research that suggests that as this occurs, proper levels of calcium within the cell can actually slow the attack down or stop it all together. The levels of calcium within the cell are going to be dictated, to a large extent, by the management of calcium within the soil.

The Soil

Calcium plays many roles in the soil, but it is its relationship with other nutrients such as magnesium, potassium and sodium that is most significant. To associate calcium only as a buffer of pH in the soil is an injustice. In fact, pH can be driven by numerous minerals such as magnesium, potassium, sodium or even aluminum. Oftentimes calcium is applied to the soil to *lower* pH. It is important to understand that an imbalance of calcium will lead to tight, hardpan soils that will restrict the flow of air and water through the soil profile. This will not only affect the plant roots, but also—perhaps even more important—will slow down the growth of beneficial microorganisms.

The soil is an extremely dynamic environment consisting of numerous chemical, biological and physical reactions. It is on all three levels that we must manage the soil. We can change the physical structure of a soil by properly managing the chemistry, thus providing a stronger biological environment. It is this biology that is so important to the success of managing any crop, turf being no exception. For the first time in recent memory, soil biology has risen to the forefront of our industry. Pathologists are introducing soil inoculants as biological controls for pests, advocates of IPM are starting to look closer at soil management as an integral part of their success and we are all beginning to understand the need for soil carbohydrates. If we are going to make any improvement in the health of the plant, proper soil management is imperative, and this all starts by managing calcium levels in the soil.

Managing Calcium in the Soil

Dr. William Albrecht, the former head of the soils department at the University of Missouri, established the protocol for balancing the basic cations on the soil colloid over 50 years ago. Today, that research is the backbone of a growing interest in sustainable soil management. Many of the predominant soil-testing laboratories, including Brookside Labs—a company that Dr. Albrecht helped to form—use this methodology today. His research focuses on the soil tests' base saturation readings, where calcium plays the largest role.

Base saturation measures the relationship between the cations

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on the soil colloid. These nutrients are expressed in percentages and will always add up to 100%. The beauty of base saturation methodology is the fact that it deals with the relationship among the cations, not the actual pounds per acre of any one nutrient. On a soil with a high holding capacity, or CEC, the pounds per acre of a nutrient is naturally going to be much higher than on a similar soil with a lower CEC. If we manage soils to specific levels of a nutrient, the relationship between the cations will vary significantly depending on this holding capacity.

When evaluating the base saturation percentages of a soil, the ideal targets are:

- 68% calcium;
- 12% magnesium;
- 5% potassium;
- 2% sodium;
- 3% trace nutrients;
- 10% hydrogen.

With an ideal range of calcium in the high 60th percentile, it becomes very clear why calcium is so important. Using these percentages as a standard, the manipulation of these nutrients becomes manageable. If one nutrient is high, it can be exchanged off the soil colloid by applying one of the other nutrients. For example, if magnesium is excessive in a soil, 20% or higher, another nutrient becomes weaker. The relationship is always 100%, so it becomes a game of "give and take." Very often, the nutrient given up will be calcium. The addition of calcium will drive out the excessive magnesium, allowing calcium to saturate the colloid. This manipulation will work with any nutrient that is out of balance.

One of the great fallacies of conventional soil management is that we too often manage exclusively to soil pH. The acidity of a soil is dictated by the percentage of hydrogen on the soil colloid. On the above example, base saturation of hydrogen is 10%. On this test, with 10% hydrogen, the pH will always be 6.3. As the percentage of hydrogen increases, the pH drops, and as it increases, it rises. If we effectively manipulate the relationship of the base saturation, we can always manage the soil to 10% hydrogen and end up with a pH in the range where we have the greatest potential nutrient mobility (6.0 - 6.5).

When imbalances among the cations exist, the soil becomes very tight and air and water can not penetrate. When this occurs, roots are not the only thing that suffers, but beneficial bacteria suffer as well. Since the relationship between calcium to magnesium makes up 80% of the soil colloid, it is this relationship that is most important. As calcium drops

below 60% and magnesium creeps above 20%, the soil becomes very tight. These are looked at as heavy, unmanageable soils, and excessive mechanical aeration appears to be the only help. Unfortunately, this does not address the real problem and until the Ca:Mg ratio is addressed, that soil will remain tight.

