PREPARING FOR TURF STRESSES IN 1989

By James M. Latham, Director
Great Lakes Region
USGA Green Section

Golf course superintendents must have more opportunities to learn than anyone in golf or in the turfgrass industry as a whole, and rightly so because there are so many facets of the game which demand their attention. In the gentler days, greens were everything as long as a golfer could drive a peg into the tee and the fairways were cut once or twice a week. Those days are gone forever and some Turf Advisory Service visits today are more involved in bunker quality than putting quality. What a fine compliment to those superintendents' turf managing abilities.

Even so, we still do not know how to grow grass without leaves. Ultra close mowing does a great job of defoliation which reduces the photosynthetic potential of the turf. It is necessary, then, to determine the minimum TRUE mowing height for the turf species and cultivar involved. Some cultivars were selected under a quarter-inch height of cut. Bench settings are the published part of the story and vary from machine to machine. The only gauge we have is the consistent trueness of line and the drag on a ball as it rolls after being struck.

Putting consistency is greatly enhanced by light and frequent topdressing, the control of fertility and good water management. Fertility control should be the most easily managed factor. We have the information on nitrogen release patterns of most sources and should be able to plan accordingly. Every nitrogen component of blended fertilizer must be taken into account when programming applications through the growing season, since their conversion to nitrates may depend on soil temperature, soil moisture **and** soil air (the source of oxygen needed for the conversion of ammoniates to nitrates).

Vargas has pointed out the depletion of soil oxygen after sulfur application to near-anaerobic soils. Its conversion to sulfate depletes the soil oxygen further and then anaerobic bacteria convert the sulfates to sulfides which results in the formation of black layer. He suggests the application of nitrates as a source of oxygen for the anaerobic bacteria. This nitrogen, of course, will be lost as a gas through the process of denitrification under anaerobic conditions. Would not the same oxygen demand occur during the nitrification of ammonium nitrogen in the soil?

The point here is a constant need for a supply of oxygen in the soil for these and other biological processes in the soil. This is a reason why high sand content greens performed so well last summer. Water percolated through the profile readily, pulling air into the non-capillary pore spaces as they drained.

These are fine points, to be sure, but as long as we are dealing with defoliated turf we need all the help we can get. There are few black or white options. For instance, at what point does shade become a limiting factor? Or, how much wind movement is necessary across a putting surface for best moisture and heat dissipation?

It is now mandatory to exert maximum control on the controllables. Sand quality is easily determined by sieving and particle size distribution can be specified. This is a simple and direct situation. The success of straight, uniformly sized sand topdressing has been widely demonstrated since Madison proposed it in 1974. Organic additives are another story, and are bothersome.

Peat bothers me because of the tremendous variation possible in the sources. The amount of detrimental non-organic material can vary widely within a very small area in a "mine". Clay, silt and very fine sand content can be amazingly high in peats that "look" and "feel" good. The only judge of quality is a rather detailed laboratory test. In construction, quality control is possible because purchases are in large, checkable lots. In year-to-year topdressing, though, some change is inevitable.

We cannot argue with the success that many superintendents have had with sand/peat topdressing, even though an 80/20 mix is not 80/20 after the little peat balls are dragged or mowed off. (Perhaps that loss is beneficial.) Variability here is seldom checked, making straight sand topdressing more and more palatable.

Research projects and experiences during the 1988 season have clarified a few points for 1989 consumption:

1. Regardless of the weather conditions in May and June, Summer Patch treatments should begin when soil temperature at a 2″ depth reaches 65°F. A second application should follow in a month. The Michigan State trials showed Rubigan, Bayleton and Banner to be very effective fungicides. Dr. Vargas feels that Banner may also be effective with slightly later applications.
2. Dr. Shearman at Nebraska believes that on days when it is evident that syringing will be needed, it should begin just before noon so that the water droplets on the turf will dissipate the heat via evaporation during the period when solar radiation is at its peak. This will reduce the amount of heat reaching the turf, thus minimizing heat build-up.
3. Relative humidity levels are extremely important as the temperatures rise and when the soil is adequately moist. Evaporative cooling is minimal when atmospheric moisture is high, so general irrigation may be more harmful than beneficial. Daytime hand watering (or just syringing) the high spots when needed is a better idea. Making wet soil even wetter has no cooling effect — it just reduces the soil oxygen supply. Even the most sophisticated irrigation system is incapable of solving all the water problems on undulating terrain. That's when quality **man**agement shows its value.

