NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(Ac.)

CODE 590

DEFINITION

Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments.

PURPOSE

- To budget, supply, and conserve nutrients for plant production.
- To minimize agricultural nonpoint source pollution of surface and groundwater resources.
- To properly utilize manure, municipal and industrial biosolids (biosolids), or organic by-products as a plant nutrient source.
- To protect air quality by minimizing odors, nitrogen emissions (ammonia, oxides of nitrogen), and the formation of atmospheric particulates.
- To maintain or improve the physical, chemical, and biological condition of soil.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied. This standard does not apply to one-time nutrient applications to establish perennial crops.

CRITERIA

General Criteria Applicable to All Purposes

Nutrient management plans include a nutrient budget for nitrogen (N), phosphorus (P), and potassium (K) that considers all potential sources of nutrients including, but not limited to, commercial fertilizer, animal manure, waste water, legumes, green manures, compost, organic by-products, biosolids, soil organic matter, crop residues, and irrigation water.

Plans for nutrient management shall specify the amount, source, placement and timing of plant nutrients on each field to achieve realistic production goals while minimizing nitrogen and/or phosphorus movement to surface and ground water and minimizing nitrogen emissions to the atmosphere.

For additional guidance on nutrient management planning refer to Practice Specifications for Nutrient Management (S-590).

Appropriate assessment tools shall be used to evaluate the risk of nutrients to be lost to erosion, runoff and leaching. Install erosion, runoff and water management practices as needed on fields that receive nutrients.

Plans for nutrient management shall comply with all applicable Federal, state, and local laws and regulations.

Persons who review or approve plans shall be certified through any certification program acceptable to the NRCS with the state.

Soil Sampling and Laboratory Analyses (Testing).

Nutrient planning must be based on current soil test results developed in accordance with University of Nebraska recommendations.

Current soil tests are those that are no older than 5 years, but may be taken on an interval recommended by the University of Nebraska or as required by State code.

Soil samples shall be collected and prepared according to the University of Nebraska (see NebGuide G1740 “Guidelines for Soil Sampling” and S-590). Complete soil sampling prior to the application of commercial fertilizer and / or manure.

Soil test analyses must be performed by laboratories successfully meeting the requirements and performance standards of the North American Proficiency Testing Program-Performance Assessment Program (NAPT-PAP) under the auspices of the Soil Science Society

of America (SSSA) and NRCS, or other NRCS-approved program that considers laboratory performance and proficiency to assure accuracy of soil test results.

Soil tests must include analyses pertinent to monitoring or amending the annual nutrient management plan and budget. At minimum, soil test must include: pH, soil organic matter, phosphorus, potassium. Test for nitrogen where applicable. Other nutrients can be required based on University of Nebraska guidance. Test for electrical conductivity (EC) and sodicity where salts are a concern. Follow additional testing requirements based on federal, state and local regulations (e.g. Department of Environmental Quality, Natural Resource Districts, etc.).

Supplemental Testing.

Supplemental testing may be encouraged or required in nutrient planning. Grid zone soil testing, tissue sampling and testing, chlorophyll meters, and corn stalk nitrate test shall be completed accordance with University of Nebraska guidance. Testing shall include analysis for any nutrients for which specific information is needed to develop the nutrient management plan.

The 4Rs

Consider the 4Rs of nutrient management – apply the **R**ight nutrient source at the **R**ight rate at the **R**ight time in the **R**ight place – to improve nutrient use efficiency by the crop and to minimize nutrient losses to the surface and groundwater and to the atmosphere.

Nutrient Application Rates.

Planned nutrient application rates for nitrogen, phosphorus, and potassium shall be based on the University of Nebraska recommendations, or where absent, on bordering state university recommendations that consider soil test results, plant tissue results where relevant, realistic yield goals and management capabilities.

Realistic yield goals shall be clearly documented for each field and established using the best available records and information from similar fields and management systems in the location of interest. Realistic yield goals must be attainable yields and should be based on expected yields as follows:

- The average of the previous five years' yields using actual records such as scale tickets, yield monitors, certified crop insurance yield documentation, or Farm Service Agency (FSA) certified yields plus 5%. Do not include any yield records significantly influenced by hail, drought, wind damage, etc.
- If actual records are not available, use five year county average yields from FSA or National Agricultural Statistics Service plus 5%.

For new crops, industry-demonstrated yield, and nutrient utilization information may be used until University of Nebraska information is available.

Lower-than-recommended nutrient application rates are permissible if the grower's objectives are met.

