Nutrient Losses In Pasture

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Plant nutrient losses in pasture differ considerably from that in crops such as corn or soybeans or forages harvested for hay. Obviously, when a hay crop is removed from a field, the nutrients such as nitrogen, phosphorus, and potassium go with it. However, when cattle are grazed in a pasture, one would expect most of the nutrients to he recycled and remain on the land as little is removed by the animal when it is sold. The body of a 500 pound calf contains only about 12 lb of nitrogen, 3.5 lb of phosphorus, and 0.75 lb of potassium. Obviously, something else is happening in the pasture that results in nutrient losses and require fertilization to maintain productivity. In this article, we will discuss where some of these nutrient losses occur and what can be done about them if anything.

Nitrogen

Nitrogen is added to pastures in several ways but losses occur in recovery by the growing grass. For a chemical fertilizer such as ammonium nitrate, about 80 to 90% of the nitrogen is recovered by the grass. For nitrogen fixed by clovers, about 40 to 60% is transferred to the grass. For poultry litter, only about 50% of the nitrogen is recovered by the grass. Much of this is **volatilized** (lost as ammonia in the atmosphere) and some is leached into the soil. These losses occur both on pasture and on hayland.

Cattle grazing on a pasture contribute to additional nitrogen losses. When cattle graze a well-managed pasture, they may consume 60 to 75% of the available grass and excrete 75 to 95% of the nitrogen they ate. Animals grazing very high protein grass (such as annual ryegrass or wheat) excrete urine with a greater nitrogen concentration than those on pastures with lower protein content (such as unfertilized bahiagrass). Animals grazing grass high in nitrogen may excrete 70% of the nitrogen in urine as compared to as little as 20% in a low nitrogen grass. Thus, high nitrogen fertilization may increase the potential for losses from volatilization of ammonia in urine.

Heavy losses of ammonia into the atmosphere occur during urination and after the urine forms the urine patch in the pasture. Urine patches may concentrate the equivalent of up to 1,000 lb N/acre. Several factors affect the amount of nitrogen volatilized: (1) high soil temperature, (2) high wind velocity, (3) nitrogen content of the forage, (4) coarse soil texture, and (5) open grass canopy or overgrazed condition. The amount of nitrogen lost by volatilization from urine can be high. Research in New Zealand and Australia show that under warm and dry weather conditions nitrogen losses reach 60 to 80% but under cool and moist conditions they are under 30% .

Solution losses of nitrogen by leaching and runoff also add to the problem. Leaching is highest with high rainfall, coarse textured soil, and high application rates of nitrogen by urine and fertilizer. Losses of nitrogen from dung is relatively low in comparison to urine. Thus, volatilization of ammonia from urine is the major loss of nitrogen from pasture. Unfortunately, the grazing animal collects nitrogen from grass and clover in a pasture and releases much of it into the atmosphere rather than allowing it to recycle.

Phosphorus

The vast majority of phosphorus is in the dung. About 80% of this is in inorganic form and available to plants. Breakdown of the organic portion is slow. Fortunately, losses of phosphorus from a pasture are low. Leaching is limited. On some clay soils, especially at lower pH, some phosphorus is fixed on iron and aluminum oxides and made unavailable to plants.

Potassium

About 90% of the potassium excreted by the animal is in the urine. This results in enormous concentration of potassium in urine patches with application rates of up to 2000 lb/acre of potassium chloride. Volatilization is not a problem with potassium but leaching can cause serious losses of this nutrient. It is highly soluble and heavy rains can quickly leach it into sandy soils.

Concentration of Nutrient

Cattle grazing on a pasture collect nutrients and concentrate them on a limited area. In a New Zealand study, 83% of an area grazed continuously with 1 cow/acre will have received no urine after 1 year; 43% will have received no urine after 5 years. A similar situation occurs with dung. Unfortunately, the concentration of nutrients on these small areas is far in excess of what is needed by pasture plants. Of course, the nitrogen and potassium of the urine will stimulate grass growth and phosphorus in the dung will stimulate legumes. However, plants beneath dung pats may be killed and urine may scorch the grass. The main problem is a drain of nutrients from most of the pasture to small areas. Stock camps where water, shade, and salt are available concentrate nutrients from dung and urine.

Are there any solutions to the problem of nutrient concentration and losses? Obviously, one cannot train cattle to defecate and urinate at desired places in a pasture! Some improvement can be made by locating water, salt boxes and shade at different locations in a pasture where possible so that cattle will have to travel between them. Cross-fencing and rotational stocking of cattle has been shown to get better distribution of nutrients. The question of course is whether the additional costs will be made up in nutrient savings. Long term, fertilizer nutrients will become more costly to produce and become more expensive to the cattle producer. This may change attitudes in high rainfall areas such as ours to eventually replace our generally high input pasture systems with different management systems relying on pasture species that persist under lower nutrient levels and accepting lower animal output. Fortunately, we are not yet to that point but at some time in the future we may have to reevaluate nutrient management in pasture ecosystems. Nutrient losses and pollution of ground and surface water supplies may in some situations become a problem where large amounts of animal wastes are utilized for fertilizer. These problems are currently being researched at the University of Georgia and we will keep you informed on progress.