Strategies for overused fields

BY **STEVE COCKERHAM**

Sports field use today is a function of the attention given to recreation, organized sports, and physical fitness. The owner, user, and spectator each have expectations of facility performance. The performance is related to the traffic demands and the resource input for construction and cultural care. Field overuse occurs when the traffic volume exceeds the performance capability.

Sports field demands are basic to ownership expectations and, thus, determine the ownership values. As ownership values connect with the demands to be made the expectations for the site evolve. The demands and expectations determine the degree of maintenance intensity required with the associated expenditures for developing a maintenance program.

Sports fields can be segregated into four levels of quality and performance expectations: PREMIUM, CHOICE, STANDARD, and PLAY decreasing in traffic tolerance respectively.

PREMIUM fields would have high visibility and as such be expected to be of very high quality. They typically would have high traffic from sports and events. Management intensity would be very high to meet the expectations. These fields would generally support major professional league and major college sports teams.

CHOICE sports fields have high visibility in a community and high quality would be expected. They would have moderate to high traffic from sports and events. Management intensity would be high. These fields would generally support minor league professional, college, and high school sports teams. Local school stadiums are faced with community pressures for access to the field.

Optimum care of a Choice level sports field includes enough fertilizer applied as needed to meet the performance expectation, timely uniform irrigation, mowing, aeration, topdressing, rolling, overseeding, and repair of traffic injury. A high traffic level results from actual use of approximately 18 game-time hours of soccer/week or 12 game-time hours of youth football/week or 30 game-time hours of baseball/week.

STANDARD sports fields may have high community visibility with moderate quality expectations. These fields typically have very high traffic from a community college and several high school sports teams as well as practice fields at all levels, including professional, college, and high school. Resource input is restricted with moderate management intensity. Practice fields generally receive less attention during design, construction, and care but are subjected to greater use than game fields and generally have lower maintenance budgets. The use intensity on practice fields is very high and compaction and wear reduce the turf surface performance.

Care of a Standard sports field includes enough fertilizer applications to allow the grass to grow, timely uniform irrigation, mowing, and aeration as needed. For that minimum investment the performance expectation of actual use would be approximately 10 game-time hours of soccer/week or 6 game-time hours of youth football/week or 20 game-time hours of baseball/week. These demands can be met with the minimum input on a field built on at least a loam soil and with reasonable drainage. It is not unusual for traffic levels on Standard fields to far exceed this.

PLAY fields are park and school fields with very high traffic. Quality is low due to restricted resource input resulting in low management intensity.

Performance

Performance is judged against the expectations of the interested parties. The parameters of sports field performance are SAFETY, PLAYABILITY, AESTHETICS, and DURABILITY.

Safety is estimated by measuring hardness and traction, which are related to impact absorption (ability of the turf to take shock), shear resistance (ability of the turf to resist the tearing of the shoe cleats sliding over the turf) and footing.

Playability is both measurable and perceptual. A smooth, uniform surface is conducive to good play. The speed of the turf surface related to a ball or runner can be measured. The feeling of speed to the athlete relates to several factors resulting in the perception of the speed of the surface. The controllable factors are the firmness, surface uniformity, height-of-cut, puffiness, and thatch.

Aesthetics. Turf, wherever it is, has an important aesthetic function. It is supposed to look good. Appearance of the field, even though it is primarily a concern of the spectators in attendance and television audiences, does reflect the pride of the maintenance personnel. A bad looking field, especially if the playability is poor, is a highly visible civic embarrassment.

Durability. Faced with increasing demands, sports field use limitations are pushed to the extremes of their potential. Through the selection of proper construction techniques, turf species, and management practices, the sports turf manager can maximize durability.

Overuse of sports fields doesn't just happen. The traffic volume exceeds the performance level chosen by the owner. There is more play than planned and the resource input is less than needed. Overused fields are not necessarily abused fields. Overuse shows up as turf worn through primarily in traffic patterns, which may become muddy or hard playing surface. Field abuse shows up as ruts, holes, dead patches, irrigation patterns, pathways, and muddy or hard playing surface. Fields of all levels of performance expectations can be completely

worn out. Even the finest, most durable surfaces, including roads, have traffic limits beyond which they fail. Field abuse is less excusable.