In the future we must give more consideration to the grass plant as a whole and its interactions with the rest of the environment. The more than we reduce any factor limiting growth, the better the turf can withstand the cultural stresses which we inflict. That future is now.

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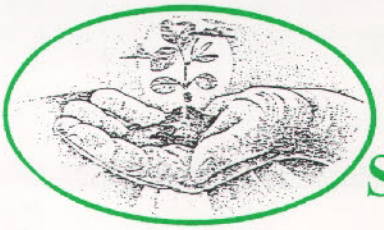

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RANKINGS AND AWARDS, ODDS AND ENDS

By Monroe S. Miller

Lest anyone start feeling "guilty" about our aggressive position defense in the AG 29 hearings, a stance led by Red Roskopff, Terry Kurth, et. al., read this bit of news and relax: Wisconsin rates in the top five states on environmental issues.

The survey by Renew America, a private environmental and conservation organization, tied Massachusetts and Wisconsin for fourth in the rankings behind California, Oregon and Minnesota. Tennessee and Louisiana were at the bottom.

I like to have this kind of evidence at hand when some screaming zealot wants to ban all golf courses and golf course pesticides because they are "ruining" the state's environment.

●

Since I'm on the subject of rankings, both of our city newspapers had articles on March 24 with headlines "WISCONSIN TAX BILL TOPS LIST" and "WISCONSIN TAX LOAD HIGHEST IN THE NATION." What a claim to fame. If most of us were to choose something we didn't want to be "first" in, it would be the taxes we pay. Certainly it gives reason to hold some of the boneheads we elect to the state senate and state assembly accountable, accountable to explain and defend why we have to continually read results like these.

Or they can explain why the headline two days later, on March 26, read 'BUDGET CUTS UW AG COLLEGE STAFF," despite our first place finish as taxpayers. Those ag staff cuts hurt **US**, you and me in the golf course management business.

We seem to have money for scores of hairbrain schemes and social programs (I won't start on welfare, I promise), but we cannot afford to replace a retirement in the Horticulture Department to help the huge Wisconsin potato industry. The scary thing is that it could have been a turfgrass faculty position.

I feel for Dr. Leo Walsh. As the CALS dean, he has the umpleasant task of facing commodity groups like ours that are furious because retired extension faculty or research positions aren't filled. He calls it "gut-wrenching" and said "it's like asking yourself whether you'd rather lose your right arm or your left arm."

Hopefully, front page (Sunday paper even) stories like this will help move bureaucrats, administrators and legislators to finding solutions to these problems.

It seems we have some responsibilities here, too. The first is to write to your state senator and your state assemblyman — most of them can read — and express your outrage. The second is to VOTE. When the time comes, if support from your representative isn't forthcoming, vote the bum out of office. Finally, let's redouble our efforts to get the NOER CENTER on line even **before** our plans call for it. The presence of this facility will help our cause a lot.

This state can afford to fill funding in where the federal government has fallen away. Or the feds could solve these problems by building a couple fewer Stealth bombers (at $500 million a copy).

Oh, by the way, we have finished first in another area: Wisconsin has the nation's highest gas tax.

●

Well, he's done it again. *GRASS ROOTS* author (and *Capital Times* sports writer) Rob Schultz has again been chosen as a finalist in a writing category in the Associated Press Sports Editors contest.

Last year he won recognition for his great story on the Packers' victory in the Ice Bowl. His 1988 entry is a golf story. He wrote about Jamie Hutton, a Monona youngster suffering from leukemia, and his relationship with pro golfer Greg Norman. Norman befriended the youth last year at the Heritage Classic at Hilton Head, South Carolina.

I know a good story when I read one, and Rob wrote a great one. I hope he wins the top award; he deserves it.

Congratulations from all of us.

