Phosphorus Losses and the Urban Envir

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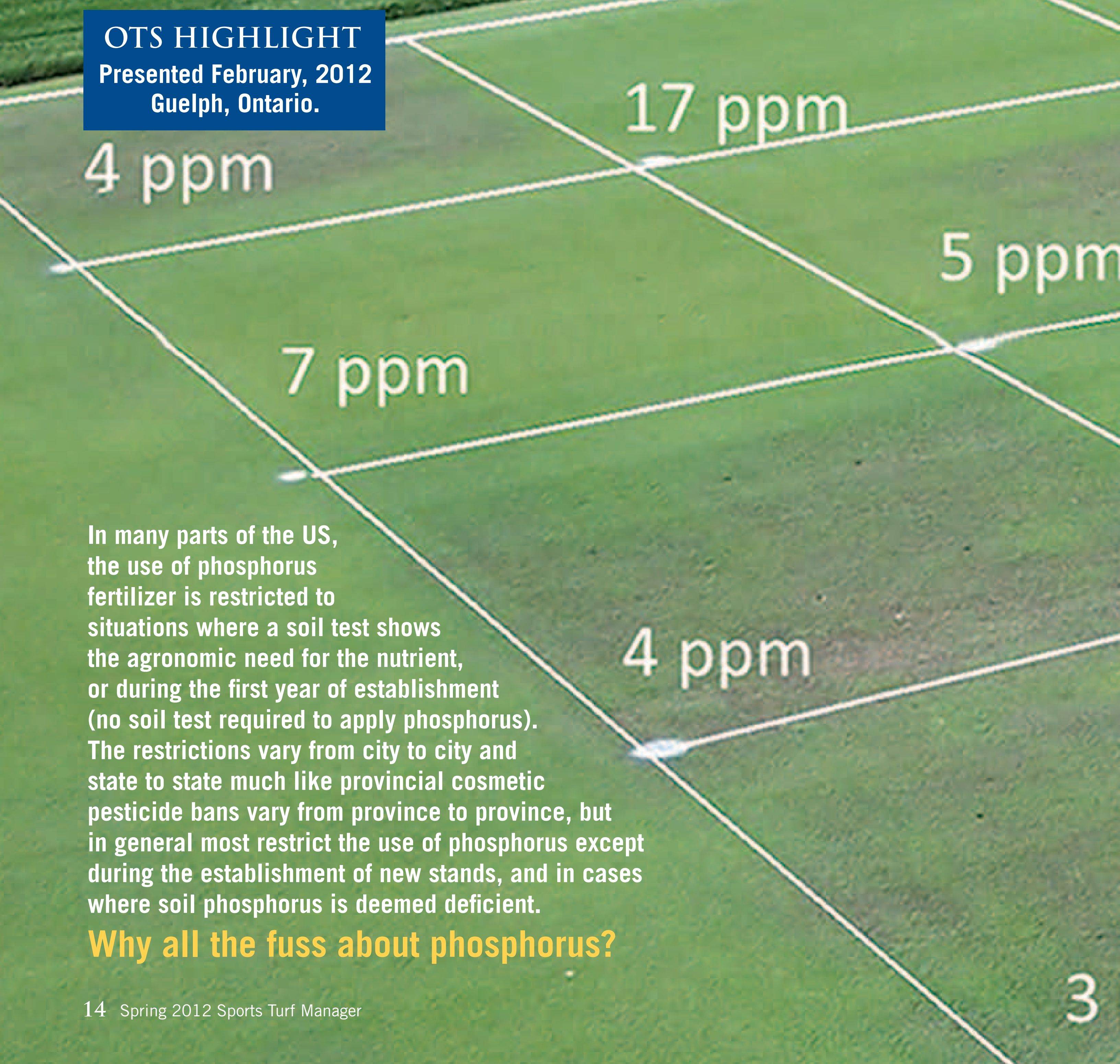

In many parts of the US, the use of phosphorus fertilizer is restricted to situations where a soil test shows the agronomic need for the nutrient, or during the first year of establishment (no soil test required to apply phosphorus). The restrictions vary from city to city and state to state much like provincial cosmetic pesticide bans vary from province to province, but in general most restrict the use of phosphorus except during the establishment of new stands, and in cases where soil phosphorus is deemed deficient.

Why all the fuss about phosphorus?

from Turfgrass
onment

Figure 3. Mehlich-3 soil test phosphorus levels below 7 ppm negatively affected turfgrass quality on this sand-based putting green. There were no differences in turf quality above 7 ppm.

Excessive phosphorus can be a major detriment to water quality, especially in fresh water ecosystems. In many lakes, streams, and rivers, phosphorus is the most growth limiting nutrient. Therefore, additions of phosphorus are usually accompanied by increases in algal growth. Increased algal growth decreases the recreational value of the water body, depletes oxygen in the water which harms aquatic life, and increases the need for chemical treatment of the water.

Phosphorus is often a limiting nutrient in turf and agricultural systems too, so farmers and turf managers apply phosphorus fertilizer to maximize yield or turf quality. However, when excessive phosphorus is applied, it builds up in the soil and eventually finds its way to a water body. Phosphorus is very insoluble in soil and tends to bind tightly with soil particles in the upper few inches. In agricultural areas where phosphorus-rich manure is continually applied, soil phosphorus levels often vastly exceed what is required for optimum growth. Once phosphorus is built up in the soil, the primary way it finds its way to water bodies is by soil erosion (Figure 1). Large rains or snow melt events cause a process called runoff where water flows over the land until it reaches a body of water. If the soil is poorly protected, runoff will also carry away the phosphorus-rich topsoil – once the topsoil is detached from the land, we call it "sediment".

