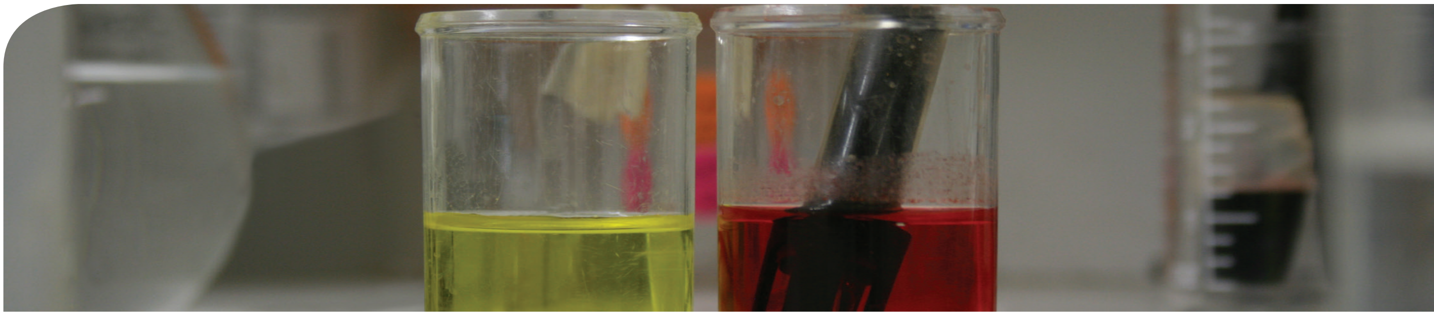
# Potassium in Turf Grasses





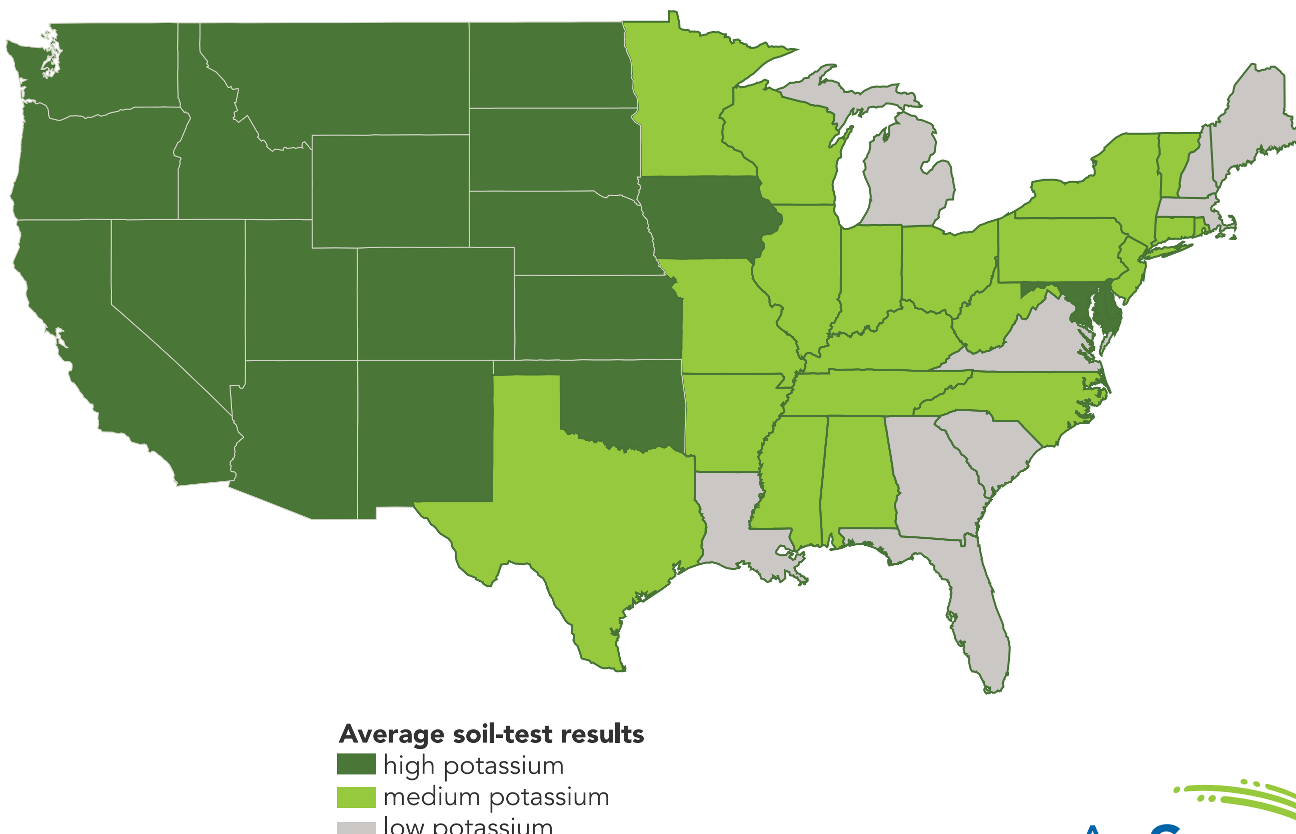
Potassium is essential for plant growth and is used by more than 60 plant enzymes that are involved in various biochemical reactions, including the production of sugars and starches. In addition, potassium helps plants by increasing disease resistance, strengthening cell walls, increasing winter hardiness and increasing drought resistance.