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In recent years I've tried to attend the University of Massachusetts Turfgrass Conference held late each winter. I like their format a lot — plenty of time is given to speakers so they may develop a topic. The roster of speakers is usually excellent and the four days given to education puts forth enough information to digest until our own Symposium in the fall.

I find it valuable for other reasons as well. It really seems to be a regional meeting and addresses problems throughout the northeast. And their problems and management challenges seem to precede ours by a season or two.

For example, drought conditions arrived there several years ago and the golf course superintendents in the northeast have done well in securing a fair share of that precious resource — water. They seem to have to learn to deal with pests before we do, pests like the gypsy moth and the BTA beetle.

They also experience some of the same tough regulatory standards we do, and that gives me a clue to what will probably be facing us in Wisconsin.

For the past couple of years, the northeast has been bothered by what is becoming a terribly serious pest — the insect pear thrips. The target or host of these tiny winged insects is the sugar maple, Wisconsin's state tree.

These insects hibernate in the soil in the winter and climb into maple buds during the spring days of April. They feed on the bud tissue, causing the tree to produce tattered and shriveled leaves.

I first read about the problem last year, although I believe it was present before that. The damage from last year has prompted many maple producers to cut back on tapping. There is also worry about timber and firewood industries along with the lucrative fall foliage tourist season. And we can be certain such damage will be felt on their golf courses, as well.

Last year, pear thrips (obviously they are hosted by trees other than pears)

defoliated 469,000 acres in Vermont, 1-2 million acres in Pennsylvania and additional acres in Massachusetts, Connecticut, New York and New Hampshire.

Researchers there are trying to develop both short- and long-term solutions for fighting the insect, which only recently has become the subject of serious scientific study. Some of them are going to travel to Europe to find out how pear thrips is controlled there. The hope is that information will help in developing combat plans here in the U.S. and Canada. So serious is the study that states are allowing spray testing to see if insecticides will be effective in keeping this insect's numbers under control.

Someday I'll remember to ask either Chuck Koval, Phil Pellitteri or Julie Nara about the chances of pear thrips moving west toward Wisconsin. We don't need this problem.

●

It was just a year ago when Bill Bengeyfield made the long trip (by car) from his golf season headquarters in Frankfort, Michigan to the Pine Hills Country Club in Sheboygan. He spoke to us about turfgrass research in general and the USGA research venture specifically. Well, this year the USGA will distribute $660,300 in grants, an all-time high. In fact, it represents an increase of $190,000 over 1988's total. The support is going to 19 projects underway at various institutions around the country. The USGA Turfgrass Information File program, headed by Peter Cookingham, is also receiving funding from the USGA.

If you include the 1989 monies, almost $3 million in grants has been awarded to develop new turfgrasses and management techniques to reduce golf course maintenance costs. This is an impressive achievement and much credit for its success belongs to Bill Bengeyfield.

If you haven't already, take a look in the February 1989 issue of *Grounds Maintenance*. This respected journal named Mr. Bengeyfield recipient of their fourth annual **Turf Master Award**. It's an extremely well written and accurate piece about him. Congratulations, Bill!

●

Will golf course superintendents ever cease talking about the weather? Not likely since our lives and our success is so closely tied to it. So here is the latest from Douglas Clark, associate professor of meteorology and soil science at the University of Wisconsin-Madison. He's optimistic and said, "I'm pretty confident we won't have a spring drought like we did in 1988." "It is unusual to get two years of severe drought basically in the same area, and typically you won't see it happen," adds Carroll Spencer, state statistician in the Department of Agriculture.

I hope they're both right. March, in Madison at least, ended well below normal in participation. The deficit leaves a lot of catching up to do in April, as this is written.

Most of us won't forget the dry spring of 1988, a year Wisconsin had an average of 25.7 inches of precipitation. That was above the record low of 21 inches in 1976 and well below the average of 31 inches. The all-time record amount of rainfall, curiously, came in 1938, the year after the "dust bowl" drought.

That 1976 drop in precipitation was followed by 10 years — 1977 to 1987 — when nearly every year had normal or well above normal precipitation.

Despite his feeling that we'll have a moist spring, Clark is standing by his long-range forecast that may see summer return to droughty conditions. Beyond that, he sees the outlook for precipitation in 1990 on the downside, too.

