Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

CODE 590

(ac)

DEFINITION

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

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- To budget, supply, and conserve nutrients for plant production
- To minimize agricultural nonpoint source pollution of surface and groundwater resources
- To properly utilize manure or organic by- products as a plant nutrient source
- To protect air quality by reducing 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

A nutrient budget for nitrogen, phosphorus, and potassium must be developed that considers all potential sources of nutrients including, but not limited to, green manures, legumes, crop residues, compost, animal manure, organic by- products, biosolids, waste water, organic matter, soil biological activity, commercial fertilizer, and irrigation water.

Enhanced efficiency fertilizers, used in Illinois must be defined by the Association of American Plant Food Control Officials (AAPFCO) and be registered for use by the Illinois Department of Agriculture.

To avoid salt damage, the rate and placement of applied nitrogen and potassium in starter fertilizer must be consistent with University of Illinois Agronomy Handbook.

Nitrogen applied to crops must meet guidelines established in the Illinois Agronomy Handbook.

For purposes of implementing the 590 Nutrient Management Practice Standard and Assessments, a field will be considered tile drained when at least 50 percent of the field acreage is drained via subsurface drains. The Illinois Drainage Guide will be used to determine the extent of drainage.

Fields that are tile drained and/or contain soils that have high risk characteristics for nitrogen leaching will achieve a Medium risk for nitrogen as outlined in the Illinois NRCS Nitrogen Management Guidelines.

The Illinois NRCS Phosphorus Index must be completed when:

- phosphorus application rates for the planned crop(s) or crop rotation exceed guidelines established in the University of Illinois Agronomy Handbook or,
- the planned area is within or contributes to a HUC 12 watershed impaired for phosphorus or algae as designated by Illinois Environmental Protection Agency (i.e. water bodies with total phosphorus or aquatic algae listed as a cause of impairment according to the most recent 305(b) assessment report.)
- Fields not meeting these conditions will not be required to use the Illinois Phosphorus Index unless otherwise required under other criteria of the standard.

On organic operations, the nutrient sources and management must be consistent with the USDA's National Organic Program.

Applications of irrigation water must minimize the risk of nutrient loss to surface and groundwater.

Soil pH must be maintained in a range that enhances an adequate level for crop nutrient availability and utilization.

Average crop yields for each crop will be determined using one of the following methods:

- Average of five years for each crop based on producer records, excluding individual years where the yield varied plus or minus 25% of the five year average. Multiply the average by 1.05.
- Crop insurance yields, Farm Services Agency yields, or county average yields.
- Weighted average of the yields based on soil type and yields from the University of Illinois "Average Crop, Pasture, and Forestry Productivity Ratings for Illinois Soils: Bulletin No. 810 or Optimum Crop Productivity Ratings for Illinois Soils: Bulletin No. 811".

Soil, Manure, and Tissue Sampling and Laboratory Analyses (Testing)
Nutrient planning will be based on current soil, manure, and tissue test results (used as supplemental information) developed in accordance with University of Illinois recommendations, or standard industry practices recognized by the University of Illinois.

Soil sampling and testing will be performed according to methods described in the University of Illinois Agronomy Handbook and Illinois Agronomy Technical Note No. 23 "Soil Sampling Guidelines for Immobile Plant Nutrients". Soil tests must be obtained at least every 4 years unless required more frequently by state or federal regulations.

The soil and tissue tests must include analyses pertinent to monitoring or amending the annual nutrient budget, e.g., pH, phosphorus, potassium. Testing for CEC, organic matter, and/or nitrogen is optional.

Soil test analyses must be performed by laboratories successfully meeting the requirements and performance standards of the Illinois Soil Testing Association Lab Accreditation Program (ISTA-LAP) http://www.soiltesting.org/ or the North American Proficiency Testing Program-Performance Assessment Program (NAPT-PAP) http://www.naptprogram.org/pap , or other NRCS-approved programs that consider laboratory performance and proficiency to assure accuracy of soil test results.

Nutrient values of manure must be determined prior to or during land application.

Manure analyses must include, at minimum, total Kjeldahl Nitrogen (N), ammonium Nitrogen, total phosphorus (P) or P2O5, total potassium (K) or K2O, and percent solids. Plant available Nitrogen from the organic fraction of the manure will be estimated based on animal species, animal production phase, storage and application method. Nitrogen will be credited to the nutrient budget at 50, 25, and 12.5

percent of the estimated year of application plant available organic nitrogen respectively for subsequent years 1, 2, and 3.

