Herbicide Resistance:

A Problem on the Horizon for Athletic Field Managers?

▶ **A DORMANT** bermudagrass athletic field

ALTHOUGH CERTIFICATION PROGRAMS are in place to limit the presence of weeds in turfgrass seed and vegetative material (i.e., sod, sprigs, etc.), infestations are common on warm- and cool-season athletic fields. Weeds such as crabgrass (Digitaria spp.), goosegrass (Eleusine indica) and annual bluegrass (Poa annua) can be found on fields at all levels of play. Controlling these species is important to athletic field managers in that weed infestations can reduce both field quality and safety. Implementing sound agronomic practices and integrated pest management strategies can help discourage the presence of weeds on athletic fields. However, in many cases herbicide applications are often required for complete eradication.

HERBICIDE RESISTANCE IS A PROBLEM

Herbicide resistance has been defined as the inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide normally lethal to the wild type (Vencill et al. 2012). The onset of herbicide resistant weed biotypes is a global problem of agriculture, turf included. Nearly 400 biotypes of herbicide resistant weeds have been reported worldwide, spanning over 200 different plant species (Heap 2013). The rate at which herbicide resistant weeds have developed in agricultural production has increased following the adoption of herbicide-tolerant crops (i.e., Roundup Ready). This technology allowed for herbicides targeting a single site of action (i.e., herbicides that work in a similar manner) to be repeatedly used for effective weed control; thus, reducing the diversity of techniques used for weed management (Vencill et al. 2012). As a result, selection pressure for herbicide resistant weed biotypes increased.

Despite the fact that herbicide resistance in crop production has been an issue since 1970, several reports of herbicide-resistant turfgrass weeds have surfaced in recent years, illustrating that herbicide resistance is an emerging problem of turfgrass weed management requiring intervention. While most of these cases of herbicide resistance have occurred on golf courses, it is imperative that athletic field managers A) become aware of this emerging issue and B) make changes to their programs to prevent herbicide resistance from becoming widespread on athletic fields in the near future.

▲ **GLYPHOSATE** resistant annual bluegrass (Poa annua) in dormant bermudagrass.

WHAT CAUSED THE PROBLEM?

While herbicide tolerance traits (i.e., Roundup Ready) are not used in the turfgrass industry, diversity of weed management techniques is often lacking. Turfgrass managers often repeatedly apply the same herbicides for control of problematic weeds year-after-year. This has led to the development of herbicide resistant biotypes of annual bluegrass (Poa annua), goosegrass (Eleusine indica), and smooth crabgrass (Digitaria ischaemum) in turfgrass.

GLYPHOSATE RESISTANCE

Bermudagrass (Cynodon spp.) athletic fields

enter a period of dormancy during winter where growth ceases. Non-selective herbicides such as glyphosate (e.g., Roundup, etc.) that normally would be injurious to turfgrass can be used to control weeds during this dormancy period (Anonymous 2010). Many athletic field managers in the transition zone apply glyphosate for weed control during bermudagrass dormancy. Glyphosate applications to dormant bermudagrass fields often provide effective and more economical broad-spectrum weed control during winter conditions than other materials, particularly inhibitors of acetolactate synthase (ALS) such as foramsulfuron (e.g., Revolver), trifloxysulfuron (e.g., Monument), and flazasulfuron (e.g., Katana).

As a result, many weed populations on bermudagrass athletic fields are under intense glyphosate selection pressure, similar to that which has been reported following the advent of glyphosate-tolerant crops in agricultural production systems. Recently two biotypes of annual bluegrass with resistance to glyphosate have been reported in Missouri and Tennessee (Binkholder et al. 2011; Brosnan et al. 2012). In both cases, repeated applications of glyphosate were used to control annual weeds during periods of winter dormancy for over 10 consecutive years.

RESISTANCE TO OTHER HERBICIDES

Resistance is an issue with herbicides other than glyphosate. ALS-inhibiting herbicides such as foramsulfuron (e.g., Revolver), trifloxysulfuron (e.g., Monument), and flazasulfuron (e.g., Katana) are commonly used on warm-season athletic fields to remove overseeded perennial ryegrass (Lolium perenne) and control other problematic grassy weeds such as annual bluegrass and goosegrass. Repeated use of these herbicides for annual bluegrass control has led to the development of annual bluegrass biotypes with resistance to ALS inhibiting herbicides. Cross et al. (2013) identified multiple biotypes of annual bluegrass in the southeastern United States resistant to foramsulfuron and trifloxysulfuron. Populations of annual bluegrass in Tennessee have recently been identified that are tolerant to 8x label rate applications of foramsulfuron and trifloxysulfuron.

Photosystem II (PSII)-inhibiting herbicides such as simazine (i.e., Princep) and amicarbazone (i.e., Xonerate) are used for annual bluegrass control in warm-season turf. Repeated use of these materials, particularly simazine, has led to populations of annual bluegrass resistant to PSII-inhibiting herbicides in Alabama, Mississippi, North Carolina, Oregon, and Virginia (Heap 2013). Hutto et al. (2004) documented the presence of simazine-resistant annual bluegrass on 43% of the golf courses in Mississippi.

Dinitroaniline (DNA) herbicides such as pendimethalin (e.g., Pendulum) and prodiamine (e.g., Barricade) are regularly used for preemergence control of grassy weeds such as crabgrass, annual bluegrass, and goosegrass. Multiple biotypes of annual bluegrass and goosegrass resistant to the DNA herbicide prodiamine have been reported in the southeastern United States as the result of repeated use of prodiamine (Cutulle et al. 2009; Isgrigg et al. 2002; Lowe et al. 2001; McCullough et al. 2013; Mudge et al. 1984).

WHY ANNUAL BLUEGRASS (POA ANNUA)?

