NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(Ac.)

CODE 590

DEFINITION

Managing the amount, source, placement, form and timing of the application of plant nutrients and soil amendments.

PURPOSE

- To budget and supply nutrients for plant production.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To minimize agricultural nonpoint source pollution of surface and ground water resources.
- To protect air quality by reducing nitrogen emissions (ammonia and NO_x compounds) 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.

CRITERIA

General Criteria Applicable to All Purposes

A nutrient budget for nitrogen, phosphorus, and potassium shall be developed that considers all potential sources of nutrients including, but not limited to animal manure and organic by-products, waste water, commercial fertilizer, crop residues, organic matter, legume credits, and irrigation water.

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

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

Realistic yield goals shall be clearly documented and shall be established using the best available records and information from similar fields and management systems in the location of interest.

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

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

Plans for nutrient management shall be developed in accordance with policy requirements of the NRCS General Manual Title 450, Part 401.03 (Technical Guides, Policy and Responsibilities) and Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy); technical requirements of the NRCS Field Office Technical Guide (FOTG); procedures contained in the National Planning Procedures Handbook (NPPH), and the NRCS National Agronomy Manual (NAM) Section 504, Amendment NE16.

Persons who review or approve plans for nutrient management shall be certified through any certification program acceptable to NRCS within the state.

Soil Sampling and Laboratory Analyses (Testing). Nutrient planning shall be based on current soil test results developed in accordance with the University of Nebraska recommendations.

Soil samples shall be collected and prepared according to the University of Nebraska NebGuide G1740 “Guidelines for Soil Sampling”.

Soil test analyses shall be performed by laboratories that have successfully met the requirements and performance standards of the Soil Science Society of America. Required soil test analysis shall use procedures that have been calibrated or interpreted by the University of Nebraska. Soil testing shall include analyses for any nutrients for which specific information is needed to develop the nutrient management plan. Request analyses pertinent to monitoring or amending the annual nutrient budget, e.g. pH, electrical conductivity (EC), soil organic matter, nitrogen, phosphorus and potassium.

Supplemental Testing. Additional test results shall be used as a supplement to nutrient planning. Grid or zone soil testing, tissue sampling and testing, chlorophyll meters, and corn stalk nitrate test where used shall be collected and prepared in accordance with University of Nebraska guidance and recommendations. Testing shall include analysis for any nutrients for which specific information is needed to develop the nutrient plan.

Nutrient Application Rates. Recommended nutrient application rates shall be based on the University of Nebraska recommendations (and/or industry practice when recognized by the university) that consider current soil test results, plant tissue results where relevant, realistic yield goals and management capabilities.

The planned rates of nutrient application, as documented in the nutrient budget, shall be determined based on the following guidance:

- Nitrogen Application **-** Planned nitrogen application rates shall match the University of Nebraska recommended rates as closely as possible, except when manure or organic by-products are a source of nutrients. Refer to Appendix A for a list of NebGuides. When manure or organic by-products are a source of nutrients, see “Additional Criteria” below.
- Phosphorus Application **-** Planned phosphorus application rates shall match the recommended rates.
- 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. A chemical test procedure for potassium does not measure total potassium in the soil. The value from the chemical analysis is an index of the soil’s ability to supply potassium to different crops. See NebGuides for tables useful in determining potassium fertilizer needs for crops.
- Lime - 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 of other nutrients shall be consistent with University of Nebraska guidance.
- Starter Fertilizers - When starter fertilizers are used, they shall be included in the overall nutrient budget, and applied in accordance with the University of Nebraska recommendations.

Nutrient Application Timing. Timing and method of nutrient application (particularly nitrogen) shall correspond as closely as possible with plant nutrient uptake characteristics, while considering cropping system limitations, livestock waste control system limitations, weather and climatic conditions, risk assessment tools (e.g., leaching index, P index), and field accessibility.

Nutrient Application Methods. Application methods to reduce the risk of nutrient transport to surface and ground water, or into the atmosphere shall be employed.

