TURFGRASS TRENDS

FERTILITY AND STRESS

Fertility Optimization Vital to Help Turf Recover From Traffic

By J. S. Ebdon, L. Hoffman and M. DaCosta

Turfgrass function and quality are affected by wear and soil compaction, the two major components of traffic stress. With increased traffic, there's an increasing need for fertility programs that maximize wear tolerance and recovery under intensely trafficked conditions.

Perennial ryegrass is commonly used on golf courses grown in cool-season climates because of its excellent wear tolerance. Nitrogen (N) and potassium (K) are frequently applied nutrients to golf courses, but little is known about their influence on wear tolerance and recovery.

There has been little agreement from species to species as to the optimum N and K levels for achieving maximum wear tolerance. Optimum N for maximum wear tolerance varies with the species.

Increased shoot density with N provides more tissue (cushioning or resiliency) available to absorb the impact of the injury caused by wear. Nitrogen can promote an increase in wear tolerance up to some critical threshold beyond which wear tolerance can decrease. In perennial ryegrass, optimum N when applied alone following wear was found to be about 4.5 pounds of nitrogen per 1,000 square feet per year.

In recent years, there has been a trend by practitioners towards applying relatively high rates of K equal to or exceeding N. The effect of K, however, on overall wear tolerance is unclear. Wear tolerance in creeping bentgrass increased with K with the largest increase in wear tolerance occurring with 5.5 to 7.5 pounds of K per 1,000 square feet per year. However, numerous studies have reported no effect of K on wear tolerance.

This lack of agreement as to optimum fertility may be because of the effects nutrients have on turfgrass growth when applied alone. They can be distinctly different when applied in various combinations with other major nutrients.

Accordingly, wear studies investigating N applied alone may have little relevance to N applied in combination with K. The objectives of this research was to compare the effects of N and K on wear tolerance and recovery in perennial ryegrass

N and K treatments

This study was conducted at the University of Massachusetts Amherst, Joseph Troll Turf Research and Education Center (South Deerfield, Mass.). Perennial

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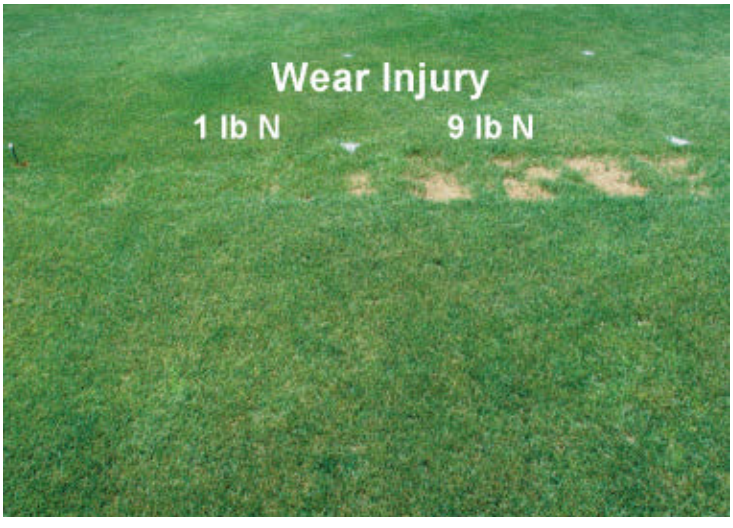
ryegrass (Brightstar) was established Aug. 4, 2004, and fertilized using 15 N-K treatments that were initiated in April 2000. The N-K treatment combinations included five rate levels of N (1, 3, 5, 7 and 9 pounds per 1,000 square feet per year) with urea (45-0-0) as the sole source of N.

Potassium sulfate (0-0-50) was used as the sole source of K and was applied at three rate levels (1, 5 and 9 pounds per 1,000 square feet per year) in all combinations with N. Treatments were arranged as a randomized complete block design with four replicates.

Monthly fertilizer applications are generally applied during the last week of each month. Approximately 60 to 70 percent of the total annual N was applied during the fall period from late August through late November. Applications made in November were applied after the last mowing when shoot growth had ceased.

Treatment plots were 5 feet by 10 feet and were mown twice per week at 1.25 inch height of cut using reel mowers. Clippings were returned except when collections were made for growth determinations. A total of four clipping collections were made in each year of 2006 and 2007, which included the months of May, June, September and October.