The planned rates of nutrient application shall be determined based on the following guidance (See S-590):

- Nitrogen application – Determine the amount of nitrogen fertilizer necessary for a crop after accounting for nitrogen credits already available to the crop, such as (but not limited to) mineralization from soil organic matter, residual soil nitrate, organic resources, previous legume crops, organic by-products, compost, animal manure, and irrigation water.
- Phosphorus Application – Base phosphorus fertilizer needs for crop on phosphorus soil test levels and the method of fertilizer phosphorus application.
- When manure, wastewater, organic by-products, compost, or biosolids are the source of nutrients, see "Additional Criteria" below.
- Potassium Application – Potassium shall not be applied in situations in which it causes unacceptable nutrient imbalances in crops or forages. When forage quality is an issue associated with excess potassium application, state standards shall be used to set forage quality guidelines.

Most Nebraska soils are capable of supplying enough potassium for excellent corn yields. The University of Nebraska recommendations for potassium are based on the sufficiency concept using soil test values that indicate the soil's ability to supply potassium to different crops. See NebGuides for tables useful in determining potassium fertilizer needs for crops.

- Lime shall be applied, as needed, to adjust soil pH to an adequate level for crop nutrient availability and utilization.
- Other Plant Nutrients (i.e. sulfur, iron and zinc) – The planned rates of application shall be consistent with University of Nebraska recommendations.
- Applications of biosolids, starter fertilizers, or pop-up fertilizers must be accounted for in the nutrient management plan and budget.

Nutrient Sources.

Use nutrient sources compatible with the application timing, tillage and planting system, soil properties, crop, crop rotation, soil organic content, and local climate to minimize risk to the environment.

Commercial fertilizers and enhanced efficiency fertilizers, used in the State, must be defined by the Association of American Plant Food Control Officials (AAPFCO) and accepted for use by the Nebraska Department of Agriculture (NDA) who verifies the nutrients claimed on the label are within the product.

On Certified Organic or Certified Transitional Organic operations, use nutrient sources and manage nutrients consistent with the USDA's National Organic Program.

See Additional Criteria Applicable to Properly Utilize Manure, Municipal and Industrial Biosolids, and other Organic By-products as a Plant Nutrient Source below for criteria for these nutrient sources.

Nutrient Application Timing and Placement.

Consider nutrient source, cropping system limitations, soil properties, weather conditions, drainage system, soil biology, and nutrient risk assessment results in planning the optimal timing and placement of nutrients to correspond as closely as possible with nutrient uptake.

To minimize nutrient losses:

- For nitrogen, timing and placement should correspond as closely as practical with crop uptake.
- For phosphorus, injection application is encouraged when runoff risk potential is high.
- For anhydrous ammonia, to avoid losses during application, apply when soil moisture conditions are conducive to proper injection and sealing. For fall application wait until soil temperatures are 50 degrees Fahrenheit or lower.
- Apply nutrients uniformly to application area(s), except when variable rate application is employed using site specific management.

Areas contained within minimum application setbacks (e.g., sinkholes, wellheads, gullies, ditches, or surface inlets) must receive nutrients consistent with the setback restrictions.

Nutrient applications associated with irrigation systems shall be applied in accordance with the requirements of Irrigation Water Management (Code 449).

Any irrigation distribution system though which chemical fertilizers, manure (liquid wastes) or pretreatment wastes (municipal effluent) are distributed shall be equipped with properly designed and operating valves and components to prevent backflows into the water source(s) and/or contamination of groundwater, surface water or soil.

All local, state and federal applicable laws and regulations must be followed for fertigation where:

- persons planning to apply commercial fertilizer though an irrigation system must contact the local Natural resources District (NRD) to determine what permits are necessary.
- in addition to contacting the local NRD, persons applying liquid wastes or municipal effluent through an irrigation system must contact the Nebraska Department of

Environmental Quality to determine if any permits are necessary.

Nutrients must not be surface-applied if nutrient losses offsite are likely. This includes spreading on:

- frozen and/or snow-covered soils, and
- when the top 2 inches of soil are saturated from rainfall or snow melt.

Exceptions for the above criteria can be made for surface-applied nutrients when specified conditions are met and adequate conservation measures are installed to prevent the offsite delivery of nutrients (See S-590).

Planners should identify lower risk fields for nutrient application during extreme weather conditions when developing nutrient management plans and comprehensive nutrient management plans (CNMPs).

