

Mowing Frequency Affects Creeping Bentgrass Health

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Frequent mowing is necessary to maintain uniform playing surfaces for sports turf areas. However, mowing wounds grass plants, creating openings that facilitate water loss and that are susceptible to entry of disease-causing organisms. Plants respond to wounding by increasing production of hydrogen peroxide. This is the same chemical used as a disinfectant to treat cuts and scrapes. Hydrogen peroxide regularly is produced by plants in low concentrations as a byproduct of photosynthesis and other metabolic reactions; however, production of hydrogen peroxide increases substantially after wounding.

Hydrogen peroxide plays an important role in many responses to wounding. Hydrogen peroxide acts as a signal to kill damaged tissue near cut leaf tips. This is similar to formation of scabs on our own bodies. Scabs form a cover to stop blood loss and provide a barrier to infection. In plants, hydrogen peroxide-mediated cell death near the cut leaf tip limits water loss and entry of disease-causing fungi. Mowing removes leaf tissue used for photosynthesis and food production; therefore, grasses must temporarily limit growth to conserve energy. Hydrogen peroxide also acts as a signal to slow cell division and induces accumulation of plant hormones that reduce growth and allows grasses to better adapt to limited energy production.

High concentrations of hydrogen peroxide are toxic to plant cells, and ultimately will result in cell death if not removed. Plants have developed enzymes that detoxify hydrogen peroxide to limit cell damage. Catalase is an important hydrogen peroxide detoxification enzyme. Unfortunately, the activity of catalase is reduced in severely wounded tissue, which may result in accumulation of hydrogen peroxide and extensive damage or even death.

Grasses often are double-cut to improve the uniformity and visual appearance of the playing surface. However, multiple-cuttings likely are more stressful to the plant than single-cuttings and may limit the vigor and recuperative potential of mown grasses. The objective of this study was to determine the activity of catalase and photosynthetic efficiency over time in double-cut, single-cut, rolled, and uncut grasses.

Results and discussion

The activity of catalase consistently was lowest in grasses that were double-cut and highest in uncut grasses (Fig 1). Catalase activity also was reduced in single-cut grasses, although the magnitude was not as great as the reduction observed in double-cut grasses. The largest reduction of catalase enzyme activity in both single- and double-cut grasses occurred 12 hours after mowing. Coupled with a decrease of catalase enzyme activity in mown grasses is an increase in production of hydrogen peroxide. This may result in increased levels of hydrogen peroxide and the associated reduction in plant growth and initiation of cell death. The additive stress of multiple cuttings may contribute to slower growth and vigor of grasses in the clean-up pass or in overlap areas between successive mower passes or cutting units.

Photosynthetic Efficiency

Photosynthetic yield is a measurement of the light use efficiency of a plant, i.e., the percentage of absorbed light energy that is used to form chemical bonds and not fluoresced or released as heat. A large photosynthetic yield value indicates low levels of stress, whereas a smaller value indicates that photosynthetic components have been damaged and that the plant is under stress. Photosynthetic yield was highest in uncut and rolled grasses, whereas photosynthetic yield consistently was lowest in double-cut grasses (Fig 2). Reduced photosynthetic yield in double-cut grasses is likely the result of high concentrations of hydrogen peroxide caused by increased production in wounded tissue and decreased removal because of limited catalase activity. Photosynthetic yield also was reduced in single-cut grasses, although the duration and magnitude was not as great as the reduction observed in double-cut grasses.

Take home message

Multiple-cuttings damage grasses more than a single-cut or rolling. Although double-cutting can be used to create better playing surface uniformity and playability, caution should be used especially during adverse environmental conditions. Grasses that have been double-cut may be less vigorous in growth and more susceptible to other stresses.

Materials and methods

Eighty-four pots of 'L-93' creeping bentgrass (*Agrostis stolonifera* L.) were established on sand and grown in a growth chamber with PAR of 500 $\mu\text{mol m}^{-2} \text{s}^{-1}$ for a 16 hour photoperiod (0600-2200). Temperatures were 70/60 °F (day/night). Sand was fertilized weekly with a modified Hoagland's solution. Grass was mowed three times weekly at a height of 1.3 cm (0.5 in) with an electric walk-behind greens mower (Toro, Minneapolis, MN).

Treatments were applied on the third day after the previous mowing. Leaf tissue was collected 0, 3, 6, 9, 12, 15, and 24 hours after application of treatments. Enzymes were extracted with a potassium-phosphate buffer (pH 7.0). Catalase activity was determined as described previously by Change and Maehly. Photosynthetic yield was measured by using a chlorophyll fluorometer (Walz, Germany). The study was in a completely randomized design with three replications per treatment. Data were analyzed by using the MIXED procedure of SAS (Cary, NC).

