University of Minnesota UPDATE

The Art of Spraying-Fungicides

By Dr. Ward Stienstra
Extension Plant Pathologist
University of Minnesota/St. Paul

"To Put" and "To Putt." What is the difference? One is a verb, the other a noun. The first is to "place something where I want it" and the other is often a "futile attempt to do the same thing." Spraying could be likened to "a Putt" when you are reminded that approximately 85% of spray operations make significant errors in — mixing, loading, equipment set-up and operation as well as delivery rates. The National loss was estimated to be 1 billion dollars. The same study reported that less than 25% apply within 5% plus or minus of the goal. How are you doing? I expect most will not need to make changes, but some should.

Since 1991, events like Sprayer Tune-Up Week have focused on "Safe, Accurate and Environmentally Sound Application to Avoid Drift." The environmental concerns like "not in my air, water or yard" have focused most comments and research on spraying to reduce drift. What is Effective Spraying? What is golf course spraying like today? Is it only done when the course is closed? As fast as possible? At low dilution rates to reduce refill times and travel time? Are multiple products in the tank? Is spraying related to irrigation schedules and dry turf? The idea for this topic developed after seeing spray operations on golf courses by superintendents who have challenged me about product applications/recommendations I've made and because of increasing concerns about "Fungicides Resistance" and product failure reports. Are such concerns related? Does application method/technique affect the result? I believe it does and hope to convince you that effective spraying is more than drift avoidance. What is Effective Spraying?

Some basic facts about spraying you must understand:

1. Flow Rate. To double the flow rate you must increase pressure four times. Pressure adjustment up, while it is an easy way to change flow rate it also must be noted that this also reduces the drop size and increases nozzle wear rate. This can result in increased drift potential-smaller drop size and loss of uniformity in the spray pattern-ineffective nozzle openings.

2. Spray Angle. An 8002 nozzle operated at 40 PSI will cover 30 inches of turf when positioned 18 inches high, but will cover only 23 inches of turf at 18 inches high if the pressure is too low. Spray angle may be less than the reported degree if pressure is below the recommended range. A smaller spray angle results in less coverage and may produce strip or band patterns.

3. Volume Median Diameter. This is a measure of droplet size, half of the drops are larger and half are smaller. A larger Volume Median Diameter (VMD) results in less drift, but smaller VMDs may be required to obtain maximum surface coverage on the target plant. The number (VMD) is given in Microns. One Micron is equal to 0.001 millimeter or 1/25,400 inch. A 1/8 inch drop is 3,175 microns. A standard to remember is that drops less than 200 Microns are considered to be drifters. The percentage of spray volume less than 200 Microns in an 80 degree nozzle is 16% and it is 21% for a 110 degree nozzle operated at 40 PSI. These same two nozzles when operated at 20 PSI have 8% and 14% driftable droplets; clearly increasing pressure increases drift potential. Nozzles designed to reduce drift, a Drift Guard 80 degree versus the XR (Extended Range) 80 has 10% less driftable droplets when operated at the same pressure.

4. Nozzle Flow Rate. The last number in the nozzle identification number indicates its flow rate at 40 PSI. The 8008 has a greater flow rate than either an 8005 or an 8003, and it is interesting to note that at pressure from 10 to 80 PSI the larger flow rate nozzle has fewer drops in the smaller VMD range. The droplet size is smaller when 100 degree nozzles are used over the same range of pressure. The better method of increasing spray volume rates is to change nozzle size, not to increase pressure. A method of reducing drift is to lower the pressure at the nozzle. Nozzles sold to reduce drift usually operate at a lower pressure due to designs that have lower pressure at the exit opening. Standard nozzle operating pressure is 40 PSI; below that the angle of coverage can be reduced and above that a higher percentage of driftable drops result. Pressure from 35 to 40 PSI at the nozzle is desired with fan type nozzles for most effective spraying.

