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.

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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

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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.

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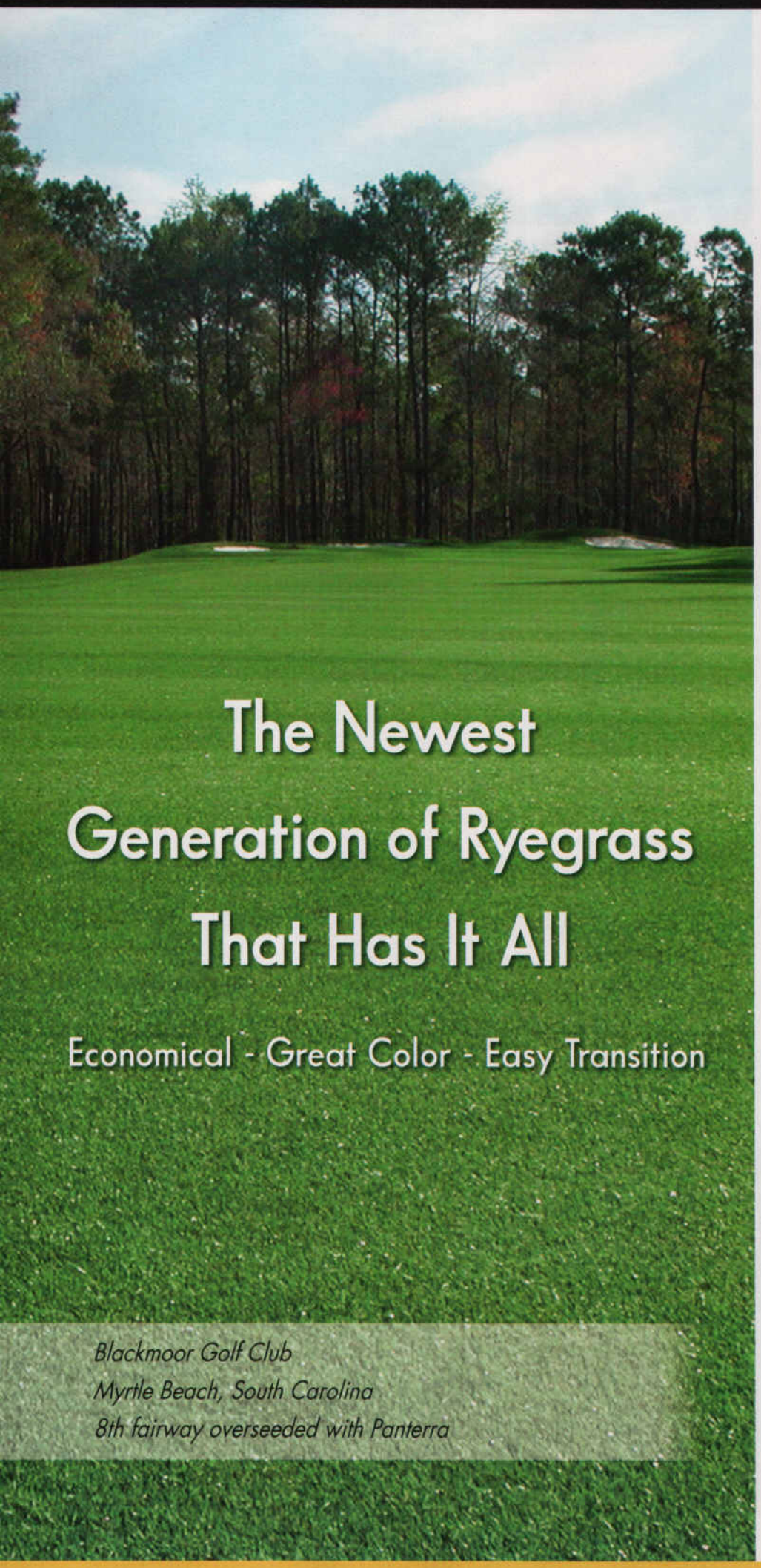

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Irrigation system scores several goals

BY **CHRIS HARRISON**

The American Hebrew Academy has a twist on the old rule of physics. Their variation would say, "What comes down must keep going down." While they have a state of the art irrigation system, they want the water to keep moving through the profile of their showcase soccer field.

That was one of several goals when the Greensboro, NC facility was built.

