PLANT NUTRITION TODAY

2016-17 ISSUE 4, NO. 6

PLANTS TAKE UP TRACE ELEMENTS VITAL TO LIVESTOCK

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It is much simpler being a plant nutrition scientist compared to a livestock nutritionist. Plants only require 14 mineral nutrients compared to 23 for healthy livestock. Of course, the length of both these lists of essential nutrients might grow over time as research discovers the need for minute concentrations of additional mineral nutrients.

Just considering the mineral elements, plants need **nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, boron, chlorine, copper, iron, manganese, zinc, molybdenum,** and **nickel.** Admittedly there is evidence that certain plant species also benefit from sodium, silicon and cobalt, but these are only considered beneficial not essential.

The additional mineral nutrients not needed by plants, but are considered essential to livestock include: **chromium, cobalt, fluorine, iodine, selenium, silicon, sodium, tin,** and **vanadium.** When a mineral element is needed in a very small quantity, it is called a **micronutrient in relation to plants,** and **for livestock it is called a trace element**, but that is just a difference in terms used in plant nutrition lingo compared to livestock nutrition discussions.

Beef cattle grazing near Vanderhoof, British Columbia.

It is useful to mention that besides mineral nutrients, plants and animals both need carbon, hydrogen, and oxygen supplied from surrounding air and water. Plants, and in some cases microbes in livestock rumen-stomachs and intestines, also manufacture essential compounds such as proteins and vitamins that livestock absolutely need. Livestock can't obtain these compounds except by consuming plant products, or from the help of the microbes in their stomach.

The uptake of mineral nutrients by plants occurs primarily at the root cell membrane. Minerals enter the plant through specialized pores in the roots. These pores have been compared to tiny doors or portals of different shapes and sizes, and specific mineral ions are only allowed into roots through specific openings. There are complex biochemical regulation systems that allow sufficient and usually non-toxic levels of mineral nutrients into the plant. Some specific elements are closely regulated within a sufficiency range. For example, the concentration of potassium within crop plants is usually between 2 to 3%. In the case of the trace elements needed by livestock,

PLANT NUTRITION TODAY is a quarterly publication of compiled scientific information developed by the International Plant Nutrition Institute (IPNI). Website: http://www.ipni.net/pnt

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small amounts are dissolved in soil water that is pulled into the roots. Without this passive uptake, livestock feeding on plant materials would become deficient in these critical elements.

Cobalt (Co) is an excellent trace element example to explore. It is a metal element widely dispersed in the earth's crust, but it is in low concentrations in some rock minerals. Areas known to possibly have low concentrations of Co on forage lands are the central North Island plateau in New Zealand, parts of the east coast of Australia, Scotland, Kenya, England, and in areas in Florida, Massachusetts, New Hampshire, Northern Michigan, and Wisconsin. Its deficiency is usually a combination of naturally lower concentrations of Co in the soil parent materials, a coarser soil texture, high rainfall, and lower levels of organic matter. Forage species mix is another factor as broadleaf plants tend to remove more Co from the soil, and store more Co in plant tissues. Thus, if a pasture is dominated by grass species, Co deficiency in grazing livestock is more likely, but if there is inclusion of legume broadleaf species Co nutrition of the animals is improved. Even bushes present in a pasture that livestock can lightly graze can provide sufficient Co to the animal.

A forage considered adequate in Co has a concentration around 0.1 part per million (ppm), and forage under 0.05 ppm are considered deficient. Of the livestock types, ruminant grazing animals have the greatest need for Co to produce vitamin B12 in the livestock's rumen, which in turn is required for the proper digestion of forage cellulose and lignin.

Many of the same principles of essential trace element availability to livestock from crops and forages apply to the list of the other livestock trace elements not necessarily provided as plant nutrients. However, passive uptake into crop and forage plant roots usually supplies sufficient levels for adequate livestock health. The main diagnostic tool used by livestock nutritionists is to have livestock feeds and pasture forages analyzed for trace element concentrations. In most cases, livestock deficient in specific trace elements will receive a mineral supplement to correct the deficiency. In some instances, soil or foliar applications to crops and forages have been used successfully to correct livestock trace element shortages **Table 1**.

Table 1. Forage cobalt (Co) concentration (ppm) of first cut hay in response to Co fertilization, Hurry Road, Prince Edward Island 1988.

Forage Type	Control	Soil applied 150 g Co/ha	Foliar applied 30 g Co/ha	Std. Err. (n = 4)
Alfalfa	0.03	0.09*	0.09*	0.02
Timothy Grass	0.01	0.02	0.14*	0.02

* indicates adequate concentration of Co for ruminant grazing animals.
Source: Gupta, U.C. 1992. Can. J. Soil Sci. 73:1-7.

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