Figure 1. Two of the best ways to keep phosphorus from entering water bodies are to not let phosphorus build up to excessive levels in the soil, and to protect the soil from being washed away – usually by maintaining a dense ground cover. While these practices sound relatively simple, scores of scientists continue to study ways of reducing phosphorus losses from agricultural areas as it remains a very important environmental issue. *Photo: Webster's Online Dictionary.*

So far, this has been a story about agriculture. But research has shown that urban areas actually contribute as much or more phosphorus to water bodies than agricultural areas. Urban areas don't seem to have a manure spreading problem or an apparent issue with topsoil washing away, so where is the phosphorus coming from? The average politician or citizen has reasonably concluded that lawn fertilizer must make up a large portion of this amount, and therefore banning turfgrass fertilization will likely solve the problem. However, there is much more than meets the eye with urban phosphorus pollution.

First, it's clear that sediment losses actually are a serious issue in urban environments. Scientists at the United States Geological Survey examined the phosphorus and sediment losses urban and rural watersheds in Southeastern Wisconsin. They found that the phosphorus losses from urban areas were slightly greater than from the rural areas, but that the sediment losses from urban areas were four times greater than from rural areas (Corsi et al., 1997). Controlling the sediment loss from urban areas would presumably also reduce the phosphorus losses from these areas. So where does the sediment from urban areas come from? Building and road construction are major culprits. David Thompson maintains a blog called *The Contractor Report* (contractorreport.blogspot.com) which attempts to document the impact of construction practices in and around Madison, WI. The collage in Figure 2 was taken from that blog.

Areas that have dense turfgrass cover are notoriously low in sediment losses (Soldat et al, 2008). However, when the ground is bare, the exposed soil can be quickly washed away. In rural areas, top soil may be carried away from the farm but eventually be caught in a grassed buffer strip and never reach a body of water. But urban areas have well-connected networks of impervious surfaces. Sediment that is deposited on these surfaces can be quickly washed away into a storm sewer and find its way to a water body. The Wisconsin Department of Natural Resources estimates that 50 to 100% of eroded top soil in urban areas reaches a body of water compared to less than 10% from rural land uses (Johnson and Juengst, 1997).

Controlling sediment losses from urban areas should become a top priority if reducing phosphorus losses from these areas is a major goal. However, the focus in the US has been disproportionally on reducing phosphorus fertilizer applied to lawns and other turf areas. Will this approach work? The research suggests that the restrictions are not likely to have a large impact on urban water quality. Dr. Wayne Kussow (2008) at the University of Wisconsin measured phosphorus losses from three turfgrass management systems: 1) non-fertilized control, 2) Scotts Turf Builder (with phosphorus) and 3) organic fertilizer (with phosphorus). Even though no fertilizer was applied to the control treatment, more phosphorus (0.54 kg/ha/yr) was found in the runoff than the other two treatments receiving phosphorus (0.34 and 0.36 kg/ha/yr). The non-fertilized treatment had poorer density and therefore greater exposed soil and greater amounts of

Figure 2. Everyday images of sediment losses from construction sites in urban environments. Images: contractorreport.blogspot.com

runoff during storms than the two fertilized treatments. Similarly, researchers in Minnesota found no signification differences or significantly less phosphorus in runoff from plots receiving fertilizer than non-fertilized control plots during a three-year period (Bierman et al., 2010). They also found greater phosphorus losses when phosphorus was applied at three times recommended rates, but similar losses to no phosphorus at all when the recommended rate of phosphorus was used. These and other studies (see Soldat et al., 2008) clearly demonstrate that dense ground cover reduces phosphorus losses.

However, often soil phosphorus levels are sufficient to sustain healthy turf without additional applications. In these situations, adding phosphorus fertilizer is wasteful economically and environmentally. Soil testing is an effective technique to determine if phosphorus fertilizer should be applied. Fertilizer prices are at nearly all-time highs, and are unlikely to drop if a global demand for fertilizer continues to rise. Additionally, phosphorus is mined in only a few locations worldwide, and phosphorus reserves are critically low. For these reasons, it pays to be miserly with phosphorus fertilizer.

WHEN ESTABLISHING TURFGRASS FROM SEED, APPLYING PHOSPHORUS FERTILIZER NEARLY ALWAYS ENHANCES ESTABLISHMENT.

Figure 3 (pages 14-15) shows a picture of a phosphorus soil test calibration study recently completed (Kreuser et al, 2012). When soil phosphorus levels were at or above 7 ppm (Mehlich-3), the turf quality was excellent. Below 7 ppm, classic phosphorus deficiency symptoms appeared. Most soil testing labs will use 30 ppm as the cut-off for optimum soil P – a fairly conservative number. I strongly recommend not applying phosphorus fertilizer unless soil test levels indicate a potential problem, and keep in mind that every plot in Figure 3 would come back from the lab with a “low” or “very low” for every single plot, even though true deficiency symptoms only showed up on plots with less than 7 ppm phosphorus.

When establishing turfgrass from seed, applying phosphorus fertilizer nearly always enhances establishment. Hamel and Heckman (2006) found that turf establishment was enhanced when phosphorus was applied to soils with less than 200 ppm Mehlich-3 P, above 200 ppm yield was usually not increased further. In my experience, it’s fairly rare to find soil test phosphorus levels exceeding 200 ppm. Applying phosphorus to speed establishment is an environmentally friendly practice because the shorter amount of time bare ground is exposed, the lower the potential for sediment loss.

In conclusion, turf fertilization is a component of phosphorus coming from urban areas, but pales in comparison to the phosphorus that is lost from urban building and road construction practices. Legislation restricting the use of phosphorus fertilizer is likely to have a limited effect on urban water quality. However, application of phosphorus when soils already contain a sufficient supply is a wasteful use of a precious resource.

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