

# Potassium Levels in Forages on Dairy Farms Reflect Manure and Fertilizer Applications



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Are your soil potassium levels increasing? Are you reluctant to eliminate potassium fertilizer applications to your fields? Are you considering using hog or poultry manure as an inexpensive source of fertilizer on your farm?

This report will summarize observations on forage potassium concentrations and the impact of feeding high concentrations of potassium on animal health. We will explain how potassium is recycled from the animal to the soil, from the soil to the plant, and from the plant back to the animal. We will discuss how inputs of potassium as feed, fertilizer, or imported manures such as hog or poultry manure affect soil potassium levels.

Our goal in this report is to provide information to make good decisions about potassium management in your farm in your total farm system.

## Hay and Grass Silage Potassium Concentrations Are Increasing

According to data on samples submitted to the annual BCMAFF forage competition, potassium concentrations in grass silage samples increased from 2.7% in 1983 to 3.6% in 1992. A number of samples were over 4.0% in 1992. Hay samples have shown the same trend. The potassium concentration of corn silage samples has remained relatively constant (1.2 to 1.5%). Local feed companies have also noted higher potassium concentrations in forages submitted for routine analysis.

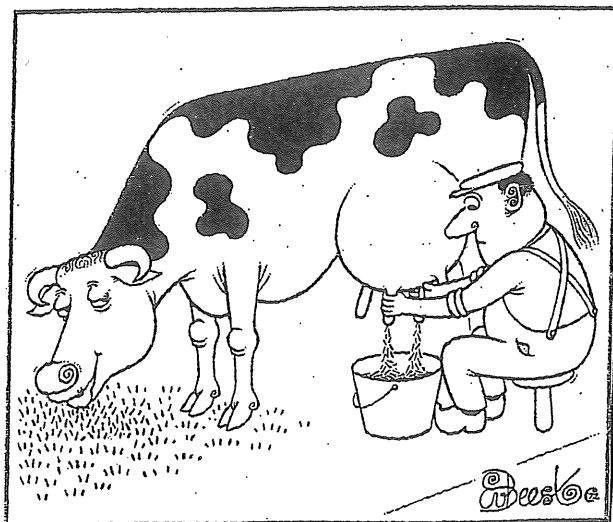
## Lactating Cows Are Stressed by High Levels of Dietary Potassium

### *Increased urine output*

Dairy cattle require 0.8% potassium in their diet. Research at Agassiz Research Station has shown that water use increased and urine output tripled when the potassium concentration in the diet increased from 1.6 to 4.6%. This meant that additional energy was required by the animal to flush out the salts and caused additional stress on the kidney.

### *Decreased magnesium uptake and lower blood calcium levels*

Research also showed that excess dietary potassium resulted in decreased magnesium absorption, lower plasma levels of calcium and decreased calcium content of milk. Cows fed forages high in potassium may experience magnesium deficiency (grass tetany), and may be more prone to milk fever.



## High Potassium in Forages Linked to High Soil Potassium Levels

Grass is a luxury feeder of potassium, which means that with more potassium in the soil, there will be more potassium taken up by the plant. Corn, on the other hand, takes up only the potassium it requires. That is why potassium concentrations of corn silage samples in the forage competition in the Fraser Valley haven't increased over the last 10 years. Most incidences of high potassium levels in forages come from farms where the potassium soil test values are high. Soil test potassium values are increasing on many dairy farms in south coastal B.C.

