EVENTS

CALENDAR

JULY

25 Facilities Management Seminar, Professional Grounds Management Society, Ohio State University, Columbus, OH. Contact: PGMS, 10402 Ridgland Road, Suite 4, Cockeysville, MD 21030, (301) 667-1833.

28-30 International Power Equipment Expo, Outdoor Power Equipment Institute, Kentucky Fair and Exposition Center, Louisville, KY. Contact: Expo '91, (800) 558-8767 or (502) 473-1992.

29 Turfgrass Field Day, South Farm, University of Missouri, Columbia, MO. Contact: Missouri Valley Turfgrass Association, 344 Hearnes Center, University of Missouri, Columbia, MO 65211, (314) 882-4087.

30 Midwest Regional Turf Field Day, Midwest Regional Turf Foundation, Purdue University Agronomy Research Center, West Lafayette, IN. Contact: Clark Throssell, (317) 494-4785.

31 Griffin Field Day, Georgia Golf Course Superintendents Association, Georgia Experiment Station, Griffin, GA. Contact: Karen White, GGCSA, P.O. Box 683, Watkinsville, GA 30677, (404) 769-4076.

AUGUST

1 Turfgrass Research Field Day, National Turfgrass Evaluation Program, USDA Beltsville Agricultural Research Center-West, Beltsville, MD. Contact: Kevin Morris, USDA-BARC-West, Building 001, Room 333,Beltsville, MD 20705, (301) 344-2125.

5-6 Summer Meeting, Georgia Golf Course Superintendents Association, Lake Lanier Islands Hotel and Golf Club, Lake Lanier Islands, GA. Contact: Karen White, GGCSA, P.O. Box 683 Watkinsville, GA 30677, (404) 769-4076.

6-8 Field Diagnostic Course for Turfgrass Managers, New York State Turfgrass Association, Inc., Cornell University, Ithaca, NY. Contact: Joann Gruttadaurio, (607) 255-1792.

8 Turfgrass Research Field, Rutgers Cooperative Extension, Adelphia Research Center, Halls Mills Road, Freehold, NJ. Contact: Edmund Milewski, Rutgers Cooperative Extension of Morris County, P.O.Box 900, Morristown, NY 07963-0900, (201) 285-8300.

Send announcements on your events two months in advance to editor, Golf & SportsTURF, P.O. Box 8420, Van Nuys, CA 91409. Fax: (818) 781-8517.

THE FRONT OFFICE

OPINION PAGE

SOMETHING FOR EVERYONE...

In planning and creating this magazine each month, the promise of "Something for everyone" is easy to make, but difficult to keep. Our readers are diverse. They include people like Ross Kurcab, superintendent of the Denver Broncos' practice facilities, and Ed Bacon, a Salem, OR, resident who cares for his own baseball field, notched out of the hillside next to his home. We go to the keepers of obscure, suburban three pars, as well those who care for well-known, 18-hole private courses.

Satisfying everybody's needs is tricky at best. One reader may find an article too complicated, another too simple, and still another simply irrelevant. No matter how completely we try to cover the field, we will always fail someone. We know this, but that doesn't mean we accept it, sit back, and stagnate.

The best way for us to learn what you need from Golf & sportsTURF is to hear your criticisms. (Certainly, praise is nice, but it's hard to really *learn* anything from it.) We can stay in our offices, waiting for the phone to ring or for the morning mail to arrive, but it's far more enlightening for us to get out in the field and meet you face to face.

In mid-June, I traveled to the Northwest for the first time for field days and tours of seed companies. In a somewhat frantic week, I visited seed companies in Oregon and Idaho. Along the way, I learned a bit about the seed trade, got lost in the spectacular countryside and liked it, met readers, and made a few friends. Best of all, I heard, firsthand, a number of suggestions for this magazine. What follows are a few of the many I wrote down:

"We should provide useful information for superintendents at the high school and junior high school level. We should be more attentive to what's going on in the middle regions of the country. We shouldn't be too 'commercial,' but should keep readers abreast of the latest products. We should concentrate more on the people in the industry."

Valid points, one and all. We will incorporate each of them into our editorial focus, in addition to the areas we're already striving to cover. I can't say that *every* issue will have an article specifically geared to, for example, the high school field manager, but that area will become a regular part of our rotation.

There are a number of fine turf management magazines, but any one that claims to "have it all covered" is kidding itself and you. That's an irresponsible attitude for an editor to take-one that hints of complacency. When a publication becomes "satisfied" with the job it is doing, it stagnates. We won't let that happen. We can always do better. That's the standing challenge of magazine publishing and, I suspect, most professions.

