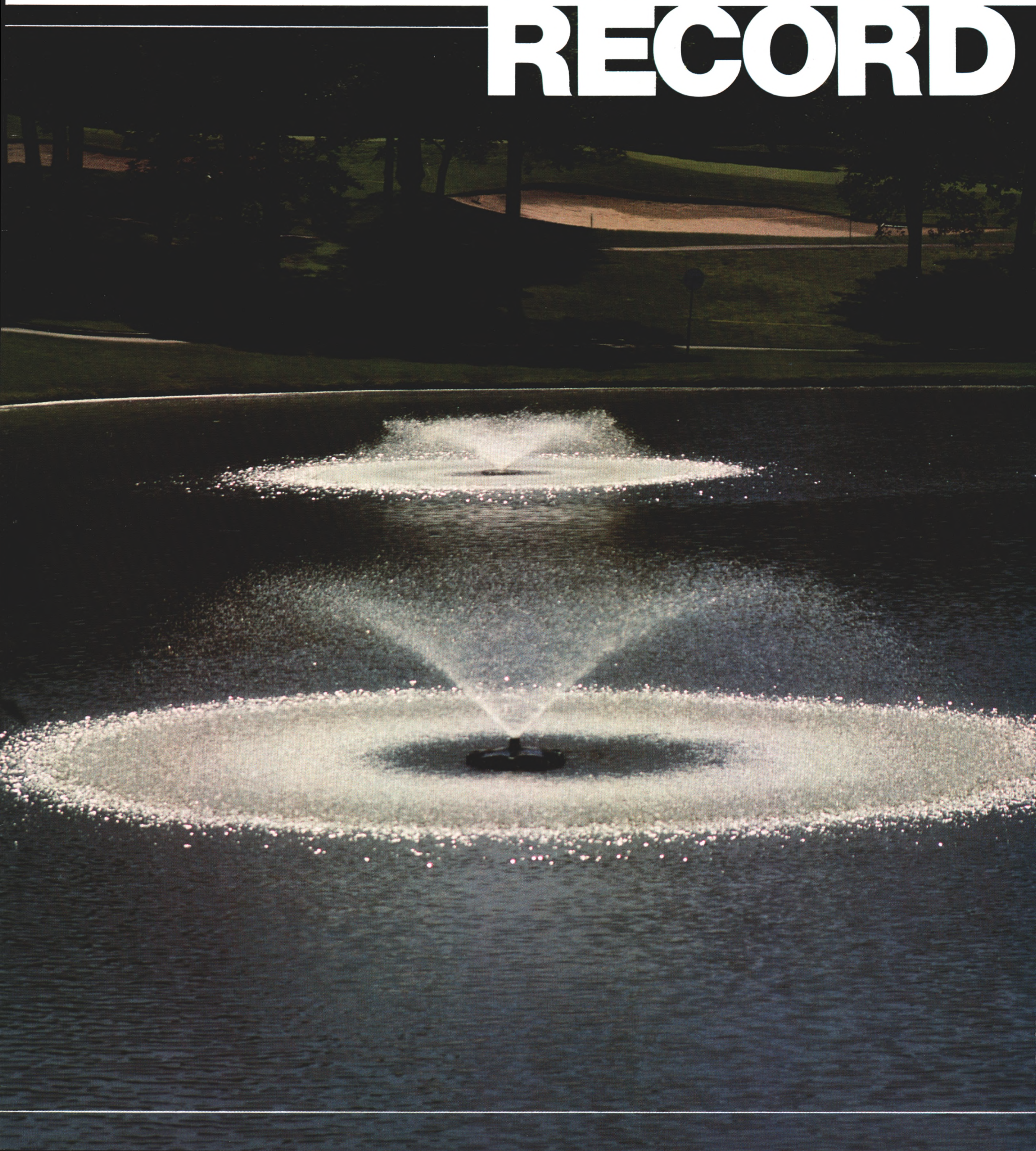
A Publication on
Turfgrass Management by the
United States Golf Association®

September/October 1990

USGA®

Green Section RECORD



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Green Section RECORD

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Vol. 28, No. 5
SEPTEMBER/OCTOBER 1990

Cover Photo:
A well-maintained pond to the right of the 12th green at Medinah C.C., site of the 1990 U.S. Open.

GREEN SECTION RECORD (ISSN 0041-5502) is published six times a year in January, March, May, July, September and November by the UNITED STATES GOLF ASSOCIATION®, Golf House, Far Hills, N.J. 07931. Subscriptions and address changes should be sent to the above address. Articles, photographs, and correspondence relevant to published material should be addressed to: United States Golf Association Green Section, Golf House, Far Hills, N.J. 07931. Second class postage paid at Far Hills, N.J., and other locations. Office of Publication, Golf House, Far Hills, N.J. 07931. **Subscriptions $9 a year. Foreign subscriptions $12 a year.**

It will take a well-balanced management approach to get this pond back into shape.

A Different Look at IPM: Integrated Pond Management

by JAMES CONNOLLY
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THE MANAGEMENT of ponds on golf courses can be a complicated business. In a sense, managing a body of water can be likened to the managing of the human body. The human body is affected by the things around it and what enters it. When someone has a fever, he often treats the symptom with medicine. The medicine may work to relieve the symptom, but it may not treat the actual cause of the distress. Likewise, treating the symptoms of a pond problem may not provide a permanent resolution to the cause of the problem.

For example, if aquatic plants are determined to be a nuisance, attempts are made to control the plant with certain treatments. Aquatic weed control guides provide instructions for applying chemicals for temporarily controlling the weed, but such an approach probably would not produce a long-term cure.

The best management approach to pond problems involves managing the pond ecosystem, not just the individual organisms. An organism approach treats the symptom, but an ecosystem approach identifies and treats the cause. This concept can be called IPM: in this case, Integrated Pond Management.

Ponds and lakes serve many purposes on a golf course. They can influence the strategy of a golf hole or provide irrigation water. Ponds serve as drainage containment areas or add aesthetic value to the course. The different uses of a water body dictate the maintenance parameters that must be considered. For example, irrigation reservoirs must contain a minimum of debris, particulates, and other contaminants. Management of these water bodies is concerned mostly with water quality. Irrigation ponds are different from most ponds because the turnover of water is usually quite rapid. Other water bodies demand more complex IPM practices because the water passes through the system much more slowly.

Construction of a new pond at the Brae Burn C.C., West Newton, Massachusetts.

Pond construction at Brae Burn included protection of a nearby stream.

It is presumed that a golf course manager should have a thorough understanding of agronomy, but must he have an equal degree of understanding of lake management? Probably not, but he should be familiar with the basics of limnology (the science of fresh water bodies). After all, he is responsible for decisions made regarding pond management.

The first step is to contact experts in the field of limnology; the actual management plan should be developed by an experienced water manager. Nevertheless, a basic understanding of how a pond ecosystem and surrounding watershed operates will get you started on the right foot to successful pond management.

The dictionary defines lakes and ponds as "bodies of water." This term is very accurate. A water body is a living organism which develops from year to year and changes over time.

Knowing what goes into and comes out of a water body is an important part of understanding a pond's life cycle. The operation of a pond ecosystem depends on available energy and nutrients. Aquatic flora and fauna need nutrients to live and grow. When nutrients are limited, growth is limited.

Controlling nutrient levels in a pond can be an effective management tool for controlling nuisance weeds. Phosphorus, nitrogen, and, to a lesser extent, potassium are used by aquatic plants. Phosphorus is often the limiting nutrient in ponds. A difference as low as 10 ppb can change a pond from oligiotrophic (poorly nourished) to eutrophic (well nourished). That is a very small concentration! It is the well-nourished pond that frequently has excess plant growth.

Nutrients enter ponds in several ways (*Diagram 1*). It is here that the turf manager can minimize lake eutrophication by controlling the pond's diet. Eutrophication is a biological response to increasing nutrient inputs. Eutrophic lakes are commonly high in aquatic weed populations, and oxygen levels can be out of balance with biological oxygen demand. Even though many lakes are "choked" with weeds, however, it does not mean they are eutrophic. Most lakes are in a steady state of development and seem to buffer most effects of a mature watershed.

