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PRESIDENT'S MESSAGE

Roger Barton

Tim Dark did a very nice job with the August meeting at Marywood Country Club. I would like to thank him and the Club for hosting the meeting. We had a very nice day. The golf course was in great shape. We played golf in the morning, and the afternoon was spent by the pool with a great steak fry. Thanks again Tim.

Our next meeting is at Spring Lake Country Club. Paul Richter will be our host. This is our annual meeting, so let's try to attend and have some fun.

We were unable to complete plans for a July 23rd picnic with families, so this year it was in combination with our August meeting at Marywood Country Club.

Everyone have fun with your fall projects, and I will see you at the September and October meetings.

Sincerely,

Roger Barton
Blythefield Country Club

— LOCAL LOGGINGS —

Steve Tedhams is the new superintendent at Forest Hills Golf Course. . .

L.E. Kaufman Golf Course has a new superintendent, Jack Thomasma, who moves to that position from the assistant's spot at Point O'Woods . . .

Tim Dark takes over at Barton Hills in Ann Arbor for Bruce Wolfrom, who has moved to Tree Tops at the Sylvan Resort...

CONGRATULATIONS TO ALL!

SOME DATES TO REMEMBER:

November 28 - 30 —
Turfgrass and Ornamental Chemical Seminar, Purdue University.
Contact Jeff Lefton (317) 494-9737

December 4 - 7 :
Ohio Turfgrass Foundation Convention, Columbus, Ohio
Contact John Street (614) 292-2601
(Very Good Conference)

January 15 - 17 —
Michigan Turfgrass Conference, East Lansing, Michigan
Contact Mike Saffel (517) 353-9022

January 22-24 —
Midwest Regional Turf Conference, Indianapolis, Indiana

February 19-26 —
61st International Golf Course Conference and Show, Orlando, Florida

GCSAA NEWS

GCSAA HOSTS GOLF COURSE CONFERENCE AND SHOW IN ORLANDO:

The latest innovations designed to assist golf course superintendents in managing the world's golf courses will be unveiled during the 61st International Golf Course Conference and Show Feb. 19-26 in Orlando, Florida. Nearly 500 companies will exhibit a vast selection of products and services for professional golf course superintendents from the United States and abroad during the Trade Show Feb. 24-26.

The Golf Course Superintendents Association of America (GCSAA) has sponsored the event annually since 1928. It has grown to become one of the 150 largest annual American trade shows.

During the week long program at the Orange County Convention/Civic Center, educational opportunities abound: 38 continuing-education seminars, six concurrent education sessions, a state government relations forum, meetings of allied associations and symposia on a wide range of topics. Educational subjects for 1990 include management, safety and risk management, golf course design, construction and renovation and more.

Also on the agenda are the association's annual meeting and election of officers and the GCSAA Golf Championship. The championship's 600-player field will compete on five of Florida's top golf courses: the Grand Cypress Resort's New Course, Hunter's Creek Golf

Course and Walt Disney World's Magnolia, Palm and Lake Buena Vista golf courses.

Ken Blanchard, author of *The One Minute Manager* and an avid golfer, will deliver the keynote speech at the opening session Feb. 22.

Following the presentation of GCSAA's coveted Old Tom Morris Award, pop singer Tony Orlando will perform at the gala closing banquet Feb. 26 at the Peabody Orlando Hotel.

GCSSA'S INTERNATIONAL SHOW DRAWS GOLF COURSE INDUSTRY TO ORLANDO:

Orlando, one of Florida's hottest golfing destinations, is set to host an expected 15,000 attendees for the 61st International Golf Course Conference and Trade Show. The Golf Course Superintendents Association of America (GCSAA), sponsor of the annual event, is predicting that new records for both attendance and trade show participation will be set with the 1990 Conference and Show, which is set for Feb. 19-26.

Exhibit space at the newly expanded Orange County Convention/Civic Center was 95 percent sold by the end of October. More than 70 new exhibitors are already scheduled to display their lines at the 1990 show. The total number of exhibitors for the 1990 show is expected to be 475-500. The 1989 GCSAA Trade Show in Anaheim, California, featured 463 exhibitors from the United States and around the world.

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Millions of dollars worth of turf equipment and golf course management products will be on display during the Trade Show, which is set for Feb. 24-26. The latest innovations to help golf course superintendents stay on top of their profession will be unveiled at the two-and-one-half day show, recognized by *Tradeshow Week* as one of the 200 largest trade shows.

Irrigation equipment, drainage systems, geotextiles, seed, turf chemicals, safety products and all manner of turf maintenance equipment will be featured in the exhibit hall, along with the whole gamut of golf course accessories.

The 1989 GCSAA Conference and Show drew more than 14,000, including more than 1,000 international participants representing 39 countries outside the United States.

ORLANDO — THE MAGIC KINGDOM AND MORE:

Orlando, Florida, is not just **any** "Mickey Mouse" convention city.

No, GCSAA's host city in 1990 offers much, much more besides Mickey and the rest of the attractions at Walt Disney World.

The 61st GCSAA International Golf Course Conference and Show will take place Feb. 19-26 at the newly remodeled and expanded Orange County Convention/Civic Center, a 350,000 square foot complex set on a 115-acre, tropically landscaped site that is no more than 15 minutes from any of the 17 GCSAA Orlando hotels.

Within an hour of the city, guests will find a multitude of attractions, from the alluring natural beauty of central Florida and its warm, sun-drenched climate to the dizzying variety of visitor attractions.

The Walt Disney World Resort complex alone offers the fantasy of the Magic Kingdom, the marvels of EPCOT Center, the "Hollywood" glamour of the new Disney/MGM Studios theme park, the wet and wonderful Typhoon Lagoon water park, Pleasure Island nightlife and more.

And then there's Cypress Gardens, Gatorland Zoo, Boardwalk and Baseball, Busch Gardens, Spaceport USA, Silver Springs nature theme park and Sea World.

More than 60 golf courses are within a 30-mile radius of the city, and 2,000 area lakes offer fishing, water-skiing and other water sports. For sun-seekers, miles and miles of sandy beaches along the Atlantic and Gulf coasts are only an hour's drive away.

Fine dining, theater, museums, galleries, cruises, hot-air balloon flights, helicopter tours, sports and numerous shopping opportunities all await GCSAA Orlando Conference and Show participants and their families.



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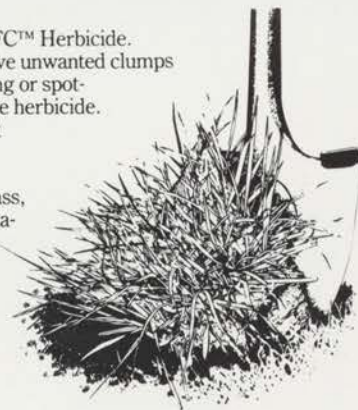
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MTF FOUNDER'S SOCIETY GUARANTEES FUTURE TURFGRASS EDUCATION AND RESEARCH

by
Jim Bogart

Education in the coming decade will be a fast-paced, ever-changing entity that will be spurred on by rapidly increasing technological innovation. It will be very difficult for educators, particularly at the university level, to keep pace with these technological changes without proper support from the industries they serve. That's where the Michigan Turfgrass Foundation Founder's Society enters the picture.

When begun in 1983, the Founder's Society set as a goal a \$100,000 fund that would produce income in support of future turf grass research projects. To reach this goal the Founder's Society opened 100 memberships to allow individuals the opportunity to return something to the industry. It was hoped that such a fund when completely raised would support research at MSU for years to come.