To date, the majority of instances of herbicide resistance in turf have occurred in annual bluegrass. The reason for this phenomenon is not completely understood; however, herbicide resistance is most common in annual species (Heap 2013). Prolific annual bluegrass seed production may result in more rapid and effective dispersion and survival of herbicide resistant plants (McElroy et al. 2004). In agricultural production systems, many weed species developing herbicide resistance, such as Palmer amaranth (Amaranthus palmeri) and horseweed (Conzya canadensis), produce copious amounts of seed as well (Nandula et al. 2006; Norsworthy et al. 2008).

WHAT CAN BE DONE?

In order to prevent herbicide resistance from becoming a problematic issue on athletic fields, turf managers must change their approach to weed control. The first step is to learn the manner in which different herbicides work to control weeds. Be sure to consult with local University Extension offices for more information on this important topic. Acquiring this knowledge will not only improve the professionalism of athletic field managers in general but it is also critical for developing weed control programs to prevent resistance development on warm- and cool-season athletic fields. Applying a rotation of different herbicides targeting varying sites of action (i.e., using products that work differently) will reduce selection pressure for herbicide-resistant weeds. However, it is critical that field managers rely on more than just herbicide applications to control weeds. Diversified weed management programs involving sound agronomic practices, integrated pest management strategies, and herbicide applications will ensure that herbicide resistance does not become a problem of athletic field turf in the future. ■

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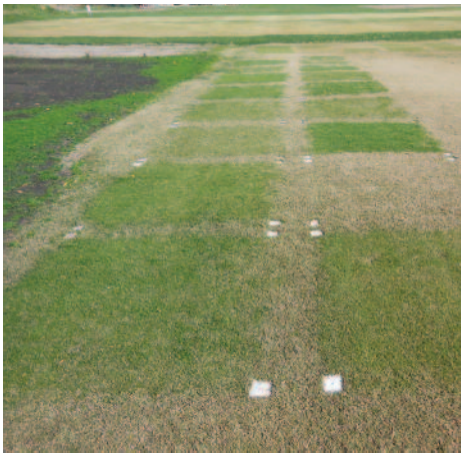
▶ **PURDUE UNIVERSITY'S** Boilermaker soccer complex.



▲ **Top: OVERSEEDING** is largely for cosmetic purposes but the cool-season grass also provides some wear tolerance and recovery.

▲ **Bottom: ANNUAL RYEGRASS**, left, compared to perennial ryegrass, right.

Winter overseeding athletic fields update: 2013

BERMUDAGRASS provides one of the best playing field surfaces throughout many parts of the United States. When properly maintained it forms a uniform, dense, attractive and durable turf. Its strengths are that it readily tolerates close (< 1") cutting heights resulting in a "fast" surface players and coaches like. During the warmer months of summer it is a fast grower. This provides wear tolerance and rapid self-repair of divots from creeping rhizomes and stolons. This dense matrix of stems and roots also provides surface stability, good traction characteristics and an overall stable base for footing.

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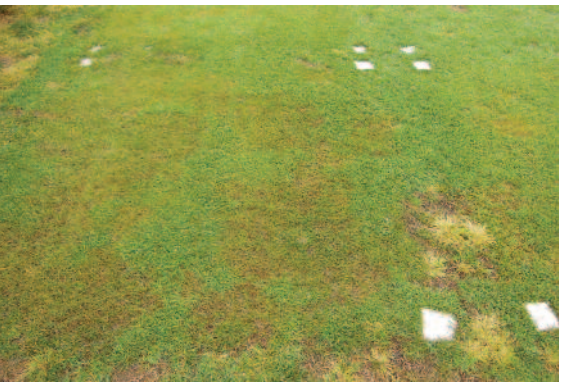
Like all grasses, it is not perfect, and there are negatives. Being a warm-season grass, active growth slows as the days shorten in late-summer or mid-September. As the first hard frosts of autumn approach, bermudagrass begins to lose its vibrant green color and it slowly turns to a golden straw-brown color. In addition to this color loss, rapid growth stops resulting in decreased wear tolerance and less rapid recovery.

Probably one of the biggest weaknesses and one that limited wide-spread adoption in prior decades was the risk for severe winter-kill. Turf managers were reluctant to use a grass that "might" need replanting each year. With the development of very winter hardy cultivars and the ability to rapidly establish bermudagrass from seed, it is now used in many areas where it once was never considered.

To offset some of the aforementioned negatives and to satisfy the public's desire for green grass "all the time," bermudagrass field managers often overseed with a cool-season grass. Overseeding is largely for cosmetic purposes but the cool-season grass also provides some wear tolerance and recovery in trafficked and heavily divoted areas. In recent years many different overseeding strategies and philosophies have emerged. The purpose of this article is to highlight and share some of these thoughts and considerations.

WHAT TO PLANT?

Historically, the grass of choice for winter overseeding has been the ryegrasses. This group includes annual, perennial and "inter-



▲ **OVERSEEDED** species competing with bermuda during spring transition.

▲ **UP-CLOSE VIEW** of a ryegrass seed germinating.

mediate" ryegrasses. The ryegrasses have a large seed size, with significant endosperm (food reserves), which helps them germinate fast and mature quickly when planted under ideal conditions. Generally, most managers select and plant good quality perennial ryegrasses for winter overseeding, especially where they plan to chemically remove the overseeding. There are, however, alternatives that can be considered.

Annual ryegrass is one of the options among the ryegrasses and appears to be attractive from a price point, 25-40% less than a high quality perennial ryegrass. Most annual ryegrasses tend to form a lower quality turf than the perennial ryegrasses, even when well established. Many people do not like the light-green/yellow-green color and the turf may be prone to becoming "stemmy" with poor mowing quality/leaf shredding. Lastly, annual ryegrass is sensitive to harsh winter conditions and will die quickly with the onset of summer heat, making it somewhat unreliable. Although breeders continue to improve and advance this grass, it may best be left for use in places where appearance is not paramount like utility lawns.

Some researchers have been evaluating the tetraploid ryegrasses for overseeding with some success. These ryegrasses are sometimes referred to as "intermediate" ryegrasses and have turf quality characteristics similar to the perennial ryegrasses but their heat tolerance is not very good, somewhat similar to an annual ryegrass. This lack of heat tolerance helps as the turf stand transitions back to bermudagrass during late-spring without the need for chemical transitioning.

