

NATURAL RESOURCES CONSERVATION SERVICE
MONTANA CONSERVATION PRACTICE SPECIFICATION

NUTRIENT MANAGEMENT (ACRE)
ORGANIC PRODUCTION

CODE 590D

DEFINITION: Nutrient management under organic production systems is managing the amount, source, placement, form, and timing of plant nutrients and soil amendments.

PURPOSE: Nutrient management effectively and efficiently uses scarce nutrient resources to adequately supply soils and plants appropriate nutrients to produce food, forage, fiber, and cover while minimizing environmental degradation. Nutrient management is applicable to all lands where plant nutrients and soil amendments are applied.

ORGANIC MANAGEMENT SYSTEMS. Nutrient management is a component of an organic conservation management system. Fertile soil is essential to successful organic crop production systems. Organic soil management techniques build organic matter and humus, protect the soil from erosion, reduce nutrient loss, and maintain soil in a condition that supports diverse life forms. Crop rotations are an essential component in fertility management and long-term sustainability.

NUTRIENT MANAGEMENT PLANNING. The nutrient management plan is a dynamic tool and must be monitored and adjusted on an annual basis. As a minimum, a nutrient budget for nitrogen, phosphorus, and potassium will be designed that considers all sources of nutrients including animal manures, organic by-products, waste water, irrigation water, organic commercial fertilizer, crop residues, and legumes.

Nutrient management components of the conservation plan will include the following information:

- Field maps and soil maps
- Planned crop rotation or sequence
- Results of soil, water, plant, and organic materials sample analysis
- Realistic expected yields
- Sources of all nutrients to be applied
- Nutrient budget, including credits of nutrients available
- Nutrient rates, form, timing, and application method to meet crop demands and soil quality concerns
- Location of designated sensitive areas
- Guidelines for operation and maintenance.

Nutrient management is most effective when used with other agronomic practices, such as cover or green manure crops, residue management, conservation buffers, water management, and crop rotation.

SOIL TESTING

Soil testing is an important practice in managing an organic farm and may be required of many organizations providing organic certification. Proper soil sampling and testing should be completed regularly to provide a record of soil nutrient status. A soil test will include information on texture, pH, organic matter content, nitrate-nitrogen, P_2O_5 , and K_2O , salinity and electrical conductivity.

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Soil testing allows a producer to make informed decisions while measuring the benefit of various agronomic practices. If practical, sampling should be completed as at the same time every year (early October for spring seeded crops) and use the same certified laboratory in order to track changes over time. Soil samples should be collected at two depths: 0-6" depth for N, P, K, OM, EC, and pH, and 6-24" depth for nitrate-nitrogen.

Plant tissue analysis is also a useful tool in evaluating soil management practices and crop nutrition. It can provide a reliable reading of nutrients taken up by the crop and can be used to indicate what nutrients are available. To interpret tissue analysis using standardized nutrient sufficiency levels, samples must be taken according to laboratory instructions regarding timing and plant portion.

When organic matter mineralizes it releases nitrogen into the soil for potential plant uptake. The Montana Fertilizer Guidelines assume an average organic matter level of two percent. This is directly incorporated into the available nitrogen requirements. For soils that have organic matter levels that exceed two percent, additional nitrogen will be released to the soil through mineralization at a rate of 15-20 pounds of nitrogen per acre for each one percent of organic matter. Therefore, for nutrient budgeting purposes, nitrogen fertilizer rates can be decreased by 15-20 pounds of nitrogen per acre, if the soil has three percent organic matter or more, assuming moisture and heat conditions are adequate (limits: dryland crops maximum 30 pounds; irrigated crops maximum of 60 pounds).

$$\frac{\text{Soil sample depth (in.)}}{6 \text{ (in.)}} \times 2 \times \text{ppm} = \text{lbs./acre NO}_3$$

Where two soil samples are taken and analyzed at different depths, i.e., at 0-6" and at 6-24", calculate pounds of nitrogen using the above formula for each sample depth and add the results to get a total.

SOURCES OF NUTRIENTS

NITROGEN (N)

The primary source of N on an organic farm is atmospheric N fixed by legumes. Forage legumes and "plow-down" of legume green manure can provide much of the N required to grow crops. Nitrogen can also be provided to the organic farm through the application of manure and by incorporating straw and organic wastes back into the soil.

PHOSPHORUS (P)

Phosphorus is important in many plant metabolic processes that stimulate root growth, promote early maturity, kernel development and increase winter survival, particularly in perennial legumes. Montana soils are naturally low in available phosphorus so supplementation is usually required. Organically available sources of P include manure, crop residue, green manure and rock phosphate fertilizer. Green manure can increase the availability of P. Legumes, buckwheat and many brassica's provide acidity around their roots which assists in stabilizing soil P and increasing uptakes.

Rock phosphate is low-analysis organic source of P. It is more practical for perennial hay and pasture fields because the breakdown of rock P is very slow on high pH soils found across Montana. Annual crops, therefore, benefit less from applications of rock phosphate.

POTASSIUM (K)

The K requirement is typically high for perennial crops, forages, potatoes and tomatoes. Most of Montana's soils are naturally high in K and can meet the typical needs of a crop. Exceptions are sandy soils and those with exceptionally high organic matter content. A good source of K includes manure, however, K is water soluble and care must be taken to minimize leaching during storage. Potassium can also be added to the soil in the form of composted straw and hay and wood ashes.