We have seen soils all over the country "open up" through the use of appropriate liming materials and the balance of base saturation. Soils that once went to battle with a GA60 aerator now see that machine walk across the fairways with great ease! Because air and water movement improves, so does biological activity. This helps to suppress disease problems, reduces isolated dry spots and allows for the reduction of nitrogen usage. Earthworms that were once absent are now actually becoming a management problem, one that agronomically is the best "problem" to have.

Types of Calcium

There are a number of good ways to supply calcium to a soil, but when calcium levels are below 60% base saturation, limestone is the most appropriate. Not all limestone is created equal, though! There are two basic forms of lime: high-calcium lime, or calcitic lime, and high-magnesium lime, or dolomitic lime. Depending on the source, calcium levels can vary from around 30% to 45%, but the real difference is that percentage of magnesium. High-calcium lime will have a magnesium oxide reading of about 5%, while dolomitic lime will read closer to 20%. This difference in magnesium is significant since it will drive pH up faster than calcium and will quickly create a tight soil. In soils with excessive magnesium levels, dolomitic lime would not be appropriate, and in fact can create even worse imbalances in the soil. In this situation, high-calcium lime will actually allow for the exchange of magnesium for calcium and can often actually lower soil pH by better balancing the base saturation and allowing for better hydrogen saturation. In many situations, both high-calcium and dolomitic lime would be called for to best balance this critical Ca:Mg ratio. The specifics of these recommendations are often best left to a qualified consultant, but in general terms, if the soil shows a high percentage of magnesium and calcium levels are below 60%, high-calcium lime is the lime of choice.

Gypsum is calcium sulphate and is typically around 23% calcium and 18% sulfur. It has this magical reputation of reducing soil compaction, which it will do in many situations, but is often misused. Gypsum is not very effective in a soil that shows less than 60% base saturation calcium.

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A soil with a significant calcium deficiency often needs large quantities of calcium to saturate the soil colloid. If this is applied as gypsum, too much sulfur is being applied and problems can occur. It is important to use the appropriate type of lime on calcium-poor soils. Once the calcium base saturation is above 60%, gypsum becomes the calcium of choice. Here it will help to knock excessive magnesium (or any other excess) off the soil colloid through a reaction with sulfur and the exchange with calcium. Since it is sulfur-rich, it will typically not raise the pH.

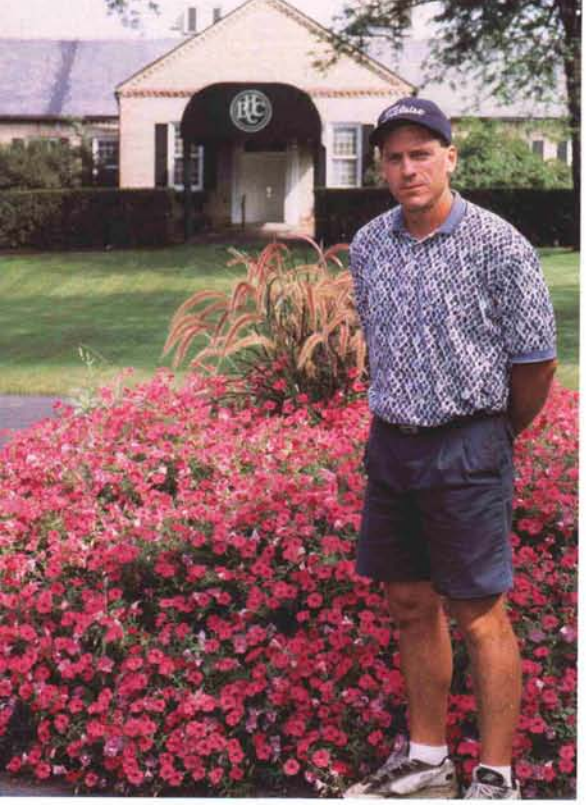
Calcium is an extremely immobile nutrient. This is supported by the water-soluble LaMotte soil tests and tissue testing. Even in the calcium-rich soil with strong biological activity, calcium does not mobilize well. In heavily managed soils with high compaction, such as a golf course green, calcium mobility is very weak. If it is appropriate to use gypsum, mobility can be improved slightly but in order to get the calcium to the plant, foliar applications are best. Foliar calcium is perhaps the greatest vogue in the industry today, and it's about time! It is imperative we balance the calcium in the soil so we can provide the environment that microbial populations need to proliferate, but it is also very important that we provide the plant cell with calcium. Since the large majority of golf course soils do not provide enough mobile calcium, foliar feeds are important. This is very true on all the greens and tees but often can be justified in the fairways as well.

