Does the Grass Know the Cost?

Don't get your green thumb by handing over cash.

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A well-conditioned golf course is the goal of every turf manager, and it takes fertilizer to accomplish this goal. The challenge is to provide that well-maintained golf course for less money.

Today's golf course superintendent has a huge range of products to choose from for turfgrass fertilization. This is good. Competition brings better products, better service on these products, and lower costs. In today's challenging economic times, anything we can do to reduce or control costs is good, especially if the health, appearance, and playability of your turf is not compromised. After all, the vast majority of golfers still want and expect to play a well-conditioned golf course. The challenge for many golf course superintendents is to provide these conditions at a lower cost.

This article considers options that may do just that. It is a basic discussion about fertilizers. Does the grass really know the difference among the myriad fertilizer products available to today's turf manager? Does a high-priced fertilizer produce better grass? Should you consider less expensive fertilizers that are easy to use, provide the response you want, and cost less? Let's find out.

THE QUESTION

How do you buy your fertilizer?

1. Cost per bag?
2. On sale?
3. Convenient to get?
4. Have experience with that particular fertilizer?
5. You like the distributor and salesperson?
6. How easily the bag opens?
7. Rate of release? (What's in the bag?)
8. Fertilizer analysis (based on soil test results)?

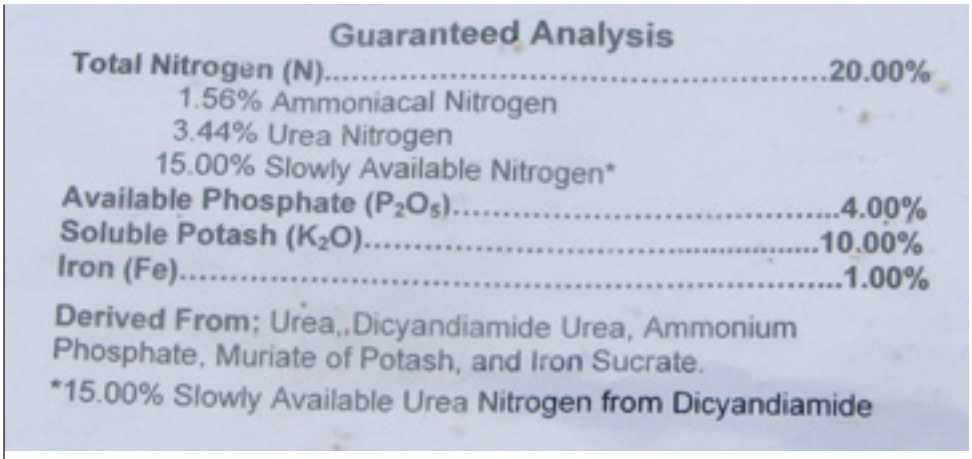
9. What do you want that fertilizer to do (quick green-up, dormant feed, etc.)?

10. Cost per pound of the nutrients you *actually need*?

You probably already know the answer. Your fertilizer purchase should be influenced by numbers 4, 7, 8, 9, and 10, and less by numbers 1, 2, 3, 5, and 6.

Does the grass know the difference in the fertilizer you use? Our team suspects that you are already answering that question in your own mind. The answer — probably not! You are essentially correct. Most nutrients enter the grass plant in an inorganic form. Therefore, all fertilizers must be converted into a form the grass plant can use. Most commercial fertilizers are blends of quick-release, intermediate-release, and slower-release plant foods, primarily nitrogen. Nitrogen remains the most important of all fertilizer ingredients. Nitrogen promotes plant growth, and other nutrients support plant growth. But there is a difference.

Everything about the actual makeup of that fertilizer is on the label. Read it. After all, if you are looking for a quick response, then nitrogen is the primary plant food you are seeking. All the other nutrients, while important, may simply be unnecessary, especially if soil tests do not show a deficiency for that nutrient. Why use and pay for nutrients that the grass does not need or the soil does not require? You could be wasting money, adding extra nutrients to the soil that the grass plant does not need, or having a negative environmental impact. There has been a trend in our industry to base soil fertility recommendations on Base Cation Saturation Ratios (BCSR). Research results show that extra fertility from BCSR recommendations does not mean healthier grass. Also, the trend to spray soluble fertilizer onto the grass (spoonfeeding) is becoming common. What a great program! Here again, do expensive liquid fertilizers result in better plant response than simple (and less expensive) urea? Again, you probably know or suspect the answer.



