

Mineral concentrations and availability of forages for grazing livestock in the Northern Great Plains ^{1 2}

[Woodrow W. Poland](#)

Dickinson R/E Center, NDSU, Dickinson, ND

¹*Project collaborators include Drs. Elaine Grings (Fort Keogh LARRL, USDA-ARS, Miles City, MT), James Kam (Northern Great Plains Research Laboratory, USDA-ARS, Mandan, ND) and Llewellyn Manske (Dickinson R/E Center, NDSU, Dickinson, ND).*

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The purpose of the project is to address various aspects of the mineral nutrition of grazing livestock. Collectively, these studies address seasonal/maturity changes in nutritive quality of native range/pasture plants in western ND, the effect of forage intake on mineral bioavailability and, the effects of water stress, soil fertility, genotype and grazing management on forage chemical composition. Dry matter intake does not, while forage type can, affect mineral availability from forage. Drought conditions can affect P, S and Mg concentrations of forage, while nitrogen fertilization can affect Ca, P, K, S, Cu and Zn. Under normal conditions, beef producers should consider Na, Ca, P, Mg, S, Cu and Zn when designing mineral supplementation regimens for grazing beef cows.

Introduction

All forms of life require inorganic elements, or minerals, to support normal life processes. Furthermore, all animal tissues and all feedstuffs contain minerals in widely varying amounts and proportions. Unlike other nutrients, minerals can not be synthesized by living organisms, therefore animals must acquire adequate amounts of required elements from their environment if survival and production goals are to be maintained. Livestock usually derive most of their dietary nutrients from the feed they eat, however significant quantities of minerals may be obtained from water, soil consumption and nonfeed contamination. Feed sources of minerals are typically divided into base feedstuffs (e.g. range or pasture plants, harvested forages, concentrates) and mineral supplements. Efforts to reduce the cost of mineral

supplementation in livestock production requires a thorough understanding of the supply and availability of mineral nutrients in typical feedstuffs.

Voluntary intake and mineral concentrations of base feedstuffs determines the level of mineral consumption. Adequate intake of forages by grazing animals is essential in meeting mineral requirements. Factors that reduce forage intake (e.g. low protein, high degree of lignification) also reduce total mineral consumption. The concentration of minerals in plants is dependent upon interactions among a number of factors including soil type, plant species, stage of maturity, dry matter yield, grazing management and climate. Although total concentration of a mineral in a feedstuff is important, the biological availability of the mineral is equally important. Biological availability (absorption and utilization) of minerals varies substantially among animal species and breeds within a species, as well as among feedstuffs. The combination of all of these factors makes it extremely difficult for livestock producers to determine the actual mineral status of their herd, whether or not mineral supplementation is necessary and the degree of supplementation that may be needed to meet production goals.

Three experiments have been previously conducted that address various aspects of mineral nutrition of grazing cattle. Collectively these studies address seasonal/maturity changes in nutritive quality of native range/pasture plants in western North Dakota, the effect of forage intake on mineral bioavailability, and the effects of water stress, soil fertility, genotype and grazing management on forage chemical composition. The limiting factor in each of these experiments is the high cost of nutrient, particularly mineral, analyses.

Materials and Methods

The first experiment was conducted at the Manning ranch of the Dickinson Research Extension Center (L. Manske, DREC). Forage samples have been collected since 1983 from replicated pastures maintained under two different grazing management schemes (4.5 m season-long system and 4.5 m rotational grazing system). Nutrient analyses of the forages from this experiment will help describe seasonal changes in nutrient content of native range plants. Combined with other data collected throughout the region, quantifying seasonal variations in nutrient concentrations should help producers identify periods during the grazing season when nutrient supplementation may be necessary to maintain optimum performance. Additionally, if grazing management can be altered so that adequate nutrient concentrations are maintained for longer periods of times, yearly supplemental needs may be reduced while overall production is increased.

In the second experiment (E. Grings, LARRL), two trials focused on determining the effect of dry matter intake on mineral bioavailability from forages. Mineral balance and retention will be determined in steers fed two forages at two levels of intake (1.8 and 2.3% of BW). Establishing the effect of dry matter intake on mineral bioavailability of forages will help producers refine estimates of available mineral supply, and subsequently, need for mineral supplementation.

In the third experiment (J. Karn, NGPRL), diploid and tetraploid Russian wildrye plots were established in a rainout shelter. In three years, forage samples were collected at four stages of maturity beginning in May and ending in June. After collection, samples were separated into leaf, stem and head portions. Chemical composition data from this experiment will help define possible relationships between soil

water and nitrogen levels and forage quality. Data will also be used to assess if the grass tetany potential of Russian wildrye is affected by ploidy level, water and nitrogen. This study is very unique because in most studies it is impossible to grow plants outside and still control water levels.

Results and Discussion

A final report was submitted to SBARE in April, 2001. Major findings from this work include:

- Beef producers should place emphasis on sodium (Na, salt), copper (Cu), zinc (Zn) and possibly sulfur (S) when designing mineral supplementation programs for grazing livestock in the Northern Great Plains. Strategic supplementation programs for calcium (Ca), phosphorus (P) and magnesium (Mg) would also seem warranted for beef cows.
- Overall dry matter intake does not affect mineral availability from forage.
- Trace mineral levels and concentrations of animal tissues can be altered by feeding different types of forages (grass vs alfalfa). Some of these alterations may be due simply to differing trace mineral concentrations in the forages, while others may be related to differing solubilities within the gastrointestinal tract.
- Drought conditions (50 percent of normal precipitation) result in plants with lower phosphorus in both leaves and stems. Conversely, sulfur and magnesium concentrations are increased with restricted water conditions.
- Nitrogen fertilization increases leaf and stem concentrations of calcium, potassium, sulfur, copper and zinc, while concentrations of phosphorus is decreased.

Producers are encouraged to look for expanded discussions of these and other results in future news releases, at local beef meetings and field days, and on the DREC website (<http://www.ag.ndsu.nodak.edu/dickinsol/>).

Literature cited

None.

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