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EXPERT REVIEWED

Publication 430-011

Lawn Fertilization in Virginia

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Introduction

Fertilization of lawns is essential for the production of quality turf in Virginia. However, exceeding recommended fertilizer application rates or improper application timing can negatively impact surface water and groundwater quality. A well-planned and environmentally sound turfgrass fertilization program will take the following factors into account

- Soil type.
- Inherent soil fertility.
- Nutrient source characteristics.
- Desired turfgrass quality or performance.
- Nutrient application rate.
- Application frequency.
- Season of application.
- Application method.

The objective of this publication is to help Virginians effectively fertilize lawn turf in an environmentally sound manner.

Selecting a Fertilizer

Fertilizers are used to improve or maintain turfgrass quality. The value of a fertilizer depends on the total amount of nutrients and the source of nitrogen in the fertilizer. Terms to be familiar with before selecting a fertilizer are "soil testing," "fertilizer analysis," "fertilizer ratio," and "nitrogen availability."

The Soil Test

Soil tests taken every three or four years provide important information about the fertility of your lawn soil. The results will indicate the amounts of phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) your soil can provide to the turfgrass. It will also indicate the acidity (pH) of your soil and whether lime is needed. Virginia Cooperative Extension publication 452-129, "Soil Sampling for the Home Gardener", provides detailed instructions on how to take a soil test and interpret the results. A soil test report will indicate the specific amounts of lime, phosphorus, and potassium your soil needs to provide adequate nutrition for the turfgrass, and it may indicate that you do not need to apply some nutrients.

Generally, a soil test level of at least "medium" for phosphorus and potassium is desirable for existing turf. The nitrogen (N) requirements of turfgrass cannot be reliably evaluated by a soil test. Therefore, the soil test report will not contain a nitrogen test level but will contain a nitrogen recommendation for the kind of grass being grown. Nitrogen applications on lawns in Virginia are best made following the programs in this publication (Programs 1 [table 2] and 2 [table 3]) that were developed on the basis of the grass, its optimal growing period (warm season or cool season), the anticipated nitrogen fertility needs of that grass in a standard home lawn setting, and the nitrogen water solubility (quickly or slowly available to the plant) of the fertilizer.

Your local Virginia Cooperative Extension office can assist with the supplies and data forms needed to submit a sample to the Virginia Tech Soil Testing Lab for analysis. Most VCE offices even have soil probes on loan to take a more representative soil sample. Information about your soil type is also available in most counties. A list of VCE offices and their contact information is available at arewww.ext.vt.edu/offices/index.html.

Fertilizer Analysis

Fertilizers are most often described using three numbers, such as 12-4-8 or 46-0-0. These three numbers indicate, respectively, the percent by weight of nitrogen, phosphate (P_2O_5), and potash (K_2O) in the fertilizer and are required to be on every fertilizer bag or container. For example, a 12-4-8 fertilizer would contain 12% nitrogen, 4% phosphate, and 8% potash on a weight basis. These fertilizers have traditionally been called "complete fertilizers" because they contain nitrogen, phosphorus, and potassium, but they are now often called "starter fertilizers" because it is common for complete fertilizers to be used when establishing turfgrasses. If soil tests indicate high levels of P and K availability, then fertilizers supplying only nitrogen (referred to as "lawn maintenance fertilizers") need to be applied. High-analysis fertilizers are more concentrated and therefore require less total fertilizer per application (see table 1).

If a soil test indicates additional phosphorus or potassium is needed, it may be applied with a complete fertilizer or in separate applications of phosphate- or potassium-specific fertilizers. Fertilizers normally used to correct severe phosphorus and/or potassium deficiencies are 0-20-20, 0-28-0, 0-0-50, or 0-0-60. Never apply more than 3 pounds of 0-0-50 or 0-0-60 per 1,000 square feet to an established turf in hot weather without watering-in the material to prevent foliar burn.

Fertilizer Ratio

If phosphorus and/or potassium are needed, it is likely that the soil test results will recommend a fertilizer with a certain ratio of nitrogen:phosphate:potash ($N:P_2O_5:K_2O$) to meet the turfgrass's specific nutrient needs. It is not always possible to find the exact fertilizer ratio suggested by the soil test, but strive to find something as close as possible to the ratio given in the soil test analysis.

