Burning the Candle At Both Ends

High temperatures and low cutting heights lead to a dead end!

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CREEPING BENTGRASS grows vigorously when air and soil temperatures are within its preferred range. During July and August, when temperatures increase to 90°F or higher, new root production slows, many roots die, and the turf canopy may thin and turn brown. This decline in quality is a primary concern of golf course superintendents in the southern and transition zone states.

The researchers at Kansas State University have conducted a series of experiments over two years that have documented the effect of temperature and cutting height on the physiology of Penncross creeping bentgrass.

Temperature

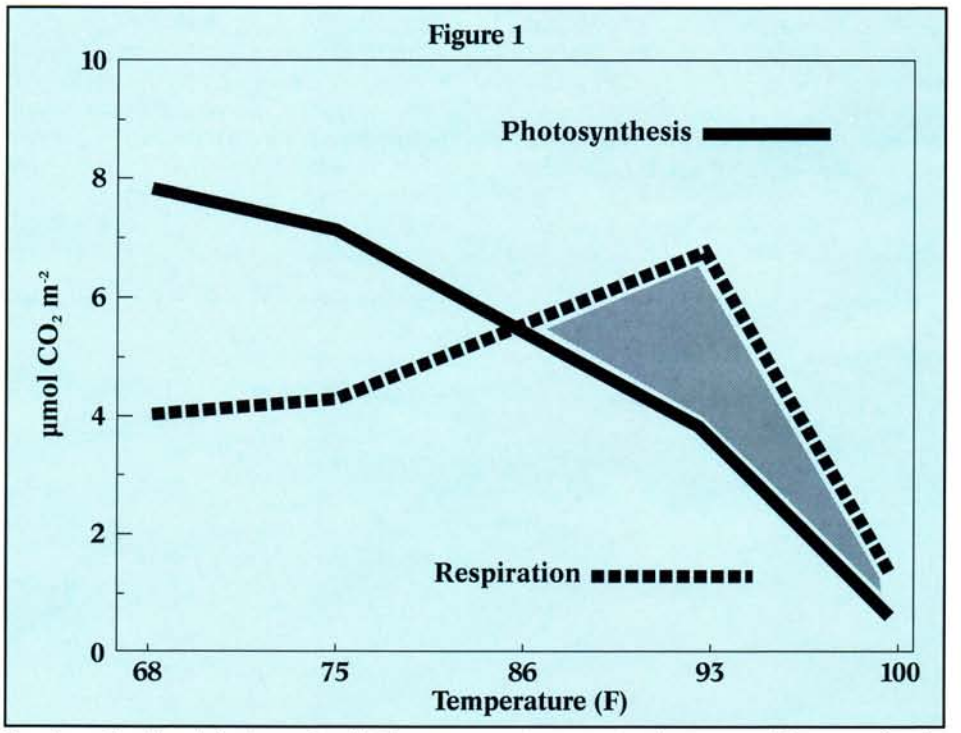
Figure 1 describes the relationship between temperature and carbon dioxide (either fixed by photosynthesis or consumed by respiration). Photosynthesis is the measure of the amount of energy, or food, that the bentgrass plant produces from sunlight. At low temperatures, the bentgrass plant is capable of producing an adequate amount of energy or food. However, as the temperature increases, photosynthesis declines, and the amount of energy available for vital life functions continues to decrease.

The surprising result from the Kansas State University research is that the respiration rate, or the amount of energy consumed by the plant, increases as soil temperature increases. This leads to the dilemma of "burning the candle at both ends" because the leaves produce less energy while the plant demands even higher amounts. Ultimately, this can lead to a total collapse of the biological processes in the bentgrass plant.

