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. Consider the ***4 Rights*** of nutrient management: *Right nutrient Source at the Right Rate at the Right Time in the Right Place* to improve nutrient use efficiency, achieve realistic production goals, and minimize nutrient losses.

How it helps the land and water quality

Nutrient management lessens the likelihood of over-application, poor timing and/or placement of fertilizers; thus reducing surface and/or ground water pollution by phosphorus and/or nitrogen, and minimizing nitrogen emissions to the atmosphere. Using nutrients more effectively (4Rights) 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, technical service provider (TSP) 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, wastewater, organic by-products, municipal and industrial biosludge, organic matter (O.M.), green manure, compost, legume crops & irrigation water.

Set realistic yield goals based on the five year averages of documented yields (i.e. certified yields, etc.) plus five percent or NASS county yields plus five percent.

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 Realistic Yield Goal) minus
(8 lbs x ppm nitrate-nitrogen) minus
(0.14 lbs x Expected Yield x % O.M.) minus
(Other Credits (i.e. legumes + irrigation water + manure + green manures, etc.)).

Where:
- **Realistic Yield Goal –** 5-yr yield ave. plus 5%.
- **ppm Nitrate-Nitrogen –** value from soil test results
- **% O.M. (Organic Matter) -** from soil test results; Use 3.0% ceiling for budget calculations
- **Credits for legumes, irrigation water & manure** - from charts contained in this planning sheet or actual analysis values

Nitrogen Credit for Legumes

Legume Crop (Plants / Ft^2)	Crop Condition (plants/ft^2)	Nitrogen Credit (lb/ac) Medium or Fine Soils	Nitrogen Credit (lb/ac) Sandy Soil
Soybeans	Average	45	45
Soybeans	Distressed	1 bu/ac=1 lb./ac	
Drybeans	Average	25	25
Alfalfa 70-100%	Good (>4)	150	100
Alfalfa 30-69%	Fair (1.5-4)	120	70
Alfalfa 29 %	Poor (<1.5)	90	40
Sweet & Red Clover		80% of credit allowed for Alfalfa	
Sugar Beets	Average	50	50

Pounds of N Applied via Irrigation Water

*Applied Irrigation Water (inches)	**Nitrate Content of Water (ppm) 10	20	30	40
6	14	27	40	54
12	27	54	81	109
18	41	81	121	163

*Use 80% of applied irrigation water or inches applied up to the milk stage, if the corn..
**Use Irrigation water nitrate values of 10 ppm or greater as nitrate credit in nutrient budgets.

Soil Sampling & Testing

Collect and prepare soil samples according to UNL guidelines & S-590.

- Surface sample at 0-8" & test for:
  - P, K, pH, O.M., once each crop rotation; no less than once every 5 years.
  - Nitrate-nitrogen if nitrogen will be applied (excludes starter N on soybeans). Soil sample prior to first application of nitrogen for the crop. In sandy soils, collect soil samples the same season the crop is planted.
  - Micronutrients, such as sulfur, zinc & iron, as recommended.
- Optional phosphorus surface soil test depth of 0-2" to determine soil P levels is suggested on no-tilled fields with a manure history and P runoff is a concern.
- Deep sample (minimum of 8"- 24") for nitrate-nitrogen is required when applying nitrogen (manure, commercial N, etc.) two or more consecutive years. Collect deep soil samples prior to second continuous year that nitrogen is applied (and all continuous, subsequent years).

UNL Recommended Deep Soil Sampling Depths for Nitrogen

Crop System ([1]Dryland; [2]Irrigated)	Sampling Depth
[1]Corn & grain sorghum	4 feet
[2]Corn & grain sorghum	3 feet
[1]Wheat (western ½ of state)	2 feet
[2]Wheat (eastern ½ of state)	3 feet
Sugarbeet	6 feet

Soil Testing Frequency

- Surface samples should be taken at least once every 3-5 years based on crop rotation, no less than once every 5 years.
- Deep samples for nitrates are only valid for the current crop year.
- Collect samples at the same point in crop rotation and same time of year in subsequent years to determine trends.

Manure Testing

Adjust commercial fertilizer application rates to account for nutrient availability in manure.

Annually analyze each type and source of manure for nutrient content. Use 5-year average values for determining planned rates.

Test for Total N, Total Ammonium-N, Total P, Total K and percent dry/moisture content; and document Total Organic-N. For new operations, use book values (or estimates shown below) until samples can be analyzed.

The table below provides *estimated* first year N availability based on manure source and application method (NebGuide "Determining Crop Available Nutrients from Manure").

Estimated Nitrogen Credits for Manure

Manure Source	1st year N Availability - Application Method	
	Surface Applied, No Incorp.	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 (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	

Nitrogen Sources

Organic nitrogen sources include compost, solid beef and dairy manure. *Inorganic nitrogen* sources include: urea-ammonium nitrate; urea; ammonium nitrate, anhydrous ammonia, deep pit swine slurry and fresh poultry litter, etc.

Consider the following as you choose fertilizer source(s):

- Application method must be compatible with the residue / tillage management requirements in your conservation plan.
- Apply close to crop uptake to avoid leaching and volatilization losses.
- Injected anhydrous ammonia has minimal N volatilization losses when soil moisture conditions are ideal.
- Ammonium nitrate or controlled release nitrogen fertilizer, such as sulfur-coated urea, can minimize N losses when no incorporation occurs.
- Urea should be incorporated / injected or applied with irrigation water. High N losses, due to volatilization, will occur when surface applying urea in the fall, on wet residue, and hot days.

Timing & Placement - Nitrogen

Adjust application timing to avoid excessive nitrogen leaching losses. Complete Nitrogen Leaching Risk Assessment for each field annually using the table below.

When planning nitrogen application, consider the following:

- Time N application closer to plant nutrient uptake to reduce N losses from leaching and denitrification.
- Avoid fall N application on sandy soils.
- Avoid fall applications of inorganic sources of N on medium risk soils unless soil temperature is 50ºF or less.
- Consider nitrification inhibitors.
- Identify low risk fields for spreading or stockpiling nutrients when the ground is frozen or snow-covered.

Nitrogen 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

Timing & Placement – Phosphorus

When applying phosphorus above crop rotation P removal, use NE Phosphorus (P)-Index to determine the risk for P runoff (see S-590). Employ land treatment and erosion management to minimize phosphorus loss.

Avoid surface application of nutrients, especially phosphorus, when soils are frozen or snow-covered and the following field conditions are not met (590 compliance):

- Phosphorus runoff potential of 3.0 or less (based on NE P-index score),
- Phosphorus application rates consistent with info provided in NE P-index completed risk assessment,
- Slope is less than12%,
- Ground cover is greater than 30%,
- Existing land treatment practices are good condition,
- Management practices being used are appropriate for low erosion & runoff,
- State setbacks are respected, and
- Surface application is not within 100 feet of tile inlets that discharge into surface water.

Application Method

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

- To limit nitrogen volatilization, inject or apply nitrogen 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.
- Use chemvalves for fertigation with pivot systems for ground water protection.

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:

- Applicable Test Results (soil, etc.)
- Annual Nutrient Budget;
- Actual Nutrient Applied Records;
- Crops planted, planting & harvest dates & actual yield.

Other References

UNL publications are available at http://www.ianrpubs.unl.edu./edu/epublic/pages/index.jsp.

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