Unfortunately, inflation has increased pressure for additional funds to maintain the quality turf program that we have all come to expect at MSU. Due to this inflationary pressure, and in spite of the fact that the original 100 "Charter Memberships" have been purchased, Founder's Society chairmen, Bill Madigan, has introduced an expanded membership program.

Persons wanting to show their support of turf by joining the Founder's Society have several membership options available to them. In addition they have an opportunity to begin at one level of membership and continue moving up to higher levels. The various categories outlined by Bill Madigan's committee are as follows.

Bronze Member	\$100-249
Silver Member	\$250-499
Gold Member	\$500-999
Emerald Member	\$1000-2499
Diamond Member	\$2500 +

Founder's Society growth will guarantee the future for turf research in Michigan. Membership in the Founder's Society supports the Hancock Turf Research Center where research and teaching are conducted. These research projects help all of us to maintain high turf quality through evaluations of new products and methods to increase turf maintenance efficiency. Founder's Society membership also sponsors annual field days and turf conferences where turf managers can share their thoughts and ideas about turf management.

(Continued on Page 9)

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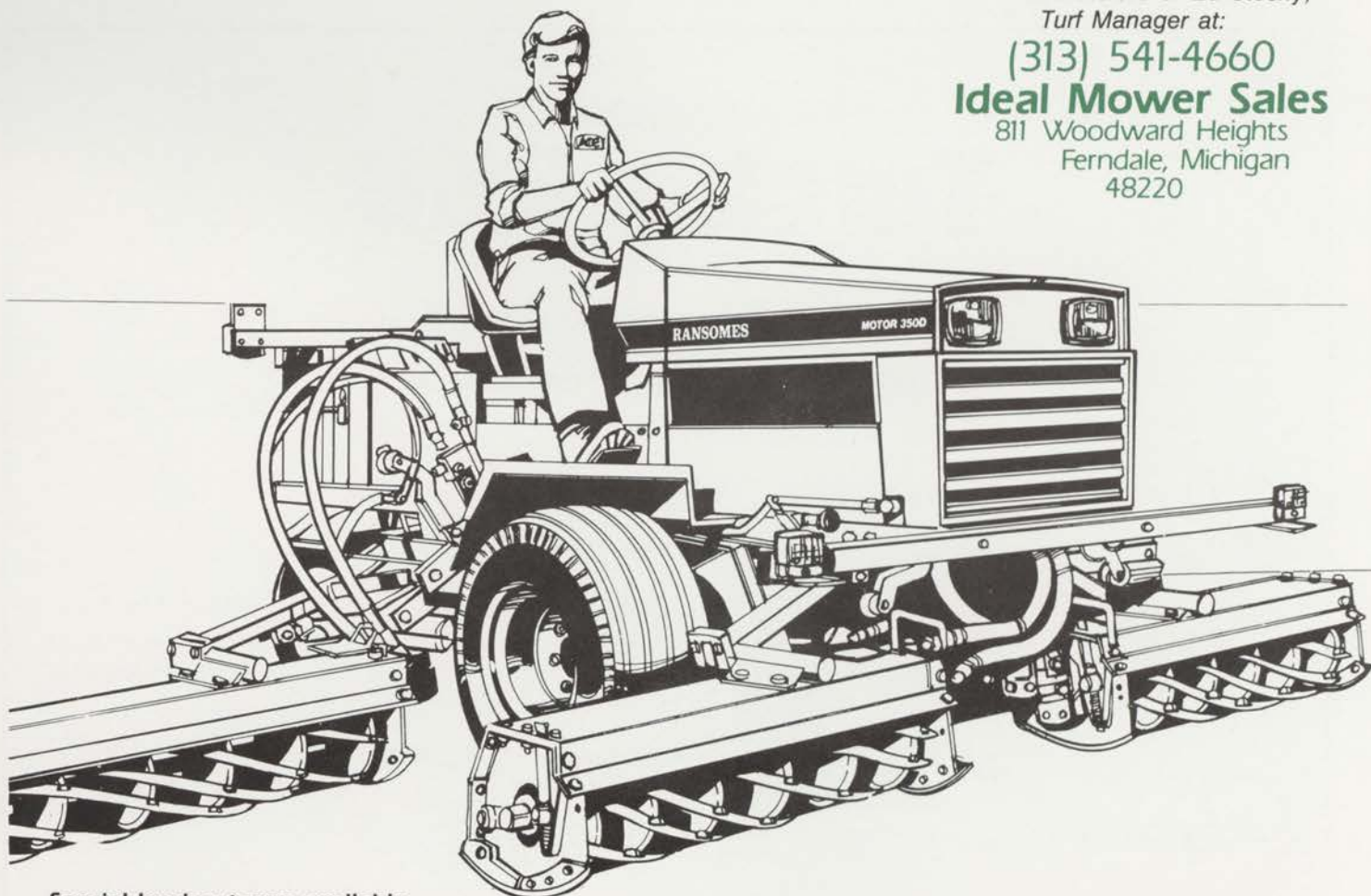
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(Continued from Page 7)

In addition to supporting turf research and educational programs at MSU, membership in the Founder's Society also offers several special opportunities to donors. Among these are the following:

- 1) MTF Founder's Society lapel pin with a diamond for cumulative Diamond membership gifts and pledges of \$2500 or an emerald for cumulative Emerald membership gifts and pledges of \$1000.
- 2) Invitation to MSU Presidents Club membership, including opportunities to meet the President at the fall football brunch, basketball reception, and spring Presidents Club Day. (\$1000 + Emerald member)
- 3) Founder's Society cocktail reception at the MTF January convention to meet with key leaders from state government and MSU for informal discussions in a casual setting. (\$250 + Silver member)
- 4) MSU Dean's Club membership and invitation to

annual March Dean's luncheon. (\$250 + Silver member)

- 5) Recognition as an MSU Centurion donor. (\$100 + Bronze member)
- 6) Recognition at the annual MTF Convention Founder's Society Dinner.
- 7) Recognition by level of membership in MTF publications and in MSU's College of Agriculture and Natural Resources Honor Roll.

By joining the MTF Founder's Society you, too, can help guarantee turf's future in Michigan. Make your commitment today so Michigan and MSU can remain at the forefront of turf. For further information in Western Michigan contact either of the Founder's Society representatives:

Roger Barton
Blythefield
616/363-5945

Jim Bogart
Turfgrass Inc.
616/866-9389

60th ANNUAL MICHIGAN TURFGRASS CONFERENCE PLANS

The 60th Annual Michigan Turfgrass Conference will be held Monday, January 15 through Wednesday, January 17, 1990. There are several exciting new features being planned by Chairman Fritz McMullen and the Turfgrass Conference Planning Committee.

First, the conference will be expanded to three full days starting Monday morning with Basic Schools. This change was made in response to the survey for the 1989 conference in which many M.T.F. members participated. Conference participants will be able to select from eleven Basic Schools which are scheduled either Monday morning or Wednesday afternoon.

The opening session for the conference on Monday afternoon will feature research reports by the M.S.U. faculty followed by the Michigan Turfgrass Foundation annual business meeting. A new feature for both the opening session and the annual business meeting will be time provided for the M.S.U. professors to respond to questions posed by conference participants. This, too, is being arranged in response to suggestions made in the survey from the 1989 conference.

Split sessions are scheduled both Tuesday morning and Wednesday morning for Gold Turf; Lawn Care; and Grounds and Athletic Field clientele. The Awards Luncheon will be held Tuesday noon as usual. The new M.T.F. Board members will be introduced at that time.

