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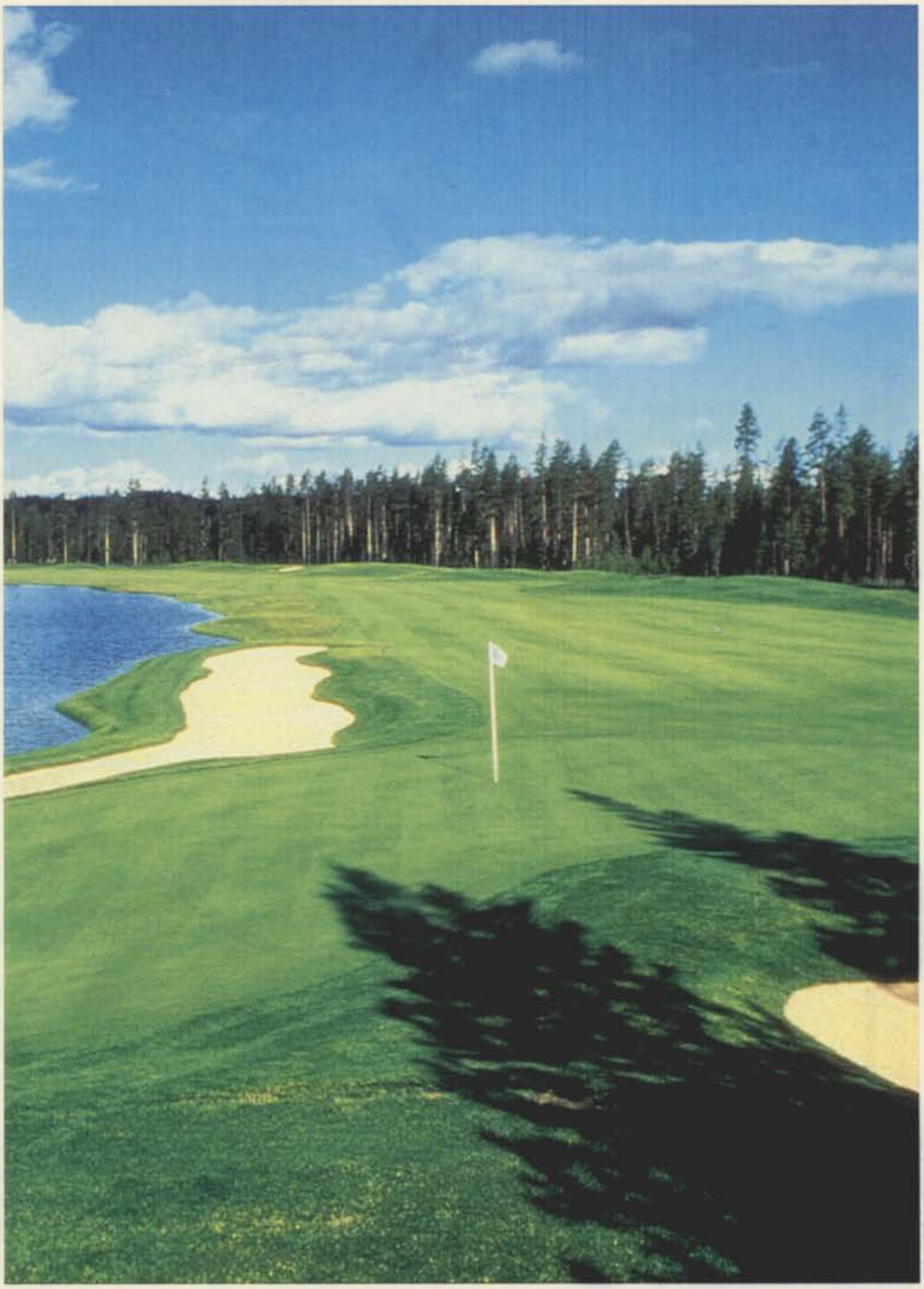

51st Conference October 12-16, 1997

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PRESIDENT'S MESSAGE

In just over one year Sahalee Country Club will host the 1998 PGA Championship. The following are a few facts about the PGA and what we have been up to the last few years.

The PGA is a separate and distinct organization from the PGA Tour. The PGA Tour is the former Tour Division of the PGA who split off several years ago to form their own organization known as the PGA Tour.

The national headquarters are in West Palm Beach, Florida. They are governed by a Board of Directors of sixteen, one from each of it's thirteen sections, two appointed from the business world and one from the PGA. They have a staff of four hundred with the day to day business affairs run by Jim Awtry, CEO. Jim paid the first official visit some seven years ago which in turn started an action plan. We have been dealing primarily with Kerry Haigh, Senior Tournament Director. One of Kerry's responsibilities includes course setup and course conditioning. He has been a pleasure to work with.