If the fertilizer analysis is 16-4-8, the fertilizer ratio is 4-1-2; similarly, a 14-7-14 analysis would have a 2-1-2 ratio. Mature lawns generally require much more nitrogen than phosphorus and potassium, and it is common that N-only sources are used for maintenance fertilization. Turf maintenance fertilizers vary in nitrogen content and may contain a portion of the nitrogen as water-insoluble or slowly available nitrogen.

Nitrogen Availability

The source of nitrogen in fertilizers influences nitrogen availability and turf response. There are two categories of nitrogen sources: quickly available and slowly available. Quickly available materials are water-soluble, can be readily utilized by the plant, are susceptible to leaching, and have a relatively short period of response. Quickly available sources include urea, ammonium sulfate, and calcium nitrate. The Virginia Department of Conservation and Recreation's Nutrient Management Standards and Criteria (revised 2014) allows for no more than 0.7 pound of available nitrogen per active growing month for cool-season turfgrasses, and seasonal nitrogen totals up to 3.5 pounds nitrogen per 1,000 square feet for cool-season lawns and 4 pounds nitrogen for certain warm-season lawns. (Note that not all grasses or all situations require this annual level of nitrogen). Slowly available nitrogen sources release their nitrogen over extended periods of time and are applied less frequently and at somewhat higher rates than the quickly available nitrogen sources. Nutrient Management Standards and Criteria defines a slowly available nitrogen source as one that contains ≥15% slow-release nitrogen and allows for no more than 0.9 pound nitrogen per 1,000 square feet per growing month for cool-season turfgrasses or 1.0 pound nitrogen per 1,000 square feet per growing month for warm-season turfgrasses.

Slowly available sources are less-susceptible to leaching and are preferred on sandy soil types that tend to leach. Slowly available sources include urea formaldehyde, urea-formaldehyde-based products (methylene ureas), sulfur-coated urea, polymer-coated urea, isobutyraldehyde diurea, natural organics (bone meal, fish meal, dried blood, and animal manures), and Class A biosolids.

If a fertilizer contains a slow-release nitrogen source, it will be listed on the label. For urea-formaldehyde or

methylene-urea-based fertilizers, the portion of the nitrogen that is slowly available is listed on the fertilizer bag as water-insoluble nitrogen (WIN).

For instance, a 20-10-10 fertilizer with 5% WIN has five-twentieth or one-fourth (25%) of the nitrogen in the slowly available form. If you chose a fertilizer that provides nitrogen in a slowly available form, you should understand how to calculate WIN in order to determine which fertilizer program best fits your lawn (see Programs 2 [table 3] and 3 [table 4]). For example, assume that a fertilizer label provides the following information:

Guaranteed Analysis

Total Nitrogen 16%

5.6% Water Insoluble Nitrogen

Available Phosphoric Acid (P_2O_5)..... 4%

Soluble Potash (K_2O) 8%

To find the percentage of nitrogen that is water-insoluble, use the following calculation:

% WIN/% total N × 100 = % slowly available N.

(5.6/16) × 100 = 35%,

so 35% of the total nitrogen is slowly available, and this fertilizer meets the criteria to use in Program 2 (table 3).

If water-insoluble nitrogen is not listed on the fertilizer label, you can assume it is all water-soluble or quickly available nitrogen unless the fertilizer label indicates that it contains sulfur-coated urea. Sulfur-coated and polymer-coated urea fertilizers do provide slowly available nitrogen, but the fertilizer label does not list it as water-insoluble nitrogen. If the fertilizer contains sulfur-coated urea, include that portion as water-insoluble nitrogen when determining the amount of nitrogen that is slowly available.

Statements on a fertilizer bag such as "contains 50% organic fertilizer" do not mean the fertilizer is 50% slowly available. An actual calculation of water-insoluble nitrogen using the information in the Guaranteed Analysis is the only reliable method of determining the portion of the fertilizer that is slowly available.

