Several industry researchers and superintendents talk about tomorrow's fertility programs and solutions

The View From the Top

ALSO:

The Future of Fertility Rests On Our Advocation, page 4

Biofertilizers Could Help Reshape the Industry , page 45

Tomorrow's Fertilizer, page 46

As the World Turns, So Should Your Fertility Program, page 50

PHOTO BY: MIKE KLEMME

ABOUT THIS SERIES

Golfdom, in unison with AGROTAIN International and LebanonTurf, aims to educate golf course superintendents through this special three-part series.

Part three features a peek into the not-too-distant future to see what superintendents will use as fertilizer and how they'll use it. Part three also includes a story on fertility programs according to seasons by turf professor Karl Danneberger. **Part two** of the series, which appeared in November, focused on the art and science of fertility. **Part one**, which appeared in October, examined modern-day fertility management.

The Future of Fertility Rests on Our Advocation

By Mike Stegmann

An article regarding Chesapeake Bay restoration just caught my attention. The health of the Chesapeake Bay has been a concern for more than 25 years. Past regulations have made some progress, but they have apparently not been aggressive enough. It was announced that new legislation is proposed that would expand the federal resources to put all necessary measures into place to achieve a healthy, restored Chesapeake Bay. The legislature would set a legally binding deadline of 2025 for states within the watershed. It also stated that this is the most significant advancement on the Chesapeake Bay in 20 years. Is this the future of fertility?

The turf industry has been working hard to educate the public and get credit for its environmental stewardship efforts, but the time for increased regulation is quickly approaching. Unfortunately, the trend is that well-intentioned voluntary initiatives are turning into strict regulations. The proposed Chesapeake Bay legislation is a great example.

Another good example is the Mississippi River Basin Healthy Watersheds Initiative (MRBI). Through this new initiative, Natural Resources Conservation Service and its partners will help to implement voluntary conservation practices in select watersheds. In turn, the participation in such practices will lead to a payment. In the future, these voluntary initiatives such as the MRBI may eventually be replaced with regulations that won't have payment incentives, but legal ramification for noncompliance.

So what can we — the collective members of the turf industry — do to address this growing national trend? For starters, we can take a more active role in voluntary initiatives when they develop in our own backyards, keeping up with proposed legislation and proposed changes. In addition, we can stay active in the Golf Course Superintendents Association of America and involve ourselves with local chapters, so we can serve as advocates of the golf course industry, serving as experienced educators to the general public.

This is why we, AGROTAIN International, makers of UMAXX, UFLEXX and HYDREXX, are working closely with government regulatory agencies and the research community to provide guidance and education regarding the benefits of our products. The philosophy behind our products is to improve the efficiency of nitrogen fertilizer and provide a product that is economical and environmentally stable, while providing proper plant nutrition. We take great pride in the extensive research that has gone into creating our product line as well as the continuous efforts to improve our product technology for the environmental benefit of the future.

Our unique stabilized nitrogen technology provides a solution for many concerns about nitrogen. Products that contain stabilized nitrogen technology, like UMAXX, UFLEXX and HYDREXX, represent the fertilizers of the future. They are user-friendly, economical, environmentally stable, and provide consistent color and fewer clippings.

In fact, the USDA is conducting research regarding greenhouse gas emission and our products are an integral part of this continuous five-location study. Three years of this research has been completed and the results show adding stabilized nitrogen to your fertility program improves nitrogen efficiency by reducing greenhouse gas emissions.

But replicated research such as the U.S. Department of Agriculture greenhouse gas emissions study is just one data source that should properly influence future regulations. In states such as Florida, regulations are being written on a grassroots level, sometimes without the guidance of research and end-user expertise.

As a superintendent, you're a proven steward of the land and have expansive knowledge regarding what is best for turf. Now is the time to use your influence by participating in voluntary initiatives to ensure future regulations include best management practices that you can utilize. ■

Stegmann is president of Lange-Stegmann Company and AGROTAIN International.

Biofertilizers Could Help Reshape the Industry

What if Usain Bolt, the Jamaican sprinter and three-time Olympic gold medalist, could run as fast as he does with only about half the training or nutrition? That would be a formula for efficiency the likes of which world-class athletes have never known.