When discussions about prolonged dry spells crop up, we are talking about unprecedented natural occurrences. For example, the last time Wisconsin saw even two severe droughts back-to-back was during the Civil War years of 1863-1864. That may be why I'm so frightened at the thought of a 1988-1989-1990 drought period.

I'm just not ready for palm trees in Wisconsin; they seem a poor substitute for oak, hickory and maple.

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We know golf is in a boom time now — new courses are being built while old courses are being updated and remodeled. Many individual nagging problems are being solved. Courses are busy; waiting lists at golf clubs are growing.

Well, the prosperity extends to manufacturers too. And we are lucky in Wisconsin to have many of them. Ransomes Sims and Jeffries of Johnson Creek, manufacturers of commercial and turfgrass mowing equipment, had a banner year in 1988. Their sales exceeded $160 million, a 25 percent increase over 1987 sales and the sixth consecutive year of record sales and profit growth.

Congratulations to Helmut Adam and his excellent staff.

●

WORTH REPEATING: From Dr. James B. Beard on March 8, 1989: "There is a trend toward modifying the USGA system (of putting green construction), such as using 100 percent sand rather than a mix because it is easier and cheaper. The USGA system remains the preferred approach."

And as Jim Latham has said innumerable times, "there isn't such a thing as a 'modified' USGA specification putting green.

These quotations are in line with Dr. Kussow's remarks on USGA putting green construction (coarse sand layer)

in the last issue of the *GRASS ROOTS*. All are evidence ("ammunition") that can be used in negotiations with architects, owners, builders or members who propose otherwise.

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MOST INTERESTING RESEARCH DATA FROM THE WINTER TURF CONFERENCES: From Dr. Don White's excellent work on *Poa annua* at the University of Minnesota (which is being funded in part by the USGA Green Section) comes some information on how dynamic the population shift is on *Poa annua*/bentgrass greens. This data is part of his study of the ecology of annual bluegrass/bentgrass communities on putting greens. He has developed truly ingenious ways to return to the same exact community so an accurate plant count can be made throughout the season. Each week he evaluates the vigor of specific plants, as well. He's noticed, for example, that during periods of seeding or some other physiological stress, the annual and biennial types are lost.

But back to the data. Below are percentages of *Poa annua*/bentgrass on a primarily *Poa* green during the season (I assume 1988) in Minneapolis:

Date	Percent *Poa annua*	Percent Bentgrass
May 2	90	10
June 13	78	22
August 1	36	64
August 15	24	76
October 3	60	40
October 25	90	10

The changes are dramatic and although many of us may have had suspicions of such activity, I'll bet few had any idea of its extreme. It seems to me that when you tell someone what percent *Poa annua* your greens are, the answer should be qualified with a calendar date.

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HOW WOULD YOU ANSWER? Given my impression that most golf course superintendents are, for the most part, happy with their profession, I wonder how our poll results would compare with the Gallup Organization's results when they asked a statistical sample of the adult population, "If you could start your working life over again, would you pick the same profession?"

The results were surprising to me. Forty-seven percent said they would pick a different one, 36 percent said they would choose the same and the rest said they weren't sure.

I say surprising because I can still hardly wait to get to work each morning. How about you?

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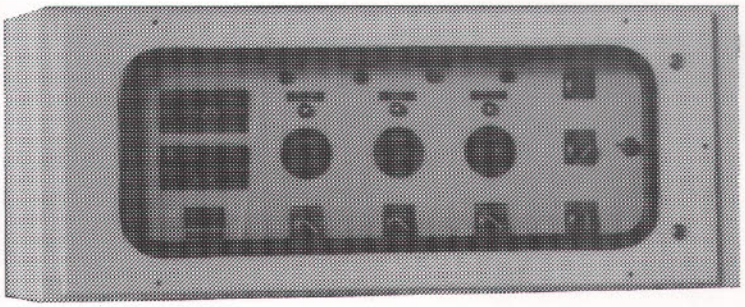