Note the "derived from" line on this complete fertilizer. The main nitrogen component is urea and urea derivatives. This portion of the label often goes unread, yet it lists what is in a bag of fertilizer.

READ THE LABEL

Every fertilizer bag lists what is contained in that bag. The most important part of the label is at the bottom: "Derived from." It lists the actual ingredients contained in the bag. Note that the first listed nutrient is urea, the primary plant food in most commercial fertilizers. It is readily available (turf managers like to see a quick response), has a reasonably low burn potential, especially when blended with slower-release nitrogens, and is relatively inexpensive. This begs the question, "If plant response is your goal, is there a need to fertilize with anything other than nitrogen?" Certainly, as it pertains to spoonfeeding low-rate soluble nitrogen products sprayed onto the grass, the answer could well be no.

Obviously, every situation is different. As the turf manager who makes decisions on the fertilizer and fertility programs for his golf course, these are the decisions that only you can make. As field agronomists for the USGA, we see that golf courses have different fertilizer programs. Some are based on science (soil testing), and other decisions on fertilizer applications are based on the *art* of greenkeeping — the experience the turf manager has with the grasses, soils, and the different growing environments that exist on each golf course. The thoughtful golf course superintendent combines both the *science* and the *art* of turf management to do what is best for the golf course, while being mindful of the budget and considering ways to save money — not compromising the appearance or playability of the golf course. That said, there are some basic factors that should be part of every fertilizer purchase.

DO THE MATH

For the purpose of this article, we will compare urea (46-0-0) to a fairly common and relatively inexpensive complete fertilizer. Note: The complete fertilizer contains phosphorus and potassium, which urea does not contain. However, if your turf needs the response that only nitrogen can provide, these other nutrients just aren't needed. The prudent turf manager should do the math for any and all fertilizer elements applied to the turf. You may be surprised about what you find. Following are some simple fertilizer comparisons. The first is for large acreage and the second is for a soluble, spoonfeeding program.

- Urea (46-0-0) costs about $20 per 50 lb. bag.
- Each 50 lb. bag contains 23 lbs. of N (50 lbs. × 0.46).
- One lb. of N costs about $0.87 ($20.00/23 lbs. per bag).

- To apply 1 lb. of N/1,000 sq. ft. over one acre costs about $38.00 (43.56 × $0.87).
- FYI: 1 lb. of N/1,000 sq. ft. over one acre using 20-4-10 fertilizer costs about $70.00.

As mentioned earlier, in the most simple of terms, and if the lowest cost per unit of nutrient is desired, fertilizer purchases should be based on the unit cost or the cost per acre (or the cost per 1,000 sq. ft.) of that specific product as it pertains to nitrogen. Again, of all the fertilizer nutrients, nitrogen is the one most needed out on the golf course.

SPOONFEEDING

- To apply ⅛ lb. of N/1,000 sq. ft. using urea costs $4.75/acre (⅛ lb. × 43.56 × $0.87/lb.).
- FYI: Applying the same ⅛ lb. of N/1,000 sq. ft. using 20-20-20 fertilizer costs $51.00/acre.
- For 3 acres of greens, the difference is $138.75 per application for the same amount of nitrogen!

What does all of this mean? First, nitrogen is the most important element for plant growth. Although other macro and micronutrients are important, nitrogen is the driving force in plant response, something that seems to be lost or diminished as we are sold and as we buy fertilizers for our golf courses. Basic fertilizer can save money simply because it contains higher amounts of the most needed nutrient — nitrogen. It also costs less.

To help in the calculation of actual fertilizer costs, the following is a turf fertilizer calculator website produced by Purdue University. It is a simple way to figure out the cost per pound of fertilizer: *Turf Fertilizer Calculator*, Jonathan Hardebeck, Purdue University — http://www.agry.purdue.edu/turf/fertcalc/fertilization%20calc.html.

