strength was constant or decreased from June through August, indicating that very little root development occurs from June through August. Very few increases in rooting strength occurred from May to June, indicating that installation by early April would be highly desirable.

Late fall sod installation is an attractive alternative to traditional spring sod installation for three main reasons: 1) sod rooting strength will be considerably greater than spring or early summer installed sod throughout the growing season, 2) the greatest root development occurs fairly early in spring (i.e. April to May) when sod installations are typically difficult due to wet soil conditions, busy contractors, or anticipated athletic field use, and 3) based on the rooting strength data collected, athletic fields established in early December will likely be ready to use in May of the next year. The primary advantage to late fall sod installations is having the ability to re-establish an athletic field during a time when typical field use is minimal.

A more comprehensive form of this research has been published in *Applied Turfgrass Science*, an online journal for applied turfgrass science professionals.

Editor's note: The author would like to thank Bob Hudzik, Head of Stadium Operations and Athletic Grounds at the Pennsylvania State University, a well-respected industry leader, innovator, and mentor in the turfgrass profession, for sparking the idea for this research. ■

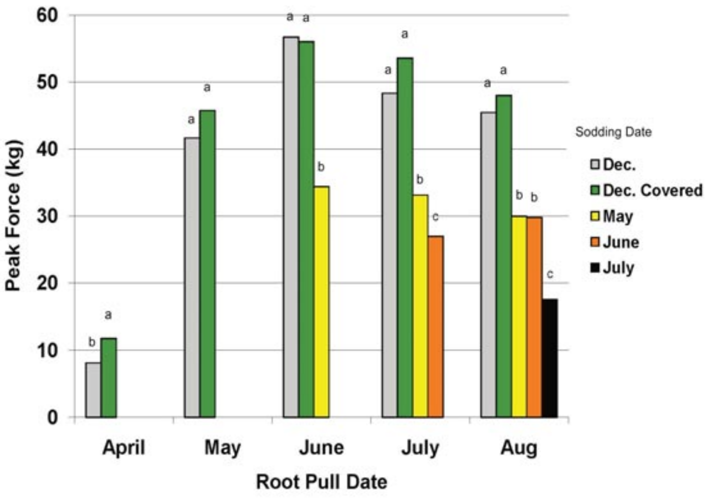


Figure 4. ROOTING STRENGTH of Kentucky bluegrass in relation to sod installation and root pull dates, 2007. Means within a root pull date followed by the same letter are not significantly different ($P < 0.05$).

Jason J. Henderson, Ph.D., is assistant professor, Turfgrass and Soil Sciences, Department of Plant Science and Landscape Architecture at the University of Connecticut.

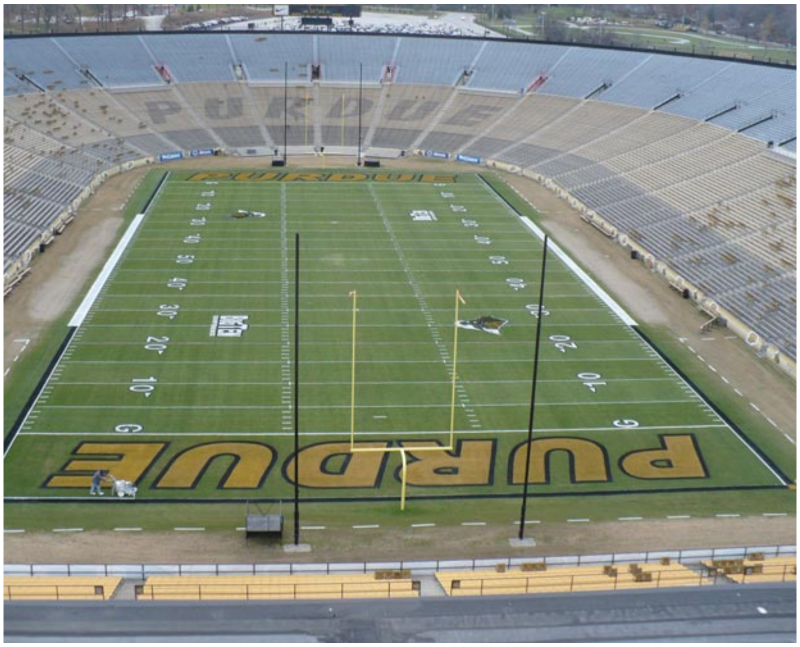
Overseeding bermudagrass fields on the north edge of the transition zone