What about other species and options? Turf breeders continue to advance all species with the help of feedback from turf managers and desirable characteristics. In some parts of the country I have heard of managers exploring the incorporation of Kentucky bluegrass into their bermudagrass. The goal I am told, is to create a polystand of warm and cool-season spreading, self-repairing grasses that would ebb and flow throughout the growing season. This mixture of bermudagrass and bluegrass might allow for greater intense use across all seasons, spring, summer, autumn, while providing moderate green color all season without a need to overseed/interseed. This technique has not been well evaluated in research trials and it is possible that over a period of years the turf could become very patchy due to segregation. This approach may have some merit where appearance is not paramount and is not a suggested option for stadium fields.

The turf-type tall fescues are another species that has not been well explored, particularly the very narrow leaved ones. The seed size of tall fescue is similar to perennial ryegrass and germination, emergence and establishment is about the same, but ever so slightly slower. Further, with some of the new turf-type tall fescues the visual (color/density) and mowing characteristics are similar to perennial ryegrass or a Kentucky bluegrass. One advantage to using tall fescue is it is not quite as susceptible to gray leaf spot compared to perennial ryegrass. Tall fescue does, however, have very good heat and drought tolerance and would need to be chemically removed the following spring.

The final point I should make is to remember, like anything, you get what you pay for! Purchasing a higher quality ryegrass that germinates quickly and has good turf characteristics (color, leaf texture, density) would in most circumstances be preferred over a less expensive species that has poor seed quality. These less expensive, lower quality seed lots tend to have a greater potential for annual bluegrass (*Poa annua* L.) contamination and that introduces a whole group of other future problems.

HOW MUCH SEED?

If you look up published seeding rates for any grass species the values are normally based on the assumption that you will be seeding on bare soil with the intended purpose of an ornamental lawn, etc. As we all know athletic

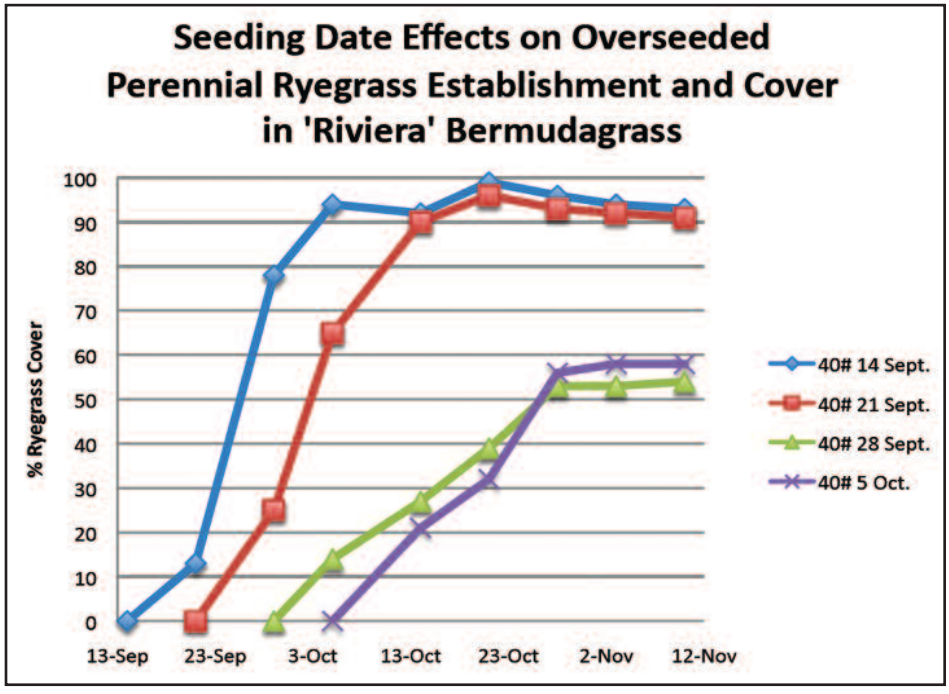


Figure 1

fields serve a very different purpose than an ornamental lawn. The sometimes intense traffic, particularly in concentrated areas like between the hashes, sidelines, goal mouths, and field entry/exit points along with the mechanical forces involved in close mowing and foot traffic, can be a harsh environment for a turfgrass seedling to develop and survive. As one of my colleagues has said, the adage "more is better" bears some truth when it comes to winter overseeding, and I agree.

For athletic field overseeding, it is recommended that the seeding rates be double or many times more than normal, simply because a great deal of seedling mortality is expected. For example, a common seeding rate for perennial ryegrass on bare ground is about 5 pounds of seed per 1000 ft2 or 220 pounds per acre. For general overseeding purposes a rate of 2 to 4 times as much or 400 to 800 pounds per acre is not uncommon. Without these higher seeding rates you risk producing an overseeded turf that may have a patchy appearance. This can be worse than not overseeding at all.

For overseeding on American football fields used at the collegiate and professional level it is not uncommon to use extremely high rates, doubling those aforementioned rates to 1500-1600 pounds per acre. Some of our research at Purdue on winter overseeding indicated that these very high rates, 40-50 pounds per 1000 ft2 or 1600 pounds per acre, appear necessary if the goal is to produce a dense, closely mowed that will persist. Remember, these fields are subject to very intense traffic compared to soccer, etc. The athletes at this level are larger, more aggressive in the way they move on the field, and basically there is much more potential for large divots. Compounding the overseeding challenge for us in north central Indiana is that we have a very short window to achieve good establishment. Thus, the strategy is seed heavier early, then top off the stand throughout the season. Remember, if these very high seeding rates are used you will most certainly be considering chemical removal if you want the bermudagrass turf to fill back in quickly the following spring.

The other consideration is that if you are using these extremely high seeding rates it is important to regularly scout for disease. If an "Indian summer" persists resulting in prolonged late-summer heat and humidity these seedling diseases will be more of a concern. Loss during late-season establishment can really set back any overseeding program. You should have appropriate plant protectants available for either preventative or curative control. It is also important to at least be aware and scouting for potential seedling mortality from gray leaf spot. This disease is a very real concern wherever ryegrass is planted and can be particularly devastating to seedling ryegrass. The symptoms are very similar to drought stressed turf, so keep a watchful eye.

