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Managing Potassium Nutrition

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TURF LINE NEWS

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Potassium is required in relatively large quantities by turfgrass, second only to nitrogen. Potassium has little impact on turf visual quality or turf clipping yields, but it plays a critical role in plant stress resistance. A potassium nutrition program should be based on soil analysis and then fine-tuned through tissue analysis. The chemical properties of different potassium fertilizers determine their suitability for different management situations.

Potassium and Turf Health

The fact that potassium is involved in the activation of at least 60 enzymes helps illustrate its complex role in turf nutrition. Perhaps the most important of these catalyst reactions is in the formation of starches and sugars in the plant. The level of these carbohydrates in the crown and roots of turf is directly correlated with cold temperature hardiness. In addition, plant carbohydrates provide "energy" when mowing triggers foliage growth.

Water regulation is the other critical relationship potassium has to turfgrass health. Potassium has a positive influence on water uptake, which helps the plant utilize soil water more effectively. Potassium also maintains cellular water pressure; strengthening plant tissue and combating traffic related stress. Finally, potassium plays a role in the function of leaf stomata, the small openings that regulate transpirational cooling and CO2 intake. In short, potassium has a dramatic impact on the ability of turf to withstand environmental and mechanical stress.

For a number of reasons visual symptoms of a potassium deficiency, marked by brown or yellow leaf margins, are rarely observed in turfgrass. This phenomenon is primarily attributed to the physiological nature of the plant itself, as turf just doesn't readily exhibit potassium deficiency symptoms. But since potassium is mobile within the plant, a deficiency will show up first on the oldest leaf tissue – the tissue that is constantly removed by mowing. So even in very severe circumstances, a potassium deficiency will usually go unnoticed. Monitoring potassium nutrition and diagnosing hidden hunger before it limits turf health is critical.

Soil Potassium Fertility

Soil potassium exists in three forms, the portions of which are influenced by different types of clay in the soil. Permanently bound between soil clay layers, unavailable potassium accounts for 90-98% of total soil potassium. Slowly available potassium accounts for about 1-10% of the soil total and is gradually released from fractured clay particles. These two fractions of soil potassium are not available for plant uptake.

Readily available potassium, the third and most important type, is a combination of "free" potassium in the soil solution and potassium loosely held by soil clay particles. This type of potassium is also referred to as "exchangeable" and is in constant movement between soil exchange sites and the soil solution. Though it only accounts for 1-2% of total soil potassium it is the only portion available for plant uptake.

Its important to note that readily available or exchangeable potassium is the portion measured by soil test extraction methods. These testing procedures have been developed and refined over decades and are highly accurate in assessing the amount of potassium that will be available for turf consumption through the growing season. Extracted potassium levels are then measured against the amount of potassium removed from the soil by turfgrass growth. The difference between the projected removal of potassium and its available supply must be supplemented with fertilizer in order to prevent a health limiting deficiency and to maintain soil potassium levels. Additional potassium fertilizer may be recommended to offset anticipated leaching losses or to build soil potassium to a healthy level. Referred to as SLAN (Sufficient Level of Available Nutrients), this is the most agronomically sound approach to developing a potassium fertility program.

The ability of a soil to supply potassium is linked to its Cation Exchange Capacity (CEC). Soil clay particles have a negative electrical charge while potassium, a cation, has a positive electrical charge. The more clay a soil contains the greater its ability to hold and release a positively charged cation like potassium. This explains why low CEC sand greens are chronically deficient in potassium while high CEC clay soils are often high in potassium.

