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Understanding Potassium for Crop Production in Nebraska

This NebGuide discusses the availability of and the need for potassium in Nebraska soils

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Potassium (K) is an essential nutrient absorbed from soils by crops in relatively large amounts. Therefore, it is classified as a major nutrient. Although large amounts are absorbed, potassium is not necessarily needed in a fertilizer program. Numerous studies conducted with all major crops have definitely shown that adding potassium to a fertilizer program does not lead to yield increases on the large majority of soils in Nebraska.

Forms of Potassium

Potassium exists in three forms in all soils:

1. unavailable (fixed)
2. slowly available
3. readily available

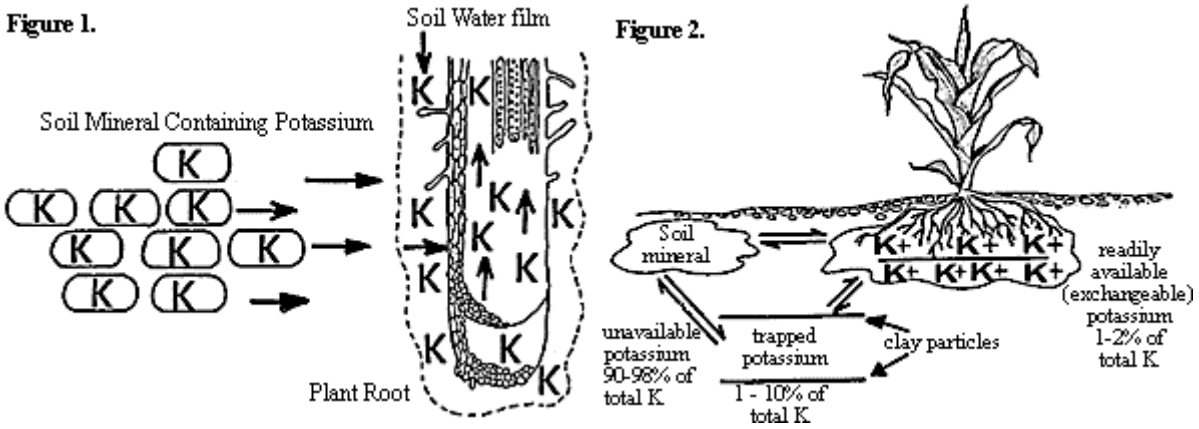
Unavailable, or fixed, potassium is a part of the minerals (feldspars and micas) in the soil. This form of potassium is converted to either the slowly available or the readily available form by the process called weathering. The rate of weathering is not the same across the state. It is affected by such factors as the type of mineral being weathered, moisture content of the soil, and temperature.

The slowly available form of potassium is held tightly to the clay-sized particles in soils. In some cases, this form may be "trapped" between two clay particles.

Plants use potassium in the readily available form. This form consists of exchangeable and water soluble potassium. The soil water contains a small but significant amount of potassium for plant use. This

amount can range from 5 to 40 lb/acre in the top foot of soils. This form of soil potassium is at its highest level in early spring and decreases throughout the growing season as plants take it up. The movement of potassium from the minerals into the plant root is shown in *Figure 1*. Also called exchangeable potassium, this is the form that is measured by standard soil testing procedures.

The three forms are related to one another and one form can change to another as shown in *Figure 2*.



The ranges for the amount of potassium that exists in the various forms are given in the following table.

Form of Potassium	**lb/Acre**
Unavailable	800 - 4,500
Slowly available	45 - 80
Readily available	5 - 40
Total	15,000 - 40,000

It's important to point out that the arrows in *Figure 2* are pointed in both directions. This means that the changes in potassium form that take place in soils can be reversed. While unavailable potassium is converted to readily available potassium under most situations, readily available potassium can sometimes be converted to unavailable potassium.

The minerals found in Nebraska soils are quite different from those found in states farther to the east. Minerals containing potassium are present in large quantities in Nebraska soils, and when they are broken down (weathered), relatively large amounts of potassium are released for use by plants. In the eastern states, however, potassium is not readily released from the minerals in the soils. Therefore, recommendations for the use of potassium fertilizers on Nebraska soils are quite different from those in the eastern states where responses to potassium fertilizers are common.

An example of the difference in potassium content of soils is given in the following table. The Clarion soil is representative of several soils in Minnesota and Iowa that respond to the application of potash fertilizer. The Hall soil is typical of the irrigationd soils in the Central Platte Valley. The Thurman soil is representative of sandy soils in Nebraska.

Readily available potassium (exchangeable K) content of three midwestern soils.

Depth	Soil Name		
	Clarion	**Hall**	**Thurman**
Inches	----------*lb/acre*----------		
0 - 6	143	1488	247
6 - 12	97	922	156
12 - 18	61	725	87
18 - 24	33	712	72
24 - 30	30	1020	71
30 - 36	33	1358	89
	397	6295	722

It's evident that even the sandy soils in Nebraska have much larger amounts of readily available potassium in the root zone when compared to soils from Minnesota. The large majority of Nebraska soils are generally well supplied with potassium throughout the root zone.

Potassium Fertilizer Recommendations

People who make fertilizer suggestions for farmers usually follow one of two theories. To some, a certain "balance" among potassium, calcium and magnesium is important. Following this concept, potassium fertilizer suggestions, adjusted somewhat for crop removal, are made to maintain this desired "balance." Others base potassium fertilizer suggestions on the results obtained from field research.

Nebraska field research results clearly show that potassium suggestions that are based on the "balance" concept are excessive. These suggestions increase costs to the farmer without a corresponding increase in yield. In fact, field research shows that the probability of obtaining a yield increase from the application of potassium fertilizer is quite low.

Potassium and Crop Lodging

In states where responses to potassium fertilization are common, its use is usually associated with increased stalk strength. This has not been the case in Nebraska.

Corn does lodge or go down in the fall in Nebraska, but this problem is more often caused by stalk rot disease rather than a shortage of potassium in the soil. The organisms that cause stalk rot are present in all soils, and their harmful effect is stimulated by one or more of the following: 1) excessive use of nitrogen; 2) stress caused by a plant population that is too high; 3) stress caused by drought; and 4) use of excessive amounts of irrigation water.

Potassium in Irrigation Water

Up to this point, this NebGuide has concentrated on the potassium in Nebraska's soils. For those who irrigation, irrigation water can be an important source of potassium. The concentration of potassium in irrigation water varies across the state. Typical values are listed in the following table.

Potassium content of irrigation water in Nebraska.

County	Potassium Content, ppm
Adams	9
Antelope	6
Cedar	5
Gage	4
Holt	5
Keith	17
Madison	7
Red Willow	24
Scots Bluff	19
Wayne	8

Irrigators can determine the amount of potassium applied per acre for each 12 inches of irrigation water applied by multiplying the parts per million (ppm) of potassium by 2.72.

With modern fertilizer technology, it's possible to inject fluid fertilizers containing potassium into the irrigation water. However, unless the soil is deficient in potassium, this practice will not increase yields and is not recommended.

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