Misguided phosphorus restrictions could impact field management

BY **DR. JOHN STIER**

Safe and acceptable quality athletic turf requires good mowing, fertility, and irrigation. State and local regulations are starting to take away the right to use good fertility practices due to concerns about phosphorus (P) in turf fertilizers. Regulations restricting or banning P-containing turf fertilizers have already been enacted in Minnesota and Wisconsin, with Indiana, Michigan, Texas, and other states considering regulations. Sports turf managers need to know why such regulation is occurring and where P is actually coming from to ensure forthcoming regulations actually benefit the environment and allow science-based turf management.

Phosphorus is essential to all life and is contained primarily in DNA and the energy-carrying molecule ATP. Phosphorus is present in turf between 0.25-0.5% by weight. Much of the P and potassium (K) come from the soil but soil P is not always adequate for turf growth. Turf absorbs N-P-K in roughly a 4-1-3 ratio. Inadequate P slows turf growth, enhancing the likelihood of bare soil and weeds especially in high traffic areas.

Why is P undesirable?

Phosphorus levels > 0.02 ppm in surface waters cause algae to grow (algal "blooms") and sometimes aquatic weeds. In many soils the background level of P is naturally above 0.02 ppm. When rain hits bare soil, some of the P in the soil dissolves into the rainwater; this is known as "soluble P". Since bare soil can't stop water as well as a dense turf, runoff from croplands dwarfs potential runoff from turf (Table 1, p.10). Heavy rainstorms can carry sediment with its attached P-this is known as "sediment P." Both soluble and sediment P can be either inorganic or organic P (from a living or dead organism). Total P is the sum of soluble and sediment P and is usually what is measured in water samples as both soluble and sediment P can become "bioavailable" for algae growth.

Where is P?

Agriculture and construction account for a majority of P entering surface waters due to the lack of vegetative cover and high sediment loss in runoff. A Kentucky study showed the underlying geography and soil type can dictate the amount of P runoff; 50 years after a wooded watershed was converted to fertilized farmland, P concentrations in the streams remained the same because the soil absorbed P from fertilizer and controlled its release. In 2003 Roger Bannerman from the United States Geological Survey estimated lawns in Madison, WI contributed 1-4% of P entering area lakes but the amount due to turf fertilizer was unclear. Research actually shows a properly fertilized turf has less runoff than non-fertilized turf because the dense turf reduces runoff and sediment loss (Kussow, 1995; 1998). Therefore it may be better for the environment to fertilize turf than to avoid fertilization. Another Wisconsin study in an urban area determined that lawn and garden fertilizers contribute insignificant N and P unless they're applied to paved areas (Lee and Klusner, 1974). A small background level of P will also be present as P is present in dust, pollen, and can be leached from vegetation. Another study determined streets with 80% tree cover had 0.8 ppm P in runoff while street without overhead trees had only 0.1 ppm P in runoff (Waschuch et al., 1999).

Who is pushing P regulation?

The Environmental Protection Agency has set Total Daily Maximal Loads for P and other contaminants in certain parts of the country. In many cases local regulation is occurring due to citizen complaints that something be done to reduce algae and weeds in lakes used for recreation. Because the Green Industry is not well organized and is without lobbyists, turf fertilizers are politically a much easier target compared to agriculture or construction. Once a municipality has passed regulation, others are quick to follow in a case of "me-too"ism. Unfortunately banning turf P applications will have no measurable effect on reducing P levels in water. Our surface water quality will continue to deteriorate until officials take steps to combat the major sources of P and redesign urban areas to stop runoff from impervious surfaces such as roads.

Most P in synthetic fertilizers is from monoammonium phosphate and is water soluble. As soon as it contacts soil moisture most of the P is tightly bound to soil. At pH < 7, P binds to iron and aluminum to form insoluble P forms. Above pH 7, P binds to calcium and magnesium to form insoluble P forms. Only a small amount of P is ever found in the soil solution. Natural fertilizers, sometimes mistakenly referred to as "organic" (organic is defined as any carbon-containing molecule, which would include the synthetic fertilizer urea), are usually based on animal or human waste products. Some natural fertilizers include activated sewage sludge, composted turkey manure, and fish or plant by-products.