5. Delivery Volume or Dilution Rate. A surface area of 1,000 square feet covered to a depth of 12 inches requires 7,480 gallons of water. Sixty-two point three (62.3) gallons of water will cover that same 1,000 sq. ft. to a depth of 0.1 inch, while 6.2 gallons will only produce a layer of water 0.01 inch deep and 0.62 gallons results in a very thin water layer, 0.001 inch. How thin is a layer of water 0.001 inch? Take a 1-inch piece of paper and cut it in half ten times. What is left is 1/1024 inch. When spraying one gallon of water per 1,000 sq. ft. a layer is produced 0.0016 inch thick; at two gallons per sq. ft. the layer is 0.0032 inches thick. This assumes all of the volume is spread evenly and none is lost. Sprayer technology and operator skill are seldom so exact.

6. Disease Control/Delivery Volume. It was shown that the length of effective disease control with Bayleton was dependent on the delivery volume. Significantly less disease control was reported at 23 and even at 37 days after treatment if delivery volume was reduced from 2 to 1 gallon of water. Optimum dilution ranges are 1 to 2 gallon for many products. Some new fungicide labels provide dilution guidelines.

7. Post Spray Water. Maximum disease control was

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obtained from contact and some systemic fungicides when they were applied to dry turf and allowed to dry before rain or irrigation was applied. The period of time from initial wetting from spray application until dry on the leaf appears to be important for uptake and diesease control. While the mechanism is not understood, the basic effectiveness of a fungicide is reported to be established by the initial water amount when applied; therefore application to dry turf is desired and the turf should not be rewet until the product has dried. Watering systemic fungicides after the leaf is dry may not reduce effectiveness, nor will it improve product performance. Contact fungicides do suffer a significant drop in disease control if watered before they dry. Products with sticking agent(s) remain effective if the spray has dried on the leaves before wetting.

The application of fungicides for turf winter disease management last fall began a study to evaluate three dilution rates: 2, 1 and 1/2 gal. per 1,000 sq. ft., two rates of a combination, tank mix fungicide program and three nozzle types. The results are not yet completely in, but initial readings at Duluth suggest some differences related to all variables. One year does not make a good test and future results are needed. I'll be preparing a first year summary after the next set of notes are taken at Duluth.

I'd suggest that you very carefully consider the dilution rates used for fungicide application, as low dilution rates of products appear to perform poorly in research reports and in the first trial for winter disease control. It is possible, not proven, that low dilution rates are part of the problem in allowing for rapid development of fungicide resistance. Clearly the repeated use of fungicides with the same mode of action and application of such products at lower than label rates are important and significant factors in resistance development. Application of fungicides at the tested/recommended dilution rates may result in better disease control and fewer reports of resistance or product failure concerns. Nozzle type, size and pressure are significant factors affecting fungicide performance.

The sprayer output should be tested following procedures given in operation manuals or in spray nozzle catalogs. Your goal is to measure the delivery of product per unit area of turf. This is a function of nozzle size, number, pressure and speed of the sprayer. How well does your sprayer perform?

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Golfing Privileges:

A little courtesy can get you almost anywhere!

By Peter Grass, CGCS
Hilands Golf Club, Billings, MT

For most of us a round of golf can be a relaxing, enjoyable, mind-erasing of work responsibilities experience. That is if it is being played somewhere other than our own course. Getting out and seeing the work of our peers throughout the area or even nationally can be a great privilege, especially when that course allows you complimentary green fees.

As a new golfing season begins, it is a good time to discuss with your golf professional and club or course officials, your facility's policies dealing with Superintendent/Assistant Superintendent and maintenance staff guest play. Everyone should remember there is no master policy that applies to all. Each course has its own guidelines that work for them.

The best protocol to follow when trying to play as a guest somewhere is to contact the host Superintendent and to have your membership card available for identification at the course if required.

