Sunland Analytical
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Management of Soil Potassium for Agriculture or Landscaping

Whether it is called Potassium, Potash or K (the chemical symbol for Potassium); if plants don't have adequate amounts they will not thrive. Not thriving may mean that there is not an optimal yield from a prune orchard or that plants around a home look sun burned and unattractive. Whatever the location, appropriate management of soil Potassium (K) provides significant benefits.

One of the major roles played by potassium in the plant is facilitation of water movement and temperature maintenance in hot weather. Thus, a lack of Potassium in the plant tissue will lead to marginal leaf burn where the temperature at the edges of the leaf tissue have risen to a point that the tissue dies.

Potassium uptake by the plant has been demonstrated to be the result of a small amount of contact absorption, some mass transport and a significant amount by diffusion. In corn, for example, there is 2% by contact absorption, 20% mass flow (incorporated with imbibed water) and 78% diffusion. This means that the soluble potassium must be at a higher concentration in the soil solution surrounding the root than within the root. Since potassium does not move very far in the soil and the plant can effectively deplete the soluble potassium in areas immediately surrounding the roots, the plant must continually move the roots (by growth)into new regions. It has been demonstrated that most of the potassium uptake is accomplished by root extensions that are less than a week old.

As might be recalled Potassium is one of the most abundant elements in the earth's crust being approximately 2.6%. This means that in the top six inches of an acre of soil there is an average 30,000 pounds of Potassium. So why can plants

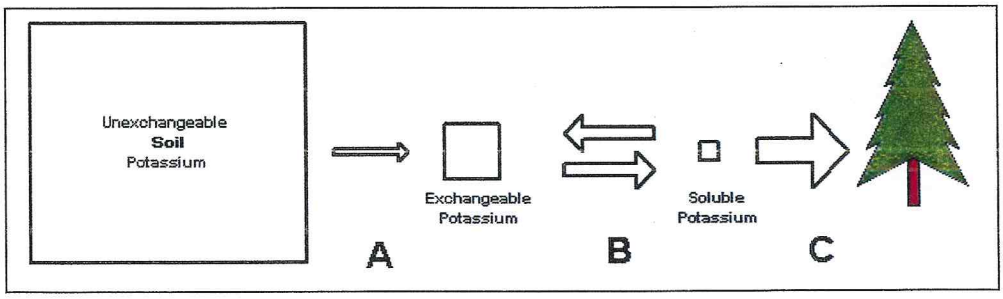

Figure 1. Changes in Soil Potassium

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have Potassium deficiencies? Only a small percent of this is readily available for plant use (10 to 500 pounds per acre). Potassium exists in essentially three forms within the soil; Unexchangeable, exchangeable, and soluble (Figure 1).

The rates at which Unexchangeable K converts to Exchangeable K is usually very slow. Typically, soils depressed in exchangeable potassium by a heavy demand will take weeks, months or even years to convert Unexchangeable K and replenish prior exchangeable K concentrations. In contrast, the rate at which exchangeable K is converted to soluble K is much more rapid. The soluble K on a typical acre may only be 3 to 9 pounds. If it is totally used by the plants it can be replenished, usually within hours, by release from the exchangeable K. Assuming there is adequate amounts of exchangeable K. However, with heavy crop demand, as in potatoes or tomato, the amount of soluble potassium localized around the root zone can be limited by the rate at which exchangeable K is converted into soluble K. This situation is usually limited to high potassium demand crops and to where there is a relatively low amount of exchangeable K.

Note in Figure 1 that there is an arrow pointing from soluble K to exchangeable K which means that soluble Potassium applied as fertilizer can be converted into the exchangeable form. This has the advantage that soil potassium is not readily leached. Thus, what you apply stays close to where it was applied. Figure 2 depicts the potassium, mostly near the surface, at application and still near the

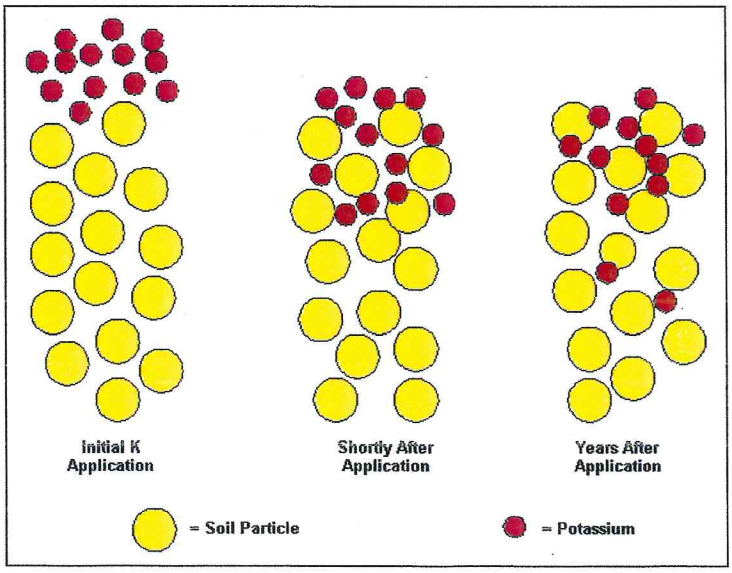

Figure 2. Movement of Potassium through Soil at varying Times

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surface even years after application. Indeed, researchers Patterson and Richter found that after 77 years of moderate potassium applications only the top two feet had increased in exchangeable Potassium. With such rate of movement it is important to incorporate the required potassium into the root zone before planting if at all possible. Where this is not possible, as in orchards or fertilization of landscaping trees, potassium fertilization can be facilitated by applying more generous amounts of potassium in a single application. This does require that the total salt concentration of the soil be considered such that the plants are not burned by excess salt. The effect of this type of application is to totally saturate all the soil potassium binding in the upper layers of soil thus allowing soluble potassium to mover further into the soil before it is converted to the exchangeable form. A usually acceptable application would be 650 pounds per acre or 15 pounds per 1000 sq.ft. of K_2O. See below for different fertilizer types. This application is typically done only once every three to five years.

Unfortunately, some soils also have the ability to readily convert soluble K into Unexchangeable K, thus, tying the K up and making if relatively unavailable for highly Potassium demanding crops. In these cases the potassium application should be banded to provide maximum benefit to the crop.

What should be known about the soil to evaluate Potassium availability? Soils submitted for a fertility evaluation generally have the exchangeable Potassium determined. This provides a baseline that may be all that is needed to manage many cases. Exchangeable Potassium concentration above 80 ppm will generally provide adequate Potassium availability when reasonably supplemented for plant utilization. However, Potassium below 80 may require different management depending on the desire to maintain plant growth or build fertility in the soil. Further, if the plants or crop create a very high demand on soluble Potassium, the rate at which soluble Potassium is replaced (Potassium Release Rate) should be evaluated. Again such information will allow for best management practices.

Forms of potassium fertilizers available include Muriate of Potash (Potassium chloride) which has the advantage of cost and availability while being a good source of potassium. It does have the disadvantage in some cases of transiently increasing the soil chloride level with the potential adverse effects of excessive chloride. Potassium sulfate (sulfate of potash) has the added advantage that it provides a source of sulfate for plant growth, but may be more costly.

Whether you need the exchangeable or soluble potassium or the potassium release rate determination, Sunland can make the determinations and provide recommendations for your soil management.