Wear Tolerance of Kentucky Bluegrass-Tall Fescue Blends

by Douglas D. Schoch

Introduction

Wear on turf is a term loosely defined as stress resulting from general use, including running, walking, and vehicular traffic. These stresses have varying degrees of severity and are a direct result of a tearing or crushing type of motion that breaks down the basic structures of grass plants. Under severe wear, crowns as well as leaves and stems may be damaged. The ability of turf to withstand the effects of traffic is termed wear tolerance (8).

Wear tolerance is reported to have two main components (1). The first is resistance of the grass to compression. This is most important during times of slow growth and slow recovery from damage. The second component is the ability to recover from damage that has been inflicted. Recovery is through growth of tillers, stolons or rhizomes, or seed production, the actual mode being dependent on the species of grass.

Whatever type of traffic the turf is enduring, it must be able to tolerate stresses resulting from soil compaction, soil displacement, and turf removal as well as foliar damage. Soil compaction reduces soil aeration, turfgrass rooting, and water infiltration and is known as hidden traffic stress (3). Soil compaction significantly influences the amount of damage to the turfgrass plant and its ability to recover from wear stresses. This needs to be distinguished from wear injury by recording wear injury soon after it occurs rather than several days later when soil compaction effects come into play (5). Soil displacement stress results from movement of soil by cleats, tires or erosion and exposure of crowns and roots. Turf removal via divots creates gaps into which turfgrass regrowth must occur if good ground cover and wear tolerance are to be maintained.

Various characteristics of turf and turfgrass contribute to wear tolerance (9). These involve the degree of tissue hydration, the total amount of above-ground biomass, the quantity and location of sclerenchyma fibers in the plant, the leaf and stem lignin contents, the coarseness of leaves and stems and the shoot density of the turf. The more biomass above ground, the greater the surface area of plant tissue over which wear occurs and the greater the tolerance to wear. This suggests that wear tolerance will be directly proportional to the height of cut. Such is often not the case. Research (10) has shown that turf mowed at 5 cm (2 inches) often exhibits more visual signs of wear than does turf mowed at 3.8 cm (1.5 inches). This is thought to be from the ability of the more closely mowed turf to remain more upright and proportionately more high sclerenchyma content stem tissue that enables the grass to better withstand bending pressures.

Other research (10) indicates that verdure, shoot density, and load bearing capacity do not account for turfgrass interspecies differences in wear tolerance. Rather, the interspecies differences relate to combinations of leaf tensile strength and width, with tensile strength being a function of sclerenchyma fiber and lignin content. Plant cell wall cellulose content may also be involved (9).

Nutrition has also been implicated in the wear tolerance of turf. Carroll and Petrovic (4) examined the wear tolerances of creeping bentgrass and Kentucky bluegrass during the third and fourth years of fertilization with different amounts of N and K. They found that increasing the N supply improved creeping bentgrass wear tolerance in the fourth year, but had no effect in the Kentucky bluegrass. Potassium was found to have no effect on wear tolerance or recovery from injury in either turf. Hawes and Decker (7) also saw no effect of K on the healing capacity of creeping bentgrass. In contrast, Shearman and Beard (10) noted that increased potassium supply improved creeping bentgrass wear tolerance. These conflicting reports of the effects of K may well be due to differences in the K status of the soils in which the grasses were grown or differences in research methods.

While the ability of turf to withstand wear varies with turfgrass species and cultivar, the cultural practices used and the intensity and type of traffic, the importance of thatch and mat should not be overlooked. Duncan (6) observed up to 400% increases in wear tolerance that were attributed to the presence of thatch and mat. The optimum thatch and mat thicknesses appeared to be around 1.4 and 0.4 inches, respectively. Thatch and mat presumably affect wear tolerance by cushioning the turf and soil and protecting stems and crowns.

A rather novel approach for simulating the effects of thatch and mat is that of incorporating crumb rubber into soil prior to turf establishment followed by topdressing with the material (14). Early results have shown these practices to be more effective for perennial ryegrass than for Kentucky bluegrass.

There is a wide range among turfgrass species in their wear tolerance. Zoysia appears to be one of the most wear tolerant grasses even though its recuperative rate is slow. Least wear tolerant is creeping bentgrass, with its poor traffic and soil compaction tolerance and relatively high disease susceptibility (2). Turfgrasses with intermediate wear tolerances include Kentucky bluegrass, perennial ryegrass, bermuda grass, and tall fescue.

Significant cultivar differences also exist in the wear tolerances of turfgrasses. Recent reports from the National Turfgrass Evaluation Program provide wear tolerance ratings for Kentucky bluegrass (12) and for perennial ryegrass (13) cultivars.

Methods

This research project was conducted at the O.J. Noer Turfgrass Research and Education Facility on plots seeded in 1993 to various blends of two Kentucky bluegrass cultivars (Park and Adelphi) and Rebel Jr. tall fescue. The objective of the study was to observe the effects of the percentages of each species on wear tolerance. While the study was specifically directed toward late-season wear tolerance of athletic turf, the results are applicable to any highly trafficked area.