Seasons of Application – When to Apply

Proper timing of nitrogen applications is different for warm-season and cool-season turfgrasses because of their different growth cycles. The optimal time (in terms of both desirable plant response and environmental protection) to fertilize cool-season grasses in Virginia is from mid-August through early November, keeping in mind that the timing will vary somewhat depending on where you are located in the state. Warm-season grasses perform best when fertilized between April 1 and August 15 in Virginia, again with the understanding that the grasses might be at very different stages of growth on the front and back ends of this date range, depending on where you are located. As indicated in the fertilization programs that follow, adding small amounts of nitrogen to cool-season grasses can be beneficial for spring root growth, but very aggressive spring nitrogen programs are counterproductive and increase the injury potential to lawns from summer disease and drought. Similarly, aggressive late summer and early fall applications of nitrogen to bermudagrass can make the turf more succulent and increase its susceptibility to winter injury. Every third year or so for most native soils (heavy-textured clays and silt soils), be sure to conduct soil tests so you know whether or not additional phosphorus, potassium, or lime is needed. Having sufficient quantities of these nutrients available to the turfgrass is particularly important for summer survival of cool-season grasses and winter survival of warm-season grasses.

Nitrogen Fertilizer Programs

Programs 1-3 (tables 2-4) provide information on when to apply nitrogen and the recommended rates over a 30-day growing period:

- Program 1 (table 2) details nitrogen fertility strategies that use quickly available nitrogen.
- Program 2 (table 3) details the use of slowly available nitrogen sources.
- Program 3 (table 4) details nitrogen fertility strategies that use fertilizer products with the majority (>50%) of nitrogen being from slowly available nitrogen sources.

The programs differentiate between the anticipated nitrogen needs of the grasses (for example, fine fescue and zoysiagrass require significantly less nitrogen than either Kentucky bluegrass or bermudagrass on an annual basis). The units used are pounds of actual nitrogen per 1,000 square feet of lawn area. Refer to table 1 to determine the quantity needed of various fertilizers to apply the recommended nitrogen rate per 1,000 square feet.

Factors Affecting Nutrient Management

After using your water-insoluble nitrogen calculations to choose the appropriate program of fertilization for your lawn, you should then determine the amount and frequency of fertilization that is proper for your situation. This will be influenced by the source of nitrogen, soil type, type and age of turfgrass, length of growing season, traffic, shade, quality desired, whether clippings are recycled, and micronutrients.

There are site and application factors that should be considered with all fertilizer applications too. For instance, how close is your nearest water source? Are you prepared to blow or sweep any fertilizer than ends up on your street, driveway, or sidewalk back onto the lawn? Always keep the environment in mind when it comes to fertilizer applications, particularly any that contain nitrogen and/or phosphorus. Before making a treatment, evaluate your lawn situation based on the following factors and how each affects the amount and frequency of nitrogen application. Then choose the amount and frequency of application that best suits your situation.

Source of Nitrogen

The primary advantage of slowly available nitrogen sources is that they can be applied at higher rates, which reduces the total number of times the fertilizer must be applied. When properly applied, they also reduce the chance of nitrogen loss into the environment by minimizing the leaching potential. In general, lower application rates and higher application frequency allow turfgrass to better use applied nitrogen, but depending on the quality desired, higher application rates one or two times a year can also be effective at maintaining quality turfgrass in mature lawn settings.

Fertilizer "Burn"

When properly applied, slowly available nitrogen sources reduce the chances of foliar burning that sometimes occur with soluble sources such as urea. Foliar burning is the brownish discoloration that occurs on grass blades as a result of contact with soluble fertilizer. Watering the lawn immediately after fertilizing can minimize burn.

Soil Type

Sandy soils will generally leach more nitrogen than heavier-textured clayey or silty soils. Therefore, more frequent nitrogen applications are often required in sandy soils when quickly available sources of nitrogen are used. Leaching can be minimized by using slowly available nitrogen sources.

Type and Age of Turfgrass

Newly established lawns or lawns lacking satisfactory density or groundcover will benefit from properly timed applications of nitrogen until groundcover and density have reached a desirable level. Mature zoysiagrass, centipedegrass, and fine fescue lawns require lower levels of nitrogen than Kentucky bluegrass, tall fescue, perennial ryegrass, or bermudagrass. As your lawn matures, it is very likely that you can use the lower levels of nitrogen applications and still maintain desirable color and quality, especially if you return the clippings from mowing. Think of turfgrass clippings as a form of slow-release fertilizer.

Length of the Growing Season

Areas at higher elevations in western Virginia may have a growing season that is three months shorter than areas in southeastern Virginia. Similar turfgrasses growing in an area with a longer growing season will likely require more nitrogen.