BERMUDAGRASS is widely used in southern and transitional zones of the United States for athletic fields. Its popularity is due to its recuperative potential via aggressive stolons and rhizomes and tolerance to heat, drought, and low (≤ 1 inch) mowing. With improved cold hardiness in seeded and vegetative cultivars, bermudagrass has been pushed to the northern edge of the transition zone. The major drawbacks of use in more northern climates are the possibility of winterkill and an extended dormancy period that results in a straw-brown appearance that can last from first frost in the fall until soil temperatures at a depth of 4 inches rise above 50°F; this is usually late May to early June in the northern transition zone.

To overcome this, turf managers routinely overseed bermudagrass athletic fields with a cool-season ryegrass mixture in late summer/early fall to achieve year-round color and improved aesthetic quality. Although dormant bermudagrass can withstand considerable traffic, overseeding can improve resiliency and performance under intense use.

Overseeding bermudagrass also has its disadvantages. From an agronomic standpoint, overseeding is basically growing two types of plants with different management requirements in the same location. Ryegrass out-competes the dormant bermudagrass for light, nutrients and water throughout the fall, winter and transition period in the spring. Another potential disadvantage is scheduling the overseeding within the optimum planting window without interfering with play on the field. Overseeding too early in the fall reduces establishment of the ryegrass seedlings due to the competition with bermudagrass and the possibility of disease, whereas overseeding too late hampers establishment because of reduced germination and seedling development in suboptimal temperatures.

>> THIS PHOTO OF ROSS-ADE STADIUM at Purdue was taken right before the last home game, November 20, 2010. The field has bermudagrass from wall to wall but is overseeded only inside the media lines; see the contrast of overseeded vs. non-overseeded.



Although the majority of literature is geared toward the golf course industry, recommendations for overseeding rates of perennial ryegrass (PRG) range anywhere from 12 to 15 pounds pure live seed/1000 ft2/year for southern athletic fields. These recommendations were found to be very inefficient in the colder climate when they were followed the first year (2006) we had bermudagrass at Purdue University's Ross-Ade Stadium. In addition, while several of the studies evaluated the effect of seeding rates when planted on a single date, little research had been conducted evaluating the impact of multiple overseeding events into bermudagrass turf. The objectives of this study were to determine optimum perennial ryegrass seeding rates for overseeding bermudagrass athletic fields in the northern transition zone and to determine if multiple seeding events improved overall (PGR) establishment compared to a single seeding event.

STUDY DETAILS

The study was conducted at the Purdue University varsity football practice complex in West Lafayette, IN, which is in the USDA Hardiness Zone 5a, approximately 220 miles north of zone 6a and 6b, which could be considered the transition zone between cool- and warm-season turfgrass adaptability. This site was selected because it provided a moderate amount of wear from the football team while practicing four times per week from August to November. The test plots were located just outside the hash marks in an area where the defensive backs ran their daily drills ensuring that each one received similar traffic. This gave us a more practical understanding of how the overseeding would respond to wear, rather than using the standard cleat simulator.

The field was originally sodded with Patriot bermudagrass in June 2006 and subsequently overseeded with Riviera bermudagrass in May 2007 after approximately 70% turf loss resulted from winterkill. This was a 2-year study that consisted of three application strategies and five seeding rates. Seeding rates of the perennial ryegrass blend were 12.5, 25, 50, 75, and 100 pounds/1000 ft2/year pure live seed. Application strategies included applying 100% of the total seed in one application (100), 70% of the total seed in the initial application plus 10% of the total in each of three successive applications 10 days apart (70/10/10/10), or 25% of the total seed applied in four events applied on ten day intervals (25/25/25/25). Before seeding, a flexible steel drag mat commonly used for baseball infields was used to open the bermudagrass canopy, as opposed to verticutting. We found that verticutting a football field in the northern climate before the start of the season weakens the stability of the bermudagrass, essentially setting up the possibility of field failure. This is due to the shorter window for bermudagrass grow-in, where our fields typically do not reach 100% coverage until mid- to late July.