Lakes near heavily populated areas, including cities, towns, and agricultural lands (golf courses), are subject to outside influence. For this reason, the incoming nutrient load should be measured and monitored. Data from this testing can be used by a limnologist in developing a nutrient budget, which can provide a valuable predictive and diagnostic tool.

How can a superintendent manage the watershed so impacts on the pond are minimal? The first step is to have a lake management firm test the water for phosphorus, dissolved oxygen, volume of inflow and outflow, and a battery of other factors. This information, along with land use and watershed statistics, provides a base of information.

The second step typically involves a close review of the changes needed to reduce the negative input to the pond. The management process can be divided into two major sections: watershed, or **out-of-lake** management, and **in-lake** management.

The following are descriptions of some watershed management methods.

Septic Systems: Septic leaching fields are designed to allow bacteria and minerals to filter the wastewater before it enters the groundwater, stream, or lake. Golf courses commonly are affected by leach fields coming from the clubhouse or surrounding homes. Tests should be done to determine the amount of phosphorus entering the pond from septic fields.

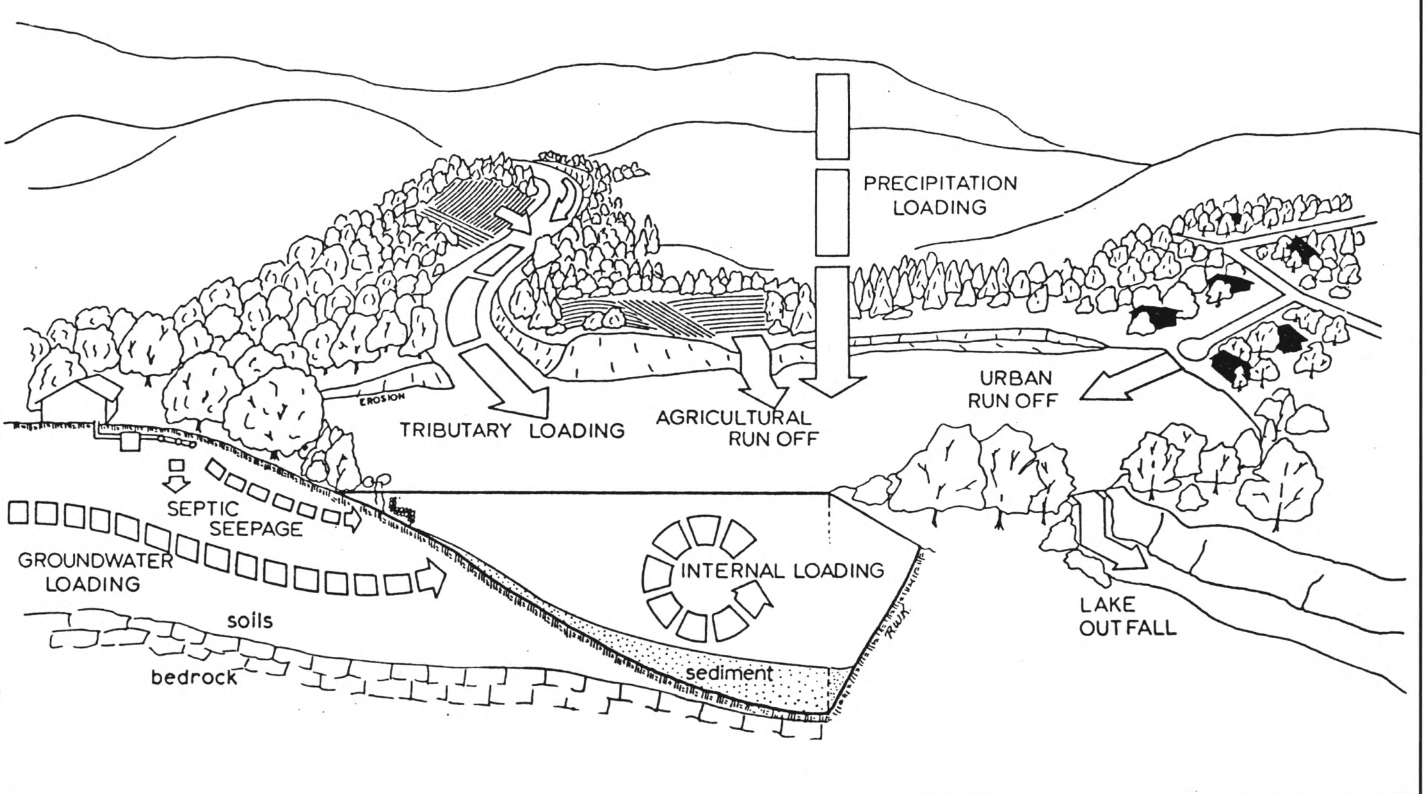
Storm Runoff: Runoff in the form of drainage can be a source of pond contamination. Watersheds in commercial or residential areas can produce large amounts of phosphorus in runoff, especially in the first wave of runoff. One way to mitigate this effect is to have the first wave of drainage water coming into a golf course enter a dry well. This effectively catches a good portion of phosphorus in the first flush, whereas later flood water is significantly lower in phosphorus concentration and can bypass the dry well.

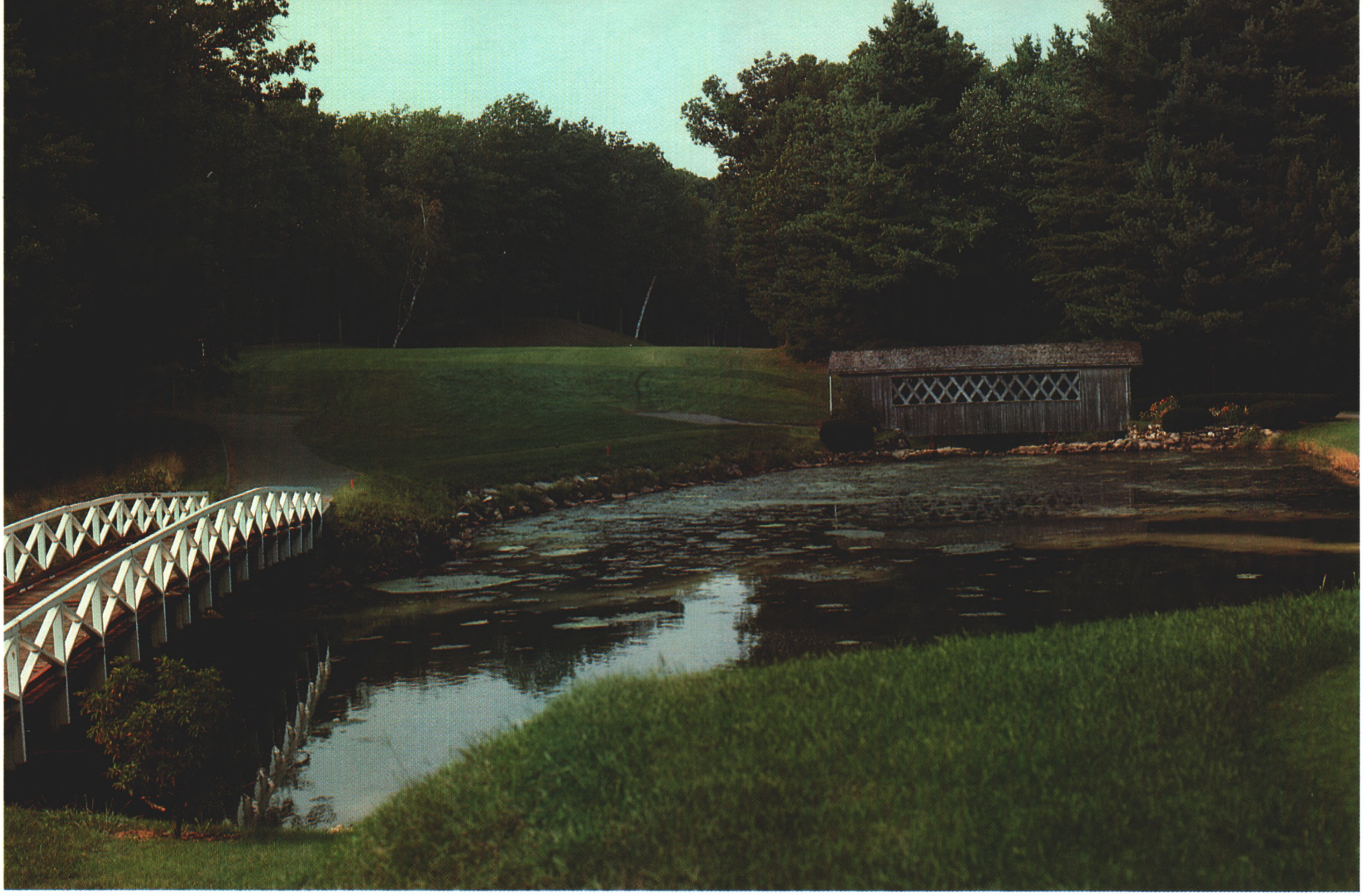
Agriculture: Livestock waste contains nutrients that can enter waterways, and croplands upstream from golf courses can be a source of sediment and nutrients. Your county extension office should have handbooks for calculating soil loss and quantities of animal waste nutrients.

