

Forages: Nitrogen Management

cycling rate organic matter placement residue timing

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An important step towards soil fertility is nurturing soil health to improve plant resistance to stress and increase yields. In forage production, adequate plant recovery time, plant species diversity, cover and standing material to buffer changes in soil temperature and help store water, and sound fertilizer management contribute to soil health.

However, even healthy soils may be nitrogen (N) limited. This Soil Scoop is a synopsis of *Soil Nutrient Management for Forages: Nitrogen* (EB0216) and provides general guidelines on N management. See the full bulletin for more details.

The key to N management for optimal forage yield and quality is to select the right N source, rate, placement, and timing. Selecting the right crop, the best management practices to maximize legume N fixation, and the right crop rotation are also critical.

NEW- OR INTERSEEDINGS

For new seedings, up to 60 lb N/acre may be beneficial the first year, but do not exceed 10 to 15 lb N/acre applied with the seed. Surface broadcast only after the seedlings establish secondary roots.

ESTABLISHED STANDS

Maintaining and improving forage stands with fertilizer is more effective than mechanical methods (e.g., aeration) and less expensive than reseeding. Fertilizing stands containing legumes with N will reduce the legume population and favor grasses. Forage stands containing greater than 50% legume may respond little to applied N if soil conditions are suitable for N-fixation.

Source Urea and ammonium based fertilizers are less likely to accumulate as toxic nitrate in forage than nitrate-containing fertilizers, however they are more susceptible to volatilization loss.

Nitrogen sources that need to decompose or break down in the soil to become plant available (manure or polymer coated fertilizers) will have a lag effect between application and forage response. If applied in the spring, they may

provide N too late to stimulate early growth. However, slowly available N sources can extend benefits for season-long pasture or a late cutting.

Manure is a good source of N. Cattle manure solids may only release 30% of their available N in the first year, but will continue to release N at a slow rate for at least 10 years. The rate of N release depends on the manure source and amount of composting before application. Microbes decomposing fresh manure solids tie up N for their own use, making N unavailable to plants for several weeks. Manure can contain viable weed seeds or herbicide residues toxic to forage species.

Legumes interseeded to at least 35% of stand composition are an excellent source of N to increase yield and protein throughout the growing season, and improve net margins.

Rate Base N rate on soil tests, the expected yield and the percentage of legume in the stand (Table 1). Fertilizer N equals the crop's available N need minus soil nitrate-N (to 2 feet depth).

Higher yielding grass species generally respond more to N fertilization than lower yielding species adapted to low rainfall. As yield increases, grass digestibility decreases and protein content may decrease, unless N is added above generally economically viable rates (60 to 80 lb N/acre). Forage nitrate toxicity may occur at N rates well below those that maximize yield. See *Nitrate Toxicity of Montana Forages* (MT200205AG) for information on forage and livestock management to minimize nitrate toxicity.

Timing Timing of N fertilization depends in part on the N source. Sources that slowly release N over time should be applied well before N is needed, whereas sources that supply readily available N should be applied in the spring shortly after green-up. If the goal is early spring grazing, and spring field conditions might not allow fertilization, then apply N in the fall. Fall application must be early enough to get plant growth, then allow time for the plant to restore sugars and transition into winter dormancy to reduce risk of winterkill. Early fall timing will vary with plant species and growing season. Alternatively, application can be after

plant dormancy with the risk that some N will be lost to overwinter volatilization and leaching. In-season split applications may not increase total yield but distribute forage production over a longer portion of the season.

Placement Ideally, ammonia- and ammonium-based N fertilizer, including manure, should be immediately incorporated. A ½-inch of irrigation or rainfall in a single event is needed to minimize volatilization loss from broadcast urea. Under dry conditions subsurface banding may be better than surface broadcast. Band at least 2 inches deep and try to leave the slit produced by banding well-closed. Foliar N is useful for in-season N adjustment if leaf burn is minimized. Foliar N must be washed into the soil with at least a ½-inch of water for maximum benefit. UAN (28-0-0 or 32-0-0) is better applied as a surface band than a foliar spray.

Economics The economic benefit of N fertilization should be evaluated over several years, including the long term plans for the stand and the cost of alternative feed sources (hay or forage). Yield increases and net returns from applied N tend to be highest in fields with less than 35% legume in the stand and less than 5 lb soil nitrate-N /acre. Nitrogen is not recommended when the stand contains more undesirable than desired species.

For more information:

Fertilizer Guidelines for Montana Crops EB0161

Soil Nutrient Management for Forages: P, K, S and Micronutrients EB0217

Nitrate Toxicity of Montana Forages MT200205AG

Available under “Extension publications” at <http://landresources.montana.edu/soilfertility/> or at MSU Extension Publications, (406) 994-3273, <http://msuextension.org/store>.

TABLE 1. Nitrogen fertilizer guidelines for alfalfa and grass in Montana based on soil nitrate analysis, yield potential and alfalfa/grass mix¹.

Yield Potential (ton/acre) ²	Alfalfa/Grass				
	80/20	60/40	40/60	20/80	0/100
	Available N need (lb/acre) ³				
1	5	10	15	20	25
2	10	20	30	40	50
3	15	30	45	60	75
4	20	40	60	80	100 ⁴
5	25	50	75	100 ⁴	125 ⁴
6	30	60	90	120 ⁴	150 ⁴

¹ From EB0161.

² Attainable yield when all growth factors optimized.

³ Fertilizer N = Available N need – soil nitrate-N (from soil test).

⁴ Do not exceed 100 lb/acre in a single application on cool season grasses.