What if plants could do the same thing? What if plants could grow to be as green, dense and healthy as they do under traditional fertilization programs, but with only about half the inputs? In our industry, that's an equally compelling proposition. As leading university professors and our own researchers are discovering, that radical level of efficiency is now possible through the emerging category of biologicals.

As we conclude *Golfdom's* three-part report on fertility with a look to the future, those of us at LebanonTurf don't need a crystal ball to realize that biological-based fertilizers have the potential to reshape our industry. That's not an overstatement when you consider that test results show fertilizer applications with biological additives can be reduced by as much as 40 percent over synthetic fertilizers without affecting plant health or performance.

But what are biologicals, what do they really do and how do they do it?

Biologicals is the name given to the wide range of living organisms, including microbes, bacteria and fungi, that can be added to a fertilizer prill or are standalone products that help nourish plants. They promote a healthy give-and-take with the plant: fungi consume carbohydrates exuded by the plant's roots and give back water, phosphorous and other minerals. Bacteria also consume carbohydrates, which are eaten by protozoa that, in turn, convert the bacteria's protein into nitrogen that feeds the plants.

Think of it as an underground revolution led by nature's own powerful army.

While the scientific turfgrass community has been studying organic fertilizers for several decades, only recently has the research started to uncover more of their story. Even now, Roch Gaussoin, a professor at the University of Nebraska and one of the leading authorities on biologicals, admits to a lack of understanding. "I wish we could better define it and explain it," he says. "But right now we're just excited by the biological products and impressed by the efficiency they're demonstrating."

Efficiency in the world of golf course superintendents and landscape professionals translates to lower fertility, labor and fuel costs. In addition, because the majority of the organic fertilizer is taken up into the plant without significant loss into the soil or water table, biologicals also promote ecofriendliness.

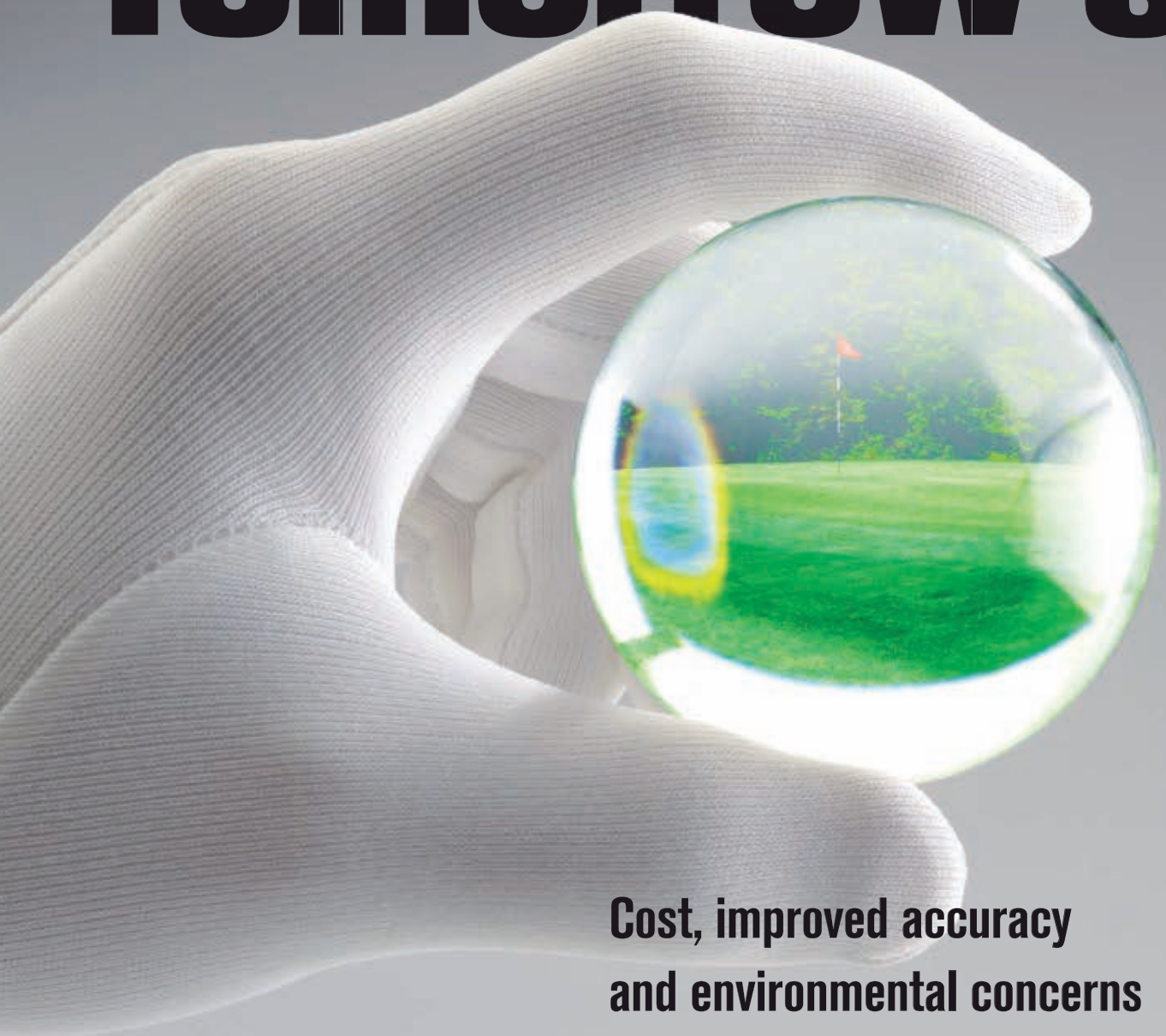
Biologicals have the potential to replace some traditional granular fertilizer applications that incorporate synthetic chemicals, especially nitrogen, as their main ingredients.