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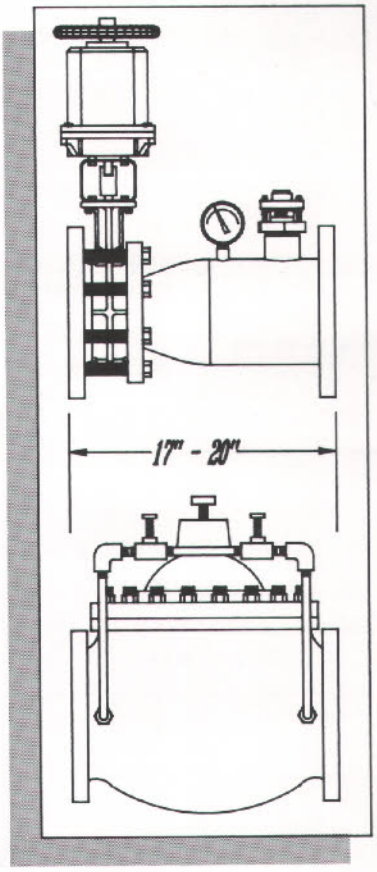

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Triazone, NOT Triazine

By Dr. Wayne R. Kussow

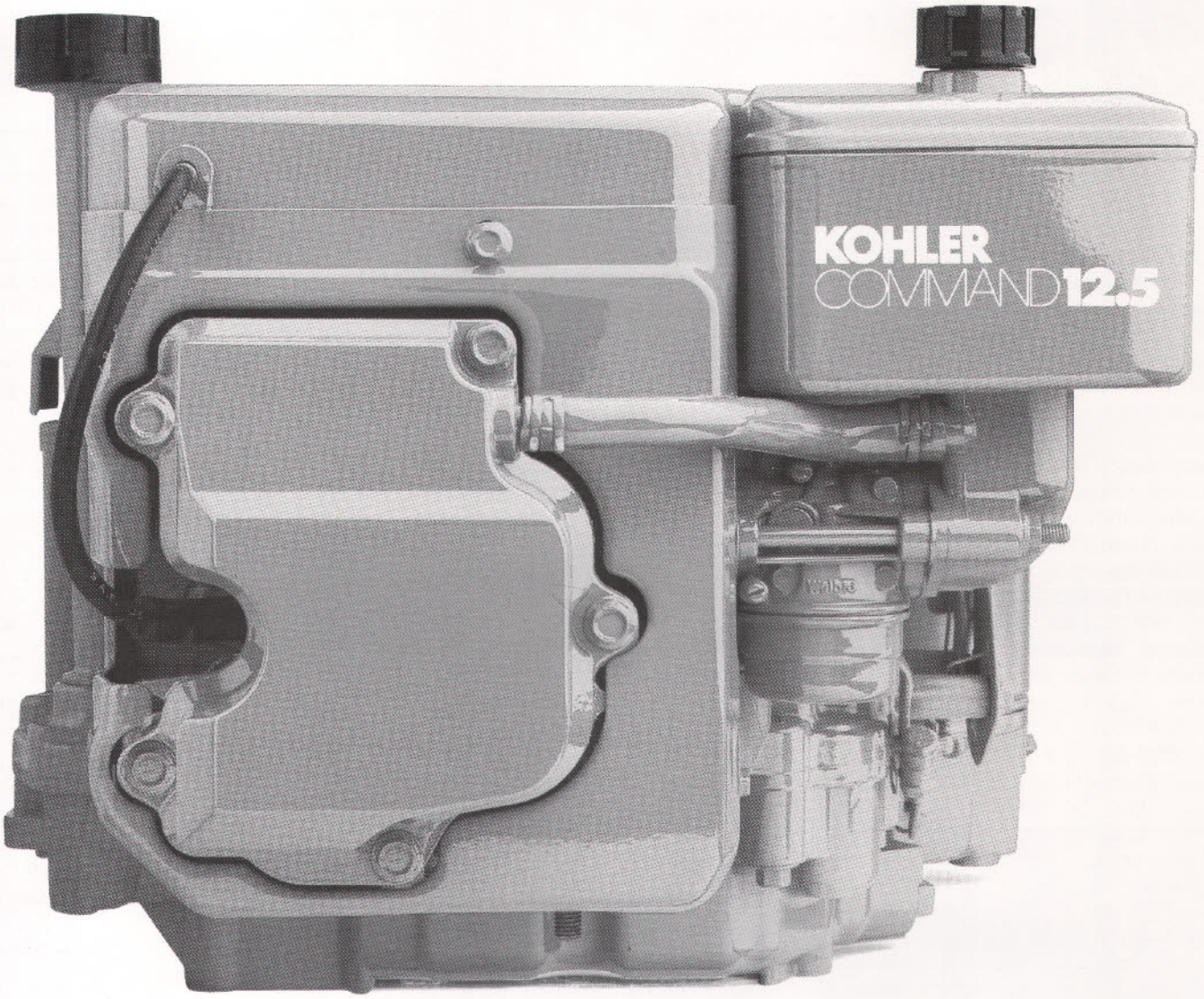
In the last issue of the *GRASS ROOTS*, I attempted to respond to some questions on various aspects of turfgrass management. One question dealt with N-Sure. This is one of what probably are many trade names not in my turf product file. I was led to believe that N-Sure is a triazine product and responded accordingly. The fact of the matter is, N-Sure contains triazone, not triazine.