Tuesday afternoon will be devoted to a joint session on environmental issues which are of great importance to all turf managers.

The Vendors Appreciation Hour will be Tuesday, January 16 from 5:00 to 8:00 p.m. Again, we expect a full complement of vendors so plan early to reserve space. Details will be coming soon.


We have another group of excellent out-of-state speakers who have some very interesting comments to make. Speakers participating include Dr. Daniel Potter,

entomologist from the University of Kentucky; Dr. Michael Raupp, entomologist from the University of Maryland; and Dr. Henry Wilkinson, Turf pathologist from the University of Illinois.

The 60th annual conference promises to be a special program. Plan now to participate. A brief outline of the program is given below.

Monday, Jan. 15	9:00 - 11:00	Basic Schools
	1:15 - 4:45	Opening Session: Research Reports
	4:30	M.T.F. Annual Business Meeting
Tuesday, Jan. 16	9:00 - 11:45	Split sessions
	12:00 - 2:15	Awards Luncheon
	2:30 - 5:00	Joint Session: Environmental issues
	5:00 - 8:00	Vendors Appreciation Hour
Wednesday, Jan. 17	9:00 - 12:00	Split Sessions
	1:00 - 3:00	Basic Schools

For more information contact: Mike Saffel, Dept. of Crop and Soil Science, Michigan State University, (517-353-9022)



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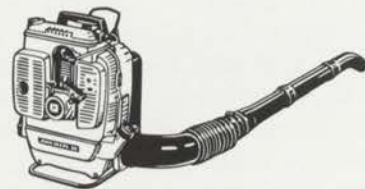
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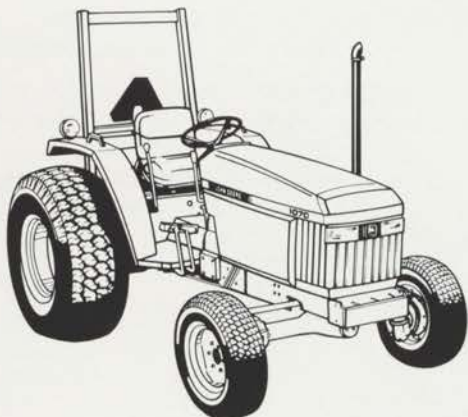
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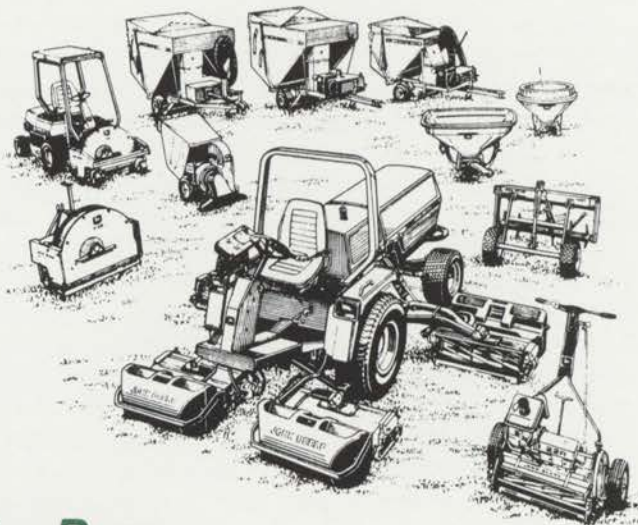
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THOUGHTFUL TREE PLANTING

To the novice golfer or average club official, planting a tree on a golf course seems fairly straightforward. After all, it only takes a short trip to the nursery and 10 minutes to dig a hole.

Well, not exactly. An improperly placed tree of the wrong species can seriously interfere with the original intent of the course architect, or even worse, completely destroy a putting green.

The following are 10 guidelines that one should ponder before attempting to plant a tree. Hopefully, these guidelines will help ensure that a new tree becomes an asset to the entire club rather than a thorn in the superintendents side.

Before reviewing these guidelines, please realize that each may not always apply strictly in all situations. For example, a large tree planted 25 yards away from a putting green on the south side will cause greater problems than a tree planted the same distance on the north side, due to heavy shading.

Guideline No. 1: Make sure to select a planting location so that the mature canopy of the tree will not protrude on the line-of-flight between a tree and a fairway. Trees with protruding limbs dramatically reduce the usable size of a tee.

For example, a tree planted too close to the front right-hand side of a tee will promote concentrated use on the left-hand side of the tee. The result of such concentrated

devoting on one side of the tee usually promotes discussion about the superintendent's abilities. The solution to large overhanging limbs is usually sympathetic pruning that leaves the tree permanently disfigured. Actually, complete removal of a tree could be the best solution.

Guideline No. 2: To allow for vital air movement and exposure to sunlight, resist the temptation to plant dense groves of trees around greens, tees and fairways. Poor air circulation, especially in areas where greens are located, produces soaring temperatures and humidity during the summer that in turn promotes harmful disease development. Furthermore, poor air circulation and dense shade during the winter produces colder soil temperatures that severely retards the growth rate, leaving greens helpless against foot traffic. In situations where poor air circulation and restricted sunlight penetration cause an unacceptable turf loss, tree removal is absolutely necessary.

Guideline No. 3: Never try to completely fill in rough areas between adjacent fairways with trees for the sake of safety. No matter how many trees you plant to protect neighboring players, the odds are the first high handicapper will find a way through. Once they do, look out!

The player automatically feels qualified to join the PGA tour and aims directly into the oncoming players, hoping to hit a high fadeback over the trees. If your intent is to protect golfers in adjacent fairways, then plant groups of

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trees strategically near the tee. This will prevent errant shots from even having a chance to stray. Leave several openings between adjacent fairways near the landing area so that if someone does stray, they have the opportunity to return to their fairway uninhibited.

Guideline No. 4: Never plant large trees closer than 75 feet from a green or tee, because they will become serious competitors for available water and nutrients. Most individuals are under the mistaken impression that tree roots cannot extend outward from the trunk further than the drip line of the tree. In reality, tree roots can extend outward from the trunk approximately one to one and a half times the total height of the tree.

For example, if a tree is 100 feet tall, its roots can extend as far as 100-150 feet. Once tree roots have invaded underneath a green or tee, they sap water and nutrients away due to their overwhelming size. In situations where tree roots are a problem, sever them with a trencher and install a permanent barrier.

Guideline No. 5: Without question, flowering trees add unmistakable beauty to any course. However, due to their tender bark and dwarf stature, they are extremely sensitive to mower damage. This extreme sensitivity makes most flowering trees a poor candidate for use on golf courses unless they can be carefully protected. August National is a good example. The beautiful flowering dogwoods and azaleas have been planted underneath large pine trees where there is never an occasion to operate heavy mowing equipment.

Guideline No. 6: Try to avoid screening out scenic vistas. Scenic vistas include the clubhouse, ocean or mountain views, lakes or other open areas of the course. Once a scenic vista has been lost it is usually forgotten and, consequently, may be lost forever.

Guideline No. 7: It is often best to avoid using a standardized tree planting as yardage indicators. Problems arise in the future when one of the plantings is lost or damaged.

For example, if palm trees are used on each hole to indicate a distance of 150 yards, it will be impossible to replace a dying palm with one of matching size. In addition, a tree planted to the edge of the fairway can severely penalize a golfer.

A better means of indicating yardage may be to mark large landmark trees already present throughout the course with a small wooden or metal plaque. The advan-

tages of marking landmark trees is that they blend in with the course surroundings, they are already present throughout the course, and because of their size they can be seen by golfers that stray into adjacent fairways.