Still, I know that in the "Something for everyone" department, we will always come up just a little bit short. But that won't stop us from trying. We'll keep listening, learning, and growing. Golf & sportsTURF is *your* magazine, and your comments play a big role in the final product. Call or write Bruce Shank or me, any time.

West Side Tennis Club provides four different types of court surfaces for its members.

West Side Tennis Club:

Superintendent Preserves Tradition In An Evolving Sport

Tennis comes into full swing during the summer. Television coverage of the Grand Slam and the U.S. Open boosts the popularity of the game. Courts fill with everyone from novices to life-long hobbyists seeking exercise outdoors.

Like golf, tennis is a sport for all ages. As a person grows older and finds flag football, basketball, and softball a bit too much to handle, tennis is an excellent alternative. He can set his own pace on a tennis court and, with regular practice, can remain competitive long into retirement. From the sport's origin, men and women have participated equally.

Tennis facilities are adapting to the varied condition and skill levels of our maturing population. Today, a choice of tennis surfaces helps control the safety and pace of the game. It also increases the responsibility and value of the superintendent or groundskeeper.

Jim Sheridan, club superintendent at The West Side Tennis Club in Forest Hills, NY, has witnessed the changes in tennis over two generations. His father, Owen Sheridan, began grooming the 13 acres of colonial bentgrass and clay courts in 1932. Located just outside New York City, West Side helped launch tennis in the United States and for decades was the site of the U.S. Open.

What has taken place at the club closely follows the evolution of tennis in this country from a gentlemen's sport to a highly commercialized attraction. It helped build recognition for tennis, served as a primary stage for television coverage, and then drew the line when the Open outgrew its stadium. It remains one of the premiere private tennis clubs in the world and fulfills its promise to members that they will not have to wait more than one hour to get on a court.

Tennis Tradition

West Side still serves metropolitan New York as well as an international membership. It hosts numerous tournaments between May and October. Tennis professionals of all ages, countries, and genders frequent its courts during the year. Most of them know Jim Sheridan on a first name basis.

They should. He started working there under his father when he was 14 years old. He continued part-time throughout high school and college. His father encouraged him to complete a degree in Ornamental Horticulture and Turf Management at Cornell University in Ithaca and a Masters in

Business Administration at Fordham University in the Bronx. Even after he became administrator of grounds at Fordham in 1976, he exchanged information with his father. In 1980, he assumed the superintendent's position after his father retired.

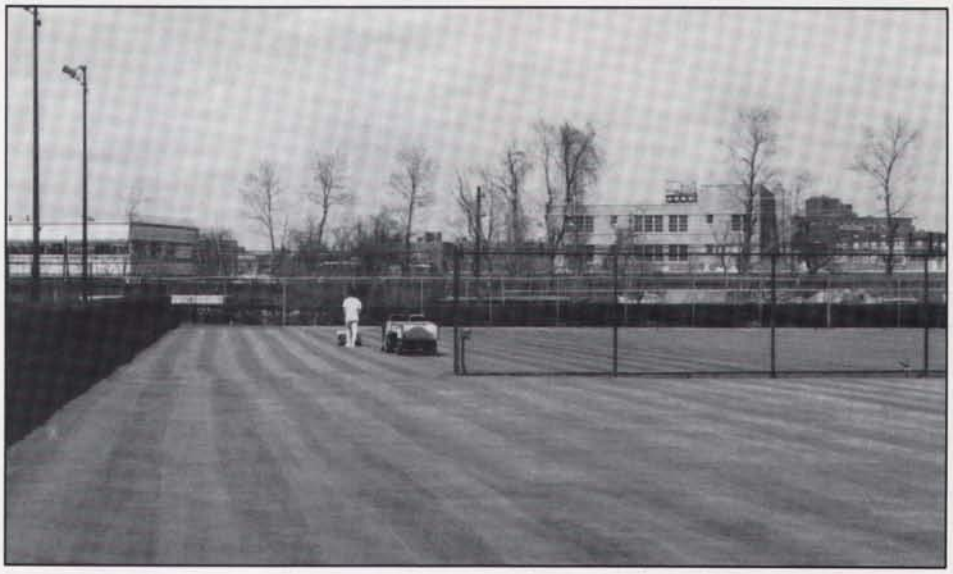
It didn't take Sheridan long to begin changing the way athletic facilities were managed at Fordham. "Before you can permanently solve the problems associated with athletic fields, you have to treat them separately from the rest of campus maintenance," he told the university's administration. The fields really should be under a separate budget with specially trained personnel. You don't get results without making a commitment, one that isn't constantly being challenged by other campus needs. Fordham adopted Sheridan's idea and has since rebuilt its main fields. Now the athletic department is in the process of reinstating the school's once successful football program.