Triazone and triazine are both organic, slow-release N compounds, but that's where their similarities end. Manufacture of triazone results in a solution containing urea, methylol urea and triazone. The product typically contains 28 percent N and, by varying the amounts of the various components, anywhere between 50 and 70 percent of the N can be in a controlled release form.

Microbial action is responsible for N release from triazone and triazine. As noted last time, triazine releases virtually no N during the first month after application and then releases N rather slowly over a period of 16 weeks or more. In contrast, N release from triazone begins shortly after application. Depending on environmental conditions, microbial release of triazone N is complete with eight to 12 weeks after application. The faster rate of N release from triazone suggests that when the two products are applied in the same N rate, better turfgrass color can be expected from triazone than from triazine.

In addition to its controlled N release characteristics, triazone solutions have other features appreciated by turfgrass professionals. For one, the product has low burn potential that allows application of N rates as high as 0.5 lb/M virtually anytime during the season. Secondly, N-Sure and other triazone products have good storage properties. They do not salt out at temperatures as low as 0°F or when stored for a year or more. Finally, as solutions, the triazone products offer the opportunity for one-step fertilization and weed or disease control. Although triazone solutions have pH values of 8.0 or more, they have been shown to be compatible with tri-blends of turfgrass herbicides and with fungicides.

If you're intrigued by N-Sure or any other triazone solution but are hesitant to give it a try, you need to be aware that the product has a history of use on turfgrass in Wisconsin. There are a number of colleagues you can talk to about N-Sure. Just to indicate a few possibilities, the product has been used for one year or more on the Silver Spring, Edgewater, Sentry World, Westmoor and West Bend golf courses.



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Continued from front page
formation I received in the survey responses has mandated a two-part article. The first part will review the background information and examine the nutritional aspects of putting green management. The second part, which will appear in the next issue of the *GRASS ROOTS*, will deal with the remaining survey topics. When reading both parts of this article, please bear in mind that the discussion and conclusions pertain only to the information supplied by the 25 respondents to this survey.

When comparing putting green management programs, it is necessary to first identify the background conditions under which those programs are administered. For example, a putting green built in 1910 with a poorly-drained native soil and a 50-50 mixture of bentgrass and *Poa annua* will probably be managed differently than a two-year-old putting green constructed with an 80 percent sand/20 percent peat mixture and seeded to Penncross bentgrass. On the surface, it would appear impossible to link these two management programs together and arrive at any valid conclusions. As the two articles unfold, however, you will notice that I attempt to not only average all survey results for a given topic, but I also make observations about management programs that are tailored to specific background conditions. All in all, I think you may be surprised to see some of the across the board similarities in management programs despite the various background conditions.

As we might expect, there is a relationship between the age of the putting greens and the soil mix they were constructed with. Table 1 indicates the age of the putting greens in the survey and Table 2 lists the soil mixes. Putting greens over 30 years old were constructed without the benefit of USGA specifications and are generally built out of the native soils. For many golf courses, this means poorly drained putting greens that create additional management problems. At some golf courses, however, the native soil was a well drained sandy loam that was quite adaptable to putting green use.