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. Manure tests results from the previous year may be used for initial plan preparation unless there has been a change in the operation that would be expected to cause significant changes to the manure chemistry such as changes in feed management, storage methods, livestock type or animal production phase. The running average manure nutrient content test values can be used to calculate the appropriate manure rates that can be applied to meet the nutrient requirements specified for the current year. Prior to establishing stable nutrient content averages, sampling will occur at a frequency based on the designed storage period. For example, manure storage facilities designed for 6 months storage will sample twice yearly. Storage facilities designed for 9 months storage will be sampled every 9 months.

Storage facilities designed with 12 or months of storage will be sampled at least annually. Over the course of the plan implementation, if no operational changes occur, less frequent manure testing is allowable where operations can document a stable level of nutrient concentrations for the preceding three consecutive years, unless federal or state regulations require more frequent testing.

Manure samples must be collected, prepared, stored, and shipped according to the protocols and procedures outlined in: the Livestock Facilities Handbook, MWPS-18, Section 1.

When planning for new or modified livestock operations, acceptable “book values” may be obtained from: the NRCS Agricultural Waste Management Field Handbook, Livestock Facilities Handbook, MWPS-18.Section 1.

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.
http://www2.mda.state.mn.us/webapp/lis/manurelabs.jsp

Nutrient Application Rates
Planned nutrient application rates for nitrogen and phosphorus must not exceed University of Illinois Agronomy Handbook guidelines or industry practice recognized by the University of Illinois. Nutrient application rates may deviate from standard University of Illinois recommendations if appropriate adaptive management techniques and procedures are implemented. Refer to Illinois NRCS Adaptive Nitrogen Management Guidelines.

At a minimum, determination of rate must be based on crop/cropping sequence, current soil test results, realistic yield goals, and NRCS approved nutrient risk assessments.

Estimates of yield response must consider factors such as poor soil quality, drainage, pH, salinity, etc., prior to assuming that nitrogen and/or phosphorus are deficient.

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

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

Crop nutrients provided by the application of biosolids, starter fertilizers, or pop-up fertilizers must be accounted for in the nutrient budget.

Estimate legume-nitrogen credits from guidelines provided in the Illinois Agronomy Handbook.

On fields where the median soil test Bray P1 or Mehlich 3 exceeds 70 /acre, dual carrier fertilizers such as 10-34-0, 18-46-0, or 11-52-0 may be applied pre-plant to late summer/fall seeded small grains or forages. The rate of the dual carrier product will not be applied to exceed 30 lbs. N/acre.

Nutrient Sources
Nutrient sources utilized must be 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.

Nutrient Application Timing and Placement
Timing and placement of all nutrients must correspond as closely as practical with plant nutrient uptake (utilization by crops), and consider nutrient source, cropping system limitations, soil properties, weather conditions, drainage system, soil biology, and nutrient risk assessment results.

Starter fertilizer applications containing phosphorus may be applied on phosphorus restricted fields where the:

- field has at least 50% ground cover
- fertilizer is placed below the soil surface

Unincorporated, surface-applied nutrients must not be applied if nutrient losses offsite are likely. This includes spreading of manure, urea, UAN solutions, ammonium sulfate, and/or ammoniated phosphates:

- on frozen and/or snow-covered soils, and/or
- 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 adequate conservation measures are in place such as and not limited to, Conservation Crop Rotation (328), Residue and Tillage Management (329, 344, 345, and 346), Contour Farming (330),
- Stripcropping (585), Cover Crop (340), Field Border (386), and Filter Strip (393).
- when adequate ephemeral erosion control practices are installed to prevent the offsite delivery of nutrients such as and not limited to Terraces (600), Water and Sediment Control Basins (638), and Grassed Waterways, (412).
- when top dressing fertilizers for small grains or pastures on frozen soils prior to green up, or when frost seeding legumes and,
- adequate treatment must achieve a **Medium** Phosphorus Index rating.

Additional Criteria to Minimize AgriculturalNonpoint Source Pollution of Surface andGroundwater
Planners must use the current NRCS-approved nitrogen, phosphorus, and soil erosion risk assessment tools to assess the risk of nutrient and soil loss. Identified resource concerns must be addressed to meet current planning criteria (quality criteria). When there is a high risk of transport of nutrients, conservation practices must be coordinated to avoid, control, or trap manure and nutrients before they can leave the field by surface or subsurface drainage (e.g., tile). The number of applications and the application rates must also be considered to limit the transport of nutrients to tile.