WHEN TO PLANT?

The ideal time to plant cool-season grasses for optimum germination and the fastest establishment is late-summer through early to mid-fall. The most important factors affecting overseeding success are sustained soil temperatures and seed-soil contact. Rather than put a hard and fast planting date on overseeding, some published guidelines suggest monitoring air and soil temperatures. For example, some books suggest initiating overseeding when night-time temperatures are consistently around 50F or soil temperatures at 4 inches are in the mid 70'sF. These are good guidelines and in many cases it is probably better to be slightly early than too late when initiating overseeding.

A suggested planting date or monitoring soil temperatures can be a bit of a moving target and sometimes as a field manager you are stuck with a seeding window dictated by field use schedules. If you have a choice, starting earlier is highly suggested and then topping off throughout the rest of the season. This is particularly true if you are pushing the northern edge of growing bermudagrass in the transition zone. One thing I have learned is that the farther north you are, it is amazing how quickly the soil temperatures can drop and limit establishment success. We have been evaluating perennial ryegrass overseeding dates and it continues to surprise me how much of a difference even a few weeks makes once you get into late-September in West Lafayette. It is essentially the difference between achieving roughly 90% ryegrass versus 60% when planted the last week of September or the first week of October, even at a very high seeding rate, 40 pounds of seed per 1000 ft2 (Figure 1).

Continued on page 44

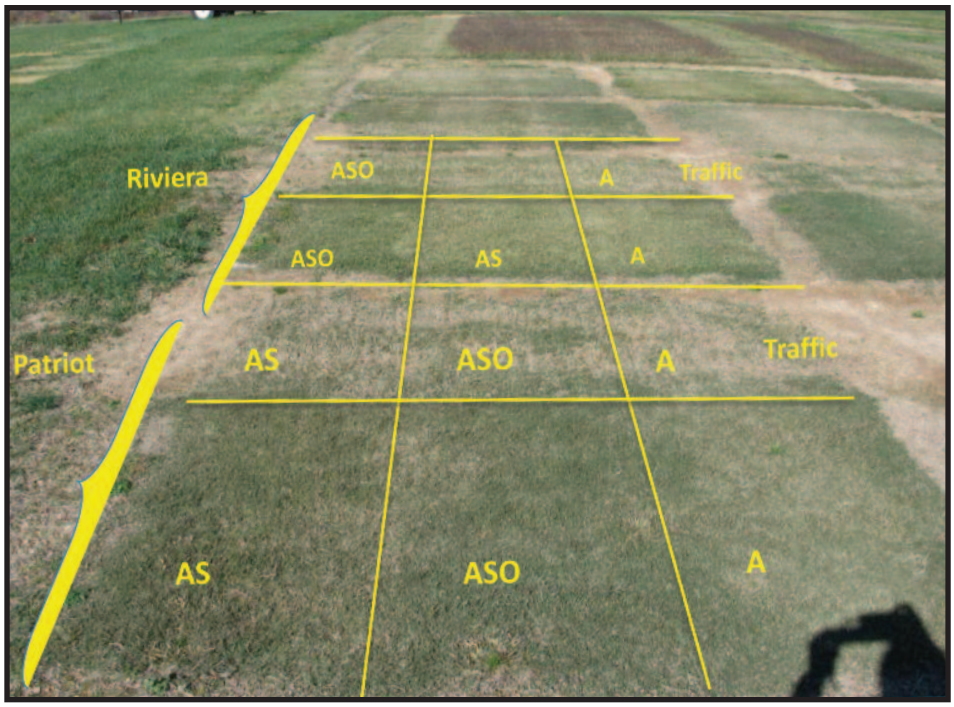
Improving

bermudagrass fall traffic tolerance and spring recovery through fall fertilization

BERMUDAGRASS is considered one of the most desired turfgrass species for athletic field use in the United States. Bermudagrass's aggressive growth habit of stolons and rhizomes offers stability and traffic tolerance to maximize player performance with the ability to recuperate from wear stress. Mostly grown in the southern half of the United States, bermudagrass growth north of the transition zone is limited by cold winters. However, with improved cold tolerant cultivars, bermudagrass management in the transition zone and north is becoming more common. When grown in colder climates the bermudagrass enters dormancy sooner, meaning that if a green turf is desired, the field must be overseeded with ryegrass.

Bermudagrass traffic tolerance and outstanding recuperative ability during its active growing periods have allowed bermudagrass athletic fields to become multi-sport facilities. The intensive use of these fields increases the importance of proper cultural practices such as irrigation, cultivation, pest management, and fertilization to obtain maximum bermudagrass performance. Nitrogen (N) fertilization is especially important in order to optimize bermudagrass growth. A typical bermudagrass fertilization program includes N applications up to one pound of soluble N per 1000 square feet per active growing month. Research has shown this amount of N can supply bermudagrass with adequate nutrients without losing valuable resources to the environment during these active growing periods. But what about fall N fertilization applied outside the optimal windows of application to bermudagrass? Can it improve fall traffic tolerance and spring recovery of bermudagrass athletic fields?

Research has shown this amount of N can supply bermudagrass with adequate nutrients without losing valuable resources to the environment during these active growing periods.



▲ **PICTURE TAKEN OCTOBER 29, 2010**. Two months after traffic initation and one month after last fertility application.

