Nutrient Management

Nebraska Conservation Planning Sheet No. 11

NRCS Natural Resources Conservation Service

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What is Nutrient Management?

The purpose of nutrient management is to budget and supply nutrients for plant production. Nutrient management includes the amount, form, timing and application method of nutrients on each field in order to achieve realistic production goals. A nutrient budget shall be developed that considers all potential sources of nutrients.

How it helps the land and water quality

Nutrient management reduces the likelihood of over-application or poor timing, thus reducing the potential for ground and surface water pollution by nitrogen and phosphorous. It also helps to protect air quality by reducing nitrogen emissions and can reduce production costs improving net income.

Where to get help?

For assistance in planning a nutrient management system, contact the local Natural Resources Conservation Service (NRCS) office, Cooperative Extension office or a private crop consultant.

Crop Nutrient Budget

A nutrient budget for nitrogen (N), phosphorus (P), and potassium (K) shall be developed that considers all potential sources of nutrients including: residual nutrients from soil tests, commercial fertilizer, manure and other organic by-products, organic matter (O.M.), legume crops & irrigation water. Nitrogen credits for legumes, irrigation water & manure are provided in the following tables.

Set realistic yield goals based on yields of the last five years plus five percent.

All fertilizer recommendations should be based on soil type, organic matter content, and crop needs. Soils with higher organic matter will be more fertile and require less N to achieve similar yields than those with less organic matter. A maximum of three percent organic matter can be credited.

If using starter fertilizers, they must be included in overall nutrient budget. Avoid starter P when soil P levels are adequate.

Corn Nitrogen Budget (lb/ac) =
35 lbs + (1.2 lbs x Expected Yield) – (8 lbs x ppm nitrate nitrogen) – (0.14 lbs x Expected Yield x % O.M.) – (Credits for legumes + irrigation water + manure).

Expected Yield – 5-year yield average plus 5%.
ppm Nitrate-Nitrogen - from soil test results
% OM (Organic Matter) - from soil test results
Credits for legumes, irrigation water & manure - from charts contained in this planning sheet or actual analysis values

Nitrogen Credits for Legumes

Legume Crop	Nitrogen Credit (lb./acre)
Soybeans	45
Alfalfa (>4 plants per square ft.)	150 (100 on Sandy soils)
Sweet or Red Clover	80% of Alfalfa

Pounds of N Applied via Irrigation Water

Applied Irrigation Water (inches)	Nitrate content of Water (ppm)			
	5	10	20	40
6	7	14	27	54
12	14	27	54	109
18	20	41	81	163

Soil Sampling & Testing

Soil samples should be collected & prepared according to Nebguide "Guidelines for Soil Sampling" (G1740). Collect soil samples prior to manure and / or fertilizer applications.

- Surface soil tests (0"-8") should be taken for pH, O.M., N, P & K. In addition, test for sulfur, zinc & iron on sandy soils or soils low in organic matter.
- Annual deep samples (at least 24") for nitrates should be taken when planting corn, milo or other nonlegume row crops. See the table below for recommended sampling depths. For sandy soils samples should be taken four weeks or less prior to planting to account for potential N leaching losses.

Recommended Deep Sampling Depths for N

Crop System	Sampling Depth
Corn & grain sorghum (dryland)	4 feet
Corn & grain sorghum (irrigated)	3 feet
Wheat (non-irrigated western 1/2 of state	2 feet
Wheat (non-irrigated & irrigated eastern1/2 of state)	3 feet
Sugarbeet	6 feet

Soil Testing Frequency

- Surface samples should be taken at least every 3-5 years.
- Deep samples for nitrates are only valid for the current crop year.

Manure Application

Manure & sludge should be analyzed for nutrient content. If testing is not possible, use book values or estimates shown below. Application rates for N, P & K fertilizer must be adjusted to account for nutrient availability of manure.

For fields receiving manure, the P-Index assessment tool is used to determine the risk for P runoff and determine if erosion control practices & manure management measures are needed to reduce P loss ("The NE Phosphorus Index (2007): Background & User Guide" (EC195)).

The table below provides an estimate of 1st year N availability based on manure type & application method (if manure has not been applied to this ground previously) based on NebGuide "Determining Crop Available Nutrients from Manure" (G1335).