"Granulars are a great technology, but because their uptake from the soil is often unpredictable, we can end up putting on more product than the plant can actually utilize efficiently at the time of application," Gaussoin says. "As a result, we can lose nutrients to the soil or groundwater, which is not only inefficient but a detriment to the environment."

They say it's not nice to fool Mother Nature. But in this case, biological-based fertilizers that borrow from the laws of nature are giving us clues to more efficient and cost-effective ways to help our customers. ■

Zimmerman is marketing manager for LebanonTurf's professional line of biological plant nutrition turf products.

Tomorrow's



Cost, improved accuracy and environmental concerns shape the future of fertility

BY JOHN WALSH, CONTRIBUTING EDITOR

Fertilizer

GENERALLY, FERTILIZATION hasn't changed much through the years. It's still about getting basic elements to turfgrass plants to help them survive. Fertilization is a necessity for plant health, considering all the stress that's put on turfgrass, including the amazing things golf course superintendents can do, like mowing a putting green so low that it runs about 12 feet on the Stimpmeter.

When it comes to predicting the future of fertilizer, not many in the industry have a clear crystal ball. Generally, superintendents have all they need to feed turf. So, what will change in the future?

Up ahead

With something as fundamental as human health, did people know years ago that blueberries have antioxidants that are good for them? Well, the industry is at that same point with turf, says Roch E. Gaussoin, Ph.D., professor and extension turfgrass specialist in weed science at the University of Nebraska – Lincoln.

"We're barely scratching the surface," he says. "We have a better knowledge of how plants grow. However, I don't have much of a vision for the future."

However, Gaussoin does know there are some products used today that won't be used in the future. In many ways, it's a cycle based on research and knowledge.

Even though turf plants are under unbelievable amounts of stress, researchers won't genetically engineer a plant that doesn't need the 17 basic nutrients, Gaussoin says, adding that a turf system is always young because of mowing.

The future of fertilizer will incorporate nitrogen stored in organic matter released over time, says Frank Rossi, associate professor of turfgrass science in the department of horticulture at Cornell University in Ithaca, N.Y.

"We won't supplement it," he says. "This will significantly alter fertility programs."

For Cale Bigelow, associate professor of agronomy at Purdue University in Lafayette, Ind., the future of fertility holds potential for biologicals, a focus on improving uptake and rooting and a more holistic approach in general.

"We're now feeding the plant less than we were 20 years ago," he says. "We're using more liquid products, but with the low height of cut, especially on greens, the liquid products are needed."

