

**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.

- commercial fertilizer,
- crop rotation,
- soil nutrient availability,
- and irrigation water.

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.

Land receiving nutrients shall be evaluated for environmentally sensitive areas such as, but not limited to:

- perennial water bodies,
- areas of concentrated flow,
- surface inlets,
- Karst topography,
- wellhead protection areas,
- flood plain,
- coarse textured soils.

Soil and Tissue Sampling and Laboratory Analyses (Testing)

At a minimum, obtain soil test analyses for phosphorus, potassium, and pH. All soil samples shall be collected according to Iowa State University (ISU) for sampling methods based on soil maps, management zones, or grid sampling. See ISU PM 287 "Take a Good Sample to Help Make Good Decisions." The minimum frequency for soil testing shall be once during a four-year period for continuous row crop or once during the cycle of other crop rotations that consists of close grown crops such as grasses and legumes. The sampling frequency can be less frequent for organic matter, however no greater than every 12 years.

Use of the Late Spring Nitrate Test and Fall Corn Stalk Test is encouraged in determining rates of nitrogen and/or evaluating the nitrogen management program. See ISU publications PM-1714 "Nitrogen Fertilizer

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 management plan for nitrogen, phosphorus, and potassium shall be developed that considers all potential sources of nutrients including, but not limited to:

- legume credits,
- animal manure and organic by-products,
- waste water,

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service [State Office](#) or visit the [electronic Field Office Technical Guide](#).

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Recommendations for Corn in Iowa” and PM 1584 “Corn Stalk Test to Determine Nitrogen”.

All soil tests shall be analyzed by a soil test lab that is certified according to Iowa Department of Agriculture and Land Stewardship (IDALS) soil test lab certification standards. See ISU-Extension publication, PM-1310 (rev) "Interpretation of Soil Test Results. and PM-1688 “A General Guide for Crop Nutrient and Limestone Recommendations in Iowa.”

Nutrient Application Rates

Nutrient application includes form, source, amount, timing and method of application on each field. Plant nutrients may be applied as broadcast, starter, surface band other than starter, or injected band applications. Nutrients shall be applied to achieve realistic production goals, while minimizing nitrogen and/or phosphorus movement to surface and/or ground waters.

All commercial nutrient applications shall be based on ISU recommendations for the soil type and crop to be grown. Use the most recent publications. See ISU-Extension Publications PM1714 “Nitrogen Fertilizer Recommendations for Corn in Iowa”, PM-1688 “General Guide for Crop Nutrient Recommendations in Iowa”, and PM 869 “Fertilizing Pasture”. Unless specific nutrient content for animal manure has been obtained through sample analysis, the nutrient value of animal manures will be estimated using the Agricultural Waste Management Field Handbook (AWMFH), Chapter 4.

All nutrient applications shall be based on realistic yield potential for the field. Guidance for estimating realistic yield potentials is outlined in ISU-Extension Publication PM-1268 (rev) "Establishing Realistic Yields." Realistic yield potentials can be established based on soil productivity information, historical yield data, climatic conditions, level of management and/or local research on similar soils, cropping systems, and soil and manure/organic by-products tests. For new crops or varieties, industry yield recommendations may be used until documented yield information is available.

Phosphorus and Potassium.

All nutrient values for phosphorus and potassium should be expressed in pounds of P_2O_5 and K_2O .

Phosphorus and potassium application for crop and forage production (including non-crop areas) shall be based on soil test results. Phosphorus and potassium additions shall not exceed crop removal rates when soil test levels are optimum or above unless specified under “Additional Criteria Applicable to Manure and Organic By-Products or Biosolids Applied as a Plant Nutrient Source”.

Commercial Nitrogen:

The amount of nitrate-nitrogen that moves below the crop root zone is directly related to nitrogen application rate. Therefore, over-application in an attempt to produce unrealistic yields or offset anticipated losses shall be avoided.

