>> **KEVIN TROTTA,** left, of the Global Sports Alliance and Jerad Minnick.

troleum products to operate. Gasoline, diesel fuel, oils, and grease are all big expenses. Additionally, operating such a large fleet of equipment constantly emits exhaust into the air during a workday.

Evolution Potential for Maintenance Programs: Hybrid and electric technologies are no longer advancements solely owned by car companies. Equipment companies are now producing hybrid mowers that require up to 40 percent less diesel fuel and are comparable in cost to conventional mowers. Not only do the hybrid mowers dramatically eliminate emissions, but it also requires less maintenance with less fluid changes and the engine running at less rpm's decreases noise pollution. In addition, vegetable-based hydraulic fluids and greases reduce petroleum dependence, along with reducing the risk of hydraulic leaks onto the grass and shop spills. As more machines are designed to burn engineered fuel, bio-diesel will continue to grain strength and popularity

WATER CONSERVATION/ WATERING EFFICIENCY

Environmental Impact: Water is our earth's most valuable resource. Overuse and waste of water not only impacts our overall water quality, it also adds to disease pressure on stressed turfgrass and washes fertilizers through the soil more quickly.

Evolution Potential for Maintenance Programs: When considering water conservation and irrigation, turf managers should strive to water efficiently and purposefully.

The effects of improper timing for watering are harmful. Not only is water wasted but the likelihood of disease outbreaks increases because of prolonged periods of leaf wetness.

Overwatering is also harmful. Roots are damaged when overwatering takes place as the water reduces the air space in the soil and the nutrient food bank is lost because the water washes them through the soil profile.

Improvements in weather forecasting resources to monitor weather conditions provide valuable information for reaching

>> **RYAN BJORN** painting a logo.

maximum watering efficiency. Wind speed and direction, humidity, and UV index are all factors that lead to evapotranspiration (ET). ET is the term used to describe the amount of water lost from the soil during a given day. Monitoring the precipitation forecast in combination with the actual ET and ET forecast, can help determine whether to wait an additional day for irrigation or until a rain event. Larger or busy facilities should consider the merits of a paid subscription weather service as well as employing real-time consulting services to be able to make better decisions on watering. The money savings from skipping only a few watering cycles will pay for the subscription.

Additional technology such as rain and wind sensors should be used in a water conservation program as well. These sensors can be installed on irrigation satellites to stop watering if sufficient rainfall has been received or if wind is gusting as to cause the water to blow off target. High-efficiency irrigation heads should replace aging irrigation heads that are leaking at the base seals and water pressure should be monitored in order to use the correct nozzles to reduce misting. Aggressive aeration also helps with water penetration so that less water is required to soak into the soil and lessens run off.

New paints are now available with low or no VOC content.

Water is a vital natural resource, and everything must be done to use it efficiently.

PAINT

Environmental Impact: Sports field paint historically been considered at least somewhat environmentally "safe" as these water-based paints break down relatively quickly. However, the colorant in these paints still holds VOC's (volatile organic compounds) that could be harmful for the environment. These VOC's are known pollutants to the environment that do not break down quickly.

Evolution Potential for Maintenance Programs: A soccer field has nearly .50 mile of lines to be painted each week. A football field has over .75 miles of lines before numbers, hash marks, and logos. Because of this large volume of paint being used, it is important to be mindful of the VOC content that is being added to the environment. New paints are now available with low or no VOC content. Your sales or paint manufacturer can give you the exact VOC content of the products you are using.

According to studies at Colorado State University and North Carolina State University, well maintained turfgrass sequesters up to .45 tons of carbon from the atmosphere per year. So the turfgrass in a park or large sports facility has the ability to remove the carbon amount equivalent to the emissions of driving a car from Washington, DC to Los Angeles, CA 45 times.

As maintenance programs continue to evolve to reduce carbon inputs, sports fields and parks will be able to improve the overall quality of the environment and save money. Certainly there are many more parts of a program where environmental protection can be found. But examining the standard approach in each of these five areas begins the journey toward long-term results for environmental protection. In addition, facilities will save money along with providing a more quality experience for the visitors and players who frequent the fields and parks. Yet most importantly, the environmental stewardship sets an example for the young patrons of the parks to follow. These young patrons are the sports field and park managers of the future that will carry on your example of environmental stewardship. ■

Jerad R. Minnick is sports turf manager for the Maryland Soccer Foundation, Boyds, MD. He thanks Sarah Hardy for her helping editing this article.