Fertilizers: Properly managing fertilizer applications within a watershed is extremely important. Fertilizer applications within 50 feet of a water body or stream should be applied with a drop spreader. Normally, nitrogen leaching from fertilizer applied to turf is very small when slow-release sources are used, but it can be higher under optimum conditions and when soluble fertilizer sources are used. Runoff contaminants from turf are usually negligible, which makes turfgrass an excellent buffer strip.

The ability of turf to limit nutrients entering the water supply depends upon

MAJOR NUTRIENT PATHWAYS IN LAKES





Before (above) and after (opposite page) — The reconstruction of the dam has eased the maintenance of this pond at the Pleasant Valley C.C., Millbury, Massachusetts.

grass type and density, fertilizer source, method of application, temperature, soil type, rainfall or irrigation events, and timing of application. The turf manager can control nutrient loading into water bodies and have a dramatic effect on the health of a pond.

Following are some basic guidelines:

1. Use slow-release nitrogen sources.

2. Minimize late fall fertilization with soluble nitrogen sources, especially near watersheds and on sensitive sites.

3. Develop dense, healthy turf.

4. Apply fertilizer under carefully controlled conditions.

Wildlife: Some view birds and other wildlife as an indication that the environment is favorable to nature. The presence of wildlife gives a sense of harmony with nature. Some types of wildlife, however, can be a real nuisance.

Canada geese feed on new grass sprouts and lush turf, and golf courses are some of their favorite restaurants. The major problem with geese is their excrement. One goose can excrete 50 grams of phosphorus per month, contributing to the eutrophication of a water body; therefore, their presence should be discouraged. Deterrents include styrofoam swans, dogs, pop-guns, and yellow rope stretched across the water. Burrowing animals can break down lake and stream banks, causing erosion and sedimentation. Trapping and removing them is the most feasible control method.

Buffers: Buffer strips along ponds and waterways help filter certain types of pollutants. Buffers can be grass, brush, trees, or other vegetation. Grass buffers can be an excellent choice because of their good filtering activity and minimal litter characteristics.

Water in shallow streams and drainage ditches can heat up if exposed to intense sun. Wooded buffers along streams help minimize thermal pollution.

Channelization: Streams and drainage ditches constructed in a straight line (channelization) are subject to erosion and degraded water quality. Water can reach a high velocity of flow in these circumstances and carry silt and contaminants into ponds. Pond dredging is often a treatment of the symptom caused by channelization.

Streams and ditches should meander, thereby reducing flow velocity, and rocks can be used as rip-rip to stabilize banks. Velocity reducers, such as weirs, check dams, etc., also can be used effectively. Furthermore, sediment ponds and sediment traps can collect debris before it enters the pond.

Air Movement: Ponds that are totally surrounded by trees can become stagnant if wind movement is blocked. In response, trees can be removed to allow prevailing winds to naturally aerate ponds.

The following are **in-lake** management processes:

Nutrient Precipitation: Water bodies that are becoming or have become eutrophic may benefit from aluminum sulfate (alum) applications. This material precipitates phosphorus from the water column into chemically unavailable forms in sediment.

Aerators: Aerators influence the rate of oxygen transfer from air to water by

creating turbulence and increasing the surface area of water in contact with air. The end result is more oxygen in the water up to the point of saturation. Oxygen/water relationships are quite complex, however, and the idea of aeration as the key to lake health is much like saying orange juice is the key to good human health.

Algae Control: Much less phosphorus is released into the water from bottom sediments when the water overlying these sediments is oxygenated. Aeration can be a method of controlling phosphorus release in some lakes, and this can help reduce algal bloom.

If aeration is not carefully controlled, however, phosphorus in bottom sediments can be stirred up and may actually increase the algae population. Since the entire water column is mixed, the surface scum of algae is spread out in the water column and gives the illusion of algae control.

Some biologists state that aerators do not control algae, and may make the problem worse. Most agree, however, that careful aeration is beneficial.

A type of aeration that selectively aerates different layers of the lake is being used successfully in some situations. The term is **hypolimnetic aeration**. This, and similar selective aeration methods, show great promise and are relatively inexpensive.

Still another fairly new method actually withdraws nutrient-rich bottom water and discharges it out of the lake. Both hypolimnetic and subsurface withdrawal leave the natural stratification intact.

Ozone injection, a spin-off from water treatment plants, is making a move into lake management. Ozone, a powerful oxidant, can remove odor, color, viruses, taste, algae and organics, and helps flocculate micopollutants. This, too, offers promise as a tool, but not as a cure-all.

Biological Management

Grass Carp *(Ctenopharyngodon idella)***:** Different studies reveal different opinions on this plant-eating fish. One study found that carp eat many plants with minimal effect on native fish (depending on stock rates), but waters become higher in phosphorus, turbidity, and algae.

Other reports contradict this, stating that carp eat algae and do not cause murky water. More information is needed, and each state has different guidelines regarding their legality.

Other biological agents are being tested in several states. Some weeds in the South have been reduced by using insects, but their effectiveness is limited. Researchers at the University of Massachusetts are working on a caterpillar to control Eurasian millfoil. Biological controls are not yet available on a wide scale in most areas.

Many other popular methods of treating pond problems exist: chemical applications, dredging, harvesting, lake drawdown, dyes, and screening. Each method has a specific effect on the pond ecosystem. Integrated pond management looks at watershed and lake techniques for minimizing nuisance aquatic plants. Water quality is also a consideration in pond management. The manage-

REGULATIONS FOR IMPORTATION OF GRASS CARP*

1 — Permit required
2 — Ploidy inspection required by authorized government inspector
3 — Disease inspection required
4 — All purchase of grass carp is presently for research purposes only
5 — State uses authorized dealers