Guidance for the adequate treatment level and specified conditions for winter applications of nutrients are provided in Specification for Nutrient Management (S-590). At a minimum, the following site and management factors must be considered:

- slope,
- organic residue and living covers,
- amount and form of nutrients to be applied, and
- adequate setback distances to protect local water quality.

Additional Criteria to Minimize Agricultural Nonpoint Source Pollution of Surface and Groundwater

When applying manure, wastewater, compost, biosolids, and organic by-products, plan nitrogen and phosphorus application rates based on nutrient risk assessment results. Use approved risk tools as determined by NRCS (See S-590) to assess the risk for nutrient loss to surface and ground water through erosion, leaching and runoff.

The NRCS-approved nutrient risk assessment for nitrogen must be completed on all fields where nitrogen is applied. Refer to S-590 for guidance.

The NRCS-approved nutrient risk assessment for phosphorus must be completed on fields that phosphorus is applied that exceed crop removal rate for the planned crop or crops in rotation. Refer to S-590 for guidance.

Manure or organic by-products may be applied on legumes at rates equal to the estimated removal of nitrogen in harvested plant biomass, in accordance with University of Nebraska recommendations for manure application.

Nutrient Management Strategies to Reduce Nonpoint Source Pollution

Consider the following nutrient-use efficiency strategies or technologies:

- timing and number of applications,
- incorporation or injection,
- calibrate application equipment and apply nutrient materials uniformly,
- coordinate nutrient applications with optimum crop nutrient uptake,
- slow and controlled release fertilizers,
- nitrification and urease inhibitors,
- late-spring soil nitrate test, tissue testing, chlorophyll meters (SPAD), and spectral analysis techniologies.
- Corn Stalk Nitrate Test (CSNT), Pre-Sidedress Nitrate Test (PSNT), and Pre-Plant Soil Nitrate Test (PPSN),
- other University of Nebraska recommended technologies that improve nutrient use efficiency and minimize surface or groundwater resource concerns.

Additional Criteria Applicable to Properly Utilize Manure or Organic By-Products as a Plant Nutrient Source

Utilizing organic residues, which includes various materials such as manure, wastewaters, organic by-products, compost, and biosolids, can be an important part of managing nutrients in a cropping system.

Manure, Wastewater, Compost, and Organic By-products, and Biosolids Sampling and Laboratory Analyses (Testing).

Manure, organic by-products, and biosolids samples must be collected and analyzed at least annually, or more frequently if needed to account for operational changes (feed management, animal type, manure handling strategy, etc.) impacting manure nutrient concentrations. Sample each type of livestock manure (i.e. beef, swine, dairy, poultry, etc.); each form (i.e. solids, wastewater, slurry, compost, etc.); and each manure storage structure (i.e. holding pond, sediment basin, stockpiles, compost piles, deep pits, storage ponds, lagoons, etc.).

Samples must be collected, prepared, stored, and shipped, following University of Nebraska guidance (NebGuide G1450 "Sampling Manures for Nutrient Analysis") or approved industry practice.

Manure testing analyses must be performed by laboratories successfully meeting the requirements and performance standards of the Manure Testing Laboratory Certification program (MTLCP) under the auspices of the Minnesota Department of Agriculture, or other NRCS-approved program that considers laboratory performance and proficiency to assure accurate manure test results.

Manure analyses must include, at minimum, total nitrogen (N), ammonium-N, total phosphorus (P) or P_2O_5, total potassium (K) or K_2O, and percent solids, or follow University of Nebraska guidance regarding required analyses. Manure analysis reports must include the above nutrient plus organic-N. Follow federal, state (NDEQ, NRD, etc.) and/or local regulations for additional requirements.

Municipal and Industrial Biosolids Analysis

Where the metal content of municipal wastewater, sludge, septage and other agricultural waste is of concern, the analysis shall also include determining the concentration of metals in the material. Heavy metals including: Arsenic, Cadmium, Copper, Lead, Mercury, Molybdemium, Nickel, Selenium, and Zinc shall be monitored in accordance with the U.S. Code Reference 40 CFR, Parts 403 and 503, and all applicable state and local laws or regulations. Grazing and crop use restrictions should be followed according to this code and all applicable state and local laws or regulations.

Crop production activities and nutrient use efficiency technologies must be coordinated to take advantage of mineralized plant-available nitrogen to minimize the potential for nitrogen losses due to denitrification or ammonia volatilization.