Since its establishment in 1993, the plot area has been uniformly maintained with moderate amounts of N, mowing at 2½ inches and irrigation to prevent severe moisture stress. Three weeks prior to initiation of wear stress, mowing height was reduced to 2 inches to better simulate athletic field conditions. Wear stress was applied with tandem rollers outfitted with golf shoe spikes and towed with a sand rake. The rear roller is geared to turn more rapidly than the front roller, thereby creating some tearing action. Prior to applying the wear stress, the percentages of tall fescue in each plot were visually assessed and verdure removed from a 7.6 in2, randomly selected area in the plots. After traversing the plots 10 times with the simulated wear device, all plots were visually rated for wear tolerance and resiliency on a scale of 1 (least) to 9 (best).

Results and Discussion

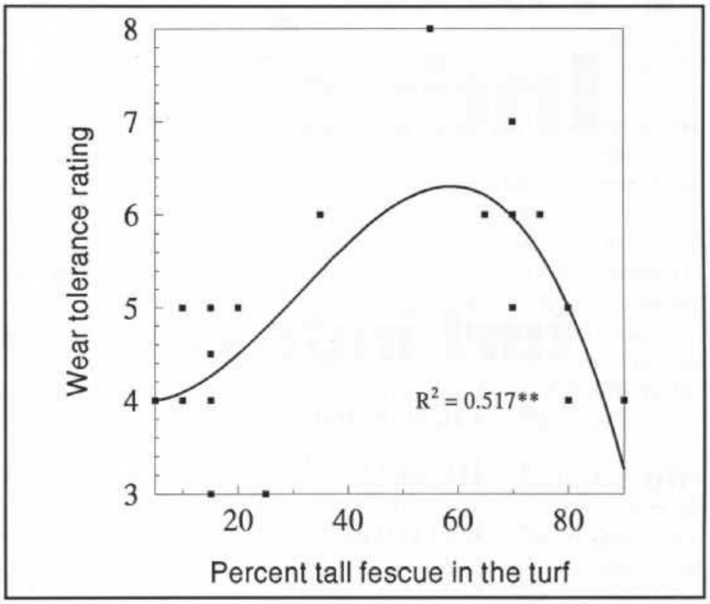
Visual ratings of the percentages of tall fescue in the plots correlated highly ($r = 0.952$) with the 1993 seeding percentages. Thus, if any species population shifts occurred during the first three years after seeding, they were not visually detected.

Verdure turns out to be a very poor indicator of the wear tolerance and resiliency of the Kentucky bluegrass-tall fescue blends. The relationships of wear tolerance and resiliency to verdure were not only insignificant, but negative as well. In other words, there was a slight tendency for wear tolerance and resiliency to decrease with increases in verdure even as verdure ranged from 0.54 to 0.12 lb/ft2.

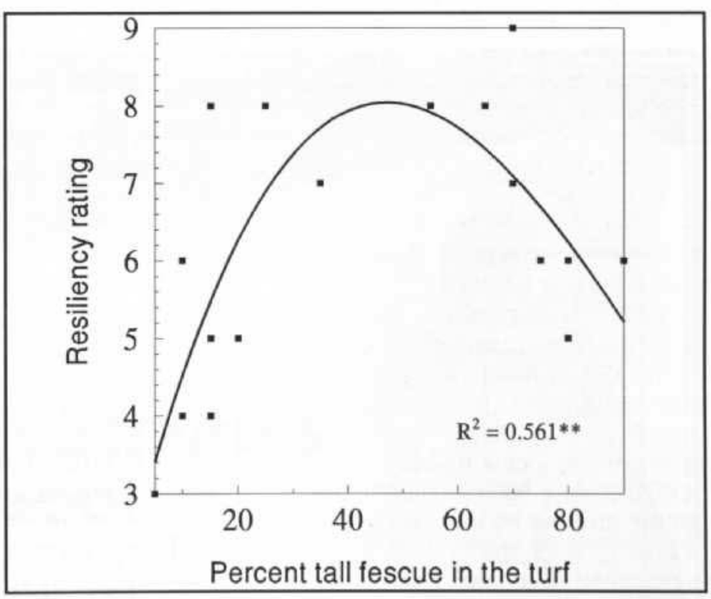
Tall fescue did not appear to contribute more to verdure than did the Kentucky bluegrass. This was evidenced by the fact that verdure did not increase significantly as the percent tall fescue in the blends was increased.

The percentage of tall fescue in the blends did influence the wear tolerance and resiliency of the turf, but these were not simple, linear relationships. Both wear tolerance and resiliency ratings were low at low tall fescue percentages and increased with increasing tall fescue percentages, but only up to a point. Wear tolerance ratings declined quite rapidly after the proportion of tall fescue reached about 60% (Fig. 1). Resiliency ratings began to decline when the percent tall fescue exceed about 50% (Fig. 2).

Relationship between turf wear tolerance ratings and the percentage of tall fescue in the turf.



Relationship between turf resiliency ratings and the percentage of tall fescue in the turf.



These were not the results anticipated at the start of the study. The expectation was that as the percentage of tall fescue increased in the blends, there would be a corresponding increase in verdure and, in turn, progressive improvements in wear tolerance. Resiliency was viewed somewhat differently, owing to observations by others that tall fescue loses resiliency late in the season when growth slows. This line of reasoning leads to the thought that resiliency should have showed progressive declines as the percentage of tall fescue in the blends increased.

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Why the results of this study were contrary to expectations cannot be explained without more detailed observations. It is also possible that had the study been conducted at different times during the season with more intense or a different type of wear, the results may have been quite different. Further study is clearly needed before firm conclusions can be drawn about what proportions of Kentucky bluegrass and tall fescue are needed in a blend to create a turf for high traffic areas.

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