NATIONAL CEMETERY ADMINISTRATION
SED
Agronomic Information Sheet # 4

Turfgrass Fertilizer Selection

This protocol provides an overview of the current range of product choices that exist within the turfgrass maintenance industry. Although a substantial portion of the fertilizer products utilized by turfgrass managers today is common or Agricultural grade material, the specialty type products developed specifically for turfgrass are of greatest importance and value. Most of these are based on various technologies designed to control the rate at which nutrients are released for use by the targeted plant material. As the showcase nutrient in most fertilizer programs, nitrogen attracts the greatest attention of both suppliers and users.

Voluminous research has been conducted on the nutritional requirements of healthy stands of turfgrass for various uses. There is general understanding of the quantities of essential, secondary and minor elements required for producing healthy turf and the approximate ratio in which the essential nutrients, N(nitrogen)-P(phosphors)-K(potassium) should be delivered. That ratio is in the 3-1-2 to 4-1-2 range for established stands of turf and in the 1-2-2 area for products used during stand establishment.

Fertilizer Technology Alternatives:

Although by its basic nature, fertilizer is fertilizer, the battle for competitive differentiation is waged utilizing unique processes designed to control the release and availability of the plant nutrients the fertilizer contains.

One of the primary differentiating categories for fertilizer is based on the initial source of the nitrogen component, natural organic versus synthetic. The former is based on naturally occurring materials that contain nitrogen such as animal manure, organic materials, etc. These types generally contain only small percentages of nitrogen, generally less than 6%, and are slow to release their nitrogen when applied for plant growth. They are also much more costly per unit of nitrogen than most synthetic sources.

The additional plant nutrients, potassium and phosphorus that are added to nitrogen to constitute a complete fertilizer are naturally occurring minerals and are produced through mining activities. The manner in which the three; N, P, K are combined becomes one of the differentiating qualities that is used by suppliers to entice users to their brand.

The least sophisticated and costly is a simple physical blend of sources of the three nutrients. Almost all agricultural grade complete fertilizers are blended in this manner. Typical analyses might be a 15-15-15 or 20-20-20 or 5-10-10. Although these types are not the primary marketing focus of fertilizer suppliers and distributors serving the T&O

markets, they do constitute a significant percentage of the total tons used annually. Their lower cost obviously drives the use of these fertilizer types.

The next step up the differentiating ladder is the production of a homogenous fertilizer particle. These particles contain all primary nutrients and are sized to meet the turfgrass density demands of the site being fertilized, i.e., golf course fairway, putting green, home lawn, athletic field, cemetery and are screened to have a narrow range of particle sizes in a finished batch. These types of products are considered superior for utilization on highly maintained stands of turfgrass as they provide a more uniform growth response and are generally dust free and much easier to apply. Beyond the three primary nutrients around which the T&O fertilizer market revolves, secondary plant nutrients such as iron, magnesium or sulfur and various micro nutrients (boron, molybdenum) are often added to create additional differentiating features that might sway a potential buyer.

The final step up the differentiation ladder is the use of various processing technologies that result in finished fertilizer particles whose plant nutrients are slowly released for plant use. Urea is the most widely used source of nitrogen for turfgrass fertilization. By itself, urea is a water soluble rapidly available source of nitrogen. When urea is either reacted with various complexing compounds such as formaldehyde or mechanically coated with sulfur or plastic-like polymers, it becomes the basis for the controlled release forms of nitrogen that are marketed at the premium end of the turfgrass and ornamental fertilizer spectrum.

Controlled release forms of nitrogen include urea formaldehyde, various methylene ureas, isobutylidene diurea (IBDU), sulfur coated urea, polymer coated urea, sulfur and polymer coated urea, aminoureaformaldehyde, and stabilized nitrogen.

Urea formaldehyde reaction products were first introduced to the turfgrass industry in the 1960’s. They are produced by reacting urea and formaldehyde to create complex chain structured molecules of various lengths. Generally, the more complex the chain structure, the slower the nitrogen release. The rate of nitrogen release for these molecules is determined by microorganism activity in the soil. High temperatures, neutral soils and an adequate supply of moisture and oxygen favor microbial activity and then promote nitrogen release from urea formaldehyde. Urea formaldehyde fertilizer used alone will not release an adequate supply of nitrogen until 2 or 3 years of consecutive use. They have essentially no turfgrass burn potential nor are there any likelihood of nitrogen loss due to soil leaching. Their use as a primary source of controlled release nitrogen has diminished significantly over the last 10 to 15 years.