The PGA Championship has been played annually all over the U.S. since 1916 with the exception of World War I and II. Glen Proctor was the Golf Course Superintendent at Manito Golf and Country Club in Spokane, Washington in 1944 when they hosted the PGA Championship. Bob Hamilton, former baseball player just turning to pro golf, defeated the galley favorite and reigning champion, Byron Nelson, one up on the 36th hole. A crowd of over 6,500 was on hand for the finals. Sahalee will limit ticket sales to 25,000 per day!!

A study was made of the golf markets in the U.S.. The Seattle metropolitan area was found to be one of the ten largest golf markets and the PGA wanted to come to the Northwest. The official announcement came in 1993 at the PGA at Inverness Country Club. Since 1992 Sahalee has sent a posse to each of the PGA events. The Championship will be played on the North and South nines. The course will be played at par 70, with six and eighteen currently par 5's to be played as par 4 's. The East nine will be used for various support services.
The tournament will be televised internationally August 13 through 16, 1998. Approximately 1200 accredited media representatives from all over the world will attend, of which 400 to 500 will be working media. A media tent will be located on the 1 East fairway. It will be fully equipped with all available multimedia equipment and be open virtually around the clock to meet different time zone requirements. Most, if not all, hotel and motel rooms have been reserved. Logo merchandise is for sale now and will also be at the merchandise tent.

In This Issue...

Our Cover Photo is provided courtesy of Sunriver Resort, Sunriver, Oregon

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Gross sales will be well over one million dollars. The economic impact to the area will be in excess of sixty million dollars. Twenty-five hundred volunteers will be required. The cost to volunteer is $155 and includes access to grounds, uniform, parking, shuttle and a program.

The principal items that finance the Championship are 1) admission tickets, $250 (season ticket only) 1-800-742-8258, 2) hospitality tents (chalets), $135,000, 3) Corporate tables, $20,000, 4) program advertising and 5) concession income. Television revenue is exclusive property of the PGA and is not tournament income. The PGA assumes all risk and responsibility and bears all losses, if any. The site fee paid to Sahalee will be 50% of tournament profits.

A basic requirement of the PGA is community acceptance as well as participation. The executive committee obtained letters of support from the Governor, Mayors of principal cities, King County Executive, Presidents of Chambers of Commerce's, Convention Bureaus and Sports Councils.

After receipt of the 1998 site award the only requirements of the PGA were that the bunker rehabilitation be completed, a new tee on the finishing hole to make a par 4 instead of a par 5, to develop consistent rough at a height of 3.5 to 4 inches and that the golf course be in championship condition. The original bunkers were contaminated with rocks and badly needed attention. Sahalee elected to employ Rees Jones to redesign the bunkers. We used the firm of Ron Hall to do the work. When the tee on 9 North was being considered, we lobbied for deepening the lake on 8 North. Both of these projects are now completed. Since then the PGA requested 3 North be extended 20 yards to play 450 to 460 yards. This work is also completed. In the original plan we were going to completely renovate the rough by using Round-up and seeding with a blend of Ryegrass. We calculated the cost at $120,000 plus future treatments with Prograss to help minimize the invasion of Poa annua. The cost was too much and it was decided to grow he existing rough to 3.5 to 4 inches, The final requirement is that the golf course be in championship condition. Frankly, we all have different views of what championship condition is. I believe this is a catch-all clause in the contract however it has worked for our best interests. Our goal is the same as everyone in this business - provide the best condition possible with all available funds. The PGA has a well laid out plan that calls for fairway width, rough height, square cutting of the championship tees, gallery ropes, fairway crossing, T.V. towers, bleacher locations, cutting heights - fairways and tees 3/8 and green speeds by our contract calls for 10.5 to 11.5. The senior tournament director makes the decision on all items relating to the golf course. All previous superintendents for the last 5 years hosting this event have nothing but good to say about Kerry Haigh and I concur. It would be okay if there were 500 members here just like him!

Unless something changes, we expect to begin a twelve foot wide road through the East nine in June. We have had our fun and disappointments, but I must say that without an exceptionally dedicated staff we would not have progressed as far as we have today.

Our best for a good summer,
Thomas M. Wolff, President
Sahalee Country Club

EDITORIAL COMMENT

Spring is about over. Most areas in the Pacific Northwest have already had summer-like temperatures and lots of sunshine. Nature has been jump-started!!

Of major importance in this issue of *Turfgrass Topics* is the Columbia Cup. (See centerfold of newsletter). This tournament is sponsored by Western Equipment Distributors, Inc., and The Toro Company™ with lunch provided by Softspikes™. All members of the Pacific Northwest turfgrass groups will enjoy a day of golf while learning more about their fellow professionals in the turfgrass industry and provide support for turfgrass research. DON'T MISS IT!!

Your President, Tom Wolff, is making preparations for the PGA Championship in 1998, but he has also been very active with a meeting schedule this past winter that will impact your future. He has just chaired the best and most productive Summit Meeting between Inland Empire Golf Course Superintendents Association, Northwest Turfgrass Association, Oregon Golf Course Superintendents Association and Western Washington

Continued on Page 34

A Sign of the Times?

