Best Management Practices for Nutrient Management of Turf in New Jersey

Bulletin E327

Cooperative Extension

James A. Murphy, Ph.D., Extension Specialist in Turfgrass Management,
Stephanie L. Murphy, Ph.D., Director, Rutgers Soil Testing Laboratory

Nutrients are often needed to improve the quality and productivity of many soils for the growth and maintenance of landscape plantings, including turf. However, the inappropriate use of some nutrients, primarily phosphorus (P) and nitrogen (N), can contribute to eutrophication, a reduction in the quality of surface water bodies. Nitrogen can also be found as contaminate of groundwater.

Best management practices (BMPs) for nutrient management in turf refer to all effective and practical methods that assure efficient utilization of nutrients and prevent or reduce the movement of sediment and nutrients (and possibly other pollutants) from the land to surface water bodies or ground water. BMPs are based upon the specific needs of a site and are used to advise and educate land owners and managers. This publication provides a concise yet broad overview of all practices (BMPs) that will result in an effective and environmentally sensitive use of nutrients within urban and suburban landscapes. More details on these practices can be found in other Rutgers Cooperative Extension publications at *www.njaes.rutgers.edu/pubs/*.

This overview of BMPs regarding nutrient management in turfgrass systems is recommended by Rutgers Cooperative Extension for turf managers, consultants, property owners, and policy makers. Additionally, these BMPs are useful guidelines for developing new and reviewing existing turf management programs.

Turfgrass Species Selection

- Choose or recommend the best-suited turf species/varieties based on the best available technologies (i.e., new or improved cultivars/varieties; see *www.ntep.org* and *www.njaes.rutgers.edu/pubs/subcategory.asp?cat=5&sub=35*)
- Choose or recommend adapted turf species/varieties that have minimal nutrient needs, reduced maintenance requirements, and tolerance to important pests and drought conditions.
- Tall fescues and fine fescues are known for lower nitrogen needs compared to Kentucky bluegrass and perennial ryegrass. Many turf areas in NJ are well suited for these species. Tall fescue and fine fescues should be considered when establishing new turfs or renovating older turfs.

Planting Practices During Establishment to Prevent Nutrient Loss in Sediment by Erosion

- During the grow-in period, stabilize soil with weed-free straw, spray tack, hydromulch, mulch pellets, fiber blankets, sod, etc.
- Develop and implement strategies to stabilize soil and control sediment runoff from areas of disturbed soils.
- Design active areas to minimize disruption of natural waterways and native sites.
- Irrigate seeded soil lightly and frequently to prevent runoff and soil erosion.
- Ensure compliance with state stormwater management rules (N.J.A.C. 7:8 et seq.) and standards for soil erosion and sediment control (N.J.A.C. 2:90-1.1 et seq.) and local ordinances.
- The greatest nitrogen and phosphorus losses to surface and ground water occur during the establishment period, usually until the ground is completely covered with turf or if sodded until the sod is rooted. Unless starter fertilizer (P & K) will be tilled into the soil, wait until there is germination or sod has rooted before applying a starter fertilizer and then apply only a small amount (about ½ pound of nitrogen or phosphorus per 1,000 square feet of turf). Generally, this will not be enough nutrition to fully establish the turf; so continue to make applications at this rate of nitrogen and phosphorus every two to four weeks as the new turf covers the ground or transplanted sod becomes rooted.

Nutrient Management Practices to Prevent Unwarranted or Over-Application of Nutrients

- Apply smaller amounts of nutrients more often, as opposed to large amounts only a few times per year (this is particularly important for water-soluble nutrients). Smaller amounts of nutrients would be represented by nutrient values of ½ pound per 1000 square feet and less; whereas, large amounts would be represented by values of more than ¾ pound.