Traffic

Where heavy traffic or use is anticipated, higher rates of properly timed nitrogen can be beneficial in generating recuperative potential.

Shade

Grasses growing in heavily shaded areas require only one-half to two-thirds as much nitrogen as grasses growing in full sun. Shade also affects the timing of nitrogen applications. Since grass plants in shade can best use nitrogen when sunlight can reach the grass leaves, fertilizer applications should be timed after the majority of leaves have fallen from the trees in the fall. Applications made in October and November are generally most effective. In heavily shaded areas with fine fescue turf, it may be beneficial to reduce fertilization rates even further or omit applications until leaf collection is finished in the fall.

Quality Desired

Turfgrass quality is a measure of density, color, uniformity (free of weeds and off-type grasses), smoothness, growth habit, and texture. If high levels of turfgrass quality are desired, a commitment must be made to proper turfgrass species and variety selection, frequent mowing, and slightly higher rates of nitrogen and increased application frequency. Additionally, irrigation, aeration, and pesticide application may at times enhance quality. One of the simplest means of improving overall turfgrass quality, especially for cool-season lawns, is to raise the cutting height before summer stress arrives. Leaving the grass tall shades weeds; cools soil temperatures, which causes less soil moisture evaporation; and promotes a deeper, more-extensive root system

Clipping Recycling

As previously mentioned, significant amounts of nutrients are returned to a lawn when clippings are returned. Research has indicated that up to one-third of the seasonal nitrogen requirement can be met by returning clippings; this is an important reason why seasonal totals for nitrogen fertilization programs can be reduced for mature lawns. Recycling turfgrass clippings contributes very little to thatch (a layer primarily composed of undecomposed stems between the soil and the turfgrass surface), provides nutrients and organic matter, and is an environmentally friendly method of clipping disposal. The organic matter from clippings improves the soil structure and its chemical and physical properties. If clippings must be collected, be sure to compost them and return that compost to the lawn. Where clippings are regularly collected, expect there to be a need for higher rates of nitrogen and potassium in particular.

Micronutrients

By far the most effort is spent in detailing fertility programs for all the macronutrients — nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur — the elements required by plants in large quantities. However, the micronutrients — iron, manganese, copper, zinc, boron, etc. — are equally important for plant growth and development. They are required only in very small amounts and, as a rule of thumb, they are not needed in most lawn situations where the soil is heavy-textured and the pH is suitable. Micronutrient deficiencies are possible in sandy soils, so conduct more frequent soil tests if this describes the soil for your lawn; however, this would not be typical for most lawns in Virginia.

The micronutrient that gets the most use in home lawn management is iron (Fe). Foliar spray applications of iron on high-quality cool-season turf during the fall, winter, and summer seasons will improve color, vigor, and root growth without promoting excessive shoot growth. Similar darkening effects are possible on actively growing warm-season grasses, especially centipedegrass. Three to four foliar applications of labeled rates of iron sulfate or chelated iron products during fall and winter on cool-season grasses and another three to four applications at the same rate during the summer will give maximum results. Application of iron in the coldest parts of winter when cool-season turf is brownish in color may result in a gray-green appearance.

Fertilizer Application Equipment and Methods

Nitrogen fertilizer will “green up” a lawn; therefore, it is important to uniformly apply nitrogen-containing fertilizers. This will eliminate streaking caused by different shades of green turf in the lawn. Proper application of nitrogen fertilizers by hand is difficult — even for a trained professional — so drop-type or rotary spreaders should be used. When using drop-type spreaders, be sure to overlap the wheel tracks because all the fertilizer is distributed between the wheels. Drop-type spreaders are not as easy to maneuver around trees and shrubs as rotary spreaders are. Rotary spreaders usually give better distribution where sharp

turns are encountered because they tend to cover a broader swath and fan the fertilizer out at the edges of the swath.

Until you are experienced with a spreader, it is advisable to apply half the fertilizer in one direction and the other half in a perpendicular direction in order to minimize streaking. Avoid applying any fertilizer to nonturfed areas (driveways, roads, or bare soil) because it is then prone to run off into drainage ways where it can enter waterways and contaminate estuaries.

How Much Fertilizer to Apply per 1,000 Square Feet?