For existing operations, if manure is tested before application, the results can be used to adjust application rates. If sampling and testing prior to manure application is not practical, livestock operations that are consistent in their feeding and manure management practices can determine application rates based on the average of the past 5-years' of manure analyses.

When planning for new or modified livestock operations, acceptable "book values" recognized by the NRCS (e.g., NRCS Agricultural Waste Management Field Handbook) and the University of Nebraska, or 5-year average analyses from similar operations in the geographical area as approved by NRCS, may be used if they accurately estimate nutrient output from the proposed operation.

Additional Criteria to Protect Air Quality by Minimizing Odors, Nitrogen Emissions and the Formation of Atmospheric Particulates

To address air quality concerns caused by odor, nitrogen, sulfur, and/or particulate emissions; the source, timing, amount, and placement of nutrients must be adjusted to minimize the negative impact of these emissions on the environment and human health. One or more of the following may be used:

- slow or controlled release fertilizers,
- urease inhibitors for surface applied urea fertilizers,
- incorporation,
- injection, or
- other technologies that minimize the impact of these emissions.

Additional Criteria to Improve or Maintain the Physical, Chemical, and Biological Condition of the Soil to Enhance Soil Quality for Crop Production and Environmental Protection

Manage or apply nutrients to maintain or improve the physical, chemical, or biological

condition of the soil to enhance soil quality for crop production and environmental protection.

When possible, avoid applying nutrients when field activities will result in soil compaction.

In areas where salinity is a concern, select nutrient sources that minimize the buildup of soil salts.

CONSIDERATIONS

Use legume crops and cover crops to provide nitrogen through biological fixation and nutrient recycling.

Excessive levels of some nutrients can cause induced deficiencies of other nutrients, e.g., high soil test phosphorus levels can result in zinc deficiency in corn.

Use soil tests, plant tissue analyses, and field observations to check for secondary plant nutrient deficiencies or toxicity that may impact plant growth or availability of the primary nutrients.

Soil test information should be no older than 1 year when developing new plans.

Variable Rate Nutrient Management

Use variable-rate nitrogen, phosphorus, and potassium application rates based on site-specific variability in crop yield, soil characteristics, soil test values, and other soil productivity factors as proven by the University of Nebraska.

Develop site-specific yield maps using a yield monitoring system. Use the data to further diagnose low- and high- yield areas, or zones, and make the necessary management changes. See Title 190, Agronomy Technical Note (TN) 190.AGR.3, Precision Nutrient Management Planning.

Safety

Workers should be protected from and avoid unnecessary contact with plant nutrient sources. Extra caution must be taken when handling anhydrous ammonia or when dealing with organic wastes stored in unventilated enclosures.

Material generated from cleaning nutrient application equipment should be utilized in an environmentally safe manner. Excess material should be collected and stored or field applied in an appropriate manner.

Nutrient containers should be recycled in compliance with State and local guidelines or regulations.

Consider the development of a farm / operational safety plan with emergency phone numbers, farm 911 address; post near business telephones; and review with employees.

NEVER enter a manure deep storage pit unless absolutely necessary and only when proper safeguards have been taken!

Considerations to Minimize Agricultural Nonpoint Source Pollution of Surface and Groundwater.

Use conservation practices that slow runoff, reduce erosion, and increase infiltration, e.g., filter strip, contour farming, or contour buffer strips. These practices can also reduce the loss of nitrates or soluble phosphorus.

- drainage water management to reduce nutrient discharge through drainage systems.

Use application methods and timing strategies that reduce the risk of nutrient transport by ground and surface waters, such as:

- split applications of nitrogen to deliver nutrients during periods of maximum crop utilization,
- banded applications of nitrogen and/or phosphorus to improve nutrient availability.

Considerations to Properly Utilize Manure, Biosolids and Other Organic By-Products as a Crop Nutrient Source

Apply manure at a rate that will result in an “improving” Soil Conditioning Index (SCI) without exceeding acceptable risk of nitrogen or phosphorus loss.

Modify animal feed diets to reduce the nutrient content of manure following guidance contained in Conservation Practice Standard (CPS) Code 592, Feed Management.

Considerations to Protect Air Quality by Reducing Nitrogen and/or Particulate Emissions to the Atmosphere.

Avoid applying manure and other by-products upwind of inhabited areas.

Use high-efficiency irrigation technologies (e.g., reduced-pressure drop nozzles for center pivots) to reduce the potential for nutrient losses.

Do not apply poultry litter, manure or organic by-products of similar dryness/density when there is a high probability that wind will blow the material offsite.