I also need to discuss a misconception that seems to be circulated out there. Membership in GCSAA does not carry with it any guest golfing privileges; however, many courses will allow within some time and space availability restrictions, GCSAA member play on their course. The best protocol to follow when trying to play as a guest somewhere is to contact the host Superintendent and to have your membership card available for identification at the course if required. When discussing playing privileges for GCSAA member guests at your facility with your pro shop staff, remind them that only class A, B & C (Superintendent/Assistant Superintendent) should be considered for playing privileges if it is the intent of your facility to recognize those persons directly involved in golf course management. There are other GCSAA membership categories (e.g. Affiliates, Educators) who are also given membership cards that are colored green. Class A, B & C cards are gold with the classification noted on them. I believe this is an important area to stress because of the potential for abuse of obtaining golfing privileges through GCSAA membership by those not directly involved in golf course management.

In the Billings, Mont. area all courses allow not only Superintendents and Assistants guest play but also staff play as well. This play is subject to each course's rules as to time and number of players, but the major rule we enforce is that all staff play is arranged and verified by the Superintendent or Assistant. The conduct of those players is the responsibility of their Superintendent while they are the guest of another facility. This is a great benefit that is extended to us and by giving it respect, it continues to be a privilege everyone enjoys.

The key to maintaining any privilege is to not abuse it. The enjoyable round of golf we can all have is one worth working for. In closing, please take the time to discuss these ideas with the Superintendents, Golf Professionals and Course Officials in your areas. Encourage all areas of the game of golf to work together to make all our jobs more enjoyable.

1995 MGCSA MONTHLY MEETINGS

June 12	**Bemidji Town & Country Club** Host Superintendent – Thomas Johanns
July 10	**Stillwater Country Club** Host Superintendent – Kevin Clunis and TBA *(Garske Scramble)*
August 14	**Baker National Golf Course** Host Superintendent – Keith Greeninger *(MGCSA Amateur Championship)*
Sept. 11	**Minikahda Club & Town & Country Club** Host Superintendents – Douglas Mahal and Bill Larson *(Stodola Scramble)*
October 9	**Chisago Lakes Golf Estates** Host Superintendent – David Zimmer
Dec. 6, 7 & 8	**MTGF/MGCSA Conference and Trade Show** Minneapolis Convention Center

Did You Know?

According to a USGA study, the average golfer takes 56 paces per green. With 12 spikes on the average golf shoe, that means 672 impressions left on each green for each player. By this calculation, take into account 18 greens and you have 12,096 impressions per round per player. And to take it a couple of steps further, assume a course receives a daily average of 200 rounds. That means the greens receive 2,419,200 impressions every day — which comes to more than 72.5 million spike marks each month.

SOIL CORE ANALYSIS A DIAGNOSTIC TOOL

By Joe Farina, Golf Course Turf Specialist
Read Sand & Gravel, Inc., Rockland, MA

(Reprinted with permission)

The turfgrass plant, much like a human being, requires a proper balance of air, water, food and a healthy environment to sustain life and survive in its flora world. The basic teachings of turf physiology have sharpened the expertise of many a superintendent to help combat against the elements that seek to upset this balance and to weaken, stress or kill our grasses. When an adverse condition is noticed—whether a pathogen, insect or climatic influence—the turf manager becomes a physician of sorts who analyzes, defines and resolves the problem using diagnostic methods of on site visual or off site laboratory tests. Most of the time this occurs after the damage has been done to some degree. We know that a weakened turfgrass plant is more susceptible to disease, stress and parasitic invasion. Identification of what causes a weakened plant in the first place could be the key to prevention and could increase the survivability of the turfgrass. A soil core analysis should be part of your check list.

True, many factors from close mowing to foot traffic or phytotoxicity can put a turfgrass plant in a weakened state, but the subsurface environment of the root zone area can set the stage for "do or die" of the turfgrass plant. Infiltration, porosity, organic content and particle distribution are the dynamics of a soil structure engineered for turf. Harmony and balance must exist among these root zone characteristics below the surface in order to support your cultural program atop the surface. When a soil imbalance exists, the turf cannot respond fully to the applications you apply to enhance its quality and vigor. Thus the turf plant becomes weak due to the soil environment in which it is anchored. Unfortunately, by the time the weakening effects are felt the mercury hits 90 plus, humidity is oppressive, there is a shotgun member guest at 12 o'clock, and you cancel lunch while you grab that bottle of antacid. Sound like the summer of '94? It's "no holds barred" with Mother Nature and the last thing on your mind is a soil test.