It is possible verticutting would be an acceptable practice on a baseball or softball field where there is less demand on the turf. Initial seeding dates for both locations were 24 August 2007 and 25 August 2008. Plots were lightly topdressed with rootzone sand after each seeding and brushed into the turf canopy with a stiff bristled broom.

RESULTS

Perennial ryegrass coverage rarely increased at seeding rates higher than 50 pounds/1000 ft2/year regardless of location, seeding strategy, or rating date. The 12.5 pounds/1000 ft2 /year seeding rate consistently produced the lowest coverage in this study and would not be recommended, but 25 pounds/1000 ft2/year was occasionally amongst the top grouping for PRG coverage in this study. The seeding strategy of 25/25/25/25 consistently produced the most PRG coverage, nearly 20% greater than that from the 70/10/10/10 and nearly 50% greater than that from the 100 strategy. This could be due to the fact that both the 25/25/25/25 and 70/10/10/10 strategies introduced PRG seed on more than one occasion to counteract the seedling mortality from disease and cleat traffic.

Another interesting discovery from this study was when disease conditions were favorable, any one time seeding amount that exceeded 25 pounds/1000 ft2, resulted in high disease activity. Therefore, based on this study, it is recommended to seed a total of 50 pounds/1000 ft2/year in four equal applications 10 days apart to maximize PRG overseeding coverage on bermudagrass athletic fields in the far northern transition zone. Ultimately, it will be your budget and level of maintenance that determines the total amount of seed you apply at your facility.

For a more comprehensive look at this study, see “Strategy and Rate Affects Success of Perennial Ryegrass Overseeding into Bermudagrass Athletic Fields Located on the North Edge of the Transition Zone” in the *Applied Turfgrass Science Journal*. ■

Brian F. Bornino, MS, is the Graduate Assistant Sports Turf Manager, Department of Intercollegiate Athletics, Purdue University.

Water's true impact on your sports turf

And what it all means for decision making

Editor's note: *Carmen Magro is vice president of agronomy for UgMO Technologies. He has a degree in turfgrass science from Penn State and was superintendent of Bidermann Golf Club, Wilmington, DE from 2000-04 before becoming an instructor in Penn State's turfgrass program. He later worked for Floratine and Advanced Sensor Technologies.*

