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Potassium for Kentucky Turfgrasses

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Potassium (K) is an essential plant element and is the most abundant mineral, macro-nutrient in turfgrass after nitrogen (N). Sufficient concentrations of K are important to maximize turfgrass tolerance to stresses caused by temperature, drought, traffic, and salinity. Understanding the function, soil content, and fertilizer forms of K is essential to creating an efficient nutrient management program.

Function of Potassium in Turfgrasses

Potassium has many functions in turfgrass tissue. Perhaps the most important function of K is the activation of at least 80 enzymes. Enzymes are compounds that reduce the activation energy of biochemical reactions within the plant. Therefore, in the absence of K, plant activities such as sugar translocation and energy transfer either do not occur efficiently or cease all together. Secondary to enzyme activation, K is also the primary element responsible for maintaining cell turgor pressure and electroneutrality. Potassium does not enter into any organic compound inside the plant tissue. Instead, K is actively transported throughout the plant to locations such as cell vacuoles. The presence of K in the vacuole lowers the water potential, which results in the movement of water into the vacuole. In this manner, K controls the movement of water into and out of cells as needed. When K is deficient, the ability of the plant to move water is reduced. This reduction in water movement is an important variable influencing various turfgrass stresses. For example, when K is limited, the ability of the plant to close their stomata is limited. This results in increased water loss, high temperature stress, and a reduction in cell turgor pressure. If turfgrass is exhibiting these symptoms and is then exposed to traffic, the ability to resist and recover from damage may be reduced.

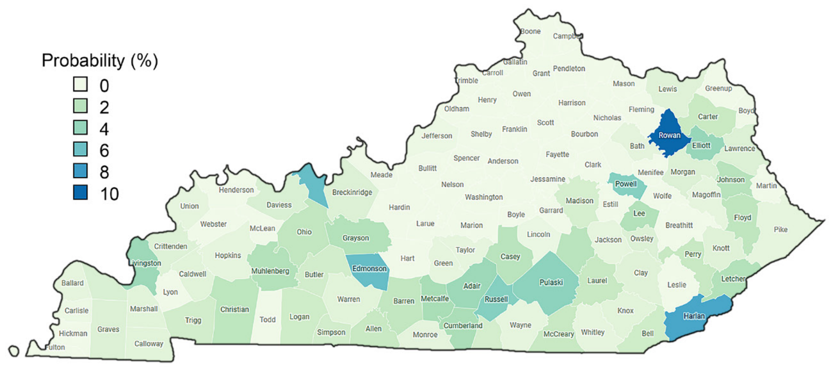

Figure 1. Probability of growing turfgrass on a native Kentucky soils testing less than 40 ppm K where a turfgrass response to applied potassium is likely.

Soil Potassium

Potassium exists in the soil in one of five possible forms: primary minerals, nonexchangeable, exchangeable, readily available, or organic (microbial). Turfgrass takes up K as the K^+ ion directly from the readily available pool in the soil solution. After K is removed from the soil solution, soil solution K may be replenished from the exchangeable K held on the soil exchange sites.

Kentucky soils are naturally high in K and, therefore, turfgrass growing on native Kentucky soils often do not require additional K (Figure 1). However, turfgrass grown on golf course putting greens and/or sand-capped sports fields are comprised primarily of sand. Because sand does not retain K as well as native Kentucky soils, applications of K may be necessary to sustain acceptable turfgrass on putting greens or sand-capped sports fields.

Soil pH can influence turfgrass uptake of K. At low pH, aluminum and hydrogen compete with K for soil exchange sites. As pH increases to 6.5, the competition is reduced and more exchange sites are available for K retention. However, as pH continues to increase above 7.0, calcium and magnesium may compete with K. Therefore, a pH of 6.5 is recommended for efficient K use by most turfgrasses. Waterlogged and low oxygen soils may result in reduced K uptake. In these cases, K uptake is inhibited to a greater extent than many other nutrients. Alleviation of compact and/or waterlogged soils by mechanical aeration can result in increased K uptake. Inversely, failure to properly aerate low-oxygen soils can result in K deficiencies.

Soil Testing

Soil tests for turfgrasses can determine if K should be applied. When a soil contains > 40 ppm Mehlich (Mā lik) III K, a turfgrass response to applied K is unlikely. Inversely, when Mehlich III K concentrations are ≤ 40 ppm, K applications may be warranted.

A soil test cannot determine how much K should be applied to turfgrasses. Unfortunately, many soil tests will include a recommendation to apply a specific amount of K. These recommendations are largely based upon agricultural research where yield is the primary determinate and, therefore, have little use for turfgrasses. In order to provide a meaningful recommendation, soil K concentrations must be calibrated to a turfgrass response to applied K. Potassium calibrations are not easily conducted on Kentucky soils because the soil already contains large quantities of K. In fact, the level of K in most Kentucky soils is high enough to mask turfgrass responses to applied K (Figure 1). For this reason, K soil test calibrations have not been validated for turfgrasses in Kentucky. Therefore, applying specific amounts of K to turfgrasses based upon a soil test is not recommended.

Tissue Testing

Tissue testing determines the mineral status of the plant tissue at the time the tissue is sampled. Managing K applications based upon tissue sampling requires greater knowledge than turfgrass science currently possesses. Foremost, one must know what "normal" K levels are for each turfgrass species. What may be "normal" K levels for a specific turfgrass in June may be different than the "normal" K levels in September. In this case, the change in K concentration is simply due to the natural changes that occur in response to the changes in seasons. In fact, it is known that turfgrass tissue K concentrations fluctuate based upon species, season, soil, and moisture, to name a few.