The right price

No matter the aspect of golf course maintenance, cost is always a factor for many superintendents. Fertilizer is no different. The bottom line is superintendents want inexpensive fertilizer.

"Nobody cared about fertilizer five years ago because it was cheap," Rossi says. "Now everyone is looking at its cost and saying, 'So, maybe I don't need certain things.' "

For example, the cost of phosphate, which is more expensive than urea, has increased. A 50-pound bag of urea rose from $8 to $30, and now it's back down to about $16. Much of the fertilizer market has been, and most likely will continue to be, affected by the global food market as a result of an increasing population.

"It's a big, twisted web," Bigelow says.

Continued on page 48

No matter the aspect of golf course maintenance, cost is always a factor. Fertilizer is no different.

PHOTO BY: ISTOCK INTERNATIONAL INC.

Continued from page 47

Todd Voss, superintendent at Double Eagle Golf Club in Galena, Ohio, wants affordable fertilizer. But he says the golf market is behind the ag market in terms of pricing.

"Ag can take advantage of the fluctuation in the market better," he says. "It seems it takes a long time for potassium prices to come down before I purchase fertilizer. Recently, they came down in the commodities market but not in the golf market."

Better products

It's safe to say improved slow-release products will find their way to market amid a more restrictive (legislatively) environmental climate, as well as more precise applications in general. It's a technology that will continue to be improved upon.

However, Rossi doesn't think the industry will see any significant advances in fertilizer technology, like something akin to dispersible granular technology. Neither does Bigelow.

"A few new products are interesting, but nothing is earth-shattering," Bigelow says, adding that some fertilizer companies, via their products, are taking the fertilizer approach down to one or two applications, yet some superintendents want more control throughout the course in different areas.

There are only so many ways to package urea, which is plants' basic nitrogen source, Voss says.

However, encapsulated fertilizer will be more predictable with its slow release to avoid nutrient deficiencies, says Mike Richardson, Ph.D., professor of turfgrass management and physiology in the department of horticulture at the University of Arkansas in Fayetteville.

"Additionally, some companies are looking at biological (microbial) additions to fertilizer to enhance nutrient uptake," he says. "They're not fully tested yet, but there's potential."

The market also is seeing nitrification inhibitors, which slow down the breakdown of nitrogen and urea inhibitors. "It's new technology outside what we were playing with in the past," says Charles Peacock, Ph.D., professor and extension turfgrass specialist in the department of crop science at North Carolina State University in Raleigh.

Academics still are conducting research to make recommendations about the use of high-grade foliar products. "Are they worth the extra money? I don't know," Peacock says.

Breaking fertilizer down further, micronutrients are more tricky than macronutrients because they're difficult to detect via research, Peacock says. "I don't think there will be more research about micronutrients because the plant overcomes low levels of micronutrients and are efficient at nutrient uptake," he adds. "Costwise, it's not that expensive to add micronutrients."

Micronutrients such as amino acid and humates don't have a measurable benefit and are difficult to measure, Rossi says.

Still, there's definitely more research needed about micronutrients, Voss says.

Improved accuracy

As with other cultural practices, superintendents are becoming more precise with their fertility programs, and soil and tissue tests are the main reason for that. However, the industry needs more information about soil and tissue testing methods and interpretations, Rossi says.

"We need to develop good and reliable tissue-testing methods," he says. "Right now, interpretable tissue testing is questionable at best. We don't really know what the nutrient baseline is. The baseline we're using is artificially high."

Nonetheless, superintendents save money in the long run by basing their fertility programs on soil tests. Voss, for example, tests soil twice a year.

Technology, too, will help determine nutrient needs via satellite. The ag market already is using this on a larger scale.

"Can we get it down to 1,000 square feet versus 1,000 square acres?" Voss asks.

"Are we going to save money fine-tuning fertility in smaller areas with precision mapping? That's to be determined," Peacock says.

Superintendents are applying smaller

> "We will only be putting down what the plant needs because of the economy or regulations."
>
> **– TODD VOSS**
> Double Eagle Golf Club

quantities of fertilizer more frequently. But the bottom line is more applications in the future will be based on need (via soil tests) and be more precise than they are now, collectively. There will be fewer broad applications of nutrients.

The future is prescription turf, Voss says, citing the different growing conditions and soil profiles throughout a golf course.