No fall application of commercial nitrogen shall be made with the following exceptions:

- Anhydrous ammonia if: (1) mid-day soil temperatures, at 4”soil depth, is not greater than 50°F and trending lower; (2) soil moisture conditions are conducive to proper application and sealing and (3) soil texture conditions favor the retention of applied nitrogen.
- Application of nitrogen associated with products that contain phosphorus and/or potassium.
- Nitrogen associated with the production of winter grains.

For more information consult Iowa State University website on nitrogen management. <http://extension.agron.iastate.edu/soilfertility/nutrienttopics/nutrienttopics.html>

Where the Late Spring Nitrate Test is not applicable, use the general recommendations for nitrogen found in Iowa State Publications ISU PM-1714 “Nitrogen Fertilizer Recommendations for Corn in Iowa”, ISU PM-869 “Fertilizing Pasture”, ISU PM-1584 “Cornstalk Testing to Evaluate Nitrogen Management”.

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All nutrient additions shall be adjusted for contributions from legumes, manure or other organic nutrient sources.

Legume contributions are shown in ISU Publication PM-1714 "Nitrogen Fertilizer Recommendations for Corn in Iowa".

Soil pH shall be maintained at levels shown in ISU Publication PM-1688 "General Guide for Crop Nutrient Recommendations in Iowa". All recommendations are based on Effective Calcium Carbonate Equivalent (ECCE).

For soil tests requiring less than 2000 pounds per acre ECCE, the lime requirement may be waived.

Application equipment for fertilizers and manure shall be calibrated at least annually to determine actual applied rates. After calibration, adjustments can be made in the application process to meet the planned or intended rates.

All specifications will be consistent with federal, state, and local regulations.

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, weather and climatic conditions, risk assessment tools, (e.g., P-index) manure storage capacity 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).
- 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.

- Nutrient applications associated with irrigation systems shall be applied in a manner that prevents or minimizes resource impairment.

Nutrients and organic nutrient sources shall not be surface applied to frozen, snow covered ground, or saturated soil if a potential risk for runoff exists. A potential risk for runoff exists on slopes greater than 5% unless erosion is controlled to soil loss tolerance levels ("T") or less. Manure may be surface applied to frozen, snow covered or saturated ground if a potential risk for runoff exists only under one of the following conditions.

- Where manure storage capacity is insufficient and failure to surface apply creates a risk of an uncontrolled release of manure.
- On an emergency basis.

Manure surface applied to frozen, snow covered, or saturated ground shall be based on a manure disposal plan. That plan shall include:

- Under what circumstances the manure may be applied to frozen, snow covered, or saturated ground. (Ex: storage capacity exceeded).
- Rates of application.
- Area of application.
- Other requirements such as runoff control as indicated through the use of the Iowa Phosphorus Index assessment tool

Conservation Management Unit (CMU) Risk Assessment

In areas with identified or designated nutrient related water quality impairment, a CMU (which is defined as a portion of a field, field, group of fields, or other land units of the same land use and having similar treatment needs and management plans) shall be assessed for the potential phosphorus transport risk from the area. See Agronomy Technical Note 25,

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Iowa Phosphorus Index.

Any one of the following threshold factors will trigger CMU risk assessment:

- The CMU is located in a watershed directly draining into waters identified in the Iowa Department of Natural Resources (DNR) Iowa Integrated Report as impacted by phosphorus. <http://wqm.igsb.uiowa.edu/wqa/303d.html>
- Manure or organic by-products are applied
- Soil loss exceeds the tolerable level
- The average soil test phosphorus level in the very high range as shown in ISU Publication PM-1688 "General Guide for Crop Nutrient Recommendation in Iowa".

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

When animal manures or organic by-products are applied, the Iowa Phosphorus Index will be used as the risk assessment tool to evaluate the potential for phosphorus transport from the CMU and to adjust the amount, placement, form and timing of application of phosphorus sources.