To minimize nutrient losses:

- Apply nutrient materials uniformly to application area(s), except when variable-rate application is employed using site-specific management.
- Nutrients shall be applied considering the plant growth habits, irrigation practices, and other conditions so as to maximize availability to the plant and minimize the risk of runoff, leaching, and volatilization losses.
- Avoid application of anhydrous ammonia on wet soils or other situations where application slots will not seal adequately.

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

Any irrigation distribution system through 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 sources(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 through 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.

Additional Criteria Applicable to Manure and Organic By-Products as a Plant Nutrient Source

When animal manures or organic by-products are applied, a P-Index risk assessment of the potential for phosphorus transport from the field or MU shall be completed to adjust the amount, placement, form and timing of application of nutrient sources, as recommended by the University of Nebraska.

Manure and Organic By-Product Nutrient Application Timing. Manure and/or organic by-products shall not be applied to frozen, snow-covered or saturated soil if the potential risk for runoff exists.

Manure and Organic By-Product Nutrient Application Rates. Manure and organic by-product samples shall be collected and prepared according to the University of Nebraska recommendations (NebGuide G1450 “Sampling Manures for Nutrient Analysis”).

The application rate (in/hr) of liquid materials applied shall not exceed the soil intake/infiltration rate and shall be adjusted to minimize ponding and to avoid runoff. The total application shall not exceed the available water holding capacity of the soil within the crops root zone and shall be adjusted, as needed, to minimize loss to subsurface tile drains.

The planned rates of nitrogen and phosphorus application recorded in the plan shall be determined based on the following guidance.

Nitrogen Application Rates

- o When manure or organic by-products are used, the nitrogen availability of the planned application rates shall match plant uptake characteristics as closely as possible, taking into consideration the timing of nutrient application(s) in order to minimize leaching and atmospheric losses.
- o Management activities and technologies shall be used that effectively utilize mineralized nitrogen and that minimize nitrogen losses through denitrification and ammonia volatilization.

Phosphorus Application Rates

- o When manure or organic by-products are used, the planned rates of phosphorus application shall be consistent with one of the following:
  - ◊ P-Index Rating. Nitrogen-based manure application on “Low” or “Medium" risk sites; phosphorus-based or no manure application on

"High" risk sites; and no manure application on "Very High" risk sites. Refer to Nebraska Agronomy Technical Note 107 "Nebraska Phosphorus Index: Background and User Guide" or NebGuide EC195.

◊ Soil Test. Nitrogen-based manure application on sites for which the soil test recommendation calls for phosphorus application; phosphorus-based or no manure application on sites for which the soil test recommendation calls for no phosphorus application.

Additional Criteria Applicable to Biosolids Applied as a Plant Nutrient Source

Biosolids (sewage sludge) shall be applied in accordance with USEPA regulations. (40 CFR Parts 403 (Pretreatment) and 503 (Biosolids) and other state and/or local regulations regarding the use of biosolids as a nutrient source.

When sewage sludge (biosolids) is applied, the accumulation of potential pollutants (including arsenic, cadmium, copper, lead, mercury, selenium, and zinc) in the soil shall be monitored in accordance with the US Code, Reference 40 CFR, Parts 403 and 503, and/or any applicable state and local laws or regulations. Refer to practice standard Waste Management (code 633) for additional guidance.

Additional Criteria to Protect Air Quality by Reducing Nitrogen and/or Particulate Emissions to the Atmosphere

USEPA-designated non-attainment areas for criteria atmospheric pollutants that are nutrient management-related can be found at http://www.epa.gov/oar/oaqps/greenbk. Within these areas , any component(s) of nutrient management (i.e., amount, source, placement, form, timing of application) identified by risk assessment tools as a potential source of atmospheric pollutants shall be adjusted, as necessary, to minimize the loss(es).

When tillage can be performed, surface applications of manure and fertilizer nitrogen formulations that are subject to volatilization on the soil surface (e.g., urea) shall be incorporated into the soil within 24 hours after application.

When manure or organic by-products are applied to grassland, hayland, pasture or minimum-till areas the rate, form and timing of application(s) shall be managed to minimize volatilization losses.

When liquid forms of manure are applied with irrigation equipment, operators will select weather conditions during application that will minimize volatilization losses.

