



## Fertility

# Nutrient Cycling in Pastures

## Illinois

### Introduction

Many of the nutrients consumed by grazing animals are returned to the soil in the feces and urine. These animals also import nutrients to the pasture after consuming feeds purchased by the producer. This fact sheet addresses the importance of understanding and managing nutrient (mainly nitrogen, phosphorus, and potassium) cycling in pastures. It complements fact sheets titled "Soil Sampling and Testing" and "Pasture Fertilization".

### Essential Mineral Nutrients

Sixteen elements have been determined to be essential for growth and function of all plants. Carbon (C), hydrogen (H), and oxygen (O) are termed organic elements and are obtained from atmospheric carbon dioxide and water. Nitrogen (N), phosphorus (P), and potassium (K) are called primary nutrients. Calcium (Ca), magnesium (Mg), and sulfur (S) are referred to as secondary nutrients. Chlorine (Cl), boron (B), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), and molybdenum (Mo) are termed micronutrients-required but in very small quantities.

The goal of soil fertility management for pastures is to maintain the plant available pool of nutrients at a sufficient level to support quality forage production while protecting the environment.

### Nutrient Cycling

A nutrient cycle describes the flow of nutrients into, out of, and within a pasture.

Export (hay, meat, milk, soil erosion, nutrient leaching, and ammonia nitrogen volatilization) of nutrients from the pasture lowers the plant-available nutrient pool in the soil by moving nutrients out of the pasture instead of recycling them back into the soil pool.

Typically, hay and row crop fields have a high nutrient export while pastures are low-export systems for most nutrients. See Table 1.

Table 1. Estimated removal of nitrogen, phosphorus, and potassium from a field under two different management systems.

System	Phosphorus (P)	Potassium (K)	Nitrogen (N)
Hay	6 lbs. per ton	40 lbs. per ton	50 lbs. per ton
Grazing-beef cow-calf pair	3 lbs. per pair	1 lb. per pair	10 lbs. per pair

University of Missouri-Columbia, Dairy Grazing Manual, M168

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### Phosphorus and Potassium Cycling

Grazing animals will retain less than 15 percent of the phosphorus and potassium they ingest. The balance is excreted.

Since grazing animals are attracted to water, shade, and higher ground, these areas typically have higher concentrations of excretions, compared to where animals ingest the forage. Thus, a nutrient redistribution occurs in the pasture. For livestock manure to be effectively utilized, nutrient redistribution by grazing animals must be as uniform as possible.

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## Phosphorus and Potassium Cycling (continued)

In most cases, the distribution of feces and urine by grazing animals are independent of each other. This further reduces the evenness of redistribution since most phosphorus is contained in the feces and most potassium is contained in the urine.

If manure is well distributed in the pasture, there will be little loss or even an increase in soil test phosphorus and potassium values. Soil testing every three to four years will monitor the level of these two nutrients.

## Nitrogen Cycling

In contrast to phosphorus and potassium, 25 to 50 percent of the nitrogen in the feces and urine can be lost as ammonia to the atmosphere due to volatilization. Some of the nitrogen in manure is in the organic form or is not immediately available to plants. This further reduces the value of manure nitrogen to the pasture.

Annual applications of nitrogen are recommended in grass-dominant pastures. If legumes (clover, alfalfa, etc.) comprise at least 30 percent or more of the sward, fertilizer nitrogen does not need to be applied to the pasture since the nutrient will become available to the grass via legume root and nodule decomposition.

## Benefits of Managed Grazing

A goal of a managed grazing system (grazer decides when, where, and for how long animals will graze a pasture/paddock) should be to enhance the uniformity of manure distribution. High stocking densities and short grazing periods are two ways to encourage uniform manure distribution. As grazing intensity increases, the time needed to have complete coverage of the pasture by manure decreases.

## Summary

Grazing systems differ from hay systems and row crop systems in that a large portion of the nutrients consumed by animals during grazing is returned to the pasture in the form of manure. Managed grazing systems improve the recycling of nutrients in a pasture, minimizing but not eliminating the need for nutrient inputs.

## Where to Get Help

For more information contact the local office of the Natural Resources Conservation Service or University of Illinois Extension.

## Acknowledgments

Information in this fact sheet was adapted from the Missouri Grazing Manual, the University of Missouri Dairy Grazing Manual, and proceedings from the Nutrient Cycling in Forage Systems Conference, March 1996.

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