ALABAMA	Diploid	—	—	—	—	—
ARIZONA	Triploid	1	2	3	—	5
	Visual disease inspection only					
ARKANSAS	Diploid	—	—	—	—	—
CALIFORNIA	Triploid	1	2	3	—	—
	Entire state may open for commercial importation in 1991					
COLORADO	Triploid (Western)	1	2	—	4	5
	Diploid (Eastern)	—	—	—	—	—
CONNECTICUT	Triploid	1	2	—	—	5
DELAWARE	Triploid	1	2	—	4	5
	State may open for commercial importation in a few months					
FLORIDA	Triploid	1	2	3	—	5
	Disease inspection only for fish going into state-owned lakes					
GEORGIA	Triploid	1	2	—	—	5
HAWAII	Diploid	1	—	3	—	—
IDAHO	Triploid	1	2	3	—	—
ILLINOIS	Triploid	1	2	—	—	5
INDIANA	Triploid	1	2	—	4	—
	State will likely open for commercial importation in 1991					
IOWA	Diploid	1	—	—	—	—
KANSAS	Diploid	—	—	—	—	—
KENTUCKY	Triploid	—	2	—	—	5
LOUISIANA	Decision to accept triploid grass carp is pending					
MICHIGAN	State may consider introduction of triploid grass carp in future					
MISSISSIPPI	Diploid	1	—	—	—	—
MISSOURI	Diploid	—	—	—	—	—
MONTANA	State may consider introduction of triploid grass carp in future					
NEBRASKA	Triploid	1	2	—	—	5
NEVADA	Triploid	1	2	3	—	5
	Visual disease inspection only					
NEW JERSEY	Decision to accept triploid grass carp is pending					
NEW MEXICO	Triploid	1	2	—	—	—
NEW YORK	Triploid	1	2	—	—	—
NORTH CAROLINA	Triploid	1	2	—	—	5
OHIO	Triploid	1	2	—	—	5
OKLAHOMA	Diploid	—	—	—	—	—
OREGON	Triploid	1	2	3	4	—
PENNSYLVANIA	Decision to accept triploid grass carp is pending					
SOUTH CAROLINA	Triploid	1	2	—	—	5
	State requires ploidy inspections by their own inspector, not USFWS unless specifically mentioned					
SOUTH DAKOTA	Triploid	1	2	—	—	—
	No shipments have yet entered state					
TENNESSEE	Triploid	1	—	—	—	—
Tennessee Valley Authority		—	2	3	—	—
	Visual disease inspection only					
TEXAS	Triploid	1	2	—	4	—
	State may open for acceptance of commercial shipments in future					
UTAH	Decison to accept triploid grass carp with disease inspections is pending					
VIRGINIA	Triploid	1	2	—	—	5
WASHINGTON	Triploid	1	2	3	4	—
	State may open for commercial importation in a few months; visual disease inspection only					
WEST VIRGINIA	Triploid	1	2	—	—	—
WYOMING	Triploid	1	2	3	—	—
	Visual disease inspection only					

*States that allow diploid grass carp also allow triploid; all states not listed ban any grass carp. Many states conduct random ploidy inspections on distributors.

Source: U.S. Fish and Wildlife Service — 6/27/90

ment plan will probably utilize two, three, or more of the techniques in this report. One control method is seldom, if ever, the total answer.

Proper Construction

Good pond management actually starts with proper construction techniques. Site selection, the size of the pond, intended use, subsoil type, and many other factors must be considered before building a pond.

The Brae Burn Country Club in West Newton, Massachusetts, recently built a four-acre-foot pond for irrigation and aesthetic purposes. The golf club has been dependent upon municipal water for years, and they wanted their own water source. A pond was proposed, and a professional engineer developed the plan.

The pond was lined with 20 mil PVC, and a ballast of sand was placed 10 inches deep on top of the PVC. A bottom outlet was installed to allow for drawdown.

A 15-foot buffer of grass was installed that pitched away from the water. The nearby stream was left undisturbed to prevent the possibility of nutrients entering the stream. The moral of this story is that ponds can indeed be built that are both functional and environmentally benign.

Water body management is complex. It involves both terrestrial and aquatic factors, internal and external nutrient sources, food chains, oxygen balances, stratification, and a myriad of influences. On top of this, cycles change during the seasons and through the years. Lake management that is comprehensive and holistic, tailored for a specific purpose, has hope for real success.

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A USGA-SPONSORED RESEARCH PROJECT

Comparing Hollow- and Solid-Tine Cultivation

by J. A. MURPHY and P. E. RIEKE
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AS FAR AS golfers are concerned, cultivation (or aerification) is perhaps the least appreciated management practice used by golf course superintendents. Disruption of the playing surface and interruption of play are the main concerns of most golfers. On most golf courses, however, cultivation is necessary for the benefit of the turf. There are both short-term and long-term advantages to cultivation practices.

The objectives for using vertical-operating tine cultivation include: (1) relief of soil compaction, (2) improvement in rooting, (3) modification of thatch, (4) rejuvenation of turf by severing stolons and/or rhizomes, (5) renovation and overseeding, and (6) enhancement of fertilizer and lime penetration. The most frequently cited objective of cultivation is relief of soil compaction. By relieving soil compaction, cultivation improves water infiltration, soil aeration, surface resiliency, and turfgrass root growth in highly compacted soils.

Soil Porosity and Compaction

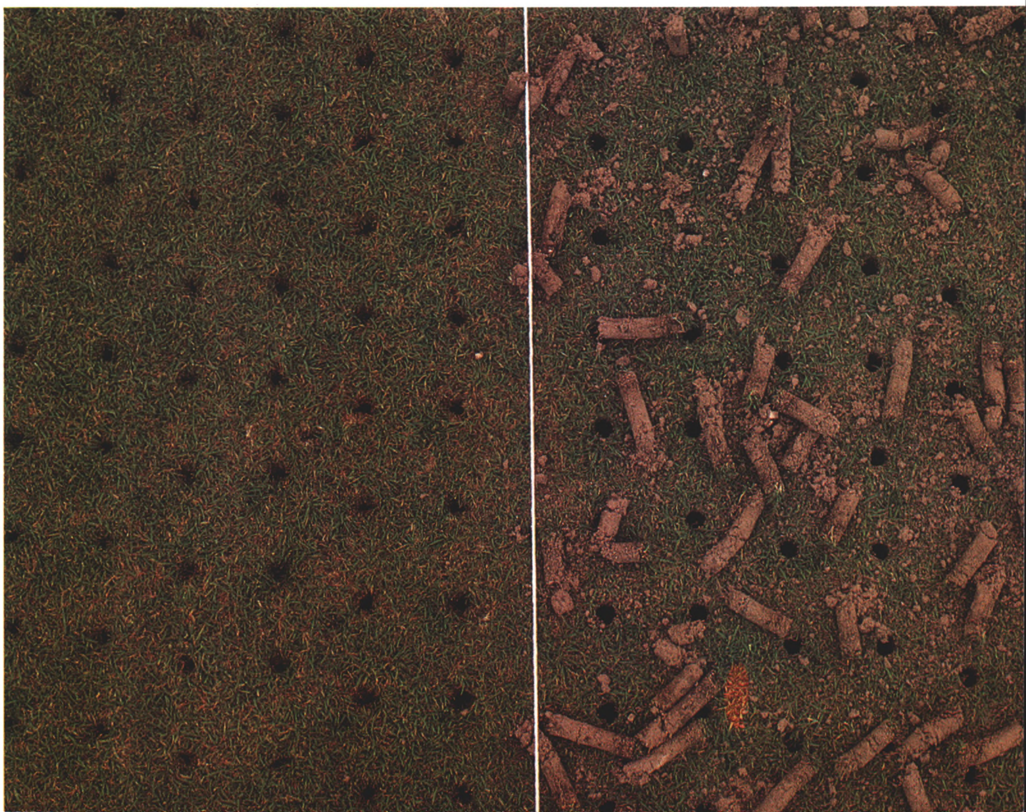
Macropores and micropores refer to the two general size classes of soil porosity. Macropores, the large soil pores, allow air and water movement into and through the soil. Macropores are also the passages through which roots grow and explore the soil. Micropores, on the other hand, are the small soil pores, and function mainly as water retention sites in the soil. Compaction of soil results when a compressive force (traffic) reduces the soil macroporosity while the microporosity remains unchanged or increases. When there are few macropores, air and water flow into and through the soil are limited, and root growth patterns are changed. The most important objective of core cultivation is to increase the amount of macroporosity in a compacted soil.

Solid-Tine Cultivation

While past cultivation practices have involved the use of hollow tines, solid-tine cultivation (STC) has recently received considerable attention as a means of reducing soil compaction. STC has been called shattercore cultivation or shattercoring. STC uses the conventional vertically operating tine units but replaces the hollow tines with solid tines. On dry, hard soils, considerable shattering of the soil mass is observed provided the equipment is heavy enough to permit adequate tine penetration. Less surface and soil disruption occurs on well-watered soils when using STC.