Cultural practices

The maintenance practices that are fundamental to sports turf culture are mowing, irrigation, fertilization, aeration, rolling, and repair. As traffic levels increase it is sometimes possible to push turf growth to meet the demand. Knowledge of the cultural practices can be useful in extending or increasing field performance.

MOWING can be a useful tool for the turf manager who is trying to get the most out of a field. Raising the height of cut increases carbohydrate production and the depth of rooting, leaf width, and rhizome and stolon number, weight, and internode. Lowering the height of cut gradually decreases turf vigor with the decrease in plant size, while thatch and puffiness are reduced as a result the durability declines. Lowering mowing height will increase shoot density and playability speed, though at the expense of shorter roots and lower traffic tolerance. It all means that raising the height of cut increases the traffic tolerance while reducing turf density and speed.

The optimum mowing height range is determined to be where the performance of that grass as a turf is greatest, with good topgrowth, root development, and plant density.

Height of Cut for High Traffic Grasses (inches)

	Growth Optimum	*Traffic Minimum**
Kentucky bluegrass	1 1/2-2.0	5/8
Perennial ryegrass	1 1/2-2.0	1/2
Tall fescue	1.0-2.0	3/4
Common Bermuda	3/4-1.0	5/8
Hybrid Bermuda	1/4-0.75	1/2
Zoysiagrass	1/2-1.0	5/8
Kikuyugrass	3/4-1.0	5/8

**Height of cut below which turfgrass fails under traffic pressure*

Traffic on turf adds a significant stress and increases the impact of the other stresses. Lowering the mowing height below the optimum range reduces field performance including durability. The traffic minimum mowing height is that point at which traffic tolerance decreases dramatically and the turf will fail.

Mowing frequency is determined by the growth rate. Removal of more than 40% of the top in a single clipping completely stops root growth for a period of time. The larger percentage of foliage removed, the longer the root growth remains stopped. The rule of thumb is to mow frequently enough to remove less than 1/3 of the leaf blade at one time to prevent the root growth from being completely stopped. For example, a turf mowed at 1 inch should be cut before the turf reaches 1.5 inches. If that is two weeks, one week, or two days then that becomes the mowing frequency.

Irrigation and drainage. Managing water on sports fields will make or break the performance of the field. Maximum wear tolerance and recuperative ability require optimum irrigation and good drainage.

Irrigation as an art on sports fields is as important as the science considering the irrigator's knowledge of the "hot" spots, wet spots, runoff, wind, shade, etc. and what to do about them. Regular scheduling of irrigation is often impractical for heavily used turf facilities during the periods of activities and hand watering specific areas may be needed. Irrigation with poor distribution uniformity not only wastes water, it wastes resources, all other cultural practices, and the integrity of the turfgrass surface creating the potential for field overuse.

The application of a light spray of water either by hand or by a short irrigation cycle is called syringing and it can be very helpful for turf that is overworked. Syringing is an important irrigation management tool cooling the grass and the environment around the grass blades. It slows wilt and increases the turgidity of grass blades causing them to stand up. It perks up the grass.

Syringing immediately after a game or an event can contribute significantly to turf recovery. When the turf has been covered for an event such as a concert, syringing immediately upon removal of the cover can mean the difference between the grass reviving and not reviving in a reasonable period of time.

Drainage. Most high traffic turfgrass failures are directly related to inadequate drainage. Poorly drained sports fields wear excessively and quickly lose playability and quality. Rutting and soil displacement in wet soil destroys the soil structure further reducing drainage.

Drain lines are the most effective outlets for internal drainage and for carrying the water away from the site. Soils with poor internal drainage can sometimes be helped with the use of sand filled slits. A machine cuts a slit about an inch wide and a foot deep then fills the slit with sand in a single operation with minimum disruption of the playing surface.

French drains are trenches filled with coarse gravel or rock. Grass is allowed to grow over the top of the drains. The bottom of the trench must have fall to carry the water away from the site being drained.