There are no great secrets with calcium. The two most popular forms of foliar calcium are calcium nitrate (8% Ca) and calcium chloride (12% Ca). There are many forms of chelated calcium products available and they do provide an added value by stabilizing the calcium and making it more available to the plant. The chelates are more expensive but can be worth the cost. Another way to make calcium available is to use ammonium sulphate. This will actually knock calcium off the soil colloid, putting it into solution and making it more available. This is how it can lower the soil pH, which is getting a lot of attention for disease suppression. Is it possible that this available calcium may play a role in this disease suppression?

Conclusion

Calcium perhaps plays more roles in the overall health of both the plant and the soil than any other nutrient. If well-balanced on the soil colloid, it will help to physically open up the soil for better air and water movement. This, in turn, provides the needed environment for beneficial bacteria creating checks and balances for pathogens. Within the cell, it provides turgidity and is needed for numerous physiological reactions. It helps in root and leaf development and makes phosphorous and micronutrients more available. If well-balanced, the proper levels of calcium are going to help reduce the need for nitrogen by making nitrification more efficient. As Dr. Albrecht explains it in his volumes of research, if we get the calcium right in the soil, most of our work is done.

This article was first published in TurfNet Monthly, *December 1997, and appears here thanks to Dave Holler of Arthur Clesen, Inc., who obtained reprint permission. The author is the owner of Earth Works Natural Organic Products. He is currently teaching soil fertility at the Rutgers Turf Management Program.*



Mark Bobb.

SUPER -N- SITE

Larry Tomaszewski *AXA Advisors LLC*

Mark Bobb –N– Barrington Hills Country Club

Like most MAGCS members, every spring I look forward to the list of the upcoming season's monthly meeting locations. What does the Golf Committee have up their sleeves? Who has committed his course, time and effort to the betterment of the Association? Once again in 2001, thanks to the generosity of various meeting hosts, the Golf Committee has produced an impressive list of venues. Through August, members have traveled from the southwest suburbs to DeKalb County, from Michigan to the far western suburbs to Indiana. The venues have ranged from public to private clubs, old to new courses, open to tree-lined layouts.

Barrington Hills Country Club's no. 3 handicap hole, no. 6 is a 415-yard par 4 with a 30' elevated tee.

It is my good fortune to have the opportunity to introduce everyone to the host and host venue for September's monthly meeting: Mark Bobb and Barrington Hills Country Club. Admit it—you mark certain meeting locations on your calendar early in the year. Barrington Hills C.C. should be one of those. This is a can't-miss meeting.

Barrington Hills is 225 acres of old-time golf; hundreds and hundreds of old-growth mature trees; large, undulating greens (averaging from 6,000 to 8,500 square feet—the largest 10,000 square feet); elevated tees and greens; 40 acres of rolling fairways up to 50 yards in width; and doglegs on 50% of the holes.

Playing to a par 71, Barrington Hills has two par 5s and three par 3s on each nine. The remaining holes are challenging par 4s. Most are doglegs, ranging in distance from 350 to 430 yards. A couple par 4s fall short of 350 yards but club selection is the key. Of the 75 large bunkers strategically placed around the course, very few line the greens. Their flat lip entices the golfer into questions of what club to use.

Barrington Hills was built in 1921. A Mr. Ebel laid out the original design. In the '50s and '60s, the course was redesigned by one of the Packard boys. Tom Doke did some design work on the

fairways and greens during the mid-'90s.

But as much as members considered further redesign, the prevailing sentiment is for the true course layout to remain the same. Barrington Hills doesn't try to surprise or shock the golfer with hidden streams or lakes, concealed traps or trees that pop out of nowhere. The course is challenging but fair. The smart, straight golfer is rewarded.

Most memorable here: not the clubhouse entrance way, the clubhouse, the tee markers (or lack thereof) or the scorecard. Rather, it's the mood: the serenity spanning hole to hole. The time afforded to think about the next challenging shot. The golf course, and your game, are what remain.