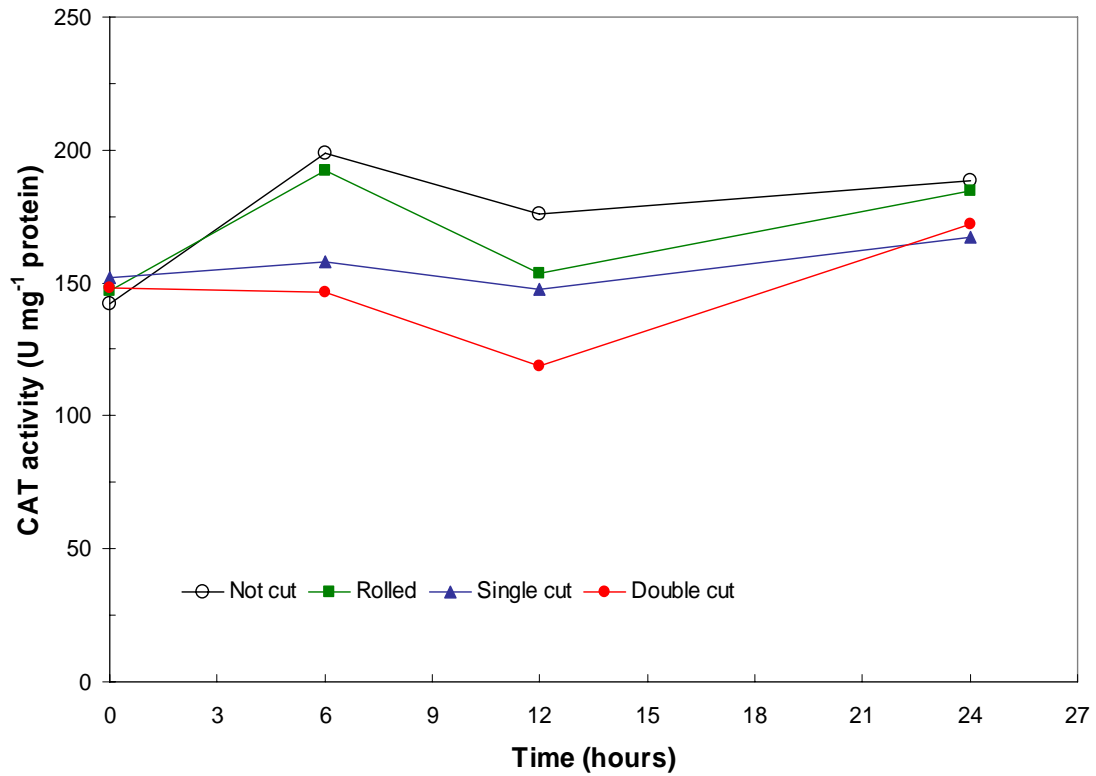


Figure 1. Catalase activity of uncut, rolled, single-cut, and double-cut creeping bentgrass over time after mowing. Plants, when wounded, increase production of hydrogen peroxide that is toxic to plant cells. Catalase is an enzyme that detoxifies hydrogen peroxide. Decreased activity of catalase in single- and double-cut grasses may result in accumulation of hydrogen peroxide.

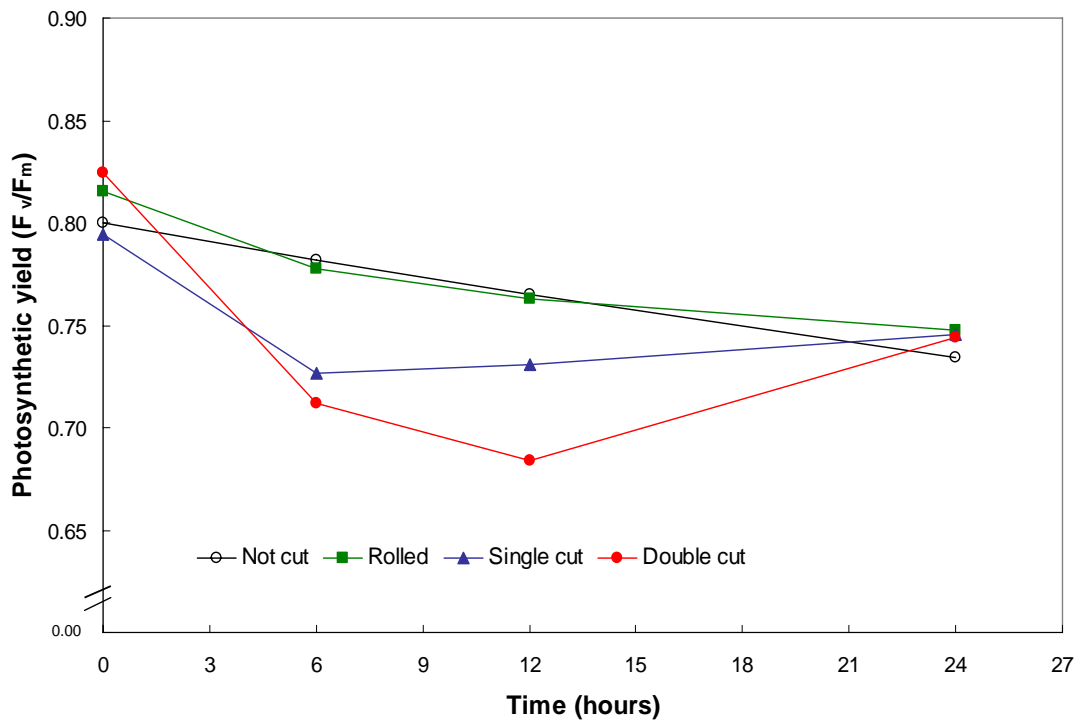


Figure 2. Photosynthetic yield of uncut, rolled, single-cut, and double-cut creeping bentgrass over time after mowing. Photosynthetic yield is a measure of stress. Smaller values indicate reduced efficiency of photosynthesis and greater stress.