Improving Traffic Tolerance with Fertilization

The most significant turf management problem common to golf courses, athletic fields, and institutional grounds is traffic. It separates golf and sports turf from all other types of maintained lawn areas.

Traffic involves more than wear caused by the weight of people or machines. The scope of traffic extends to compaction and lateral forces which tear or shear turf foliage and roots. Selection of turfgrasses and management practices to combat traffic must take all these factors into account.

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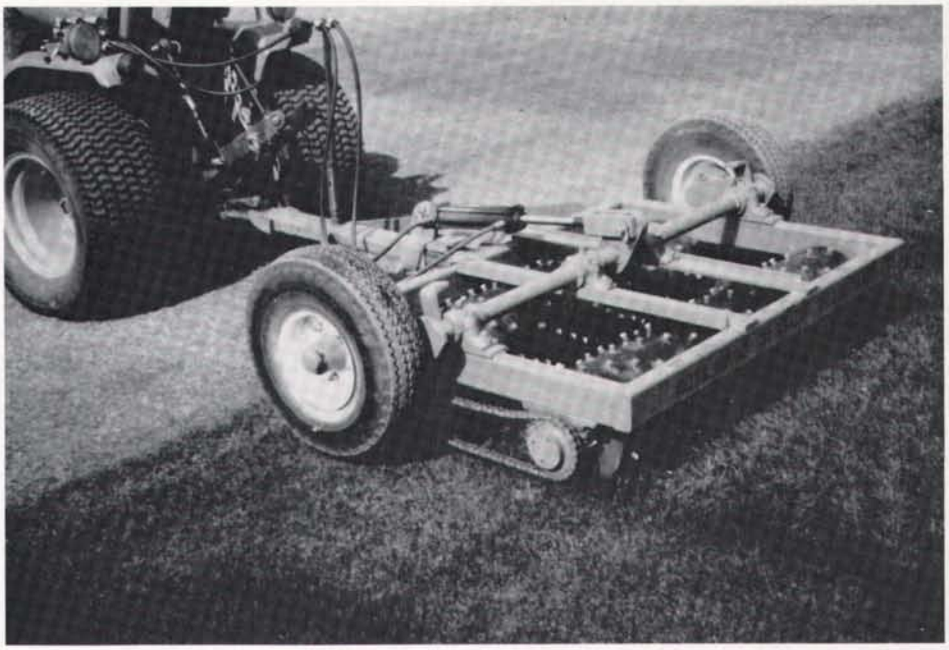
The full impact of traffic is just beginning to be understood. Research is now underway at various universities and private facilities to develop important information related to the traffic tolerance of different turfgrass species and cultivars. A clearer picture of how turfgrasses recover from traffic stresses will eventually lead to more durable natural turf surfaces.

Historically, a common remedy to the ills of conventional turf areas caused by traffic is a simple application of fertilizer. The reasoning is that nitrogen and other nutrients will stimulate the grass plant to recover from damage. Fertilizers are typically applied in greater quantities to golf and sports turf than to conventional turf to increase the growth rate and the density of the stand, and to establish more vigorous root systems.

This logic is sound to a degree. However, research has shown that there is a point at which fertilizer, primarily nitrogen, actually decreases traffic tolerance. P. M. Canaway at the Sports Turf Research Institute in Bingley, England, revealed that the traffic tolerance of Loretta perennial ryegrass growing in sand diminished as annual nitrogen rates exceeded approximately five pounds per 1,000 square feet.



Traffic simulators, such as the Brinkman model developed at UC-Riverside, enable researchers to evaluate the effect of cultural practices on the traffic tolerance of turfgrasses.

In his tests, he measured percent of ground cover before, during, and after applying artificial soccer-type wear treatments on both soil and sand root zones seeded in August. Before traffic, higher rates of nitrogen did increase the ground cover significantly. However, once wear was applied, plots receiving high rates of N deteriorated at a faster rate than those receiving between four and six pounds per 1,000 square feet.

The fertilizer solution Canaway applied contained nitrogen, phosphorus, and potassium in a ratio of 4:1:3. The turf growing on local topsoil could not withstand the effects of eight months of treatment with a wear machine. The coverage of the sand-based plots was three times greater at the optimum fertilizer rate than those receiving no nitrogen or high rates.

Canaway suggests that high rates of nitrogen result in turf with a high moisture content and low wear tolerance. He also found that traction did not improve as nitrogen rates rose above moderate rates.

Potassium is the nutrient that impacts the water relationships in turf, explains Dr. Robert Carrow, professor of agronomy at the University of Georgia. Adequate levels of potassium in the root zone make plant cells stronger and more rigid, he points out.

In 1975, research at Texas A&M University by Dr. James Beard and Dr. Robert Shearman showed that traffic tolerance of Toronto creeping bentgrass dropped significantly as potassium levels were reduced. In fact, Beard observes today that low potassium has more of an impact on traffic tolerance than low nitrogen. He recommends a 1:1 or 4:3 ratio of nitrogen to potassium for high-traffic turf, especially in sand root zones. "There is a point at which potassium can interfere with the uptake of other nutrients," warns Beard.

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Deficiencies in potassium can be magnified by excess calcium or magnesium, advises Dr. Dean Mosdell of Scotts. "Soil tests are a necessity for anyone with high-traffic turf," he adds. "Sand root zones require closer monitoring than others."

Potassium also reduces the wilting tendency of turf. This can prove valuable in scheduling irrigation around events. Many superintendents and groundskeepers prefer to have root zones on the dry side during high-use periods. Wet soils compact more easily and are less resistant to impact. By preventing wet conditions, turf damage can be reduced significantly.