RESEARCH METHODS

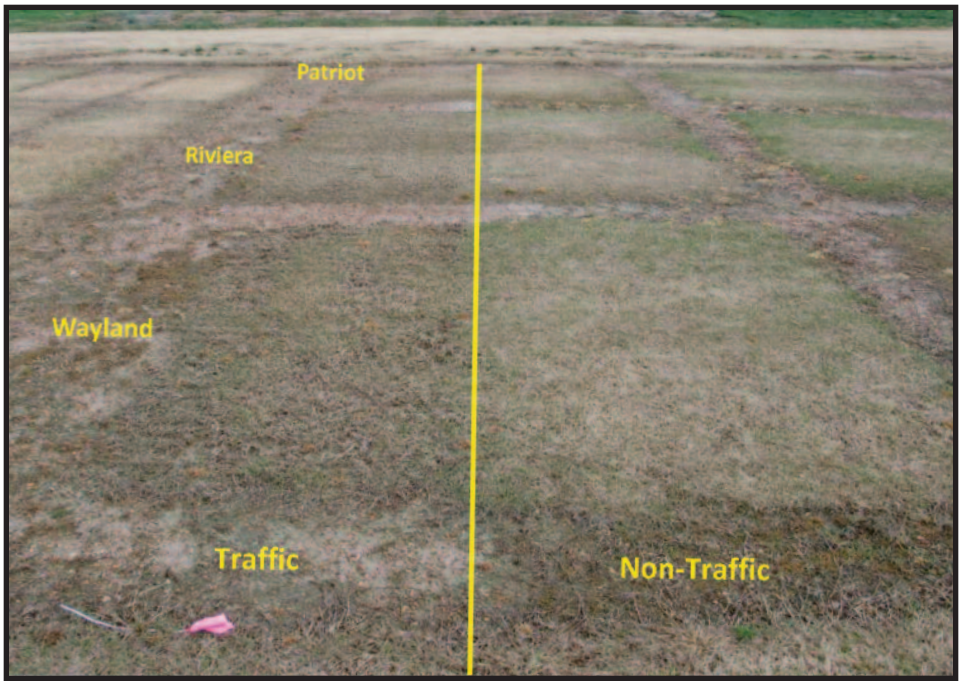
The research was initiated in June 2010 at Virginia Tech's Turfgrass Research Center using plots established by sprigging Patriot, Riviera, and Wayland bermudagrass. Patriot and Riviera are both commercially available cultivars, while Wayland is an experimental ecotype selected at Virginia Tech for its rapid spring green-up and spring dead spot tolerance. The research has continued into 2013. Irrigation was applied to promote active growth; the plots were mowed three times weekly at 1.25 inches, and N (urea, 46-0-0) was applied at 1 lb N/1000ft2 per month on the first day of June, July, and August. The fall fertilization treatments extended N applications into September and October resulting in a possible total of 5 lbs N/1000 sq ft for the season (October fertilization treatments are split into two ½ lb N/1000 sq ft applications on 2 week intervals in case a killing frost event might negate an application). Beginning on approximately August 30 of

	% turfgrass cover							
	----------18 Oct. 2010----------				----------1 Nov. 2010----------			
	A	AS	ASO	LSD	A	AS	ASO	LSD
Traffic	67.1b *	73.0a *	75.4a *	2.9	70.8b *	77.5a *	77.5a *	2.9
No Traffic	100	100	100	-	100	100	100	-
Means within the same row and measurement date followed by the same letter are not significantly different at p = 0.05.								
Means within the same column and measurement date separated by a * are significantly different at p = 0.05.								

▲ **Table 1: VISUAL PERCENT TURFGRASS COVER RATINGS** of three bermudagrasses as influenced by traffic and fall N fertilization programs (Aug (A), Aug+Sept (AS), or Aug+Sept+Oct (ASO)) in their establishment year.

	% bare ground							
	----------12 April 2011----------							
	'Wayland'	'Riviera'	'Patriot'	LSD	A	AS	ASO	LSD
Traffic	34.2a *	31.3a *	20.8b *	6.7	34.2a *	25.8b *	26.3b *	6.7
No Traffic	0	0	0	-	0	0	0	-
Means within the same row and measurement variable followed by the same letter are not significantly different at p = 0.05.								
Means within the same column and measurement variable separated by a * are significantly different at p = 0.05.								

▲ **Table 2: VISUAL PERCENT BARE GROUND RATINGS** of trafficked and non-trafficked bermudagrasses ('Wayland', 'Riviera', and 'Patriot') prior to spring greening as influenced by fall N fertilization programs (Aug (A), Aug+Sept (AS), or Aug+Sept+Oct (ASO)) or cultivar in their establishment year.



▲ **PICTURE TAKEN APRIL 12, 2011** during spring green-up illustrating the percent bare ground of the trafficked plots as compared to the non-trafficked plots. 'Patriot' had less bare ground than the other two cultivars.

each year, simulated traffic was applied at a level of six events per week using a Brinkman traffic simulator, with traffic ending during the first week of November in order to simulate a typical fall high school football schedule.

The lower bare ground ratings of fall fertilization will also lead to faster spring green-up and recovery, allowing for a longer active growth period to increase traffic tolerance for the upcoming sports season.

RESULTS

Establishment year data will be emphasized for this report. Rate of establishment was monitored by tracking visual percent turfgrass cover throughout the weeks following establishment. Two weeks after planting in June 2010, Patriot achieved 50% coverage whereas the other two cultivars had not reached 40% coverage. All grasses reached 95% or greater turfgrass cover by August 6, with Patriot covering the quickest, followed by Riviera and Wayland. The establishment rate of Patriot gives it an advantage over the other two cultivars because Patriot will have time to form a dense canopy to better withstand the fall traffic. This was shown to be true by percent turfgrass cover ratings taken on October 18, 6 weeks after initial traffic treatment. Percent turf cover of trafficked plots was significantly higher in Patriot than Riviera which was significantly higher than Wayland. Compared to the 100% covered non-trafficked plots, trafficked Patriot had 75.8%, Riviera had 72.5%, and Wayland had 67.1% coverage. Patriot tolerated more traffic in its first growing season, suggesting it would be the premier choice for high-use fields during the first football season. The greater traffic tolerance of Patriot compared to the other grasses is further supported by visual percent bare ground ratings prior to spring green-up. Data taken April 12 show Patriot to have significantly less bare ground than Riviera and Wayland which both had greater than 30% bare ground. Even though Patriot has less bare ground in early spring, Wayland and Riviera greened

up faster throughout spring until late spring where there were no differences.