"The field was designed to enable quick drainage to allow playing at any time," says Todd Kowalsky, facilities superintendent at the American Hebrew Academy. "Whether it is irrigation or natural rainfall, there isn't a time when we can not play on the field. The drainage system was specifically designed for the location," he adds.

Like other sports fields, there is a crest on the field. But it is not enough to provide natural drying. The underside of the field is a clay-and-sand mixture, Kowalsky continues. "It works really well."

The field will drain over seven inches in a 24-hour period.

The soccer field is used by both the boy's and the girl's teams. It was started in 2002 as new construction, and the project took about a year to complete. Along with a separate baseball diamond and two practice fields, it is the centerpiece of the school's athletic program.

Even in the rain-rich Carolinas, it is the irrigation system that keeps the turf growing.

"Our goal was to provide an efficient irrigation system utilizing the highest quality products, professional design and installation procedures," says Gary Comer, irrigation manager at Turf Service, Inc. (TSI). He knows that, in every case, accomplishing those goals will provide the athletes with a high-quality and safe playing surface.

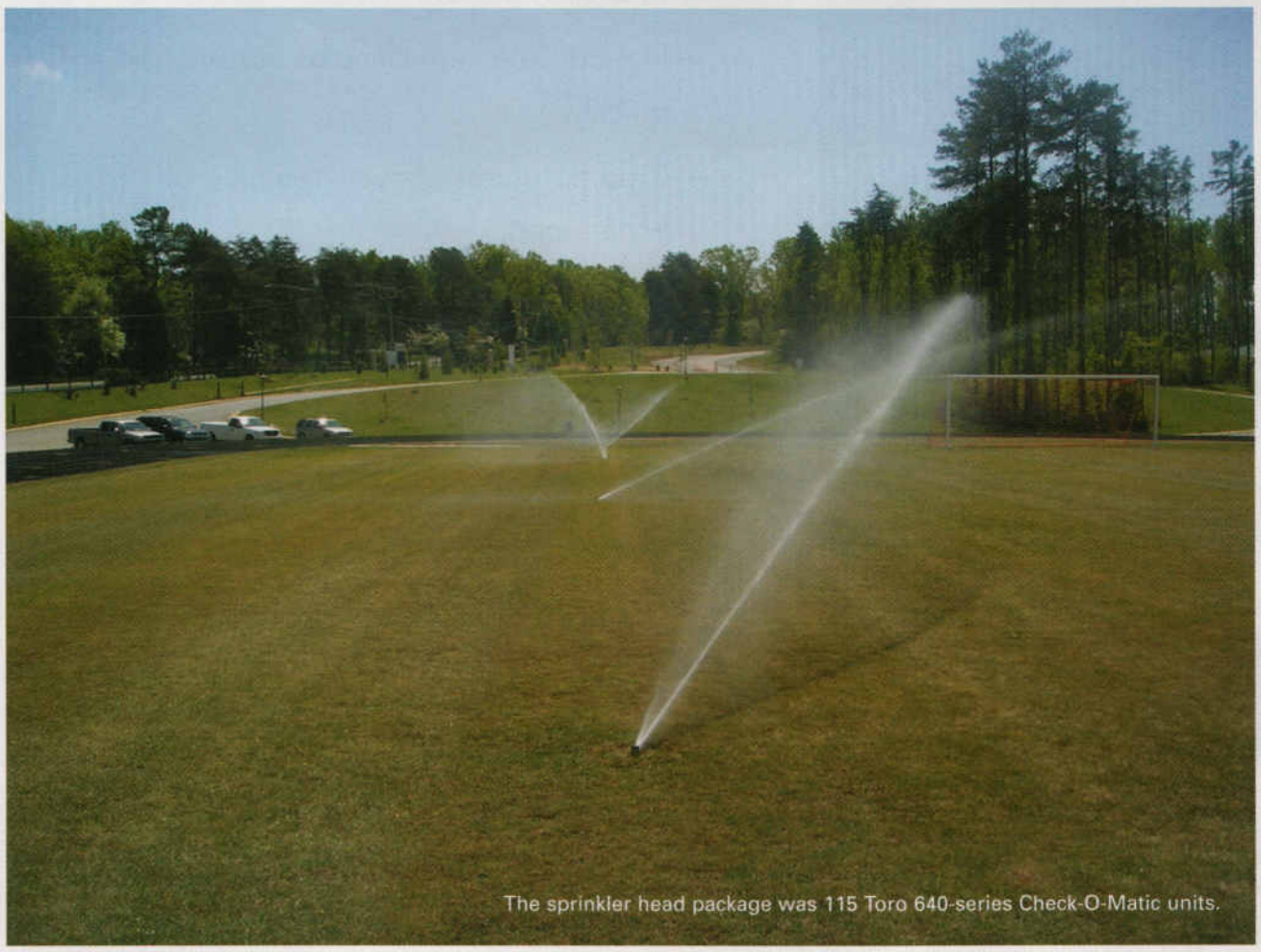
All of the main athletic fields were sodded with TifSport Bermudagrass. The margins were seeded with a blend of fescue grasses.