After you have calculated water-insoluble nitrogen and selected a fertilization program, use table 1 to find the correct amount of fertilizer to use on your lawn. Nitrogen recommendations are made in pounds of nitrogen per 1,000 square feet. Any fertilizer analysis can be used, but there is usually little reason to apply complete fertilizers that also contain phosphorus and potassium unless it is indicated on the basis of a soil test. Supplemental applications of potassium do not have nearly the same environmental concerns as phosphorus in terms of water quality protection, so it is likely that you will find many standard lawn maintenance fertilizers at big-box retailers with analyses like 29-0-7. Lawn maintenance fertilizers are now phosphate-free, and if a soil test indicates no phosphorus is needed, these are the types of fertilizers you should select. If the particular fertilizer you are using is not listed in the table, use the following calculation to determine the exact amount of fertilizer to apply per 1,000 square feet of lawn area:

$$\frac{\text{Desired lb N per 1,000 sq ft} \times 100}{\text{\% N in fertilizer}} = \text{lb of fertilizer needed per 1,000 sq ft}$$

For example, if you want to apply 1.0 pound of nitrogen per 1,000 square feet using a 28-0-4 fertilizer,

$(1.0 \div 28) \times 100 = 3.6$ lb of 28-0-4 required per 1,000 sq ft.

Applying these basic principles in the selection and application of fertilizers will help provide a healthy, attractive lawn and will also help protect water quality.

Table 1. The amounts of various types of fertilizers required to apply targeted levels of nitrogen (N) fertilizer per 1,000 square feet.

	Pounds of nitrogen desired per 1,000 square feet				
Fertilizer analysis	**0.5**	**0.7**	**0.9***	**1.0***	**1.5****
6-2-0	8.3	11.7	15.0	16.6	25.0
10-10-10	5.0	7.0	9.0	10.0	15.0
16-4-8	3.1	4.4	5.6	6.2	9.3
24-25-4	2.1	2.9	3.8	4.2	6.3
28-0-4	1.8	2.5	3.2	3.6	5.4
32-0-10	1.6	2.2	2.8	3.2	4.8
20-0-0	2.5	3.5	4.5	5.0	7.5
38-0-0	1.3	1.8	2.4	2.6	3.9
45-0-0	1.1	1.6	2.0	2.2	3.3

** This level is recommended only for N sources containing 15-49% slowly available and/or water-insoluble N in the guaranteed analysis.*

***This level is recommended only for N sources containing ≥50% slowly available and/or water-insoluble N in the guaranteed analysis.*

Table 2. Program 1: Recommended monthly and seasonal nitrogen totals for Virginia's primary turfgrasses when using predominantly water-soluble (<15% slowly available) nitrogen (N) sources.

Month of application	Pounds of N per 1,000 sq ft per active growing month to apply to tall fescue, perennial ryegrass, or Kentucky bluegrass	Pounds of N per 1,000 sq ft per active growing month to apply to fine-leaf fescue	Pounds of N per 1,000 sq ft per active growing month to apply to bermudagrass or St. Augustinegrass	Pounds of N per 1,000 sq ft per active growing month to apply to zoysiagrass or centipedegrass
Sept	0.7	0.7	0.5[y] to 0.7 across the period	
Oct	0.7			
Nov	0.5[z]			
Apr	0.5 to 0.7	0.7	0.5	
May	across the period		0.7	0.7
June	0		0.7	
July	0		0.7	0.7
Aug	0		0.5	
Possible seasonal N totals per 1,000 sq ft[x]	2.0-3.5	1.0-2.0	2.0-4.0	1.0-2.0

[z] *Areas highlighted by green shading indicate optional fertility timing and N levels. Adjust use rates to meet site-specific needs of a particular grass based on the factors affecting nutrient management that are outlined in the Factors Affecting Nutrient Management section (e.g., higher quality, recovery from traffic, etc.).*

[y] *Virginia Tech researchers discourage winter overseeding of all warm-season turfgrasses except for bermudagrass due to poor spring recuperation potential of the warm-season turf. If bermudagrass is overseeded, additional N (highlighted by the yellow shading) can be applied to support the establishment and development of the overseeded grass after the bermudagrass enters winter dormancy.*

[x] *Seasonal totals are not necessarily intended as target levels, but the upper limits represent the maximum amount of N that should be applied during the growing season. Program 1's recommended rates of water-soluble N do not always reach the seasonal totals maximums. The rates are lower to encourage the use of slowly available nitrogen sources (as seen in Program 2) that, when properly applied, can help protect against the loss of N to the environment.*

Table 3. Program 2: Recommended monthly and seasonal nitrogen totals for Virginia's primary turfgrasses when using nitrogen (N) sources that are 15-49% slowly available and/or water-insoluble N, according to the guaranteed analysis of the fertilizer.