"It's fine-tuned," he says. "It'll be critical to do soil testing, if it's not already. We will only be putting down what the plant needs because of the economy or regulations."

Environmental concerns

Amid the discussion of better products, cost and accuracy is, of course, the environment. Environmental stewardship is a common goal for superintendents, no matter what they do, albeit it's more important for some. Voluntarily or legislatively, the environment will impact the fertility programs in the future.

As a result, Richardson foresees more companies developing organic-based fertilizers.

"As more people are concerned about the environment, we'll see more organic-based fertilizers," he says. "It's a good thing to use waste or other by-products from other industries to show how turf can help use the waste of other industries."

And you can't talk about the future of fertilizers and the environment without talking about phosphorus, which has been restricted in Wisconsin.

"There's a lot of pressure with the environment," Bigelow says, citing talk about banning phosphorus use to improve waterways in Michigan, for example. "But there's not a lot of proof lawn fertilizer was the reason for the damaged water ways. There are a zillion different sources of phosphorus out there."

Amid concerns about phosphorus use in North Carolina, Peacock conducted research that didn't find any phosphorus problems with runoff. "We'll continue to battle those concerns," he says.

Turf does a good job of retaining phosphorus, and superintendents have gotten better about using lower rates, Gaussoin says.

"Phosphorus should be monitored, but we shouldn't go cold turkey," he says. "A lot of the concern has resulted in knee-jerk reactions from environmental groups who don't understand the biology of plants. There's a disconnect with science and the public. We can't pull this essential nutrient. Data shows the plant needs phosphorus."

An important part of fertilizer development is that there will be more requirements from companies who make fertilizer to get them approved, such as providing runoff data, Richardson says.

But if a nutrient problem exists, superintendents will have to do better, Voss says. Still, research has shown that when fertilizer is applied properly, there's no negative impact to the environment, he says.

In Illinois, there's discussion about phosphorus bans, but nothing has been decided, says Jon Jennings, certified superintendent of the Chicago Golf Club in Naperville, Ill., adding that superintendents need to stay abreast of the situation, which is different in each state. The phosphorus level at the Chicago Golf Club has been consistent throughout the years, so Jennings hasn't had to add any. And, at five-hundredths of a pound per spray, the potential for fertilizer runoff is zero.

"We have very high nutrient soil and are lucky the grass grows tremendously," Jennings says, adding that he rarely uses phosphorus. "Plus, I don't have a lot of play so I don't deal with wear issues (which might require additional fertilizer use)."

Jennings emphasizes that superintendents need to educate the public that golf courses aren't the waste dumps some people portray them to be.

"We're going to have to be vocal about why we use fertilizer and not get run over by legislation geared toward other industries," he says.

Considering all the difference aspect of fertility, some want more clarity.