Potassium is the most abundant cation utilized in plant growth. Potassium is taken up by the plant roots from the soil and circulated throughout the plant in the form of K+. Unlike nitrogen and phosphorus, which take a number of different forms, potassium is only present in the soil in a single form and does not change. However, the amount of potassium present is complicated by the different soil textures and climatic conditions.

## Native Potassium Reserves

Different soil types developed from different geological material, each having varying levels of potassium. As a result, native potassium levels are widely varied throughout the United States. Figure 1 is based on native undisturbed soils. Where conditions of extensive dirt work (cutting and filling) exist, it is difficult to know if the completed grading consists of mainly native top soil, or a type of sub soil. In these constructed soils, potassium levels, and all other nutrient levels as well, will be low. It is essential to perform a soil analysis to determine native potassium levels, as well as other fertility levels. This establishes a benchmark, as all soils are different.

Figure 1. Potassium Soil-Test Levels in the Continental U.S.

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Feldspars and micas are geological minerals rich in potassium with concentrations as high as 80 – 100,000 parts per million (ppm). The potassium contained in feldspars and micas is held very tightly within these minerals and is generally unavailable for plant uptake. However, the potassium imprisoned within these minerals can be released through climatic conditions. These conditions contribute to what is called weathering. Weathering is the decomposition of rocks into smaller and smaller minerals – a process taking thousands of years. Precipitation is the key climatic condition resulting in potassium being released during the weathering of potassium containing minerals.

In addition to the weathering of soil minerals, precipitation causes released potassium to leach through the soil over time. Normally, we do not consider potassium to be a nutrient that can leach in medium and fine textured soils. (The process of leaching is greatly magnified on constructed sand soils.) In fact, at the most, movement would be measured in millimeters per year. However, after thousands and thousands of years of precipitation, the amount of potassium present in the soil has been leached downward throughout the soil profile. On today's undisturbed soils, this results in native potassium levels.

As you can see by Figure 1, soils in the southeastern U.S. are more deficient in potassium than other regions, particularly in the West. As stated, this is directly related to precipitation.

If native potassium levels are dependent upon precipitation, high rainfall should result in low potassium levels. However, even in areas with higher potassium reserves, the amount of potassium available for plant growth may be low due to the soil clay type and the soils cation exchange capacity (CEC). Both soil clay type and CEC are physical properties of the soil that cannot be changed.

## Soil Clay Types

There are three basic structures of silicate clay which determine availability of potassium in the soil. The basic structure types are shown in Figure 2.