The fall fertilization treatments did not yield the same distinct treatment differences as reported for the various cultivars shown. Table 1 shows visual percent turf cover of the three cultivars influenced by traffic and fall nitrogen fertilization programs. Percent turfgrass cover of trafficked September-ending and October-ending fertilization plots was similar on ratings taken 6 and 8 weeks after initial traffic treatment. However, on both the rating dates, the extended fertilization showed significantly higher percent coverage than the August-ending fertilization. These findings suggest applying fall N will increase fall traffic tolerance. Spring turf density was also increased from fall nitrogen applications due to the significantly lower bare ground percentages in early spring. Both September and October-ending fertilization events decreased to below 27% bare ground, whereas the August-ending fertility treatment had greater than 34% bare ground (Table 2).

The lower bare ground ratings of fall fertilization will also lead to faster spring green-up and recovery, allowing for a longer active growth period to increase traffic tolerance for the upcoming sports season. Extended fertilization provided benefits that persisted beyond the current season.

As the research has continued on what are now well-established plots, the degree of treatment responses from the fall fertilization is somewhat less as compared to the establishment year. There are still recorded differences in turf density in the fall and spring rating periods, but the genetic differences in the cultivars result in differing greening and growth rates exceeds the treatment responses due to the fall fertilization. We recommend that transition zone managers strive to keep bermudagrass actively growing as long as they can in the late growing season, but that they use lower levels and split applications of N so that the nutrient is used efficiently and there is little potential for nutrient leaching or runoff.

Establishment and overall growth rates/traffic tolerance are ranked Patriot > Riviera > Wayland. Extending N fertilization treatments into September and October increased fall percent turfgrass cover in trafficked plots for all cultivars, decreased early spring bare ground ratings, and accelerated spring greening. While all three cultivars tend to have better fall and spring turf coverage ratings from extended fall fertilization, the differences in traffic tolerance seem to be more related to differences in inherent growth rates and turf density than fertilization treatments as the plots mature. ■

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WHEN FUNGI ATTACK

YOU, MY GOOD MAN OR WOMAN, are on a roll. It's August 1 and your fields are pristine. The players don't make a single negative comment about its condition, and even better the boss gives you that rare compliment for how it both looks and plays. It's time for a celebratory beer(s). Now it's August 2, and you notice a small brown patch the size of a softball near midfield. No big deal, it's probably just a tad dry, and you increase the irrigation a bit to compensate. You take the weekend off, come back on August 5, and you have most certainly fallen off that roll. Not only has the one patch expanded to the size of a basketball despite increased irrigation, but new patches seem to be popping up all over the place. You make sure to get a fungicide application down that day, but a week later your prized field went from pristine to the surface of the moon. Instead of compliments from the athletes and your boss the athletes are turning ankles and you're receiving stern warnings. What the heck happened?

▼ **Figure 1: GRAY SNOW MOLD** following snow melt in the spring can seriously hamper spring sports activities in temperate climates.

Maintaining athletic fields under today's demands with today's budgets can seem daunting, and usually one of the last things on a manager's mind is the possibility of disease. While diseases of athletic fields don't require the same intense preventative techniques as those found on golf courses, there are a few that can be serious if you aren't paying attention. Since everything is better in list form; here are my top 5 diseases of athletic fields (cool-season turf edition):

5. SNOW MOLD

This disease (*Typhula incarnata, T. ishikariensis, Microdochium nivale*) is higher up the list for those in harsher winter climates, and not even close to the list in many climates. Snow mold is actually an umbrella term referring to three distinct diseases: gray snow mold (*T. incarnate*), speckled snow mold (*T. ishikariensis*), and pink snow mold/Microdochium patch (*M. nivale*). Snow molds rarely kill turf, but can leave significant damage following snowmelt that can severely impact the playability of a field in the early spring (Figure 1). Snow mold can be minimized by avoiding late fall fertilizations heavy in fast-release nitrogen. However, if avoiding late fall fertilization is not practical or the snow cover in the winter routinely persists for 2 or more consecutive months, a preventative fungicide application may be warranted. Many fungicides will provide effective snow mold control when applied preventatively; including but not limited to most members of the strobilurin and demethlyation inhibitor (DMI) class of fungicides (Table 1).

4. RUST

Though reports of aggressive rust (*Puccina* spp) (Figure 2) are becoming more prevalent in certain parts of the country, this disease remains a relatively minor disease for most athletic field managers (except if a team's white uniform is orange after the game [Figure 3]!). Rust is most severe on

Fungicide Class	Active ingredient	Common trade names[z]
Strobilurin (QoI)	Azoxystrobin Pyraclostrobin Trifloxystrobin	Heritage Insignia, Insignia SC Compass
DMI	Metconazole Myclobutanil Propiconazole Tebuconazole Triadimefon Triticonazole	Tourney Eagle Banner MAXX, Propiconazole Pro, Spectator, Savvi Torque Bayleton Trinity, Triton FLO

[z]List of trade names was taken from the University of Kentucky's Chemical Control of Turfgrass Diseases 2013 and is not an endorsement of any particular product.

◄ **Table 1: LIST OF COMMON TURFGRASS FUNGICIDES** in the strobilurin (sometimes called QoI) and demethlylation inhibitor (DMI) classes.

▼ **Left Figure 2: RUST** is an easy disease to identify (look for the orange pustules), but can be a hard disease to control when money is tight.

▼ **Right Figure 3: A NON-CHEMICAL** rust solution is to make sure the home team only wears orange uniforms.

slow-growing or stressed turf during July, August, and September though it can appear earlier than that in southern locales. Turf growing on heavily compacted soil, which can be common on heavily trafficked fields, is especially at risk for developing rust. The same goes for fields that are under-fertilized or poorly irrigated. If rust appears on your field, immediately fertilize with a water-soluble nitrogen source and water in to encourage turf growth. For long term prevention of rust, be sure to regularly aerify high-traffic locations of the field to prevent soil compaction. If you continually struggle with rust

year after year, numerous fungicides from the strobilurin or DMI class of fungicides can easily provide 21-28 days of rust control.