So how can tissue testing be useful in managing K applications to turfgrass? If the tissue is tested regularly from the same turf at the same time of year for multiple years, then a baseline or "normal" K concentration may be determined. If so, then changes relative to the established baseline may provide useful information when diagnosing potential problems. It is important to remember that a change in K concentration from normal levels may be the symptom of a problem and not the cause.

Applying Potassium

If the turfgrass is acceptable, then additional K is normally not necessary regardless of soil test K values. However, if the turfgrass is not acceptable and a soil test confirms that the soil concentration is ≤ 40 ppm Mehlich III K, then the application of K may be necessary.

All Turf Except Golf Putting Greens

Potassium is commonly applied in blended fertilizers with N. When applying K with N, K should be applied at approximately half the rate of N or less. In Kentucky, lower rates of K relative to N are common and more efficient because Kentucky soils are high in K. Therefore, applying K at rates as low as 1/10 the amount of N is likely adequate. Applications of 100 percent K are generally unnecessary, and applying increased amounts of K in autumn to "winterize" the turfgrass is not likely beneficial to turfgrasses in Kentucky. In fact, current research suggests that increased K applications in autumn to bentgrass may result in increased disease incidence the following spring. Therefore, it is recommended that K be applied with N during the regularly scheduled N application. In this manner, when N applications cease, K applications will also cease. Recommended N application rates and intervals may be found in *Fertilizing Your Lawn* (AGR-212).

Golf Putting Greens

Because putting greens are grown on sand-based rootzones and the turfgrass is cut at a height much lower than other turfgrasses, K applications to putting greens may differ from other turfgrass locations. The amount of K applied to putting greens may be approximately equal to that of N (N:K 1:1). The additional K is often necessary to alleviate the increased stresses putting greens encounter as a result of foot traffic, lower height of cut, reduced moisture levels, etc. On putting greens, a "spoon-feeding" approach is often necessary to maintain sufficient K in the turfgrass. This approach requires reducing the application rate of K but applying K more frequently. In many cases, this is more efficiently achieved by using liquid sources of K rather than granular. This effect may also be achieved by using slow-release K sources such as polymer- or sulfur-coated K. Slow-release K sources have been shown to provide a more consistent and extended uptake of K by turfgrass. However, the use of these products on putting greens, where the height of cut is much lower, increases the potential for the mower to damage the coating. Therefore, the benefit, if any, of slow-release K sources relative to soluble K sources on putting greens is poorly understood. Potassium application timing and intervals will differ depending upon the K source, expectation, and budget. The goal is to ensure that actively growing putting greens are supplied with available K as uniformly and consistently as the budget allows.

Forms of Potassium Fertilizers

In rare cases where a soil test results in Mehlich III K concentrations ≤ 40 ppm, K may be needed. In these cases, several K fertilizers are available. Essentially, all K sources are salts and therefore their burn potential (Table 1) may play an important role in selecting the appropriate K source.

Potassium Chloride

Potassium chloride may be referred to as potash, KCl, or muriate of potash. KCl is the most commonly used K source for turfgrasses because it is the least expensive. KCl also has the highest concentration of K (60% K_2O) compared with other K sources. Granular KCl may appear as a pink angular crystal or a white prill. KCl has a high burn potential and should be watered into the soil immediately after application.

Potassium Sulfate

Potassium sulfate (or sulfate of potash) contains 50 percent K_2O and often appears as an angular white particle. The burn potential of potassium sulfate is less than half that of KCl and is, therefore, a safer K option, especially in locations that also have chlorine sensitive plants. When K is being applied to turfgrass that is already showing signs of stress, potassium sulfate may be a better option than other, high-burn potential K sources.

Potassium Magnesium Sulfate

Potassium magnesium sulfate may also be referred to as sulfate of potash magnesia, SulPoMag (SPM). SPM has a lower concentration of K (22% K_2O) than either KCl or potassium sulfate, but SPM also provides a component of magnesium

Table 1. Common potassium sources applied to turfgrass and their relative burn potential

Material	Based Upon Amount of Raw Material*	Based Upon Amount of K**
Potassium magnesium sulfate	43	1.97
Potassium chloride	116	1.94
Potassium nitrate	74	1.58
Potassium sulfate	46	0.85

* Relative to sodium nitrate = 100.
** First column divided by the K percent of the raw material.
Adapted from Rader et al., 1943.

(Mg), which can be advantageous if Mg is also needed. More information on Mg can be found in *Magnesium for Kentucky Turfgrasses* (AGR-243), SPM has a similar burn potential to KCl and should not be applied to turfgrass without watering it in.

Potassium Nitrate

Potassium nitrate, or PotNit, contains 44 percent K_2O and 13 percent N. PotNit is of equivalent agronomic value as the previously mentioned K sources on a pound of K basis. The additional N component provides an advantage to other K sources. However, PotNit is not as commonly used as other K sources due to the higher cost.

Coated Potassium

Coated K sources may include any of the above mentioned K sources, but KCl is most common because it tends to be the least expensive. Coatings may be made from polymer, resin, or sulfur. Because the K source is coated, the burn potential of the K sources is greatly reduced. However, the rate of K applied must be increased so that the amount of K released at any one time is sufficient to meet the turfgrass needs.

Summary

On normal Kentucky soils, the application of K to turfgrass will not likely result in a beneficial turfgrass response because Kentucky soils already contain high concentrations of K. In some cases, increased applications of K in autumn may increase turfgrass disease in the spring. However, turfgrass grown on sand-based rootzones are unique and may require regular K applications to sustain acceptable quality turfgrass.

References

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