"Fordham is like an oasis in the middle of the Bronx," he boasts. "It's a beautiful campus that helps build pride in the midst of the city."

The same can be said for the tennis club. When the club moved from the west side of Manhattan to Forest Hills in 1913, the area was farmland. It soon featured 36 grass courts and more than 20 clay. The stadium was built in 1923 to hold 15,000 tennis fans, a phenomenal crowd for the times. The U.S. Open was held in this stadium until 1978, when it moved to the National Tennis Center in Flushing Meadows. In 1980, the club hosted its first Tournament of Champions.

"The Open was played on grass until 1975," said Sheridan. "Then the stadium was converted to Har-Tru because the players wanted more uniformity. Maintaining grass for tournament play is a nightmare. We'd resod patches along the baselines almost every night. By the end of two weeks, though, the courts were essentially dirt. The climate and the construction of the courts here is a lot different from Wimbledon. The soil there contains more clay than our topsoil. Even when the grass wears thin, play can continue."

The popularity of grass courts continued to wane during the '80s. The original 36 courts were converted to other surfaces gradually over the years. First to 22 and now to eight. "Grass is nice for the recreational player," states Sheridan. "We protect our courts by rotating them daily, maintaining a sod nursery, and using a few techniques to keep the bent growing vigorously. Each year we host the Men's Eastern and National Women's Senior Grass Court Championships.



Bentgrass courts are mowed at 5/16-inch.

"There's definitely a place for grass courts in tennis today," continued Sheridan. "After a lull ten years ago, the use of our grass courts picked up again. Some players prefer grass over anything else. We make sure they have a place to play."

Variety of Surfaces

Today, Sheridan maintains eight grass courts, seven red clay courts, four DecoTurf courts, and 23 Har-Tru courts. The club also has three platform tennis courts and covers four Har-Tru courts with a bubble for winter play.

The hard court is actually an adaptation of tennis brought on by American court builders and the glamorization of the fast-paced, power game played by young professionals in this country. Hard courts play faster, have a more predictable bounce, and provide superior footing. They benefit the younger player and power in regard to shotmaking. However, they also are less forgiving on knees and leg muscles.

Clay and grass courts take some of the speed off the ball when it bounces. The emphasis is placed on shotmaking. Most foreign tennis professionals develop their skills on clay and grass. In fact, most major tournaments outside the United States are held on other than hard surface courts.

West Side has four Deco-Turf hard courts for its members who enjoy the fast game. But the majority of its courts are surfaced to please those who like more traditional playing conditions.

Court Maintenance

"This country has ventured away from traditional tennis surfaces partly because of the maintenance involved in clay and grass courts," Sheridan points out. "They require a daily regimen of maintenance practices. Most parks don't have the budget or trained staff to manage anything besides hard courts. As a result, most people learn tennis on hard surfaces and aren't exposed to the differences grass and clay courts offer."

According to Sheridan, there is a general lack of knowledge on how to care for more traditional tennis surfaces. He is constantly receiving phone calls from tennis enthusiasts with their own courts. "I frequently consult members on court care," says Sheridan. He also is a regular speaker at Har-Tru's annual maintenance school.

"Just like no two golf greens are exactly alike, no two grass or clay courts are the same," explains Sheridan. "There is a wide variation in grass courts because of the soil and the varieties of bentgrass used. Our courts and nursery were constructed with a local topsoil amended with USGA greens mix. The surface is probably in the range of 70 percent sand and 30 percent humus. We aerate, drill seed, topdress, and roll the courts in October. Deep aeration in April has also proven helpful."

Sheridan has gradually incorporated different varieties of creeping bentgrass and perennial ryegrass into the courts. "I've tried using just one variety in the past and found that mixtures are more wear tolerant," he reports. The courts are now a mixture of ryegrass and Cobra, Penncross,

continued on page 14

West Side Tennis Club
continued from page 13

and Penneagle bents.

"In the '40s, my father tried Ugandagrass on a portion of the nursery," adds Sheridan. "It didn't green up until the end of June."

The other items Sheridan watches closely are moisture and fertility. "Our irrigation system is all manual with quick-coupler heads," he says. "There is no zoning. I'd prefer an automatic system, but our night irrigation man knows to watch the grass courts very closely."

