Fertilizer Management

Description

Nitrogen, phosphorus, potassium and other nutrients are necessary to maintain optimum growth and stress tolerance of most vegetation. This BMP addresses the proper selection, use, application, storage, and disposal of fertilizers.

Although most of the information in this BMP applies to trees, shrubs and ground covers, as well as turf, the *application* of fertilizer on trees, shrubs and ground covers should be done following the procedures given in the Trees, Shrubs and Ground Covers BMP. All storage, mixing and disposal of fertilizers should be done in accordance with this fertilizer management practice.

Other Terms Used to Describe

Nutrient Management
Nitrogen/Phosphorus Management

Pollutants Controlled and Impacts

Nutrients applied at appropriate times and rates will minimize the potential for pollution of surface and ground waters. Nutrients are also essential in order for vegetation to stay healthy. Healthy plants require fewer inputs.

Application

Land Use
This practice is applicable to all land uses--wherever fertilizers are used.

Soil/Topography/Climate
Fertilizer programs will vary from site to site, partially due to varying soil characteristics, topography and climate. For example, sandy soils are more prone to nitrogen leaching than finer-textured soils.

When to Apply
A fertilizer program for lawns should begin in the fall (as opposed to spring) to promote deep, healthy root systems and hardy lawns. This, in turn, will help grass compete with unwanted grass species and weeds. Spring applications of fertilizer will help the grass start growing, but may promote more top (leaf) growth than root growth. Shallow root systems are unable to sustain lawns through a drought or harsh winter.

Fertilizers should not be applied to turf when the soil is frozen because turf cannot utilize the nutrients and runoff rates are high. Fertilizers should also not be applied before significant intensive rainfall events.

Where to Apply
Fertilizer management practices should be applied in all areas where vegetation is managed.

Relationship With Other BMPs

A sound fertilizer management program is just one of the elements needed to maintain healthy vegetation. Healthy vegetation also requires proper irrigation management, Pesticide Management, Soil Management, and, in the case of turf grasses, using the proper mowing frequency and height. Many of these principles are mentioned in the Lawn Maintenance BMP, with additional specifications in individual BMPs.

Specifications

General Information:

Plants need a certain amount of nutrients (nitrogen, phosphorus, etc.) to grow and stay healthy. Nutrient deficiency may result in weaker plants, which may make them more susceptible to disease. This, in turn, may increase the amount of pesticides or other inputs needed. Proper fertilization will help plants stay healthy and reduce other inputs.

Excess nutrients which are applied beyond that needed by the plant may get washed off the soil and end up in lakes, streams and wetlands, or leach into ground water. When nutrients such as nitrogen and phosphorus run off into surface waters (i.e. rivers, lakes), they can cause algae blooms and nuisance aquatic plant growth.

Ground water can be impacted by excess nitrogen, which readily converts to nitrates. When nitrate leaches to ground water, it can contaminate drinking water supplies. Phosphorus generally doesn't affect groundwater since it binds readily with the soil.

Application rates for fertilizers should always be based on soil tests. To take soil samples, follow the directions in the Soil Management BMP.

The recommendations below are given to ensure healthy vegetation, while maintaining water quality. It includes the proper application, storage and disposal of fertilizers. **Always follow directions on the label**. If the label is not legible, contact the distributor for proper application and storage information.

General Considerations:

A fertilizer management plan should be developed for each of the vegetative species in the managed area, and for each use of that species. All vegetative species should be chosen following guidance in the Pesticide Management BMP, which includes integrated pest management (IPM) principles. The first step in any IPM program is selecting disease-resistant species. Proper species selection also depends on the use of the vegetation. For example, if the purpose of the vegetation is to give a natural appearance and prevent erosion, then fertilizer needs will be far less than for a turf used for golf course greens.

Fertilization rates will differ depending on the existing nutrient needs of the soil. Collect soil tests to determine existing nutrient needs, following specifications in the Soil Management BMP. Soils should be analyzed for nitrogen, phosphorus, potassium and any micro-nutrients of concern. Soil tests should be conducted regularly, such as every three years on low-maintenance turfs and every year for high-maintained turfs.

