NUTRIENT MANAGEMENT GUIDELINES FOR SOD PRODUCTION IN MARYLAND

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Nutrient management laws passed by the Maryland Legislature in 1998 require that turfgrass sod producers in Maryland participate in agricultural nutrient management programs. This publication is intended to serve as a nutrient management guideline for the production of sod in Maryland in an efficient, timely, and environmentally sound manner.

A nutrient management plan incorporating these guidelines must be developed by a nutrient management consultant certified and licensed by the Maryland Department of Agriculture.

Some differences exist between the goals and practices of general agriculture and sod production. The primary goal in most crops is to maximize yield in a manner that makes economic sense. The goals in sod production are twofold: 1) To produce turfgrass of sufficient quality that is marketable, and 2) To produce harvestable sod in the quickest manner possible.

Quality sod needs to be dense, relatively uniform, and free of weed, disease, and insect pests. Sod must also be harvestable (i.e., it must be sufficiently knit that it holds together when cut, can be transported, rolled, unrolled and laid onsite without falling apart). A good nutrient management program is a major component of producing quality sod that is marketable.

For economic purposes, sod must also be produced in the timeliest manner possible. The seasonal window for seeding cool season turfgrass species to produce sod is relatively narrow. Seeding must be done from late summer through early fall if sod is to be harvestable before the prime seeding period is reached again the next year. Failure to produce harvestable sod within this timeframe means that sod production is on a two-year rather than one-year cycle, which has serious economic consequences. Again, a good nutrient management program is critical in producing sod in an economically timely fashion.

Water Quality

Properly managed turfgrass has been shown to be an environmental asset. Water runoff is greatly reduced and water infiltration increased compared to most other agriculture systems.

Once turfgrass is established, soil loss is negligible. Runoff from established turf has compared favorably to forested land. Because turfgrass is an organic matter producing system, little nitrogen (N) or phosphorus (P) is lost from turfgrass sites if sound nutrient management practices are followed.

Indeed, onsite monitoring and numerous research studies have shown that nutrient losses from turfgrass sites are very small. However, research has also shown that certain types of improper N applications on specific types of sites can result in excessive nitrate (NO_3) leaching.

KEY POINTS

A nutrient management plan must be developed by a certified nutrient management consultant.

Adequate nitrogen and phosphorus are critical for producing quality sod in a timely, economical fashion.

Adequate nitrogen and phosphorus are essential for rapid establishment and reducing potential soil erosion.

Most nitrogen for sod production should be applied during periods of active turfgrass growth.

The problem of nitrate leaching is very specific and has occurred as follows:

1. Very high rates of N were applied using soluble NO_3-N containing fertilizers, such as ammonium nitrate [NH_4NO_3],
2. The fertilizer was applied to dormant turf, such as bermudagrass during the winter,
3. Soils were predominantly sand, and
4. The sites had high water tables.

A sound turfgrass nutrient management plan must consider this set of conditions that can cause a potential problem.

Soil erosion from established turf is not a problem. However, from the time of soil preparation to the time seed has germinated and plants have become established, soil erosion can occur. Enhancing the rapidity of sod establishment, therefore, is an important factor in minimizing potential soil erosion. A sound nutrient management program is an important factor in enhancing rapid establishment and minimizing the potential for soil erosion.

Nitrogen Applications

Nitrogen fertility is of primary importance in producing quality sod in an economically timely fashion. Nitrogen has a major impact on root and shoot growth rates. The density of sod, the ability to withstand the encroachment of weeds (thus also reducing the need for herbicide applications), the incidence of some diseases, the recovery from summer stress problems, and the length of time from seeding to harvestable sod are all highly dependent on adequate N.

Three major factors must be considered in developing an N application plan:

1. What types of N should be applied,
2. How much N must be applied at seeding and during the year for production, and
3. When should N be applied?