Among the advantages of STC are (1) reduced cleanup of putting surfaces, (2) reduced labor needs, (3) faster healing of the "coring" holes and improvement of putting surface playability, and (4) the ability to cultivate more frequently as a result of the other three benefits. Critics of STC are concerned that compaction at the lower end of the cultivation zone due to the cultivation treatment is more severe with STC compared to hollow-tine cultivation (HTC). The term "cultivation pan" refers to the compacted layer which can develop at the lower end of the cultivation zone.

The lack of soil cores is one advantage solid-tine cultivation (left) has compared to conventional hollow-tine cultivation.



Influence of recent solid-tine cultivation (center) on water infiltration compared to noncultivated turf (right) and turf cultivated one month previously (left).

This is similar to the plow pan commonly observed in agricultural soils when fields are plowed to the same depth each year. This plow pan is known to restrict air and water movement and limit rooting.

Research at Michigan State University has compared hollow- and solid-tine cultivation on a "Penneagle" creeping bentgrass green grown on a loamy sand soil (83.5% sand). Hollow- and solid-tine cultivation were performed on compacted and noncompacted plots over three seasons. Compaction was applied weekly with a Ryan Rollaire water-filled vibrating roller. Also, both cultivation methods were performed under dry and wet soil conditions. Cultivation treatments were applied once in 1984 and three times each in 1985 and 1986. This research was jointly funded by the USGA Green Section, the Michigan Turfgrass Foundation, and the Michigan Agricultural Experiment Station.

Soil Responses

Laboratory studies using computed axial tomography (CT) scanning showed HTC caused soil compaction along the sides and at the bottom of the coring hole (Petrovic, 1979). Compaction along the side of the coring hole is not considered a major concern with HTC, because compaction tends to dissipate with time as these sidewalls collapse into the coring hole. Soil compaction at the bottom of the coring hole does not dissipate quickly, and is considered to be of greater concern (Petrovic, 1979).

Our field studies have shown that HTC and STC result in different soil responses. STC did not reduce soil density because "coring" holes (very large macropores) were made without removing soil. As coring holes were created with STC, some of the macropores existing prior to treatment were destroyed. Overall, STC did not increase macroporosity under compacted soil conditions because the amount of macropores created (coring holes) did not exceed the macropores destroyed. Under noncompacted conditions, more macropores were lost than created with STC for an overall loss in macropores.

Since HTC removed soil, the adverse effect on existing macropores was minimal compared to STC. In noncompacted soil, the loss of existing macropores was smaller with HTC than with STC, with no net change in macroporosity. In compacted soil, HTC increased overall macroporosity compared to noncultivated soil. Therefore, the development of a cultivation pan is of greater concern with STC than HTC. In our research, cultivation pan development with HTC was only a problem in noncompacted soil.

As the cultivation pan developed with continued treatment, water movement to depths below the zone of cultivation slowed. Soil which was not compacted was affected by both HTC and STC, while compacted soils were negatively affectd only by STC. One way to reduce the tendency to form a cultivation pan is to allow the soil to dry prior to cultivation. Water infiltration rates remained high when cultivation (both HTC and STC) was done under dry soil conditions compared to when the soil was wet.

The shattering effect of STC can provide a significant loosening of the soil surface and allow for better surface infiltration of water and improved aeration. But this effect is short term compared to HTC. The loosening achieved with STC dissipates rapidly with continued traffic, and the soil quickly returns to a compacted condition. Conversely, HTC removes soil, providing space for soil to collapse into the holes when compressed, thus resisting a quick return to a more compacted condition. If a loosened soil condition is desired, routine STC will be required on turfgrass sites subjected to high levels of traffic. Unfortunately, this type of compaction management enhances the development of a cultivation pan. Varying the depth of cultivation, cultivating only under dry soil conditions, and using small diameter tines are ways to counteract cultivation pan development. Cultivation pan formation will vary with soil texture, compaction level, and soil moisture level at the time of cultivation.

Alternatives for Management of a Cultivation Pan

Several new tools which reach to a greater depth in the soil have come into use recently. Some units cause greater surface disruption than others, but all have been used on greens as well as other turf areas. The different techniques which cultivate to greater soil depths include (1) deep drill, (2) deep tine (hollow and solid), (3) subaerification, and (4) water injection aerification. Deep cultivators can break through cultivation pans which have formed. In our research with the Verti-Drain (deep tine), we noted significant loosening of the soil to a depth below six inches. Usually it is necessary to roll the greens after the use of solid tines to smooth the putting surface. Our studies with the Hydroject 3000 (water injection) showed surface disruption to be minimized while achieving deep soil cultivation.

Plant Response

Significant turf injury is a distinct possibility when cultivating under relatively dry soil conditions. Considerable soil disruption occurs when cultivating dry soil. As the soil shatters, roots are torn and severed. Also, HTC removes plant material and temporarily lowers turf density. This mechanical injury sets back the turf, slowing growth and recovery, and reducing the number of viable roots.

Midseason cultivation with either hollow or solid tines reduces the surface rooting of creeping bentgrass greens (Murphy and Rieke, 1987). Root growth in the coring holes is a slow process because the initiation of new roots is lowest in the summer months for creeping bentgrass (Koski, 1983). A significant increase in rooting following cultivation will occur during the early spring when new root formation is greatest, whereas root formation falls sharply in late spring. Although summer cultivation may not increase the number of roots, the functioning of the root system should improve due to the improved soil conditions, particularly on highly compacted soils.

Quality ratings on the compacted turf improved with both HTC and STC. However, when soil brought to the surface with HTC was worked back into the turf, HTC provided a superior quality turf compared to STC. Cultivation under wet soil conditions resulted in better turf quality than cultivating under dry soil conditions. Soil disruption is greater and the turf is under greater water stress when soils are dry during cultivation, resulting in greater root damage and lower turf recovery.

The ability to work soil into the thatch layer is a clear benefit of HTC over STC. A thatch modified with soil resists extreme changes in water content and temperature, thereby helping reduce the stresses imposed on a turf. Soil incorporated into the thatch also provides good conditions for rooting. In our research, coring three times a season was sufficient to maintain a well-mixed thatch/soil layer.

Soil profile after three years and seven treatment applications of cultivation; hollow tine (right) and check (left). Solid tine (not shown) is similar to check.

Recommendations for STC

STC with closely spaced, small diameter (¼ inch) tines can be used for temporary relief of compaction on heavily trafficked sites. Severely compacted soils will benefit from the temporary loosening achieved with STC, which can be used effectively on a monthly basis, if necessary. In our view, the potential for cultivation pan development is not a major concern when the site is already receiving severe compaction stress. In this situation, the problem in need of immediate attention is surface compaction. Additionally, STC may be effectively used when performed on a spot treatment basis. A regular program of STC with small diameter tines on high, dry areas susceptible to runoff and localized dry spots or on highly compacted traffic zones should improve water infiltration. By limiting STC to a spot treatment program, the potential for cultivation pan formation is isolated to known areas.

To counteract the development of a cultivation pan, it is best to cultivate when the soil is more dry and to vary the depth of cultivation, if possible. There must be sufficient soil water to allow tines to penetrate, of course. Also, small diameter tines should help limit the formation of cultivation pan, yet allow some loosening of the soil to improve water infiltration. Because no soil is removed with STC, the gain in improved water infiltration will be short-lived, and repeat treatment will likely be necessary.

STC can be an effective cultivation method when used in combination with HTC. The spring and fall seasons allow HTC to be used, while midseason cultivation can be accomplished with small diameter STC. On sites where soil compaction is not a severe problem, STC is not recommended. It is useful to review your overall management objectives and goals to determine which equipment and program are best for use in a particular situation.

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Liability on the Golf Course

by J. MICHAEL VERON
Member, USGA Sectional Affairs Committee

THE PAGES of this publication are normally devoted to responding to the numerous challenges that agronomic conditions pose to managers and superintendents of golf courses and clubs. However, in an increasingly litigious society, managers and superintendents are now becoming aware of the many ways in which their operations may invite litigation.

Liability on the golf course can conveniently be divided into three principal subjects. First, there is liability for injuries to employees, which generally involves the law of workers' compensation. Second, there is liability for injuries to golfers and others, which implicates the law of tort liability for personal injuries. Finally, of increasing prominence is the law governing liability for chemical damage to the course, which can best be described as tort liability for property damage.

