**Nitrogen Losses from Pasture**

C. Alan Rotz, USDA/ARS, Pasture Systems and Watershed Management Research Unit, University Park, PA 16802

**Introduction:** Substantial nitrogen (N) losses from volatilization, leaching, and denitrification occur from manure deposited by grazing animals. The amount of loss is related to the weather conditions, soil type, plant canopy, and many other factors. An extensive literature review was conducted to summarize and quantify typical N losses from pastures.

**Results:** Most of the N excreted on pasture (55 to 75%) is in urine where higher levels occur with overfeeding of protein. Urinary N (urea) is rapidly hydrolyzed to form ammonia. Ammonia volatilization can be very high, but rapid absorption of the urine into the soil surface will reduce this loss. Reported losses vary from 5 to 66% of the urine N with higher losses under hot, dry conditions. Fecal N is in a more stable organic form where only 5% is volatilized. Average total loss is about 10% of the excreted N. Ammonia emission is greatest during and immediately after a grazing event. Rain, poor drying conditions, and low wind all help reduce this emission rate.

Leaching loss of N can be much higher under grazing than occurs with spread manures. Nitrogen concentrations under a urine patch are very high, equivalent to an application rate of 300 to 1,000 lb N/acre. Much of this N is in excess of crop needs and is leached through the soil profile. Reported loss ranges from about 10 to 60% of the urinary N. Factors affecting this loss are soil type or texture, rainfall following deposition, and the time of the year. Urine N deposited in the spring is more likely to be used by a growing crop and thus provides about half the loss of that deposited in the fall. Leaching loss from fecal N is small, about 2% of that deposited. Combined leaching losses are 10 to 30% of the total N excreted on the pasture. Runoff loss also occurs from pastures, but this loss is normally small averaging 1% or less of the N deposited. On poorly drained soils though, runoff loss may be much greater with less leaching loss.

Denitrification loss from pastures can also be substantial, particularly under urine deposits. Reported losses range from 5 to 30% of the applied urine N. Most of this loss appears to be in the environmentally benign form of $N_2$, but some portion will be in the form of $N_2O$, a potent greenhouse gas. Available data indicates that less than 8% of the applied N will be lost as $N_2O$ with a typical loss around 2%.

**Implication:** Management can reduce N loss from grazing animals. A practical step that should always be considered is to feed supplemental protein feeds efficiently, and thus reduce urinary N excretion. Overstocking of animals along with a large import of forage and other supplemental feeds should be avoided. Movement of watering and supplemental feeding areas will improve nutrient distribution, thus increasing plant uptake and reducing loss. Volatile loss may be reduced by irrigating the paddock immediately after grazing to wash the urine N into the sod. Leaching loss can be reduced by avoiding grazing in the late autumn or winter when plant uptake of N is low. Removing the autumn growth through silage harvest can also help reduce the accumulation of excess soil nitrate, which at this time of the year will likely be lost by leaching. Less use of N fertilizer with greater use of clover and other legumes to supply needed crop N can also reduce soil N levels and leaching loss.