Roy L. Goss, Northwest Turfgrass Association, Executive Director Emeritus

Last fall's presidential election brought out the lowest number of registered voters since 1924. Is this apathy? Such an important matter and less than 50% of the voters cared a whit. The 50th Northwest Turfgrass Conference, a very special event held Sept. 30 -Oct. 2, 1996 at Victoria, B.C., likewise suffered a disappointing attendance. Your officers and directors really went all out to make this historic conference a truly memorable educational event, and it was, but many of you were missing.

About 50 years ago, five dedicated individuals, John Harrison, Glen Proctor, Louis Schmidt, Wilfred Brusseau, and Al Law expended a great deal of effort to put together an association whose sole purpose was for education and research. They needed help, and so did all turfgrass managers and industry. In subsequent years scores of dedicated people continued to build on this concept and developed a very respectable Northwest Turfgrass Association. We enjoyed the reputation of the best educational Conference after the G.C.S.A.A.

Now, I know that most of you have your expenses paid to your conferences, workshops, and seminars, so why don't you take advantage of these educational opportunities that are designed for your specific needs? If you don't have the interest or enthusiasm to go to your conference, I would question where you get your technical information and the reliability of it's source. Without a doubt, Agri-businesses have many capable people at your disposal, but not without biases - they have products to sell. University research, extension, and teaching programs cannot deal with you on a one on one basis, as they once did, but they are a vital part of the turfgrass conferences - your opportunity to learn and perform better for your employer.

If the educational program at the Northwest Turfgrass Conference is falling short of your expectations, please take the initiative to let the program Chairman or the Board of Directors know your needs, or better still volunteer your time and energies. If the conference location is not to your liking, let the Executive Director know. He will take your wishes to the board.

Now we all know that, occasionally, emergencies arise, preventing our attendance at the turfgrass Conference, but not to the extent of over 50 % of our membership. Glen Proctor and John Harrison told me several times, "If I gain one new idea or a bit of information that will improve my performance or make my job better, the expense is justified.". Having been involved in research, extension, and teaching programs for nearly 50 years, I too, always, learned something I could put to use by attending and listening to other speakers. The challenge is yours, I'd love to see you at Sunriver for our 51st Conference.

GETTING THE MOST OUT OF RESOURCES--IRRIGATION, MOWING EQUIPMENT, AND PEOPLE

James R.(Jim) Watson, Ph.D.,Vice President, Agronomy, The Toro Company, Minneapolis, MN

It would be useful at the outset for you to know the order of importance of the three resources I have been asked to discuss... irrigation, mowing equipment, and people.

We all know that no living thing can exist without water. Water is vital to the health of turfgrass. Not enough and it will wilt and die. Too much and it will become diseased and die. So irrigation and the equipment needed to apply water correctly is important.

Good mowing equipment, properly operated and properly maintained, is, of course, vital to healthy, good looking, serviceable turfgrass. But it is not the most important.

People, of course, are the most important resource.

People are the most important resource for many reasons. For one thing, although modern technology makes it possible for us to perform almost any function... including turfgrass maintenance... with less labor, with fewer people, a certain amount of physical labor will always be necessary for the care of healthy turf.

To get the most out of equipment and people in today's market, managers of turfgrass facilities must realize that maintenance of these areas is more important than ever -- not only on the golf course but in private and governmental -- municipal, county, state and national -- recreation areas as well. Maintenance must be extensive not only to ensure the best possible conditions for recreational activity but also to protect the heavy investment in property values that individuals, governmental agencies and club members have made. The turfgrass manager must now utilize his managerial skills to analyze each facet of his job function, the performance of his equipment, his operating procedures, his maintenance programs and his personnel policies. He must ensure efficiency at all levels.

From a resource standpoint we must first assess the short term implications and direct our attention to measuring the problems with which we are currently confronted. This approach will help provide a base for the preparation and development of proposals for long range solutions. Shortages always force new thought and I have confidence in the long range solutions of today's problems.

To get the most out of our equipment we should concentrate on that which is currently available. Manufacturers spend millions of dollars each year to develop equipment to answer the needs of the industry. Update your equipment, update the design of your facility to accommodate equipment that will cut more acres per day per man, purchase high capacity equipment that is maneuverable, sturdy and which is readily serviced.

We normally don't associate water with energy savings, but we should. We can't use water without expending energy and we do both very wastefully. We waste water and we waste the energy it takes to transport it: to put it where it is needed. We must learn to get maximum efficiency from the energy used to provide our water. We must use our water more wisely and more efficiently. To do so and to get the most out of this most important natural resource:

<u>Treat each day as if you are in the middle of a severe drought</u> with restricted or limited water supplies.