LET'S GET TECHNICAL

In what form are the principal fertilizer elements — nitrogen, phosphorus, and potassium — absorbed by the grass plant?

Nitrogen: "Although nitrogen (N) mostly enters the plant as an inorganic nitrate ion (NO_3), which is soluble and moves passively into the grass plant via the transpiration stream, the plant quickly converts nitrate to the amide form of NH_2 with the help of the enzyme nitrogen reductase. Then, through the linkage of carbohydrates and nitrogen metabolism, the amide is attached to six simple carbon sugars that are the end product of photosynthesis ($CO_2 + H^2O = C_6H^2O_6 + O_2$)." As the grass grows, it fixes carbon from the air for plant growth. "The result is a formation of basic amino acids, which, through a myriad of permutations, produce the proteins necessary for growth and the enzymes

Spoon-feeding fertilization is the frequent application of fertilizers at low rates. The method allows the turf manager to more closely control the amount of nutrients reaching the plant in one application.

necessary to catalyze a host of necessary metabolic reactions." (Dr. Thomas Watschke, Professor Emeritus, Penn State University)

Phosphorus: "Plant-available phosphate ions ($H_2PO_4^-$ and $HPO_4^=$) are usually present in soil water and are taken up by roots to supply the plant's growth requirements." (Dr. Peter Landschoot, Professor, Penn State University)

Potassium: "K exists in minerals and through weather is decomposed to K^+ ions." (Dr. Peter Dernoeden, Professor, University of Maryland)

Therefore, the primary macronutrients for the grass plant, N-P-K, are absorbed and entered into the plant as inorganic ions. Is there a difference between fertilizers? In the most basic molecular terms, no. The only difference lies in the burn potential — the salt index — between different fertilizers. The accompanying chart is for the most common forms of nitrogen and potassium at levels normally applied to turf. It is presented in descending order. That is, from the fertilizer having the least burn potential to a fertilizer having the highest burn potential, sodium nitrate.

Nitrogen/Potassium Source	Salt Index*
Natural Organic (6% N)	0.70
Potassium Sulfate	0.85
Diammonium Phosphate	1.61
Urea	1.62
Potassium Chloride	1.94
Monoammonium Phosphate	2.45
Ammonium Nitrate	2.99
Ammonium Sulfate	3.25
Potassium Nitrate	5.34
Sodium Nitrate	6.06

*Salt Index based on equal amount of nitrogen supplied

Micronutrients: Many fertilizers contain other ingredients generally referred to as micronutrients. Micronutrient deficiencies are rare. The most common micronutrient deficiency is for iron, one of the most readily available and least expensive micronutrients. Other ingredients in fertilizers, such as humates, wetting agents, seaweed extracts, and biostimulants, all have different functions. It is for the turf manager to determine whether or not the turfgrass needs these additives that increase the cost of the product over that of nitrogen. This, then, begs the question, do extra fertilizer nutrients in the soil make grass extra healthy? To answer that question, the following is an abstract from the Soil Science Society of America (SSSA).

NOTABLE QUOTES

A Review of the Use of the Basic Cation Saturation Ratio and the "Ideal" Soil (Dr. Peter M. Kopitike and Dr. Neal Menzies, School of Land and Food Science, the University of Queensland, Australia): Our examination of data from numerous studies suggests that, within the ranges commonly found in soils, the chemical, physical, and biological fertility of a soil is generally not influenced by the ratios of Ca, Mg, and K. The data do not support the claims that the BCSR, and continued promotion of the BCSR, will result in the inefficient use of resources in agriculture and horticulture.

Clearly, extra fertilizer nutrients only increase the cost of your fertilizer program with little benefit to the turf. Using simple soil tests remains the most efficient way to monitor soil pH and nutrient levels. Comprehensive soil tests are best used for sandy soils and less so for mineral soils.