Spring and Fall are more opportune times to conduct a soil test analysis as a diagnostic tool prior to aeration and topdressing, and to make proper decisions on what material you should or shouldn't be amending the root zone with. Conventional soil testing methods are good for choosing a new root zone or topdressing material for greens and tees. However, for an existing soil profile in either a new high sand or an old push up green, a more surgical approach is required to locate, pinpoint and isolate a soil malfunction within a specific area from 0 to 12″ so that you can implement the proper corrective action (a "smart bomb" analogy, if you will). Such a method has been developed by International Sports Turf Research Center of Olathe, Kansas, to test intact, undisturbed soil cores inch by inch and evaluate the physical well-being of the soil medium as it relates to the root system and health of the turf plant. This is especially effective on golf greens where intense culture and abuse struggle to find an equilibrium. Now soil testing technology has devised a way to bring your golf green to the laboratory. Okay, sure, core samples have been done for years by using a cup cutter or pounding in random lengths of PVC, but never with this high degree of accuracy.

This New ISTRC SYSTEM cores with a plugger device and extracts a 2″ diameter by 3″ deep intact core into a copper sleeve that is then capped and sent off the the lab. Two types of cores are extracted which represent specific levels of the root zone for analysis. First, the most crucial upper tier — 0″ to 3″ — that is subject to general aeration practices, topdressing, soil amending, surface contamination and direct compaction. Second, the lower 3″ to 6″ tier that can harbor hard pan, fines build up, and is affected during vertidrain, deep tining and hydrojet practices. Additional lower tier cores may be extracted from 6″ to 9″ and 9″ to 12″, especially when considering deep tining or rebuilding. Identification of the make up of the soil profile with inch by inch accuracy is the intended purpose when subject to the following series of tests: USGA physical evaluation guidelines including infiltration rates; Walkley/Black organic; Particle distribution and textural analysis; Bouyoucous test; Porosity in capillary and non-capillary; Particle sphericity/angularity; and Root mass and feeder roots analysis.

Where and what are the most common soil problems found through core testing? Definitely in the upper tier 0″ to 3″. Buildup of organic and fine layers that seal off the root zone and impede proper infiltration, choking of the soil porosity creating an imbalance of air and water, the restriction of feeder roots from penetrating the depths of the root zone, and confining the root mass to the upper portion of the root zone. What could cause all the mayhem? The cause could be as simple as using improper topdressing material. Not that your topdressing material may be bad, but it just might be too much of a good thing such as high organics or particles too abundant in coarse or fines. Can you imagine what would happen to our cholesterol levels if we ate steak and eggs every day? Just as a blood test is a good diagnostic tool for human health, soil core analysis is a good diagnostic tool for the health of your turf.

OSHA REQUIREMENTS

FOR ROLLOVER PROTECTION/SEATBELTS AND HEAD PROTECTION

The letter from Terry Mueller, OMT Director of Minnesota OSHA and the session at the MGCSA mini-seminar with Don Strot, Senior Safety Investigator of Minnesota OSHA, has left Minnesota Superintendents and Club Officials with many questions, concerns and anxieties over the requirements and enforcement of ROP's and head protection.

No one objects to improving safety standards in the work place. It is part of our responsibility to provide safe working conditions for employees and to take a positive approach to the statute.

MGCSA is working with Minnesota OSHA on these issues. It is important to identify misinformation and concerns, and to get correct answers out to MGCSA members.

The following is a list of questions and concerns regarding OSHA's statute on ROP's and head protection. These questions come from MGCSA members. The MGCSA Board of Directors has worked on answering these questions as accurately as possible. If you have other questions or need more information, please contact Minnesota OSHA Division.