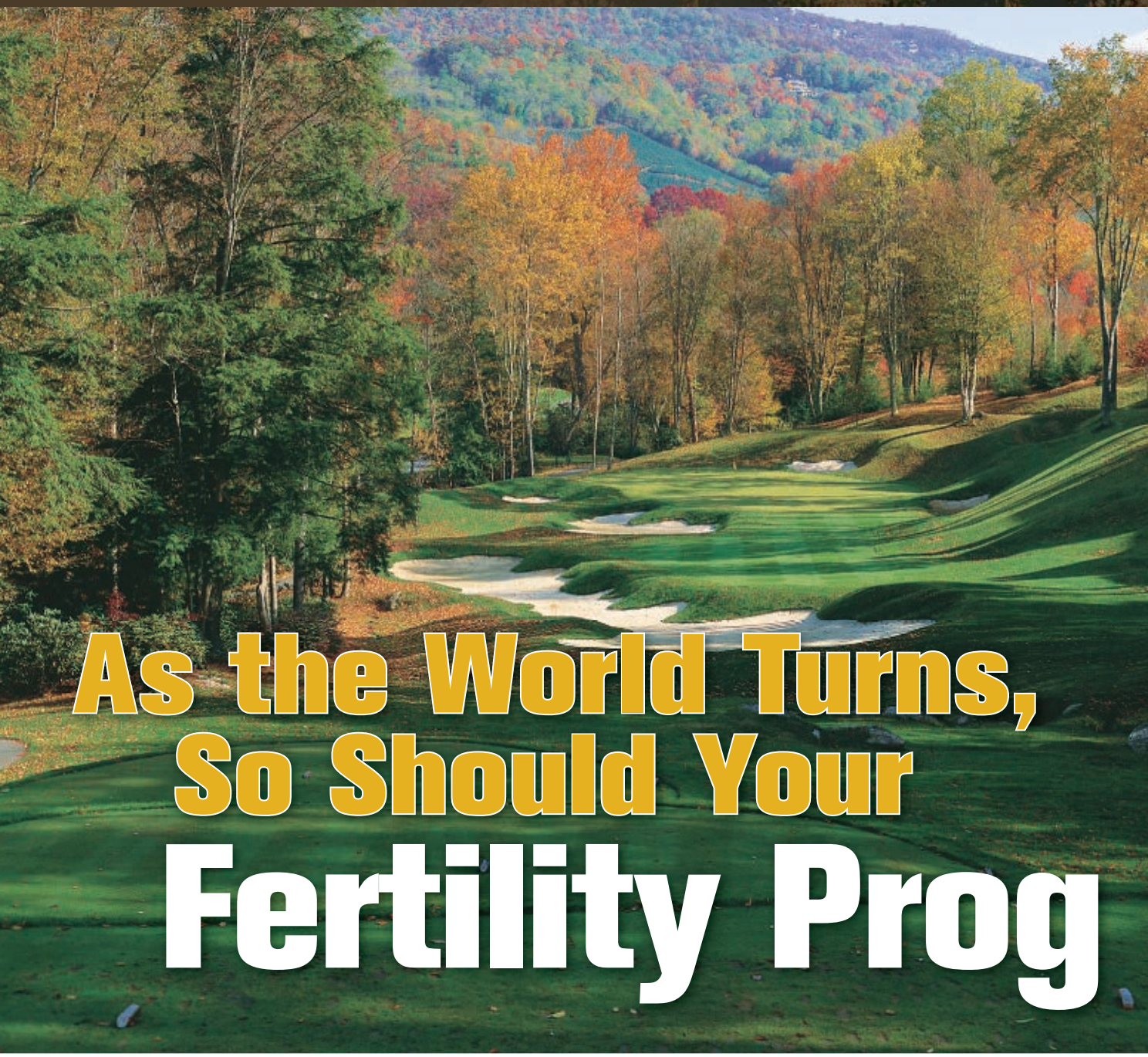
"I hope the future gets a heck of a lot simpler," Rossi says. ■

Walsh, a contributing editor to Golfdom, is based in Cleveland.

"We're going to have to be vocal about why we use fertilizer and not get run over by legislation geared toward other industries."