IBDU was developed as an improvement over urea formaldehyde. It is the reaction product of urea and isobutylaldehyde. It depends solely on water to hydrolyze it to urea. The rate at which this occurs varies with soil ph, temperature, particle size and moisture. IBDU is effective between ph 5 and 8. From a manufacturing and processing perspective, IBDU particle size is used to vary the nitrogen release rate. The finer the granule, the greater the surface area, and the faster the rate of hydrolysis. Thus, varying the sizes of IBDU granular allows nitrogen release to be distributed over a longer period. Particle sizes between 8 and 24 mesh are recommended for turfgrasses. Properly sized and used, IBDU is generally a more efficient source of nitrogen than urea formaldehyde.

Sulfur coated urea is produced by spraying preheated urea with molten sulfur. Release of nitrogen for SCU depends on the time required for microorganisms to break down the sulfur coating. SCU is the least uniform of the slow release nitrogen sources. Imperfections in the sulfur coatings result in each particle having a slightly different rate of release. Coatings can also be crushed in handling and in the bag. An additional benefit eventually results from SCU when released sulfur becomes available to the plant but it can also increase soil acidity. Despite its imperfections, SCU is the most widely used form of CRN in the market. This is driven somewhat by a relatively low cost of production verses some other slow release sources.

Polymer coated urea is produced by applying a plastic like polymer to each urea particle. This results in particles that will only release nitrogen through the process of osmosis. Water from the soil moves through the polymer coating, dissolves the urea within slowly and it then moves outward into the soil for uptake by plant roots. This process is independent of the quantity of water available. Excessive rainfall will therefore not accelerate the release process. The primary determinant of nitrogen release from polymer coated products is temperature. Varying the thickness of the polymer coating is a technique used to tailor these products to delivering their nitrogen content over a desired span of time. This is accomplished by coordinating the coating thickness for the average soil temperatures expected at the use site to achieve the desired span of release. Products ranging from 90 to 180 days are commonly offered.

Combinations of polymer and sulfur coating technologies are also being utilized to provide some of the benefits of each approach.

Stabilized forms of nitrogen (urea) are produced by adding both a urease inhibitor to stop volatilization and a nitrification inhibitor to stop leaching. Since this process does not involve any additional processing/manufacturing or expensive chemical coats, the end product is substantially less expensive to produce than many other controlled release types. This approach to nitrogen release keeps the available nitrogen in the ammonium form, which is also usable for plant uptake.

The most recent technological innovation in the slow release nitrogen category is a new process for producing urea formaldehyde. It adds ammonia to the normal reaction process to stop the urea and formaldehyde reaction at a point that reduces the growth of methylene urea polymers. The new product is called aminoureaformaldehyde and is claimed to contain a higher percentage of hot water soluble nitrogen, a lower percentage of unreacted urea and hot water insoluble nitrogen. This combination results in a more efficient form of controlled release nitrogen.

CONTROLLED RELEASE NITROGEN: TECHNOLOGIES AVAILABLE

Technology Classification	Ingredient Brand Name(s)	Primary Supplier(s)
Urea Formaldehyde (methlylene ureas)	Nitroform, Blue Chip Nutralene	NuGro Technologies
IBDU	ParEx, IsoTek	Lebanon Seaboard
Sulfur Coated Urea	Numerous	Lesco, Purcell Andersons, Lebanon
Polymer Coated Urea	Polyon, MultiCoat	RLC Technologies TRI-Pro
Polymer plus Sulfur Coated	Poly S, Poly Plus TriKote	Lesco, Purcell Andersons, TRI-Pro
Aminoureaformaldehyde	Novex	Lesco
Stabilized Nitrogen	UMAXX, UFLEXX	Agrotain

How does a turfgrass manager make the decision which of these many variations and combinations of slow release technologies is best for his/her circumstances? Obviously, personal experience over time will dictate which fertilizer types provide the performance results any particular user prefers. Despite the extremely broad range of available choices, an educated user can effectively manage the health and vigor of the turfgrass stand using any of the available alternatives in a suitable manner. The sales representative's pitch to his customer is often shaded in dubious claims regarding unique or superior performance for whichever fertilizer type he happens to represent. This blue smoke and mirrors approach must be largely ignored and replaced with a combination of informed awareness based on creditable university test results and hands on use experience.