<u>Establish watering priorities</u>. Highest priority to the most intensively managed areas; for example, on a golf course, greens are the most valuable and are the most critical.

<u>Follow sound irrigation practices</u>. This is much easier to do, of course, with an automatic irrigation system. Irrigate when there is the best combination of little wind, low temperature, and high humidity.

Reduce, or avoid where possible, other causes of stress. Be alert to soil conditions and to soil-air-water relationships and how these affect watering practices. Use single head control and monitor controllers until the proper balance between water needs and application is obtained.

<u>Alter cultural practices where feasible</u>. Test the soil annually to ensure adequate fertility, especially for phosphorous, which encourages root system growth--deeper roots, thus expanding the areas from which the turfgrasses can draw nutrients and moisture.

Raise the height of cut for all areas.

Mow less frequently. Increase the frequency of spiking or cultivate (core) -- if temperatures are not extreme -- to trap moisture and hold it longer in the vicinity of the root system.

Expand use of mulch. This is very important. Apply heavy layers of mulch -- any organic debris that's available-- around the base of trees, shrubs and flower beds, to hold in moisture -- and to help control weeds.

Erect wind barriers, especially where there are large expanses of open space.

Consider use of surfactants. They may be very beneficial under certain circumstances.

Experiment with anti-transpirants. Although techniques for inhibiting transpiration have had mixed results, some reduction in moisture loss through transpiration might be accomplished with the use of chemicals, emulsions or films.

Aggressively seek additional sources of water. Among the several possibilities are wells and ponds, collections of marginal water and -- the most abundant and most often wasted supply -- treated sewage effluent.

At my company we are convinced that wastewater will become a major source of irrigation water in the future. We believe it will be used widely for all types of irrigation, especially for large turf areas and in agriculture.

To get the most out of the "people" resource, there are several key points. The first is understanding. The crew member must first understand why the turfgrass on the facility where he works is important. For that matter, all of us who work in the "green industry" need not only to understand and recognize this point -- but we need, also, to articulate its importance to others -- for too long we've talked only to ourselves .. and if we are not careful, we may find ourselves "outsold" when it comes time to allocate scarce resources.

Why is turfgrass important? It is more than just something pretty to look at, or a soft predictable surface for a golf ball to roll on. Those are important functions. But turfgrass is more important for many other reasons.

Without it ... without those expanses or even just patches of managed turf... this planet would be a far more unpleasant environment for human existence.
Besides providing comfortable, pleasant space for recreation, turfgrass also, filters out dust and dirt from the air. It moderates temperatures ... cooling in the summer and warming in the fall, winter and spring, and it dampens noises.

It also ... contributes to the economic well being of our communities -- because it attracts business and industry. The crew member also must understand the job to be done, how and where it's to be done, what equipment, tools or supplies are needed, how they operate and what the limitations on their use may be; who, besides himself, will be involved, and finally, how he and his job relate to other projects or maintenance programs. If the supervisor has properly trained and effectively communicated his instructions the chances are the job will be done properly and timely. How often does one of your crew fail to carry out an assignment in the manner and time you expect? Just once could be enough to be disastrous under some circumstances!

Communications is the second point. I have always felt that many, if in fact not most, "people problems" stem from a failure to effectively communicate or comprehend. Too often, words and phrases mean one thing to the person (supervisor) giving the instructions and something else to the person being advised (the crew member). Maybe the other party only "hears what he wants to hear" - perhaps - but maybe he did not understand - why?

One reason well may be unfamiliarity with the specialized language of your profession Most specialists tend to talk with their everyday vocabulary. Unfortunately, the specialized vocabulary is not one with which most laymen are familiar. Incidentally, a layman is anyone who is not familiar with your specialty. How sure are you that your crew member or club member, for that matter, really understands when you say "aerify." And, what does he think when you say fertilize -- thatch-- and other everyday words common to your profession?

Establishment and maintenance of a harmonious and productive relationship between you, the turf manager, and your crew is the third step in getting the most out of the people resource. To do this effectively there must be adequate supervision, management and motivation.

Management as a profession is sometimes defined as "the art of getting things done through people." The professional manager, like the physician, combines science and intuitive judgment in the practice of his profession. The use of science in management as we know it today need not, and must not, be confined to the management of industrial plants. "It won't work here - and -"we're different" - is an admission of failure to keep progressive and to admit that yours or any other organization is not being run in the most efficient manner. Certainly, individual cases are unique, and solutions, of course, vary from organization to organization, but sound management principles are not unique and their application should not be limited to the factory! Any group activity regardless of the nature of the group or its goal, benefits from the application of professional management. Representatives of churches, schools and government agencies, realize the benefits to be derived from effective management, and often participate in national management conferences for the express purpose of gaining more insight into management activities and principles.

