

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
Nutrient Management
(Acre)
Code 590

DEFINITION

Managing the amount, form, placement, and timing of applications of nutrient fertilizer.

PURPOSE

- ❖ To supply plant nutrients in amounts dictated by soil test, or tissue analysis, or accepted recommendations based on realistic yield expectations or plant performance for an intended use
- ❖ To minimize excessive nutrient application while meeting a plant's performance based requirement for a particular nutrient
- ❖ To minimize nutrient loss to surface and ground water.

CONDITIONS WHERE PRACTICE APPLIES

On lands where nutrients are applied. This standard applies to management of nutrients associated with organic waste, commercial fertilizer, legume crops, and crop residues.

CRITERIA

1. Fertilizer source, time, and method of application shall be planned to conform to seasonal variation in plant uptake needs and soil profile properties to optimize economic return and minimize nutrient loss by leaching or surface transport. Nitrogen or phosphorous are the most critical nutrients in planning for water quality.
2. Soil pH affects the availability of nutrients. Use soil tests to adjust soil pH to the level best suited for the crops being grown. University crop production guides and the North Carolina Agricultural Chemicals

Manual can also be consulted to find this value.

3. Soil shall be tested every two years. As deficiency of any of the 16 essential elements will limit uptake and utilization of other more environmentally active nutrients. Soil testing identifies these yield limiting deficiencies as well as identifying imbalances, excesses and levels potentially toxic to plants.
4. Zinc and Copper levels in the soils shall be monitored and alternative crop sites shall be used when these metals approach excess levels. Refer to Table 2 in Standard 633 for threshold levels of these nutrients.
5. All sources and forms of plant nutrients including carryover from legumes and animal waste being made available for plant growth and production shall be considered in developing a nutrient management plan.
6. All animal waste products shall be analyzed by the agronomic division of North Carolina Department of Agriculture (NCDA) or other acceptable laboratories and the recommendations used to develop and implement a nutrient management program. Waste shall be tested within 60 days of utilization. Unless otherwise required nitrogen shall be the rate-determining nutrient.
7. Establish a Realistic Yield Expectation (R.Y.E.) for any crop to be fertilized. This is accomplished by determining the mean of the best three yields of the last five consecutive crop harvests. If this information is not available, R.Y.E. can be established from specially developed soil interpretation records for Nutrient

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To obtain the current version of this standard, contact the Natural Resources Conservation Service.

management planning, Farm Service Agency records, university trials, or inference from crop performance on soil with very similar physical and chemical features.

8. Application rates for nitrogen shall not exceed the amount determined by the R.Y.E. concept. Application rates for all other nutrients shall not exceed the amount recommended in a soil test report or any approved source of this information for any nutrient targeted as a planning priority. There are situations where a soil test report would not make a recommendation (based on economic return, i.e., a soil test index of 51), but an environmental problem would not result until the index reached 200. Where animal waste is involved, this situation may be common. Even where additional response is not expected, it should be feasible to add amounts which will be removed in the harvested crop without significant degradation of the environment.
9. Choose a fertilization rate within recommended ranges that considers local water quality needs.
10. All nitrogen rates for hay production are for pure grass stands. Reduce all hay crop nitrogen rates by 25 percent when grazing. For each ton of hay harvested from a pasture system the nitrogen application rate may be returned to the R.Y.E. application rate for hay.
11. Important considerations for nutrient application include amount, source, placement, and timing. Plant nutrients may be applied as broadcast, starter, surface band or injected band applications. Any one method may have its advantages under a given set of plant nutrient demands, soil characteristics, and fertilizer source.
12. Section I-B of the Technical Guide, leaching index maps, demonstrates the comparative leaching potential of soils of North Carolina. These examples provide the guidelines for assessing nitrate (NO_3) leaching risk and recommended management programs. Use Section I-B of the Technical Guide, leaching index maps, along with soils information for the field, to identify the potential for nitrogen loss.
 - a. The rate of nitrification in North Carolina soils is extremely rapid, the leaching of NH_4 is likely, the availability of anhydrous is on the decline, and the cost of pure nitrate sources very high. Where high leaching rates exist, and where appropriate for the crop in question, nitrogen use efficiency and environmental safety can be enhanced by using split applications.
 - b. On soils of intermediate leaching potential, split and side dress nitrogen applications are highly recommended for best efficiency.
 - c. For soils with a leaching index (LI) of 2 or less, there is little concern for nitrate leaching losses.
 - d. Erosion control and water management practices shall be included to minimize soil loss transport and runoff which may carry attached and dissolved nutrients to surface waters. This is of particular importance where soils contain high levels of phosphorous. Incorporating nutrients into the soil generally reduces the chance of loss in runoff in the dissolved form.
13. Nutrients for a spring-planted crop shall not be applied in fall or winter. Nutrients shall not be applied more than 30 days prior to planting of the crop or forages breaking dormancy.
14. Equipment shall be calibrated to apply recommended rates on the field. Special precautions must be taken to avoid well contamination when using fertigation.