All of the putting greens in this survey that were built after 1960 were based on some variation of the USGA specifications and contain a sand content ranging from 60 to 90 percent. Unfortunately, some of these variations have proven to be candidates for rebuilding due to the poor quality of the raw materials and/or the mixing process. Several superintendents stressed the importance of laboratory analysis for the sand and peat plus the benefits of off-site mixing.

With the recent boom in golf course redesign, many golf courses (eight in the survey) now have several sand based putting greens to go along with their older soil based putting greens. This has created two different management programs for some of the topics included in the survey and I will point out those differences at the appropriate times.

Table 1.
Age of Putting Greens in the 1989 Wisconsin Survey

Age of Putting Greens	Number of Golf Courses[1]
Over 60 years	12
Between 30 and 60 years	4
Between 10 and 30 years	5
Under 10 years	12

[1]Golf courses with old and new putting greens are listed twice.

Table 2.
Soil Mixes for Putting Greens in the 1989 Wisconsin Survey

Soil Mix	Number of Golf Courses[1]
Poorly drained native	9
Well drained native	7
Sand mix with less than 80% sand	5
Sand mix with more than 80% sand	12

[1]Golf courses with native and sand mix putting greens are listed twice.

The pH of the putting greens fell in a range from 6.2 to 7.8 with an average of 7.1. While this range appears somewhat broad, I find no indication of any management techniques that were pH dependent. Micronutrient availability appears not to be a concern due to the universal use of fertilizers containing most of the essential micronutrients. In addition, there is no evidence that the efficacy of any pesticides is influenced by pH.

It comes as a surprise to me that the lower pH putting greens do not correspond to the higher bentgrass populations. In fact, one golf course with pH values of 7.8 has over 90 percent bentgrass while another golf course with pH values of 6.2 has 50 percent bentgrass. So much for low pH as a valuable tool to encourage bentgrass!

The determination of the bentgrass and *Poa annua* populations in putting greens is a difficult one. The issue has been further complicated by Dr. Don White's work at the University of Minnesota on the dynamics of the bentgrass and *Poa annua* populations in putting greens. Dr. White's research indicates that *Poa annua* populations peak in Spring and Fall and can decrease dramatically during the summer. For the purpose of this article, I assume that the bentgrass-*Poa annua* population estimates reported were from last summer when bentgrass levels would have peaked. Table 3 lists the bentgrass population estimates.

Table 3.
Estimated Bentgrass Population for Putting Greens in the 1989 Wisconsin Survey.

Bentgrass Percentage	Number of Golf Courses
Over 90	6[1]
75 to 90	8
50 to 75	5
Under 50	6

[1]Three of these golf courses are only two years old.

The most striking fact about the results in Table 3 is that the majority of the golf courses whose putting greens contain around a 50-50 mixture of bentgrass and *Poa annua* are among the finest in the state. So much for *Poa annua* ruining putting greens and superintendent's reputations! In fairness to bentgrass, however, the superintendents at the above golf courses, along with all the other survey respondents, indicate that their long range putting green management programs are designed to favor bentgrass.

While popular opinion generally links older, poorly drained soil mixes with higher *Poa annua* populations, the

bentgrass-*Poa annua* populations in this survey were not correlated to the age of the greens or the type of soil mix (with the exception of three new golf courses with sand based putting greens that were over 95 percent bentgrass). In fact, some of the oldest golf courses with putting greens that were constructed using poorly drained, native soil reported some of the highest bentgrass populations. The management programs at these golf courses must be very pro bentgrass in order to compensate for the inferior soil mix.

In general, the bentgrass-*Poa annua* battle is still being hard fought in Wisconsin. It is the conservative nature of Wisconsin superintendents that yields putting green management programs that encourage bentgrass without jeopardizing the health of *Poa annua*. The result appears to be a gradual shift to higher bentgrass populations, but not at the expense of playing conditions or our jobs! The specifics of these pro bentgrass programs will be discussed throughout this article.