Author Mike Veron

Liability to Employees: The Law of Workers' Compensation

Anyone who suffers an injury is ordinarily entitled to recover damages for the injury if it was caused by the negligent conduct of another. Negligent conduct is that which falls below what we expect people to do in a given circumstance, such as to obey traffic signals to avoid automobile accidents. An individual injured because of someone else's negligence is entitled to recover full damages from them: all lost wages, future lost earnings, medical expenses, and pain and suffering. This is part of the law of tort, which is discussed more fully below.

An employee who is injured on the job as a result of the negligence of his employer or a fellow employee is ordinarily not allowed to sue them for damages. In other words, the employer and fellow employees are immune from damages under the law of tort. Instead, the employee is limited to recovering benefits provided by state statutes. These benefits are called workers' or workmen's compensation benefits. Typically, all medical expenses are paid by the compensation insurer, and an employee who misses work receives additional weekly benefits that approximate a fraction of his average weekly wage, usually either 2/3 or 3/4. He does not receive any damages for pain and suffering.

In return, the employee is not required to show that his injury was caused by the negligence of another. He is entitled to workers' compensation benefits simply by showing he was injured on the job, regardless of whether the accident was anyone's fault.

It is possible to have both legal remedies (tort and workers' compensation) apply to an accidental injury. For example, a grounds crew member may be seriously injured by the equipment he was operating. Because the injury occurred on the job, he would be entitled to workers' compensation benefits. However, he could not recover general damages from his employer, the club, or from any fellow employees

An accident waiting to happen.

because of the tort immunity provided by workers' compensation laws.

On the other hand, if the equipment was defective, it is possible that the injured worker might recover damages from the manufacturer of the equipment. If he were able to show that the equipment was defective by reason of poor design or manufacture and that this defect was a cause of the accident, then he could recover damages from the manufacturer under tort law. This kind of tort is called **product liability**. It is discussed in more detail below in the context of chemical damage to the golf course.

Every employer is required by law to carry workers' compensation insurance in order to enjoy immunity from tort. If the workers' compensation insurer paid any medical bills in the above example and/or furnished weekly benefits, it would be entitled to intervene in the tort action and to be reimbursed in preference and priority out of any proceeds recovered by the worker against the third party equipment manufacturer.

Liability to Non-Employees: The Law of Tort

Golfers and others on the course who are not employees of the club or course are not entitled to workers' compensation if they are injured. They are allowed to sue for damages if they can show that their injury was caused by the negligence of another. Theoretically, therefore, a golfer who hits a shot that injures another golfer may be liable for the injury and all damages associated with it.

Fortunately, the courts have generally recognized that hitting an errant golf shot does not constitute civil negligence because an occasional bad shot is an inherent part of the game [*e.g., Baker v. Thibodeaux, 477 So. 2d 245 (Ls. App. 4th Cir. 1985)*]. However, one court has held that an adult golfer was liable for striking a nine-year-old child in the eye, blinding him, even though the child had consented to allow the adult golfer to play through but had remained only slightly out of the way. The court theorized that the adult was negligent in not making the child move to a safer place out of the zone of danger [*Outlaw v. Bituminous Insurance Co., 357 So. 2d 1350 (La. App. 1st Cir. 1978)*]. Interestingly, some courts have suggested that the golfer who fails to yell "fore" after observing his ball approaching another golfer may well find himself on the wrong end of a lawsuit for his negligence in failing to warn a fellow competitor, not for hitting the poor shot in the first place.

Injuries caused by a member of the maintenance crew, rather than another golfer, fall under the same rule. In fact, under the tort law of most states, an employer is automatically liable in damages for any negligence of an employee who injures a non-employee if the conduct in question arises during the course and scope of the employment. Thus, any golfer injured on the course by a member of the grounds crew or other employees of the club may recover damages from the club if he can show that the employee was guilty of negligence that caused the injury.

At the same time, the law also recognizes that, with respect to certain activities, people assume the risk of being injured because of dangers associated with the activity. For example, baseball spectators are generally not allowed to recover for injuries when struck by a foul ball because that is part of the risk they assume in attending a baseball game.

So it is with golf. Errant shots occur even among the best golfers in the world. No one would play the game if he were liable for any injury he might cause because his ball went in an unexpected direction.

In legal terms, the **assumption of risk** is a complete defense to an action for damages because of negligence. Simply put, every golfer is considered to have assumed the risk of being injured by a poorly executed golf shot when he steps onto the course. At the same time, assumption of the risk does not apply to all situations: One may assume the risk that other golfers may strike errant shots, but that does not mean he assumes the risk that other golfers may fail to warn of the shot or fail to wait until the group ahead is past the intended landing area.

By way of further illustration, one may assume the risk of being struck by a golf ball on the course, but he does not assume the risk of being struck by a limb falling from a tree being trimmed by the maintenance crew. If the crew is negligent in not warning golfers that they are trimming overhead, they — and the club that employs them — may be liable in damages for any injury they cause.

Tort liability for injuries caused by a defect in property is generally called **premises liability**. Simply put, anyone who owns or controls property has a duty to keep the property free of hidden dangers that may injure those who come on the property. It is difficult to generalize very much in this area, as the rules vary substantially from state to state. The rule that applies in a given situation depends on the kind of defective condition that is involved, whether the person injured was lawfully on the premises, and other factors. In some states, liability is strict; the injured person need only prove that the defective condition existed without showing that it was caused by the owner's negligence. In fact, the owner may not even have been aware of the condition. That will not exonerate him if strict liability applies.

Golf clubs and courses face a special problem in this area because the footwear worn by golfers, while ideal for the golf course, can be dangerous on other surfaces. Simply put, spiked shoes provide little traction on concrete and may cause slips and falls. On carpets and rugs, spiked shoes may produce tears and may cause trips and falls. Either situation raises potential liability for the premises owner [*e.g., Beauchamp v. Los Gatos Golf Course, 273 Cal. App. 2d 20, 77 Cal. Rptr. 914 (1969)*].

There are frequent references in the cases on premises liability to what is called an **attractive nuisance**. This term refers to a dangerous condition that has an appearance that is inviting and may lure passersby to danger. The term originated in swimming pool cases where the owner of a back yard swimming pool failed to erect a fence or other barrier to prevent curious children from being lured to the pool and exposed to the danger of drowning.

Obviously, an analogy can be made to the ponds that exist on many golf courses. While it is not practical to fence in water hazards, clubs should have rules preventing any swimming in the water hazards by the members or their children and further should post warning signs against trespassing at any point on the course's boundary where it is suspected that children or other intruders gain entry. Such measures may prevent a tragic accident. Even if they do not, they may exonerate the course or club from civil liability in the event of a suit by showing that all reasonable steps are taken to prevent the accident.

The rules on premises liability have obvious consequences for golf course operators. Two common problems involve joggers and golf carts.

Some courses permit joggers, some tolerate them, and some outlaw them altogether. One case in particular illustrates the potential problems that can result when someone jogs along the golf course.

In 1981, a club in New Orleans had a rule that allowed members to jog on the golf course, but only after dark so they would not interfere with the golfers. One member of the club, who lived next to the course, liked to take advantage of this. One night he fell into an open drain while jogging. Although he was aware of the drain because of his familiarity with the course, he usually identified it by tall grass that surrounded it, forming a natural barrier of sorts. For some reason, the tall grass had been cut, and the jogger failed to recognize the drain hole.

Although there were few objective medical findings to speak of, the jogger filed suit against the club and its insurer. Despite the fact that he unquestionably knew about the hole (he had even complained to club personnel prior to the accident that it had no cover), a jury found in his favor and awarded him $830,000. On appeal, the award was reduced to $693,500 for reasons not relevant here [*Fritscher v. Chateau Golf & Country Club, 453 So. 2d 964 (La. App. 5th Cir. 1984)*].

In its ruling, the Court of Appeal affirmed the trial court's refusal to allow the assumption of the risk defense urged by the club, finding that the jogger's familiarity with the hazard did not even justify submitting the issue to the jury! The moral of this story: Any work on the golf course that is hazardous when left unattended should be prominently marked and roped off or barricaded if at all possible. The plastic mesh or netting that is available in bright colors is ideally suited for this purpose.