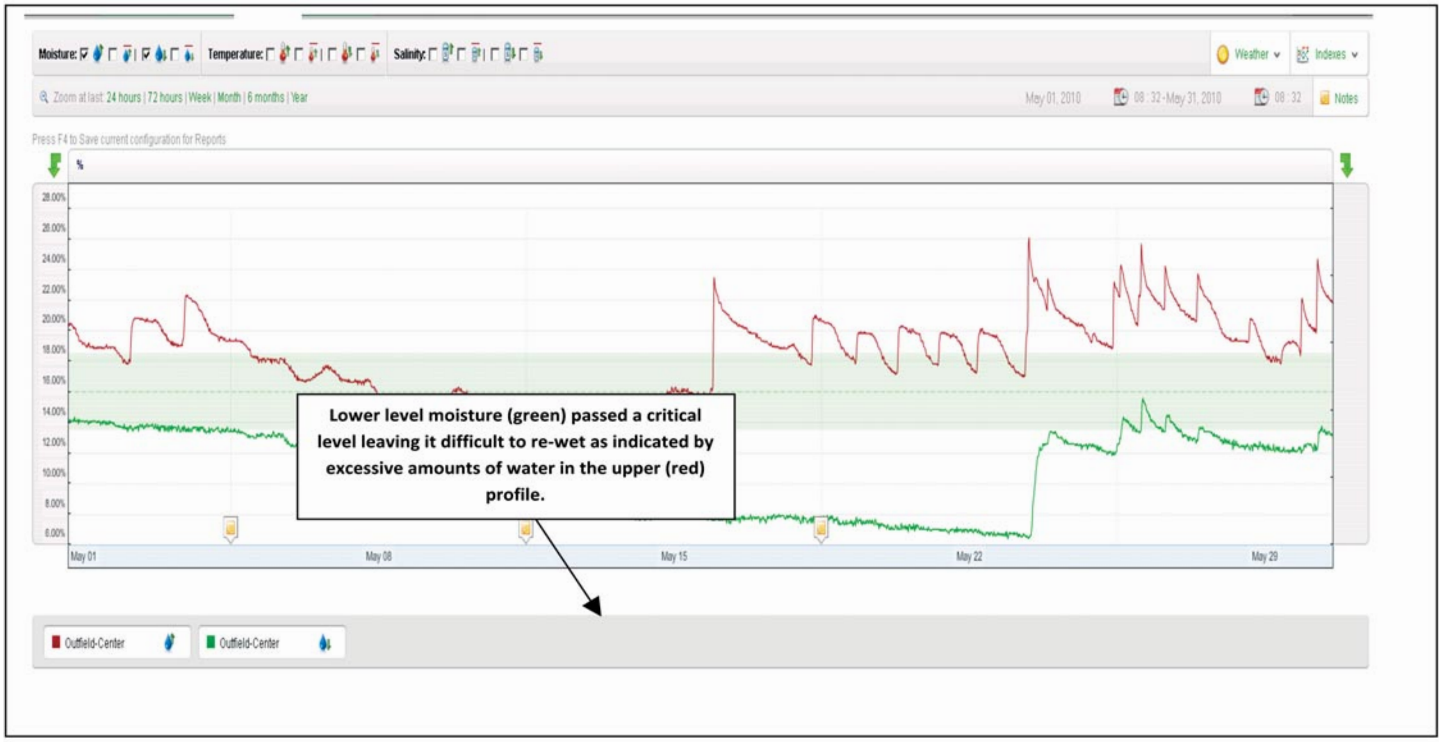
IT HAS BEEN SAID more than once that you cannot manage what you don't see. Then someone needs to explain to me how we as turf managers have been finding a way to do just that for a long time. But have we really managed to the best of our ability? Having been a golf course superintendent and instructor in turfgrass management for golf and sports turf students alike, I have experienced times when I wondered if I was making the right decision when it comes to irrigation practices and water movement through my turf system.

In my 20th year in this business now, having seen millions of data points collected from various soils around the world in real time, I've learned what water truly does in the soil and in our turf systems. More importantly, I've learned from sports turf managers how a simple assumption and decision on water use can make or break a game, a season or even a career.

For the past few years I have served as the VP of Agronomy for UgMO Technologies, a company who specializes in monitoring soil conditions in sports turf, golf, agriculture, residential and commercial landscapes and environmental systems. Through multiple recorded cycles of water in sandy to clay soil types, dry to humid climates, sunny to shady conditions and every other changing variable that you understand far too well, I've learned what water truly does before, during and after an irrigation cycle is initiated. For sports turf users, the question as to whether or not we can gain more information to make better decisions has certainly been answered with a resounding yes when it comes to soil monitoring. Currently, UgMO has recorded millions of data points making it likely the largest real time soil data base in the world as its patented wireless technology allows for sensors to be placed anywhere desired.

Take the skin of a baseball field. Using UgMO in its earliest phase, Eric Hansen of the Los Angeles Dodgers learned quickly that turning off the water completely when the team was out of town was not doing him the best justice for maintaining his skin most effectively. He explained to me that, "I learned how the lower profile in the skin became so dry during the away stands that it took me much more water (and time) to get the skin to the optimum moisture I wanted for the next home stand. I found it much easier on us to maintain better conditions by maintaining a consistent moisture level throughout the skin at moderate levels even during away stands while the overall water use had no significant change."

I certainly understand the need for optimum conditions. Matt Shaffer, superintend-



ent of historic Merion Golf Club, Ardmore, PA says, "I don't manage my course for health; I manage it for playability. Ironically, doing what is best for playability is what is best for water use as far as doing the right thing and being environmentally conscious."

Matt used the sensor system to dry his fairways to a level and keep it there for an extended period of time that resulted in a significant reduction in pesticide use as he simply took the disease pathogen facilitator (water) out of the equation by understanding what his moisture levels were throughout the soil profile.