Work planning is an integral part of doing a good job and because understanding and training are keys to successful personnel management there are 2 or 3 points to keep in mind. How long does it take to do a job, for example, mow a green an athletic field, an acre of highway or airport turfgrass? How long should it take? An annual, monthly, weekly and daily schedule will give you and your crew a guide to follow when the playing season rush is on as well as insurance that all the necessary work is done before the season starts.

In a business with a seasonal pattern like the turfgrass industry, planning during slack periods will result in substantial cost reductions when maximum use periods occur. For rainy days -hold training sessions in which the crew participants keep a list of items specifically for such days.

Where is the job to be done? This question may also stimulate constructive thinking about the jobs to be done. Obviously, a green has to be cut on the green, but the question is which green, which fairway, and which rough? If the job is cup setting, which holes are to be reset? This decision then determines where the employee goes to do the work. The sequence of greens cut or holes reset may be chosen to require the least travel time between holes. In this respect, an accurate scaled map showing all major work areas, irrigation lines and accurate green sizes is mandatory.

Maintenance work may be done on equipment in the field, in a shed, or in a well equipped shop. The most economical answer may not be the most obvious. Don't be fooled into thinking that because a certain route or certain practice has always been done in this manner that the job can't be accomplished in a more efficient way if it's carefully analyzed and studied.

How long does it take to do the job? How is it to be done?

As you work on your plans and study your employees' activities, two questions are going to keep coming up. First, how much time should it take to do the job, and, how much time does it actually take to do the job?

The second question can be answered by keeping records on how many hours are required to cut a certain area or to perform any of the other projects and jobs. Such records, however, do not usually tell how well the job was done, by what method it was done, or how much idle time occurred while the job was being done. In industry, the work of Frederic W. Taylor at the beginning of this century showed there was a vast difference between how long it takes to do a job and how long it should take to do the job. Taylor discovered when equipment was properly used and the unnecessary work removed from the job that the actual effective working time was frequently from 50 to 60 percent of the time actually spent in the past. We also know from repeated studies of industrial operations that anywhere from 10 to 50 percent of the man's day may be spent in idleness or non-productive work. An interesting fact about this idle or non-productive time is that roughly 2/3 of the idleness is the result of inadequate supervision or management and on the average only 1/3 is chargeable to the man himself. To properly answer the questions of how long the job should take, break the job down into elements or steps and determine how long each step takes by the best available method. Then, put together the necessary steps to arrive at the total time the job should take if there are no delays or wasted time.

Good supervision then becomes one of the keys to satisfactory crew relationships and along with effective communications is a major factor contributing to crew motivation.

The following ten points are frequently cited as supervisory responsibilities:

1. Build employee job satisfaction. Not job-happy, but job-satisfied
2. Provide development and growth chances for employees. Develop individual talents - point toward promotion.
3. Treat employees with

complete fairness. consistency, impartiality.

4. Cultivate proper work atmosphere, efficient, business-like, but pleasant - good camaraderie - good fellowship - take crew on a picnic or a fishing trip.

5. Deal effectively with all gripes, no matter how small, and all grievances. Handle promptly and completely no matter how simple you may think the problem to be-remember it is very important to your employee.

6. Protect employees' physical well-being. Check on safety aspects - daily health habits - OSHA and similar organizations are demanding compliance

7. Develop employees, through training, coaching, motivating, personal supervision.

8. Promote upward communication. Listen to gripes, grievances and suggestions -involve the crew individually and collectively in performance and job critiques

9. Promote downward communication. Pass on all company factual data pertinent to employees and work - also compliments, on jobs well done.

10. Take personal interest in employees.

Among the other more significant factors that may help to motivate the crew are those that deal with them as individuals. For example, provide an environment at the facility conducive to good working habits. Keep the shop clean inside and out, keep the tools in place and organized to do an effective job. Provide shower facilities and a place for the crew to have lunch. This same room may be used for training sessions or as a conference room. Bringing the crew together for discussion will help to instill a sense of "belonging."

Provide opportunities for training and education. Remember the crew member who performs poorly may not understand his job or his equipment - he may not appreciate his role or his importance in the overall organizational structure. Remember that "school" or educational opportunity may have a different meaning to different crew members - school to one may mean an opportunity to finish high school, to another an opportunity to attend a turf conference or a factory training program. Know your people, understand their basic needs, call them by name, discuss their job and give praise when it is deserved and take corrective action when needed, but do your reprimanding in private with the individual, not in a group discussion or in critiques.

Finally, although job security in times of recession may be sufficient to keep an employee performing in an exceptional manner, in the final analysis you, your crew, and your organization are better off with satisfied employees who feel they belong and that they contribute to the beauty and recreational, value of your turf facility.

Many of the ideas and concepts I've outlined probably are not new to you. I hope, however, that all of us recognize the need, the essentiality, of "doing our best." Not like the old farmer who was visited by a young county agent he had never met before.