The crops shown in Table 1 are the typical recommended crops for waste utilization but is not an inclusive list. Waste may be applied to other crops based on the nitrogen recommendation for R.Y.E. as shown in NC Cooperative Extension Service Crop Production Guides, the NRCS Agriculture Waste Management Field Guide or the NC Agriculture Chemicals Manual.

Table 1. Nitrogen (N) Fertilization Rates by Crop Yield

A range is shown for N fertilization rates because N uptake is dependent on the available water holding capacity (AWHC) of the soil. AWHC is primarily determined by the soil's texture, percent organic matter and rooting depth. Make your selection from the chart based upon the soil's texture, inherent ability to produce, the occurrence of necessary conservation practices to protect the resource base, and the landuser's historical crop production.

<u>Crop</u>	<u>Nitrogen Recommendation</u>
Wheat ²	1.7 - 2.4 lbs. N/bu.
Barley ²	1.4 - 1.6 lbs. N/bu.
Oats ²	1.0 - 1.3 lbs. N/bu.
Rye ²	1.7 - 2.4 lbs. N/bu.
Triticale ²	1.4 - 1.6 lbs. N/bu.
Corn-grain	1.0 - 1.25 lbs. N/bu.
Corn-silage	10 - 12 lbs. N/ton
Sorghum-grain	2.0 - 2.5 lbs. N/cwt.
Soybeans ¹	3.5 - 4 lbs. N/bu.
Cotton ²	0.06 - 0.12 lb. N/lb. lint
Tobacco-Burley - See current year Burley Tobacco Information Guide available from North Carolina Cooperative Extension Service.	
Tobacco - Flue-cured - See current year Tobacco Information Guide available from the North Carolina Cooperative Extension Service.	
Sorghum-Sudangrass	45 - 55 lbs. N/ton hay
Sudan grass	45 - 55 lbs. N/ton hay
Pearl Millet	45 - 55 lbs. N/ton hay
Bermudagrass (all areas of state) ²	40 - 50 lbs. N/ton hay
Tall fescue	40 - 50 lbs. N/ton hay
Orchardgrass	40 - 50 lbs. N/ton hay
Timothy	40 - 50 lbs. N/ton hay
Crabgrass	40 - 50 lbs. N/ton hay
Eastern Gamagrass	40 - 50 lbs. N/ton hay
Rescuegrass	40 - 50 lbs. N/ton hay
Small grain	50 - 60 lbs. N/ton hay
Switchgrass ³	See footnote ³
Pine Trees	40 - 60 lbs. ac/yr
Hardwood Trees	70-100 lbs. ac/yr

NOTE: Reduce all hay crop nitrogen rates by 25 percent when grazing. For each ton of hay harvested from a pasture system the nitrogen application may be returned to the RYE (N) application rate for hay.

¹ When waste is to be applied to soybeans, it should be accomplished at preplant or planting. The crops entire nitrogen needs should be met with this application

² N rates in excess of 120 pounds per acre are seldom justified for wheat, barley, oat, rye, triticale, and cotton. Do not apply more than 100 pounds of N when overseeding small grain or Ryegrass into Bermudagrass.

³ The total Nitrogen application shall not exceed 120 lbs. Per acre per year.