Types of Fertilizers:

Many liquid and solid fertilizers are available. The characteristic of common materials used in fertilizers are summarized in Table 1, below. The material used in a fertilizer determines the rate nutrients are released into the soil. For example, *water-soluble* nitrogen such as urea is readily available to turf roots and provides a quick response after application. These materials are the least expensive forms of nitrogen. However, water-soluble N fertilizers have a high potential for chemically burning turf. Again, select the type of fertilizer based on the intended use of that vegetation.

Table 1

Characteristics of Fertilizer Materials for Turf

Material	Type	Nutrient Content %	Soil Reaction	Rate of N Release	Burn Potential
Ammonium sulfate $(NH_4)_2SO_4$	inorganic	21 (N)	strong acidifier	water soluble	moderately high
Ammonium nitrate	inorganic	33.5-34 (N)	acidifier	water soluble	high
Urea $CO(NH_2)_2$	synthetic organic	45-46 (N)	acidifier	water soluble	moderately high
Activated sewer sludge	natural organic	5-6 (N)	no change	slowly soluble	low
Urea-formaldehyde	synthetic organic	38 (N)	no change	slowly soluble	low
IBDU	synthetic organic	31 (N)	no change	slowly soluble	low
Sulfur-coated urea	synthetic organic	31 (N)	acidifier	slow release	low
Triple super-phosphate $Ca(H_2PO_4)_2$	inorganic	45-46 (P_2O_5)	no change	–	low
Muriate of potash KCL	inorganic	60-62 (K_2O)	no change	–	high
Potassium sulfate K_2SO_4	inorganic	50-53 (K_2O)	no change	–	moderate
Ferrous sulfate monohydrate	inorganic	31.5 (Fe)	acidifier	–	high

Adapted from *Landscape Management* by J.R. Feucht and J.D. Butler.

Source: "Turfgrass Pest Management: A Training Manual for Commercial Pesticide Applicators". Michigan State University, Cooperative Extension Service, Bulletin E-2327.

Slow-soluble forms of N include natural and synthetic organic fertilizers. *Slow-release* products are formulated so that elements are released relatively slowly over time. Slow-release products are more expensive than water-soluble fertilizers, but fewer applications at higher rates are possible with less chance of burn.

Complete fertilizer contains nitrogen, phosphorus and potassium. As a rule, turf fertilizers have a

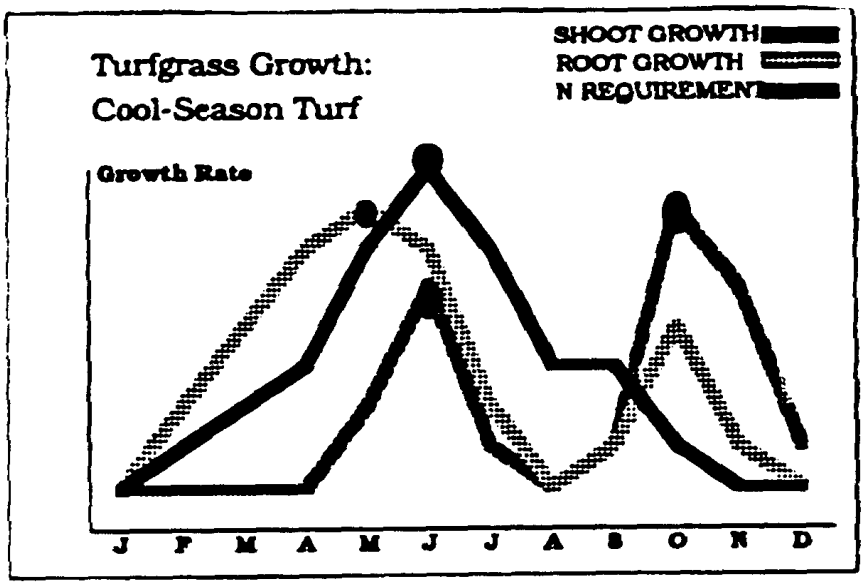
high ratio of nitrogen to phosphorus and potassium. The ratio of these three nutrients ($N:P_2O_5:K_2O$) is called the fertilizer analysis. Common turf fertilizer analyses include 20-10-5, 20-5-10, and 21-3-7. One hundred pounds of 20-10-5 fertilizer contains 20 pounds of nitrogen, 10 pounds of phosphorus and 5 pounds of potassium. The rest is inert material.

Before Applying Fertilizers:

Take soil tests and have them analyzed by Michigan State University or other approved laboratory for nitrogen, phosphorus, potassium, and any other nutrient of concern. Follow procedures in the Soil Management BMP.