Guideline No. 8: When selecting a tree, choose species that match the existing vegetation and have favorable characteristics. Cottonwoods and large fruit trees are not good candidates for golf courses because they are either strong surface rooters or require continuous maintenance.


In addition, try to limit the number of different species as much as possible. A continuous vegetation scheme is often the trademark of many of America's highest ranked courses. For example, the site of this year's U.S. Open is Oak Hill CC in Rochester, N.Y. This particular course has a continuous theme of oak trees from the first tee through the 18th green. Courses that tend to plant a potpourri of tree species are usually unflatteringly referred to as tree zoos or specimen parks.

Guideline No. 9: Try to naturalize the appearance of large tree plantings by randomizing the distance between each tree. A good way to develop a randomized tree planting would be to hit several dozen golfballs into a rough area from a distance of 200 yards. Then place a small flag where each ball has landed and selectively remove one flat at a time until there are an appropriate number left.

Guideline No. 10: To prevent unnecessary neglect of newly planted trees, never plant more than the maintenance staff can adequately maintain. During the first year of establishment, small trees require extra attention and frequent hand-watering during the summer. If you must purchase trees in large numbers due to cost, it might be best to establish a tree nursery near the maintenance facility where they can be easily cared for. Then, over the next several years, slowly spread them over the course.

Summary: Remember that a good tree-planting program on any course starts with a long-range plan. What makes a golf course different from a park or from your front yard is the presence of sensitive putting greens and the integrity of the game.

The agronomic impact of misplaced trees is commonly seen in the form of shade, root competition and poor air circulation. Thoughtful tree planting should not only improve the appearance and playability of your course, but more importantly, remove the thorn from your superintendent's side.



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A common problem with the lighter greens-mowing reels competitors use is their tendency to rise up in heavy thatch, giving the fairway a "wavy" look. But the heavy-section Jacobsen reels are specially designed to hug the turf. Combine that with our fully floating, steerable reels and you get smooth, flawless fairways with the LF-100 that are the envy of the industry.

The weight of the LF-100 is evenly distributed over four low ground pressure tires. Plus, each tire rolls on a separate track, for the lowest compaction possible and less marking . . . to make sure a greens-like cut is all the LF-100 leaves behind.

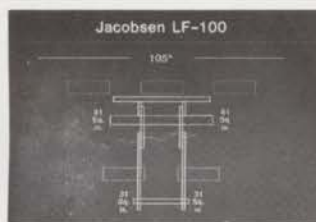
What's more, the LF-100 stands alone on steep, hard-to-cut fairways. Its low-profile, four-wheel, wide track stance provides exceptional stability and traction. And our new "on-demand" 4-wheel-drive option helps the LF-100 climb hills where others give up—without the turf-damaging wheel spin and slippage competitive units can produce.

The operator can go from 2-wheel-drive to 4-wheel-drive and back, "on-the-go." For confident braking even on slopes, the



Up-front wing reels and four-wheel design deliver increased mowing efficiency.

Unlike competitive mowers, the LF-100 has the outer reels up front for better operator visibility. This allows the operator to see the trimming edge without looking back over their shoulder, away from the mowing path. The end result—a closer, cleaner mowing line for maximum productivity.



This unique configuration also provides a shorter uncut circle of grass on turns and better access to all grass catchers, so there's less time wasted when emptying them. The wide, low-profile configuration delivers better traction and stability on slopes for more efficient mowing with less turf damage due to wheel spin and slippage.

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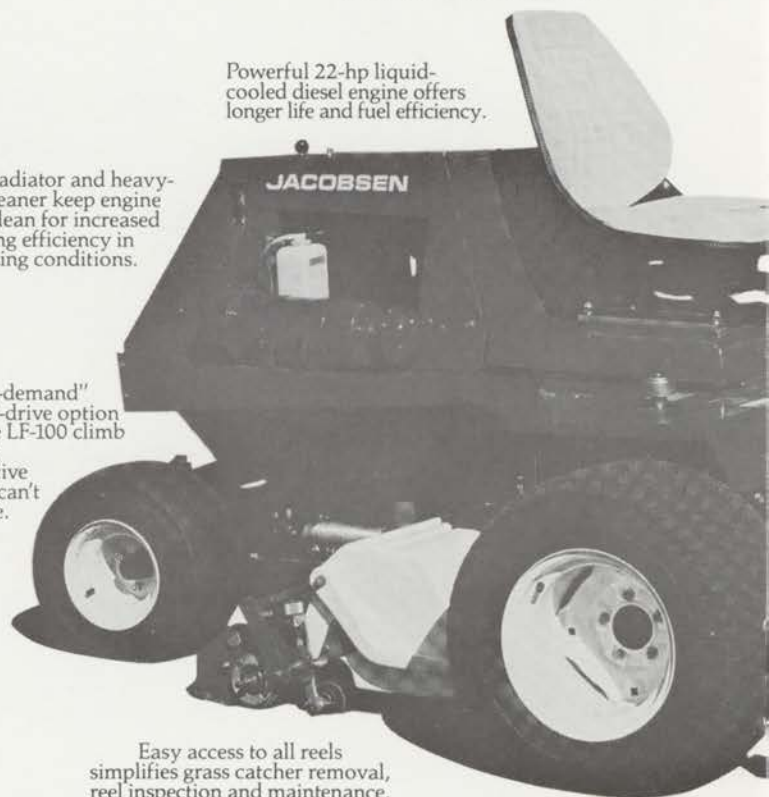
Powerful 22-hp liquid-cooled diesel engine offers longer life and fuel efficiency.

Wide-core radiator and heavy-duty air cleaner keep engine cool and clean for increased operating efficiency in demanding conditions.

"On-demand" 4-wheel-drive option helps the LF-100 climb hills that competitive mowers can't negotiate.

Easy access to all reels simplifies grass catcher removal, reel inspection and maintenance.

Trim weight and low-profile turf tires produce the lightest ground pressure in the industry.



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LF-100 comes equipped with powerful drum brakes.

As nimble as it is productive, the LF-100 features "on-the-go" pedal-operated reel lift to cross-cut fairways more efficiently.

Also, a tight turning radius and power steering provide extra maneuverability and improve striping accuracy.

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LF-100 withstands the day-in, day-out pounding of high-production fairway mowing. It has a rugged, time-proven chassis design and extra-heavy-duty lift arms. Separate high-capacity pumps for traction and reel drive functions deliver increased efficiency and simplify maintenance. And for longer life and



Responsive power steering offers exceptional maneuverability with less operator fatigue.

Simple hydraulic system design with separate, high-capacity traction and reel drive pumps for increased efficiency and performance.

Extra-heavy-duty lift arms handle the abusive conditions of high-production fairway mowing.

Wing reels located up front for better visibility and greater productivity.

dependability the LF-100 comes equipped with a tough 22-hp liquid-cooled diesel engine. Diesel economy can save you up to 50% in fuel costs over an air-cooled, gasoline engine. A wide-core radiator and heavy-duty air cleaner help keep the engine cool and clean in demanding conditions.

And to keep you up and mowing, the entire machine is backed by your Jacobsen distributor, so you're never far from dependable parts and service support.

In today's increasingly competitive golf industry, the all-new Jacobsen LF-100 gives you a powerful advantage—tournament-quality fairways, day after day.