Similar horror stories exist with respect to accidents involving golf carts on the course. In fact, the great bulk of litigation against golf courses and clubs for personal injuries arises from accidents involving golf carts [*see generally Annot., Liability for Injury Incurred in Operation of Power Golf Cart, 66 A.L.R. 4th 622 (1988)*]. Essentially, golf course owners and operators can be liable for injuries to a patron or member arising from the operation of a golf cart if improper maintenance of the cart, a cart path, or any other condition caused or contributed to the accident [*e.g., Ryan v. Mill River Country Club, 8 Conn. App. 1, 510 A.2d 462 (1986)*, steep slope unreasonably dangerous in absence of guardrails or warning signs; *Goodwin v. Woodbridge Country Club, 170 Conn. 191, 365 A.2d 1158 (1976)*, golfer recovers for injuries caused by improperly maintained golf cart]. In some jurisdictions, a golf cart

High-voltage hazards should be secured.

has even been held to be a "dangerous instrumentality," and a club or course renting a cart is liable for its misuse by anyone operating it with the consent of the owner [*e.g., Meister v. Fisher, 462 So. 2d 1061 (Fla. 1985)*]. This effectively makes the club or course the liability insurer of each cart renter! A club or course also has a duty to warn its golf cart passengers of any dangerous condition they are likely to encounter, and it may be liable for injuries sustained as a result of its failure to warn [*e.g., McRoy v. Riverlake Country Club, 426 S.W.2d 299 (Tex. Civ. App. 1968)*, tree stump].

These and other cases make it clear that a course operator has an obligation to maintain its cart paths free of defects and to mark all potentially dangerous conditions with prominent warning signs. Moreover, a club operator who rents golf carts has an obligation to make certain that each one is properly maintained and functions in a way that does not endanger the occupants. This includes a duty to provide proper instructions to renters in the safe manner of operating a cart.

Liability for Chemical Damage

Every superintendent's nightmare is to apply a chemical that causes unanticipated damage to the golf course. Anyone who has been a golf course superintendent for very long has had a problem with chemical damage to his course at one time or another. If he is lucky, the damage is neither great nor permanent. If he is not, he is often not around long enough to find out how the damage occurred.

As noted above, there is a branch of tort law called **product liability**. Anyone who makes a product is liable for any damage caused by a defect in that product when the product is used in a normal or foreseeable manner [*Restatement of Torts (2d) S402A*]. A defect is any flaw in design or manufacture that renders the product unreasonably dangerous when in normal or foreseeable use. The danger might be associated with a personal injury, as with the example of the worker injured by defective equipment. The damage might also be property damage, such as the destruction of golf course turf caused by a defective chemical product.

As a practical matter, it is important to understand that the mere fact that a chemical is associated with damage does not mean that the manufacturer of the chemical is liable. A course operator

Protection must be provided for the crew too.

who experiences damage to his course from the application of a chemical bears the burden to prove that the chemical caused the damage. It will likely be the chemical company's first line of defense to show that the damage that occurred was not caused by its product but rather was a result of other environmental stresses or misapplication.

This invites a comment about problems of proof. Just because something is true does not mean it is self-proving in a court of law. The rules of evidence determine how claims are to be proven. Ordinarily, witnesses are only allowed to testify about what they have seen or experienced personally. They are not allowed to offer opinions. An exception to this is the **expert witness rule**. The rules allow an individual who is an expert in a particular field by virtue of this education an/or experience to offer expert opinions about a subject if doing so will help explain matters pertinent to the case [*Fed. R. Evid. 701-03*].

In order to prove the cause of turfgrass damage, expert opinion is often necessary. A superintendent himself may be qualified to offer that testimony, depending on his own education, training, and work experience. Often, the club's attorneys may want to bring in a well-recognized expert in the field to evaluate conditions and to offer his own independent opinion.

It is important not to neglect this aspect of the case. It is reasonably certain that the chemical company will have an expert who can be expected to testify that, based on his inspection of the problem, some local condition, other cause, or product misuse was responsible for killing the greens. Thus, it is vital that the club have an expert who can show that the chemical caused the damage.

In addition, the club must show that it used the product in its normal or foreseeable manner. This is called **label compliance**, and it is the second line of defense for the chemical company, which may claim that the club misused or misapplied the product. Simply put, the club must show that the product was used in accordance with the directions that came with it, which in most cases is required to be on the label of the container holding the product.

This is simply a question of fact. To avoid application problems, only the superintendent or his assistant should mix or dilute chemicals. Leaving the mixing to an inexperienced worker invites problems. A log should be kept showing what was done — how the chemical was mixed or diluted. Another worker should witness the mixing or dilution, and both the mixer and the witness should date and sign the log. This provides persuasive evidence as to what was done in applying the chemical. In the event of problems, the log is a convenient record identifying individuals who will provide testimony regarding the application of the chemical. It is also important that the container, with a small amount of the chemical sufficient for later testing, be kept until it is certain that no damage occurred from application.

This kind of record has another important purpose. It documents what the superintendent has done — and can exonerate him when an irate Green Committee Chairman wants to know why he poisoned the greens.

Obviously, this essay can provide only an overview of the various legal issues that may confront golf course operations. The particular facts of each situation are critical. It is important, therefore, not to assume that a given situation will be controlled by the various rules discussed here. Additionally, the rules vary from state to state. For that reason, specific questions should be directed to an attorney in the club's jurisdiction.

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Nobody uses the left side of this tee because of tree limb interference.

Ten Timely Tips to Avoid Tree Troubles

by PAUL VERMEULEN
Agronomist, Western Region, USGA Green Section

CONSIDERING THE positive impact of green vegetation on our urban environment, it is only natural that people want to plant more trees on golf courses. In short, trees exchange carbon dioxide for oxygen via photosynthesis, and in the summer offer welcome relief from the hot sun. But before scheduling that next tree fund golf tournament, remember that too many trees can block good air circulation and sunlight exposure to vital areas of the course, such as near greens and tees. Furthermore, when not properly located, their presence can impose severe and unwarranted penalties on golfers in pursuit of the club championship or just out for a friendly match.

There are a few simple guidelines for adding trees to golf courses without creating unwanted side effects. Adhering to the following ten tips will help ensure that a new tree becomes a long-term asset to the club, and not a long-term maintenance nightmare.

Before reviewing these guidelines, realize that any one may not apply in all situations. For example, a large tree located 75 feet away from a green on the south side will cause more severe shade problems than a same-sized tree located an equal distance on the north side.

Tip Number 1. Make sure to locate a tree where its mature canopy will not protrude on the line-of-flight between a tee and fairway. Interfering limbs cause players to use only a fraction of the available teeing space, making an otherwise adequately sized tee show signs of needing enlargement.

For example, a tree planted too close to the front right side of a tee will cause wear problems on the left side.

Tip Number 2. To allow for good 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, increases temperature and humidity, inhibits surface and soil drying, and promotes disease development. Furthermore, dense shade during the winter can prolong snow and ice cover on greens in the North, and render greens in the South and Pacific Northwest helpless against foot traffic as cooler temperatures retard active growth and inhibit drying.

In locations where these problems exist, heavy pruning is usually required, (Below) Competition between tree roots and low-cut turfgrass can lead to serious problems. Black locust roots invading a tee.

(Right) Heavy shade during the winter months can reduce a green's ability to recover from foot traffic.

and tree removal is often necessary. Given that these two measures are unpopular and costly, the best advice is to plant new trees in such a way as to avoid sunlight penetration and air circulation problems.

Tip Number 3. Avoid the temptation of filling every bit of rough between adjacent fairways with trees, even if it would be done for the sake of safety. No matter how many trees are planted to protect players in neighboring fairways, it is inevitable that golfers will find a way through. Once they do, LOOK OUT!

All of a sudden the stray golfer is faced with aiming right over the heads of oncoming players in the next fairway, hoping to hit a high fade back over the trees. FORE!