3. NECROTIC RING SPOT

As a root-infecting fungus, this (*Ophiosphaerella korrae*) is one of the more frustrating diseases an sports turf manager can face because once symptoms appear it's too late to treat for the fungus. Adding to the frustration, fungicide applications are notoriously ineffective for this disease because the timing of application is critical and the fungicide also must be watered into the rootzone to the point of infection…and it's darned hard to water a fungicide through 2 inches of grass and a half inch of thatch. The necrotic ring spot fungus is only active on turf roots when soil temperatures are roughly between 55 and 65°F, which is usually mid to late spring. But the circular frog-eye patches characteristic of the disease (Figure 4) often don't appear until early summer, after the fungus has gone into dormancy.

▲ **Figure 4: NECROTIC RING SPOT** can be devastating on recently-sodded turf, something quite common on athletic fields.

At this point, all you can do is manage or 'baby' the turf and its weakened root system the best you can through more frequent irrigation and fertilization. If you repeatedly observe this disease on your field, implement any healthy rooting practices you can think of to increase the number of healthy roots and help the plant ward off symptoms. In addition, use acidifying fertilizers or other acidifying amendments because the disease is more severe when soil pH is above 7.2. Since excessive thatch layers can harbor the fungus, work to minimize the thatch layer to one half inch of thickness or less. As a last resort, some granular fungicides may be able to provide suppression if applied at the proper soil temperature and watered in.

2. BROWN PATCH

If you manage a field with a significant amount of tall fescue, you likely know all about brown patch (*Rhizoctonia solani*). This foliar fungus requires prolonged periods of hot, humid weather to cause disease and can ravage tall fescue plants if left unchecked. Symptoms appear as diffuse patches of slightly brown or even purple-colored turf, and in active infections white mycelium can be present in the turf canopy (Figure 5). Fungicide applications are an effective means for controlling brown patch, especially Prostar or those from the strobilurin class. However, limiting nitrogen fertilization and irrigation during hot periods can significantly suppress the disease in the absence of fungicides. However, if you manage tall fescue or experience prolonged periods of hot and wet summer weather, fungicides may be required for effective brown patch control.

▲ **Figure 5: IF YOU SEE** white mycelium following hot, humid weather in the summer don't automatically assume it's Pythium blight…it may be brown patch.

1. SUMMER PATCH

This root-infecting disease (*Magnaporthe poae*) is similar to, and often confused with, necrotic ring spot but has a few key differences. Like necrotic ring spot, summer patch is a root-infecting fungus that primarily impacts Kentucky bluegrass (though ryegrass and fine fescues can also be impacted). Like necrotic ring spot,

▲ **Figure 6: OFTEN** similar in appearance to necrotic ring spot, summer patch can be destructive even on high-end athletic fields because of the inability to detect its presence until the damage has been done.

symptoms appear as roughly circular patches of tan turf that can sometimes partially fill in with weeds or grass to create 'frog-eye' patches (Figure 6). The key difference, however, lies in the active temperature range of each disease. Whereas necrotic ring spot only infects when soil temperatures are between approximately 55 and 65°F, the summer patch fungus BEGINS to infect roots once soil temperatures reach approximately 60°F.

As the soil temperatures rise through summer the fungus infects more and more turfgrass roots until sometime in mid-summer when the remaining functioning roots cannot support the plant and it wilts and dies. A fungicide application once symptoms have appeared will stop the current infection from spreading (assuming you get the fungicide down into the roots). However, because the infection decimated so much of the root system, the symptoms are likely to persist and the plants weakened for the rest of the summer. Methods for reducing summer patch infection include healthy rooting practices (summer patch is worse where thatch is excessive and in poorly draining or compacted soils) and reducing the soil pH to under 6.5 through acidifying fertilization or other means. Where summer patch is a consistent problem, fungicides from the strobilurin or DMI class can be used and should be applied in the late spring when soil temperatures are approaching 60°F. Care should be taken to water the fungicides into the top inch of the soil where the fungus is active.

The aforementioned diseases are not the only diseases you will find on your athletic field, and even determining which disease is present on your turf (or if it's a disease at all!) can be very taxing. If you're unsure, I recommend submitting a sample to a diagnostic lab that specializes in turfgrass diagnostics to confirm the presence of a disease PRIOR to applying a fungicide. It's better to spend $100 on proper diagnostics than waste $500 on a misapplied fungicide. Many universities around the country, including the Turfgrass Diagnostic Lab at Wisconsin (www.tdl.wisc.edu), have excellent turf diagnostic facilities and can provide needed support to properly diagnose your problem. For the most effective chemical control options check with your local sales representative, extension agent, or look up the University of Kentucky's "Chemical Control of Turfgrass Diseases 2013" online. ■

Paul Koch, PhD, is an associate researcher, turfgrass pathology, at the University of Wisconsin-Madison.

State of Seed Supply REPORT

Editor's note: *We asked principals from seed companies across the country to answer two questions: What is the state of the supply of your grass seed crop used for sports fields heading into the overseeding and heavy-use football seasons? And, what is the state of supply for sports turf looking like for Spring 2014 growing season? Here are the responses we received:*

AARON KUENZI,
VP-Marketing Manager
Mountain View Seeds

As we analyze the "State of the Seed Supply" for 2013 and spring 2014 we can be assured of one thing, change. One change will be pricing due to limited supplies.

Supplies of most species of cool-season grass will be tight due to less inventory, lower seed production acres and solid demand. Our seed inventory carryover from the previous year is near a record low. Seed production acres are low as well. Our growers are making economic and agronomic choices to grow other crops. Economically these other crops produce either a higher net return or a quicker return. Growers are also choosing to rotate between crops such as clover, wheat and grass for the agronomic benefits. Looking forward we don't see a lot of change from the production side.