RUTGERS
New Jersey Agricultural Experiment Station

Rutgers, The State University of New Jersey
88 Lipman Drive, New Brunswick, NJ 08901-8525
Phone: 732.932.5000

- Because a reliable test for nitrogen needs in turf is not available, recommendations for nitrogen fertilization are based on the specific conditions of an individual site (see table); reduced (½) rates of nitrogen fertilizer should be used on soils with 6% or more organic matter content. Other plant nutrient recommendations, including phosphorus, are based on soil test results.
- Use slowly available fertilizer when applicable to reduce the chance of large losses to the environment . As a short term strategy, this is particularly effective when a single fertilizer application applies more than ¾ pound of nitrogen per 1000 square feet; products containing 15 to 30% of the total nitrogen as slow-release (water insoluble nitrogen or WIN, on the product label) are commonly available. Greater WIN portions may also be available. There is concern that continual, long term applications of higher rate, slowly-available nitrogen fertilizer will become a water quality issue at some future date. Turf-soil systems do not function as an indefinite sink for nitrogen; over application of slowly-available nitrogen fertilizers will eventually compromise water quality. Single applications of more than ¾ pound of nitrogen per 1000 square feet should be made with fertilizer containing WIN. For example, a 1 pound per 1000 square feet application should contain at least 25% WIN.
- Lowering the amount of nitrogen and phosphorus applied reduces the risk for a large amount of runoff or leaching losses; however, it is very difficult to uniformly apply a low amount (<1/3 pound per 1000 square feet) of nutrients as a granular product unless the fertilizer has a very low nutrient analysis or is applied as a liquid via fertigation or sprayer.
- Test soil to determine the amount of nutrients (other than nitrogen) needed in a fertilizer; knowing the proper amount of phosphorus, if any, to apply is important because excessive or improper application of phosphorus fertilizers increases risks to water quality. Nitrogen recommendations coming from soil test labs are not based on calibrated soil-turf testing and typically are very generalized (not site specific). As a result, nitrogen recommendations coming from laboratories may need to be ignored. See table for details on determining the proper nitrogen fertilization rate for a turf.
- Phosphorus-containing fertilizer should not be applied during late fall or winter; deficiencies in phosphorus are best managed before late fall and winter.
- Do not make nutrient applications before a storm event (heavy rainfall), when the turf or soil is saturated by evidence of standing water, or very squishy soil, or when soil is frozen.
- Organic matter used as soil amendments, including composts and biosolids, are applied at very high rates to improve the physical, chemical or biological properties of soils. These materials contain nutrients, especially phosphorus and nitrogen, and should be applied with caution. Unless thoroughly tilled into the soil during establishment, these materials should be applied more like a fertilizer (low rates) than a soil amendment to protect water quality.
- Avoid spreading fertilizer onto non-target areas such as impervious surfaces and around bodies of water. All fertilizer spills must be cleaned immediately, and any fertilizer that has been incidentally applied to any impervious surfaces, such as streets, parking areas, and sidewalks, must be redirected (swept/blown) to turf areas immediately after application. If necessary, cover storm drains with a tarp before spreading fertilizer and before blowing fertilizer off of impervious surfaces to prevent fertilizer from entering the storm sewers.
- Calibrate fertilizer spreader for accurate application amount and placement. Calibrate more than once each year.
- Establish buffers in sensitive areas (waterways, wells, impervious surfaces, pond/stream edges) where fertilizer will not be applied. Properly managed buffers can provide several functions to improve water quality. Small buffers (minimum of three feet) in sensitive areas (waterways, wells, pond/stream edges, etc.) likely serve as a place to receive fertilizer instead of the adjacent water body; the size should be at least as wide as the width of the fertilizer spreader or the distance that drift may occur from a fertilizer spray or fertigation. Buffers intended to function as a water quality treatment structure, that is, reduce the amount of runoff or filter sediment and/or nutrients, often need to be much wider. In this case, size of the buffer depends on the nature of the watershed (land area, slope, land use, etc.). Buffers of this nature may also have steps of increasing higher (taller) vegetation to be more effective. Care must be taken with large buffers to avoid loss of vegetative cover; otherwise exposed soil will be subject to erosion resulting in severe nutrient and sediment loading of nearby water bodies. Note some municipal ordinances require buffers to be as large as 25-feet.
- Implement turfgrass cultural practices including aeration, topdressing, and vertical mowing when necessary to maximize the effectiveness of nutrients.