SCIENCE AGREES

Science agrees with both of these gentlemen. But it is important to highlight one point that is consistent throughout the world of turf management. Those managers that seek information AND use that information to make better decisions are the leaders of the industry and are predominantly more successful than those that ignore information that helps them make better decisions. Even in areas where resources such as pesticides are absent, turf managers that pay attention to the always changing environment in the turf system succeed at developing those playability conditions that are sought after day after day.

Science tells us that if we allow a soil to get too dry it repels water due to hydrophobic reactions. On the flip side, if we allow the soil to remain too wet, water again is repelled but in a way that causes surface ponding and runoff as well as quickly deteriorated conditions from the wear and tear of play and maintenance. In addition, a sandy soil with an immature turf (less than 6 years) has quite a different reaction to soil than the same soil with mature turf on it due to the significant qualities of organic matter.

Much focus is on organic matter and how much is too much. After sensing many soils and conditions, what is true is that organic matter nearly has no limits if it is consistent throughout the soil profile. It is particularly when we have a high level of organic matter condensed into a very small region where it gets compacted and restricts water movement that we really see problems develop. In addition, we lose the control of water through the profile in situations like this.

The UgMO ProHome system that is being used across the country in residential and commercial landscapes as well as ball parks, will not allow irrigation to take place and will even adjust it appropriately to maintain the optimum level of moisture in the soil. This is not something that everyone is willing to give up…that is, the control of their water. Don't worry, we've heard that over and over and ultimately, it is the information that comes from the UgMO monitoring that allows the turf manager to make decisions he or she is most comfortable with making.

So how does the system truly work and is it worth looking into as a resource for your operation? The later is a question only you can answer. However, the use of the system is simple. First it is important to understand some simple characteristics of water and soil physics. Remember from turf school that water has a very strong bond to itself. In addition, the smaller the particles in the soil the more attractive the water to soil bonds are. That is why soils with high organic matter contents have a larger affinity for water than soils with limited organic matter as OM consists of smaller particles than anything else that makes up the physical structure of soil.

Finally, water in the upper profile and its movement depends on the amount of moisture in the lower profile. If water is present up top but not down bottom, it will take cultural practices in most situations to make a change as there is something holding that water up (OM, hard layer, sod layer, etc). Many of you use wetting agents when this is the case. We've learned from managers like you who have installed sensors to monitor water movement throughout the profile that all wetting agents are certainly not created equal (a topic for another article).

On the flip side if we have a lot of water in the lower profile and not much in the upper, this is typically conducive for strong root growth assuming the water is not backed up due to a drain clog or there is no layer dividing the two regions. But what we have learned is that there most certainly is a region of moisture that is best for turf quality to be at its finest at the surface and it is typically when there is slightly moist to dry conditions in the upper two-thirds of the root system to slightly moist to moderately moist in the lower profile. In addition, the depth of measurement varies from site to site and can only be identified when the sensors are installed.

Kenny Pauley maintains the football field at the University of Georgia and says, "UgMO has allowed me to understand what my optimum game day conditions are. I didn't use the system to tell me what those conditions are…I prepared them and then used the measurements to know what the conditions are for my field. With that information I can now understand days before a game, depending on the forecast and other influential events what I need to do to get those conditions back. Do I need to get water deep or shallow, uncovered or covered…whatever it takes to get the conditions I need for the best playability."

Pauley is expanding his use of the sensors throughout many areas of the campus as he is finding the information more and more useful.

DODGER STADIUM

In the early use of the system at Dodgers Stadium, Eric Hansen found that the park was not initially set up to monitor every gallon used on the field since much of the water was shared outside of the stadium and other areas. Interestingly, the goals of Eric are similar to that of the others…they are managing for the best playability. While saving water is important, they are not operating to save water but simply to use it most efficiently to manage the property in the environmentally conscious way while providing the conditions necessary for the game. I worked closely with Eric to achieve his goal of finding how low he can actually go on his moisture levels before he had too little water in the soil. He learned that there is a limit. More importantly he learned that reaching that limit is not a good idea but maintaining at a level slightly above it is wonderful. As a result of crossing the limit, his bermudagrass was set back and took a lot of attention, time and water to bring back. Other areas that were maintained at or above that threshold held up quite well throughout the season.