Mark's biggest challenge, then, is to improve the course while keeping the course's character intact. Mark took over the superintendent's position in 1990 from the soon-to-retire John Ebel. To date, Mark's major accomplishments have included:

- 1997—new driving range with bentgrass tees and four target greens;
- 1998—addition of championship tees to all holes;
- Ongoing—enlargement of all greens (two to three each year).

In addition, there is the ongoing upkeep of cart paths, tree pruning and bunker work.

The 250 members have a master plan and Mark is the overseer of their plan. Bring the course back to the original design while always keeping up with the necessary ongoing maintenance. Future projects include additional tree replanting, bunker renovation and reclamation, and returfing greens.

Mark is a native of Jacksonville, Illinois (a remote suburb of Springfield). Like many superintendents, Mark started his career in a completely different area. He studied to be an engineer at Southern Illinois University in Carbondale. In 1982, he graduated with a degree in horticulture specializing in turf management. However, one could argue that his future was always leaning toward golf course management as throughout high school, Mark worked at Jacksonville Country Club.

No. 3 green in the early morning fog.

Upon graduation from college, Mark worked another summer at Jacksonville C.C. But Mark yearned for the big city. In 1983, he became assistant superintendent at Villa Olivia, then onto Kemper Lakes for a year-and-a-half. In 1987, he joined Barrington Hills as John Ebel's assistant. Shortly thereafter, John notified the club's board of his intentions to retire. The natural choice for a replacement was Mark Bobb. In 1991, Mark officially became the superintendent at Barrington Hills.

Mark's wife of 13 years, Melissa, works for the state in Elgin. Their daughter, 12-year-old Kaileigh, is soon to be a teenager and an honor roll student at Hampshire Middle School. Mark is a member in good standing of both MAGCS and GCSAA.

I applaud Mark for his ability to manage his time, both personally and professionally. Mark actually keeps reasonable summer hours, efficiently managing Barrington Hills while keeping ample time for his wife and daughter (and all of her sports activities), as well as for personal hobbies such as golf and 12″ softball. Mark keeps a fairly steady 7-handicap in golf and a 200-plus bowling average.

And, as if managing and beautifying 225 acres weren't enough, Mark has 1.5 acres of home turf to maintain. The Bobb family has a beautiful home outside Elgin. Between mowing the grass and cultivating the bushes, trees and flowers, Mark gets his hands dirty ensuring that his garden flourishes.

Mark and his staff are very excited about hosting the September meeting. This venue promises to give each and every golfer time (during interludes looking for lost balls amongst hundreds of trees or traveling between tees) to reflect on the many privileges of this industry, our Association and our friendships. Make sure to thank Mark and most of all, hit it straight.

Jim McNair, CGCS *Orchard Valley G.C.*

A Tale of Two Seventies

Editor's Note: One article couldn't possibly do justice to 75 years of history. So, in honor of the Midwest's 75th anniversary, On Course *presents a special decade-by-decade retrospective. This installment features the psychedelic 1970s. Coming in October: the '80s.*

It was the best of times. It was the worst of times. It was a decade of extremes. The Seventies brought many new ideas and innovations into being; however, the decade also meant the demise of many others. The passions of the Sixties' social revolution evolved into laissez faire attitudes toward civil rights during the Seventies. The incident at Kent State and the decreasing involvement in the Viet Nam War diminished the antiwar protests. The free growth enjoyed during the post-World War II era became burdened by the governmental restrictions of the Seventies. It was a time when society began to take a hard look at our planet and implement changes to protect it.

In 1976, celebrations nationwide mark America's bicentennial.

As a new college graduate in 1970, I was ready to put the "Age of Aquarius" behind me. Get on with life and my career as a golf course superintendent. The best times of my life were ahead. There were many new products available to help me. I had just purchased a new Chevy 3/4-ton pickup truck for $3,100, and a new Jacobsen Greensking for about the same price. My first-year salary was a whopping $7,500!

