

## Crop Plants Take Up (Absorb) Nutrients in Inorganic Form

**T**here is an ongoing debate as to the relative advantages and disadvantages of organic farming compared to conventional farming. At the center of the issue is the use of organic nutrient sources—animal manures, plant residues and biosolids—versus commercial (mineral) fertilizer sources. While the resolution of the overall debate involving organic and inorganic remains to be found, crop preference for nutrient sources is a given. Crops take up (absorb) and use **almost exclusively** inorganic nutrient forms.

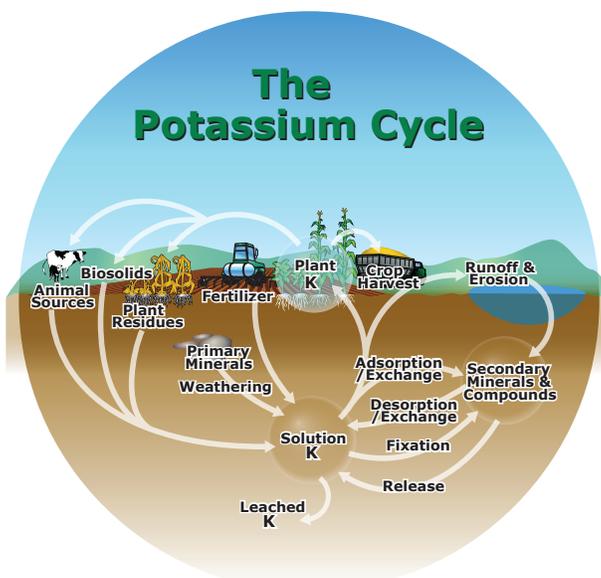
Except for potassium (K), all the other nutrients contained in any organic source remain unavailable for crop use until the material is decomposed (mineralized), releasing its nutrients to the inorganic soil pool. Since K does not form any organic compounds within a living cell of an organism, most K, if not all, in plant residues or other organic sources can be easily leached out by water before decomposition and mineralization of the organic material has taken place. While organic substances are found to some extent in all agricultural soils, they are continuously in some stage of transformation—mineralization or decomposition—back to the inorganic form. They are valuable nutrient sources, **but the nutrients they contain must be transformed to their inorganic form to be taken up by plants.**

**In fact, plants take up nutrients as ions.** Ions are electrically charged forms of each nutrient or element. Some are cations (positively charged) and others are anions (negatively charged). For example, the three major plant nutrients nitrogen (N), phosphorus (P) and K are taken up by plant roots as follows:

- N is absorbed as ammonium ( $\text{NH}_4^+$ , a cation) or nitrate ( $\text{NO}_3^-$ , an anion).
- P is absorbed either as  $\text{H}_2\text{PO}_4^-$  or  $\text{HPO}_4^{2-}$ , both anions.
- K is absorbed as  $\text{K}^+$ , a cation.

**Using K to illustrate, the following series of events might take place when a nutrient is added to the soil.** Remember, it doesn't matter whether the nutrient source is animal manure, crop residue, biosolid, or commercial fertilizer, the K must be available as  $\text{K}^+$  before the crop can use it. Once it is in this ionic form, there is no distinction as to what its original source might have been. It is now subject to all the processes that ordinarily take place in the soil.

- It can be taken up immediately by the crop, if one is growing at the time.
- It can remain in the soil until the crop uses it.
- In some cases, it can be leached out of the root zone.
- It might be lost from the soil through erosion and water run-off.



The illustration of the K cycle in soil shows some of the conditions involved with this important nutrient.

**Remember, regardless of nutrient source, crop plants use nutrients in the inorganic form.**

### FOR FURTHER READING:

Blevins, D.G. 1994. In Ch. 10A. Physiology and Determination of Crop Yield. ASA-CSSA-SSSA, Madison, Wisconsin. USA. pp. 259-275

Epstein, E. and A.J. Bloom. 2005. Mineral Nutrition of Plants: Principles and Perspectives, 2nd Edition. Sinauer Associates, Inc. Sunderland, Massachusetts. 380p.

Marschner, H. 1986. Mineral Nutrition of Higher Plants. Academic Press. London. 674p.