



Responsible phosphorus management practices for lawns

Phosphorus (P) is an essential macronutrient that all plants need in relatively large quantities. The amount of P fertilizer needed by turfgrass is usually significantly less than nitrogen or potassium. However, P is particularly important during early grass seedling growth and development stages. Phosphorus plays a role in establishment, rooting, maturation, growth, and reproduction of plants. Plants can extract the relatively immobile soil P as dihydrogen phosphate (H_2PO_4^-) or hydrogen phosphate (HPO_4^{2-}). The terms available phosphate, available phosphorus, available phosphoric acid, and P_2O_5 may be used to refer to phosphorus fertilization.

While P is an important nutrient for grasses and other plants, it is also a vital nutrient for algae and weeds in our lake systems. Phosphorus is usually the least abundant nutrient in freshwater lakes and is often a limiting factor for the growth of algae and weeds. Lake enrichment of P can cause undesirable algal blooms and increased aquatic weed pressure, a process termed eutrophication. A result of eutrophication is an environment unsuitable for many fish and wildlife inhabitants.

Phosphorus deficiency signs and soil availability

Turfgrass P deficiencies are usually first recognized by stunted growth and reduced seedling vigor. It is unusual to see a P deficiency in a mature plant. In addition to the reduced growth, leaf blades can turn a purple to reddish color. The turf stand will begin to decline in quality if the deficiency is not addressed.

Not all purple discoloration of grasses is due to P deficiency. Many turfgrasses can develop a purple discoloration in late fall due to cold weather. This is not generally a P deficiency problem. The best way to determine if there is a P deficiency is to apply P fertilizer. If it is a deficiency, the plant will turn green in a few days. If the discoloration is due to cold weather, P fertilizer will have no effect.


Generally, phosphorus is considered relatively immobile in the soil because it may take a few months to move a few inches. Phosphorus immobility, unavailable forms, and the short roots of seedlings require additional applications in some situations.

Phosphorus availability is dependent on the pH of the soil and the presence of positively charged nutrients. Cations such as iron, aluminum, manganese, magnesium, and calcium can bind to P, rendering it unavailable. This occurs most frequently in situations where the soil pH is outside the optimal range of 6.0 to 7.0. In acidic conditions, the H_2PO_4^- is more susceptible to fixation with iron, aluminum, and manganese. In high pH situations, phosphorus is unavailable due to insoluble complexes created by formation of calcium and magnesium phosphates. The best way to improve phosphorus availability is through pH optimization.

Potential for offsite movement of phosphorus

The same reasons that make P unavailable for plant uptake keep P from leaching through the soil profile into groundwater reserves. Phosphates (P combined with oxygen) are quickly removed from the soil solution and

Table 1.1

Phosphorus Fertilizer	Percent Plant Food					Relative Release Time	Reaction per 100 lbs Material		Additional Information
	N	P ₂ O ₅	K ₂ O	Elemental	Elemental		Acidity	Alkalinity	
Inorganic									
Ammoniated Superphosphate	16	40	0			Moderate	7		
Concentrated Superphosphate	0	46	0	14 Ca		Rapid	N	N	Also known as triple superphosphate (TSP). 90-95% water soluble.
Diammonium Phosphate	18	46	0			Rapid	120		Most popular fertilizer in the world. Works best on acidic soils and should not be applied to calcareous soil.
Monoammonium Phosphate	11	48	0			Rapid	80		100% water soluble. Highly acidic.
Ordinary Superphosphate	0	20	0	20 Ca	12 S	Rapid	N	N	Also known as monocalcium phosphate. 80-85% water soluble. Highly efficient in calcareous soils and high pH soils
Organic									
Bone Meal	3.5	22	0	31.5 Ca		Slow		20	
Sewage Sludge	6	2	0			Slow	10		
Soybean Meal	7	1.2	1.5			Slow			
Tobacco Stems	1.5	0.5	5			Slow		25	
Castor Pomace	6	1.2	0.5			Slow	6		
Cotton Seed Meal	6	2.4	1.5			Slow	10		
Dried Blood	12	1.5	0.8			Moderately Slow	23		
Fish Scraps	5	3	0	8.5 Ca		Slow	10		
Ground P Rock	0	33	0			Very Slow		10	
Peruvian Guano	13	8	2			Moderate	13		

Ca = Calcium, N = Neutral, S = Sulfur

immobilized in the soil. Consequently, P does not pose a threat to groundwater reserves from leaching. In established turfgrass areas, the runoff potential is quite low due to the dense nature of turfgrass and its fibrous root system.

Off-site transport of P tends to be associated with sediment erosion from newly established areas and runoff from hard surfaces. Phosphorus can be carried in an eroded soil (silt and clay primarily) and organic matter sediments. Phosphorus also may be carried by wind erosion and later deposited into lakes. Living

plants such as trees, shrubs, and turf areas around lakes can help stabilize the soil against wind and water erosion. In addition, they act as vegetative buffers to help remove these fine soil particles from the air, trapping both the soil particles and any associated nutrients. To prevent offsite transport of P, avoid applying fertilizer to frozen soils, paved surfaces, and when heavy rainfall is expected. To prevent runoff loss, water all P fertilizers into the soil.

