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Phosphorus & Potassium, Two Essential Turf Macronutrients

By Achille Correggia, *B.Sc. (Agri.) Agronomy, A.PAg,* ***CCA-ON***

A nutrient is considered essential if (a) in its absence turf is unable to complete a normal lifecycle, or (b) that element is part of essential plant function(s).

Two nutrients classified as essential are phosphorus and potassium.

Phosphorus

In order to manage soil phosphorus levels for economical turf management and environmental land stewardship, turf managers must understand the different forms of phosphorus within the soil. Soil phosphorus can exist in three completely separate and different forms; soluble (1%), organic (40-50%) and inorganic (40-60%). It is important to know that only phosphorus in its soluble form is available to turf.

The table below provides ideal phosphorus levels for a proper fertilization.

Optimum Phosphorus Range			
Soil Cation Exchange Capacity (CEC)			
0-6	**7-15**	**16-25**	**26+**
Parts per million			
56-93	**44-83**	**34-55**	**24-43**

Turf grown on soils that are low in phosphorus could show signs of deficiencies. These signs can include; reductions in turf density and root growth, reddening or yellowing of leaf margins, death of mature leaves and poor seed development. Phosphorus deficiencies in turf can also be described as a dark green colour that progresses to a purplish to reddish purple colour in the older leaves; visually turf stands will appear wilted which may be confused with the onset of drought stress.

The availability of phosphorus to turf can be affected by soil moisture, soil temperature, fertilizer application, and soil clay content, but the primary factor in phosphorus availability is soil pH. Soil pH levels do not have a direct affect on phosphorus, but are an indicator on how certain minerals will interact with phosphorus in the soil. Soils with a pH level less than 5.0 or higher than 7.0 will have reduced phosphorus availability. At pH levels lower than 5.0, phosphorus will react with high levels of iron and aluminum, creating iron or aluminum phosphate minerals. Soil with a pH level higher than 7.0 has a high concentration of calcium which will react with phosphorus, producing unavailable calcium phosphate. If a soil pH problem is not addressed, any phosphorus addition through fertilizer applications can become bound up in forms that are not available for turf grass uptake.

A possible solution is the addition of lime to acidic soils with a pH lower than 5.0 and elemental sulphur to basic soils that are well above a pH of 7.0. The amount of lime that needs to be applied to an acidic soil can be easily calculated from the soil's buffer pH and the limestone's agricultural index (A.I). The addition of sulphur on the other hand to basic soil is somewhat more difficult to predict and correct. A typical soil can contain anywhere from 1% - 5% lime. At the 5% level, the top three inches of soil can contain up to 25 tonnes of lime. These higher calcium levels may require an application of up to eight tonnes of elemental sulphur to amend this pH problem, not a practical solution for established turf. These high sulphur rates would need to be applied prior to turf establishment, which make soil testing prior to turf establishment so vital in correcting any soil problems. On established turf no more than 5 lbs of elemental sulphur per 1000 ft^2 should be applied in one application.

Potassium

After nitrogen and phosphorus, potassium is the third most likely essential nutrient to limit plant productivity. Many soils are rich in potassium although only 1% - 2% of soil potassium is readily available for turf uptake. The remaining potassium is stored in two different forms known as slowly available and relatively unavailable. Slowly available potassium typically constitutes 1% - 10% of the potassium in a soil profile while the remaining 90% - 98% is relatively unavailable.

Correct potassium levels are vital for chlorophyll, protein and starch production, water regulation (stomata opening and closing), as well as turf respiration. Good potassium nutrition is linked to improved drought tolerance, enhanced winter hardiness, better resistance to certain fungal diseases, and greater tolerance to insect pests.

A deficiency in potassium will typically begin in older leaves as chlorosis, followed by necrotic lesions (spots of dead tissue) at the leaf margins. The most common causes of potassium deficiencies are under-fertilization, restricted root growth from soil compaction (potassium uptake is through root interception) and low cation exchange capacity on constructed sand soils. Sandy soils have minute amounts of clay and organic matter, resulting in very few exchange sites. Potassium, as all other cations are subjected to rapid leaching from sand-based, low organic matter soils. In these types of soils, it is better to maintain lower K values and apply K fertilizers with multiple applications annually. The table below provides ideal potassium concentrations for environmentally and economically sound potassium fertilization programs.

On average, 3 to 4 lbs of K/1000 ft^2 are removed annually when clippings are exported from a mown site. The combination of turf's tendency to over consume large quantities of potassium combined with the removal of grass clippings during mowing may potentially lead to potassium deficiencies within the soil, eventually affecting the health of turfgrass.

Optimum Potassium Range			
Soil Cation Exchange Capacity (CEC)			
0-6	**7-15**	**16-25**	**26+**
Parts per million			
91-180	**121-240**	**161-320**	**201-400**

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Achille Correggia, is a Certified Crop Adviser, employed by Nu-Gro Corporation in Brantford.

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