1. **What is OSHA's definition of flat terrain, and do golf courses fall under this definition with elevated greens/tees and bunker banks?** The definition of flat terrain is having no pitch or hills. Golf courses do not fall under this definition with the exception of some driving ranges.
2. **Does governing down or modifying engines to decrease horsepower under 20 h.p. meet the requirements?** No, whatever horse power is stamped on the engine is what Minnesota OSHA will go by.
3. **Are three-wheeled vehicles and mowers equipped with engines under 20 h.p. exempt from the statute?** Yes.
4. **With the sudden increase in demand for ROP's on existing equipment, some manufacturers and distributors cannot fill all orders for several months. What documentation, if any, is needed by Superintendents to demonstrate that ROP's for existing equipment have been ordered?** To the best of our knowledge, no documentation from manufacturers or distributors is needed. Superintendents need to put together a program for ROP's installation on existing equipment and have it on site.
5. **If a piece of equipment is scheduled to be replaced, does it need ROP's installed? If no, is there a time period for which the piece of equipment must be sold or traded in?** May 1, 1996. In your plan, explain the situation with that piece of equipment and request an exemption for ROP's installation.
6. **Is the Minnesota Department of Labor and Industry Safety Grants Program applicable for meeting the requirements? If yes, whom is eligible for the grants and who do people contact for more information on the grants?** Yes, golf courses are eligible for the grants. For more information or application contact James Collins, Workplace Safety Consultation at 612-296-5433.
7. **If ROP's are not available for older equipment, is there a manufacturer that can fabricate ROP's that meet OSHA standards?** Yes. Custom Products, Box 718, Litchfield, MN 55355. Phone: 1-800-222-5463 or 612-693-3221.
   (Note: Some non-commercial/non-industrial equipment may be exempt from the statute. If you have a piece of equipment in question, contact Minnesota OSHA on its exemption policy.)
8. **With the back orders on ROP's for existing equipment and the sudden financial burden this may bring to golf courses, why is OSHA not willing to provide a grace period for implementation of the program?** To the best of our knowledge, there will be a grace period to May 1, 1996 — but you need to get started on your plan.
9. **Is screening on equipment required to protect employees from flying objects (golf balls)?** No, but it is highly recommended.
10. **What is OSHA's definition of head protection and what type of head protection meets the standards?** To the best of our knowledge, any types of safety cap that meet or exceed ANSI Z89.1 specifications for impact resistance. *(see standards)*
11. **Who is required to wear head protection on the golf course?** Any employee, employed at your facility, that is on the grounds, who may be exposed to flying objects (golf balls) is required to wear head protection. Non-employed personnel, such as green committee/board members, contractors, sales representatives/distributors or outside service personnel are exempt from the statute.

If you have other questions or concerns, please contact the Minnesota OSHA Division at 612-296-2116. Remember your main objective is protecting the interest of your facilities and the safety of your employees. Don't ignore it. Get started on your programs and take a positive approach to this issue.

— Human Resources Committee

Reviewed by Terry Mueller
OMT Director of Minnesota OSHA

Open Letter To All Interested Parties:

Due to an increase in injuries involving riding lawn mowers and similar vehicles, Minnesota OSHA would like to remind those working with these types of vehicles of the following:

Rollover Protection and seatbelts are required on all motorized, self-propelled vehicles and mowers that are equipped with a 20 horsepower motor and above (§ 182.653, Subp. 2). Four-wheeled vehicles and mowers operating on flat terrain only will be exempt. Three-wheeled vehicles have no exemption.

This regulation is especially relevant in the maintenance of landscaping such as on golf courses, cemeteries, parks, and roadsides. In addition to the above regulation, employers should know that:

Any employee exposed to flying objects or subjected to possible injury by flying objects needs to wear head protection (such as a hard hat). Employers are required to provide this head protection for their employees.

Minnesota OSHA will be assuring compliance with the above standards during investigations at businesses where the above vehicles are in use and/or flying objects are a hazard for employees. If you have any questions about either of these standards, please contact your nearest OSHA office or call (612) 296-2116.