In studies, 1 pound N per 1,000 square feet per year (shown to the left) was adequate for wear tolerance, but shoot growth and recovery from wear was too slow. Conversely, 9 pounds of N per 1,000 square feet per year (shown to the right) following simulated wear was excessive and caused significant wear injury. But shoot growth and recover was rapid. Optimum N for wear tolerance and recovery in perennial ryegrass is about 5 pounds of N per 1,000 square feet per year.

May and June collections were averaged and represented spring yields while September and October averages represented fall growth rates. Clippings were oven dried at 70 degrees Celsius for 48 hours, weighed and expressed as grams of dry weight per meter per day.

The wear simulator used was a differential slip-wear (DSW) machine developed according to the design by the Sports Turf Research Institute. The wear simulator was designed to create a scuffing action, while minimizing pressure to the soil, therefore limiting soil compaction.

A cumulative total of 150 passes were applied on June 22 and June 23, 2007. Recovery was rated at two weeks after treatment (2WAT), 4WAT, 8WAT, 12WAT and 16WAT following DSW in 2006. In 2007, recovery ratings following DSW are reported at 2WAT, 4WAT, 8WAT, 12WAT and 14WAT.

Ratings for wear tolerance and recovery following DSW were visually recorded as the percentage of surface covered by green vegetation after wear treatment using a scale of 1 to 9 (9 = no injury or 100 percent green cover, 1 = no green vegetation).

Results and discussion

Potassium had no effect on wear tolerance, which is in agreement with other wear studies using DSW or rollers.

The effect of N, however, accounted for about 95 percent of the variation in wear tolerance in 2006 and 2007. Nitrogen caused a significant reduction in wear tolerance in June 2006 and 2007 when perennial ryegrass was fertilized at rates exceeding 5 pounds of N per 1,000 square feet per year.

A 40-percent reduction in wear tolerance was observed as N increased beyond 5 pounds N per 1,000 square feet per year. These results are in contrast to reported optimum N rates for wear tolerance in other species (10, 11), which are above the 5 pounds

Shoot growth accounted for as much as 94 percent of the variation in wear tolerance. Wear injury and shoot growth rate increased with increasing nitrogen, especially when fertilized in excess of 5 pounds of nitrogen per 1,000 square feet per year.

N per 1,000 square feet per year optimum for perennial ryegrass in this study.

Perennial ryegrass is known to be more responsive to fertilizer N; greater leaf growth response is observed with each incremental increase in N applied. Excess shoot vigor and growth can reduce wear tolerance and deteriorate faster under wear. A greater increase in growth and vigor by perennial ryegrass per unit of N applied may account for this species' lower N requirement for optimum wear tolerance. Perennial ryegrass fertilized with N rates ranging from 1 to 5 pounds N per 1,000 square feet per year exhibited less visible wear injury than plots receiving 7 and 9 pounds N per 1,000 square feet per year.

Recovery ratings in perennial ryegrass in response to N were distinctly different from wear tolerance ratings following DSW in 2006 and 2007. Higher N rates promoted greater recovery compared to 1 and 3 pounds of N per 1,000 square feet per year.

By 8WAT, the 5 pounds of N per 1,000 square feet per year rate was statistically superior during recovery than all other N rates, particularly in 2007. By 12WAT in 2006 and 8WAT in 2007, all K combinations fertilized with 5 pounds of N per 1,000 square feet per year were statistically equivalent to non-wear checks, according to the LSD (0.05) value (i. e., equal to 9 on the 1 to 9 rating scale). The 5 pound N per 1,000 square feet per year rate was the first N-K treatment combination to achieve full recovery in 2006 and 2007.

Unlike N, K was generally not important in recovery. Better recovery promoted by N is due to greater vigor and shoot growth exhibited by perennial ryegrass in response to N.

Shoot growth accounted for as much as 94 percent of the variation in wear tolerance. Wear injury and shoot growth rate increased with increasing N, especially when fertilized in excess of 5 pounds of N per 1,000 square feet per year. Like shoot-growth rate, perennial ryegrass shoot density in our studies increased with N at rates above 5 pounds per 1,000 square feet per year.

However, higher N comes with diminishing returns as greater shoot growth (and density) can promote greater wear injury in perennial ryegrass. Practices that promote significant increases in shoot growth or tissue moisture may be especially detrimental to wear tolerance in perennial ryegrass. Optimum N for maximum wear tolerance and recovery in perennial ryegrass is about 5 pounds of N per 1,000 square feet per year.

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