NUTRIENT LOSSES

Conserving nutrients is an important part of any farm operation. Nutrient losses may harm the environment, in addition to the loss of yields, time, and resources. Nitrate leaching increases when certain factors exist:

- Coarse-textured soils or soils with macropores
- Nutrients are applied near water recharge areas
- Significant precipitation while crops are in stages of less water uptake
- Limited plant root zone to intercept nitrate due to shallow-rooted or immature plants.

Nutrient runoff increases when certain factors exist:

- Fine-textured (clay) soils with low infiltration rates
- High rainfall, short duration events
- Excessive tillage and lack of crop residue.

Nutrient loss can be reduced with effective use of catch crops, cover crops, crop rotations and good manure management techniques.

SOIL FERTILITY

Nutrients to meet both the needs of the crop and organic certification standards may be supplied by several management tools or techniques:

ANIMAL MANURE

- Composting may be necessary for a specific period of time before application on organic fields (check with certification body for specific requirements). Raw animal manure must not be applied to land that is used to grow food for human consumption unless it is incorporated not less than 90 days for above-ground crops and 120 days for below-ground crops.
- Composted plant and animal materials must be produced following a process that meets certification requirements.
- Manure must not be allowed to pollute water sources.
- Manure analysis is important to determine nutrient content of manure for calculation application rates at agronomic rates.
- Its physical and biological characteristics make manure an excellent amendment for low organic matter, eroded, salinized and other poorly-structured soils.

GREEN MANURE

- Grown primarily for purposes of being incorporated into the soil to add nutrients and organic matter.
- Many field crops and forages can be used as green manure (see Field Office Technical Guide (FOTG), Section IV, Cover Crop (Code 340) for species and seeding rates.
- Effective in controlling erosion, adding organic matter, improving soil structure, stimulating biological activity in the soil and reducing compaction.

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- Breaks insect and disease cycles and provides a habitat for pollinators, parasitic wasps, and other beneficial organisms.

The value of green manure can vary with the type of crop and the timing of the plow-down process. Typically, legumes turned under as green manure at the blossom stage can contribute upwards of 100 lbs./ac. of nitrogen. A mixture of grasses and legumes turned under at blossom stage will typically contribute 50-100 lbs./ac. of nitrogen. Grass and legume residue after harvest will add less than 50 lbs./ac. of nitrogen. The rate of decomposition also varies with soil and climatic conditions.

Incorporating green manure into the top 3-4 inches of soil allows favorable rates of decomposition. Deeper levels of incorporation will slow down the rate of decomposition. Incorporation deeper than 6 inches should be avoided. Tillage in early summer may leave a considerable portion of nitrogen in the nitrate form by winter, vulnerable to leaching or denitrification losses. Fall tillage will keep N in organic form over the winter, allowing N to mineralize during the next season.

As microbes break down the green manure residue, micro-and macro-nutrients from these plants are made available over a number of years. Organic acids are released in the breakdown process, resulting in lower soil pH and increased plant-available phosphorus.

LEGUMES IN THE ROTATION

When properly inoculated before planting, annual legumes such as peas and lentils will fix 50-90% of the N they require from the air. Legumes break down more quickly than non-legume residue, which allows N to be available sooner to subsequent crops when residue is worked into the soil. Perennial legumes such as alfalfa supply a substantial amount of N to the soil from their root systems, even though much of the top growth may be removed as hay or grazed.

ROTATING HIGH- AND LOW-NUTRIENT DEMAND CROPS

Different crops require differing amounts of the various essential nutrients. Rotating high- and low- nutrient demand crops may avoid depleting one or more of those essential nutrients in the soil. Knowing the nutrient demand of various crops is essential and a nutrient budget should be developed for every crop.

CROP RESIDUES

Returning crop residues to the soil contributes tremendously to the organic matter and the nutrient pool available for plant growth. Crop residues also prevent soil erosion and improve the water-holding and infiltration properties of soils.

ACCEPTABLE FERTILIZERS

Organic producers often use certain commercially-available fertilizer to address nutrient deficiencies identified by soil tests.

Rock phosphate, certain types of elemental sulfur and gypsum, borax, microbial inoculants and other products derived from natural sources are often applied to the soil, to the seed, or to the plant as nutrient sources.

It is important that the appropriate certifying body be contacted to find out which products are acceptable to use.

Summer Fallow

Tilled summer fallow exposes soil organic matter to air and can stimulate the activity of micro-organisms that break down organic matter. This can speed OM breakdown and nitrogen release. Because summer fallow also discourages plant growth, few nutrients are used while it is in effect.

However, summer fallow also puts the soil at risk from loss of soil moisture and erosion by wind and water. Lost soil equals lost nutrients. Organic matter lost from the soil due to erosion can expose the soil to even more risk that can result in a reduced nutrient pool.

TABLE 1. NITROGEN (N) FIXATION ESTIMATES FOR DRYLAND CONDITIONS

| NITROGEN (N) FIXATION | |
|------------------------------|--------------------|
| LEGUME | (LBS./ACRE) |
| Alfalfa (after harvest) | 40-80 |
| Alfalfa (blossom stage) | 80-90 |
| Spring Pea | 40-90 |
| Winter Pea | 70-100 |
| Lentil | 30-100 |
| Chickpea | 30-90 |
| Faba bean | 50-125 |
| Lupine | 50-55 |
| Hairy Vetch | 90-100 |
| Sweetclover (annual) | 15-20 |
| Sweetclover (biennial) | 80-150 |
| Red Clover | 50-125 |
| Black Medic | 15-25 |

The health of the soil is essential for a successful organic cropping system. Any management practices that increase biological activity in the soil will enhance the productivity of the soil environment. All living things depend on a healthy soil. Proper attention to fertility in an organic production system will be the key to the farm's sustainability.