Since the rootzone contains a high portion of sand, Sheridan tries to avoid quick-release nitrogen sources. "There is a lot of concern over nitrates leaching into the groundwater around here," he states. "I also don't want lush turf growth. I'm fairly happy with a line of fertilizers from Huma-Gro. It includes complete fertilizers as well as supplements of potassium, phosphorus, and minors. The turf seems to be tougher, better in hot periods, and less prone to disease. It is not quite as green. That's where a few selected applications of nitrogen and iron come in."

Sheridan is trying milky spore to control grubs and is considering biological pesticides for billbugs and the Northern crane fly. He alternates Bayleton and Chipco 26019 for diseases. "I don't go to preventative fungicides unless there's an unusual problem caused by weather," he adds. Two applications of Trimec keep the weeds under control.

Jim Sheridan.

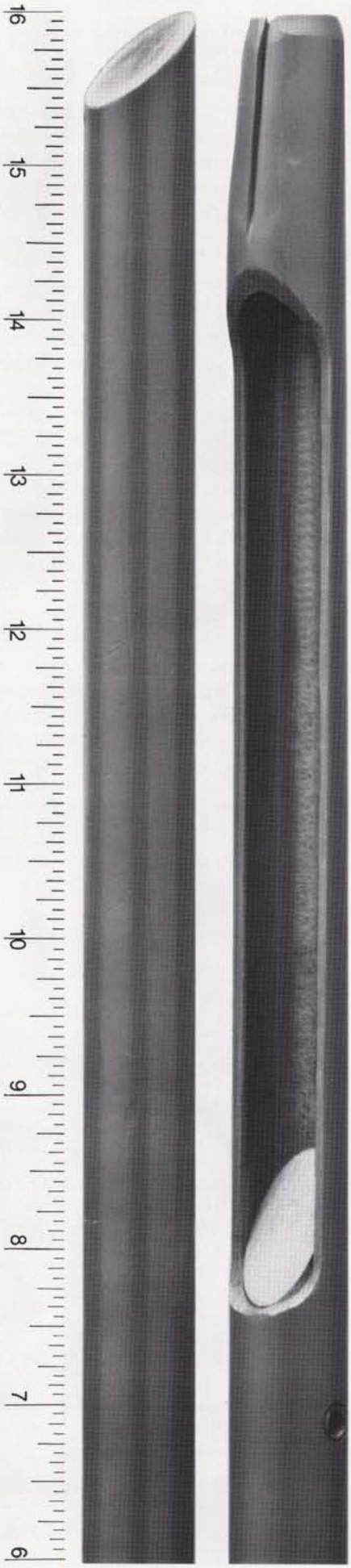
The grass courts are neatly trimmed at 5/16-inch with two walk-behind greensmowers. "They are a total of about two acres," reveals Sheridan, "so I'm considering a riding triplex greensmower."

Included in his bag of tricks are a special line marker and an occasional touch up with green dye for televised events. "The marker uses a two-inch roller to apply a light coat of paint to the grass," he says. "It helps cut down on paint buildup that you can get from a sprayer."

It might appear that the grass courts require more attention than the others. This is not true according to Sheridan. "You have different concerns with clay and Har-Tru. Brushing, filling in low spots, and maintaining the right level of moisture are constant jobs for clay-type courts. We manage our red clay courts differently from the Har-Tru. The Har-Tru is crushed light-green stone. It drains better than clay, but it also requires more water to maintain its firmness. The advantage of Har-Tru is the material is consistent," claims Sheridan. "Clays vary a great deal and they also contain fines which cling to the ball and clothing." There is enough to clay court management that it takes Sheridan more than three hours to cover the subject at the Har-Tru school.

Six years ago, Sheridan received so many calls about court maintenance that he decided to train a crew and start a side business. "We maintain more than 20 courts in the area during the summer," he says. "We have the equipment and knowledge it takes to do the job right. Properly maintained courts play the way they were intended to play. More people would have grass and clay courts if there were someone to maintain them professionally."

It's obvious that Sheridan has an affinity for grass and clay courts. Perhaps it's because he and his father have invested so much of their lives in them. Or maybe it's the impression he gets from all the tennis stars he knows personally. He presents the challenge, "If you're a serious golfer, what type of course do you enjoy playing most? It's the same for tennis. That's important when you realize you can enjoy tennis throughout your life."



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Only Verti-Drain® pulls plugs or solid tines to 16 inches deep and saves you water.

Lots of products claim to do one of these things well but only Verti-Drain can do them all well. It gives you complete versatility to hollow core or solid tine depending on your soil conditions. Tested worldwide, Verti-Drain consistently performs well developing healthy-root systems for fine grasses 8 to 10 inches deep, often through the black layer into the deep root zone.