All living organisms contain P. Fertilizers made from dead organisms or their waste products have a relatively high P to N ratio. Natural products displaying an analysis of 10-0-0 will still contain P; the manufacturer has simply decided to not claim the P, which is perfectly legal. The high P:N ratio causes more P to be applied when natural products are used compared to most synthetic turf fertilizers that have a low P:N ratio (starter fertilizers being an exception). For example, application of 1 lb N/1000 ft2 using a 25-3-12 product would supply 0.12 lb P expressed as P2O5 per thousand square feet. The actual amount of P applied would be only 0.05 lb since P is only 44% of P2O5. In contrast a natural organic fertilizer with a 6-2-0 analysis would provide 0.33 lb P2O5 per thousand square feet, roughly 3 times as much P as the synthetic fertilizer. While a University of Wisconsin study showed no difference in P runoff when natural and synthetic P-containing fertilizers were used on turf (Kussow, 1998), it seems silly to think of natural fertilizers as "better" when they actually supply more P than synthetic fertilizers.

Table 1. Phosphorus in runoff from crops, turf, and grassland prairies

Investigators	*Situation*	*Average Phosphorus loss (lb/A/yr)*
Burwell et al., 1975	Corn or corn-oat-hay (10 yrs)	10
Kussow, 1995	Lawn turf, compacted soil (2 yrs)	0.3
Sharpley et al., 1992	Native grassland (5 yrs)	0.2

What about soil testing?

Soil tests use chemicals to strip P from soil so it can be measured. Different procedures give different results: a lab which uses the Bray P1 method may show 60 lb P/acre, another lab using the Mehlich III method may show 108 lb P/acre, while a third lab using the Olsen method may show 56 lb P/acre for the same soil sample (Carrow et al., 2001). (Some labs report P as parts per million, or ppm. Multiply by 2 to convert lb/acre to ppm.)

The type of test used should depend on the type of soil, amount of organic matter, and soil pH. It is up to the soil lab to determine the appropriate method, however, many labs only use one method. A bigger problem is that all soil tests results are based on data collected over numerous years of correlating crop yields (e.g., bushels of corn produced per acre) with soil test results. Turf is grown for quality, not yield, and the required soil test calibrations have not been developed for turf. All current recommendations are a "best guess" based on crop yields, so no, current soil tests cannot reliably measure P needs for turf. However, they are the best tools we have. Regulations in some areas allow fines to be levied for persons who apply P when a soil test indicates it isn't needed. Until soil tests are calibrated for turf, soil tests should be used as a guideline for fertilization rather than a regulatory tool.

Allowing P fertilizer to be used even when a soil test indicates levels are sufficient is important for other reasons. Phosphorus is needed to re-establish turf roots of plants damaged by root rot diseases such as summer patch and necrotic ring spot. Without an adequate root system, diseased plants cannot access P in the soil and need the quick access to P provided by fertilizer. Furthermore, P uptake is reduced in cold soils which is why turf leaves may appear purple in the early spring. Sports turf with events in the spring may benefit from P fertilization regardless of soil test results. Lastly, research has shown starter fertilizer applications improve turf establishment from seed. Recent work conducted by Dr. Frank Rossi at Cornell University shows regular overseeding of athletic fields during the growing season helps maintain a denser turf (personal communication, 2005). Regulations that allow starter fertilizer applications whenever an area is being established or overseeded are critical for maintaining high quality athletic fields with reduced reliance on herbicides.

Phosphorus enters surface waters from a variety of sources, with bare or exposed soil causing the majority of runoff. Agricultural operations and building construction are the two greatest contributors, though the soil geology of the area can dictate the amount of P in the runoff. Organic sources include pollen, seeds, leaves, and even wild animal waste: 100 Canada geese produce over 5 oz of P per day (Sherer et al., 1995), while a pet dog contributes 2.6 lb P2O5 annually which is over 5 times more than a typical turf fertilization program would add to the soil. Unfertilized turf contributes more P and runoff than properly fertilized turf because dense turf slows runoff and prevents sediment P from leaving the site.