Determine Appropriate Application Rates. Fertilizer applications should be based on a number of factors, including previous fertilizations, turf quality, environmental conditions, weather conditions, use of the turf, type of turf, and soil conditions. Be sure to give credit for leaving grass clippings on lawns--this can reduce fertilizer needs by 25-50%. What follows are general considerations for nutrient applications in all areas except gardens, which are discussed in the Lawn Maintenance BMP.

Table 2



Source:"Truth and Consequences: Turfgrass Environmental Management", Michigan State University, 1991.

The appropriate number of fertilizer applications is dependent upon the rate of application, and the growth stage of the plant. As shown in Table 2, turfgrass root and shoot growth occurs primarily in the spring, with another burst in the fall. Where only one application of fertilizer is needed (again, based on the results of soil tests), apply in the fall because strong root systems will make the plants more able to compete against weeds in the spring.

Appropriate Nitrogen Rates:

-may prevent turf susceptibility to moisture stress.

-may prevent foliar burn. Note that when applying fertilizers which can cause foliar burn, the turf should be watered immediately after application.

-should be coordinated with proper irrigation rates to provide the moisture needed by the turf, yet prevent over-watering which could result in leaching.

-is especially important where there are sandy soils and/or a high water table because leaching of nitrates may occur. This may impact drinking water supplies.

i. **Application rates and the number of applications should be based on the results of soil tests**, modified only to meet the use of that turf. Where needed based on soil tests and the intended use, consider split applications.

ii. When turf roots are very short, nitrogen applications should be done at lighter rates and at shorter intervals. An example would be a golf course green.

iii. Application rates and the number of applications may also need to be adjusted, depending on turf conditions and any unique problems which may exist. An example might be significant thinning of turf by disease, which may necessitate increased nitrogen fertilization to regain the desired turf density.

Appropriate Phosphorus Rates:
Phosphorus is necessary to maintain a dense, healthy turf. Phosphorus applied in excess of what the plant needs may enter water bodies if the soil to which it attaches is eroded.

i. **Application rates should be based on the results of soil tests.**

ii. Consider split applications in areas where runoff or soil erosion is likely to occur.

Appropriate Potassium Rates:
Potassium is important for maintaining a healthy, stress-tolerant turf. Although it can be leached readily from sandy soils, potassium and the associated anions in most of the carriers used on turf (i.e. chloride and sulfate) are not considered harmful to ground or surface waters at the rates being utilized for most turfs.

Application rates should be based on the results of soil tests.

Other Nutrients:
While other nutrients may be applied to turfs, the rates and frequencies of use are low. Sulfur is not known to be deficient in Michigan turf, so no sulfur applications are routinely made. Iron is a micronutrient that is commonly deficient in alkaline soils. It will normally produce a temporary "greening" effect on the turf when applied foliarly. Such applications are often made to enhance turf color when additional nitrogen is not needed. However, since the iron deficiency is due to soil alkalinity, long-term treatment requires modifying the soil pH. Other micronutrients, such as

manganese, copper and zinc may be used on turf occasionally, but rates and frequencies of application are very low and these nutrients are tied up quickly by soils.

Equipment Calibration:

Calibrate your equipment as needed to ensure the desired application rate. Follow the calibration procedures in Appendix 4 of the BMPs, entitled "Application Calculations and Calibration." Make sure all components of your equipment are in good working order. Do not use the equipment if you are not familiar with it. Contact the equipment supplier if you have questions.

Mixing the Fertilizer:

Before mixing fertilizers, determine the size of the area which needs fertilizing. Appendix 4 includes methods for measuring the area needing fertilization. After determining the area needing treatment, and using the amount of fertilizer needed based on soil test results, mix the appropriate amount using the "Common Measuring Equivalents for Pesticides and Fertilizers", which is Exhibit 2 of Appendix 4. The equivalents allows you to mix only the amount of fertilizer or pesticide needed for your application.

Pour/mix the fertilizer into the bin/spreader/sprayer over an impervious area such as cement, so that if the fertilizer is spilled it can be easily cleaned up. Never pour fertilizers into bins/spreaders/sprayers on the turf because large concentrations of fertilizer can kill the turf, and potentially impact surface and ground waters. Avoid back-siphoning of liquid fertilizers by keeping the end of the fill hose above the water level, or by installing devices which prevent back-siphoning.