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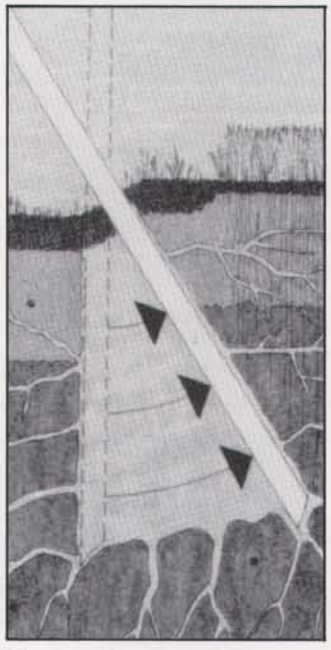

The patented Verti-Drain design permits tines to pivot back and forth while penetrating as deep as 16 inches (coring up to 12 inches) into the soil. A lifting—shattering effect occurs similar to the action of a pitchfork. The results are improved drainage and deeper, stronger, healthier root systems.

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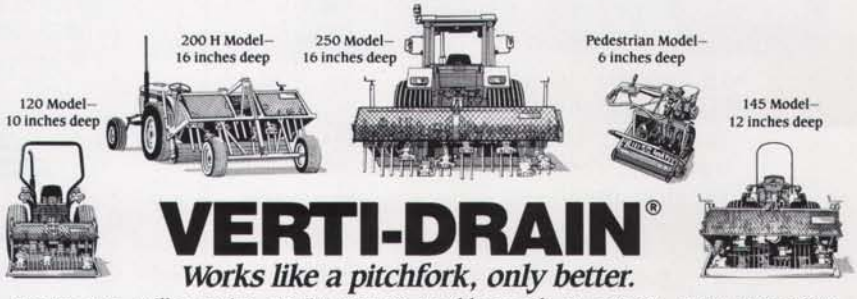

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ASGCA HONORS ST. ANDREWS SECRETARY

Presenting the award to Michael F. Bonallack (center) are (left to right) ASGCA Vice President Tom Clark, Secretary Art Hills, President Dan Maples and Treasurer Jerry Matthews.

Michael F. Bonallack, secretary of the Royal and Ancient Golf Club at St. Andrews was presented with the 1991 Donald Ross Award by the American Society of Golf Course Architects at its meeting in Broughton Park, England. The award honors an individual for contributions to the growth, understanding, and public awareness of the importance of golf course architecture to the game of golf.

MCCUMBER GOLF GOES NORTH OF THE BORDER

Construction of the 18-hole Edmonton Petroleum Golf and Country Club in Alberta, Canada, is under way. The course was designed by Mark McCumber and Associates, the design division of McCumber Golf, and is the firm's first course in Canada.

The 320-acre site was purchased by the Edmonton Petroleum club in 1990. It is located on the west side of Edmonton in the north-central region in the province of Alberta.

Predominantly flat, the land does have 20- to 25-foot ridges that cut across the lower third of the property. There is a combination of forest, peat bog, and arable land. The par-72 course will stand alone, with no adjacent residential development. Expansion to a 27-hole course is being considered.

"We have taken great care in routing the golf course throughout the property to create a variety of holes," said Mike Beebe, project architect for Mark McCumber & Associates, who has been elected to full-member status in the American Society of Golf Course Architects.

The original aeration device.

The latest concept, the Toro HydroJect.

Aeration Takes Root in Sports Turf

By Dr. John C. Harper

Sports fields, golf greens and park turf, as simple as they may appear, are complex communities of plants and organisms living in careful balance. While the vast majority of turf maintenance is directed at the foliage and thatch above ground, an equally important portion of the turfgrass community lies below the soil surface, completely out of sight. Failing to maintain the subsurface portion of turf over a period of time disrupts the balance of the turfgrass community and leads to its steady decline.

There are practical methods available today to maintain "the other half" of turf. They not only improve the overall quality of turf areas, they also increase the effectiveness of surface maintenance methods and provide the sports turf manager with greater control.

The most popular of these methods is mechanical aeration. This process makes a series of holes or slits in the soil. These openings relieve compaction, improve drainage, permit air and nutrients to penetrate the root zone, and provide channels through impermeable layers below the surface.

In the darkness of the soil, turfgrasses develop extensive root systems. Roots stabilize the foliage, they explore the pore spaces between soil particles for water, air and nutrients, and they store carbohydrates manufactured in the leaves above. Turf scientists have discovered turfgrass roots extending more than four feet into the soil. If you consider all the plant functions carried out by roots, you quickly realize they are every bit as important to the turfgrass plant as the leaves.