Phosphorus fertilizer sources

The United States is the second leading exporter of phosphorus in the world. The production of phosphorus

fertilizers involves the conversion of mined phosphate rock into more soluble P forms. There are inorganic and natural organic P fertilizers. The treatment of rock phosphate with various acids produces the inorganic P fertilizers such as superphosphates and ammonium phosphates. Organic phosphorus sources are usually a derivative of plant or animal by-products.

Best phosphorus management practices

If sufficient phosphorus is available in the soil, it is not necessary to apply additional amounts. The best means of determining the fertilizer requirements for an area is to have the soil tested. Soil tests provide valuable information on the phosphorus requirements of a soil at a nominal cost. Soils can be tested at Iowa State University's Soil and Plant Analysis Laboratory. Information can be found at www.extension.iastate.edu/publications/ST11.pdf.

Most soils in Iowa contain adequate amounts of phosphorus and no additional phosphorus should be used in a fertilizer program unless indicated by a low soil test. A 1.0 lb. of P_2O_5 per 1,000 sq. ft. is permitted for establishment purposes; however, it is still strongly recommended that this application follow a low soil phosphorus determination. Recent regulations in Minnesota and Wisconsin restrict residential landscape phosphorus applications in an effort to minimize environmental threats. While there are no phosphorus restrictions in Iowa, phosphorus should only be applied when a soil test has indicated a need for additional amounts. The Iowa Professional Lawn Care Association (IPLCA) has placed a self-enforced restriction on the use of P fertilizers on lawns surrounding lakes and other waterways. IPLCA members use fertilizers containing P in these areas only at the time of establishment. They are also careful to remove all fertilizer from hard surfaces to prevent movement into sanitary sewer systems.

It is best to apply P in the spring or fall when an application of P promotes nitrogen uptake. Ammonium (NH_4^+) and $H_2PO_4^-$ work cohesively to provide ionic balance in the soil. During the summer, more nitrification (process of breaking down ammonium to nitrate (NO_3^-)) occurs in the soil and the negatively charged nitrate competes with phosphorus for uptake. Warmer weather suppresses uptake and creates a situation where P is more prone to escape from the soil.

During the winter months, freezing and thawing can break down leaves, dead grass, and other organic debris and release soluble forms of phosphate and nitrates.

These nutrients potentially can runoff from frozen ground (especially slopes) during spring snowmelt and rains. Grass clippings, leaf litter, and other forms of organic debris should be removed and kept off hard surface areas where they are prone to runoff. Obviously, these same materials should not be dumped on or near shoreline areas where nutrients released during decomposition can move directly into the water.

Protecting newly seeded areas, especially slopes, with some type of mulch cover during establishment helps prevent nutrient runoff and erosion of soil. Applying P to an established turf following core cultivation helps move P down into the soil, protecting it from loss by runoff.



General fertilization practices

In addition to the specific phosphorus management practices already mentioned, some general lawn fertilization practices follow that can help reduce potential water pollution.

- Never directly deposit or inadvertently apply fertilizer materials into lake areas. Maintain a 10-foot buffer zone of unmanaged grasses or natural vegetation surrounding all bodies of water. This can help prevent soil erosion and will retain some of the nutrients that might otherwise enter the lake.
- Next to shoreline areas, apply fertilizer around the perimeter of the water source with a drop spreader to create a buffer zone. A drop spreader is recommended because it is more precise than a rotary type spreader. The rest of the area farther away from the shoreline can be fertilized with a rotary spreader. The same kinds of precautions should be taken when using liquid fertilizer.



Improper management or use of turf fertilizers may contribute to potential pollution of surface water and groundwater. However, combining appropriate landscape management practices with a modest lawn fertilizer program will reduce the threat of eutrophication.

For more information

Horticultural information is available from your local Iowa State University Extension and Outreach office and these websites.

www.yardandgarden.extension.iastate.edu

<https://store.extension.iastate.edu/>

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- Because unvegetated slopes or thin, low quality turfgrass areas are more likely to produce runoff and off-site fertilizer contamination than healthy, well-maintained turfgrass areas, it is important to properly maintain your turfgrass.
- Only apply fertilizers based upon low soil test determinations.
- Never apply fertilizers to drought stressed, dead, dormant, or frozen turf because of the increased potential for nutrient runoff.
- Fill granular fertilizer spreaders on a hard surface where any spills can easily be cleaned up. **NEVER** wash fertilizer spills into the street or other hard surface areas where they can easily enter storm sewers and surface water areas. Wash off granular fertilizer spreaders over turf areas to prevent runoff of fertilizer from hard surfaces.
- Close the gate on the fertilizer spreader when crossing hard surface areas or go back and sweep up the material. Reuse it another time or put it back into the spreader.
- Avoid getting fertilizer into natural drainage areas or pathways on a property. These areas may not necessarily be hard-surfaced areas, but they can carry fertilizer directly into the surface water before having the chance to infiltrate into the surrounding turf/soil area.