Like nitrogen, potassium is subject to leaching, especially in sandy soils. The problem is amplified if nitrogen sources containing ammonia are applied frequently, adds Beard.

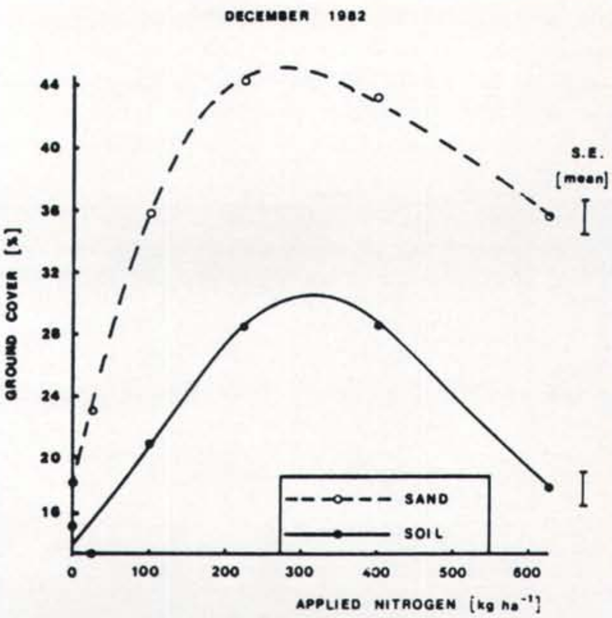
Since reseeding and overseeding are important cultural practices on high-traffic turf, Beard also recommends paying attention to phosphorus levels. This nutrient is vital to young turf. It assures rapid establishment of seedlings and also promotes root and shoot growth. From the standpoint of traffic, phosphorus speeds up maturation of new plants. Turf becomes more durable as it matures.

Phosphorous is relatively immobile in soils. Still, Beard suggests that managers of high-traffic turf apply it with nitrogen and potassium. "The only detrimental effect of high phosphorous levels could be an increased population of *Poa annua*," he states. Annual bluegrass infestations are also promoted by poor drainage, excessive irrigation, and compaction.

Rapid establishment is critical for high-traffic turf, remarks Dr. Paul Reike at Michigan State University. "The turf manager needs to build density quickly, encourage rapid maturity, and get his turf to harden off as much as possible before traffic is allowed," he states. "A certain amount of thatch is important to protect the crown. Topdressing can also help if the material is compatible with the existing soil mix. Do not overwater either. You'll never have wear-tolerant turf if you keep the soil wet. You have to approach traffic tolerance from a total turf management perspective."

Other management practices that can improve turf density are frequent mowing at moderate heights, proper drainage, well-planned aeration, overseeding, and late-season fertilization. Dr. Richard Schmidt at Virginia Polytechnic Institute, says that fall fertilization does not increase winterkill of bermudagrass. He also has shown that spring traffic causes more compaction than autumn or winter traffic on dormant bermuda.

Carrow has revealed that nitrogen availability is influenced by compaction. "The underlying problem is often compaction, not a lack of nitrogen," he reveals. "The solution should be to take steps to relieve compaction instead of applying more nitrogen. More fertilizer can make matters worse since high nitrogen levels and compaction combine to markedly reduce root systems." Carrow adds that compaction does not have the same effect on potassium or phosphorus.



Percent turf ground cover in response to nitrogen after two months of treatment with a wear simulator. Note decreasing tolerance beginning at 275 kg/ha^{-1}, about five pounds/1,000 ft^2 annually. Data from P.M. Canaway, Sports Turf Research Institute, Bingley, England.

One potential problem with reducing nitrogen levels to more moderate levels is an equivalent reduction in potassium and/or phosphorous when using complete fertilizers. Since many turf managers use complete fertilizers to supply all three major nutrients, they should switch to fertilizers with a higher analysis of potassium during periods of heavy use and phosphorus when overseeding.

A relatively new solution for those who make infrequent fertilizer applications, is sulfur-coated potassium. It provides the same benefits as slow-release nitrogen sources, such as reduced leaching and continuous availability during the playing season.

Most research on the relationship between fertility and traffic tolerance has been conducted in England, Germany, and the Netherlands. For the past ten years there has been limited evaluation in the United States. The primary limitation has been the lack of a standard, scientific method to artificially create traffic on turf.

To solve this problem, Steve Cockerham and D. J. Brinkman at the University of California in Riverside (UCR) developed the Brinkman Traffic Simulator illustrated on the previous page. This device simulates wear from friction and scuffing, compaction slightly greater than that caused by an average football player, and lateral shear injury. Hex nuts the size and shape of shoe cleats are welded on two rollers which turn at different rates. The rollers are mounted on a frame which is pulled by a tractor or utility vehicle.

With the traffic simulator, turf plots at different fertilizer rates can be compared for traffic tolerance. Most of the work at UCR has centered around evaluation of traffic tolerance between different turf species and varieties. "We are seeing differences in traffic tolerance and fertility levels," Cockerham points out. Cockerham has helped Dr. Stan Brauen at Washington State University, Dr. David Minner at the University of Missouri, and John Rogers at Michigan State University build their own simulators. "We are beginning to reach a point where we can conduct fertility research on all types of turf and root zones," adds Cockerham.

In Hubbard, OR, Dr. William Meyer has had his own traffic simulator since 1981 to assist his breeding work for Turf Seed, Inc. "We now have the technology to identify turfgrasses which withstand traffic better than others," Meyer says. "By crossing cultivars with greater tolerance we can genetically create superior turfgrasses."

As Reike pointed out, traffic tolerance requires a total management perspective. Closer attention to fertility is one of many cultural practices that can be adjusted to improve the durability, playability, and safety of golf and sports turf.