Sources Of Nitrogen

A wide range of N-containing fertilizers are available to the sod producer. These fertilizers generally fall into one of two broad categories:

1) fertilizers that contain only soluble quickly available N, or
2) fertilizers that contain some N in a slowly available form which is not immediately available for plant use.

Quickly available N-fertilizers contain NO_3-N and/or NH_4-N, which is soluble and readily available for uptake by turfgrass plants. Turfgrass uptake may occur within a few days with NO_3-N fertilizer. Nitrogen uptake may begin within 7–10 days with NH_4-N fertilizers as NH_4-N is converted to NO_3-N in the soil. Nitrogen uptake by turfgrass roots is predominately in the NO_3 form.

Leaching and runoff potential is much higher for NO_3-N. Thus, where conditions exist that are conducive to leaching or runoff, fertilizers that contain significant amounts of NO_3-N should not be used. These conditions include sandy sites (sands and loamy sands) with high water tables when turf is not actively growing, and sites that are highly sloped. Fertilizers high in NO_3-N include NH_4NO_3, potassium nitrate, and calcium nitrate.

Slow release fertilizers contain significant amounts of N that is not immediately available for plant uptake. Examples of fertilizer sources that contain various amounts of slow release N include sulfur coated ureas, polymer coated ureas, methylene ureas, ureaformaldehydes, IBDU, natural organics, and various types of sludge. Slow release fertilizers, while varying considerably in individual characteristics, typically provide more even turfgrass response, provide N over a longer period of time, and are less prone to N leaching and runoff as compared to soluble N fertilizers.

The expense of slow release fertilizers makes their widespread use in sod production limited. Their use, however, should be considered on the aforementioned sites that are prone to leaching or runoff, and when N applications need to be made to turfgrass that is not in prime growing conditions.

Total Nitrogen Requirements

Establishment - Whereas the annual N requirement varies somewhat with turfgrass species, particularly after the first year of growth, the N requirements at the time of seeding are rather uniform. It is recommended that up to 45 lbs. of readily available (soluble) N per acre be applied prior to seeding if fertilizer is broadcast. If fertilizer is incorporated deeper than 2 inches, then up to 90 lbs. readily available N per acre may be applied and incorporated into the soil. Research would indicate, however, that there is no great advantage in sod production with the incorporation of N deeper than the surface 2 inches of soil.

If fertilizers are applied containing slow release N (water insoluble N [WIN]), no more should be applied than that which provides the aforementioned rates of readily available N. For example, if a slow release fertilizer contains 50% WIN and the recommended application rate is 45 lbs. N/acre, then no more than 90 lbs. N/acre of this fertilizer should be applied. Also, the slow release N applied to the seedbed should be factored into the first year's production applications of N.

Production – Maintenance fertilizer applications for growing sod generally begins 4 – 8 weeks after turfgrass seed has germinated. The total annual N requirements for growing quality sod in a timely manner is dependent on many factors, including turfgrass species, length of growing season, soil type, field fertility history, and the need for recovery from stresses caused by unusual weather or pest problems. However, the annual N requirements for the most common turfgrass species grown for sod in Maryland generally fall into the ranges listed in Table 1. If fertilizer containing slow release N was applied to the seedbed at or prior to seeding, the slow release fraction (WIN) should be included in calculating the total N applied for production of the sod in the first year.

Table 1. Nitrogen Recommendations for Sod Production

	Total Nitrogen Annually (lbs. N/acre)	
Cool Season Grasses	**1st Year**	**Subsequent Years**
Kentucky bluegrass	130 - 200	130 - 175
Turf-type tall fescue	130 - 175	90 – 175
Fine fescue	90 – 175	45 – 130
Creeping bentgrass	175 – 260	130 - 220
Warm Season Grasses	**1st Year**	**Subsequent Years**
Bermudagrass	130 – 175	90 - 175
Zoysiagrass	90 – 175	45 - 130

Timing of Nitrogen Applications

The primary potential for N loss from turfgrass sites is when excessive rates of NO_3-N is applied to turf that is not actively growing. Thus, most of the annual fertilizer requirement should be applied during periods of active shoot (leaf blades, rhizomes, stolons) and/or root growth.