Larger acreage sites with more than one type (function, vigor, management level) of turf will need the turfgrass manager, consultant and/or property owner to evaluate and determine where there are distinct types of turf. A site map should be developed to illustrate these areas. Considerations for determining a maintenance level follow:

- **Function of turf.** That is, is it used as a playing surface, for intense traffic, aesthetic lawn area, utility (soil stabilization), etc.?
- **Current vigor (health) and client expectations (color, density and weeds).** Are the current level of weeds, turf color, and shoot density acceptable to the client?
- **Current fertility level.** The current fertility level will help to determine what additional nutrient inputs, if any, are needed on the property. Past records of soil testing and fertilization will help to determine this.
- **Mowing.** The level of fertility needed depends in part on clipping management. Removal of clippings increases the need for fertilization; returning clippings can reduce nitrogen fertilizer needs by as much as 50%. Frequent mowing is an indicator of higher maintenance turf.

- **Irrigation Availability.** Readily available and frequently used irrigation increases the need for fertility since it lengthens the growing season and increases biomass production (nutrient immobilization/crop removal).

Irrigation Management to Prevent Nutrient Transport with Runoff and Leaching

- Over irrigation may be the most important factor that results in excessive N leaching and more P runoff during the growing season. Irrigation should be managed to keep the soil dry to moist (not wet) so that water will infiltrate and be stored in the soil rather runoff or leach through the root zone.
- Irrigate lightly after fertilizer is applied to wash it into soil and promote nutrient uptake by turf.
- Irrigation intensity should be low enough to allow infiltration (that is, avoid ponding and runoff).
- Irrigate turf as needed based on weather (evapotranspiration) and soil water availability and not on a calendar schedule. Irrigation controller technology should be optimized to ensure efficient application of irrigation water. Rainfall sensors on shutoff valves should be used with irrigation systems to avoid excessive application of water that would result in runoff or leaching. If you don't have ready access to data from a weather station, the Northeast Climate Center (http://www.nrcc.cornell.edu/grass/) summarizes weather data for NJ and other states, which can be used to estimate the need for irrigation. Estimates will be improved if you have data from a local rain gage to refine the estimated need for irrigation.
- When feasible, direct surface water runoff to catch basins or ponds that recycle water back to irrigation holding ponds, rain gardens, or bioretention basins.
- Avoid irrigation during times of high humidity and early evening hours (before turf wets with dew) to discourage the incidence of turf disease.
- Avoid automatic irrigation during dry, windy conditions to limit evaporation losses and non-uniform irrigation coverage.
- Use hand-held irrigation methods whenever feasible to manage small, localized dryness in turf rather than automatic irrigation systems to avoid over-application of water.
- More detailed descriptions of irrigation management are available in Rutgers Cooperative Extension publications, *FS555, Best Management Practices for Watering Lawns* and *E278, Best Management Practices for Irrigating Golf Course Turf* available at *www.njaes.rutgers.edu/pubs/*.

Mowing Practices Related to Nutrient Management

- Leave grass clippings and other organic materials in place when feasible.
- Do not discharge grass clippings onto impervious surfaces where clippings may be washed into a stormwater drainage system or directly into surface water bodies. Remove tree leaves, grass clippings, other plant debris, and uncontained soil and composts from impervious surfaces where leachate would be discharged to surface water bodies.
- Recycle removed turf clippings as a nutrient resource when feasible (compost, mulching, organic matter supplement, etc.).
- Do not mow turf during periods of severe plant stress or pest pressure.
- Mowing frequency should increase during rapid, vigorous plant growth and decrease during dry stressful periods. Cutting height should dictate when mowing is performed so that no more than 1/3 of the grass blade is removed. For example, a lawn mowed at two inches (height of cut) should be mowed when the leaf growth reaches three inches tall.
- Mow at the highest acceptable height. Higher mowing reduces the need for irrigation and risk of over irrigation.

Guidelines to Develop a Nitrogen (N) Fertilization Schedule for Established Turfs in New Jersey

Recommendations for nitrogen needs in higher-cut turf and golf course turf are provided below; amounts of nitrogen fertilizer in the table generally presume established turf conditions. The function, vigor (health), and maintenance practices of the turf must be determined for each site. Assessment of function, vigor, and management intensity should include mowing, traffic (intensity of use), stress levels, soil compaction, pest pressure, irrigation, and other factors. Recommendations for nitrogen fertilization are based on the specific needs of each site. Proper use of the tabulated data requires an understanding of and adherence to the accompanying footnotes below the table. Turf managers and applicators are encouraged to use the least amount of nitrogen that is feasible. Many have observed that applications of 1/2 rates provide acceptable results.