Foliar Absorption of Nitrogen by Creeping Bentgrass Putting Green Turf Utilizing N Labeled Inorganic and Organic Sources. (Chris Steigler, Mike Richardson, Doug Karcher, and Aaron Patton, University of Arkansas): This research evaluated the potential for foliar absorption of N/labeled inorganic sources (urea, ammonium sulfate, potassium nitrate) and organic sources (three amino acids). They found only about 40-50 percent of N applied at 0.10 lb. N/M of a liquid application was foliarly absorbed 8 hours after application. All sources were similar except the potassium nitrate, which has low foliar uptake. In summary, if you apply 0.10 lb. N/M, only 0.05 lb. N/M will be absorbed through the leaves. Why pay a premium for products that are "specially formulated" to increase foliar absorption? Also, urea worked as well as the other products, so it appears that only a small portion of your total N budget can be foliarly absorbed.

Integration of Iron into Nitrogen Fertility Regimes for Regulation of Fertilizer and Water Requirements of Penn A-Series Creeping Bentgrasses. (Jing Dai, Max Schlossberg, and Al Turgeon, Penn State University): They found that iron affected color about the same as the nitrogen. This means that you can cut your N rate in half and get the same color response if you add iron to your foliar spray program of 0.10 lb. N/M/month. The take-home message: Use of iron is great for aesthetics; no need for expensive iron formulations because iron sulfate appears to work well. You can maintain good color but with less growth.

Evaluation of Cytokinin Plant Extract Biostimulants, Iron, and Nitrogen Products for Their Effects on Creeping Bentgrass Summer Quality (Dr. Derek Settle, Chicago District Golf Association, and Dr. Peter H. Dernoeden, University of Maryland): When the data were averaged over the season in both Illinois and Maryland, urea alone and treatments containing urea generally provided the best summer quality. There were, however, no significant differences among urea alone, IronRoots + urea, Roots Concentrate + urea, or PanaSea + urea at either site.

The same research compared NDVI (Normalized Difference Vegetative Index) color ratings. They were consistently highest in plots treated with urea, IronRoots + urea, Roots Concentrate + urea, or PanaSea + urea in Illinois (2007 and 2008) and Maryland (2008). There were, however, no significant NDVI rating differences among treatments containing urea.

Urea remains the most effective and cost-effective form of nitrogen. When the grass needs a nitrogen response, urea and ammonium sulfate may be your products of choice.

THE VALUE OF USING UREA

There is a subtle message in all of this research that has been quoted. Specifically, the value of using urea, 46-0-0. Urea is 100 percent water soluble and is a good choice for low-rate granular applications of nitrogen, ½ to 1 lb. N/M sq. ft. Urea has a lower burn potential than the other commonly used soluble fertilizer, ammonium sulfate (21-0-0). Urea readily dissolves in warm water, making it an ideal material to spray onto grass as part of a spoonfeeding program. The granular can also be applied. Note: There are different sized urea granules. Most turf managers use the smaller, feed-grade urea. It is easier to spread dry, provides better coverage, and is easier to dissolve (if used through a sprayer). Urea is also *the most inexpensive nitrogen source the turf manager can use.*

DISCLAIMER

Each golf course superintendent knows his or her course and its grasses better than anyone else. There is no substitute for experience. Don't change a successful program unless there is a good reason. Also, factors like "salt index" and the burn potential for all fertilizers cannot be forgotten.

Finally, there does remain the need to recycle organic byproducts (natural organics) for the good of the environment. The result is a balance between the needs of the grass, the budget, and the environment.

IN SUMMARY

With today's tight budgets, it may be time to re-think your fertilizer purchasing practices. The goal — supplying the grass with what it needs as effectively and efficiently as possible, while not over-applying necessary nutrients or nutrients the grass plant does not need, as determined by soil testing.

Remember, extra nutrients in the soil will not make turf extra healthy. Extra potassium will not make the grass plant extra tolerant to summer stresses or provide extra winter hardiness. Indeed, too much fertilizer can be wasteful (in terms of the budget) and can increase the risk of runoff and groundwater pollution (which is bad for the environment). Excessively high levels of nutrients at the wrong time of the year can even burn the grass. More is not always better.

It is very true that today's golf course superintendent has a large number of choices when purchasing fertilizers. The purpose of this article is to make turf managers better consumers.

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