In northern climates approximately 75% of the annual P runoff from turf and prairie systems occurs during winter when the ground is frozen, having nothing to do with fertilization. A small amount of P runoff will always be present as P is leached from leaves of all vegetation (trees, etc.).

In our urban environment, runoff is often funneled directly to lakes, ponds and streams where wetlands once existed to intercept and filter runoff before it entered surface waters. Ultimately there is no vegetation type better adapted to intercepting runoff from rooftops, parking lots, and roads on a wide scale than turf. Athletic fields, because of the amount and timing of play, need flexibility to apply P to maintain safe playing conditions. As state and local proposals are developed to limit or ban P applications to turf, athletic field managers will need to partner with other Green Industry groups (golf courses, lawn care companies, etc.) to ensure passage of practical and environmentally sound regulations based on science. ST

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Compost for turfgrass: multifaceted organic ally

BY **MARK HUSSEY AND CHRIS HARRISON**

Creating a strong, healthy, durable turfgrass for a soccer field is no simple matter. Because that ideal surface is so difficult to achieve, turf managers are really part of what should be called a solutions industry. At New England's largest public recreational area, compost is one of those solutions. It saved Mike Cabral, assistant public works manager for the Massachusetts Development Complex at Devens, $38,000 and gave him a better field, too.

Tally up the obstacles turf managers and supervisors have to face year round: too much moisture or too little; manipulating soil pH and quality with amendments; "going for the green" while respecting nature's complex climatic shifts—all this while having to keep the environment safe for human recreational use.

There are other challenges in the pursuit of turfgrass perfection. But what if there was a substance capable of addressing many of these issues at once? Well, there is. Cabral will tell you it is compost.

Devens is the former site of the famous Ft. Devens military base, which closed in 1996. Mass Development's 13 contiguous soccer fields on 44 of those acres (Rogers Field, officially) comprise the largest public recreational venue in New England.

"The word really needs to get out . . . the results we've seen with our compost plan have been excellent, and it just keeps improving as the years go by," Cabral says. "This season, in fact, conditions have been so favorable, we have not had to use any broadleaf prevention, or any pre- or post-emergent whatsoever so far."

Cabral's enthusiasm for compost-as-turf manager's ally spikes when he begins trotting out statistics that illustrate a huge positive economic impact: "In 2001 we were spending $75,000 for fertilizers and chemicals. Meanwhile, water usage was 3 million gallons a year and we seeded three or four times per season or more. In 2004, directly due to the incorporation of compost, our fertilizer and chemicals expenditures dropped to $28,000. Simultaneously, our water volume needs fell by nearly 2.5 million gallons," he says.

"We also were able to reduce seeding by roughly two thirds. All told, we experienced a $38,000 saving in our budget from previous years by going with a compost topdressing program," Cabral says. "The fields at Devens are heavily used for not only for soccer, but for lacrosse, field hockey, Ultimate Frisbee and other sporting events. And the truth is, those fields have never looked better."

Kathy Wiberg, recreation director at Devens, echoes Cabral's optimism, observing that the playing field surfaces are clearly more stress-resistant than she's ever seen at Mass Development.

"The turf will not brown or burn nearly so easily as it used to do; the fields are

"We experienced a $38,000 saving in our budget from previous years by going with a compost topdressing program," Mike Cabral says.

more vibrant, the grass looks, and is, obviously stronger and healthier. There's basically no comparison, then vs. now. Considering these fields are non-irrigated, the results with compost have just been outstanding."

The reasons for Cabral's compost program success at Rogers Field/Devens are many, and worth examining one at a time.

The type of compost selected for the Rogers Field includes decomposed wood chip shavings. The sponge-like quality of this mulchy compost boosts moisture retention efficiency, thus allowing root systems to absorb all the water that turf requires. Such water retention is a key factor at Mass Development, since the coastal soil of eastern Massachusetts is sandy, and vital nutrients do leach away in the absence of compost.

Another direct benefit of compost utilization: improved soil structure, porosity, and density for an all-around better plant root environment. When turfgrass roots are able to absorb more naturally occurring soil nutrients more easily, the need for amendments (synthetic or otherwise) will decrease. Due to compost topdressing, there's an abundance of nutrients for those turfgrass roots to absorb in the first place. Compost is not classified as a fertilizer, yet as a soil enhancement, it introduces vast numbers of helpful microbial organisms directly into soils where applied.