– JON JENNINGS
Chiacog Golf Club

PHOTOS BY: LARRY AYLWARD

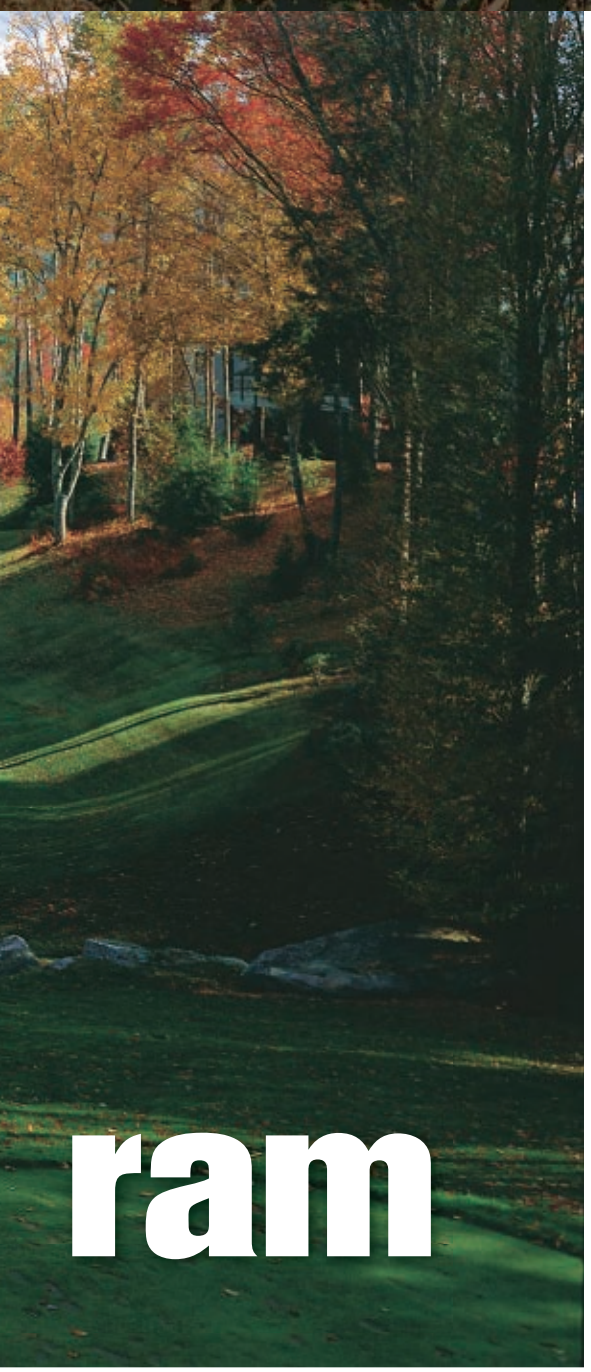


As the World Turns, So Should Your Fertility Prog

Turf professor vows that late fall is the most important time for a fertilizer application to bentgrass

BY KARL DANNEBERGER, SCIENCE EDITOR

NITROGEN FERTILIZATION PROGRAMS, like most turf-management programs, should be based on the turfgrass species and the primary stress period for the turf community. In the northern United States, creeping bentgrass (*Agrostis stolonifera*) is the primary turfgrass species found alone or in combination with Poa annua on putting greens. The stress period associated with creeping bentgrass



ram

PHOTO BY: MIKE KLEMME

is summer heat and moisture stress.

Given that it's impossible to develop a fertilization program that fits all situations because of changes in climate, soil type, individual management programs, duration of the summer stress period and budget, it's still possible to develop a general program. For creeping bentgrass, developing a fertilization program is based on its growth habit.

The start of the fertilization season in the northern U.S. begins in the fall after the summer stress period. As average soil temperatures drop below 70 degrees Fahrenheit, creeping bentgrass root growth occurs. The period of root growth actually peaks a little later in the fall for bentgrass than the other cool-season turfgrasses (Koski, 1983). At the same time, shoot growth moderates and slows. It's at this time that applications of nitrogen become extremely beneficial to creeping bentgrass recovery and health going into the next year. An important application during the fall is known as late-season fertilization (LSF). Defined here as applying nitrogen in late fall when the turf is still green but no shoot growth is occurring, LSF is the most important nitrogen application of the year.

» The fall application should carry into to mid- to late spring, just in time for the start of the summer stress period.

Historically, light and frequent fertilization was practiced during the fall. The rationale was to apply nitrogen to match the shoot growth rate potential of the turf. That changed with the first research studies that reported the benefits of LSF (Powell et al., 1967). Given that the common LSF application rate is normally between 1 pound and 1.5 pounds of nitrogen per 1,000 square feet, the benefits associated with LSF could not be matched with light, frequent fall applications.

The major reported advantages of late-season nitrogen fertilization include:

- extending the greening period later into fall;
- initiating spring greenup as much as a month sooner;
- increasing stand density late into the fall and thus reducing weed pressure; and
- increasing root growth.

Metabolically, LSF is associated with increased carbohydrate levels. Normally, carbohydrate levels increase in stems and roots during the winter months, with decreasing levels occurring in shoots. The real benefit of LSF in carbohydrate metabolism is the lack of excessive carbohydrate use in response to early-spring fertilization.

Increased shoot density and root growth is demonstrated indirectly from one of the by-

Continued on page 52

Continued from page 51

products of LSF — thatch. Although increased thatch layers are detrimental to turf health, thatch accumulation does provide insight into the dynamics of LSF. Thatch is composed of dead and living stems (rhizomes, stolons), crowns, leaves and roots between the zone of green vegetation and the soil surface. Living and dead roots comprise the greatest percentage.