Type of Turf	Annual N[1]	Timing of Application				
		Mid-March to April[2]	May to mid-June[3]	Late June to early August	Mid-August to mid-September[4]	Late September to mid-November[5]
Management of General Turfs (mowed higher than 1-inch)	pounds of N per 1000 ft^2					
Irrigated, clippings removed	1 to 5	½ to 1	½ to {1}	not required	1	1 to (2)
Irrigated, clippings not removed	1 to 4	½ to 1	½	not required	1	1 to (1½)
No irrigation, clippings not removed	0 to 2	½	not required	not required	½ to (2)	not required
Zoysiagrass	0 to 2	apply no N	½ to {1}	½ to {1}	apply no N	apply no N
Sports Turfs	1 to 6	0 to 1	0 to {1½}	0 to {1}	½ to (1½)	½ to (2)
Golf Course Turfs						
Putting Green	1 to 4	0 to 1	¼ to {1¼}	¼ to {1}	¼ to 1	½ to (2)
Tee	1 to 6	0 to 1	½ to {1½}	½ to {1}	½ to (1½)	½ to 1
Fairway	1 to 3	0 to 1	½ to {1½}	0 to {¾}	½ to 1	½ to (2)
Roughs	0 to 3	0 to 1			1 to (2)	0 to (2)
Utility	0 to 2	0 to ½			0 to (2)	

[1]Use ½ rates for older (mature) healthy turfs that have been properly managed for many years and receive low to modest amounts of traffic (play), especially those sites with 6% or more soil organic matter content. Use higher rates for turf that receives intense use (traffic) or is recovering from other forms of damage. The annual rates of five and six pounds per 1000 square feet are only recommended for unique situations, which probably represents less than 10% of the acreage of turf grown in NJ. These rates are generally only appropriate for establishing new turfs, particularly those grown on poor quality soil, and intensively used turfs including sports turfs and teeing grounds on golf courses. Improving soil before establishing turf would dramatically reduce the need for N fertilization.

- To avoid nitrogen leaching on very sandy soils, do not fertilize turf at more than ½ to ¾ pound of nitrogen per 1000 square feet in a single application unless a fertilizer containing sufficient slowly available nitrogen (WIN) is used to limit the water soluble portion to no more than ½ to ¾ pound per 1000 square feet. There is not a universal 'cutoff' rate that would apply to all situations because there are so many variables affecting nutrient uptake, fate, and transport. Applications nearer to the ½ pound rate may be better for sites where leaching concerns are great.
- Fertilizer should not be applied near water bodies or impervious surfaces where rain can wash fertilizer nutrients into water bodies. Excess nutrients entering streams, ponds, and lakes will lower water quality.

[2]March-April nitrogen application(s) may not be needed if you fertilize late in the season (September to mid-November) the previous year. When spring green-up and growth is satisfactory, delay fertilization until May or June, or possibly do not apply a spring fertilization.

[3]To avoid excessive growth approaching and during the stressful summer months, use a slowly available source of nitrogen (natural organics, sulfur-coated urea, polymer-coated urea, IBDU, or methylene urea fertilizers), especially for amounts greater than ½ pound of nitrogen applied per 1000 square feet of turf. Application rates shown in { }.

[4]When applying more than one pound of N per 1000 square feet during this time period, it is best to split the quantity into two or more applications. If splitting the quantity into two or more applications is not feasible, nitrogen applications above ¾ pound per 1000 square feet should contain slowly available sources of nitrogen. A single application should apply no more than 1.5 pounds of nitrogen per 1000 square feet and must contain 50% or more WIN. Application rates shown in ( ).

[5]Apply only when grass is still green. Do not apply if grass is dormant (brown). If aesthetics (green color) is the primary objective for late season fertilization, consider applying micronutrients [iron (Fe) and/or manganese (Mn)] to reduce the amount of nitrogen applied at this time by as much as 25%. Use higher nitrogen applications where greater turf cover (quality) is desired or turf requires recovery from extensive play (wear). When applying more than ¾ pound of N per 1000 square feet during this time period, it is best to split the quantity into two or more applications. If splitting the quantity into two or more applications is not feasible, nitrogen applications above one pound per 1000 square feet must contain slowly available sources of nitrogen. Application rates shown in ( ). Note that some municipal ordinances restrict the latest date that fertilizer can be applied to 31 October, 15 November, or 30 November.