Surfactants are chemicals that reduce the surface tension of water allowing water movement through soil. Surfactants applied to wet spots in a sports field can temporarily increase drainage reducing the effects of field softness and poor traction. A surfactant can sometimes relieve dry hard spots by helping water penetration. Sod rooting is sometimes faster when laid over an application of surfactant due to the increase in the soil permeability. Surfactants have shown to be valuable tools for overused fields and are very useful for any turf manager working with high traffic turf.

Fertilizing

The performance of many sports fields would be significantly improved simply by applying nitrogen (N) fertilizer. Premium fields that have high visibility and high play should have at least 8 lb. N/1000 sq.ft./year. Choice fields where reasonable quality is desired that are subject to relatively high traffic warm-season grasses should have at least 6 lbs. N/1000 sq.ft./year and cool-season grasses should have at least 5 lbs. N/1000 sq.ft./year. Standard fields should receive 3-4 lbs. N/1000 sq.ft./year. Play fields should receive at least 2 lbs. N/1000 sq.ft./year just to keep some grass on the surface.

The turf manager can increase the biomass and cushion on the field by increasing N applications. Doing so, however, can be at the expense of a reduction in root mass, lower recovery potential, and weaker shear strength. Increasing the cushion can make the field safer if footing is not seriously reduced.

Greener turf is not always better especially if the color is from excessive or improperly timed nitrogen applications. Since N tends to increase topgrowth, under rapid growth conditions shoots take priority over roots and rhizomes. If this occurs in the spring, excess N will cause the plant to enter the summer stresses with reduced root development and increased succulence and disease susceptibility. It will be hard to keep up with the regular mowing requirement caused by rapid turf growth.

Turfgrasses use phosphorus (P) in relatively high quantities. Since, in most forms, it is slowly soluble it resists leaching. It can become unavailable to the plant if the soil pH gets too high or too low. P deficient turf is stunted and may show a red color beginning at the leaf tips. On cool and warm-season turfgrasses, phosphorus is

applied at the rate of 0.5-1.0 lbs. P/1000 sq.ft./yr.

Potassium (K) improves turfgrass wear tolerance, disease tolerance and aesthetic quality. Potassium increases the number of new rhizomes and increases their life span. Keeping the K in balance with the N will produce a tougher sports turf on any kind of grass. The use of K at 2-4 lbs. K2O/1000 sq.ft./year irrespective of the N and P status reduces the water stress in turf and increases recovery from drought.

There are some things that can be done with fertilizer to boost sports turf performance, though often at a risk. In the early spring, we use a one-time application of 1.5-2 lbs. N/1000 sq.ft. in soluble (urea or ammonium sulfate) form can help "jump start" Bermudagrass. There is usually a cost associated with modifying a plant growth habit. The cost in pushing the turf to get started may be an increase the symptoms from spring root dieback and later increase in the reactions to stress. "Jump starting" is not effective with zoysiagrass.

Nitrogen applied in the fall before the last mowing of the cool-season grasses improves spring green-up. Nitrogen applied late in the season on warm-season grasses before they go dormant improves fall color retention. The roots of warm-season grasses going into dormancy are still capable of absorbing some N. The risk of freezing is increased by a late season N application in areas of low winter temperature. Increasing potassium will help offset the freezing problems caused by the nitrogen applications. A late season application of high N to prolong color may have a cost in the increase of spring dieback of Bermudagrass roots.

As soil temperatures at 2 inches deep drop below 50 degrees dormant warm-season grasses do not benefit from fertilizer applications. For cool-season grasses the corresponding low soil temperature is about 40 degrees. As the soil temperatures increase in the spring, the turf will begin to grow and will benefit from fertilizer applications.

Turf density and recovery from injury are functions of the vigor and efficiency of the roots, rhizomes, and tillers. An application of P, particularly with N, each at 1.0 lb./1000 sq.ft., often increases root growth.

Turf does not usually respond visibly to added potassium. It is the increased stress resistance that is important. K improves drought, heat, and cold tolerance with increased disease resistance. Traffic is the most significant stress on sports fields, and potassium increases the turfgrass traffic tolerance.

The impact of diseases tends to be less serious when a moderate and balanced level of N, P, and K is maintained in the root zone. When N is high in relation to P and K, there may be disease trouble particularly in hot weather. A high level of K helps reduce injury from some common turf diseases.