For 2013 we again should see tight supplies and firm prices, as the general consensus is we do not have enough production of seed. As of today the seed harvest is less than average and our crop will be short. We expect to see firm pricing for fall of 2013 and into spring of 2014. In our opinion perennial ryegrass, fine fescues and Kentucky bluegrass will be affected the most. So this year be prepared to order early especially if you need a specific variety and/or quality of seed.

JOHN RECTOR,
turf products manager
Barenbrug USA

New Crop 20013 seed supplies are looking good for sports turf grasses from Barenbrug USA. Though competition for seed production acres remains strong, we anticipate a good supply of seed for our distribution partners that service the sports turf industry.

RPR, Regenerating Perennial Ryegrass, named a 2011 Innovative Product by the STMA, has shown increased use each year since its first release. Now christened with a new botanical name, *Lolium perenne subs stoloniferum*, RPR's reputation for durability and traffic recovery has grown significantly in the sports turf industry. Now representing three varieties, RPR continues to perform well in the traditional ryegrass climates and in unlikely areas such as the turf transition zone. Developed from 'Virginia' traffic survivors, RPR's durability in difficult summer conditions is both remarkable and unusual for perennial ryegrass. Supply for RPR looks very good.

The newest member of our 'Sports Turf' family is our Turf Blue HGT Kentucky bluegrass blend. To date, the performance of this blend of bluegrasses has been nothing short of amazing. On one particular Maryland Soccer complex, newly seeded Turf Blue HGT was successfully played on 35 days after seeding and the field is still playing like a champ this summer. '35 days and play' is unheard of for any species, let alone a bluegrass. Its key component, Barvette HGT, performed exceptionally well in the recently completed NTEP KB trial (2005 thru 2010). In the brutal transition zone, Barvette HGT finished in the top statistical grouping or #1 for 16 different evaluated turfgrass traits. At this time new crop supply looks very good and we're optimistic for excellent quality.

Barenbrug also provides the world's only true rhizomatous tall fescues, Turf Saver RTF. With establishment, RTF develops a strong system of true rhizomes and a deep, extensive root system. Turf Saver RTF supplies also look very good.

Bermudagrass supplies also look good with prices leveling off. Our Barbados Brand, featuring SWI-1044, is an outstanding product for those fields needing an elite feel to

Yukon bermudagrass has excellent high quality seed.-Leah A. Brilman, PhD, director of research and technical services, Seed Research of Oregon

them. Also with excellent NTEP performance, 2002-2006, SWI-1044 exhibits many top performing traits for sports turf uses.

Another Barenbrug exclusive is our proprietary coating technology called Yellow Jacket. Yellow Jacket provides strong absorbant technology combined with Dormancy Breaker and Apron XL to provide the best in seedling development and protection. Yellow Jacket technology is available on most Barenbrug products and most custom mixes.

DUANE KLUNDT,
VP of sales Grassland Oregon

Most cool season turf grasses are in a balanced, to less than favorable state. This coupled with the Pacific Northwest weird weather patterns this past year (super dry fall, very wet early winter, very dry late winter, hotter than normal spring, and cool early summer, and now dry) may cause some quality issues. The result maybe some heartburn for those looking for high quality seed at a good price, it may just not be there. Perennial Ryegrass is in very tight supply and coupled with a record high grower price for the fall of 2013 and the pressure for good quality, we would recommend buying your seed as early as you can to ensure the best price and best quality you can. Kentucky bluegrass is also in a similar situation, with production being about as low as it has been in decades, and the elite Kentucky bluegrass varieties being in short supplies due to the residual scars of the past downturn in economy, again I would buy your needs early. Turf Type Tall Fescue is still in a fairly tight situation but it should be way more balanced thus maintaining a stable price throughout the year, but quality may still be an issue with some varieties being extremely short. Seed inventories are about as short as they have been in quite some time so this is not a year to procrastinate.

Quality will be a problem come spring, if the seed crop continues to come in as it is supplies could be very tight in early 2014. As stated in the fall section I would buy or book my seed as early as possible with your distributor, that way they can arrange to get the supplies the sports turf managers need. We need to remember cool season turf grass is harvested in July/August and it will not happen again until next year. It cannot simply be manufactured, so it will require the turf manager to make sure some planning is done. Do your homework now for next spring to assure you get what you need, both in quality and in the quantity.

JOHN T. LAMLE,
VP of research and production Johnston Seed Company

Johnston Seed Company is the exclusive producer and marketer of Riviera Bermudagrass seed. We had an excellent supply of seed for the sportsturf market in 2013 and will have an excellent supply to meet those needs in 2014. We do not produce any cool-season grasses for the overseeding market, so I can not contribute to that request. ■

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Also, remember it is one thing to germinate the overseeded grass; it is a whole other process to get it to establish enough to actually tolerate traffic and persist. You can always add a bit more seed to touch up worn/thin areas but you can never go back and regain the warmer days and longer period of sunlight that might be lost due to a late start. Some managers have used germination blankets and field covers to help later in the season but those are not ideal solutions compared to the natural growing conditions Mother Nature provides in September and early October.

Lastly, if you plan for only one seeding date, then it is advisable to make sure you seed in two directions, seeding the borders with a drop spreader (if you want a nice crisp edge) and the interior can be planted with a drop or broadcast spreader.

TO CULTIVATE OR NOT?

This is a highly debatable question when it comes to overseeding preparations. The research in this area is inconclusive but almost never negative in terms of overseeding success or bermudagrass survival. Remember, seed soil contact is a critical factor for success. Where excess thatch is not an issue, many turf managers have had good success with broadcasting seed and then following with moderate sand topdressing and dragging the seed/sand into the canopy with a drag implement (flexible drag, brush, etc.). Otherwise, a cultivation/coring about 2-3 weeks before the intended initial overseeding event is advisable.

GOING BACK TO BERMUDA?

Managers of bermudagrass fields work hard to get back to nearly 100% bermudagrass, at least for part of the summer. This will help ensure a good bermudagrass base and better overall long-term field performance. Thus, a grass species that transitions easily or the use of chemical transitioning herbicides is recommended. This topic, however, is a whole article in itself. ■

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