>> **CORE CULTIVATION (above)** coupled with sand topdressing **(below)** is a common practices for alleviating surface compaction and improve drainage. Photos provided by Alec Kowalewski and James Crum.

>> **Above: TWO INCHES** of sand topdressing accumulated on a native soil athletic field over two consecutive growing seasons, photo provided by Ed Everett.

>> **Above: STANDING WATER ACCUMULATES** on the sidelines of a well-managed athletic field without drain tiles despite a significant sand layer developed from frequent topdressing applications.

Selecting the proper topdressing material for your athletic field

BENEFITS OF SAND-BASED ATHLETIC FIELD SYSTEMS include a foundation that is not only resistant to compaction, but also capable of maintaining stability and rapid infiltration during periods of heavy rainfall. However, sand-based athletic fields are particularly susceptible to organic matter accumulation. Effects of excessive organic matter accumulation on sand-based turfgrass systems include decreased infiltration and hydraulic conductivity, diminished air filled porosity, which compromises gas exchange, and reduced root development and growth.

Core cultivation and vertical mowing coupled with frequent sand topdressing applications are often used to combat organic matter accumulation. Sand topdressing can also be used to improve the physical characteristics of native soil athletic fields high is silt and clay, which would otherwise provide relatively slow infiltration, have poor stability during periods of saturation and be liable to compaction. Aggressive sand topdressing (as much as 1.0-inch applied over 3.5 months), or sand-capping, can provide a cost-effective alternative to complete field renovation.

Research conducted at Michigan State University, East Lansing, MI and case study analysis have determined that intercept drain tile installation and a cumulative topdressing depth of 2.0-inhces can substantially improve native soil athletic field drainage and playability for $66,000 to 72,000 (estimates include irrigation and drain tile installation, as well as topdressing material and application). For field managers with substantial budget restrictions, topdressing alone can significantly improve playability and drainage; however, these fields will likely develop standing water along the sidelines and in low lying areas during periods of heavy rainfall.

SELECTING THE PROPER TOPDRESSING SAND

The amount of topdressing material necessary to develop a 2.0-inch sand layer over a standard high school football

Table 1

	Topdressing Material Recommendations for Athletic Field Use[w]	Alternative recommendations and specifications	
		USGA (2004) root-zone[w]	ASTM (2004) root-zone[w]
	Sieve fraction sand particle diameter (% retained)		
Fine Gravel (>2.0 mm)	<5%	<3.0	< 20.0
Very Coarse Sand (1.0-2.0 mm)	5-15%	≤ 10.0	< 20.0
Coarse Sand (0.5-1.0 mm)	20-30%	≥ 60.0[x]	25 to 50
Medium Sand (0.25-0.5 mm)	30-45%		> 25.0
Fine Sand (0.1-0.25 mm)	10-18%	≤ 20.0	< 10.0
Very Fine Sand (0.05-0.1 mm)	2-5%	≤ 5.0[y]	< 5.0
Silt (0.002-0.05 mm)	2-5%	≤ 5.0[y]	< 5.0
Clay (<0.002 mm)	2-5%	≤ 3.0[y]	< 3.0
Cost of material meeting these recommendations[z]	$30 per 1,000 lbs	$20-25 per 1,000 lbs	

field equates to roughly 600 tons, costing $12,000 to $36,000 depending on material specifications and availability. Field managers should be aware that not all topdressing material will provide the results they are looking for, i.e. improved infiltration rates and surface stability. For instance, topdressing sand containing excessive amounts of course particles, and poorly graded sand, which may be as cheap as $10 per 1,000 lbs, will compromise stability. Sands containing more than 10% silt (0.002 to 0.05 mm) and clay (<0.002), on the other hand, will compromise drainage (Table 1).

When shopping for topdressing material have a physical analysis done before selection, look for well-graded sand, with <5.0% fine gravel (>2.0 mm) and ≤ 10% silt+clay. The "Topdressing Material Recommendations for Athletic Field Use" (Table 1) suggest 2-5% very fine sand (0.05-0.1 mm), 2-5% silt and 2-5% clay. Material meeting these recommendations will increase the stability of the sand, without compromising infiltration rates. Materials meeting these standards will likely be a specialized soil blend for athletic field use and cost around $30 per 1,000 lbs. Field managers may also opt to use topdressing that conforms to USGA (2004) rootzone recommendations, which are designed to maximize drainage.