What all of the users of UgMO's soil monitoring system will tell you is in agreement with our agronomic philosophy…that is, UgMO doesn't tell you what to do. While even with the ProHome system mentioned above where it makes irrigation decisions daily based on changing soil conditions, even that system has intelligence in it that is science based with regard to how water moves through each and every soil…and how every soil is truly different. But for turf managers, particularly in sports where the camaraderie is strong, sharing information seems limitless and without hesitation. Learning from each other and seeking every piece of knowledge that can help make better decisions is more of a reality than ever with the ability to see wirelessly into the soil whenever or wherever one wants to.

In the chart on page 14, notice the upper moisture (red) dried down significantly to a point the mimicked a large decline in moisture in the lower profile. In this situation which is the opposite of what is best for strong plant growth, it becomes very difficult to rewet the entire profile and get the conditions conducive for high surface performance. The green band called the UgMO Zone on the user interface which is accessible from any internet connection indicates the target moisture level. This level is user defined and identified through the experience of the field manager and the association of recorded values with condition observations. Managing moisture to these targets allows for consistent conditions, a reduction in overuse of water and the predictability of how the turf will perform on game day. ■

JOHN MASCARO'S PHOTO QUIZ

John Mascaro is President of Turf-Tec International

Can you identify this sports turf problem?

Problem: White objects growing in turf
Turfgrass area: Six month old municipal field
Location: Pompano Beach, FL
Grass Variety: 419 Bermudagrass

Answer to John Mascaro's Photo Quiz on Page 33

Hygroscopic & humectant technology use for water management challenges

***Editor's note:** This article was written by Sarah Irwin, a marketing representative for Ecologel Solutions, LLC.*

WITH RISING COSTS, watering restrictions and recurrent drought, maintaining healthy turf with less water is a perpetually increasing challenge for many sports turf managers. Several new technologies have been developed to provide solutions for conservation without sacrificing quality. One such technology, Hydretain, is a liquid application designed to reduce overall watering requirements, and protect plants from drought stress in between periods of rainfall or irrigation.

Once applied, Hydretain forms a thin film around plant root hairs. This film, consisting of hygroscopic and humectant compounds, attracts individual water molecules from the surrounding environment and condenses those molecules into plant usable water droplets. By making use of water vapor that would otherwise be lost to evaporation, Hydretain enables plants to thrive with up to a 50% reduction in watering frequency.

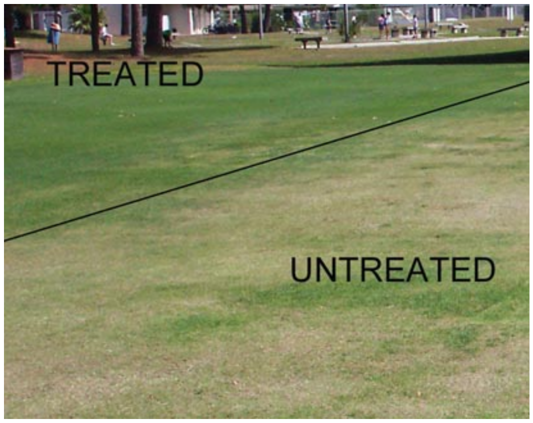
When plants do not receive sufficient moisture from rainfall or irrigation, the ensuing drought stress can do more damage than all other environmental factors combined. By supplying roots with microscopic droplets in between periods of rainfall or irrigation, Hydretain can help minimize or even eliminate the effects of drought stress.

"After applying this product to an initial 3 acres of golf course turf during the summer's severe drought and heat, I saw positive results in less than a week. The previously drought stressed, brown grass at the sites of my initial application was green and vigorous within one week of application of Hydretain. Subsequently, I proceeded to apply Hydretain to 100 acres of golf course turf. Within the first month of application, I noticed not only healthier turf under severe drought conditions," said Rich Cope, golf course superintendent for the University of Texas Golf Club, "but my irrigation demand was decreased by 33% without sacrificing turf quality. Even though I irrigate with effluent water at no cost for the water, this irrigation reduction is significant because my pumping costs, including electricity and component wear, were reduce by 1/3 and my turf quality was significantly improved under the worst climatic conditions I have experience in 20 years of golf course management."