The primary period for growth of warm season grass species (zoysiagrass, bermudagrass, and buffalograss) is from mid-spring, after dormancy has broken, through mid-fall, when the first killing frost is experienced. Thus, N applications should generally be restricted to these periods; however, fertilizer that contains primarily NH_4-N can be applied up to a month before dormancy is typically broken in the spring so that N is available for plant uptake at this time. Applications after September 1 are not generally recommended due to the possible enhancement of winter-kill, particularly with bermudagrass. However, if bermudagrass has been over seeded with a cool season species such as perennial ryegrass, up to 45 lbs. N/acre may be applied after September 1 to enhance its performance.

Cool season grasses have a much longer growth period. They can exhibit growth virtually anytime during the year if moisture and temperature conditions are conducive. The prime periods for growth are typically from late winter through early summer and from late summer through early winter. Research would indicate that 2/3 to 3/4 of the total annual N should be applied during the latter period to maximize turfgrass performance and quality.

Under extended hot and dry periods during mid-summer, cool season grasses may experience a period of dormancy until rainfall occurs. If irrigation is available or if rainfall is adequate during the summer, little dormancy will occur and N uptake will continue. During winter, although top growth may have virtually ceased, root growth and N uptake may still occur during the periods when the ground is not actually frozen, particularly with Kentucky bluegrass. Research has shown that applications of N during this period can enhance root growth and spring performance of turf. Also, it is often difficult to fertilize sod fields in late winter to early spring due to excessive soil moisture, and there is potential for significant damage to the sod from equipment used for fertilization under those conditions.

There is little risk of runoff or leaching problems from winter application of N if certain guidelines are followed. No more than 45 lbs. N/acre should be applied, fertilizers containing significant amounts of NO_3-N should not be used, and applications should not be made to frozen ground if significant rainfall is in the immediate forecast.

Phosphorus and Potassium

Phosphorus (P) is critical in the establishment of turfgrass. Inadequate soil P will result in very poor seedling vigor, slow establishment of grass, and a stand with very poor density and root growth. Not only will sod not be harvestable, but the soil will be more susceptible to erosion. Weed encroachment will also be much more severe due to the lack of competition from the thin turfgrass stand. Thus, it is essential that sufficient P be added to the soil at the time of seeding if harvestable sod is to be obtained.

Potassium (K) is not as critical as N or P during the initial establishment phase of sod. However, K plays an important role in mature sod regarding rhizome production and tolerances to heat, drought, and cold. Thus, sufficient K needs to be available to ensure that quality sod will be obtained after summer and/or winter stresses. Severe deficiencies of K will result in thin, chlorotic, and non-vigorous turf.

Whereas N application recommendations cannot currently be obtained from soil tests, recommendations for application of P and K must be obtained from them. Any field that is going into sod production for the first time should be sampled. For fields that have previously been in production, sampling every 3 years is generally sufficient to monitor soil P and K levels. However, it is advisable to sample soil prior to any new seeding. Fields having different soil types, fields with different cropping or management histories, and/or fields having substantially different fertility levels as determined by previous soil tests should be sampled separately.

Conversely, fields having similar soil types, similar cropping and management histories, and similar fertility levels as determined by past soil tests may be lumped together into one sample. Current P and K recommendations based on soil test results for the establishment and production of sod are listed in Table 2 and Table 3. In addition, the Phosphorus Site Index should be used to evaluate the potential risk for P movement from the site to state waters.

Table 2. Phosphorus Recommendations for Sod Production Based on Soil Test Results from Univ. of Md.