Minnesota Department of Labor & Industry

Sincerely,

Terry Mueller, OMT Director
Occupational Safety and Health Division

MEMBERSHIP REPORT

NEW MEMBERS—MAY 8, 1995		Class
John McCarthy	Sawmill Golf Club	A
2913 Marine Ct., Stillwater, MN 55082	W: 612-439-7819	
Rick Koring	Sundance Golf Club	A
10150 Highland Ridge, Corcoran, MN 55374	W: 612-420-4700	
Jerry Peterson	Olivia Golf Club	B
1020 Highway Ave., Bird Island, MN 55310	W: 612-523-2313	
Richard Kelvington	Olivia Golf Club	B
407 Sunrise Drive, Olivia, MN 56277	W: 612-523-2313	
William C. Kreuser	Burl Oaks G.C.	BII
315 E. 3rd St., Chaska, MN 55318	W: 612-472-7124	
Mark V. Plombon	Sawmill Golf Club	BII
2243 11th St., White Bear Lake, MN 55110	W: 612-439-7819	
Pete Gustafson	St. Cloud Country Club	BII
28 3rd Ave. NE #210, St. Cloud, MN 56304	W: 612-253-5250	
Brett R. Hetland	Bristol Ridge G.C.	BII
1600 Aspen Dr., #5, Hudson, WI 54016	W: 715-247-5778	
Mark Paffel	Spooner Golf Club	BII
Rt. 2, Box 119A, Shell Lake, WI 54871	W: 715-635-6438	
Benjamin M. Sabas	Pine River Country Club	C
P.O. Box 413, Pine River, MN 56474	W: 218-587-4774	
Eric T. Steinhoff	Creeks Bend	C
24977 Langford Ave., New Prague, MN 56071	W: 612-758-7200	
Jud Crist	Lester Park Golf Course	C
1860 Lester River Road, Duluth, MN 55804	W: 218-525-3018	
Geoff Jordan	Ridgeview Country Club	C
6788 Haugen Ln., Duluth, MN 55803	W: 218-728-2583	
Lawrence P. Gorman	Anoka Technical College	C
2509 Nevada Av. S., #6, St. Louis Park, MN 55426	H: 612-525-8687	
Edward A. Thomas	Willinger's G.C.	C
712 Washington, Northfield, MN 55057	W: 612-652-2505	
Larry Runnels		C
P.O. Box 532, Luck, WI 54853	H: 715-472-8328	
Terry Negen	Montevideo Country Club	C
5055 85th St. NW, Montevideo, MN 56265	W: 612-269-6828	
John Lindman	Edinburgh USA	C
12000 53rd Ave. N., Plymouth, MN 55442	W: 612-424-8756	
Joseph M. Fischer	Northern Hills G.C.	D
15 - 10½ St. SE, Rochester, MN 55906	W:507-281-6172	
Greg Glader	St. Cloud Country Club	E
24489 Cty. Rd. 7, St. Cloud, MN 56301	W: 612-253-1331	
Dan Olson	Olson Power & Equipment	F
39500 14th Av., Box 39, No. Branch, MN 55056	H: 612-674-4494	
Timothy J. Hagan	Twin City Swinger, Inc.	F
406 Twin Lake Terrace, Crystal, MN 55429	W: 612-535-1955	
John Timburg	The Tessman Company	F
6049 Ridgewood Rd., Mound, MN 55364	W: 612-487-3850	

RECLASSIFICATIONS—MAY 8, 1995		
Robert R. Dolan II	Castle Highlands G.C.	B to A
Thomas J. Hougnon	Grand National G.C.	B to A
Chris Youngbauer	Pine River C.C.	B to A
Craig Otto	Springfield C.C.	C to BII

David Sime, Membership Chairman

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Scott Turtinen
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Women's Western Golf Foundation

A charitable trust established in 1971, the Women's Western Golf Foundation provides a golden aura circling big brashy dreams of many a young woman whose most diligent savings plan wobbles under weight of such aspiration.

Formed as an outgrowth, WWGF is devoted to promoting educational, social and recreational advantages for women and girls in golf by encouraging sportsmanship, amateurism and interest in golf. The WWGF has enriched lives of at least 196 women since its first award in 1975 and has supported several college and university golf programs for women.

An applicant need not be a golfer but must have a decided interest in the game.

Benefactors: PGA Foundation; WWGA, WWGA Scholarship Days; many individual contributors.