Operators will handle and apply poultry litter or other dry types of animal manures when the potential for wind-driven loss is low and there is less potential for transport of particulates into the atmosphere.

Weather and climatic conditions during manure or organic by-product application(s) shall be recorded and maintained in accordance with the operation and maintenance section of this standard.

Additional Criteria to Improve the Physical, Chemical and Biological Condition of the Soil

Nutrients shall be applied and managed in a manner that maintains or improves the physical, chemical and biological condition of the soil.

Minimize the use of nutrient sources with high salt content unless provisions are made to leach salts below the crop root zone.

To the extent practicable nutrients shall not be applied when the potential for soil compaction and rutting is high.

CONSIDERATIONS

The use of management activities and technologies listed in this section may improve both the production and environmental performance of nutrient management systems. Document the activity or technology in the nutrient management plan. Note additional management to perform the activity and/or technology.

Action should be taken to protect National Register listed and other eligible cultural resources.

The nutrient budget should be reviewed annually to determine if any changes are needed for the next planned crop.

For sites on which there are special environmental concerns, other sampling techniques may be appropriate. These include soil profile sampling for nitrogen, Pre-Sidedress Nitrogen Test (PSNT), Pre-Plant Soil Nitrate Test (PPSN) or soil surface sampling for phosphorus accumulation or pH changes.

Additional practices to enhance the producer's ability to manage manure effectively include modification of the animal's diet to reduce the manure nutrient content, or utilizing manure amendments that stabilize or tie-up nutrients.

When available soils test information should be no older than one year when developing new plans, particularly if animal manures are to be used as a nutrient source. If no current soils tests are available, it is recommended that testing be completed with in a year to establish base-line information.

Excessive levels of some nutrients can cause induced deficiencies of other nutrients.

If increases in soil phosphorus levels are expected, consider a more frequent (annual) soil testing interval.

To manage the conversion of nitrogen in manure or fertilizer, use products or materials (e.g. nitrification inhibitors, urease inhibitors and slow or controlled release fertilizers) that more closely match nutrient release and availability for plant uptake. These materials may improve the nitrogen use efficiency (NUE) of the nutrient management system by reducing losses of nitrogen into water and/or air.

Additional information on application rates for other nutrients can be obtained from current NebGuides or Extension Circulars (refer to Appendix A for a complete list of references).

- Sulfur – Sulfur deficiencies generally occur only in sandy soils. Research, however, has shown that applying sulfur to sandy soils will not always increase yields. Studies have shown that the organic matter content of the soil also must be a consideration.
- Iron – Most soils in Nebraska contain adequate amounts of iron, yet iron chlorosis (yellowing) occurs in some areas of the state in some crops. Deficiency symptoms will appear primarily on younger leaves. Some crops grown in Nebraska are quite tolerant to low levels of available iron, while others, such as soybean, sorghum and field beans are not.
- Zinc – Some soils in Nebraska are deficient in zinc. Deficient soils often have a high pH, are low in organic matter, and occur where land leveling, terrace construction or erosion have removed topsoil. Corn is the most sensitive crop to low soil zinc levels. Zinc deficiency may occur on newer leaves first. In corn and sorghum, it is characterized by interveinal whitish bands on either side of the midrib. Zinc-deficient soybeans have stunted stems and interveinal chlorosis on younger leaves.

Considerations to Minimize Agricultural Nonpoint Source Pollution of Surface and Ground Water.

Erosion control and runoff reduction practices can improve soil nutrient and water storage, infiltration, aeration, tilth, diversity of soil organisms and protect or improve water and air quality (Consider installation of one or more NRCS FOTG, Section IV – Conservation Practice Standards).

Cover crops can effectively utilize, tie-up and/or recycle residual nitrogen. Refer to Conservation Standard for Cover Crop (Code 340) for appropriate cover crops to use for this purpose.

Apply nutrient materials uniformly to the application area. Application methods and timing that reduce the risk of nutrients being transported to ground and surface waters, or into the atmosphere include:

- Split applications of nitrogen to provide nutrients at the times of maximum crop utilization,
- Use stalk-test to minimize risk of over applying nitrogen in excess of crop needs,
- Avoid winter nutrient application for spring seeded crops,
- Band applications of phosphorus near the seed row,

- Incorporate surface applied manures or organic by-products as soon as possible after application to minimize nutrient losses,
- Delay field application of animal manures or organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.