	Soil Test Phosphorus Category		
	low	medium	optimum - excessive
Establishment		lbs. P2O5/acre	
Broadcast or incorporated up to 2 inches	90 - 175	45 - 90	0 - 90
Incorporated over a 2 inch depth	130 - 220	45 - 90	0 - 90
Production	90 - 130	45 - 90	0 - 90

Table 3. Potassium Recommendations for Sod Production Based on Soil Test Results from Univ. of Md.

	Soil Test Potassium Category		
	low	medium	optimum - excessive
Establishment		lbs. K_2O/acre	
Broadcast or incorporated up to 2 inches	90 - 175	45 - 135	0 - 90
Incorporated up to 2 inches	130 - 220	45 - 135	0 - 90
Production	90 - 175	45 - 135	0 - 90

Soil Reaction

Maintaining soil pH in an optimum range is important for maximizing the efficiency of nutrient use, and can be important in reducing weed and disease problems. Turfgrass can withstand a rather broad range of soil pH, but 5.8 to 6.4 is generally considered ideal. Wide deviations from this range can result in reduced P and micronutrient availability, and can interfere with soil N metabolism and availability. Depending on turfgrass species, problems in turf may start to occur at soil pH above 7.8 and below 5.4 Thus, to maximize efficiency of nutrient availability and use, soil tests should be taken as recommended previously for soil P and K to determine soil pH.

Recommended limestone applications to achieve a soil pH of about 6.4 are shown in Table 4. If diseases such as take-all patch of bentgrass, summer patch of Kentucky bluegrass, or spring dead spot of bermudagrass are of concern, maintaining lower soil pH (5.4 - 5.7) may be desirable, and reduced or no limestone should be applied to achieve this level. Also, it is recommended, when practical, that limestone be applied approximately one month or more before seeding to minimize potential P availability problems and the potential for volatilization loss of applied N.

It should be emphasized that the information presented within this publication for N, P, K, and limestone applications is meant only as a guideline. While these recommendations should result in satisfactory sod production in most situations, there are many factors that could impact whether modifications of these recommendations are warranted for a specific site. Higher rates of fertilization may be warranted for specific sites and/or conditions.

Table 4: Limestone Establishment Recommendations (Pounds per Acre)

			Coastal Plain		Piedmont & Mountain	
soil pH	loamy sands	sandy loams	loams	silt loams and silty clay loams	loams	silt loams and silty clay loams
6.4	0	0	0	0	0	0
6.3	0	0	0	0	1090	1305
6.2	0	0	1090	1090	1525	2180
6.1	0	1090	1305	1525	1960	2830
6.0	870	1525	1740	1960	2395	3700
5.9	1090	1740	2180	2395	2830	4355
5.8	1305	2180	2395	2830	3485	5010
5.7	1525	2395	2830	3265	3920	5880
5.6	1740	2615	3265	3700	4355	6535
5.5	1960	3050	3700	4140	4790	7185
5.4	2180	3265	4140	4355	5445	7840
5.3	2395	3700	4355	4790	5880	8710
5.2	2615	3920	4575	5225	6315	8710
5.1	2830	4140	5010	5665	6750	8710
5.0	3050	4575	5445	6100	7185	8710
4.9	3265	4790	5880	6315	7625	8710
4.8	3485	5010	6100	6750	8275	8710
4.7	3700	5445	6535	7185	8710	8710
4.6	3920	5665	6750	7625	8710	8710
4.5	4140	6100	7185	8060	8710	8710

1) divide the above rates by 43.5 to obtain the equivalent rates in pounds per 1000 square feet
2) divide the above rates by 2 to obtain maintenance limestone recommendations for turfgrass
3) do not apply more than 2,000 pounds per acre for any one maintenance application to turfgrass

Related Publications: TT-115 Nutrient Mgt. Guidelines for State Property and Commercially Managed Turfgrass
Univ. of Maryland Cooperative Extension Service Fact Sheet 702 – Lawns and the Chesapeake Bay