CONSIDERATIONS

1. This practice can reduce the likelihood that applied nutrients would pollute surface or ground water by limiting the amount applied to only that needed. Evaluate the vulnerability of environmentally sensitive areas and waters that have been stressed by the presence of an over abundance of plant nutrients.
2. Good tilth enhances water infiltration, thus reducing nutrient removal through soil erosion. Also adequate soil water is necessary for efficient nutrient use. Conservation practices that manage plant residues should be considered, i.e.:
 - ❖ Residue Management, No-till (329)
 - ❖ Residue Management, Seasonal (344)
 - ❖ Cover and Green Manure Crop (340)
 - ❖ Critical Area Planting (342)
 - ❖ Stripcropping (585 and 586)
3. Cover crops can be used as scavengers to take up excess plant nutrients applied in the previous season to prevent their movement out of the root zone. Very little of the scavenged nutrients are available to the following crop, (usually <15% of the N taken up). They should be harvested for maximum benefit.
4. Organic wastes can provide an important source of nutrients. State and local regulations, the NRCS Agriculture Waste Management Field Handbook, North Carolina Cooperative Extension Service (NCCES) Crop Production Guides, North Carolina State University (NCSU) Agricultural Chemical Manual, soil test and waste analysis reports will provide guidance concerning waste utilization.
5. Sources of plant nutrients may include residual amounts in the soil, crop residues including legumes, waste products, and commercial fertilizer. Commercial fertilizers are those products with a guaranteed analysis under North Carolina law.
6. Forage plants being used for nitrogen uptake should be selected based on their adaptation to the soil. Plants not adapted to a site will have a short life and maintaining a vigorous stand will be difficult.
7. Plant tissue samples should be taken to evaluate nutrient status and to support the need for additional nutrient applications.
8. Excessive concentrations of one or more nutrients may induce deficiencies. Soil pH should be maintained in the optimum range for each crop to improve availability of soil and applied nutrients and to minimize the release of potentially toxic elements.
9. C Factors from RUSLE can be more effective in controlling water runoff than LS and P Factors. C Factors effect root distribution, soil temperature and a host of other variables. Numerically low C Factors buffer yields from climatic variations most likely by improving moisture status in the soil. The same C Factors can increase the likelihood of leaching losses. Consider the environmental impact from increased leaching.
10. Consider waste storage and treatment needs to meet application timing as well as land area requirements for proper waste utilization.
11. Water table management through controlled drainage reduces the movement of nutrients by reducing total outflow from a managed area and it also promotes denitrification.

12. Riparian buffers are very effective in trapping subsurface nitrate entering a stream and even sediment, but much less effective in trapping runoff of soluble phosphorus. Filter strips and grassed waterways have little N retention capacity. Grassed waterways do little to reduce nutrients and sediments lost from fields. Based on the most likely pollutant sources for a site, consider specific practices which are most likely to reduce offsite movement of those pollutants.
13. Loss of nitrogen from the soil is dependent upon climate, soil, and fertilizer application program. Normally, with adequate soil moisture, nitrogen loss potential can be reduced by applying nitrogen fertilizer close to the time of greatest crop demand. Split applications may be needed to accomplish this. Ammonium forms are taken up by plants in significant amounts as nitrate within days after application for most crops.

PLANS AND SPECIFICATIONS

1. Establish realistic yield goals based on soil map units and the Soil Interpretation Records, or historical yield data, or compute by crop and soil combination the mean yield of the three highest yields of the last five consecutive crops.
2. Develop a nutrient management plan for the crops to be grown. Account for the residual amount of nutrients in the soil and crop residue, including legumes add estimated nutrients from anticipated organic waste applications, and then determine the amount of fertilizer needed to meet the nutrient needs of the proposed crop and target yield. Specify the crop, crop rotation, and kind, source, application time and amount of plant nutrients that will be used to meet the crop fertility needs. Identify the priority nutrient or nutrients.
3. If non-farm organic waste is to be used, it shall be analyzed for content and applied as prescribed by federal, state, or local

regulations. Appropriate documentation of amounts applied should be maintained.

4. Frequency of soil test, waste analysis, and plant tissue test shall be specified and conform with this standard.
5. Credit for nitrogen contributions from legume crops in rotation shall be consistent with land grant university recommendations.
6. Use the "Leaching Index for Soluble Nutrients" procedure or other detailed guidelines from land grant universities to evaluate groundwater pollution potential in conjunction with the water budget for the location.
7. All specifications will be consistent with state and local regulations.
8. A nutrient budget will be developed that shows sources (soil residual, crop residues, organic waste, chemical fertilizer, and legume crops) and required amount(s) of nutrient(s) for the crop to be grown. Use the Nutrient Budget Worksheet (Exhibit 590-1 & 2) to document recommendations. Indicate the priority planning nutrient(s) on the worksheet. The worksheet shall show the form of fertilizer to be used and the application rates and method shall be specified.
9. Nutrient application rates other than nitrogen on agricultural land shall be based on soil test and waste analysis, consistent with the NCDA or NCSU recommendations.
10. Nitrogen rates should be based on realistic crop yield expectations and shall consider all sources of nutrients that may be available as outlined in the attached nutrient budget worksheet.
11. The following items should be included. Those items marked with an asterisk shall be recorded as minimum documentation requirements.
 - * a. Location
 - * b. Extent in acres
 - * c. Nutrient budget sheet
 - * d. Source of nutrients

- * e. Nutrient timing and placement
- * f. Soil erosion control
- g. Equipment operation and maintenance
- h. Safety
- * i. Receiving water body (DENR-DWQ Stream Classification Index Number or other identifying nomenclature).
- j. When animal waste is utilized as a nutrient source adhere to plans and specifications in Standard 633.