Leaves have one special task, to manufacture sugars and starches (carbohydrates) by a process called photosynthesis. Chlorophyll contained in the leaves captures the energy of the sun to convert water and carbon dioxide into sugars and starches. These carbohydrates are then utilized by the plant to fuel its growth. Excess carbohydrates are sent to the roots for storage.

The roots have the job of obtaining the water, nutrients and gases for photosynthesis, respiration, and growth. A turfgrass plant in full sun without a healthy root system will not perform up to its potential. Therefore, an equal amount of consideration should be given to turfgrass roots.

By applying quality fertilizers, sports turf managers provide most of the nutrients sought by the roots. Irrigation provides the necessary moisture. Even so, poor drainage, poor soil, heavy thatch or other barriers preventing nutrients and moisture from entering the root zone greatly reduce the effectiveness of standard turf maintenance practices.

These barriers preventing proper soil/atmosphere exchange are often caused by compaction of the surface soil. Thousands of impacts caused by foot and vehicle traffic tamp down the top inch or two of soil so tightly that neither air or water can pass through.

The negatives associated with compaction have been listed by Dr. J.R. Hall, extension agronomist at Virginia Tech, Blacksburg, VA. They include destruction of the soil structure, reduced soil drainage, and increased soil-eroding runoff, reduced protection of the root zone to heat or cold, pesticides are unable to reach and control insects in the soil, and there is less storage space within the soil for water, air, and nutrients, and results in higher maintenance costs. Root growth is also stunted by compacted soil. Shorter and smaller root systems render turfgrass more vulnerable to periods of stress.

Thatch, nondecomposed stems, leaves, and roots on the surface of soil, can be harmful to healthy turf if it becomes more than 1/2-inch thick. Heavy thatch reduces the effectiveness of some herbicides and insecticides, harbors insects and diseases and can disrupt uniform infiltration of irrigation or natural rainfall. Research has shown that periodic aeration helps mix soil into the thatch layer to aid in its decomposition. Some thatch is considered advantageous for sports turf since it provides a cushion that protects both the player and the turfgrass from damage upon impact.

Another barrier to healthy turf growth is soil incompatibility, a situation created when sod grown on highly-organic soil is installed over a sandy or clay soil. Heavy applications of organic materials to a turf growing in sandy or clay soils can have the same effect. The organic layer at the surface acts like a sponge, keeping the surface excessively damp and preventing surface water from draining through the soil as it should. This environment is destructive to

continued on page 18

Holland Aerway fractures subsurface layers of soil.

Aeration

continued from page 17

organisms living in the turf that assist in the decomposition of thatch.

Compaction, thatch, and soil incompatibility are often the real causes of turf failure blamed on poor irrigation practices, diseases, insects, or inadequate fertilization. There is enough evidence to support the use of aerators by sports turf managers to prevent and break up soil barriers.

The earliest documentation of aeration is in a book titled *Making A Lawn,* written in 1912 by L.J. Doogue of the Boston Parks Department. Doogue recognized the need to work fertilizer into compacted soils. He writes, "Take a round stick about one inch in diameter and three feet long and sharpen one end. At frequent intervals, drive the stick to a depth of two feet about the grounds. Make many such holes, and into these ram a mixture of finely-powdered manure, hardwood ashes and bone meal. In a short time the good effects of this treatment will manifest themselves and during subsequent seasons the treatment can be extended to parts not touched before. It practically means that the land will be as thoroughly renovated as if it had been plowed and harrowed."

However, in 1917, the need for aeration was not recognized in the first comprehensive U.S. publication on golf course management, *Turf for Golf Courses,* by Piper and Oakley. These early agronomists worked for the United States Department of Agriculture and assisted the United States Golf Association in establishing turf management practices for its members.

Dr. Fred V. Grau, the first extension turfgrass specialist for Pennsylvania State University, reported that he had no recollection of any type of equipment being used to improve soil-air relationships or to reduce soil compaction at the USDA's Arlington Turf Gardens in the early 1930s. Grau did remember golf course superintendents using potato forks and spading forks to loosen hard spots on putting greens that resisted water penetration.

In the mid-'30s, a Michigan concern offered for sale a three-gang, pull-behind spike disk fairway cultivator, a spike disk greens cultivator, and a 10-inch-wide home lawn spike disk cultivator. In its advertising, the company stated, "It is an accepted fact that turf requires aeration and cultivation especially upon turf that receives constant play." The tractor-drawn model on the market today is essentially the same as the 1930 version.