Sands conforming to USGA recommendations may have little to no fine material (<10% very fine sand, silt and clay combined), which may reduce surface stability in comparison to materials conforming to "Topdressing Material Recommendations for Athletic Field Use." However, field managers in locations that receive heavy rainfall may be willing to compromise some stability for maximum drainage. Topdressing material conforming to USGA recommendations will likely be readily available and cheaper ($20-25 per 1,000 lbs) than the specialized athletic field soil blend previously discussed.

PREVENTING SOIL CONTAMINATION

After an adequate sand layer (2 inches) has been accumulated over time, light topdressing (0.25-inches annually) and annual cultivation should be used to prevent the accumulation of organic matter on the playing surface. If hollow or side-eject tines are used for cultivation purposes, special care must be taken to remove soil cores or prevent tines from penetrating to depths greater than the sand topdressing. If native soil is excavated by the hollow tines and deposited on top of the sand layer they must be removed to prevent the drainage system from being compromised by the poorly draining subsoil. A simple alternative to prevent this problem from occurring would be verticutting, which would allow field managers to address organic matter accumulation without disrupting the soil profile. For best results the selected cultivation method should be coupled with sand topdressing, pairing these cultural practices will ensure that the voids created by cultivation are filled with sand, allowing the system to maintain rapid infiltration rates in the long run.

It is important to note that field managers and topdressing suppliers should work together regularly testing material to ensure that topdressing specification remain consistent over time. If a field

>> **Above: IF CORE CULTIVATION DEPTH** penetrates the topdressing layer, or sand-cap **(top photo)**, these cores should be removed to prevent drainage from being compromised by the native soil that is brought to the surface.

>> **Above: WHEN CULTIVATING** a built-up sand-capped field with a sand depth of 2-inches or less, verticutting is an easy alternative to core cultivation that will not disrupt the soil profile.

manager is forced to switch to an alternative topdressing material it is essential to select a material with the same or lower proportions of fine material; fine sand (0.1 to 0.25 mm), very fine sand, silt and clay. Placing material containing a greater amount of fines over your existing sand will result in poor space discontinuity, which will decrease surface infiltration rates and produce a perched water table affect.

COST-EFFECTIVE CRUMB RUBBER USE

Crumb rubber, while being substantially more expensive than sand topdressing ($1,000 per 1,000 kg) has been shown to significantly improve turfgrass wear tolerance in extremely high foot traffic areas, when sand topdressing may no longer be affective. Due to the cost restraints associated with this material application is often restricted to localized high traffic areas, such as sidelines and soccer goal mouths. Current recommendations suggest small-particle size crumb rubber (0.05 to 2.0 mm) applied at a 0.25-inch depth (223 kg per 1,000 ft2) per application until a cumulative depth of 0.75 to 1.0-inch is achieved.

RECOMMENDATIONS

When using sand topdressing to develop a built-up sand-capped athletic field system field managers should strive to apply a 1 inch depth of sand topdressing over a 3.5 month period, with a cumulative depth of 2 inches, which is attainable in as little as two growing seasons. After this depth is achieved apply 0.25-inches of sand topdressing annually, coupled with core cultivation and/or vertical mowing to mitigate organic matter accumulation. When selecting a topdressing material field managers looking to improve stability and drainage should select materials that adhere to "Topdressing Material Recommendations for Athletic Field Use" (Table 1). While field managers looking to maximize drainage should select sand that conform to USGA recommendations for a method of putting green construction (USGA, 2004). ■

>> **THIS PHOTO** illustrates the perched water table affect that can result from applying a topdressing material with a greater amount of fine particles; fine sand, very fine sand, silt and clay, over sand with a greater proportion of coarse material.

>> **CRUMB RUBBER** is an excellent topdressing material for high traffic areas were sand topdressing may no longer affective; however, it is cost prohibitive ($1,000 per 1,000 lbs) in comparison to sand topdressing ($20-30 per 1,000 lbs, depending on specifications and availability).

Alec Kowalewski, PhD, is an assistant professor, environmental horticulture, Abraham Baldwin Agricultural College, Tifton, GA. Articles referenced available online.