Nutrients shall be applied with the right placement, in the right amount, at the right time, and from the right source (4R's) to minimize nutrient losses to surface and groundwater. One or more of the following nutrient use efficiency strategies or technologies must be utilized as applicable:

- slow and controlled release fertilizers
- nitrification inhibitors
- incorporation or injection
- timing and number of applications

- soil nitrate and organic N testing
- coordinate nutrient applications with optimum crop nutrient uptake

One or more of the following nutrient use efficiency strategies or technologies may be utilized if applicable:

- Corn Stalk Nitrate Test (CSNT), Pre- Sidedress Nitrate Test (PSNT), and Pre- Plant Soil Nitrate Test (PPSN)
- tissue testing, chlorophyll meters, and spectral analysis technologies
- other land-grant university recommended technologies that improve nutrient use efficiency and minimize surface or groundwater resource concerns.

Additional Criteria Applicable to ProperlyUtilize Manure or Organic By-Products as aPlant Nutrient Source

Manure application(s) must meet all applicable state and federal regulations such as the Livestock Management Facilities Act (LMFA), Illinois Environmental Protection Act, and Federal Clean Water Act.

The total single application of liquid manure applied through an irrigation system:

- must not exceed the soil infiltration rate and water holding capacity
- be based on crop rooting depth

The total single application of injected liquid manure must be applied in such a manner as to avoid runoff or loss to subsurface tile drains.

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.

Manure will not be applied to the following areas:

- On slopes >15% unless incorporated or injected.
- Within ¼ mile of a residence other than the operator's unless injected or incorporated within 24 hours.
- Within 200 feet of surface water unless upgrade or there is adequate diking.
- Within 150 feet of potable water supply wells.
- Within 10-year flood plains unless injected or incorporation methods are used. Surface applied manure will be injected or surface applied and incorporated within 24 hours of application.
- Organic soils with a seasonal water table within 1 foot of the soil surface.
- Grassed waterways unless incidental to liquid manure applied through irrigation systems and:
  - there is no runoff from the irrigation and,
  - the distance to surface water is greater than 200 feet and,
  - the distance to potable water is greater than 150 feet and,
  - the distance to a non-potable well, abandoned or plugged well, drainage well, or injection well is greater than 100 feet and,
  - precipitation is not expected within 24 hours.

Manure may be surface applied to fields with permanent vegetation without injection or incorporation on slopes up to 15%. Manure may not be applied:

- Within 150 feet of potable water supplies.
- Organic soils with a seasonal water table within 1 foot of the soil surface.
- Within 15 feet of either side of the centerline of intermittent drainage way within the pasture unless incidental to liquid manure applied through irrigation systems.

- Within 35 feet of either side of a drainage ditch or open surface inlet to a tile drain or open sinkhole (karst).

Liquid manure may not be applied to fields or areas within fields where soil depth to fractured bedrock, sand or gravel is less than 24 inches.

Fields targeted for manure application after small grain or corn silage harvest that meet the high risk conditions outlined in the Nitrogen Management Guidelines will be planted to a double crop grain, annual forage, or cover crop.

For fields receiving manure, where phosphorus risk assessment results equate to **LOW** risk, additional phosphorus can be applied at rates greater than crop removal rate not to exceed the nitrogen requirement for the succeeding crop.

For fields receiving manure, where phosphorus risk assessment results equate to **MEDIUM** risk, additional phosphorus may be applied at a phosphorus crop removal rate for the planned crops in the rotation. When phosphorus risk assessment results equate to **HIGH** risk, additional phosphorus may be applied at phosphorus crop removal rates if the following requirements are met:

- a soil phosphorus drawdown strategy has been implemented, and
- a site assessment for nutrients and soil loss has been conducted to determine if mitigation practices are required to protect water quality.
- any deviation from these high risk requirements must have the approval of the Chief of the NRCS.

Manure may be applied on legumes at rates equal to the estimated removal of nitrogen in harvested plant biomass.

Manure may be applied at a rate equal to the recommended phosphorus application, or estimated phosphorus removal in harvested plant biomass for the crop rotation, or multiple years in the crop sequence at one time. When such applications are made, the application must not exceed the recommended nitrogen application rate during the year of application or harvest cycle, and no additional phosphorus must be applied in the current year and any additional years for which the single application of phosphorus is supplying nutrients.

Multiple year applications will not be applied on fields that exceed Bray P1 or Mehlich 3 median test values of 300 lbs. P/ac. No phosphorus will be applied to fields that exceed median test values 400 lbs. P/ac.

