Soils on Small Acreage

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Small acreages likely have a mix of plant communities, such as vegetables, forages, trees and shrubs. Healthy soils are the foundation for all of these to thrive (*Evaluating Soil Quality and Health*). Specific needs are addressed in several Soil Scoops (*Feeding the Vegetable Garden, Forages: Nitrogen Management*, and *Forages: P, K, S and Micronutrients*).

Proper grazing is the best investment in long-term pasture health. Soil nutrient management cannot compensate for over grazing. See https://animalrangeextension.montana.edu/range/grazing-management.html for grazing management guidelines.

Soil testing (*Soil Testing: Getting a Good Sample* and *Soil Testing: Once You have the Sample*) and correctly interpreting soil test results (*Fertilizer Rate Calculations*) are necessary to determine fertilizer rates and any need for soil amendments. More fertilizer is not necessarily better. Indiscriminately adding fertilizer, compost or manure may not solve a problem, is potentially a waste of money, and can be harmful to surface and ground water. For example, a single 50 lb nitrogen (N)/acre application increased forage yields the same as a 100 lb N/acre application and was more economical over the 6 years following application (Lorbeer et al. 1994: Jacobsen et al. 1996).

Pasture management can be unique and different from commercial forage production because soil sampling to a 2-foot depth may be nearly impossible on rocky ground and forage yield potential (which affects N needs) is usually unknown as is the amount of forage and nutrients left on the pasture or returned as manure.

SOIL SAMPLING DEPTH

In pastures that are grazed, rather than hayed, with manure left on or returned to the pasture from a corral, few nutrients are removed from the pasture. The most likely nutrient lacking is N because it can be lost to the air as gas, or leached below the rooting zone to groundwater. Forage management guidelines for N are based on 2-foot soil nitrate levels and potential yields.

A rough estimate of N available in the soil is better than no idea at all. Soil nitrate values from 1-foot deep samples can be multiplied by 1.5, and from 6-inch samples by 2.7 for an approximation of soil nitrate available to 2-foot depth (the depth on which N guidelines are based).

YIELD ESTIMATES

There are a few options to estimate forage yields. Montana dryland grass pasture in 14-inch rainfall area may produce as little as 1/3 ton per acre per year, or up to 2 ton with some N fertilizer and well-timed rain (Jacobsen et al. 1995). Irrigated pasture can yield up to 3 to 4 ton per acre. Another option is to ask a local hay producer about their estimated yields.

Forage production can also be estimated by looking at what the pasture is currently sustaining. Horses need 1-2% of their body weight in forage per day (goats around 3-4%). That means, a 1,000 pound horse needs 15 pounds of forage a day, or around 1¼ ton forage from May through September. If the horse is getting enough forage without supplemental feed during the grazing season and the pasture is grazed properly (take half – leave half), then there is about 2½ ton forage (1¼ x 2) being produced, since half of the forage is left ungrazed. Note, this is over the whole grazing area. If the pasture is 5 acres, then each acre is producing a half ton (2½ ton/5 acres) forage per grazing season.

FERTILIZATION

MSU recommends a total 25 lb N per ton of grass, meaning soil N plus fertilizer N; less if there is a leguem (e.g., alfalfa) in the mix. Without knowing soil N, the landowner could be under-fertilizing if there is very little soil N or over-fertilizing if there's already plenty of N in the soil or if the grass growth is water- not nutrient-limited. In dry climates with low leaching potential (e.g., non irrigated, clay or silt), an N fertilizer application will last for up to 5 years because the N is held in the soil, forage roots and dead organic material. Nitrogen does not need to be applied every year, except possibly on irrigated grass. Seeding legumes (e.g., sainfoin, which has

low bloat risk) to fix N in the soil, at to 1/3 to 2/3 of the plant mix is a sustainable way to supply N. If more than 35% of the forage is a legume, N fertilization is unlikely to increase yields or pay off (Malhi et al. 2004). Animals grazing pasture with legume must be watched more carefully for founder and bloat, than when on mature grass.