Among these microbes are specific fungi that work symbiotically with plant roots to aid in the extraction of nutrients from soil.

It should be noted too that compost, rich in organic content, encourages the proliferation of helpful earthworms in sub-surfaces beneath and betwixt root systems. Tunneling worms increase water infiltration and aeration, further boosting turfgrass well being.

Yet another advantage of compost topdressing is natural weed reduction. When the general health and resilience of turfgrass is on the upswing, weeds have a harder time taking root and thriving. The 2005 Spring season experience cited by Mike Cabral of not needing pre-emergent or post-emergent broadleaf sprays would seem to bear this out.

Another point of emphasis for Cabral is the fact that only a quarter or a half-inch of topdressing is required to get the impressive results seen at Rogers Field.

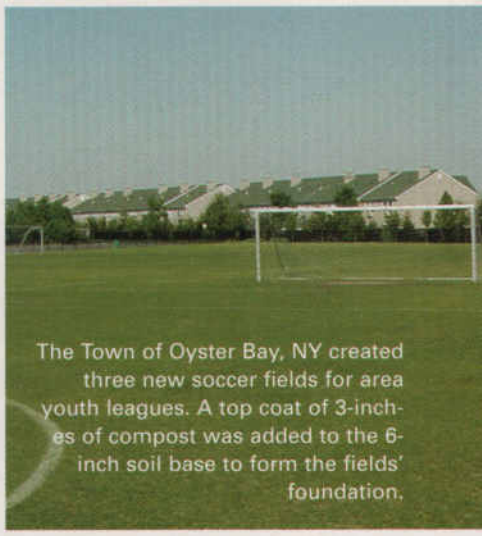
"You don't need to go crazy with this stuff, more is not going to necessarily going to be better. In fact it definitely won't be better. Just the one thin layer per year should suffice, depending on local conditions," Cabral says.

He says benefits are exponential: each year brings greater, more visible benefits. The compost benefits picture in 2005 is considerably brighter than it was when the program was first intro-

duced in 2000 at Mass Development.

If it all sounds like a "can't-miss proposition," Tim Gould agrees. Gould is VP at Agresource, Ipswitch, MA (www.agresourceinc.com), a major supplier of compost to the green industry in New England and New York. Agresource is the source for the compost used at Rogers Field/Devens. Gould, whose team has served as compost consultants to Mike Cabral's crew, says, "There are several types of compost available, and while all are beneficial, distinct gradations of quality exist, in our view. The core issue, really, is providing sufficient organic matter, and the right compost for the application at hand. So, for the Mass Development Rogers Field, it was clear a compost with biosolids was called for.

"Mike Cabral decided on our Agresoil Compost as the primary topdressing: a product that's a blend of nitrogenous and carbonaceous materials that usually includes biosolids, gelatin and food processing residuals, sawdust, wood chips and leaf and yard waste," Gould says.



The Town of Oyster Bay, NY created three new soccer fields for area youth leagues. A top coat of 3-inches of compost was added to the 6-inch soil base to form the fields' foundation.

As a conscientious and committed turf manager, Mike Cabral is concerned with more than just the robust quality of the turfgrass surfaces in his charge.

"The environmental aspect is a very big issue with us here. We have precious aquifers in this region and want to do all we can to protect freshwater resources. Going to the compost plan is already showing that improving soil quality substantially keeps more moisture where it belongs, closer to the surface. With stronger, healthier, more resilient turfgrass allowing us to use far less fertilizer, we really don't have to worry very much about runoff, and potential toxic damage to deep underground aquifers."

While engaged in the fury of their many competitions throughout the year, athletes participating at Mass Development's Rogers Field have little or no awareness of the importance of compost to the quality of their games. But ask Mike Cabral or Kathy Wiberg, and they will tell you the story behind the story: compost works on athletic fields like nothing else they've ever come across. It has had a decided and measurable impact on turfgrass surface quality at Devens. **ST**

To learn more about the benefits of using compost for new turfgrass applications and upgrades of existing sports fields see the website of the US Composting Council, which is rich in important links, at www.compostingcouncil.org.

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