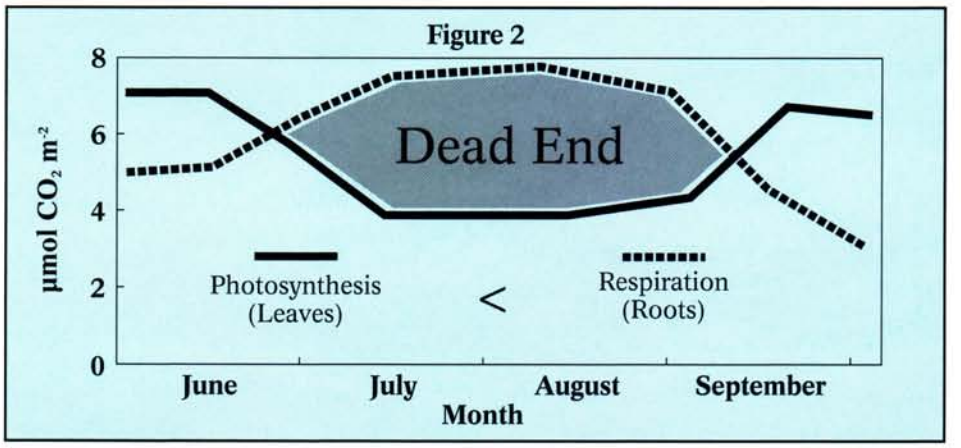
Effect of Summer Temperature

To illustrate what happens during the summer, photosynthesis and respiration are graphed in Figure 2. Photosynthesis in the leaves is the amount of energy, or carbon dioxide, that the plant fixes into food for respiration. In June, everything is going along smoothly when temperatures are below 90°F. However, in July, the temperature begins to warm and photosynthesis starts to decrease. This lower rate of photosynthesis continues throughout the hotter months of July and August. Finally, in September, photosynthesis increases in response to lower temperatures.

In Figure 2, respiration, or energy consumption, is illustrated. In June, respiration is less than photosynthesis. However, as temperature increases, respiration increases to a level higher than the amount of energy produced by photosynthesis. This continues throughout the summer months. Again, when temperatures cool in the fall, respiration returns to a level below photosynthesis. Unfortunately, there is a two-month period when the bent-



Food production (photosynthesis) decreases as temperature increases. However, food consumption (respiration) in the bentgrass roots increases as temperature increases. When food consumption exceeds food production, starvation results and bentgrass decline is inevitable.



There is a period during the summer months when food consumption (respiration) exceeds food production (photosynthesis). It is during this time that putting greens are most susceptible to other climatic stresses and disease.

grass plant uses more energy than it can produce. During this time putting greens are most susceptible to the other climatic stresses or disease.

Cutting Height

The cutting height of the putting green has a significant effect on bentgrass physiology during the summer. Figure 3 compares different cutting heights over the 1997 and 1998 summers. Regardless of cutting height, bentgrass photosynthesis declined to the lowest levels in July and August. However, turf cut at ⅛ of an inch was more adversely affected than that cut at 5/32 of an inch.

A ⅛ of an inch cutting height reduced photosynthesis by removing a large amount of leaf surface area. In 1998, bentgrass cut at 5/32 of an inch had a higher rate of photosynthesis than respiration, even during the hottest periods. This resulted in the production of additional carbohydrates, which prevented bentgrass starvation and allowed maintenance of shoot and root growth. The results indicate that food consumption is much more likely to exceed food production during the summer months if the cutting height is less than 5/32 of an inch.

Others have suggested that additional leaf tissue, under higher cutting heights, imposes additional stress on roots that supply the leaves with water and nutrients. However, the results presented in this article demonstrate that raising the cutting height by only 1/32 inch during the summer had a significant positive effect on bentgrass physiology.

Conclusion

It is essential that all plants maintain a level of photosynthesis (food production) that is equal to or greater than respiration (food consumption). When food consumption exceeds production, starvation results and decline will occur if this imbalance continues for too long.