## The Potassium Cycle

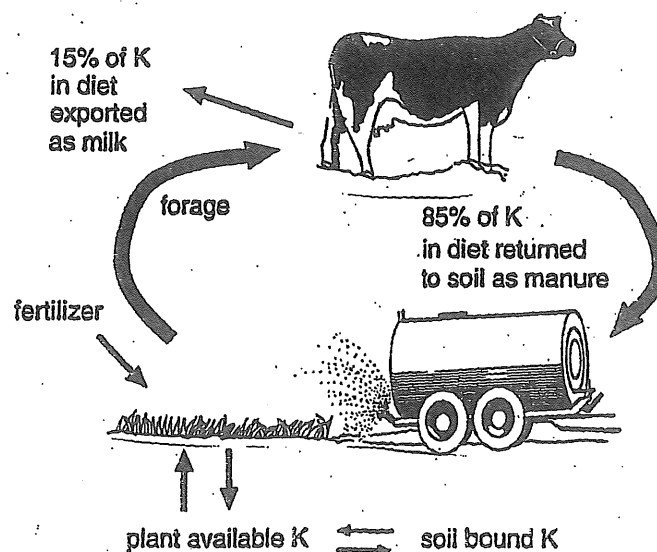
The primary sources of potassium entering dairy farms are animal feeds (concentrates, purchased forages), fertilizer, and manure brought in from other farms. Potassium leaves dairy farms primarily as milk, culled dairy cows and bull calves.

About 15% of the potassium contained in the cow's diet goes into milk production. Most of the other 85% of the dietary potassium is excreted as urine and feces, with the majority being excreted in the urine. The concentration of potassium in milk does not increase with increased dietary potassium, therefore with diets high in potassium, the urine and feces may contain up to 90% of the dietary potassium.

All of the potassium excreted by the cows is conserved with modern systems of manure collection and storage where the urine is stored along with the feces. Unlike nitrogen, potassium cannot be lost to the air during manure storage or after field application.

Potassium accumulates in soil because it binds with soil particles. Potassium is a positively charged element which is attracted to negative charges on the soil particles. Potassium accumulates more readily on finer textured soils than on sandy soils because sandy soils do not have the same ability to bind potassium. Nitrate on the other hand, leaches out of the soil very readily because it is negatively charged and is not attracted to soil particles.

## Potassium Cycle on a Dairy Farm



## How much potassium is being applied as dairy manure?

Consider how much potassium you are applying as manure produced on your own farm. Using average potassium concentrations for liquid dairy manure in the Fraser Valley, 37 kg of  $K_2O$  is applied per 1000 gallons of manure per hectare (33 lb  $K_2O$  per acre per 1000 gallons manure). This potassium application is equivalent to 60 kg 0-0-60 per hectare or 218 kg 17-17-17 per hectare. By calculating how much dairy manure you apply on your fields, you can calculate the potassium loading.

### Calculating farm potassium budgets

A farm potassium budget can also be used to measure the amount of potassium being applied to your fields. The amount of potassium imported and exported can be calculated from the quantity of imports and exports and their potassium concentration. The diagram below provides a potassium budget for a 75 cow herd on 30 hectares (75 acres) during a one year period, and the implications when hog or poultry is imported.

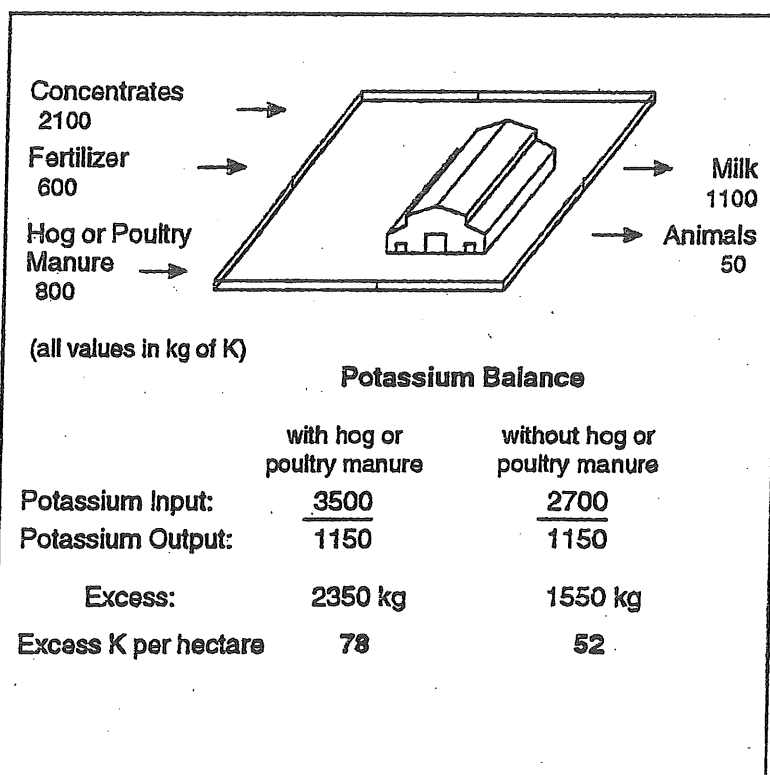
This potassium balance was calculated from an average of several farms. The inputs to this farm were 300 tonnes of concentrate containing 0.7% potassium and 150 kg 17-17-17 blend fertilizer per hectare on 30 hectares or 170 kg 0-0-60 per hectare on 7.5 hectares (Potassium in fertilizer is  $K_2O$ , therefore multiply potassium concentration in fertilizer by 0.83 to get % potassium). The hog or poultry manure imported included 7500 gallons of hog manure per hectare to 30 hectares (containing 3.6 kg potassium per 1000 gallons), or 40 tonnes of poultry broiler manure applied to the whole farm (containing 21 kg potassium per tonne).