Month of application	Pounds of N per 1,000 sq ft per active growing month to apply to tall fescue, perennial ryegrass, or Kentucky bluegrass	Pounds of N per 1,000 sq ft per active growing month to apply to fine-leaf fescue	Pounds of N per 1,000 sq ft per active growing month to apply to bermudagrass or St. Augustinegrass	Pounds of N per 1,000 sq ft per active growing month to apply to zoysiagrass or centipedegrass
Sept	0.9	0.9	0.5[y] to 1.0 across the period	
Oct	0.9			
Nov	0.5[z]			
Apr	0.5 to 0.9 across the period	0.9	0.5	
May			1.0	1.0
June	0		1.0	
July	0		1.0	1.0
Aug	0		0.5	
Possible seasonal N totals per 1,000 sq ft[x]	2.0-3.5	1.0-2.0	2.0-4.0	1.0-2.0

[z] *Areas highlighted by green shading indicate optional fertility timing and N levels. Adjust use rates to meet site-specific needs of a particular grass based on the factors affecting nutrient management that are outlined in the Factors Affecting Nutrient Management section (e.g., higher quality, recovery from traffic, etc.).*

[y] *Virginia Tech researchers discourage winter overseeding of all warm-season turfgrasses except for bermudagrass due to poor spring recuperation potential of the warm-season turf. If bermudagrass is overseeded, additional N (highlighted by the yellow shading) can be applied to support the establishment and development of the overseeded grass after the bermudagrass enters winter dormancy.*

[x] *Seasonal totals are not necessarily intended as target levels. Adjust respective N application levels to ensure N fertilization levels do not exceed possible seasonal totals.*

Table 4. Program 3: Recommended monthly and seasonal nitrogen totals for Virginia's primary turfgrasses when using nitrogen (N) sources that are ≥50% slowly available and/or water-insoluble N, according to the guaranteed analysis of the fertilizer.

Month of application	Pounds of N per 1,000 sq ft per active growing month to apply to tall fescue, perennial ryegrass, or Kentucky bluegrass	Pounds of N per 1,000 sq ft per active growing month to apply to fine-leaf fescue	Pounds of N per 1,000 sq ft per active growing month to apply to bermudagrass or St. Augustinegrass	Pounds of N per 1,000 sq ft per active growing month to apply to zoysiagrass or centipedegrass
Sept	1.0 to 1.5	1.0	0.5[y] to 1.0 across the period	
Oct	1.0 to 1.5			
Nov	0			
Apr	0[z] to 1.0 across the period	1.0	1.0 to 1.5 across the period	1.0
May				
June			1.0 to 1.5 across the period	
July	0			1.0
Aug	0		1.0	
Possible seasonal N totals per 1,000 sq ft[x]	2.0-2.8	1.0-2.0	2.0-3.2	1.0-2.0

[z] *Areas highlighted by green shading indicate optional fertility timing and N levels. Adjust use rates to meet site-specific needs of a particular grass based on the factors affecting nutrient management that are outlined in the Factors Affection Nutrient Management section (e.g., higher quality, recovery from traffic, etc.).*

[y] *Virginia Tech researchers discourage winter overseeding of all warm-season turfgrasses except for bermudagrass due to poor spring recuperation potential of the warm-season turf. If bermudagrass is overseeded, additional N (highlighted by the yellow shading) can be applied to support the establishment and development of the overseeded grass after the bermudagrass enters winter dormancy.*

[x] *Seasonal totals are not necessarily intended as target levels, but the upper limits represent the maximum amount of N that should be applied during the growing season. Program 3's seasonal totals are lower than those of Programs 1 and 2 because of the higher per-application rates that are recommended. Use the factors affecting nutrient management to determine if the less frequent and higher recommended rates per application meet the site-specific needs of a particular grass.*

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Produced by Virginia Cooperative Extension, Virginia Tech, 2021

VT/0621/430-011 (SPES-334P)