ATHLETIC TURF

Phosphorus fact & fiction

Guidelines for the responsible use of a valuable nutrient that's now in legislators' crosshairs

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Figure 1. Phosphorus deficiency (left) and phosphorus sufficiency (right) in turfgrass.

Classification of phosphorus as a primary plant nutrient is well deserved. Energy-rich phosphate bonds are what fuel the metabolic machinery of plant cells. A limiting supply of the nutrient invariably slows growth of all the turfgrass plant's organs - shoots, roots, tillers, stolons and rhizomes. In fact, it's a slowdown in growth that's the first symptom of phosphorus deficiency in turfgrass. The grass typically has a dark green color, but just isn't growing as fast as it should (Figure 1). In cases of even more severe deficiency, red pigments begin to accumulate in the leaves, and they develop a purplish coloration.

A strong start Phosphorus deficiency in turfgrass is most readily seen during its establishment. While plant seeds are typically high in phosphorus, turfgrass seeds are so tiny that young seedlings quickly exhaust the seed supply. They're then dependent on fertilizer and soil to meet their phosphorus needs. If these phosphorus supplies are inadequate, the grass is slow to establish (Figure 2), resulting in thin stands prone to invasion by weeds and washing by heavy rains. The answer to this problem is starter fertilizer.

In most cases, applying turf starter fertilizer at the rate of 1 lb. N/M (M = 1,000 sq. ft.) will suffice. Typical grades of starter fertilizer are 13-26-12, 21-28-7, 16-25-13 and 6-12-8. Thus, at 1 lb. N/M, you're applying 1.3 to 2 lbs. P_2O_5/M. If you know or suspect that the soil is low in phosphorus, increase the rate of starter fertilizer application to 1.5 lb. N/M.

Figure 2. Effect of starter fertilizer phosphate on turfgrass establishment. No starter fertilizer was applied to the plots in the upper left and lower right corners. Figure 2a. Importance of starter phosphate during turfgrass establishment. Note the difference in turfgrass growth with adequate levels of phosphate.

The rate of starter fertilizer application is but one part of the task of meeting the phosphorus requirements of turfgrass seedlings. The other part is soil placement. The fertilizer phosphate needs to be in the immediate vicinity of the seedling's juvenile root system. Lightly raking the starter fertilizer into the soil is all that's required. Incorporating the fertilizer to greater depths reduces its effectiveness unless you increase the application rate accordingly. Deep placement without a rate increase results is a reduction in turfgrass root development. This can be seen in Figure 3, where the same rate of starter fertilizer was incorporated to different depths in the soil.

There are instances where turfgrass response to starter fertilizer phosphorus may not be seen. This arises when the soil or topsoil brought in has high levels of soil test phosphorus. As a general rule, when the soil contains two to three more times soil test phosphorus than is needed by established turfgrass, the chances of seeing a response to starter fertilizer phosphorus are low.

If, for example, the soil testing laboratory you patronize says that 20 ppm (40 lb./acre) soil test phosphorus is adequate for established turfgrass, then about 60 ppm is adequate for establishment. Why this difference? It's the result of established turfgrass having a dense, fibrous root system that's efficient in taking up soil phosphorus. Juvenile turfgrass root systems need time to develop capacity to effectively forage for soil phosphorus.

How much is enough? Determining whether the existing levels of soil phosphorus are adequate can only be done through testing.

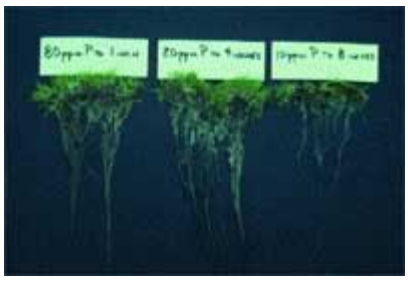

Figure 3. Influence of the depth of starter fertilizer placement on turfgrass growth during establishment.

One testing option is to collect grass clippings and have them analyzed. Lawn turfgrasses almost invariably display visual signs of phosphorus deficiency when the clippings contain 0.25% phosphorus or less. But there's a "critical nutrient range" wherein the grass doesn't exhibit visual deficiency symptoms and will produce additional growth if the phosphorus supply is increased.

The critical range for most lawn grasses is 0.25% to 0.35% phosphorus in the clippings. Turfgrasses whose clippings contain more than 0.35% phosphorus are adequately supplied with the nutrient. While clipping analysis can signal the need for more fertilizer phosphorus, it doesn't give us a notion of how much to apply. That type of information can only come from soil testing.

The recommendation here is that you utilize the services of a local soil testing laboratory. They're familiar with the soils and turfgrasses in your area and should therefore be able to

provide you with the best recommendations possible.