JOHN MASCARO'S PHOTO QUIZ

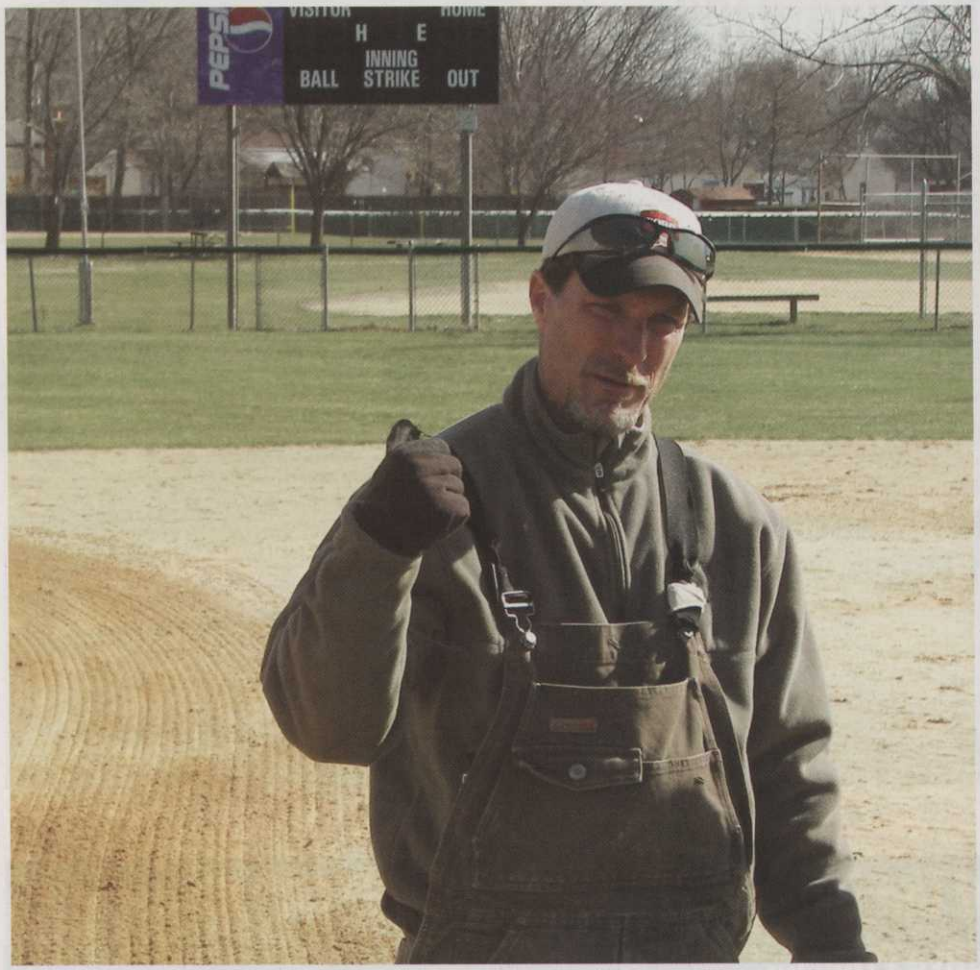
John Mascaro is President of Turf-Tec International

Can you identify this sports turf problem?

Problem: New sod installation; turf green on left
Turfgrass area: Football practice fields
Location: Cincinnati, OH
Grass Variety: Patriot bermudagrass

Answer to John Mascaro's Photo Quiz on Page 33

Background illustration courtesy of istockphoto.com



What does "safe playing fields" really mean?

>> **Above left: WATSON** is grounds supervisor at Pine Hill, a small school district in southern New Jersey near Philadelphia. The district shares a property line with world famous Pine Valley Golf Club.

I AM THE GROUNDS SUPERVISOR at Pine Hill, a small K-12 school district located in the southern part of New Jersey not far from Philadelphia. The district shares a property line with world famous Pine Valley Golf Club. The grounds department is responsible for maintaining about 60 acres of irrigated turf district wide. The Pine Hill grounds crew members are Carmelo Anguilla, Greg Bunting, Tom Crosby and Bill Loftus.

Over the course of the past year, just about everyone involved in the turf industry most likely has heard the term "safe playing fields" used by a variety of people in regards to the safety of our children. Many times sports field managers have been portrayed as being trained only to apply pesticides on a schedule to deal with pests and not someone who is aware about safer alternatives that prevent these problems long term.

I have heard terms like "careless," "uninformed" and "misguided" to describe those of us who apply pesticides on athletic fields. These types of statements have led me to stand up and try to bring some clarity to the conversation about safe playing fields in my home state of New Jersey. Lost in this conversation are the dedication, time and energy that sports turf managers put into their craft. Most people don't see the pre-dawn irrigation checks, the weekend visits on site, and the amount of time spent at home researching, plotting and planning updates to our turf plan, all in pursuit of the safety of the athletes that use

I have heard terms like "careless," "uninformed" and "misguided" to describe those of us who apply pesticides on athletic fields.

our facilities. With that being said, let's look at what really constitutes a "safe playing field."