Formulated from food grade materials, and containing no hazardous chemicals, Hydretain is environmentally friendly and safe to use around children and pets. Since Hydretain does not have the ability to store significant quantities of water, it will not encourage fungus or disease development. Although best results will be obtained by using Hydretain proactively and as part of a regular maintenance program, the product can be used for seasonal applications and for the individual treatment of localized dry spots.

Hydretain should not be mistaken for a surfactant or superabsorbent polymer. The Hydretain technology is unique in its ability to convert subsurface humidity into plant usable water droplets. As a liquid, Hydretain can be applied at any point in a plant's life. In addition to reducing overall watering requirements and helping to minimize the effects of drought stress, Hydretain is also beneficial for seeding and sod establishment. Applied immediately after seeding, Hydretain increases germination rates by keeping seeds from drying out. Furthermore, Hydretain aids in establishment and root growth by keeping more water available for the developing roots of seedlings, sprigs and sod. Hydretain is just as beneficial for the transplant, establishment, and maintenance of bedding plants, shrubs, and trees.

The Hydretain technology is sold by John Deere Landscapes under the name of LESCO Moisture Manager®; by BioPro Technologies, LLC as H3O Plus; and by Ecologel Solutions, LLC as Hydretain ES, Hydretain ES Plus and Hydretain ES Plus II. ■



ASBA recognizes new Certified Field Builders

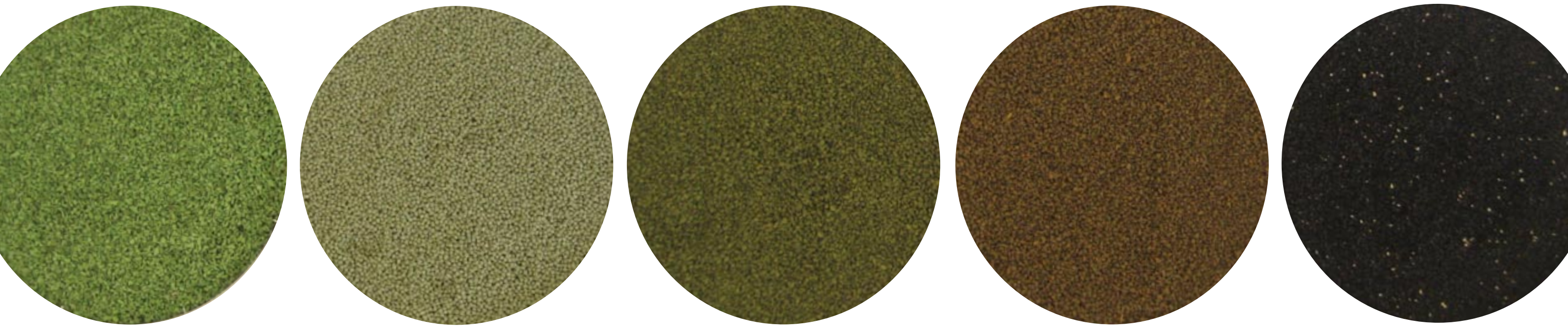
THE AMERICAN SPORTS BUILDERS ASSOCIATION (ASBA) has announced the names of the individuals most recently recognized as Certified Field Builders (CFB). ASBA's voluntary certification program allows builders of specific athletic facilities (currently tennis courts, running tracks and sports fields) to demonstrate proof of their experience, as well as their knowledge of sports facility-specific construction.

ASBA developed the program in order to help raise professional standards and improve the practice of sports facility construction. The CFB designation encompasses both natural grass and synthetic turf fields; however, an individual may choose to specialize and become either a CFB-N (the designation for those specializing in natural grass fields) or CFB-S (for those specializing in synthetic turf).

