AGRONOMY

Potassium Recommendations

A field's potassium reserves are based on geological conditions and precipitation. The amount of available potassium in a field is dependent on the soil's clay type and cation exchange capacity (CEC). These factors make potassium recommendations more complex than recommendations for other nutrients, but by knowing two key factors – the amount of potassium removed with each harvest and optimum fertility levels for the intended crop – growers can calculate fertilizer recommendations to maintain and build potassium levels.

Maintaining Potassium Levels

Potassium measured in soil testing is expressed as parts per million (ppm) of the element K. However, fertilizer recommendations and the nutrient removal rates presented below are given as pounds of potash (K_2O). Most of the potassium utilized by crops is held above ground, a third of that amount contained in the grain. For example, 175 bushels of corn will contain 45 pounds of potassium (as K_2O) in the grain and 145 pounds in the residue. Therefore, when crop residue is returned to the soil, the majority of the potassium is recycled. Below are removal rates for some common crops.

Table 1. Crop Removal Rates

Crop	Pounds of Potassium Removed per Unit
Corn (grain)	0.30 lbs./bushel
Corn (silage)	7.50 lbs./ton
Soybeans	1.38 lbs./bushel
Wheat	0.45 lbs./bushel
Sorghum	0.30 lbs./bushel
Barley	0.25 lbs./bushel
Sugar Beets	3.30 lbs./ton
Alfalfa	35.00 lbs./ton

*Pounds are as K_2O

Once the removal rate is known, use the following formula to calculate how much potassium fertilizer should be added to replenish the soil's potassium reserves.

Crop Yield x Crop Removal Rate = Maintenance Requirement

For example, if five tons of alfalfa is produced per acre, using the formula above, it would take 175 pounds of K_2O to replace what was harvested (5 tons x 35 lbs./ton = 175 K_2O).

Unfortunately, it is not that simple. Only replacing what is removed does not account for the amount of potassium, which may be insufficient for producing optimum yields, already present in the soil. Because potassium availability is a function of the reserves in the soil that are geologically determined, the soil clay type, and the CEC, growers must take a long-term path toward building potassium levels over time.

Building Potassium Levels

The optimum soil-test level for potassium varies for different growers depending on the field's geological history, the crop, and the field's yield potential. In general, 150 to 200 ppm K is an optimum range for most crops. However, this range can shift up or down depending on yield potential, the crop value, and current field-management practices.

If current soil-test levels for potassium are below the optimum level, we recommended building fertility levels over time. AgSource Laboratories uses a nine-year plan for building potassium soil-test levels to a target of about 175 ppm K. On average, it takes about 8 pounds of K_2O per acre to increase the soil test by 1 ppm K.

Therefore, to increase a soil test by 20 ppm K, for example, an additional 160 pounds of K_2O per acre is required. This amount is in addition to the potassium fertilizer needed to replenish what is removed at harvest. Building to this level over nine years would mean applying 18 pounds of potash (K_2O) per year.

Remember that different soil types build potassium levels at different rates. Some soils may require less than the average 8 pounds of K_2O per acre. Others will require more.

Conclusion

Making recommendations for potassium fertilizer application rates requires knowing harvest removal rates and optimum fertility levels for the field and crop.

- If the current fertility level is **low**, apply potassium at a greater rate than the crop will remove. Over time, this treatment will build potassium levels in the soil.
- If the current fertility level is **optimum**, apply potassium at the crop removal rate. This application will maintain the current fertility level.
- If current fertility level is **high**, apply potassium at a rate less than the crop removal rate until the soil-test level reaches the optimum range. In some cases, the potassium application rate may be zero.

The following is a sample calculation for making a potassium recommendation using the approach discussed:

Background Data & Crop Information

- **Crop**: Alfalfa
- **Yield:** 4 tons/acre
- **Potassium soil-test level:** 160 ppm
- **Desired fertility level:** 175 ppm
- **Years to build the soil:** 9 years
- **Potassium ppm rate:** 8 lbs K_2O/ppm K
  (Estimated based on soil type)

Steps for Determining Annual Application

- **Find removal rate**
  Yield x pounds of K_2O removed per unit
  4 tons x 35 lbs. K_2O = 140 lbs. K_2O /acre
- **Determine ppm difference**
  Desired fertility level – potassium soil test level
  175 ppm – 160 ppm = 15 ppm
- **Calculate build amount**
  ppm difference x potassium ppm rate
  15 ppm K x 8 lbs. K_2O per acre/ppm = 120 lbs. K_2O per acre
- **Figure years for build**
  Build amount / years to build soil
  120 lbs. K_2O per acre/9 years = 13 lbs. K_2O per acre/year
- Determine total application rate
  Removal rate + Years for build
  140 lbs. K_2O + 13 lbs. K_2O = 153 lbs. K_2O per acre

Therefore, for this example, the annual application rate is 153 pounds of K_2O per acre.

Remember, nothing is certain when it comes to potassium. Because it is impossible to know precisely what kind of soil clay type present (every field is a mixture of clay types), the potassium build rate can only be a best guess. The only way to know if potassium application is adequate is to measure the potassium soil-test level regularly. If potassium levels are not increasing in the soil over time, then one can be fairly certain that the soil is composed of illitic clay. If that is the case, the soil can 'fix' large amounts of K and, trying to build potassium levels in the soil would not be advised.