High nitrogen levels necessary for sports turf may increase the incidence of some diseases, while providing resistance to others. Good internal drainage helps in disease resistance even though there may be reasons to keep the turf under a high nitrogen level.

The unique demands of the sports field often call for forcing extraordinary growth. Frequent high N-rate applications will cause a rapid flush of primarily top-growth, but the roots also respond. This response is useful in peaking for a certain activity or recovering from a particularly damaging event. The cost in forcing growth is a risk of long term problems with the turf, depletion of carbohydrate reserves, and reduction of injury recovery potential.

While soluble materials (urea or ammonium sulfate) pose a higher risk, all fertilizers represent a risk of burning the turf. Soluble fertilizers should not be applied when temperatures are high (e.g., above 95), particularly with high humidity. If it is necessary to apply the material under these conditions it is critical to water-in the material within a few minutes of the application, though tire tracks and footprints may still show up as burns. Application of soluble fertilizer within a week of a big game is an unacceptable risk, particularly in hot weather.

If the field is to be covered for an event or rain protection it should not be fertilized within a week of the covering, because free ammonia released from the fertilizer trapped under the cover will burn the grass.

Aeration. Sports traffic, especially cleated shoe traffic, results in varying degrees of soil compaction and surface sealing. Compaction occurs primarily in the upper inch of soil and tends to follow the traffic patterns. It is expressed in reduced rooting depth when the soil is moist and a reduction in total root growth when the soil is dry.

Aeration the tilling or cultivation of the soil to (1) relieve compaction, (2) relieve surface sealing, (3) aid in thatch control, (4) disrupt undesirable soil layers, (5) prepare for overseeding, (6) enhance fertilizer and pH applications, (7) stimulate turf density by severing stolons and rhizomes, and (8) aid in soil modification without destroying the turf is the nearest thing to a magic formula that exists in sports turf management. Loosening the soil gives all the other cultural practices a chance to work.

Core cultivation can be performed with a drum aerator using open and hollow tines or by a vertically operated hollow tine aerator. Solid tines are used on dry soil to shatter the soil below the surface and the process is known as shatter coring. Spiking and slicing can be performed just before a game to increase infiltration and reduce surface crusting for a short term.

Rolling. A heavy, flat, steel roller is effective in smoothing the field and improving turf quality. Rolling can be used to correct what runners, such as soccer players, feel as a loose field. It can also be used to increase the speed of an infield or football field. The operation of rolling turf is in itself intense traffic with a cost in wear and compaction so that core cultivation is an important associated program. Soil that is too dry is hard and does not respond to rolling. Soil that is too wet compacts too readily and is very difficult to manage.

The roller should weigh a ton or more. Self-propelled construction rollers work quite well. When it is necessary to roll a field the operation should be in two directions. Fields should not be rolled more than two times in a month to give the turf a chance to recover.

Repair. The repair of sports fields is ongoing particularly on overused surfaces. The traffic patterns are guidelines as to repair. In baseball outfielders tend to stand in a small area, which localizes cleat injury. Other areas commonly damaged include the over-run at first base, the front of the pitcher's mound, and the paths to and from the mound and home plate. The area around the pre-game batting practice cage is another frequent wear area.

Football traffic injury is most significant in the field center, between the 40-yard lines and the hash marks. The areas where the coaches and players stand also wear significantly. Soccer injury is severe in the center of the field and around the goalmouths. Linesmen run over a narrow path along the sidelines wearing it down.

Sodding may be a quick, simple solution to repair of sports field damage. Thick cut sod is used if there is little time for rooting and can allow play the same day. If the soil temperatures are warm, thin cut sod can be ready for play in 3 to 4 weeks. Apply 1 lb. N/1000 sq.ft. of a fertilizer high in N and P such as 6.25 lbs. of 16-20-0 or 15-15-15/1000 sq.ft. The tough decision is often where to draw the line around the

turf to be replaced. It is generally preferable to take out all of the damaged turf to match new turf to old turf without a worn zone in between, especially using the same species and cultivar when possible.