The county agent was armed with pamphlets and literature and his mind was brimming, of course, with all the latest ideas on good farming practices. The old farmer looked at him. Moved his chaw from one cheek to the other, then said, "Young feller --before you start -- just remember I ain't farming half as good as I know how." And, in a way, turf management is a lot like farming, only more so. To get the most out of our resources, whether they are equipment or people, we've got to start managing like we know how or the turfgrass industry--as we know it today--may not survive.

Prepared for NY State Turfgrass Conference November, 1979

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These questions came straight from the customers of lawn care operators, pest control operators and other professional pesticide applicators across the country—and probably reflect the concerns of your customers. The more your customers know about the products you use, how you use them and how much is used, the more confident they will be in you and your service.

"Are the pesticides you use safe?"

"Are the pesticides that professionals use stronger and more toxic?"

"When is it safe for my children and pets to return to an area after a pesticide application?"

Communicate With Your Customers

Your customers expect you and your employees to be credible and knowledgeable sources of information about your products. Take time to talk with them about your safe and responsible use of pesticides.

Studies show that most people don't know that pesticide products are among the most highly tested products sold. The U.S. Environmental Protection Agency (EPA) registers only those uses of pesticide products that pose minimal risks.

- Emphasize that pesticide products must undergo stringent government-monitored testing before they can be sold. It is a long and costly process. For example:
  - It takes a chemical manufacturer eight to 10 years to test and register a product, at an average cost of $30 million to $50 million.
  - As many as 120 tests or more are performed, many specific to health, safety and the environment.
  - Only one potential pesticide in 20,000 makes it from the research lab to the market.
- Explain Integrated Pest Management (IPM) to your customers. Most do not fully understand the concept. Point out that a successful IPM program stresses prevention, pest identification and selection of the best method of pest control, which may require the use of pesticides. Tell how you incorporate IPM into your pest management practices.
- Identify the specific pesticides you use and the pests they control.
- Indicate that professionals use an array of products, many the same as those used by homeowners.
- Assure customers of the benefits pesticides provide for turf, trees and ornamentals, and in the home. For example:
  - Termites cause over $1 billion in structural damage each year.
  - One large, pest- and disease-free tree has the same cooling effect as 15 room-size air conditioners.
  - A well-maintained lawn and landscape adds as much as 15 percent to a home's value.
- Discuss your safe and responsible use of pesticides as a professional applicator. Note the many steps you take to ensure that the pesticides you use are used properly.
- Advise your customers that you closely follow label instructions. The label contains instructions for only those uses approved by EPA.
- Outline the extensive training that is mandatory for professional applicators in order to apply specialty pesticides. Applicators are required by law to undergo training, certification and licensing, as well as to keep records of each job performed.
- Explain what happens to pesticide containers once a job has been completed. Note that containers are disposed of properly.

What Else Can You Do?

Provide your customers with materials such as newsletters, brochures, fact sheets and bill stuffers that communicate these messages. Be sure that someone at your company, who has a basic knowledge of the products and application methods your company uses, is available to answer questions.

RISE Is A Resource

RISE is the voice for the specialty pesticide industry. Its members include manufacturers, formulators, distributors and other industry leaders.

RISE works in cooperation with your national, state and local user/applicator associations and is an additional source of information regarding issues facing pesticide users. We can help you in your role as a knowledgeable and credible information source to customers and to the public. A brochure on communicating about pesticides with your customers is available. Contact RISE to receive your copy.

We urge you to take an active part in your state and national association(s). We work together to support your business.

RISE

Responsible Industry for a Sound Environment®

For more information, contact RISE, 1156 15th St., NW, Suite 400, Washington, DC 20005, or call 202/872-3860.
Our Internet address: http://www.acpa.org/rise.

Seagull Problems - A Simple Remedy?

by Dale W. Ivan, Park Supervisor, City of Moses Lake, Washington

Those of us engaged in the business of parks maintenance work hard so others can play hard. We are overworked, cope with limited budgets, small staffs, and a myriad of problems. While this is an age of advanced technology, many of the old methods and tools, i.e. chemical controls and bird depredation, have been eliminated or regulated into an "endangered' solution status.

The City of Moses Lake, located in semi-arid Central Washington State, is small (about 12,000) but, has a rapidly expanding Parks Department. We are committed to offering facilities and services that enhance the quality of life for its residences and encourage youth involvement. One of the additions to our inventory was a massive outdoor family aquatic center. This innovative water theme park has won national and state awards and recognition. Annual attendance has soared past all calculated projections.

With this type of facility comes a host of new maintenance challenges. Our staff has been able to rise to the occasion. We have implemented a number of modifications and improvements that have increased operational efficiency and reduced costs.

One problem that did not have an easy fix, was what to do about the invasion of seagulls that adopted the water park as their seasonal home. Each year brought increasing birds, bird droppings, and patron complains. Gulls found an abundance of food in the snacks or picnic lunches trying to be enjoyed by some 1,500 patrons on any given summer day.