Apply N before plants 'take-off' in the spring. Nitrogen fertilizer containing urea must be incorporated with at least ½-inch of rain or irrigation to minimize N loss to the air. If the soil surface is moist at the time of application, or there is dew, incorporation should be done within a day after application. Applying N, whether as manure or urea fertilizer on top of snow or moist soil surface may cause up to 40% loss of nitrogen as ammonia gas. Additionally, N can be lost to runoff if the soil is frozen and N cannot seep into the ground. Surface banding of liquid N, or using polymer coated or other treated urea product are options that help N get to the plants.

Fertilization may change which plants are dominant in the pasture. Nitrogen fertilization favors introduced and rhizomatous grasses over native bunchgrasses, and grass over legumes. Phosphorus (P), potassium (K), and sulfur (S) are especially important for legumes. If they are deficient (Olsen P less than around 16 ppm, K less than around 250 ppm), legumes will die out of a forage mix.

Sulfur deficiency is seen as yellow upper leaves, in contrast to yellow older leaves which indicates N deficiency. Sulfur deficiency can also be detected by plant tissue S concentrations. The uppermost leaves of grass before heading and top 6-inches of alfalfa at early bud stage should contain 0.22 to 0.25% sulfur. Phosphorus and K are mostly recycled onsite, but S can be lost to leaching. These are discussed in *Forages: P, K, S and Micronutrients*.

Fertilization may be easier and more cost effective than buying hay or reseeding. However, fertilizing stands that have more undesirable than desirable species, may increase production of undesirable species. Timely weed control by grazing management or herbicides is worth considering. Use caution with herbicides, as they can contaminate surface and groundwater, and harm or kill much more than is intended. Legumes are particularly sensitive to broadleaf herbicides.

MANURE AND MANURE COMPOST

There *can* be too much of a 'good' thing. High levels of N from manure can leach into ground water or run off. If plant N needs are met by applying manure, it is easy to quickly reach excess levels of P and K, which can interfere with plants' ability to take up iron and zinc. High K can lead to milk fever in livestock, and P runoff can contaminate surface water. Excess P and K are not uncommon in vegetable gardens. If manure is going onto garden or pasture soils, test for P and K levels every few years.

Manure may also contain herbicide residual and high salt. Herbicide used on hay can pass through livestock 'undigested', survive composting, and damage if not kill plants; legumes are especially sensitive. If there is any doubt, sprout some peas, lentils or tomatoes in pots with compost vs known safe potting soil.

WHAT ELSE?

Many plant growth problems are caused by disease rather than nutrient deficiencies. Also, in our cold spring climate, some nutrient deficiencies may be temporary. For example, P and iron deficiency may often be seen in early spring but go away as soils warm. A chart and photos to help determine nutrient deficiencies based on visual symptoms is available at https://landresources.montana.edu/soilfertility/nutrientdeficient/.

On-site strip trials are valuable to test if an amendment will solve a plant growth problem. If a product sounds too good to be true, then it probably is.

A note on watering and frequency of fertilization. Sandy soils do not hold water or nutrients, which should be applied in smaller amounts but more frequently on sandy than clay soils.

For more information and references:

The Soil Scoop https://landresources.montana.edu/soilfertility/soilscoop/index.html

MSU Extension MontGuides and Bulletins https://store.msuextension.org/default.aspx

- *Developing Fertilizer Recommendations for Agriculture*
- *Home Garden Soil Testing & Fertilizer Guidelines*
- *Interpretation of Soil Test Reports for Ag*
- *Plant Nutrient Deficiency and Toxicity Symptoms*
- *Soil Nutrient Management for Forages: Nitrogen*
- *Soil Nutrient Management for Forages: P, K, S and Micronutrients*
- *Soil Sampling Strategies*

The MSU Extension Land Stewardship program https://montana.edu/landstewardship/ (in development)

Jacobsen et al. 1995. MSU Fertilizer Fact No. 7. https://landresources.montana.edu/fertilizerfacts/index.html

Jacobsen et al. 1996. J. Range Manage. 49:340-345

Lorbeer et al. 1994. MT AgResearch Spring. p. 7-11

Malhi et al. 2004. Recent Res. Devel. Crop. Sci. 1:237-271

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