- Late fall applications should not contain phosphorus; fertilization to correct phosphorus deficiencies are best done before late fall.

Recommended Nutrient Application BMP Checklist for Large-acreage Properties, Professional Turf Managers, and Consultants

Outlined below is a turfgrass nutrient application BMP checklist for all persons who own, lease, or otherwise control large-acreage or multiple properties upon which nutrients are applied.

I. Identification for Nutrient Management Plan (NMP)
   1. Property address ❒
      (a) Owner's name ❒
      (b) Owner's mailing address (if different) ❒
      (c) Telephone number ❒
   2. Manager's name and company (if applicable) ❒
      (a) Address ❒
      (b) Telephone number ❒
   3. Consultant's name and company (if applicable) ❒
      (a) Address ❒
      (b) Telephone number ❒
   4. Date of plan and duration of plan (not to exceed 3 years) ❒
   5. Description of the operation with an overview of the turfgrass purpose and use within the operation (i.e., aesthetics, high traffic, etc.) ❒

II. Field maps and aerial photographs of larger sites should:
   1. Identify different turf types and boundaries. ❒
   2. Identify location of wells and all surface waters including drainage ditches, streams, ponds, etc. ❒

III. Turf and nutrient recommendations
   1. Indicate total acres represented by the NMP and summarize the recommended application rates and acreage for each type of turf. ❒
   2. Description of the irrigation structure and system (well, pond, recycled, etc.), and irrigation methods to optimize fertilizer use and efficiency ❒
   3. Description of fertilization practices (if applicable) and recommended methods to optimize fertilizer use and turf uptake efficiency ❒
   4. Nutrient application recommendations must be based on the turf nutrient demands and address the factors listed in (a)-(g)
      (a) Current and planned turfgrass species and type of turf ❒
      (b) Soil sample analysis (no older than 3 years) from an agronomic laboratory capable of providing recommendations for turf ❒
      (c) Mowing height and intensity ❒
      (d) Turf clipping management (removal or recycling of clippings) ❒
      (e) Any other residual nutrients that may be available for plant uptake ❒
      (f) Turf establishment and age ❒
      (g) Application timing ❒
   5. Nutrient application rates must be based on the best available technology. The annual application rate of phosphorus to soil at phosphorus levels greater than optimum or high cannot exceed the rate of one pound of phosphate per 1,000 square feet per year or a three-year plant removal rate. Note that some municipal ordinances in New Jersey do not allow the application of phosphorus fertilizer to turf unless a soil test of the site indicates otherwise. ❒
   6. Nutrient source(s) selected, rate(s), and approximate timing of application(s) ❒

IV. Best Management Practices

General recommendations for BMPs should be described and related to enhancing agronomic practices and environmental management. BMPs shall be recommended to advise and educate people and are not to be interpreted as mandatory actions of a plan (e.g., buffer strips, timing/method, tissue samples, etc.). ❒

V. Implementation and Records

1. Document when plan changes; include rationale for change(s). ❒

2. Implementation records shall be maintained at the operation and shall include:
   - (a) Soil test results and recommended nutrient application rates of the NMP ❒
   - (b) Fertilizer spreader calibration data ❒
   - (c) Quantities, analyses, and sources of nutrients applied to turfgrass ❒
   - (d) Dates and methods of nutrient application ❒
   - (e) Weather conditions at time of application ❒

VI. Reporting

1. Information should be summarized and recorded by March 1 of every calendar year:
   - (a) Amount of organic and inorganic fertilizers applied and the quantity of land to which each is applied ❒
   - (b) NMP identification information ❒

2. NMP should be updated:
   - (a) By December 15 of every third year, or less ❒
   - (b) Upon a 25% increase in acres of turf production ❒

For a comprehensive list of our publications visit www.njaes.rutgers.edu *Revised July 2010*

Cooperating Agencies: Rutgers, The State University of New Jersey, U.S. Department of Agriculture, and County Boards of Chosen Freeholders. Rutgers Cooperative Extension, a unit of the Rutgers New Jersey Agricultural Experiment Station, is an equal opportunity program provider and employer.

RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

Rutgers, The State University of New Jersey
88 Lipman Drive, New Brunswick, NJ 08901-8525
Phone: 732.932.5000