Roof lines, parking lots and anywhere else chosen by the gulls, became their roosting place. Gulls adapt well to these urban settings. They would prey on food not closely guarded or dropped by the bathers lounging on the concrete deck or grassy areas. Bird droppings were a potential health hazard. They soiled buildings, the concrete deck, and not were appreciated by patrons being bombarded by overhead birds. Soiled concrete required us to purchase two additional pressure washers and added seven hours of labor each day to our cleaning schedule.

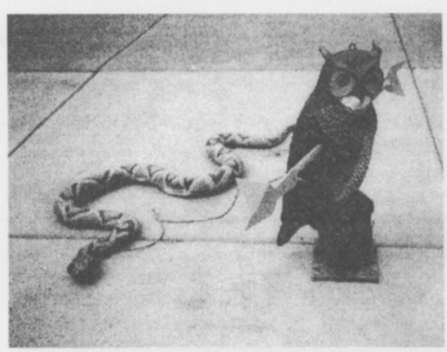
Several agencies were consulted for advice and solutions. The seagull is a protected bird, in addition to having historical significance for a large religious organization. Bird depredation was not an option within city limits or otherwise. Agency final recommendation was stringing high tensile strength wire over the entire facility, along with spined wire fastened to all roof areas.

We then experimented with numerous deterrence products including large balloon "eyeballs", electronic distress calls/noise, fake owls, snakes and more. Some of the controls were as objectionable (noise) as the birds. Gulls quickly learned to ignore our best efforts to make them move on.

<u>Solution</u>:

Knowing we are located in a windy area, movement might increase the effectiveness of stationary products such as the plastic owl. We set to work to create some options that might work. Solutions must have low visibility in order not to detract from facility features.

Owls: Plastic owls were modified with a wheel-type bearing affixed to a round piece of plywood for mounting. This was bolted to the base of the owl to allow it to spin. The owl body was drilled out to receive a round wood shaft placed through the body and extended past the body some 12 inches on each side. Plastic material was shaped like an open funnel and attached to each end of the wood shaft. This feature would help catch the wind enabling the owl to rotate in the direction of the wind. These modified owls were affixed to each roof.



Snakes: We then made a simple modification to large inflatable snakes through the face area with a string. They were attached to a nylon string between roof vents following the roof pitch. This allowed the snakes to slide around in an animated manner. Both of these deterrents had low visibility and made no objectionable noise. Seagulls and other birds now faced a more lifelike enemy.

Results: Birds no longer roosted where they pleased and populations at the Aquatic Center decreased by more than 95%. Those control levels remained constant through the year. We have reinstalled the modified owls and snakes for the 1997 season and they are working well again. This solution may be an effective deterrent for your maintenance staff to try if other methods have not been successful. For additional information the author can be contacted regarding specifics.

TURFGRASS UNIVERSITIES TURF RESEARCH FUND

Getting in Touch With Your Roots[1]

F.B. Holl Ph.D., P.Ag.[2]

Editor's Note: This talk was presented by Dr. Holl at the NTA's 50th Conference in Victoria, BC It appears in your last issue of the *Proceedings* and is presented here for those who did not make the Conference.

Introduction:

The title of my presentation was intended to evoke a variety of images - not the least of which was the "New Age" idea of understanding our past history as an indicator of our current perceptions and responses. For turfgrass, as for people, that past history may provide important clues about future responses. Our target in the golf industry, as in other areas of turf management, is to provide a playable, attractive turf appropriate to the use. My intent today is to raise your awareness of the importance of the plant root ecosystem [roots and the rhizosphere soil influenced by those roots] in turf management.

Iceberg management:

How do we approach that attractive, playable turf target ? Just as the captain of the *Titanic* focused on that portion of the iceberg above the surface of the ocean, our primary strategies for managing turf have traditionally been directed to the above ground portion of the grass plant. But that focus represents approximately 4% of the turf plant ecosystem [see Figure 1].

Figure 1.

- Shoot [3.2 mm]]4%]
- Thatch [6.0 mm] [8%]
- Roots [65 mm] [88%]

Turf management involves the application of a variety of mowing, fertility and irrigation strategies, as well as a range of secondary cultural activities (e.g. aeration, topdressing) to turf stands using as the primary evaluative tool - the appearance and functionality of the visible shoots. We manage for a minority component of the plant (albeit an important one), but often ignore the root system - a critical factor in plant growth and health, as well as a primary point of contact with many plant pathogens.

Roots - Who putts on them anyway ?

The plant shoot is what we see; the plant shoot is what we play on; why should we concern ourselves with that elusive root zone ? Surely if we manage the aboveground part of the plant effectively, the roots will take care of themselves. Before we accept that philosophy too easily, let us consider first what roots do, and why we might consider a more proactive role in their management.

Roots are the major plant organ involved in nutrient and water uptake.