Overseeding can be used as a less expensive and less disruptive operation though it requires a longer window between activities. Annual and perennial ryegrass is good for overseeding because they germinate in a few days and grow fast. Tall fescue is sometimes recommended for overseeding, but it takes 2-3 weeks to germinate and another 3-4 weeks to provide cover. Bermudagrass and Kentucky bluegrass are slow to germinate and are not good grasses to use for overseeding for repair. Overseed at the rate of 10 to 15 lbs/1000 sq.ft. of ryegrass or tall fescue. A requirement with overseeding is the need to keep the seed moist.

Divoting and tearing usually requires replacement of the turf as spot repair with sod. The sod should be thick cut and be as close to the color and texture of the surrounding turf as possible. Another patching technique is to mix sand and perennial ryegrass seed, which can be poured into the divots. Unless the turf is the same species it will be a patchwork appearance.

Light renovation involves vertical mowing and aerifying, followed by overseeding into the turf. Usually the same species is overseeded to speed up turf recovery. To stimulate the grass recovery, apply 1 lb. N/1000 sq.ft. of a fertilizer high in N and P such as 6.25 lbs. of 16-20-0 or 15-15-15/1000 sq.ft. Weeds should be treated with herbicides.

Intermediate renovation involves scalping the turf and removal of the duff with the vertical mower and aeration before overseeding. Seeding into dead grass is difficult and the old problems are just masked not corrected. Hybrid Bermudagrass stolons can be planted in the old turf surface with a planter that uses disks or coulters to cut through the old turf.

Heavy renovation involves the killing of the surface plant material including weeds and the existing turfgrass with a non-selective herbicide. Remove the old sod with a sod cutter and rototill the soil. Never lay sod over old turf even if it has been rototilled. The new sod will die even if tilled into the soil.

Local renovation involves working only in the most severely damaged areas such as the middle of a football field, goalmouths of soccer fields, or baseball outfield worn spots. It is common to overseed before games to allow the cleated players to work the seed into the surface.

Steve T. Cockerham is Superintendent of Agricultural Operations at the University of California, Riverside. This article was reproduced here with permission. The original publication in which it appeared is Publication #21617, "Establishing and Maintaining the Natural Turf Athletic Field," see http://anrcatalog.ucdavis.edu.

Seeded bermudagrass varieties offer new opportunities

BY **DR. MIKE RICHARDSON**

One of my favorite sayings is that "bermudagrass can cover a multitude of sins." Because of its toughness and tenaciousness, this tried and true turfgrass continues to be one of the most successful grasses for sports fields in southern and transition-zone environments. Some of the strengths of this aggressive grass include good wear tolerance, fast recuperative potential, good heat and drought tolerance, and relatively good disease and insect resistance. In addition to being tough, bermudagrass can produce a very high quality surface for a range of sporting activities.

There are currently some 40-50 cultivars of bermudagrass (Cynodon spp.) that are available to sports field managers in the United States. Of these, "common" bermudagrass is probably found on more municipal parks, school grounds, and recreational sports fields than any other bermudagrass type. However, there has always been a stigma associated with common bermudagrass that it produces an inferior turf and is not suitable for many higher-end sports facilities. While it does not produce a surface that will compete with some of the advanced hybrid bermudagrass cultivars such as Tifway, Midlawn, or Tifsport, there are many sports turf applications where common bermudagrass is an excellent option.

Most of the high quality bermudagrass cultivars that were developed from 1950-1990 were vegetative hybrids between C. dactylon and C. transvaalensis or natural clones that were selected for improved turf performance characteristics such as darker color, increased density, and finer leaf texture. During that period, hallmark cultivars such as Tifway, Midlawn, and Tifdwarf were released and became the dominant cultivars in the bermudagrass market. Although these cultivars did produce an outstanding surface and were genetically pure lines, a downside to the grasses was that they did not produce viable seed and had to be planted from vegetative sprigs, plugs, or sod.

In the 1980's, many private and public plant breeders began to work

with fertile C. dactylon clones, making crosses to produce seed-propagated cultivars of bermudagrass with improved performance over the standard "common" bermudagrass. The early days of that work yielded several important cultivars such as NuMex-Sahara, Mirage, and Sonesta. These cultivars showed improvement over "Arizona common," but there was still a sizable gap between these improved seeded types and the vegetative standards. However, continued efforts by several plant breeding groups made large strides during the 1990's to develop seeded cultivars that are now considered the equal of vegetative standards such as Tifway.