Let's assume your soil tests indicate a need to make adjustments in the phosphorus levels. Most labs will indicate how much phosphorus is required to adjust the soil from the existing to the optimum level. To follow such a recommendation, you have to purchase a phosphate fertilizer and calibrate a spreader to apply the proper amount.

Little by little A simpler approach, which entails gradual adjustment of soil phosphorus, is based on the fact that lawn grass clippings contain a remarkably constant ratio of N to P_2O_5 to K_2O. That ratio is 4:1:3. This tells us that when lawn clippings are removed, this is the ratio in which these nutrients are being removed and have to be replenished if soil tests are to be kept reasonably constant.

On the other hand, applying phosphorus with a fertilizer whose N:P_2O_5 is not close to 4:1 will either result in a buildup or depletion of soil test phosphorus. Applying fertilizers with N:P_2O_5 ratios of, say, 3:1 or 2:1, contain more phosphorus than the grass will utilize and will gradually increase soil levels of the nutrient. Ratios of greater than 4:1, such as 6:1 or 10:1, will have the opposite effect on soil phosphorus.

Utilizing this fact allows us to adjust soil levels of phosphorus simply by choosing and applying a fertilizer with the proper ratio of N to P_2O_5. Keep in mind that fertilizer ratios are calculated by dividing the fertilizer grade by its lowest number. For example, a fertilizer with a grade of 24-6-12 has a ratio of 24/6: 6/6:12/6, which is 4:1:2.

This approach to adjusting soil test levels of phosphorus works fine when lawn clippings are being removed. In many instances, clippings aren't being removed from lawns and some phosphorus is being recycled. Then what's the amount of phosphorus required to make adjustments in soil levels of the nutrient?

The graph in Figure 4 gives us a good first answer to this question. The graph was developed with data collected from a Kentucky bluegrass lawn established on a silt loam soil in southern Wisconsin that received 4 lb. N/M/season.

The graph tells us that, under these conditions, it takes about 1 lb. P_2O_5/M per year to maintain soil test phosphorus levels when clippings are removed, but only one-half this amount, or 0.5 lb. P_2O_5/M per year, when clippings aren't removed. These numbers will change somewhat depending on soil type, the annual N rate and geographic location, but provide a good starting point in deciding how to manage soil phosphorus on lawns. The indications are that applying more than 0.5 lb. P_2O_5/M/season where mulch mowing is practiced will gradually increase soil test phosphorus. Applying less than this amount will have the opposite result.

The blame game Effective management of phosphorus in lawns is not only good for the grass but essential for lawn care professionals. Whether it's true or not, phosphorus in runoff water from turf has been fingered as one of the causes of the degradation of the quality of surface waters in urban areas.

Figure 4

Recent legislation in Minnesota now bans phosphorus use on lawns with high soil phosphorus in the seven county area surrounding metropolitan St. Paul and Minneapolis. An exception is made for starter fertilizer. Numerous small communities scattered around the Midwest have passed similar ordinances. In Wisconsin, the intent is to require that any five or more contiguous acres of turf be fertilized according to soil tests. No phosphorus applications will be allowed where soil tests are high or excessive.

The concern is how quickly soil phosphorus will be depleted to the point where supplies are insufficient for maintenance of high-quality turf. The graphs in Figure 4 address this concern.

Per those graphs and for the conditions under which they were developed, soil P declined 4.5 ppm per year when clippings were removed and no fertilizer phosphorus was applied. The comparable figure when clippings weren't removed was a decrease of 1.8 ppm P per year. We find that many of our lawns have soils tests in the range of 60 ppm while we consider 20 ppm optimum. Under these circumstances, the soil P can be allowed to decline about 40 ppm without experiencing a reduction in turf quality. Dividing this 40 ppm by a decrease of 4.5 ppm per year when clippings are removed suggests we can go about eight years without applying phosphorus. With clippings returned, the figure is 40/1.8, or 22 years. I wouldn't wait that long in either case. Rather, I'd test the soil every three to four years and track the rate of decrease in soil test phosphorus for my particular situation.

Break with tradition The tradition of always applying fertilizers that contain phosphorus is a deeply ingrained practice. This leaves many people concerned that not applying phosphorous every year will cause turf quality to decline.

Where soil phosphorus levels are high, there's no increase in clipping phosphorus when fertilizer phosphorus is applied. In this case, applying phosphorus is a waste and not an environmentally sound practice.

The growing trend in regulation of phosphorus use on turf is a clear signal that the turf management industry needs to be prepared to react in a safe and positive manner.