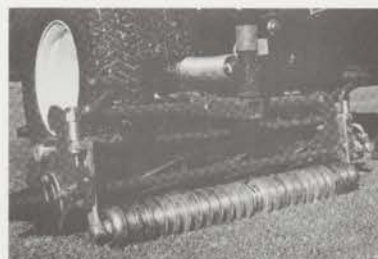
To see the all-new Jacobsen LF-100 in action, ask your distributor for a complete demonstration.

Exclusive, heavy-section reels help make the LF-100 the ultimate fairway mower.

Jacobsen introduces an innovative new reel unit for a superior quality fairway cut from a lightweight mower.

Lighter greens mowing reels tend to rise up in heavy thatch, producing a "wavy" look that detracts from your course's beauty. And these reels are designed for lighter-duty, greens mowing applications, so they lack the long-life durability needed for demanding, high-production fairway mowing conditions.

However, this innovative Jacobsen reel, specially designed for the LF-100, features heavy-section blades and bedknives, heavy-duty shafts and frames for extra strength and longer life in punishing high-production fairway conditions.



The added weight of this wide 22", seven-blade system works with the fully floating, steerable reel units to hug the turf, creating smooth, uniform fairways

your patrons will appreciate again and again.

All five of these unique Jacobsen reels are hydraulically driven for a superior cut even in heavy, wet grass. Plus, backlapping is standard, for easier maintenance.

Together, these exclusive reels and the unique design characteristics of the LF-100 make it the ultimate lightweight fairway mower.

And you'll only find it at your Jacobsen distributor. To arrange a complete demonstration, contact your distributor, today. Attractive lease and finance plans available.

ENTHUSIASM FOR GOLF CONTINUES ACROSS NATION

by

Kit Bradshaw

Public Relations Manager, National Golf Foundation

The popularity of golf in America continues to grow at a remarkable rate, according to the latest National Golf Foundation report.

The report, *Golf Participation in the U.S./1989 Edition*, also shows that six states lead the nation in enthusiasm for the game.

According to the report, the number of golfers nationwide increased in 1988 from 21.7 million to 23.4 million - a 7.8 percent rise. This is the third straight year that the number of golfers increased by more than 7 percent.

Also, the national golf participation rate (i.e. the percentage of the U.S. population which plays golf) climbed from 9.7 to 10.4 percent. This is the first time this rate has ever exceeded 10 percent.

Michigan also is one of seven states able to boast more than a million golfers. California is the leader with 2.4 million, followed by New York, 1.7 million; Texas 1.6 million; Illinois, 1.5 million; Ohio, 1.4 million; Michigan 1.3 million; Florida 1.2 million.

Dr. Gordon Benson, the Foundation's Vice President of Research, says the NGF projects that the number of golfers could reach 30 million by the year 2000," he says, "and this is based on a modest 2 percent increase each year between now and the turn of the century."

"However," he adds, "if we should average 5 percent per year, we could see 40 million golfers by the year 2000."

To accommodate such an increase in the total number of golfers, NGF researchers project that 400 additional courses a year will be needed between now and the year 2000. This is approximately one a day by the turn of the century. Currently, the national average is only about 125 new courses a year.

In addition to the rise in the number of golfers nationwide, total rounds played increased as well, from 434 to 487 million rounds.

Fueling this growth in rounds played, Dr. Benson says, is the extraordinary increase in the number of frequent golfers...those who play 25 rounds or more a year.

"The number of frequent golfers grew from 4.8 million to 5.6 million...a 16 percent rise," he notes. "This is a sharp departure from the previous year, when frequent golfers showed no increase in numbers."

"The importance of these frequent golfers is underscored by the fact that although they represent only 24 percent of the golfing population, they play 75 percent of the total rounds.

Nearly half of these frequent golfers are over the age of 50. Although they represent only 25 percent of the total golfing population, golfers over 50 average 43 rounds of golf per year...three times that of younger golfers.

The report also shows women are continuing to be an important segment of the game. In 1983, only 21 percent of the new golfers were women. Currently, 41 percent (900,000) of all new golfers are women.

Golf participation in the U.S./1989 Edition is updated each year by the National Golf Foundation. It is based on a national survey conducted each January.

A nonprofit golf market research and development organization, the NGF is supported by more than 5,000 members, reflecting a broad cross section of the game. Included are golf course architects and builders; national and state golf associations; golf course owners and operators; major golf companies and individual patrons.

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MICRONUTRIENTS FOR TURFGRASS MANAGEMENT

by

Dr. Roy L. Goss

Extension Agronomist-Emeritus

Washington State University, Puyallup Research and Extension Center

The health and vigor of turfgrasses and their ability to endure stresses are totally dependent upon their environment and management programs. The factors of soils, temperature, limited growing season, rainfall and humidity are few of the environmental concerns. Many factors make up management programs and, although there are close interrelationships between these factors, this discussion will attempt to bring out in some detail the role of micronutrients.

THE SOIL FACTOR:

Any discussion of micronutrients is more meaningful once we have considered the soil factor. Several aspects of the soil factor are briefly discussed as follows:

Texture. Soil texture, being the percentage composition of the components of sand, silt, clay and organic matter, can vary from sand to clay. Clay, organic matter and, to a much lesser extent, silt are the components that determine the cation exchange capacity of a soil. The cation exchange capacity is an expression of the potential of this soil to hold plant nutrients. It is important to remember that only ions with a positive charge are attracted to the exchange complex on clay and organic matter particles.

Likewise, it must be noted that most of the micronutrients are cations and are held closely on the exchange complex.

When we compare the ability of sand to hold nutrients as compared to clay, there is no comparison. Basically, sands have little or no cation exchange; hence, no nutrients are held or bound on the exchange complex on the surface of sand particles. Another factor in determining the availability of micronutrients are notably more available in the acid ranges than they are in the alkaline ranges (pH over 7.0). Soils with very high pH values can frequently develop micronutrient deficiencies. Although iron is not usually considered as a micronutrient, it is a classic from the standpoint of deficiency symptom where iron is literally bound by the high pH factor and is essentially unavailable to the grass plant.

One other factor worthy of mention with respect to the soil factor is the leaching rate of nutrients with respect to the texture. The leaching rate is considered to be the rapidity with which water can pass through the profile and carry nutrients with it. Obviously, sand particles, being much coarser with much larger spaces between them, will leach or drain significantly faster than heavier soils with fine particle sizes.

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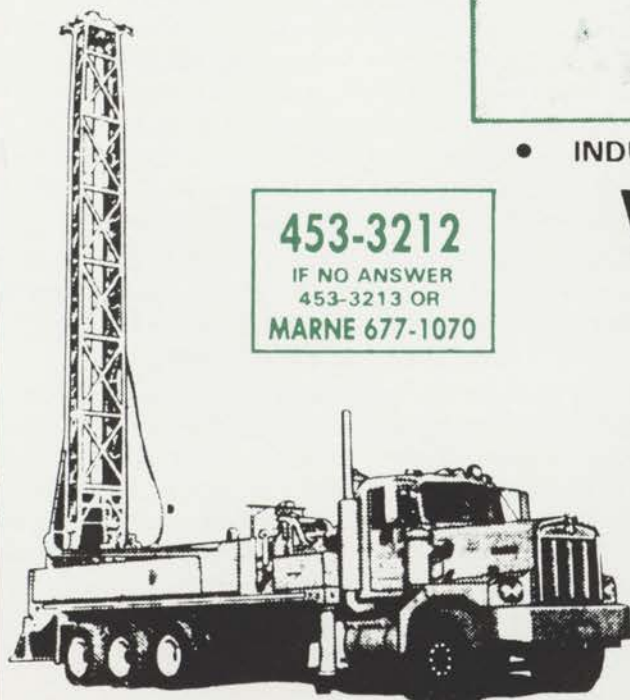
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Structure. The soil structure is simply the arrangement of soil particles. When soil structure is destroyed, there are few if any air spaces available and most of the root zone is composed of noncapillary (water containing) pores. Even when structure is not destroyed, the soil is well aggregated, and the drainage rate of sand is significantly higher than that for a heavier soil containing reasonable amounts of clay, silt and organic matter. For this reason, the leaching of nutrients, including micronutrients, would be significantly faster in a sandy soil.