PLANS AND SPECIFICATIONS

The following components must be included in the nutrient management plan:

- field maps for each budget area to include aerial site photograph(s)/imagery or site map(s), a soil survey map of the site, and topography map of the field. Include site boundaries and legal descriptions.
- soil information including: soil type surface texture, slope percentage, permeability, restrictive features, and flooding and/or ponding frequency,
- location of designated sensitive areas and the associated nutrient application restrictions and setbacks,
- for manure applications, site maps should include the location of nearby residences, or other locations where humans may be present on a regular basis,
- results of approved risk assessment tools for nitrogen (N-Leaching summary for all fields) and phosphorus (as applicable NE P-Index summary reports),
- most current soil sample test results or if not available, use default nitrate values for unsampled depths (See EC117 – Fertilizer suggestions for Corn),
- total acres, farmable acres and spreadable acres, as applicable,
- current and/or planned plant production sequence or crop rotation,
- realistic yield goals for the crops,
- nutrient test results for irrigation water, compost, manure, wastewater, organic by-product, biosolids and plant tissues applicable to the plan,
- annual nutrient budget for nitrogen, phosphorus, and potassium for the plant production sequence or crop rotation including all applicable credits,
- planned source, timing, amount (except for precision/variable rate applications specify method used to determine rate), and placement of plant nutrients for each field or management unit,
- if manure, wastewater, compost, biosolids, by-products are imported, include the source (name and address), type (i.e. beef solids, swine slurry, etc.), amount, and copy of nutrient analysis,
- for fields with planned or past manure application event and have high and very high P-index risk levels, a long-term strategy and proposed implementation timeline for reducing soil P to medium levels that includes the implementation of planned management and/or conservation practices to protect water quality, and
- guidelines for implementation, operation and maintenance, and recordkeeping.

In addition, the following components must be included in a precision/variable rate nutrient management plan:

- Document the geo-referenced field boundary and data collected that was processed and analyzed as a GIS layer or layers to generate nutrient or soil amendment recommendations.
- Document the nutrient recommendation guidance and recommendation equations used to convert the GIS base data layer or layers to a nutrient source material recommendation GIS layer or layers.
- Document if a variable rate nutrient or soil amendment application was made.
- Provide application records per management zone or as applied map within individual field boundaries (or electronic records) documenting source, timing, method, and rate of all applications that resulted from use of the precision agriculture

process for nutrient or soil amendment applications.

- Maintain the electronic records of the GIS data layers and nutrient applications for at least 5 years.

OPERATION AND MAINTENANCE

Conduct periodic plan reviews to determine if adjustments or modifications to the plan are needed. At a minimum, plans must be reviewed and revised, as needed with each soil test cycle, changes in manure volume or analysis, crops, or crop management.

Fields receiving animal manures and/or biosolids must be monitored for the accumulation of phosphorus and heavy metals (as applicable) in accordance with University of Nebraska guidance and State law.

Significant changes in animal numbers, management, and feed management will necessitate additional manure analyses to establish a revised average nutrient content. These changes may also require the existing nutrient plan and/or comprehensive nutrient management plan to be re-examined, potentially revised.

Annually calibrate commercial fertilizer and manure application equipment to ensure accurate distribution of material at planned rates in accordance with University of Nebraska guidelines. See “Calibration of Sprayers (also Seeders) NebGuide G2044.

Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation for the change.

Records must be maintained for at least 5 years to document plan implementation and maintenance. As applicable, records include:

- soil, plant tissue, water, manure, compost, and organic by-product analyses resulting in recommendations for nutrient application,
- nutrient budget for each field, including crop, realistic yield goals, nutrient credits and planned rates.
- nutrient source (type) and applied nutrient quantities (rate per acre and total amount applied),
- dates and method(s) of nutrient applications,
- if nitrogen stabilizers were used,
- for all imported manure, wastewater, compost, by-products, or biosolids, the quantities, type (i.e. beef-solids, swine-slurry, etc.), source (name and address), import date(s), and respective nutrient analysis reports,
- weather conditions and soil moisture at the time of application; lapsed time to manure incorporation; rainfall or irrigation event,
- crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass (as applicable), and crop residues removed, and
- dates of plan review, name of reviewer, and recommended changes resulting from the review.

Required records for precision/variable rate application include:

- maps identifying the variable application source, timing, amount, and placement of all plant nutrients applied, and
- GPS-based yield maps for crops where yields can be digitally collected.

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