OPERATION AND MAINTENANCE

1. Special precautions must be taken to avoid well contamination when using fertigation.
2. Equipment should be cleaned after nutrient application. Waste water resulting from flushing application equipment should be kept away from wells, streams, ponds, lakes, or other water bodies and out of high runoff areas. Follow all state and local regulations concerning storage of materials and disposal of product containers.
3. Avoid unnecessary exposure to hazardous chemical fertilizer and organic wastes. Protective clothing, including goggles, a

respirator, gloves and footwear should be worn when handling potentially dangerous materials.

4. Dispose of product containers in accordance with local and/or state regulations. Follow all local, state, and federal regulations regarding the transport of fertilizers. In case of an accidental fertilizer spill, call 911. The dispatcher will notify the County Emergency Management Coordinator who will notify the State Emergency Management Coordinator.
5. Refer to Standard 633 for operation and maintenance of an approved animal waste utilization plan.

REFERENCES

Soil Facts, Nutrient Content of Fertilizers and Organic Materials. The North Carolina Cooperative Extension Service, 6/91.

Soil Facts, Nutrient Removal by Crops in North Carolina, The North Carolina Cooperative Extension Service, 3/91.

NUTRIENT BUDGET WORKSHEET

Field number: _____ Tract #: _____ Acres: _____

Prepared by: _____ County: _____

Dominant soil type: _____ Soil Loss: _____ Leaching potential: _____ $\frac{1}{/}$

Soil Loss Tolerance: _____

Previous crop: _____ Yield: _____ Realistic yield goal: _____

Planned crop: _____

Crop Needs

Circle Priority Nutrient(s)	N (P-I x 4.896 = lbs P₂O₅)	P ₂ O ₅	K ₂ O (K-I x 4.176 = lbs K₂O)	
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Soil test levels in lbs per acre

Nutrients required for yield goal/ac

1. Soil Test Recommendations
from NCDA report or

2. Recommendation from NCSU
Crop Production Guide or NC
Agr. Chemical Manual

A

B

Nutrient Credits

Legume credit ^{4/}	_____	n/a	n/a	C
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Animal and organic waste ^{3/}

Rate _____ Type ^{2/} _____

D

Total Credits

E

Nutrient Balance

Nutrient needs (or surplus) for crop yield

F = A or B – E

F

Animal Waste

Animal waste-nutrient content _____

(kind) ^{3/} lbs per ton or lbs per 1000 gal

_____ (Method of Application)

Additional Documentation During Planning
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Source of additional nutrients needed _____

Time of nutrient application _____

Water Quality Classifying Organization _____

Water Quality Classification _____

NOTES

Refer to Waste Utilization Standard (633) or Section X in North Carolina Agricultural Chemical Manual for livestock manure production rates and nutrient content for broadcasted or incorporated. If available, use waste analysis report from NCDA.

When the LI is medium or high you should consider alternatives that will reduce the potential for leaching of soluble nutrients, consider timing of fertilizer application, split applications, and alternative crops that require less nutrients.

^{1/} Leaching Potential (High, Medium, Low) - Can be found in Section I-B of the Field Office Technical Guide.

^{2/} Type of Waste - Broiler litter, Hog Lagoon, Dairy Slurry, etc.

^{3/} Not all nutrients from previously applied animal wastes are used each growing season. For a great part mineralization rates depend on soil properties and climate. Remaining nutrients from prior applications of animal wastes can be determined from chapter 11, table 11-6 in the Natural Resources Conservation Service's Agricultural Waste Management Field Manual.

^{4/} Nitrogen from legume cover crops such as hairy vetch or legume crops such as soybeans or peanuts grown the previous year. Make a choice from the range offered considering the vigor or the legume crop, elapsed time from harvest or burndown, and the leaching potential of the residual nitrogen based on the season and soil characteristics.

Cover Crops

Hairy Vetch	80-100 lbs/acre
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Crimson Clover	60-75 lbs/acre
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Previous Year's Crop

Soybeans	15-30 lbs/acre
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Peanuts	20-40 lbs/acre
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Clover or Alfalfa Sod	80-100 lbs/acre
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