Baum Stadium, University of Arkansas

The three cultivars that have received the most interest include Princess-77, Riviera, and Yukon. These grasses are much improved over earlier seeded types and are now being used in many high-profile sports facilities.

When considering a vegetative vs. seeded bermudagrass, there are several things that a sports field manager should consider. The first and most important issue is performance. Will seeded bermudagrasses hold up on an intensively used sports field compared to vegetative grasses? Most of the data that has been collected to date in this area would suggest that they would. Research from the University of Kentucky has shown that the seeded cultivars (Princess-77, Riviera, and Yukon) performed similarly to Quickstand (vegetative) bermudagrass when simulated traffic was applied to the plots in the fall after establishment, according to David Williams at UK.

We have also used Riviera to renovate areas of our football game field at the University of Arkansas and it has thrived in areas where the existing Tifway had problems from traffic injury and winterkill. Another testament to the increased acceptance of seeded bermudagrass is that Princess-77 has been used to sod the last two Super Bowl venues, says Charlie Rodgers at Seeds West Inc.

Method of planting

A second important factor to consider in selecting a bermudagrass is the ease at which the grass can be planted and maintained. This is an area where I believe that seeded cultivars shine. As many new sports fields feature sand-based construction, the method of planting is critical to avoid soil layering or contamination. With vegetative grasses, the primary option is sprig planting, as sod will generally contain a soil base and introduce a layer that will affect drainage and long-term performance. Seeded bermudagrass can be planted directly into the sand without introducing other contaminants such as soil or weeds that might come in from the sod fields. Although an option for vegetative grasses would be washed sod, this is a very expensive propagation method and would only be feasible for elite stadiums.

In addition to the initial establishment, renovation and repair of damaged turf is a fact of life on almost every sports field. With vegetative bermudagrasses, sprig planting or sod have been the options of choice to renovate worn areas. Although sod is an excellent choice when fast turn-around is needed, the issues of soil layering and maintenance of the surface grade must be handled appropriately. Sprig planting can also be accomplished, but specialized no-till planters are typically required to incorporate sprigs into existing fields and can add significantly to the cost of repair. With seeded bermudagrasses, most renovations are possible with equipment that is readily available to the turfgrass manager, such as a verticutter, drop seeder, and topdresser. We have successfully renovated weakened areas of bermudagrass using a seeded bermudagrass by verticutting the area in several directions, seeding at an appropriate rate (0.5-1.0 lb. pure-live-seed / 1000 sq. ft.) and topdressing the seed with a light rate of sand. Complete stands of bermudagrass were ready for play within 6 weeks of planting. Also, as with initial establishment, there is minimal concern using seed with introducing contaminants or affecting the surface grade during renovation.

Another area that we have researched at the University of Arkansas includes the use of dormant seeding techniques to renovate weakened areas of sports fields. In these studies, we have found that bermudagrass can be successfully seeded as early as February 15, approximately 8 weeks before bermudagrass would normally break dormancy. This allows turfgrass managers to renovate areas during period of low use such as mid- to late-winter and the seed will maintain viability until soil temperatures reach a critical threshold (~65 degrees F).

Cost

The final area of consideration between seeded and vegetative bermudagrass cultivars is cost. When compared to sprig planting or sod, improved seeded bermudagrasses are very cost-effective. Costs for the seed are approximately 50% the cost of sprigs and less than 10% the cost of sod and installation can generally be accomplished by the turfgrass manager, where sprig and sod establishment will generally require additional equipment or labor to accomplish the task. In addition to the cost advantage, establishment rates for seeding are generally about 1/2 the time it takes to establish full cover from sprigs.

As seeded bermudagrass cultivars gain acceptance throughout the turfgrass industry, sports field managers will increasingly be asked to consider these new grasses. The initial observations that have been made through research and in some case studies would suggest that these grasses will find a more prominent place in sports field management and will give sports turf managers another tool for the maintenance of high quality surfaces. ST

Michael D. Richardson, PhD is an Associate Professor in the Department of Horticulture at the University of Arkansas, mricha@uark.edu. Photo courtesy of Johnston Seed.