The outputs from this farm included 735,000 litres of milk containing 0.15% potassium, and the equivalent of 40 culled cows (650 kg each) containing 0.19% potassium.

In this potassium budget, the excess potassium was 52 kg per hectare (62 kg  $K_2O$  per hectare) or the equivalent of 100 kg 0-0-60 or 365 kg 17-17-17 per hectare, without imported hog or poultry manure. When hog or poultry manure was imported, the excess increased to 78 kg per hectare.

The potassium budget demonstrates that the largest input of potassium on dairy farms is in concentrates and is more than the amount of potassium leaving the farm. Based on this information, many farms are experiencing a net gain in soil potassium without fertilizer application or importing any other manure.

The amount of potassium applied as fertilizer is low in this budget, however, more farms are beginning to eliminate potassium fertilizer altogether. Most potassium inputs on actual farm potassium balances were higher due to other potassium inputs, such as alfalfa hay, brewer's grain or other feed supplements.



*Dairy farm potassium balance for one year on a typical 75 cow herd on 30 hectares (75 acres) of land.*

## **What Happens if I Reduce Potassium Fertilizer Use?**

Reducing potassium fertilizer applications may help lower forage potassium concentrations. This is particularly true if large potassium applications are made in the spring. Many producers are no longer applying potassium fertilizer to grassland, because of very high soil test potassium values and the risk of high potassium concentrations in forages.

## **What About Soil Testing?**

A regular potassium soil test will provide information on whether your soil potassium levels are increasing. Based on recommendations using the Kelowna extraction procedure (Griffin Labs), grass yields will not increase with additional potassium fertilizer when the potassium test value is greater than 150, and suggests that no potassium be applied at test values greater than 250. Norwest Labs uses a different extraction procedure which extracts more potassium than the Kelowna extractant, therefore the values would be lower at which no fertilizer is required. Potassium testing should be done on your fields every two years.

The soil is sampled to 15 cm depth (6 inches) for the potassium soil test, but the active rooting zone for many of the grasses is greater than 30 cm (12 inches). This means that the potassium soil test may not completely reflect the potassium in your soil.

## **Potassium May Leach from Sandy Soils**

Sandy soils do not have the same capability to bind potassium as finer textured soils, therefore, some potassium leaching does occur on these soils in southcoastal B.C. where the rainfall is high.

## **How to Minimize the Potassium Loading on Your Farm**

The most obvious solution is to consider whether you should import more potassium as hog or chicken manure onto your farm. These manures may be readily accessible and an inexpensive source of nitrogen, but you must also consider the long term implications of increased potassium levels in your soil. Poultry broiler manure contains 21 kg potassium per tonne, and hog slurry contains 3.6 kg potassium per 1000 gallons.

Another consideration is to think carefully whether you require potassium fertilizer, especially on your forage grass. Remember to calculate how much potassium you are applying with manure.

There is generally enough land in agricultural production in the Fraser Valley to utilize the livestock wastes that are produced in the Valley. It is a matter of ensuring that the manures are uniformly distributed at rates of application that will not result in excess applications of one or more nutrient elements.