Manure shall be analyzed for nutrient content of total nitrogen, phosphorus and potassium, percent moisture, and or percent solids. This analysis shall be done at least annually for each different source of manure being generated at the animal feeding operation. Methods for sampling manure are discussed in ISU Publication PM-1558 "How to Sample Manure for Nutrient Analysis".

In planning for new animal feeding operations, acceptable "book values" for the nutrient content and volume of manure that are recognized by the NRCS may be used for the proposed animal feeding operation (NRCS Agricultural Waste Management Field Handbook, Chapter 4). In the alternative, nutrient content and volumes for proposed animal feeding operations may be based on historic nutrient content and volumes from

existing animal feeding operations utilizing similar design and management as the proposed animal feeding operation.

For additional information on manure and other organic nutrient management refer to Standard and Specification Waste Utilization (633) and the Agricultural Waste Management Field Handbook.

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.

Manure and Organic By-Product Nutrient Application Rates

Planned application rates of nitrogen and phosphorus shall be determined based on the following guidance:

A. Nitrogen Application.

When determining allowable nutrient application rates from manure or other organic sources, nitrogen may be applied based on crop nitrogen needs for that crop year. This may allow application of more phosphorus and potassium than required by the crop. This practice may continue as long as the risk of phosphorus moving to surface waters based on the Iowa Phosphorus Index is very low, low or medium.

When the plan is being implemented on a phosphorus standard, manure or other organic by-products shall be applied at rates consistent with the phosphorus standard. In such situations, an additional nitrogen application from nonorganic sources may be required to supply the recommended amounts of nitrogen.

Manure or other organic by-products may be applied on legumes at rates equal to the estimated removal of nitrogen in the harvested portion of the crop that is removed from the field in that growing season.

B. Phosphorus Application.

When manure or other organic by-products are used, the planned rates of phosphorus

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application shall be determined with reference to the Iowa Phosphorus Index (Agronomy Technical Notice 25). The Iowa Phosphorus Index (Iowa PI) assesses the potential for phosphorus movement from a field to surface water, and designates fields as very low risk, low risk, medium risk, high risk, and very high risk. Conservation practices and/or phosphorus management practices can be adopted that reduce the risk of phosphorus movement and may reduce the risk rating on the field. See Agronomy Technical Notice 25, Iowa Phosphorus Index.

- If a field is rated very low risk, low risk, or medium risk by the Iowa PI, the application of manure or organic by-products may be made based on the nitrogen needs of the crop as set forth in subpart A above.
- If a field is rated in the medium risk category, planned conservation and phosphorus management practices should not increase the rating of the field above the medium risk category.
- If a field is rated high risk or very high risk by the Iowa PI; Manure or organic by-products may be applied to meet the needs of the planned crop rotation for phosphorus removal **if conservation practices and/or phosphorus management practices are adopted to reduce the risk of phosphorus movement.**

Nitrogen application limits of Subpart A above should not be exceeded.

C. Sensitive Areas.

Manure and other organic nutrient sources shall not be applied to the following areas unless injected or incorporated within 24 hours:

- Within 200 feet of sinkholes, drainage wells, or other direct conduits to the groundwater.
- Within 200 feet of lakes, ponds, or other perennial water bodies.

- During the peak flood periods (April, May, June, July) on land that floods more than once every 10 years.

Heavy Metal Monitoring

When sewage sludge or biosolids are applied, the application of potential heavy metal pollutants (including arsenic, cadmium, copper, lead, mercury, selenium, and zinc) in the soil shall be in accordance with the Iowa Administrative Code (IAC) IA567—67 and IAC567--121.

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.

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

CONSIDERATIONS

Considerations are items to be considered during the planning process, however, are not a required component of the nutrient management plan.

The use of management activities and technologies listed in this section may improve both the production and environmental performance of nutrient management systems.

The addition of these management activities, when applicable, increases the management intensity of the system and is recommended in a nutrient management system.