Of course I don't know if there is one true definition for a safe playing field but turf quality is a good place to start the discussion. If a field has a smooth, well-rooted and groomed surface it is more than likely to provide a safe playing surface for just about any sport. The key ingredients for quality sports turf are fertility, proper seeding, good cultural practices and responsible pest management (IPM).

In New Jersey, there is a new fertilizer law in place. Every state has different laws; it is always best to stay informed and up to date with current local laws. Our law restricts the amount of nitrogen applied per year, sets blackout dates for applications (12/1-2/28), prohibits potassium without a soil test, and sets standards for professionals and homeowners alike in regards to fertilizer applications. No matter where you are, don't use the law as an excuse to ignore fertility requirements on your fields. It takes some thought and close monitoring to comply with these types of laws but consistent fertility applications throughout the year are very important to maintain quality turf. Spring turf requirements call for moderate amounts of nitrogen (my choice is ammonium sulfate), while summer stress can be dealt with by introducing an organic or slow release product. Fall should be reserved for higher amounts of nitrogen to ensure your fields will survive the demands of the season and falling soil temperatures. This is a very important point that is often overlooked.

Fall fertility serves two purposes. First, nitrogen (again, ammonium sulfate is my choice) availability is crucial to establish new seed and also for recovery from fall sports damage. Secondly, it allows turf growth to extend into the end of the fall sports season. Too often fall fields are allowed to stop growing when temps drop but field use continues. Starting early in the spring and continuing all the way through the fall season will give you maximum results for your fertilizer dollar and provide a dense, consistent turf cover for the entire year.

DEALING WITH CRABGRASS

Dr. Dave Minner from Iowa State University and I talk often about how difficult it is to overcome the amount of seed heads produced by crabgrass. Having large amounts of seed introduced into the soil and then worked in by the athletes seems like a tough thing to deal with. Crabgrass technology can be used by the sports field manager in the same manner. From August through November we live by the motto, "If you see brown, throw it down." This means introducing perennial rye seed any time you see bare soil.

Broadcasting seed during the fall sports season is the key to keeping turf coverage all year long. A common perception is that you are wasting money if you seed during field activity. I disagree. Due to unpredictable weather in the spring and hot/humid conditions in the summer, fall is the season of choice for overseeding. Unfortunately, this is when athletic fields absorb the most abuse and wear. I take a nothing ventured, nothing gained approach. If you don't seed during the fall, you will

>> **LEFT TO RIGHT:** Bill Loftus, Carmelo Anguilla, Tom Crosby, Brad Park (Rutgers University), Rich Watson and Greg Bunting.

end up with a good deal of bare soil at the end of the season. I believe that it is easier to grow turf from seed during moderate fall weather conditions than any other time of year. Perennial rye is my choice for use during this timeframe due to its wear tolerance even as seedlings.

As the season winds down, we start to introduce turf type tall fescue into the fields. This is done later because tall fescue doesn't hold up to traffic upon emergence as well as perennial rye does. Tall fescue however, has displayed more disease resistance on our fields. It is not a common mix, but it has been working for us. My friend Scott Bills, CSFM, also points out that overseeding regularly allows for the introduction of multiple generations of seeds, including newer varieties. The amount of seed planted in the fall allows our fields to emerge from winter with almost full turf cover. This gives us a better chance of fighting off pests and stress as we enter the height of the growing season.

Speaking of pests, sometimes even with your custom fertility plan in place and an overseeding program enacted things can still go wrong. In New Jersey, the School IPM Act is the law that guides schools through pest issues.

Integrated Pest Management is often a misunderstood term. The EPA has a great definition for IPM. It is an approach to pest management that blends all available management techniques- nonchemical and chemical- into one strategy: Monitor pest problems, use nonchemical pest control and resort to pesticides when pest damage exceeds an economic or aesthetic threshold. Our school IPM law in New Jersey is a little more restrictive than that. If pest problems persist with non-chemical options (proper mowing/irrigation, aeration, seeding with appropriate varieties and soil monitoring/testing) being implemented, the law requires that you consider a low-impact pesticide from a predetermined list of products before making a restricted pesticide application. In my mind it is a very simple process.

The educated field manager is moving away from blanket spray applications and beginning to treat the field within the field. Every field is different with its own needs and requirements.

By performing good cultural practices in conjunction with proper fertility and a good seeding program, you can do some impressive things with your turf. However, it is the sports turf manager's job to take responsible action when pest stresses start exceeding thresholds and put field safety at risk. Gaining an understanding of pest