Kowalsky is pleased with the TifSport. This year is the first year that they have gone back and done some re-sprigging.

They do not overseed. "We leave it dormant," Kowalsky says. "Overseeding with rye just increases the maintenance cost. It is something I don't choose to do."

The field does not suffer from not being Kelly green. "It holds up very well in the wintertime, even if the students use it," he says.

Southern Seeding in Greensboro laid the sod and contracted TSI and Carolina Green, Charlotte, NC to perform the irrigation, laser grading, and drainage systems. Southern Seeding managed the project and installed the sod. Smith Turf & Irrigation provided the irrigation components and design work.



The sprinkler head package was 115 Toro 640-series Check-O-Matic units.

Irrigation components

As with any large-scale sports turf irrigation project, there was a wide array of materials used to accomplish the end-goal. Different irrigation units were used on the athletic fields themselves than were used on the general turf.

According to Mark Scruggs, (CID), at Smith Turf & Irrigation, the basic package for the athletic field sprinkler heads consisted of 115 of the Toro 640-series Check-O-Matic units. Of those, 80 were 360-degree drive assemblies. There were 20 half-circles, seven 192-degree drives and eight 173-degree arcs.

Outside the sports turf area, they used Toro 570 and S700 series pop-up sprinkler heads. The job called for 134 of the S700 3-inch part circle pop-up units with 3 gpm standard angle nozzles. There were 42 full-circle 3-inch pop-ups with 6 gpm standard angle nozzles.

The job was built around Toro automatic irrigation controllers. All five of the controllers used are equipped with rain sensors.

They used 44 of the 1.5-inch Toro 252 series globe/angle electric valves with flow control and four Toro 250 series globe with flow control electric control valves.

The job ate up over three miles worth

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From left, Chad Price, Carolina Green, did the grading and drainage system; Garry Comer, Turf Service, did the irrigation installation; and Toby Vinson, Southern Seeding, was responsible for the turf install at Hebrew Academy.

"OVERSEEDING WITH RYE JUST INCREASES THE MAINTENANCE COST. IT IS SOMETHING I DON'T CHOOSE TO DO." - KOWALSKY

of solvent-weld PVC pipe. Included in the project was 3880 feet of 1-inch 200 pipe, 6180 feet of 1.5-inch 200 pipe, 6020 feet of 2-inch 200 pipe and 1960 feet of 2.5-inch 200 pipe.

Scruggs furnishes the design work for 90% of Turf Service's athletic field projects, including the American Hebrew Academy. As a rule of thumb, he estimates the cost of fittings at 30% of the total cost of pipe.

"We try to pay special attention to common wear patterns of athletic fields and zone sprinklers to irrigate these areas accordingly," says Mike Young with Turf Service. "For example, we almost always zone the system on football or soccer from end zone or goal to end zone or goal.

"Experience has shown us that the most wear takes place in the middle of the field (each side of the 50 yard line) and that should run separately. Even in situations where the water supply is adequate to irrigate end zone to end zone, the irrigation requirements of a playing surface will vary.

There are other, practical considerations. "Large zones limit your management options," he adds.

All valve boxes are kept off the playing surfaces.

Turf Service manages the athletic field turf complex, including all of the mowing. "We will apply approximately three-quarters to a full inch of water during the summer growing season per week," Young says. There are no plans to use the irrigation system for fertigation or similar uses.

