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POTASSIUM IN NORTHERN GREAT PLAINS SOILS

The soils of the Northern Great Plains tend to be geologically young soils because soil development has only occurred over the past 10,000 years or less since the last glaciation. This is in contrast to many soils in other regions of the world that can be hundreds of thousands, to millions of years old. One plant nutrient that tends to occur in relative abundance in the Northern Great Plains is K. This is because soil minerals have developed from rock containing naturally high levels of K. Northern Great Plains soils tend to be only slightly weathered due to the short time of soil development, the cooler climate, and only moderate amounts of precipitation. This can be in contrast to highly weathered tropical soils. Time, moisture, and warm temperatures cause weathering of tropical soils and release K from the soil minerals that leach out of the soil. Many of these weathered soils require large K fertilizer additions (e.g. at least 100 lb K_2O/A) to achieve high-yielding crops.

Knowledge of two soil analysis measurements, cation exchange capacity (CEC), and base saturation (BSat), can be used together to give an indication as to how much K may be available in a soil. CEC is a measure of how much positively charged ion (cations) a soil holds primarily on its clay-sized particles. A very low CEC is in single digits (e.g. 1 to 5 cmol/kg) compared to a high CEC soil with a CEC from 20 to 30 cmol/kg. BSat is a measure of what portion of CEC is occupied by the base cations Ca^{+2}, Mg^{+2}, K^{+}, and Na^{+}, expressed as a percentage. Other cations that can be a portion of the CEC that are not base cations are Al^{+3}, Fe^{+3}, and H^{+}. Generally, a soil with a greater CEC and high BSat, with ample K present, will have a neutral-to-alkaline soil pH and higher amounts of plant available cations.

The most common soil texture and parent material in the Northern Great Plains is a clay loam, formed from glacial till. Glacial till tends to have a homogeneous mixture of clay, silt, and sand-sized particles due to the grinding and mixing action of glacier ice. On this type of soil, K fertilization rates tend to be only 5 to 15 lb K_2O/A applied in the seed-row for a small grain crop. However, not all soils are clay loams. After glaciation a portion of the landscape was modified by flowing water and by wind movement of soil particles. These forces sorted the glacial deposits into different soil textures, some with greater proportions of sand (coarse-textured), some with greater proportions of silt (medium-textured), and some with greater proportions of clay (fine-textured). The proportions of sand, silt, and clay-sized particles greatly affect the CEC and available base cations of a soil. It is important to know what dominant texture a farmer has in a field and how this may affect the rate of K fertilization.

The Table below compares two Northern Great Plains soils located only 20 miles (32 km) apart in south central Alberta. The coarse-textured sandy loam soil has a CEC of 4, and available K of 66 lb K/A, compared to the clay loam soil that has a CEC of 21 and available K of 1,090 lb K/A. An average fertilizer K rate for the sandy loam soil is about ten times greater compared to the K rate for the clay loam soil. It is recommended that a more accurate fertilizer K rate be developed for a specific soil and field by using soil testing and analysis, along with a recommendation developed by a qualified crop adviser.

Table 1. Location of soil, soil texture, parent geologic material, percentages sand, silt and clay, CEC and plant available Ca, Mg and K, and common K fertilizer rate, on two nearby soils.

Nearest town	SoilTexture	Parent material	Sand, %	Silt, %	Clay, %	CEC, cmol/kg	Plant available cations, lb nutrient/A (24 in or 60 cm)			Fertilizer K rate, lb K_2O/A (50 bu/A wheat)
							Ca	Mg	K	
Strathmore, AB	Sandy loam	Sorted sands	75	5	20	4	2,620	780	66	50
Rosebud, AB	Clay loam	Glacial till	45	22	33	21	13,300	1,620	1,090	5

– TLJ –

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Abbreviations: Ca = calcium; Mg = magnesium; K = potassium; Na = sodium; Al = aluminum; Fe = iron; H = hydrogen.