To become a certified builder, an individual must meet specific criteria set forth by ASBA; he or she must complete an application that shows proof of a set amount of experience in the chosen type of sports facility, and then pass a comprehensive exam on construction and maintenance. In order to maintain the designation, an individual must recertify every 3 years by documenting a sufficient level of continuing education activities in the relevant field or by passing the examination again. ■

The following individuals recently completed all requirements to become Certified Field Builders:

Derek Delmonico, CFB (R.A.D. Sports, Rockland, MA)
Mark Heinlein, CFB (The Motz Group, Cincinnati, OH)
Jason Hester, CFB (Sports Turf Company, Inc., Whitesburg, GA)
Jonathan Holland, CFB (Precision Turf, LLC, Buford, GA)
John McSweeney, CFB-S (AstroTurf, Trenton, MI)
Aaron McWhorter, CFB (Sports Turf Company, Inc., Whitesburg, GA)
John Plaia, CFB (Hellas Construction, Inc., Austin, TX)
Christopher Polk, CFB, CTB (Hellas Construction, Inc., Austin, TX)
Matt Schnitzler, CFB, CTB (Hellas Construction, Austin, TX)
Craig Shonk, CFB- S (AstroTurf, Grain Valley, MO)
Joseph Williamson, CFB (Sports Turf Company, Inc., Whitesburg, GA)



>> **Figure 1. INFILLS TESTED** included (left to right) Ecofill, TPE, green crumb rubber, tan crumb rubber, and black crumb rubber.

Is there any way to cool synthetic turf?

WHEN WALKING ACROSS A SYNTHETIC TURF FIELD on a sunny summer day, it does not take long to notice the heat emanating from the surface. While synthetic turf has undergone design changes that have improved overall field conditions, the issue of high surface temperature remains. Should I irrigate my field to cool it off? Do alternatives to black crumb rubber infill really lower surface temperature as they claim? At Penn State's Center for Sports Surface Research, our studies are beginning to answer these questions.

Before we get into the results of our testing, it is useful to have an understanding of when and why these surfaces get hot. Surface temperatures reach their peak during bright, clear sunny days with little humidity and haze. The temperature of a field on an 82° F clear, sunny day will be higher than on a hazy, humid day with an air temperature in the 90's.

How hot can synthetic turf really get? The highest recorded temperature was 200° F during a summer day on the campus of Brigham Young University in Provo, UT. While this may be an extreme case, it is not uncommon for temperatures to surpass 150° F. In fact, during Penn State's Turfgrass Field Days this past summer, we recorded temperatures as high as 175° F on our research plots. For a comparison, natural turf rarely reaches 100° F, even on the hottest, clearest days.

Irrigation is the most common method used to try to reduce the surface temperature of synthetic fields. Pumping water onto synthetic turf may garner some odd looks, but the application of water can rapidly cool the surface of the field. The problem is that cooling effect is short-lived. Our research shows temperatures quickly rebound 20 minutes after irrigation stops and the irrigated surface is only slightly cooler than a non-irrigated surface three hours after watering (less than 10 degree difference). Another issue with irrigation is the potential for increased humidity directly above the turf's surface. Rising temperatures coupled with high humidity may expose athletes to even more heat stress.

The reason we have not been successful in significantly reducing the temperature of these surfaces through irrigation is that these systems have been designed to rapidly drain water. They simply do not hold onto much water and thus the evaporative cooling is short-lived. We have attempted to increase water holding capacity of the systems and thus increase the duration of the cooling effect by adding water-holding particles to the crumb rubber infill.

In our testing, we mixed a substantial amount of calcined clay with crumb rubber (1 to 1 on a volume basis). While successful in prolonging the duration of cooling initially, the calcined clay particles were reduced to dust when subjected to simulated field use. Not surprisingly, the cooling effect was lost as the particles broke down. Additionally, such a high amount of calcined clay may affect the playability of the field and the dust could impact drainage, although this was not measured in our study.

Although it is common to blame the sunlight's interaction with the black crumb rubber for the hot surface, the fibers also significantly contribute to a field's temperature. Anyone who has spent time working with traditional (non-infilled) Astroturf-type surfaces can tell you that those fields also got extremely hot and they do not contain any crumb rubber. In fact, results from our research plots show that the surface temperature of traditional Astroturf is higher than infilled synthetic turf when no irrigation is applied.

Surface temperature reduction has been attempted through modifications to both the infill material and changes in the fiber. Marketers of crumb rubber infill alternatives claim their products reduce surface temperature. Some have proposed chang-

>> **Figure 2. EXPERIMENTAL SETUP** to evaluate surface temperature of synthetic turf.