N Credits for Manure

Manure Source	1st year N Availability - Application Method	
	Surface Applied, Not Incorporated	Injected or Incorporated Immediately
Beef Cattle Solid Feedlot Manure	6 lb/T	7 lb/T
Beef Cattle Slurry Deep Pit	3 lb/ 1000 gal	8 lb/ 1000 gal
Beef Cattle Runoff Holding Pond	3 lb/ac-in	0.9 lb/ 1000 gal
Swine Solids Hoop Barn	7 lb/T	10 lb/T
Swine – Flush Building	2 lb/ 1000 gal	13 lb/1000 gal
Swine Slurry Finisher (wet-dry diet)	6 lb/ 1000 gal	46 lb/1000 gal
Swine Slurry Finisher (dry diet)	5 lb/ 1000 gal	30 lb/1000 gal
Swine Effluent Lagoon	16 lb/ac-in	3.8 lb/ 1000 gal
Dairy Cattle Solid (scraped lots)	4 lb/T	6 lb/T
Dairy Cattle Slurry Storage Pit	5 lb/T	16 lb/T
Dairy Cattle Effluent Lagoon	35 lb/ac-in	7.4 lb/ 1000 gal
Broiler Litter	18 lb/T	32 lb/T
Layer Litter	6 lb/T	23 lb/T
Sewage Sludge	2-3 lb/T	
Sheep Manure	5 lb/T	

Timing Nitrogen Application

Application timing should be adjusted to avoid excessive N leaching losses (see table below). Consider the following when planning nitrogen application:

- Don't apply N or P when soils are frozen or the in spring during rapid freeze-thaw cycles, in order to prevent loss from snow melt & runoff.
- Avoid fall N application on sandy soils.
- Avoid fall applications of inorganic sources of N unless soil temperature is 50 degrees or less, or use nitrification inhibitors.
- Timing N application closer to plant nutrient uptake can reduce N losses from leaching and denitrification.

Nitrate leaching potential of Inorganic N

Timing of Application	Soil Texture		
	Coarse (Sandy)	Medium (Silty)	Fine (Clay)
Fall	High	Medium – Low	Low
Spring or Pre-plant	High - Medium	Medium – Low	Low
Sidedress or Split	Medium - Low	Low	Low

Nitrogen Fertilizer Sources

Organic sources include manure, compost, and sludge. Inorganic sources include: urea-ammonium nitrate; urea; ammonium nitrate and anhydrous ammonia. Consider the following as you choose fertilizer sources:

- The recommended application method must be compatible with the residue and tillage management requirements in your conservation plan.
- When a medium or high N leaching potential exists, avoid fall application of inorganic N sources because they convert to nitrate-nitrogen quickly.
- Injected anhydrous ammonia has minimal N volatization losses when soil moisture conditions are ideal.
- Ammonium nitrate or a controlled release nitrogen fertilizer such as sulfur-coated urea can minimize N losses when incorporation is not possible.
- High N losses, due to volatilization, will occur when surface applying urea in the fall, on wet residue, and hot days. When possible urea should be incorporated / injected or applied with irrigation water.

Nitrogen & Phosphorus Application Methods

Adjust application method(s) to avoid nutrient losses due to runoff, leaching and volatilization. Consider the following to maximize crop nutrient use efficiency:

- To limit N leaching losses, especially on sandy soils avoid fall applications and utilize side dress, split application methods or fertigation with center pivot systems.
- To limit N volatization inject or apply N with irrigation water rather than broadcast.
- Banded application of P fertilizer is usually more efficient at lower rates than broadcast applications, especially when soil P levels are very low. However, if there is sufficient residue cover to maintain soil moisture, surface broadcast applications are adequate.
- Calibrate application equipment to ensure uniform distribution at planned rates.

Other considerations

- Apply lime according to soil test recommendations.
- For corn, grain sorghum, grass pastures, or grass hayland, the minimum soil pH is 5.0. Lime to a 6.5 pH when pH is below 5.0.
- For grass legume pastures or legume hayland, the minimum soil pH is 6.0. Lime soil to a 6.5 pH when pH is below 5.5.

Records

Cropping records necessary to document crop nutrient budgets include:

- Manure & soil test results;
- Nutrient recommendations or planned;
- Rate & sources of nutrients applied;
- Dates & method of application;
- Crops planted, planting & harvest dates & actual yield.

Other References

There are many useful references on the subject of soil fertility and crop nutrient requirements for common crops grown in Nebraska. Here are a few of the NebGuides available at the University of Nebraska Soil Fertility & Nutrient Management website located at http:// soilfertility.unl.edu:

- Guidelines for Soil Sampling (G1740),
- Setting Realistic Corn Yield Goal (G79-481),
- Fertilizer Suggestions for Corn (G174),
- Fertilizer Suggestions for Soybeans (G859),
- Determining Crop Available Nutrients from Manure (G1335),
- The NE Phosphorus Index (2007): Background & User Guide (EC195),
- Nutrient Management for Agronomic Crops in Nebraska (EC15).

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