With Light as the Deciding Factor

BY KARL DANNEBERGER

IN THE ONGOING FIGHT BETWEEN BENTGRASS AND ANNUAL BLUEGRASS, THE SUN INFLUENCES THE OUTCOME

Sunlight is ubiquitous in our everyday lives. Like many things that are repetitive, we take it for granted, unless we're trying to plan a vacation or are hoping for a big golf weekend.

In nature, the repetitive quality of sunlight is what sustains life. Plants capture light and convert it into a usable form through the process of photosynthesis. In ecology, light is a resource, like water or nutrients that can occur at excessive or deficient levels that limit the ability of plants to achieve optimal photosynthesis.

At excessive levels, or at light saturation, the photosynthetic rate doesn't increase. At low levels, the plant is not receiving enough light to achieve a desired level of growth and development.

Radiant energy, which includes gamma rays, X-rays, ultraviolet light, visible light, infrared light, microwaves and radio waves, travels from the sun to Earth in elementary particles called photons. The discrete packets of energy contained in a photon are called quanta.

Plant pigments (chlorophyll) absorb the packets of energy within the light spectrum (400 nanometers to 700 nanometers). This photosynthetically active radiation is expressed on a quantum basis — mol m-2 s-1 (moles per meter squared per second) or µmol m-2 s-1 (micromoles per meter squared per second). How we express this radiation is called Photosythnetic Photon Flux Density (PPFD).

Now, why would I go through this arduous explanation of PPFD and subject you to old classroom memories? For two reasons, the first of which is to re-emphasize that this energy is a resource the plant needs and might get it at levels that are too low or too high. The second — in the ongoing fight between creeping bentgrass and annual bluegrass in golf course turf — light influences the outcome.

The photosynthetic saturation points differ between warm- and cool-season turfgrass. At sea level, photosynthetic light intensities can reach 1,800 to 2,300 µmol m-2 s-1 on a cloudless day (Fry and Huang, 2004). For cool-season turfgrass, the saturation point ranges from 534 to 1,072 µmol m-2 s-1 and ranges from 1,794 to 2,139 µmol m-2 s-1 for warm-season turfgrass.

The saturation point is determined by PPFD and plotted against the carbon dioxide exchange rate (CER). For creeping bentgrass and annual bluegrass, the saturation point is close to 1,000 µmol m-2 s-1 (Gaussoin, et al., 1988). Given factors such as temperature, photoperiod and variable cloudiness will effect CER. On average, annual bluegrass has a 25 percent higher assimilation rate than creeping bentgrass (Gaussoin, et al., 1988).

In shaded environments, the ability of a turfgrass plant to survive at low light levels is based on two measurements called light compensation point and carbon dioxide compensation point. Although measured slightly different, the compensation point in both instances is where photosynthesis (capture of energy) equals respiration (energy use).

In nature, plants that adapt to sunny environments have four to 10 times higher compensation points than shady plants. This is because of the extremely low respiration rates of shady plants under low light conditions. When comparing the carbon dioxide compensation point between creeping bentgrass and annual bluegrass compensation points, specifically the carbon dioxide compensation point, annual bluegrass was 12 percent lower (Gaussoin et al., 1988).

So where are we in this discussion? Based on light, annual bluegrass is 12 percent to 25 percent more competitive than creeping bentgrass under average/ideal temperatures and/or shaded environments. Thus, this contributes to the competitive advantage that annual bluegrass has on golf courses in the cool-temperate regions, and in areas where shade tends to predominate in turf.

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