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

Odors associated with the land application of manures and organic by-products can be offensive to the occupants of nearby homes. Avoid applying these materials upwind of occupied structures when residents are likely to be home (evenings, weekends and holidays).

When applying manure with irrigation equipment, modifying the equipment can reduce the potential for volatilization of nitrogen from the time the manure leaves the application equipment until it reaches the surface of the soil (e.g., reduced pressure, drop down tubes for center pivots). N volatilization from manure in a surface irrigation system will be reduced when applied under a crop canopy.

When planning nutrient applications and tillage operations, encourage soil carbon buildup while discouraging greenhouse gas emissions (e.g., nitrous oxide N_2O, carbon dioxide CO_2).

CAFO operations seeking permits under USEPA regulations (40 CFR Parts 122 and 412) should consult with their respective state permitting authority for additional criteria.

PLANS AND SPECIFICATIONS

Plans and specifications for nutrient management shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s), using nutrients to achieve production goals and to prevent or minimize resource impairment. Nutrient Management (S-590) practice specification and appropriate references in S-590 will be provided to the client. Other references listed in Nutrient Management 590 Appendix A References, such as Neb-Guides or Extension Circulars shall be provided to the client as appropriate.

Nutrient management plans shall include a statement that the plan was developed based on requirements of the current standard and any applicable Federal, state, or local regulations, policies, or programs, which may include the implementation of other practices and/or management activities. Changes in any of these requirements may necessitate a revision of the plan.

See NPPH State Supplement, Section III – Nutrient Management Planning and Reporting Requirements (eFOTG, Section I. F. Conservation Planning) for a listing of components required in the nutrient management plan.

If increases in soil phosphorus levels are expected, the nutrient management plan shall document:

- The soil phosphorus levels at which it may be desirable to convert to phosphorus based planning,
- Results of appropriate risk assessment tools to document the relationship between soil phosphorus levels and potential for phosphorus transport from the field,
- The potential for soil phosphorus drawdown from the production and harvesting of crops, and
- Management activities or techniques used to reduce the potential for phosphorus loss.

OPERATION AND MAINTENANCE

The owner/client is responsible for safe operation and maintenance of this practice including all equipment. Operation and maintenance addresses the following:

- Periodic plan review to determine if adjustments or modifications to the plan are needed. As a minimum, plans will be reviewed and revised with each soil test cycle.
- Significant changes in animal numbers and/or feed management will necessitate additional manure sampling and analyses to establish a revised average nutrient content.

- Protection of fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage.
- Calibration of application equipment to ensure uniform distribution of material at planned rates.
- Documentation of the actual rate at which nutrients were applied. When the actual rates used differ from the recommended and planned rates, records will indicate the reasons for the differences.
- Maintaining records to document plan implementation. As applicable, records include:
    - Soil, plant tissue, water, manure, and organic by-product analyses resulting in recommendations for nutrient application,
    - Quantities, analyses and sources of nutrients applied,
    - Dates and method(s) of nutrient applications,
    - 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, and crop residues removed, and
    - Dates of plan review, name of reviewer, and recommended changes resulting from the review.

Records should be maintained for five years; or for a period longer than five years if required by other Federal, state or local ordinances, or program or contract requirements.

Workers should be protected from and avoid unnecessary contact with plant nutrient sources. Extra caution must be taken when handling ammoniacal nutrient sources, 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.

REFERENCES

Follett, R.F. 2001. Nitrogen Transformation and Transport Processes. pp. 17-44, In R.F. Follett and J. Hatfield. (eds.). 2001. Nitrogen in the Environment; Sources, Problems, and Solutions. Elsevier Science Publishers. The Netherlands. 520 pp.

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Stevenson, F.J. (ed.) 1982. Nitrogen in Agricultural Soils. Agron. Series 22. ASA, CSSA, and SSSA, Madison, WI