Extension
UNIVERSITY OF WISCONSIN-MADISON

The Potassium (K) Cycle

for general cropping systems in Wisconsin

NPM
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Potassium is less available than phosphorus, and moves less and cycles slower than nitrogen.

Potassium deficiency symptoms first manifest in older leaves, because potassium is highly mobile in plants and moves from older to younger tissue.

Potassium is one of the 17 essential nutrients necessary for optimal plant growth and health. After nitrogen, it is next largest amount needed by crops.

losses −

CROP REMOVAL

Potassium is removed by crop uptake and harvest. Alfalfa, grass mixes, pastures, corn silage and small grains with straw remove large amounts and can cause potassium levels to drop quickly.

EROSION & RUNOFF

Potassium losses from erosion and runoff do not threaten water quality like phosphorus does.

LEACHING

Potassium leaching is most common on soils that do not have enough clay particles to form strong bonds. These sandy and organic soils often test low for potassium.

+ additions

CROP RESIDUES

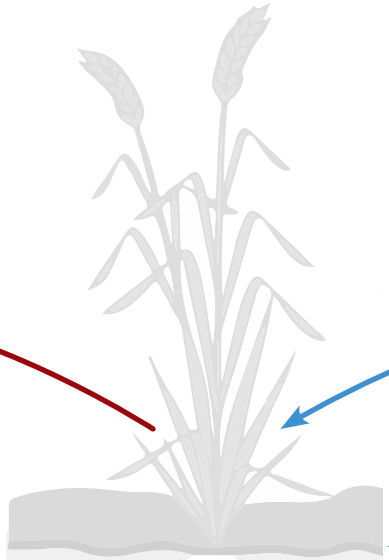
Potassium is retained when crop residues, especially straw, are left in the field to breakdown into the soil's organic matter.

MANURES & BIOSOLIDS

Potassium and other nutrients are provided by these applications and should be credited.

FERTILIZERS

Potassium fertilizers are immediately available to crops as they add to the dissolved into the soil solution.



ROOT RELEASE

ROOT UPTAKE

Dissolved K
in soil solution

available ✓

Potassium dissolved in the soil solution is utilized by plants through root adsorption.

*As **dissolved K** is taken up by plants, **exchangeable K** is released into the soil solution in a quick and dynamic equilibrium.*

Exchangeable K — available ✓

Potassium held on the surface of clay particles and organic matter can easily move into the soil solution. **Soil tests measure this form of potassium.**

Potassium is trapped or "fixed" within the layers of clay particles and then releases small amounts over extended periods of time and in certain conditions.

Fixed K — slowly available

Mineral K — not available

90–98%
is in this form

Potassium is confined within the structure of soil minerals and clay. Although a very small amount is released over time as weathering occurs, the majority is unavailable.

Authors: Mimi Broeske, Chris Clark and Jordan Kampa | This publication is available for download from the Nutrient and Pest Management Program's website: ipcm.wisc.edu

DIAGRAM IS ILLUSTRATIVE AND NOT TO SCALE | FOR RECOMMENDATIONS, SEE FOLLOWING PAGE

KEY POTASSIUM (K) CONCEPTS

- ☑ **K fertilizer recommendations** vary by soil type because soils vary in the amount of K they can supply and retain.
- ☑ **K uptake** by plants is dependent on available soil moisture: lack of precipitation can affect this.
- ☑ **K availability** is improved by incorporating organic amendments.
- ☑ **Crops recycle K** which can lead to stratification especially on no-till fields and pastures.
- ☑ **To increase soil test K by 1-ppm,** it takes 8 lbs of K_2O/acre (to convert K to K_2O multiply by 1.2).

GENERAL CONSIDERATIONS

Monitor soil K levels with routine soil testing:

- Use results to identify fields that need and do not need additional K.
- Fertilize fields that test low and very low for K; this will result in the highest return on investment.
- Prioritize fields that test low for K for manure applications; for the most accurate credits, test manure for nutrient content.
- Phosphorus (P) and K affect N use efficiency. Correct both K and P deficiencies before investing in additional N.
- For fields where the majority of the plant is removed (corn silage, alfalfa, other forage crops), soil test fields every two years since these crops remove large amounts of K, and K levels can drop quickly.
- Consider reducing or eliminating starter fertilizer.

Identify the highest demanding crop in the rotation to meet K requirements:

- Highest demand is **Level 4** (potatoes), then **Level 3** (tomatoes, peppers, brassicas, leafy greens, root, vine and truck crops), **Level 2** (alfalfa, corn silage, wheat, beans, sweet corn, peas and fruits) and **Level 1** (corn grain, soybean, clover, small grains -except wheat, grasses, oilseeds and pasture).
- Rotate crops with different K demand levels and crop removal ranges to help balance K uptake and replenishment in the soil.

SPECIFIC SITUATIONS

1— In heavy soils: K is trapped between the clay layers during wetting and drying cycles.

- As the layers expand (wet) and contract (dry), K is released into the soil solution for plant uptake or bound tightly (fixed K).

2— In coarse & organic or irrigated soils:

- It's difficult to build up K levels in these soils as they do not retain K. They may require annual K applications; spring split applications are preferred to fall.
- K movement can be underestimated in sandy to silt loam soils.
- Soils with low K buffering should monitor K by soil testing every two years. Annual soil testing on irrigated soils growing high dollar vegetable crops.
- Plant tissue test compliments K management on sandy soils.
- Organic soils hold very little K and are not suited for high K removal crops.

3— For corn on soils that are slow to warm in the spring: A minimal amount of starter fertilizer that delivers approximately 10 lb N, 20 lb P_2O_5 and 20 lb of K_2O can be beneficial.

- No more than this amount of starter should be applied to soils that are in the excessively high K range.
- Any nutrients (N, P and K) applied as starter fertilizer need to be credited against the overall nutrient recommendation from the soil test report.

4— New alfalfa stands with soil test results recommending K: Manure can be applied to the field prior to seeding. Use caution if oats are also seeded; lodging can occur if the oats are intended for grain due to the additional manure N.

5— Manure on forages or hay prior to seeding is an effective way to both supply K and distribute manure.

6— Manure on forages or hay as a topdress fertilizer is an effective way to both supply K and distribute manure. Be certain to:

- Target older hay stands (don't damage young stands with increased traffic, weed seed introduction and stimulation of grass growth).
- Limit application rates to 10–12 tons/acre or 3,000–5,000 gallons/acre (avoid smothering and salt injury).
- Spread on firm, dry soils to avoid compaction.
- Spread as soon as possible after cutting to avoid burning alfalfa regrowth.

7— Forage from fields with excessively high K level: Test forage for excessive K levels (> 3%) to prevent increased incidence of milk fever and other related illnesses in cattle.