"Our biggest problem was managing the water in the D shafts of the field," TS says. After some puzzling, they came up with a fairly straightforward solution. "We decreased the size of some of the nozzles to eliminate some wet areas."

Around campus

American Hebrew Academy's main goal is to provide a liberal Jewish boarding school education for students in grades 9-12. In addition to college preparatory courses, the students delve into Jewish studies, athletics, and other school activities. Classes never are larger than 12 students per teacher.

Sports play a big role in student life. The school completed a new 88,000 square-foot Athletic Center in January 2005 that will be home to its 8-lane swimming pool, wrestling, lacrosse, field hockey, aerobics, dance, fencing and a rock climbing wall.

American Hebrew Academy has the largest closed-loop geothermal system in the world. The 500 wells that feed the system are located under the grandstands at the soccer stadium. There are two separate well systems that provide geothermal heating for all of the buildings on the 100-acre, largely wooded campus.

The geothermal system was in place before the soccer field was built.

As a premier athletic installation, the crew at American Hebrew Academy chose to outsource the sports turf to TSI. "If I have questions about what they are doing, I contact the company and be sure they stay on course," Kowalsky says.

Problems are few. TSI maintains both the soccer and baseball fields and the practice facility. "That process is more involved than the grounds maintenance," Kowalsky says. "We don't use reel mowers on the rest of campus. It is simply more cost-effective right now to outsource and TSI does a great job."

Outdoor lighting is currently being installed on all of the outdoor fields.

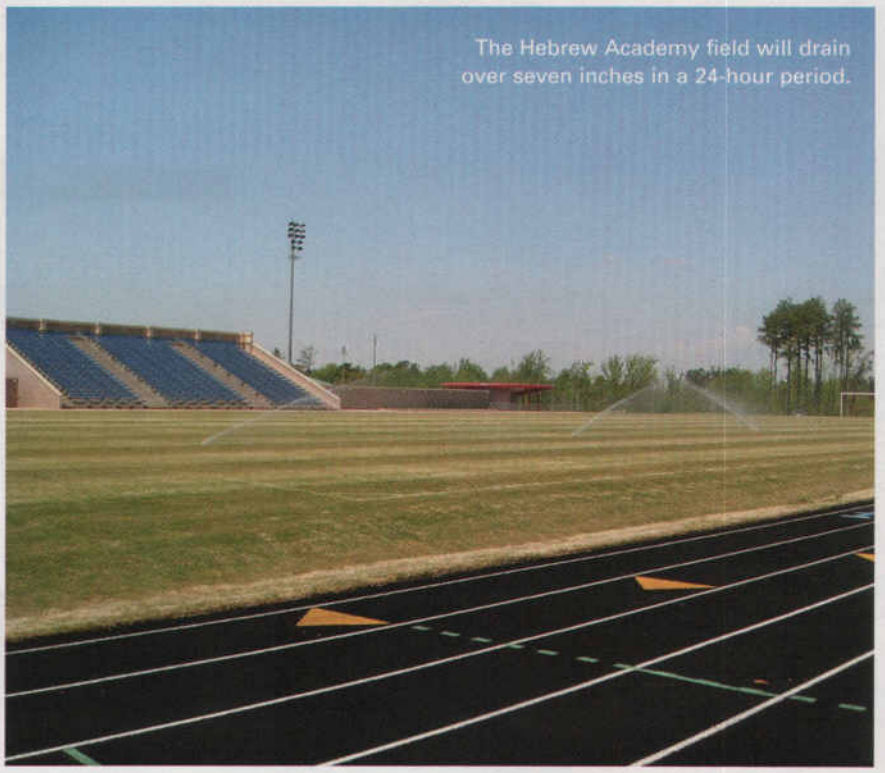
In addition to the mowing, aerification and top dressing are functions of the maintenance program and are performed as needed.

While the athletes at the American Hebrew Academy are happy with the field, the installation brings a special glimmer of pride to the installers. The irrigation team pulled together to make it all happen and there are plenty of high-fives to go around.

"We always appreciate the opportunity to work with Ralph Stout at Southern Seeding and Chad Price at Carolina Green," Young says.

Speaking for the team, Young adds, "We are proud of the finished project and feel fortunate to have been a part of it." ST

Chris Harrison is a veteran turf writer based in Ohio.



The Hebrew Academy field will drain over seven inches in a 24-hour period.