MAINE NRCS AGRONOMY TECHNICAL NOTE

Soil Potassium Management: Excessive Soil K

Nutrient Management Planners need to advise producers that the planned rates of nutrient application, especially phosphorus and potassium, may exceed recommended rates when animal manure and organic by-products are used as a nutrient source. Use of animal manure, especially liquid dairy, to supply adequate nitrogen to plants can lead to excessive soil potassium (K) levels. Excess potassium will not be recommended in situations in which it causes unacceptable nutrient imbalances in crops or forages.

Excessive soil potassium (K) usually does not affect plant growth. However, excessive soil K can reduce uptake of Mg by crops and create Mg deficiency, common in corn on acid soils. Excessive soil K or high K fertilizer rates increases K levels in forages. Plants tend to accumulate large amounts of K, sometimes in excess of 5-8% of total dry weight. While excessive soil K levels might not be an environmental concern, they are a real concern to animal health. Most of the problems encountered with excessive soil K are animal health problems resulting from consuming forage produced on soils excessive in soil K. There are two common animal disorders associated with excessive soil K, Grass Tetany and Milk Fever.

Grass Tetany
High soil K levels that suppress Mg uptake in lush spring and autumn pastures seem to be a major contributing factor in the highly fatal Grass Tetany in grazing animals. This disorder is characterized by low blood magnesium (hypomagnesemia). Lactating cows, beef and dairy, shortly after calving and/or grazing young succulent grasses are at highest risk. Sheep, especially ewes, are also at risk. Furnishing magnesium supplements will minimize the incidence of Grass Tetany and is essential in intensive grazing systems.

Milk Fever
By far, the most common animal disorder, related to excessive soil K, is Milk Fever. Milk Fever is a disorder of lactating animals and is characterized by low blood calcium levels (hypocalcemia). It is especially common in dairy cattle due to the high milk production and is potentially fatal unless promptly treated. In any case, production is lost. Susceptibility to milk fever is influenced by breed (Jersey is most susceptible) and age of the cow (third lactation and higher are most susceptible). Milk fever tends to occur more often on farms with liquid manure systems which tend to conserve K, contributing to excessive soil K. Although not common and usually not fatal, milk fever like symptoms can occur in dairy sheep and dairy goats but seldom in meat animals and horses.

To reduce incidence of Milk Fever, greater emphasis is being placed on the diets of pregnant dry cows during the transition period 3 to 4 weeks prior to calving. The transition diet has been found to be crucial in avoidance of milk fever and associated symptoms. In particular, the optimum dietary cation-anion difference (DCAD) for the transition diet seems to be markedly different than that for the lactating cow. Potassium
(K) plays a major role in DCAD. A rule of thumb for dry cow management has been to keep forage K below 2.5 percent of forage dry matter.

The DCAD is most often calculated as the sum of the sodium (Na) and potassium (K) minus the sum of the chloride (Cl) and (S), expressed on a milliequivalent (meq) basis. Diets with high levels of Na and K relative to Cl and S are cationic and have DCAD levels of +5 to +35 meq per 100 grams (g) of dry matter (DM). Conversely, diets low in Na and K relative to Cl and S are anionic and have a DCAD of −10 to −15 meq per 100g DM. Anionic diets are acidogenic; that is, they tend to increase the acidity (reduce the pH) of the blood and thereby increase the mobilization and availability of calcium (Ca) from the bones.

Recent research indicates lactating cows require 1.0 to 1.5 percent K in their diet for optimal milk production. Under heat stress, the optimal level may increase to 1.9 percent of the dietary dry matter. Lactating cows require a cationic diet for optimal milk production.

During the last few weeks of pregnancy, it is important that the cow’s diet be moderately anionic. An anionic diet during the last three to six weeks before calving reduces the incidence of milk fever and subclinical hypocalcemia. The diet can be made anionic by addition of anionic salts. However, it can be difficult to make the transition diet anionic when K levels in the diet are high (above 1.2 percent of dietary dry matter). Large amounts of anionic salts make the feed unpalatable. Immediately after calving, the anionic diet must be discontinued and a cationic diet resumed.

It is important to recognize that changing feed additives can greatly affect DCAD. Feeding grains such as Brewers dried grains help to dilute forage K. Buffers such as sodium bicarbonate can make a diet strongly cationic. Some sources of supplemental Mg contain K. Only an experienced professional nutritionalist should formulate a ration on the basis of DCAD.

**Forage and Soil K Management**

The level of K in dry cow forages is of particular concern for dairy producers in areas where cool-season forages are grown. Cool-season grasses (C3 species), generally have higher K levels than do corn, sorghum, and other warm season grasses (all C4 species). The K concentrations in haylage tend to be considerably higher than in hay. Corn silage generally has low K concentrations.

It is important for the dairy farmer to know the level of soil K in each field. Fields testing lowest in K can be set aside for producing a forage for dry cows during the transition phase. The amounts of low K forage required are approximately 5 to 10 percent of the total farm forage. The low K forage can be produced on a small acreage with a low to medium soil test for K. Applications of all forms of K need to be limited on these fields. Since forage K removal is high, the soil test level of K could decline over time to the point where economic production of forage is not possible without controlled applications of K fertilizer. A regular soil testing program is essential, with sampling every two to three years. Forages should be tested regularly.
The concentration of K in plant tissue declines as the plant matures. Therefore, **a dry cow forage should not be cut early**. Weathering, particularly rain on hay during drying, may reduce the amount of K in the forage since K in plant tissue is in a soluble form.

When soil K levels are high, higher rates of nitrogen (N) fertilizer tend to increase forage K levels. Phosphorus (P) fertility is very important to ensure optimal plant uptake of Mg and Ca, cations important in the prevention of milk fever and grass tetany. Researches have reported increased levels of Mg and Ca and reduced ratios of K to Mg and Ca in response to P fertilization.

**REFERENCES:**

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Conversations with Dr. Ken Andries and Rick Kersbergen, University of Maine Cooperative Extension

Written by Paul A. Hughes, Conservation Agronomist, CCA; USDA-NRCS, Bangor, Maine.