Applying the Fertilizer:

1. Never apply fertilizers to frozen soils, before storms, or under real windy conditions. Except where fertilizers are being applied to surface waters to increase productivity (as is done in walleye pond management, for example), **never apply fertilizers directly in or adjacent to streams, rivers, lakes, or wetlands.**

2. Select the most appropriate method of applying the fertilizer. Follow fertilizer label directions, or discuss potential options with the grain elevator, local fertilizer store, or the local Cooperative Extension Service office. Hand application of fertilizers is not recommended because it is tedious and usually does not result in an even distribution of fertilizer. Improperly applied fertilizers can "burn" and destroy turf.

   For granular forms of fertilizers, the centrifugal (rotary) type of spreaders usually distribute the material more rapidly and with minimal overlapping compared to gravity (drop-type) spreaders. The latter are safer if herbicide-fertilizer mixtures are applied around susceptible shrubs and trees.

3. Make sure the equipment has been calibrated.

4. Adjust the application equipment to fit the application rates determined above.

5. Check equipment occasionally throughout the application to ensure it is delivering the appropriate amount of fertilizer to the turf.

6. Keep equipment well-maintained to ensure it functions as designed.

7. When establishing new grass by Seeding, mix the fertilizer into the top 3 inches of soil. This will encourage better rooting and reduce the amount of fertilizer nutrients which could be lost by erosion of topsoil from the site before the turf becomes well established.

After the Initial Fertilization:

A healthy turf requires a deep rooting system. A deep rooting system can remove nitrates further down in the soil, thereby reducing leaching potential. Several management variables can influence rooting of the turf, including:

1. Irrigation. A light irrigation immediately after fertilization can be helpful in moving fertilizer down into the thatch and the surface layer of soil. Do not apply water in excess of what can be taken up by the soil. Remember, most established turfs require about one inch of water per week. See the Lawn Maintenance BMP.

2. Mowing height. Mow according to specifications in the Lawn Maintenance BMP.

3. Diseases, insects and other pests. These should be controlled following specifications in the Pesticide Management BMP.

Storage and Disposal of Fertilizers:

1. **Always follow the storage and disposal directions on the label.**

2. Most fertilizers should be kept in a cool, dry place. Be sure to store granular fertilizers separate from any pesticide that can cause contamination of the fertilizer.

3. Liquid fertilizers, like pesticides, should be stored inside another container (i.e. **secondary containment**) in case the chemicals leak from the original containers.

4. For additional guidance, or where labels do not indicate proper storage and disposal, follow the specifications in the Pesticide Management BMP.

Spill Cleanup:

A **spill response plan** should be developed for all sites which contain fertilizers. The spill response plan should include the steps which will be taken to contain and cleanup any spilled fertilizers. In general:

Small quantities of spilled liquid fertilizers should be cleaned up by applying kitty litter or sawdust, then sweeping it, wrapping it in newspaper and disposing in the trash. Small quantities of powdered fertilizers should be swept and disposed of in the trash. Never wash fertilizer spills down floor drains or driveways--the concentrated runoff will likely either go to storm sewers (and consequently directly into the local river or stream) or could leach into the ground water.

For large spills, contact the Pollution Emergency Alert System (PEAS) system at 1-800-292-4706. Where possible, use any spilled fertilizer according to appropriate rates and methods.

Record Keeping:
It is advisable to keep records of the amount and type of fertilizer used (including percentages of nitrogen, phosphorus and other nutrients), type of equipment used, date of the last calibration, weather conditions, type of soil, specific area where applied, and the name of the applicator. This will help the manager in adjusting the application rates. The Pesticide Use Record sheet in the Pesticide Management BMP can be modified for fertilizers.

Maintenance

Proper fertilizer management is an ongoing practice, starting at the onset of the first fertilization, and ending when fertilizers are no long used or stored on the site. Ongoing maintenance includes a minimum annual check to ensure:

1. Applicators are applying fertilizers based on annual soil tests.

2. Equipment is calibrated for optimal use and is well-maintained.

3. The continued proper storage and handling of fertilizers. An annual check of all fertilizer labels should be made. Illegible labels should be replaced, where possible, or the fertilizers disposed of according to the disposal procedures above. There should be secondary containment for all fertilizers.

4. Information is being recorded on the application rates, etc., as listed above.