Preventing summer bentgrass decline remains a challenge to golf course superintendents where high summer temperatures are common. Mowing at the highest acceptable height in midsummer will allow bentgrass plants to maintain the needed balance between food production and consumption. If you are not doing so now, monitor soil surface temperature throughout the summer. Discuss with your golfers the need to increase food production (photosynthesis) by increasing cutting height when the soil surface temperature is greater than 90°F. Use this information to help explain that high temperature and low cutting height can lead to a dead end because the bentgrass plant is *burning the candle at both ends.*

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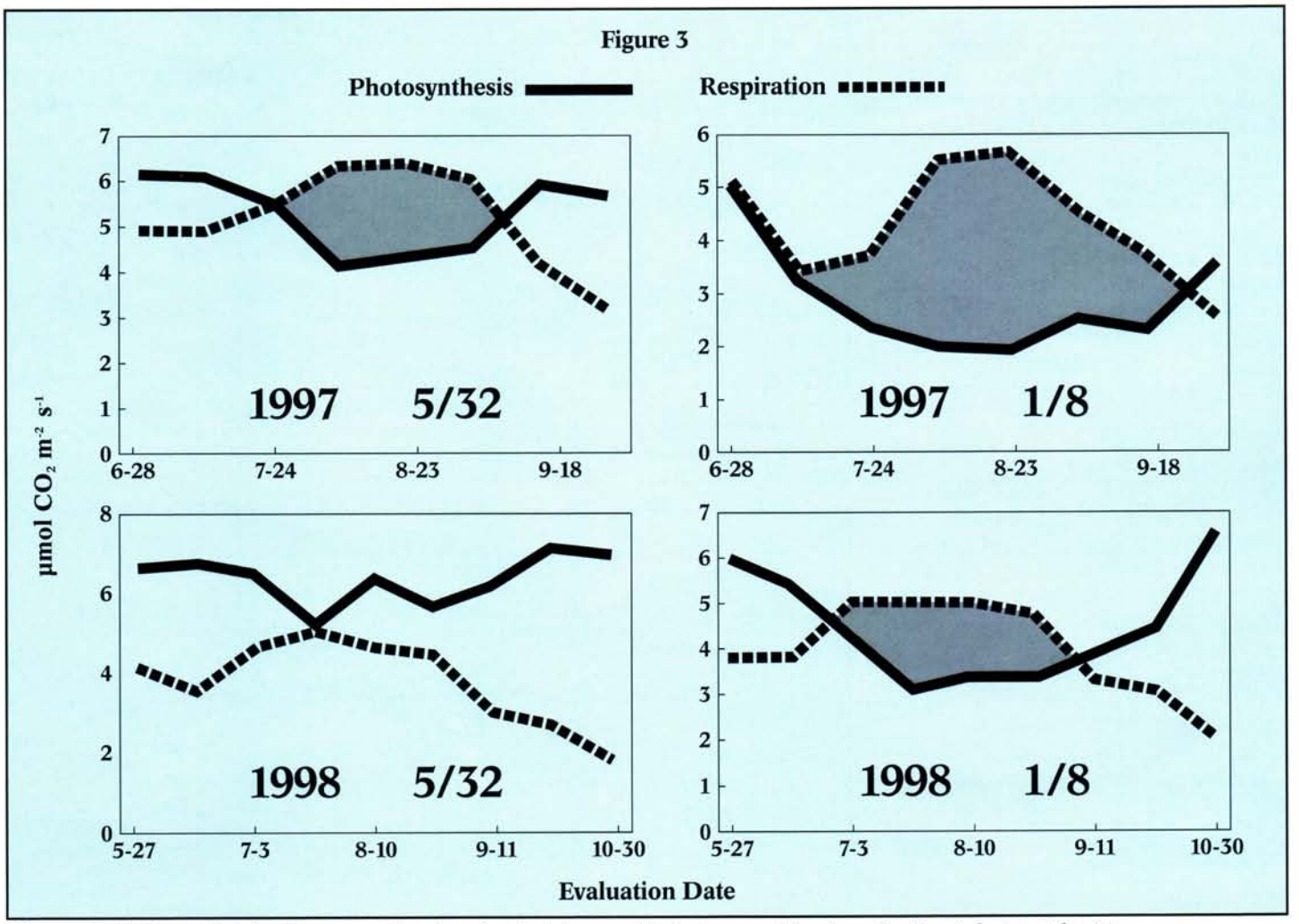
Figure 3



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