Application of organic by-products and biosolids must meet all state and federal regulations and strictly follow the conditions outlined in the appropriate NPDES permit and/or State Operating Permit as issued by the IEPA.

Fields receiving organic by products and/or biosolids must be monitored for the accumulation of heavy metals and phosphorus in accordance with applicable Federal and State law.

Additional Criteria to Protect Air Quality byReducing Odors, Nitrogen Emissions and theFormation 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
- nitrification inhibitors
- urease inhibitors
- nutrient enhancement technologies

- incorporation
- injection
- stabilized nitrogen fertilizers
- residue and tillage management
- no-till or strip-till
- other technologies that minimize the impact of these emissions

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.

Additional Criteria to Improve or Maintain thePhysical, Chemical, and Biological Conditionof the Soil to Enhance Soil Quality for CropProduction and Environmental Protection

Time the application of nutrients to avoid periods 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 no-till/strip-till in combination with cover crops to sequester nutrients, increase soil organic matter, increase aggregate stability, reduce compaction, improve infiltration, and enhance soil biological activity to improve nutrient use efficiency.

Use variable-rate nitrogen application based on expected crop yields, soil variability, soil nitrate or organic N supply levels, or chlorophyll concentration.

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.

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.

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

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

Forages grown on soils with excessive potassium levels can cause grass tetany in grazing animals.

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.

Extra caution must be taken when handling anhydrous ammonia or when dealing with manure stored in unventilated enclosures.

Considerations to Minimize AgriculturalNonpoint Source Pollution of Surface andGroundwater

Use conservation practices that slow runoff, reduce erosion, and increase infiltration, e.g., filter strip, contour farming, or contour buffer strips, and grassed waterways.

Consider obtaining soil tests more frequently than every 4 years on high soil P testing areas and/or in areas where soil P test are expected to increase.

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,
- drainage water management to reduce nutrient discharge through drainage systems, and
- incorporation of surface-applied manures or organic by-products if precipitation capable of producing runoff or erosion is forecast within the time of planned application.

Considerations to Protect Air Quality byReducing Nitrogen and/or ParticulateEmissions to the Atmosphere

Avoid surface applying manure and other by- products upwind of inhabited areas during times when public gatherings occur (i.e. weddings, churches, schools, etc…)

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

PLANS AND SPECIFICATIONS

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

- aerial site photograph(s)/imagery or site map(s), and a soil survey map of the site,
- soil information including: soil type surface texture, pH, drainage class, permeability, available water capacity, depth to water table, restrictive features, and flooding and/or ponding frequency,
- location of designated sensitive areas and the associated nutrient application restrictions and setbacks,
- results and recommendations derived from nitrogen, phosphorus risk assessment tools and RUSLE 2 calculations for erosion
- documentation establishing that the application site presents low risk for phosphorus transport to local water when phosphorus is applied in excess of crop requirement.
- current and/or planned crop rotation and associated yield levels,
- soil, water, compost, manure, organic by- product, and plant tissue sample analyses applicable to the plan,
- description of the proposed phosphorus draw-down strategy where applicable,
- complete nutrient budget for nitrogen, phosphorus, and potassium for the crop rotation,
- listing of nutrient sources, forms, rates, and timing of application including enhanced efficiency fertilizer products.
- guidance 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 methods and/or equations used to convert the GIS base data layer(s) or to a nutrient source material recommendation.
- 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.

If increases in soil phosphorus levels are expected (i.e., when N-based rates are used), the nutrient management plan must document:

- the median soil phosphorus levels at which it is desirable to convert to phosphorus based planning,
- the potential plan for median soil test phosphorus drawdown from the production and harvesting of

crops, and

- management activities or techniques used to reduce the potential for phosphorus transport and loss,
- for AFOs, a quantification of manure produced in excess of crop nutrient requirements, and
- a long-term strategy and proposed implementation timeline for reducing median soil P to levels that protect water quality.

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.

Significant changes in animal numbers, management, and feed management will necessitate additional manure analyses to establish a revised average nutrient content.

Calibrate application equipment to ensure accurate distribution of material at planned rates.

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, 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, source of nutrients, and rates of application,
- weather conditions and soil moisture(dry, moist, wet, or saturated) 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, and crop residues removed,
- dates of plan review, name of reviewer, and recommended changes resulting from the review, and
- all enhanced efficiency fertilizer products used.

Additional records for precision/variable rate sites must 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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