Scholarship application information can be obtained from: Mrs. Richard W. Willis, 393 Ramsay Rd., Deerfield, IL 60015. (Tel: 708/945-0451).

Golf Course Drainage

* * *

A Hands-On Report

By Geoffrey Corlett
Turf Grain, Inc.

It is now common knowledge that good drainage is an important ingredient for the success of a golf course. Lesser known are the causes for poor drainage, and further, how to rectify the situation. Outlined in the following paragraphs are four typical drainage problems on a golf course with options that may be applied to permanently improve drainage.

High water table, low lying area

For a golf course built with a river as the predominant feature, there is a strong possibility that at least one site on the course will exhibit the following characteristics: Comonly found in a natural low point of the watershed, a basin is formed with slopes on at least three sides where surface and ground water collects. The soils exhibit the following characteristics of anaerobic conditions: A foul odor and very dark in color. Standing water remains long after a rain and the turf is spongy throughout the season. The scale of this problem area can range from isolated pockets of less than one acre to a situation where most of the golf course is built within the basin.

Extensive drainage is required to remove the volumes of water that collect in the basin and maintain the water table at a depth conducive to growing turf. Spacing and depth of the tile is based on the grade available for fall in the drainage line and the soil characteristics. Native soil backfill is sufficient as the objective is to lower the water table, not to cut off flowing ground water. Once the depth of the soil is controlled, water holding capacity of the soil is greatly increased, allowing for the infiltration of surface water soon after a rain.

Sidehill seepage

Sidehill seepage exists anytime there are two distinct elevations separated by a well defined slope. This scenario is particularly evident where a sidehill has been excavated to accommodate a fairway. Distinctive features are soft soil along the lower run of the slope, water boiling from the ground on the lower elevation and in more severe conditions, slumping soil along the base of the slope. Sidehill seepage is the result of a head created by the ground water in the upper elevation causing an unusually high water content in the soil directly along the base of the slope.

The objective here is to intercept the ground water as it flows down the slope before reaching the lower elevation. A series of drainage lines should be installed, with granular backfill, allowing for the site characteristics for grade and outlet.

Subsoil layering

Subsoil layering is a problem not easily identified. Although water problems do occur naturally as a result of subsoil layering, they are most pronounced when the native subsoil has been disturbed through excavating and forming the architecture of a golf course. The natural ground water flow is altered by a new and non-uniform arrangement of materials in the subsoil, such as a pocket with high permeability isolated by an impervious layer of clay. Share variances in the texture of the subsoil are difficult to detect without removing a three or four-foot core sample. Poor drainage under these conditions will appear in several forms. A spring boiling from an otherwise well draining fairway with moderate grade and spongy pockets randomly located in an area which appears to be well graded. (See Fig. 1)

Once identified, drainage lines should be installed continous with the clay outcrop to a suitable outlet. If the wet area is localized, three to fifteen meters in diameter, once or two lines into the problem area are sufficient to remove the trapped ground water.

Surface grading

It is a well-known fact that high quality surface grading is critical to the success of every golf course. Unfortunately, in practice, surface grading rarely, is well-executed

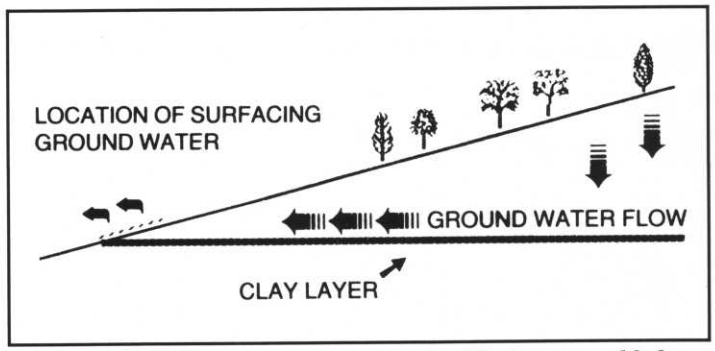

Fig. 1 — Ground water movement restricted by impermeable layer of clay. Result is an underground ponding area.

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