Depth. The depth of the soil becomes the final factor with respect to nutrient storage. Obviously, the greater the depth of profile, the greater the root system that can be developed and explore more area for nutrients including micronutrients.

MICRONUTRIENTS:

Any practice or program that severely restricts the root system of the grass plant can significantly influence the uptake of all nutrients including micronutrients. Extremely close mowing induces a very shallow root system, thereby restricting the root system to a very shallow profile where nutrients can be removed, although at a slightly lower depth there may be adequate plant nutrients. Even when we are sampling soils for laboratory testing at a depth of 3 inches, this may be an unreliable test since the root zone may be restricted to the upper 1 inch where the nutrients have been removed; whereas there is literally a banquet awaiting the root system at a depth of 3 or 4 inches. Factors other than mowing height that will influence the root system and rooting depth would include soil compaction and poor drainage. When oxygen is restricted to the root zone there will be little or no root development, which restricts the ability of the plant roots to absorb plant nutrients. Most soils have adequate supplies of these micronutrients since the plant requirements are relatively small; however, certain sandy soils and those with extremely high organic matter levels may be deficient in certain micronutrients.

The modern trend in putting green maintenance includes the use of high quantities of sand. In some instances, the entire root zone up to 12 inches is composed of pure mineral sand with no organic matter amendment. Micronutrient deficiencies can occur on root zones of this nature very readily. It should be pointed out before any discussion of micronutrients, also, that high levels of

many of these micronutrients can become toxic to the grass plant, notably ions such as boron and copper.

Visual deficiency symptoms of micronutrients is often misleading and before remedial treatments are begun, the turfgrass manager or golf superintendent should have soil or tissue analyses conducted to verify the presence of absence of micronutrients. For example, sulfur deficiency can very closely resemble both an iron or nitrogen deficiency symptom.

Boron. Very small amounts of boron are usually found in soils except in arid regions and are required in extremely small amounts by grass plants. Boron availability is very limited in alkaline soils but is readily available in acidic soils, which may account for its deficiency under highly leached acidic conditions. The function of boron, although not well understood, is more in the meristematic (young growing points) and in leaf tips.

Copper. Copper deficiencies are very common in highly alkaline and/or organic soils. Sandy soils can also be deficient in copper since they have little ability to retain these nutrients. Copper is very toxic when it occurs at levels greater than that required for plant growth. Copper is very essential in a number of enzymatic systems within the grass plant and can result in the death of the grass plant if the deficiency is severe.

Molybdenum. Molybdenum is a very important factor in the enzymatic system that functions in the reduction of nitrates. Deficiencies in molybdenum can result in accumulation of nitrate in the plant with impaired protein synthesis and can possibly lead to toxic concentration of nitrates. Molybdenum is required in very small amounts and, unlike a number of other micronutrients, is more available in the alkaline range due to its solubility at these pH values.

Manganese. Manganese is required in very small quantities by the turfgrass plant and its solubility is partially controlled by acidic soil conditions and anaerobic conditions. Due to this very factor, manganese becomes significant in the formation of black layer due to the combinations of sulfide ions and manganese ions which results in a black precipitate. Manganese is very important to the turfgrass plant in chlorophyll synthesis and is involved in a number of other enzymatic systems as well.

Zinc. Zinc is required in small amounts and is associated with a number of enzymatic functions. It is believed to be associated with certain growth hormones and auxins and deficiency can affect leaf development.

Iron. This element is probably the one most deficient in turfgrass management programs. The deficiency is most often associated with insolubility rather than an absence of the element. Iron is most deficient in alkaline soils or those high in manganese, zinc and certain other elements. Iron can also be deficient in soils with extremely high levels of phosphate; therefore, excessive applications of phosphate should be avoided. Other deleterious effects of excessive levels of phosphate, especially with their ef-

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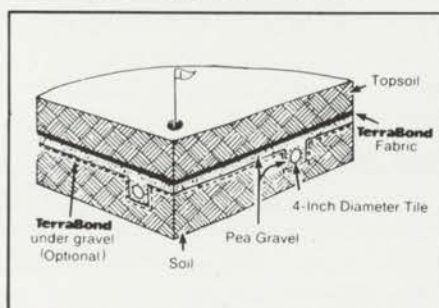
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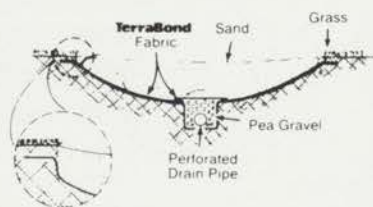
PUTTING GREEN CONSTRUCTION



Use TerraBond as a replacement for the usual 2" coarse sand layer between the greens mix and the gravel drainfield. The fabric will eliminate downward migration of the mix into the gravel and the subsequent reduction of water flow from the green.

TerraBond's high water permeability and highly engineered uniform density and EOS (AOS) make it an ideal fabric for this use. It will not rot in the soil-water environment. Its horizontal (planar) flow characteristic moves excess water horizontally out to the sides.

SANDTRAP LINING



Line the entire golf sand trap with TerraBond, including 6" under the surrounding sod. The sod's roots will knit the fabric to the soil beneath. Clay and rocks will be totally restricted from moving up into the sand.

Sand wash-down in rainstorms will be dramatically reduced, because TerraBond interrupts the interface of sand/soil. Rakeup will be greatly reduced. Time will be saved. Also, "wrap the gravel" in the trap drain to keep it flowing indefinitely. TerraBond's polyester will resist chemical and ultraviolet degradation.

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TerraBond is utilized beneath cut slope stone protection (rip-rap) as shown above. The fabric provides long-term confinement of cut slope or fill material.

Being constructed of soft and pliable needle-punched polyester, TerraBond will remain stable and functional for many years, in spite of potential exposure to the sun's ultraviolet rays and/or concentrated hydrocarbons such as gasoline, diesel fuel, oil or hydraulic fluid.

TerraBond also can be used in weed control, gravel path construction, retaining wall filtration, subsurface drainage, patio construction and planter filtration/separation.

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- Desiccation injury around test site was severe. Uncovered control area had 60% damage. TerraShield covered area had no injuries. Control area produced only 36% of the green cover obtained under TerraShield blanket.
- Green-up occurred 24 days earlier with TerraShield . . . and remained significantly greener than the uncovered control area for 21 days after cover was removed.
- TerraShield produced 3 times the recuperative potential of the control area . . . and twice that of clear plastic covered area.
- TerraShield enhanced soil temperature compared to uncovered control area.
- TerraShield remained in place all winter with no ripping or tearing despite heavy winds.

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fect upon *Poa annua* and seedhead formation, have been noted; hence, phosphate levels should be kept to a minimum plant requirement. Iron is not a constituent of chlorophyll, although it is extremely important in the formation of chlorophyll.

