surface and expressed in energy units of watts per square meter (Wm^{-2}). **A preferred, more specific term is photosynthetically active radiation (PAR),** which is the radiation in the photosynthetically active portion of the spectrum, from 400 to 700 mm. A typical PAR under direct sunlight is 400 Wm^{-2}.

Unfortunately, many architects involved in the construction of stadia where shade is a concern in turfgrass propagation fail to use the proper energy terms and measurements. They tend to use **illuminance,** which is the luminance flux per unit area on an intercepting surface at a given point. It is typically used in relation to quantifying lighting requirements for human activities, such as for recreational and sporting facilities, and especially where the event is televised. The standard unit of illumination flux is the **lumen.** To reemphasize, **it is incorrect to use illuminance in assessing the radiation energy requirements of turfgrasses in shaded environments.**

SHADE MICROENVIRONMENT

Shade alters the microenvironment in which turfgrasses must grow. **The most obvious change is a reduction in irradiance. However, a number of other important microenvironmental factors must also be considered in turfgrass shade ecology.** One of the few published comparative quantitative characterizations of the altered turf-level microenvironment under a tree monostand is shown in Table 1.

In addition to the direct blockage of incident solar radiation by the above tree canopy, there is also the reduction in radiant energy caused by **an alteration in light quality.** In the case of tree shade, there is selective screening of the blue and red wavelengths, with a higher per-

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