A drawback to late-season fertilization is the increased threat of pink snow mold.

For example, 61 percent of a Baron Kentucky bluegrass thatch layer was comprised of roots (Koski, 1986). Most likely, LSF favors root growth during the spring and early summer, while early-spring nitrogen applications discourage root development. In Koski's study, the relative percentages of roots, stems and tillers didn't vary between treatments. Thus, the associated increase in thatch also meant an increase in tiller and rhizome development.

In relation to a biological stress, a previous study found that nitrogen programs containing a late-season application had less anthracnose than a program where late-season fertilization was excluded (Danneberger, et al.,1984). The desirable amount of nitrogen applied for the season was 3 pounds of nitrogen per 1,000 square feet.

A disadvantage to LSF is the potential for increased winter disease injury. The primary winter disease associated with LSF is microdochium patch, also known as pink snow mold and fusarium patch. Its threat is highest when the fall nitrogen applications are made while shoot growth is still occurring. Succulent, rapidly growing turfgrass plants going into the winter would be more susceptible. But correctly timed LSF actually reduces the severity of other spring and summertime diseases.

Although the benefits of LSF are primarily associated with nitrogen, potassium is an element commonly applied during late season. Fall applications of potassium are associated with winter hardening. Conflicting reports exist, but potassium is associated with winter hardening of warm-season turfgrasses, including bermudagrass. On cool-season turfgrasses, the benefits of exogenous applications of potassium when soil levels are adequate have not been reported.

With any turfgrass-management practices, the advantages need to be weighed against the disadvantages. In the case of LSF, especially on cool-season turfgrasses, the positives often greatly outweigh the negatives.

With the arrival of spring, creeping bentgrass is much slower to start top growth than Poa annua and most cool-season turfgrasses (Koski, 1983). It's this time that care needs to be taken in fertilizing creeping bentgrass. Given that while the other turf species, especially Poa annua, are actively growing and the creeping bentgrass is not, the first inclination is to jump start the creeping bentgrass with a heavy dose of nitrogen. This is a major mistake in that the creeping bentgrass will not respond with top growth. In addition, the nitrogen may actually be detrimental to root growth during a time when root growth is most active.

The LSF application should carry into mid- to late spring, just in time for the start of the summer stress period. At this point, the most popular and maybe the most effective method of reducing stress, in this case basal rot anthracnose, is light, frequent applications of nitrogen (Inguagiato, et al., 2008). The rate most cited is one-tenth of a pound of nitrogen per 1,000 square feet per week.

As the seasonal circle is completed and we're back to the beginning of fall, the combination of LSF and light, frequent applications of nitrogen through the summer stress period with a total seasonal application of 3 pounds per 1,000 square feet is a good base line to start developing a strong nitrogen fertility program based on your conditions. ■

Danneberger, Ph.D., is Golfdom's science editor and a turfgrass professor from The Ohio State University.

PHOTO BY: JOE RIMELSPACH, THE OHIO STATE UNIVERSITY

REFERENCES

Danneberger, T.K., J.M.Vargas, Jr., P.E. Rieke, and J.R. Street. 1984. Anthracnose development on annual bluegrass in response to nitrogen carriers and fungicide application. Agronomy Journal 75:35-38.

Inguagiato, J.C., J. A. Murphy, and B. B. Clarke. 2008. Anthracnose Severity on Annual Bluegrass Influenced by Nitrogen Fertilization, Growth Regulators, and Verticutting. Crop Science 48(4): p. 1595-1607.

Koski, A.J. 1983. Seasonal Rooting Characteristics of Five Cool-Season Turfgrasses. M.S. Thesis: Ohio State University. 133 pp.

Koski, A. J. and J.R. Street. 1986. Late season fertilization. November. 7(11): p. 40-43.

Powell, A.J., R.E. Blaser, and R.E. Schmidt. 1967. Effect of nitrogen on winter root growth of bentgrass. Agronomy Journal 59:529-530.

Sweeney, P., K. Danneberger, D. Wang, and M. McBride. 2001. Root weight, nonstructural carbohydrate content, and shoot density of High – density creeping bentgrass cultivars. HortScience 36(2): 368-370.