During the late '30s and early '40s, many turfgrass managers developed their own versions of aerating equipment, ranging from devices as simple as large spikes drive through planks to "Rube Goldberg-type" machines that required several men to push or pull. Soil aeration was a major topic of "Lawn Schools" given by agricultural agent Charles K. Hallowell in Philadelphia during the period.

In 1945, Grau, then director of the USGA Green Section, discussed developing a commercial aeration machine with Tom and Tony Mascaro, owners of West Point Products in West Point, PA. The Mascaro brothers decided to expand their topdressing business into equipment manufacturing and designed the West Point Aerifier. This development truly became the beginning of a new era for specialized turfgrass management equipment. Hahn purchased the manufacturing rights to the "West Point Aerifier" in 1970.

The West Point Aerifier had one drawback. Because the tines entered and exited the soil at an angle, they would lift up a lip of turf at the back of the core hole. Golf course superintendents were concerned that these lips would disrupt putting on golf greens. To provide superintendents with a neater surface following aeration, the Greensaire Aerification Co., of Hopkins, MN, (purchased by Ryan in 1950) invented an aerator that drove hollow, cylindrical tines vertically into the soil and pulled soil cores straight out. These machines were considerably slower than disc-type or West Point aerators.

The first walk-behind aerator for general lawn use was the Motoraire introduced in the '50s by Soilaire Industries (purchased by Ryan in 1960). Hollow tines pivoted on solid metal wheels as they turned. The tines entered and exited the soil in an almost vertical position providing a neat enough job for residential or commercial lawns. The unit was also as fast as a West Point aerifier.

The Dedoes Co. manufactures a drum aerator which traps the soil cores inside instead of depositing them on the turf. Screens on both ends of the drums trap the cores until they can be deposited in low spots or discarded. These are convenient for smaller jobs where cores could be a problem, but impractical for large areas where the aerator may remove 10 or more cubic yards of cores per acre.

In recent years, several new concepts have appeared in aerating equipment, including an oscillating or quaking tine effect. For the most part, the method of operation has basically been two-fold. The so-called punch-type aerators drive hollow or solid tines in and out of the soil vertically with very little tearing or raising of the sod around the hole. These machines were developed primarily for golf course greens, grass tennis courts, bowling greens or other closely-cut turf areas where minimum disruption of play is essential.

The second, or rolling-type, machines are equipped with solid spikes, hollow tines, open-spoon tines, or slitting-slicing tines of varying shapes and sizes. the tines are mounted on a drum, a series of discs, or directly on an axle that rolls forward with the machine. The tines enter and exit the soil at an angle. For this reason, some tines

tend to tear and raise the soil around the lip of the hole.

As previously indicated, there are many different types of tines. Hollow tines and open-spoon tines remove soil cores while solid tines remove little or no soil. Most tines vary from 1/4 to 3/4 inches in diameter. Slicing tines are available in a variety of shapes, sizes and thicknesses. An early aerator known as the Nightcrawler designed for greens actually used augers (large drill bits) in place of tines.

The spacing of tines determines the number of holes or slices made in a given area. A machine equipped with hollow tines on two-inch centers will provide approximately 36,000 holes per 1,000 square feet. A random check of commercial literature reveals tine spacing of 2, 2.5, 2.75, 3, 3.5, 4, 4.5, 5.5, and 6 inches are currently available.

Tine mounting also varies on rolling-type aerators. Most rolling-type, core-removing machines have hollow or open-spoon tines mounted rigidly on the drum or axle. A few manufacturers of rolling-type machines have the tines mounted on hinges. The theory is the tine enters and leaves the soil in an almost straight vertical position causing less tearing of the sod around the hole. Generally, spiking, slicing and slitting tines are mounted rigidly.

Speed of operation has been a major consideration in the development of aeration equipment. Unfortunately, there has been a direct correlation between speed and the quality of the aeration results. Generally, the faster rolling-type machines do not have close tine spacing, the clean entry and exit, or the depth of vertical-core machines. The outcry for faster equipment is the result of greatly increased labor costs, down time of the turfgrass area and inconvenience to the player. Some golf courses, where cost is not a limiting factor, have begun using slow-moving punch-type greens aerators to cultivate their fairways. Classen, Cushman, Green Care International, Jacobsen, Terracare, and Toro have reengineered punch-type aerators for fairways and sports fields.

Depth of penetration also has been a concern. Most machines on the market today that pull soil cores penetrate approximately two to three inches. One U.S. manufacturer provides six inch hollow tines. Slicing or slitting machines may penetrate as deeply as six inches whereas spikers normally used to break up surface crusts only penetrate one to two inches.