The riding bunker rake, hydraulic fairway mower and systemic fungicides would come along during the next 10 years, but for now I had all I needed. In my "shop" (a 20′ x 40′ garage) or sitting alongside, I had a Toro 76″ professional, Cushman truckster, Cushman golfster, Massey Ferguson 2135 turf-special tractor, Roseman 7-gang mower (with the pins in for rough, down on the castor wheels for fairways), Jacobsen Greensking, two Jacobsen 20″ putting-green mowers, a Roseman 3-gang pull mower with hydraulic lift, and other outdated, worn-out vehicles. I was the superintendent, assistant superintendent, night waterman, mechanic and boss to seven seasonal employees. I was a happy guy; life was good.

The shop had no bathroom (save a Port-a-Potty out back), no office, no pesticide storage, no water in the winter once the line froze each year in mid-December. These things were of no real concern, though, because in 1970 there were no OSHA regulations, no EPA, no pesticide regulations and no worry. We didn't wear rubber gloves to mix our pesticides, we knew of no dangers for not using them. We used mercury-based fungicides (Caloclor and Calogran) and arsenicals

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(Chipco lead arsenate and tricalcium arsenate) and Acti Dione (cycloheximide, which has an LD50 of 3), unaware of the hazards. This was just part of the job.

As the decade developed, we would soon see many changes affecting our jobs. Development of the Environmental Protection Agency (EPA) would make conservation and environmental protection a practice, not just a concept. We could no longer just go ahead and dredge a pond, dig a septic field or even burn a brush pile without a permit. With the EPA came pesticide training and licensing for operators and applicators. OSHA legislation changed the workplace dramatically. If that wasn't enough, the Nixon administration implemented a wage and price freeze. Then there was the gas and oil embargo, the truckers' strikes of the mid-Seventies and the 55-MPH speed limit. These were not the best of times. The freedoms of the post-World War era had certainly ended. However, although we felt inconvenienced, these changes would extend our lives and the life of our planet. We were becoming a society that was more environment- and safety-conscious.

World events brought a change in attitudes of the nation. The Apollo XIII near-disaster made us reexamine the financial and human costs of the space program. The nuclear near-disaster at Three Mile Island made us rethink the safety of our energy sources. The Viet Nam War made us look at our foreign policies. Our society became more protective of what we had, and became more conservative about development. Green space became a preservation issue and the government even made funding available to municipalities, spiking a mini-building boom in municipal golf development. The gas and oil embargo brought about the demise of "muscle cars" and drag strips. Air pollution and fuel consumption were necessitating changes from the auto industry. Soil erosion and wetlands issues were limiting housing and commercial development. Planned development of sensitive areas killed the Winter Olympics in Denver in 1976. And so the golf course management industry would also see changes.

Nuclear disaster is narrowly averted at Three Mile Island in 1979.

One of the biggest changes to affect our business was the loss of products that we had used for many years. In the long run, the materials we lost were a blessing because I don't think that I or many of my colleagues would be here today if we had continued to apply mercuries and arsenicals. When I think back to how we handled some of these products, I can only thank God that my children were born with all of their fingers and toes. But the products we lost were eventually replaced with safer ones, sometimes better at controlling the pest, sometimes not. This was the beginning of the systemics. These new products were almost always more expensive due to more thorough testing and lengthy licensing procedures from the EPA.

People were enjoying more free time and golf enjoyed a significant growth curve during this decade. The Sixties had brought televised golf to the masses. The Seventies brought televised golf to the masses in COLOR. Just in case any golfer needed to be reminded, green is good, brown is not. Thanks to these telecasts, the local hacker yet soon-to-be golf agronomist (because of what he knew from watching TV) could now sit in the men's grill or 19th hole and make comparisons between his own course and the lush grass at the Masters or U.S. Open. I don't think any superintendent has slept very soundly since color came to televised golf.

Equipment technology changed dramatically with the improvement of small engines and hydraulics. Engines became smaller, lighter and more powerful. Hydrostatic drives eliminated gearboxes. Hydraulics powered the motion of the machine as well as lifted the mowers. Hydraulic-drive motors eliminated belts, chains, idlers and lots of bearings in places that were impossible to grease (anyone have a Toro Super Pro 5-gang?). The self-contained fairway mowers, Toro Parkmaster

In 1979, Iranian militants seize the U.S. Embassy in Tehran and take hostages.

and Jake F-10, evolved into lighter, smaller machines with new technology. Just about every course was mowing greens with Greenskings, GM IIIs or even the Hahn.

Golf course architecture and construction were changing to meet the growing need from the boom of the previous decade. Big-