One new development has occurred which may assist users in comparing competing claims of performance superiority. A new system, the PIN rating, has been developed for sorting out the differences between water insoluble sources of nitrogen. PIN stands for "Performance Index Number", where P is particle dispersion, I is for particle integrity and N is for nitrogen activity index. These three factors are determined using specific tests, and a quantitative measure is assigned to each. The 3 resulting numbers are then totaled to give the PIN rating.

P is a measure of how readily the fertilizer granule breaks down in the presence of moisture. Particle dispersion is expressed as the percentage of a sample that passes the dispersion test. A measured amount of fertilizer is placed in a beaker of distilled water and stirred for a fixed amount of time. The mixture is then passed over a screen. The amount that passes through the screen is the “P” in the PIN rating. The minimum acceptable value for P is 80%.

I is a measure of how hard the fertilizer particle is. This will indicate how well a fertilizer’s particles will hold up through the rigors of production, bagging, shipping and spreading. It is also expressed as a percent. Ninety is the minimum acceptable integrity rating but 95 or greater is a far more acceptable value.

N is the nitrogen activity index. It is the percentage of water insoluble nitrogen that is soluble in hot water. The higher the index, the better, because hot water soluble nitrogen provides a response in the second and third month after application. The minimum acceptable index is 65 %.

Adding the 3 numbers resulting from the individual tests gives the PIN number. The theoretical maximum score is 300, but it is safe to say that a fertilizer with a perfect 300 score will never be produced. From the minimums suggested; P=80, I=90, and N=65, will give a 235 score as the lowest acceptable PIN. A suggested target number to achieve the best performance from a slow release fertilizer is **255**. A **255** PIN might realistically be achieved with a P value of 85, an I value of 95, and an N of 75. Of the 3, the N rating is the most revealing as to the product’s performance and the total efficiency (or availability for plant use) of the nitrogen package of a fertilizer product containing water insoluble nitrogen.

The **PIN** rating is a collection of basic fertilizer attributes that allows the user to make a sound qualitative and quantitative judgment about water-insoluble nitrogen in fertilizers. If the user knows and understands the PIN rating, he knows a lot more about the fertilizer than he could have in the past.

It is most often the case that the nitrogen source(s) contained in a given fertilizer determines its positioning in the quality hierarchy. Since nitrogen is generally the nutrient that delivers the biggest growth response this preeminence is probably warranted. Potassium on the other hand has often been overlooked until more recently. As the nutrient demanded second only to nitrogen by healthy vigorous turfgrass plants, potassium has started to be recognized for the contribution it makes toward total stand well being. Disease and environmental stress tolerance are two of the key attributes optimum quantities of potassium impart on a turfgrass population.

Recognition of potassium’s importance and utilization of its presence in one of the available sources of nitrogen (Potassium nitrate) combined with the polymer coating technology already discussed has encouraged some suppliers to use poly-coated potassium nitrate as an additional item for differentiating their product from the pack. Since potassium use from more traditional sources such as KCL can also be a plant burn risk, the coating approach offers a clear benefit.

Since nitrogen represents the showcase component of almost all turfgrass fertilizers and because the use of various controlled release technologies for nitrogen impacts the finished cost so dramatically, knowledge of the relative costs of these alternatives is helpful. With urea set as the low end cost benchmark, the costs of all other technologies are indicated in the following chart.

COST PER TON – CONTROLLED RELEASE NIROGEN SOURCES

Lowest____Highest

Urea	SCU	UMAXX	Polymer Coated	Nutralene	UF	IBDU
($190)*	($340)	($575)	($650)	($760)	($990)	($1004)
	46-0-0		42-0-0	40-0-0	38-0-0	31-0-0

*The market price for urea fluctuates substantially from year to year and sometimes within a single season. Prices are currently ranging from $185 to 260/ton. These fluctuations do not normally affect the prices charged for the other sources listed. Novex, Lesco’s new controlled release nitrogen is only available in complete fertilizer analyses sold to end-users. On a cost per unit of N basis, it falls between Nutralene and UF.