Some manufacturers offer accessories for their equipment line. Attachments to windrow or pick up soil cores are on the market today. One manufacturer offers an attachment that picks up the plugs, shatters them and returns them to the turf as topdressing material. Weight trays and weights for maximum tine penetration are offered by many suppliers.

A major concern of many turfgrass managers is the development of a compacted soil layer at the point of maximum tine penetration following frequent aerification. It makes no difference whether the machine is a punch-type or rolling-type.

One possible means of reducing this problem may be the development of better depth control for existing machines so penetration depth can be varied from one aeration to the next. Unfortunately, the shallow maximum depth of many machines limits this approach. A possible alternative would be to follow a program using several machines having different depths of maximum penetration.

The development of the compacted layer is akin to the development of a fragipan or hard pan in a crops soil. Not only is drainage impeded but roots fail to penetrate the

continued on page 20

Aeration

continued from page 19

compacted layer. This layer in turf soils may be more serious than in some crop soils because it develops at such a shallow depth. The resulting shallow roots may lead to severe stress of the plants during drought periods.

Deep aeration devices have been developed in the past few years to break through subsurface compacted layers. The Verti-Drain is one example. Holland Co. of Ontario, Canada, has developed a spike-like tine that fractures the soil below the surface without damaging the turf above. Yeager Twose and Olathe have machines that aerate by cutting grooves in the soil. The Vertigroove by TurfTech removes thin, deep slices of soil instead of cores. The slices are removed or broken up like cores would be.

Obviously, tines have the potential to damage irrigation heads and shallow lines. Heads should be marked before aeration and the depth of aeration should be set to prevent tines from hitting irrigation lines or wires.

Tines glazing the sides of core holes or soil slits is also a concern. Glazed surfaces have a very thin compacted layer which reduces the movement of oxygen and water into the soil and carbon dioxide out of the soil. Some manufacturers claim that the action of their tines shatters the wall of the hole or slit and thus avoids the problem. This may be true for relatively dry soils, but moist soils do not shatter readily. Furthermore, some aerators will not penetrate dry soils well.

Aerator manufacturers have added devices to their machines that counteract some of the tearing and lifting of the sod. Springs attached to each tine compress the surface as the tine enters the soil and reduces lifting of sod when it exits. Even vertical core machines have spring-loaded guides that hold the soil around the points the tines enter. Toro has taken a different approach to this problem by introducing the Hydro-Ject which uses jets of water instead of tines to create channels in the soil.

As indicated earlier, speed of aeration is important in some turf operations. In situations where uninterrupted turf use is critical, especially from a financial standpoint, sports managers are forced to sacrifice some quality for speed. Where time is a limiting factor, slicing equipment can be operated at higher speeds than coring equipment although quality may be less. A.J. Turgeon gives a detailed discussion of the relative merits of coring as compared to slicing or spiking in his book *Turfgrass Management.*

Rapid drying out of the turf can be a problem if aeration timing is improper. During hot weather, especially under windy conditions, desiccation around the core or slit opening can occur quite rapidly. Drying out potential is greater with coring than slicing or spiking. During hot, windy weather, it is recommended that a slicing or spiking machine be used rather than a coring unit and that irrigation be available.

On the other hand, soils that are prone to remain wet for long periods benefit from coring just prior to expected periods of prolonged rainfall. When hurricane Agnes struck the Atlantic Coast in the spring of 1972, golf greens that had been core aerated that spring withstood flood waters and/or prolonged rainfall much better than those that had not been cored. Wet soils can also be dried out faster by coring providing the equipment used is capable of pulling cores from wet soil.

Opening up the soil for air, moisture, and nutrients, also opens it up for insects and weed seeds. Cutworms living in core holes and feeding near the surface will cause a brown, damaged ring of turf at the top of the hole. Aerated areas known to be infested with cutworms or insects of similar habit, should be treated with an insecticide at the first sign of insect damage.

Aeration can bring viable weed seeds to the surface that would be too deep to germinate otherwise. Crabgrass seed has the ability to lie dormant in the soil for many years and to germinate readily when brought to the soil surface. Annual bluegrass seed germination also can be increased by aeration.

It's important to note that aerators should not be used during the effective period of preemergence herbicides. These herbicides form a chemical barrier just below the surface of the soil which blocks germinating weeds. Mechanical aeration breaks through the chemical barrier and damages the effectiveness of these herbicides.

The benefits of aeration far outweigh the problems it creates. The most common benefits attributed to aeration are the improvement of gaseous exchange between the soil and the atmosphere and the reduction of compaction. By removing the cores, the bulk density or hardness of the soil decreases. This softer soil cushions the