K·STATE Research and Extension | Wildcat District

FOR IMMEDIATE RELEASE

For more information,
contact: James Coover
Crop Production Agent, Wildcat Extension District
jcoover@ksu.edu, (620) 724-8233
Photo(s) Enclosed to Print Media

Potassium: A Farmer's Analysis in Soil Potassium Chemistry

FOR IMMEDIATE RELEASE:
A couple of months ago there was an article in Farm Talk about phosphorus and its chemistry in the soil. To continue on the soil nutrient journey, this time we are going to talk about phosphorus' sister nutrient, potassium. While the two have similar aspects in the soil, they are certainly not the same. Understanding the function of potassium in the plant and its forms within the soil can help producers make long range soil fertility decisions. Focusing on the "why" of soil fertility, rather than the "how much."

Potassium is a nutrient that most of the state doesn't worry much about. However, here in the southeast, our native "parent material" rocks in the Cherokee Lowlands (a geological feature covering Labette, Cherokee, Crawford, and Bourbon Counties). Parts into the Osage Plains (covering the rest of Southeast Kansas) didn't have much potassium in them. Our background potassium levels are naturally less, so we need to watch our potassium levels closer.

- Potassium in three pools– Potassium (K) in soil is like phosphorus in that it can generally be divided into the groups; solution K, active K, fixed K. Solution P is the only form absorbable by plants. Solution K is by far the smallest of these pools, just 1 to 2 percent of total K in soils, but still a couple hundred pounds per acre. However, roots don't completely fill the soil. Only a portion, around 10 percent of that solution K can ever be reached. Active K can easily be desorbed off of the cation exchange surfaces. Since plants can only reach a portion of solution K with their roots, active K must constantly be desorbing into solution during a growing season. Fixed K will take decades or centuries to come out of the soil and rocks, as it is bound within the actual structures of the sand, silt, and clay itself. This pool is somewhere in the thousands of pounds per acre or near 1 percent of the soil. Nearly all of it completely unreachable by today's plants (and farmers).

- The potassium soil test - Like every other soil test result, the results for K are just a test index trying to capture a certain amount of the solution K and exchangeable K. A soil test with 130 ppm result is considered optimum for most agronomic crops, but that is only around 260 lbs. of K (in the top 6 inches). Researchers have calibrated their fertility recommendations to the test itself, not the actual quantity of nutrient in the soil.
- Compounds of potassium - Potash, which literally means ash from a pot, is a misnomer from when we used to get our K fertilizer from boiled down lye water. Now, potash is mined and most potash in the U.S. is imported. Fertilizer is it represented as K_2O, but fertilizer is actually potassium chloride, KCl, potassium sulfate, K_2SO_4, or potassium nitrate, KNO_3. Plants adsorb potassium only by itself as K^+.
- Potassium and pH – In comparison to phosphorus and most of the micronutrients, K is not really effected by soil pH as much. In extreme pHs the K^+ ions can complex in insoluble forms, but other nutrients will be a bigger problem before this happens. Like all nutrients, K moves with soil water, which is why K fertilizer could have a bigger response in dry years. Potassium also needs oxygen in the soil to get into the plants roots so adsorption is an issue in water-logged soil as well. Temperature is another important component for K adsorption, slowing down when soil temperatures drop below 60 degrees. This is why K deficiencies can happen in early planted corn even when background K levels are plenty high enough for later in the season. It is also why K fertility is vital for wheat in late fall and early spring.
- Potassium important to plants – Potassium is the regulator in plants. It regulates CO_2 into the leaves, water into the roots, and the creation of many enzymes. Plants deficient in K have a harder time with temperature changes and reduction in drought resistance. Wheat (and likely alfalfa) has a harder time surviving hard winters without adequate K, and, like was discussed earlier, comes at a time when K adsorption is reduced by low temperatures.
- Potassium deficiency symptoms – Deficiency in K look a little different in every crop, but there are some similarities. It is normally shown by a yellowing at the tips and along the veins of older leaves (Figure 1). Plants might have a “hidden hunger” for K long before they show deficient symptoms.
- Potassium luxury consumption – Unlike phosphorus, plants will tend to adsorb more K then they need in what is called luxury consumption. This is less of a problem in grain production as most K is stored in stover that is returned to the field. In hay production, there is a cost to excessive K fertility lost in excessive plant uptake. This is not to say it’s not a good idea to “build” background K levels to agronomic optimum but adding well beyond needed levels has an extra cost.

- Potassium Fertility - Under adequate fertility, grain crops take between 20 to 50 lbs. of K during harvest. Hay crops, however, can take between 200 to 300 lbs. of K from the field every year. This is why it is hard to start off a hay field with low K levels, because it is nearly impossible, at least finically, to apply all the K fertilizer to keep background K levels up. This is why just enough K fertilizer is applied to get the crop through the year, even if background K levels will slowly drop in time. Fortunately, K is more mobile in the soil than phosphorus and does better being top-dressed in no-till and hay pastures.

This detailed focus on one specific nutrient is to give a more well-rounded understanding of soil fertility, beyond just talking about how much fertilizer is needed. If you have any questions about crop fertility or would like me to take a look at some suspected disease or deficiency issue, please give me a call.

For more information, contact James Coover, Crop Production Agent, jcoover@ksu.edu or (620) 724-8233.

Figure 1. Yellowed edges and veins in potassium deficient corn.

# # #