Chlorine. Although the role of chlorine is not well understood today, it has been accepted as the last essential micronutrient. There is little information available on the level of chlorine to be supplied, but rarely has there ever been observed any deficiency of chlorine. In general, the chloride ion exists as an impurity in a number of fertilizers; therefore, there are frequent applications of chlorine, generally resulting in no deficiency.

SOIL AND TISSUE ADEQUACY OF MICRONUTRIENTS:

It has previously been stated that the availability of micronutrients is strongly regulated by the soil reaction (pH.) Only a very few of our nutrients are more commonly available in the alkaline range, hence, we should carefully guard this factor closely. In general, turfgrasses will respond better when the soil pH is in the mildly acid range. In general, the writer has not observed any problems with nutrient availability in bentgrass or *Poa annua* putting greens with pH values as low as 5.5. Bentgrasses usually respond very favorably to pH range between 5.5 and 7.0. It should be advised, however, that Kentucky bluegrasses perform best at pH values near 7.0.

It is extremely difficult to find in the literature and in textbooks anyone brave enough to spell out soil values and tissue values for micronutrients in turfgrasses. These factors have been fairly well identified in many of our economic agricultural crop plants, but rarely does any refer to the turfgrass plant.

The author has searched the literature carefully and has come up with what he considers the best range of micronutrients for turfgrass management, both soil levels and tissue levels. Some of these values have been taken from soil testing laboratory handbooks, but the most important factor is that these micronutrients have been "road tested" for a number of years in the Pacific northwest and we feel very comfortable with these values to prevent micronutrient deficiencies. The following table shows these values which can be used as a guide, from my point of view, anywhere in the United States.

TABLE 1. MICRONUTRIENT SOIL AND TISSUE ADEQUACY LEVELS.

Nutrient	Soil level	Tissue level
Boron	1.3-2.0 ppm	9.0 ppm
Copper	1.6-3.0 ppm	17.0 ppm
Molybdenum	0.2-0.4 ppm	5.0 ppm
Manganese	30.0-50.0 ppm	41.0 ppm
Zinc	5.1-8.0 ppm	20-40 ppm
Iron	25.0-50.0 ppm	280 ppm
Chlorine	Unknown	Unknown

Now that we have covered the academics of the subject of micronutrient adequacy for turfgrasses, let's be practical. How does the average golf superintendent or other

(Continued on Page 22)



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turfgrass managers determine micronutrient deficiency? Visual symptoms are quite often extremely misleading. We have already mentioned the fact that sulfur deficiency very closely resembles nitrogen deficiency. Possibly phosphate deficiency can sometimes be confused with sulfur deficiency or deficiency of other nutrients. In general, phosphate deficiency is a purpling of the grass tissue and is quite easy to diagnose. But other times it can be somewhat misleading and possibly result in slow growth rate. Deficiency symptoms of magnesium very closely resemble those of calcium and can be confused. Now let's consider a very practical aspect. What happens when a nutrient availability is such that a deficiency symptom is not distinct, but the growth rate and density of the turf has diminished? In this event, the only practical way to determine the micronutrient deficiency is either by tissue or soil test. The above table will be of value in helping to determine these deficiencies. In taking tissue tests, however, the operator must be extremely careful to collect a good representative sample of the tissue, it must be clean with no soil particles, and the container (basket) in which the clippings are caught must be very clean with no fertilizers apparent and they must be properly handled all the way to the laboratory. Likewise, the same advice is applicable for soil tests. The soil test will also be a good means of determining micronutrient deficiency provided you take into account the soil reaction-whether the soil is acidic or alkaline.

There is no question that on sand profiles micronutrients will be limited if not supplied. For this reason, we have

tried to develop a formulated fertilizer that supplies extremely small amounts of micronutrients with each application and can essentially be used every time a putting green or sand-based sports field is fertilized. This fertilizer formulation has proved very successful for practitioners in the Pacific Northwest for approximately 5 years at this point, and we feel it is doing a good job on sand root zones with no deficiencies ever having been observed under this program.

In conclusion, we must keep reminding ourselves that there are 16 nutrients that are required for plant growth, three of these being available from air and water, N, P and K from fertilizers, calcium and magnesium are available from liming materials and sulfur is available from any number of sources including elemental sulfur materials. The other 7 considered to be micronutrients must be supplied in very small amounts where required and on a frequency that the plant does not become deficient.



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We all know that a dog's urine will burn grass. But why? There is nothing in the dog's urine that is toxic to grass. It is all a matter of concentration. In other words, diluted dog's urine will not burn. What is involved is a physical-chemical principle of osmosis. The grass is a victim of reverse osmosis.

A simple explanation of osmosis is in order. Imagine two water solutions divided by a membrane. The membrane could be a piece of cellophane or sausage casing, which is the intestine of a pig, or a any cellulosic membrane. This membrane is semipermeable, which allows soluble salts (ions) and water to pass freely through it. If the two solutions are at different concentrations, the salts will pass through at a higher rate from the more concentrated to the less concentrated, and water will pass through at a higher rate from the less concentrated to the more concentrated. This will continue until the concentration is the same on either side of the membrane.

In the case of the dog's urine, water flows out of the cellular walls from the inside of the plant into the dog's urine, and the salts the same; the cells will not collapse

or swell due to osmosis (the movement of water and salts freely flowing through these membranes.)

The chemicals which the golf course superintendent is using can be divided into solubles and insolubles. If the chemical is insoluble in water, the manufacturer must micropulverize it to micron size and then add a wetting agent in order to get it to disperse in water so that the super can use it. But even though it is micropulverized, it is so coarse that it cannot pass through the cell walls. However, if the chemical is soluble, it is reduced in water to a molecular size, which is still at least a million times smaller than the micron of the insoluble chemical. Then, and only then, can it pass freely in and out of the grass plant.

What have we learned from the discourse is that insoluble chemicals, such as wettable powders or flowables, cannot burn no matter how much is used because they cannot freely pass through the membrane or cell wall of the grass plant - not even the stomates. Whereas, solubles can burn if they are sprayed at too high of a concentration.

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WHEN WILL THEY EVER LEARN?

There seem to be a number of situations that we deal with at our golf courses that golfers will never understand. Many of us might turn blue in the face repeating comments at our clubs, but there are several situations that never seem to be understood. It reminds me of the lyrics in a Peter, Paul, & Mary song, "When will they ever learn?"

Carts are not good for the golf course. There is no doubt that carts are good for the golfer and good for profits. This does not address the fact that compaction is caused by increased usage of golf carts. The more compaction we have the weaker the turf quality and, subsequently, the need for more aerification. Golf carts are a strong part of the game and we must take that into consideration when designing a golf course and establishing maintenance procedures. Twenty years ago we didn't have the problems created by carts. There were no cart paths, no curbs, no need for ropes and no need for directional cart signs. When you consider the cost of cart paths, including installation, maintenance, and replacement, it is not an expensive proposition. We also have the added costs of sodding and seeding areas damaged by carts as well as increased daily maintenance costs. Possibly the profits of golf carts are not as great as we think when you take all things into consideration.

Monday golf has a negative effect on the condition of the golf course. It's not hard to understand that course conditions are not helped by opening golf courses for play on Monday. Many courses are opening for outings. Some

are open to employees, caddies, and invited guests. Some golf courses will have more rounds played on a Monday than any other day of the week. One day a week the golf course needs a rest, whether or not the golfers do. Monday is a day to accomplish a number of projects important to the upkeep of the golf course. Many of these tasks need to be accomplished without the interference of players. New regulations for re-entry periods after pesticide applications may dictate that courses will be closed by law on Mondays.