The other soil cations (calcium, magnesium, hydrogen, and sodium) play a role in potassium fertility because they compete for the same space on negatively charged soil clay particles. Known as Base Saturation, the ideal balance between cations is usually displayed in percentage terms or a set of suggested ratios (K:Mg, K:Ca, etc.). Though base saturation should not be used alone to assess soil nutrient status, it provides valuable insight into broad questions surrounding soil health and nutrient availability. Take sodium for instance. When sodium base saturation exceeds 5%, soil clay particles begin to "run together" with a reduction in permeability and airspace that can threaten turf survival. Excess sodium in the soil leaves little room for other cations resulting in calcium, magnesium and potassium deficiencies. This base saturation imbalance can be corrected with gypsum, replacing sodium with calcium on the soil particles.

Plant Potassium Status

To be sure, tissue analysis is a very valuable tool in assessing plant nutrient health. Conducted on a regular basis, it provides a road map of nutrient status and indicates the areas of fertility that should be fine-tuned to maximize turf health. In addition, tissue analysis informs the turfgrass manager if an acute nutritional disorder needs to be corrected. Turf tissue analysis should not be used alone to create a fertility program, but rather to assess the effectiveness of a soil test-based fertility program already in place.

Two types of tissue analysis procedures are available, Near Infrared Reflectance Spectroscopy (NIRS) and standard Wet Chemistry. The NIRS method was developed to assess nitrogen (protein) levels in livestock forage. Though fairly accurate in estimating tissue nitrogen levels, it is a poor method to assess tissue potassium levels. In fact, independent research conducted by PACE consulting on 23 Illinois golf courses reveals that NIRS testing "is not sufficiently accurate to provide estimates of 10 other key tissue nutrients".

The best method for assessing tissue potassium is through standard Wet Chemistry testing. This procedure is conducted under strictly controlled laboratory conditions and produces exceptionally accurate results. The previously mentioned PACE study concludes, "standard wet chemistry methods are more reliable indicators of serious imbalances in turfgrass nutrition than is the NIRS method".

Potassium Fertilizer Technology

Though the types of potassium fertilizer have changed little over the years, the way in which potassium is applied has changed dramatically. Low CEC sand soils that are subject to high rates of potassium leaching are now routinely spoon-fed with light and frequent potassium applications. Moreover, recent advances in controlled release potassium offer the benefits of improved potassium utilization from a single application. Finally, foliar potassium is widely used to fine-tune potassium nutrition.

The following products are some of the more commonly available potassium fertilizers.

Potassium Chloride (0-0-62): The most popular granular potassium fertilizer. Also known as Muriate of Potash. Its high analysis and low cost make it a common component in fertilizer blends for use on fairways and playing fields. Potassium Chloride is a naturally occurring salt.

Potassium Carbonate (0-0-30): A liquid, K-Carb is one of the lowest salt index forms of potassium fertilizer available. As a result of its low salt index and compatibility with other liquid products 0-0-30 is a common component of foliar fertiliz-

ers. Excellent for use in fertigation or other soil-based applications.

Potassium Sulfate (0-0-50-17S): Its low salt index and very small particle size makes SOP the granular fertilizer of choice for golf greens. Controlled release coated Potassium Sulfate is now available from some suppliers.

K-Mag (0-0-20-20S-10.6Mg): Technically known as sulfate of potash-magnesia, K-Mag is another natural salt used primarily as a high quality source of magnesium. A common component in fairway and greens blends.

Conclusion: Integrated Turf Nutrition

When developing a potassium nutrition program you should first have your soil tested by an accredited lab. Base you annual potassium fertilizer inputs on the difference between the amount of potassium available from the soil and the amount removed by the turf. In conditions of a severe potassium deficiency, assess the soil CEC and apply additional potassium to build soil test levels. When high rates of leaching are expected, such as on low CEC sand greens, consider controlled release potassium in conjunction with frequent and light fertilizer applications. Finally, if possible, monitor plant potassium status with monthly wet chemistry tissue analysis and fine-tune nutrition accordingly.

Sources: Turfgrass Soil and Chemical Problems (Carrow, Waddington and Rieke), Tissue Analysis: Guidelines and NIRS Revisited (Stowell, Gelertner), Potassium in Turf Grass (MDS Harris Labs).

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