If the intent of new plantings is to protect golfers in an adjacent fairway, then groupings of trees should be planted in strategic areas near the tee. This should prevent errant shots from having a chance to stray. Also, leave several openings between the neighboring fairways near the landing area; if golfers do stray, they will have a reasonable opportunity to return to their own fairway.

Tip Number 4. Never plant potentially large trees closer than 75 feet from a green or tee. In addition to shading the turf, their root systems can be serious competitors with important turf areas for water and nutrients. Many people are under the mistaken impression that tree roots do not extend beyond the drip line of the tree canopy. A more realistic view is that tree roots extend outward from the trunk approximately one to one-and-a-half times the height of the tree.

For example, if a tree is 100 feet tall, its roots can extend outward from the trunk as far as 100-150 feet or more. Once tree roots establish themselves beneath a green or tee, they rob the turf of water and nutrients. In situations where tree roots are a problem, they can be severed with a trencher, and a barrier can be installed in the trench to discourage reestablishment.

Tip Number 5. Flowering trees add unmistakable beauty to any course. Many types of flowering trees have tender bark and a low branching crown, however, and are very susceptible to mower damage. This sensitivity makes many of them poor candidates for use on golf courses unless they are carefully protected.

Consider Augusta National Golf Club as an example. The beautiful flowering dogwoods and azaleas have been planted in protected areas around large pine trees where there is rarely an occasion to operate heavy mowing equipment.

Tip Number 6. Avoid screening out scenic vistas, such as ocean or mountain views, stately clubhouses, and other beautiful scenes. A vista that has been blocked by trees is usually forgotten and may be lost forever.

Tip Number 7. Trees or shrubs are usually poor choices as yardage indicators. When one of the plantings is damaged or dies, it is usually difficult to replace with one of identical appearance and size.

An alternative means of indicating yardage is to mark large, landmark trees already present throughout the course with small wooden or metal plaques. These trees can then be indicated on the reverse side of the scorecard. The advantage of using landmark trees is that they appear naturally in the course surroundings, and because of their great size, they can be seen easily by golfers who stray into deep rough.

Tip Number 8. When selecting trees, choose species that match the surrounding vegetation theme and have favorable characteristics. Fast-growing trees and trees with large fruit are usually not good candidates for golf courses because they often have invasive surface root systems or require frequent cleanup.

Also, try to limit the selection of different species to a reasonable number. A continuous vegetation theme is often the trademark of many of America's highest-ranked courses. For example, Medinah Country Club, the site of the 1990 U.S. Open, is noted for its oak trees throughout the property.

Tip Number 9. Try to naturalize the appearance of large tree plantings by randomizing the distance between each tree. A good way to do this is to hit several dozen golf balls into a rough area from a distance of about 200 yards. At the landing site of each golf ball place a small flag, and then selectively remove one flag at a time until there is an appropriate number left. Be sure to leave enough space between trees to accommodate your mowing equipment.

Tip Number 10. Never plant more than the maintenance staff can adequately maintain. During the first year of establishment, small trees require extra attention and regular hand-watering during the summer. If trees must be purchased in large numbers, it is best to establish a nursery near the maintenance facility where they can be properly cared for. Then, over the next several years, gradually transplant them throughout the course.

In developing a tree planting plan for a golf course, it is important to recognize that what makes your course different from a park or your own front yard is the importance of the quality of the turf in relation to the playing of the game of golf. Trees can play many useful roles on golf courses, but when overplanted and misused they can cause turf maintenance problems and detract from the appearance and playability of the course. Don't let trees overwhelm your golf course.

ALL THINGS CONSIDERED

WHAT'S YOUR BATTING AVERAGE?
An Opinion on Unreasonable Expectations

by STANLEY J. ZONTEK
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GOLFERS are well known for making comparisons. They seem to take pride in telling anyone who will listen how a course down the road does something this way or that. They compare budgets, acreage maintained, soils, grass types, green speed, the amount of labor, and many other facts. Sometimes the comparisons are accurate, sometimes not.

Let's take this comparison one step further. It's not really valid, but it is interesting nonetheless.

Baseball: A .250 batting average is just that — an average. A ball player hits safely one at-bat in four. A "star" bats .300, and an immortal like Ted Williams bats .400. If you are keeping score, and you should be, that's four out of ten.

Basketball: Superstars shoot just over 50% from the field. They shoot a ball into a hoop at a distance of zero (a dunk) to 18-22 feet or more.

Golf: A par round of golf is normally about 72. Golfers who consistently shoot less than par are found on the PGA Tour, making lots of money. Golfers who shoot consistently over par are found everywhere, and includes those people making the comparisons. The average handicap in the country is just over 18. The average golfer, therefore, shoots about 25% over par.

At what percentage do golf course superintendents produce quality turfgrass? As a basis for comparison, golf courses contain about 30 acres of fairways, 2.5 acres of greens, and 2.5 acres of tees. This equates to about 100,000 sq. ft. of greens and tees and 1,320,000 sq. ft. of fairways. Thus, if a superintendent "bats" .400, which would put him in great company in baseball, it means your superstar would lose the equivalent of 10.8 greens and tees out of 18. On fairways, he would lose about 18 acres of turf.

While this .400 batting average might get you into the Baseball Hall of Fame, you would probably lose your job as a golf course superintendent.

All of this may sound ludicrous, but the fact remains that golfers have set such high standards for their golf courses that maintaining these standards is difficult, expensive, and sometimes impossible to achieve. To keep alive every blade of grass on every green, tee, and fairway regardless of the conditions, and not being willing to accept anything less, is wishful thinking and a mistake.

Everything cannot be perfect on every golf course every day. Even if it were possible, what would it cost?

So, look at your golf course. My message to course officials reading this opinion is not to be so concerned if the golf course superintendent bats only .998. After all, this equates to losing about 200 sq. ft. of turf, a 10 ft. by 20 ft. area of greens or tees and 2,640 sq. ft. of fairways, or .06 of an acre.

Anyone who bats this percentage or better deserves a pat on the back, not a kick in the pants. After all, what other industry which deals so closely with Mother Nature can boast a 99% average or better? Not many.

Therefore, the next time you read about a professional athlete making $2,000,000 a year to achieve only a 30% batting average, be proud . . . because golf course superintendents are batting 99%, or better.

TURF TWISTERS

KEEP SMALL SAMPLES

Question: Many clubs in this area were damaged last season by a fungicide contaminated with simazine. Is there anything we can do to protect ourselves from this in the future? (Missouri)

Answer: Although such problems are rare, they do occur despite the best efforts of the manufacturers. While it is impractical to test every product prior to use, it is a good practice to keep a small sample of the applied pesticide for proof should damage occur. Keep a sample from each lot number in the original container. If no damage occurs, apply the remaining product during the following application.

OF MILKY SPORE DISEASE

Question: To reduce insecticide use, we are considering applying milky spore disease to control white grubs on our golf course. Any thoughts on this? (New Hampshire)

Answer: Milky spore disease can be an effective biological control measure for Japanese beetle grubs, but it is ineffective against other white grub species. It also requires several years to colonize a population large enough to be effective, and this often doesn't happen at latitudes further north than New York City. Other chemical controls must be withheld from inoculated areas since insecticides will also reduce the milky spore population. Therefore, you must be willing to live with some insect damage while waiting for milky spore to do its thing. Historically, milky spore disease has not been considered a viable alternative to insecticide use under most golf course situations. Research on this and other biological controls for white grubs is ongoing, however, and perhaps there will soon be an effective biological control available.

TO CHECK OUT THE STORY

Question: The caption for the cover photo of your May/June 1990 issue described that profile as meeting USGA specifications for green construction. It didn't look so great to me. What's the story? (Michigan and Idaho)

Answer: Good for you for recognizing a profile from one of the many infamous "modified" USGA greens that didn't work. It was being dug up at the time the picture was taken to be replaced by the real thing. The contractor went so far as to put in the drain tile, gravel bed and coarse sand layer, but he "didn't have time" to have the topmix checked out at a soils laboratory. This story is, "modified USGA greens" *are not* USGA greens!