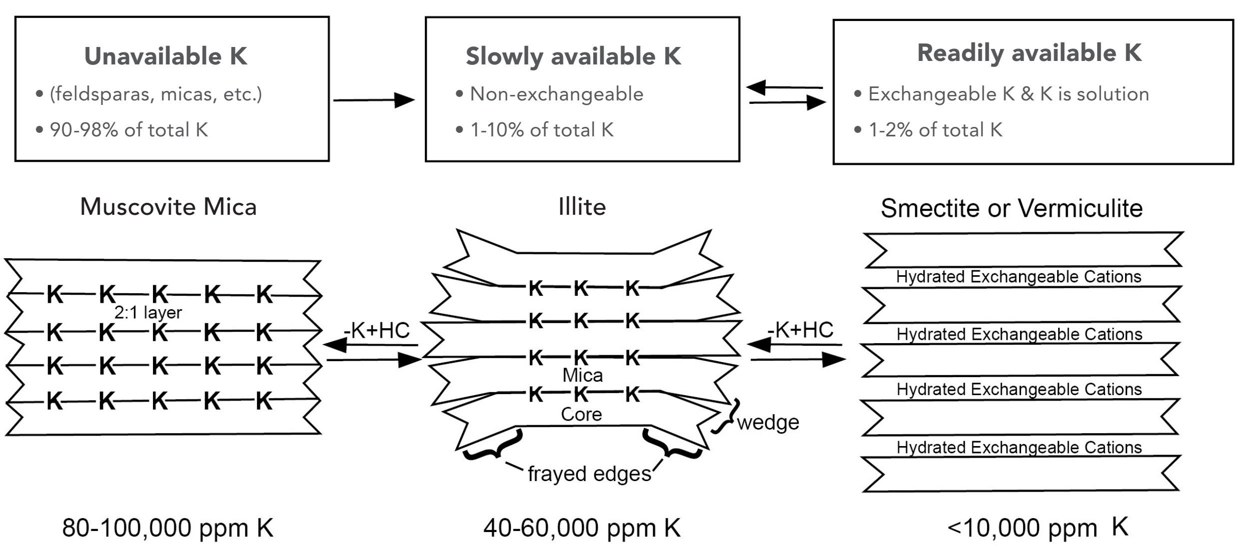
Muscovite (a type of mica) is rich in potassium, with concentrations of 80-100,000 ppm. The potassium contained in this clay type is imprisoned between the clay layers, however, making it virtually unavailable to plant roots.

Illite is a product of weathered muscovite. As shown in Figure 2, the edges of the illitic clay are frayed and wedged open, exposing the interior potassium deeper within the clay layers. The frayed edges of the clay can be repaired when potassium is applied and captured within the clay walls. Soil test potassium levels are difficult to increase when illite clay is present because of this entrapment process.

The third basic structure is shared by both smectite and vermiculite clay types. These clay types are lacking all of the interior potassium normally binding the clay layers together. This allows them to expand and contract during wet and dry cycles. These clay types hold onto potassium in a manner making the potassium readily available for plant roots.

Keep in mind all three structures can be present in the soil at the same time, and most soils have a mixture of clay types. The amount of available potassium will be

Figure 2. Forms Of Potassium In The Soil



dependent on the dominate clay type present in the soil. For example, in soils dominated by illitic clays, it would be difficult to increase soil-test potassium levels by applying potash.

## Cation Exchange Capacity (CEC)

Clay and organic matter are negatively charged and therefore have the ability to hold positively charged cations such as potassium (K+), calcium (Ca++), magnesium (Mg++), sodium (Na+) and hydrogen (H+). The ability to hold these positively charged cations is called the soils' cation exchange capacity and is an important measure for the soils fertility. CEC measures the number of available exchange sites.

The availability of potassium increases as the percentage of exchange sites occupied with potassium increases. Therefore, the interpretation of a soil test report requires knowing the soil test potassium levels and the CEC. Ideally, the potassium should occupy about three to five percent of the exchange sites.

Constructed sand soils are the exception to the above rule. These soils have virtually no clay and have extremely low levels of organic matter, resulting in few exchange sites. Potassium, as well as the rest of the cations, is subject to leaching rapidly.

On these soils, it is better to maintain lower K values and apply K fertilizers with multiple applications annually, similar to how nitrogen is applied.

Table 1. Optimum Range Soil CEC

| | Soil Cation Exchange Capacity (CEC) | | | |
|---|---|---|---|---|
| | 5 | 10 | 15 | 20 |
| | Optimum Range (ppm) | | | |
| Potassium | 91-120 | 121-160 | 151-200 | 181-240 |
| Magnesium | 60-119 | 120-239 | 180-359 | 240-479 |
| Calcium | 600-1199 | 1200-2399 | 1800-3599 | 2400-4799 |

## Potassium Fertilization

Table 1 provides the starting point for a sound potassium fertilization program. Based on CEC and soil test K values, one can determine whether K fertility is less than standard, greater than standard or optimum. The second step involves the management of grass clippings. When clippings are removed and exported from the site, usable potassium is also removed. On average, three to four pounds of K/1,000 sq. ft. are removed annually when clippings are exported. If clippings are left on site, this amount is then retained and quickly recycled as plant available K.

If the potassium value from a soil test is less than standard, then four to five pounds of K/1,000 sq. ft. needs to be applied annually. (If a quick buildup is desired, five to six pounds can be applied.) If the value is greater than standard, lower amounts of K would be needed. When soil K values exceed 400 ppm, little response from potassium would be expected. **Note**: Do not apply more than one pound of K/1,000 sq. ft. in any ONE application.

As stated above, soil potassium levels can be built up and maintained on medium and fine textured soils. However, on constructed sand soils, building K soil test values should not be your objective. Small, frequent applications are much more desirable.