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

Animal feeding operations requiring removal of manure more frequently than annually should consider taking samples more frequently (i.e. seasonally or after material changes to feed rations or other operational aspects of the animal feeding operation that may impact the nutrient content of the manure) .

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).

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.

Soil 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.

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.

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 and/or recycle residual nitrogen.

Apply nutrient materials uniformly to the

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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.
- On soils with high permeability (greater than 2 inches per hour through the 5 foot profile), apply nitrogen using split spring preplant/sidedress, at planting/sidedress or sidedress applications to provide distribution of nutrients at a time when plants will utilize the nutrients.
- Limit the application rate of liquid materials applied to not exceed the soil infiltration rate, to minimize ponding, to avoid runoff, and to minimize loss to subsurface tile drains.
- When applying manure to legume crops, limit the crop available nitrogen application to 125 pounds of nitrogen per acre.

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

In areas with an identified or designated nutrient management related air quality concern, 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 should 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) should 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) should be managed to minimize volatilization losses.

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

Operators should 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) should be recorded and maintained in accordance with the operation and maintenance section of this standard.

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

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). Nitrogen volatilization from manure in a surface irrigation system should 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 N₂O, carbon dioxide CO₂).

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

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 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.

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

- aerial site photograph(s) or site map(s), and a soil survey map of the site,
- location of designated sensitive areas or resources and the associated, nutrient management restriction,
- current and/or planned plant production sequence or crop rotation,
- results of soil, water, manure and/or organic by-product sample analyses,
- results of plant tissue analyses, when used for nutrient management,
- realistic yield goals for the crops,
- complete nutrient budget for nitrogen, phosphorus, and potassium for the crop rotation or sequence,
- listing and quantification of all nutrient sources,
- CMU specific recommended nutrient

application rates, timing, form, and method of application and incorporation, and

- guidance for implementation, operation, maintenance, and recordkeeping.

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 general soil moisture (e.g. wet, damp, dry) 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,
 - 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

These publications are available at County Extension Offices; Extension Distribution Center, Printing Building, Iowa State University, Ames, IA 50011; and several are available on the ISU Publications Home page at

<http://www.extension.iastate.edu/Pages/pubs/>.

- ISU PM-1310 "Interpretation of Soil Test Results"
- ISU PM-287 "Take a Good Sample to Help Make Good Decisions"
- ISU PM-1714 "Nitrogen Fertilizer Recommendations for Corn in Iowa"
- ISU PM-2015 "Concepts and Rationale for Regional Nitrogen Rate Guidelines for Corn"
- ISU PM-1688 "General Guide for Crop Nutrient Recommendations in Iowa"
- ISU PM-869 "Fertilizing Pasture"
- ISUPM-1268(rev) "Establishing Realistic Yields"
- ISU PM-1584 "Cornstalk Testing to Evaluate Nitrogen Management"
- ISU PM-1436 "Nitrogen Fertilizer Management for Northeast Iowa"
- ISU PM-569 "Warm-Season Grasses for hay and Pasture"
- ISU PM-1558 "How to Sample Manure for Nutrient Analysis"
- ISU PM-1941 "Calibration and Uniformity of Solid Manure Spreaders"
- ISU PM-1948 "Calibrating Liquid Tank Manure Applicators"

The following publication is available on the NRCS Fort Worth Home page at <http://www.ftw.nrcs.usda.gov/awmfh.html>

- Agricultural Waste Management Field Handbook

The following Standard on Manure Production and Characteristics is available from the American Society of Agricultural and Biological Engineers.

<http://asae.frymulti.com/standards.asp>

- ASABE D384.2 MAR2005

The following publications are available at the Iowa Conservation Partners Home page at: <http://www.ia.nrcs.usda.gov>.

- Iowa Technical Note 25, Iowa Phosphorus Index
- Background and Basic Concepts of the Phosphorus Index
- Phosphorus Index Calculator (Excel Spreadsheet)
- Waste Utilization Standard (633)