The species of bentgrass found on the putting greens provides no real surprises. Putting greens built before 1954 are dominated by South German and Washington bentgrasses with smaller populations of Seaside and Toronto (C-15) bentgrasses mixed in. Following the release of Penncross bentgrass in 1954, the vast majority of new putting greens were seeded with this species. The exceptions are two golf courses that did reconstruction in the late 1960's and stolonized several new putting greens with Toronto bentgrass.

Of the three new golf courses in the survey (all are two years old), one seeded a mix of Penncross and Penneagle bentgrasses and the other two used straight Penncross bentgrass. There is also one new Pennlinks bentgrass putting green in the Milwaukee area.

I will cover overseeding in the second part of this article; however, I will mention here that Penncross bentgrass is the overwhelming choice for overseeding putting greens, while Penneagle and Pennlinks bentgrass are used on what appears to be an experimental basis.

One of the hardest jobs we have as superintendents is to formulate a putting green management program that will both satisfy the demands of our members and daily fee players and also maintain healthy turfgrass that will provide consistent playability all season long. Table 4 lists the most common demands of members and daily fee players along with the most common management goals.

Table 4.
Player Demands and Management Goals in the 1989 Wisconsin Survey.

Demands and Goals	Players	Management
Fast and Firm - Stimpmeter over 9′	14	8
Fast and Soft - Stimpmeter over 9′	6	0
Reasonable Speed - Stimpmeter around 8′	4	13
Consistency	7	12
Healthy Turfgrass	0	11

Values indicate number of golf courses in each category. Golf courses can be listed more than once in each column.

The results in Table 4 indicate that players still want fast and firm putting greens. There are also quite a few golf courses where the players demand fast putting greens that can hold a "screaming 3 iron." Unfortunately, only a handful of golf courses have players that are comfortable with reasonable speed. Consistency is also considered important and of course why would players care about the need for a healthy putting green!

From a superintendent's point of view, a healthy, consistent putting green that has a Stimpmeter reading of around eight feet appears to be quite popular. None of us like to mention soft putting greens and those of us, myself included, who manage fast and firm putting greens are hopefully doing so only to satisfy our players' demands rather than our own egos. I'll admit some guilt on that last count!

The conclusion to be drawn from Table 4 is that we must continue to educate our members and daily fee players about the benefits of playing on healthy, consistent and reasonably fast putting greens. The all out quest for fast putting greens will, in the long run, be detrimental to the turfgrass, our profession and the game of golf.

As you might expect, any comparison of 25 different fertilization programs for putting greens can get quite complex. To simplify the analysis, I have included several tables which summarize the data from all of the surveys. While the tables contain a great deal of information, I will limit my discussion to the major points of interest.

There is one major finding which must be discussed up front. It is the fact that the almost universal use of sand based topdressing (24 out of 25 golf courses) appears to mask the variability of putting green soil mixes that occurs from one golf course to another. In fact, with an average buildup of 1.5″ of sand based topdressing on the surveyed golf courses, it seems we are now managing the topdressing layer for fertility more than the original soil mix. Since these topdressing layers are all at least 80 percent sand, the differences in fertility programs from one golf course to the next are based more on management goals and player demands (see Table 4) rather than soil mix variability.

Any discussion of fertilization programs for putting greens always seems to start off with nitrogen, and this article will be no different. To begin, Table 5 lists the total nitrogen applied to the putting greens in this survey.

As would be expected, the highest total nitrogen applications (5.5, 6.0 and 7.0 pounds of N/M) occur on the three golf courses with new 80-90 percent sand based putting greens that are still "growing in". Those golf courses with one or two of the newer 80-90 percent sand based putting greens report that they require approximately 30 percent more total nitrogen than their older style putting greens. This additional nitrogen is usually applied in conjunction with the regularly scheduled fertilizations.

The estimated 22 golf courses have a total nitrogen application range of 1.5 to 4.5 pounds of N/M and an average of 2.5 pounds of N/M. My guess is that these figures are higher than we would have found on a similar table from five years ago.

It seems we are all increasing our total nitrogen application rates in order to improve overall turfgrass health, combat algae, improve ballmark healing, and to sleep better at night.

There is no pattern relating higher bentgrass populations to lower nitrogen rates or higher *Poa annua* populations to higher nitrogen rates. As I will discuss later, the timing of nitrogen applications rather than the total nitro-