All golf courses are not created equal. Each and every golf course has been designed and built differently. There are many factors to consider, including soils, topography, and turf types. It is very difficult to compare the budget of golf courses without knowing the specifics of each club. Each club has a different philosophy for the maintenance of the course and the budget should reflect the standards set forth by the club. When it comes to golf course conditions and budgets, to compare is a mistake.

We have been preaching about these same topics for years with our sermons falling on deaf ears. In the best interest of the game of golf, let us hope that clubs no longer use the philosophy of "tell me what I want to hear". As golf course superintendents, we are charged with the responsibility of providing pleasurable playing conditions at our golf courses. If clubs start to listen to what their superintendents are saying then they will begin to learn what is truly for their golf course.

CREDIT: Bullshead

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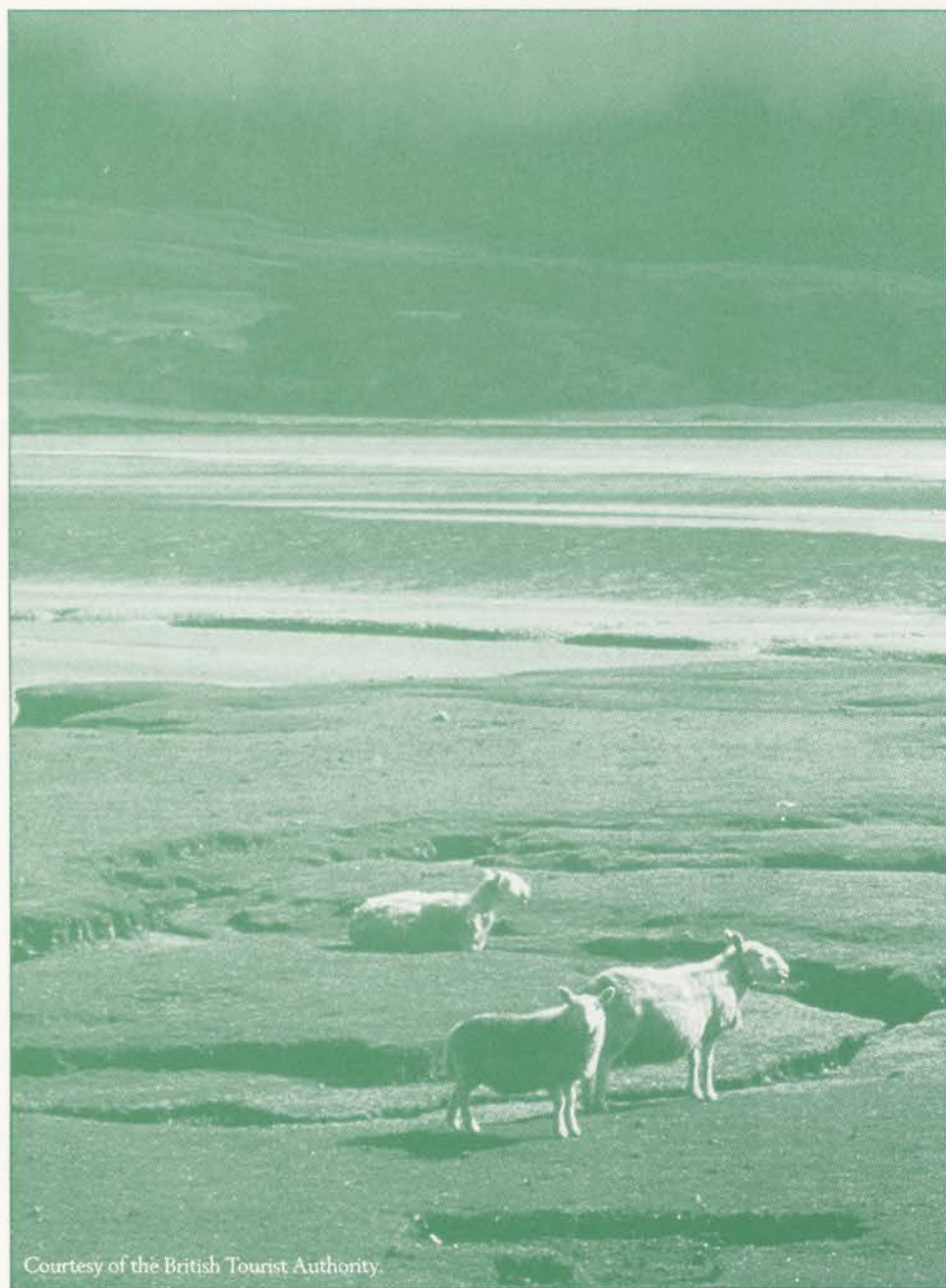
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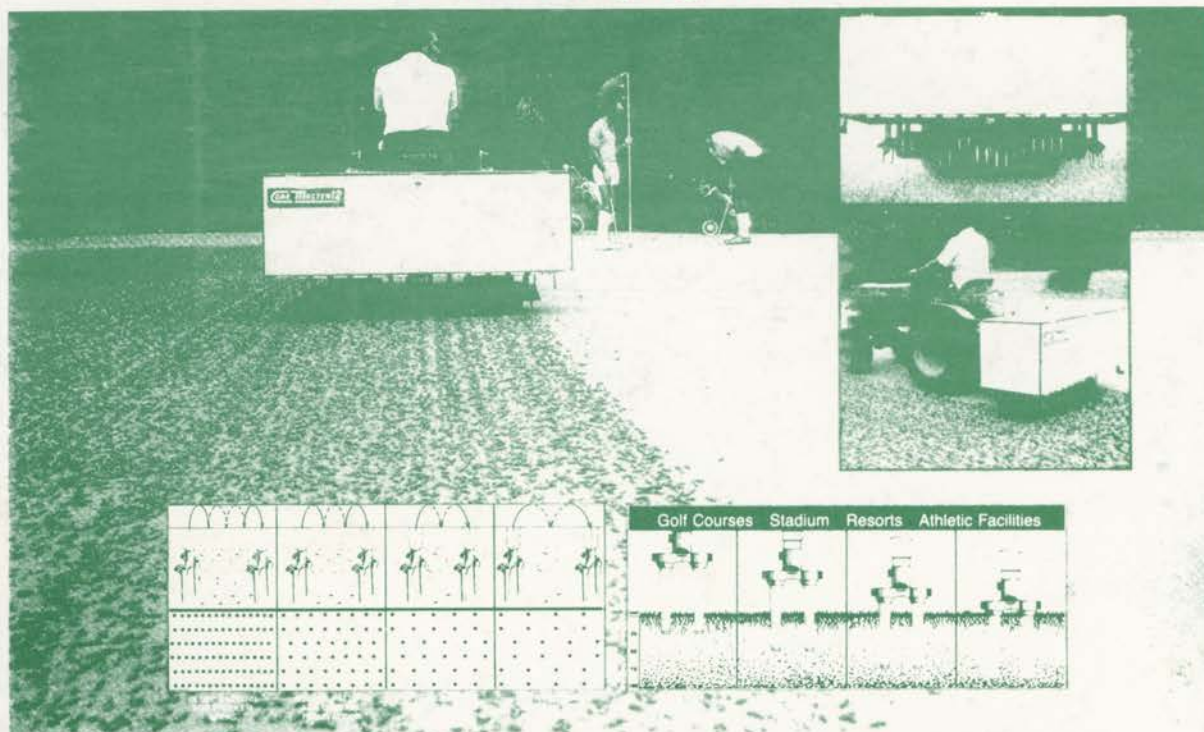
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