Water is essential for plant growth and as the primary carrier for nutrient uptake. An adequate supply of nutrients is essential for the production of quality turf, particularly under the intensive use patterns on a modern golf course. In a "normal" soil, organic matter represents the natural capital that feeds raw materials into the pool of available nutrients. This organic matter also contributes to the aggregation of soil particles which provides improved structure, and effective distribution of water and air in the soil profile. Good soil structure also creates the microhabitats essential for the development of many beneficial soil microorganisms. In sand-based turf ecosystems, organic matter may be lacking, especially in a young profile, and the system lacks intrinsic water-holding capacity and effective nutrient cycling systems. In sand-based ecosystems, healthy roots, and the management of root growth, root turnover and rhizosphere microbial are likely to become essential features of good management.

Roots are a major site of interaction with plant pathogens.
Few understand better than the turfgrass professional, the lurking danger of plant pathogens - they're out there - waiting for the opportunity to attack a stressed grass population. Our challenge is to many for reduced stress - not always an easy task when the turf is confronted with unusual situations [planned or unplanned]. When traffic demands are increased significantly [Figure 2], the consequences to the turf may be severe wear.

Not all such occurrences may be as extreme as illustrated in Figure 3, but grass under stress of heavy use, low mowing heights, sudden low or high temperatures, excessive shade, waterlogging, ice cover - will be more susceptible to damage and disease invasion, particularly if the stand has a poorly developed root system and associated rhizosphere microbial population.

While diseases are usually detected by their aboveground symptoms and impacts on the turf [Figure 4], the initial problem has often arisen in the root zone as a result of a complex interaction involving plant stress, and imbalances in the rhizosphere ecosystem.

Roots respond to management of the aboveground part of the plant.
We often forget that management of that visible plant shoot has both direct and indirect impacts on the root and rhizosphere environment. The most commonly accepted connection between roots and management is the contribution of phosphorus at seeding to stimulate root growth in the establishing grass plant.
Another important relationship is demonstrated by the root response to mowing. While it is generally understood that removing aboveground photosynthetic leaf area will reduce the ability of the plant to support growth, including root growth, it is less commonly appreciated that removal of topgrowth results in an immediate "loss of root" response belowground. Root hairs and root biomass die back in response to defoliation. Mowing thus not only reduces the ability of the plant to synthesize new carbohydrate, it also results in a decrease in the ability of the grass plant to take up nutrients and water. The turnover in root biomass also contributes carbon and nitrogen to the nutrient pool available to rhizosphere microorganisms, influencing population size and composition.
Changes in root development in response to management may also be critical; frequent light applications of water encourage shallow root growth and reduce the ability of the stand to withstand drought conditions. Droughtier soils are also generally less active microbially.

Roots are the focus of activity of many beneficial microorganisms in the soil.
While we most often associate microbes in the soil environment with pathogens and disease, there are a multitude of organisms in the soil that are both essential to sustainable plant growth, and which contribute to plant health. Bacteria, actinomycetes and fungi make a significant contribution to the living biomass in a soil. From a plant management perspective, it is also interesting to note the population size differences which have been observed between rhizosphere and non-rhizosphere soil. Rouatt et al. (1960) *(Proceedings of the Soil Science Society of America* **24:** 271-273) reported rhizosphere populations of fungi and bacteria showing 12- and 24-fold increases, respectively, compared to their non-rhizosphere counterparts.
These organisms contribute to plant growth and health via their contributions to mineralization and nutrient cycling, through solubilization of minerals such as phosphorus, by direct hormonal stimulation of plant growth, and by acting as biological control agents.
Increasingly, the focus of an environmentally-based manage-

ment program will be to design strategies and develop inputs that will encourage the development of the beneficial rhizosphere microbial populations in sand-based systems. These strategies will require an increased understanding of such populations, and an appreciation of how they respond to seasonal and management changes.

Characterization of Rhizosphere Microbial Populations

Our primary interest in looking more closely at these rhizosphere microbial populations is to try to determine the size and composition of the populations, and how they function in interacting with their respective grass plant partners. We are interested in numbers, diversity and function - but these are complex populations in a heterogeneous environment. Logistically, scientists have a limited capability for the accurate isolation, culture, identification and enumeration of these populations. It is also more widely accepted that functional activity in the rhizosphere is not necessarily linked to our ability to isolate and characterize members of these soil populations, nor is it necessarily affected by the addition or exclusion of specific bacterial types.

In the last decade, considerable progress has been made in addressing the functional nature of soil microbial populations [Garland, J.L. and A.L. Mills(1991) Appl. & Environ. Microbiol. **57:** 2351-2359]. One aspect of that progress has been the application of redox technology to the assessment of community-based carbon source utilization characteristics. Technology developed by BIOLOG, Inc. zolium dye colour change as an indicator of microbial respiration with a range of 95 carbon sources. Organisms which are capable of metabolizing a particular carbon substrate cause the dye to be chemically reduced forming a purple colour. Direct incubation of environmental samples [for e.g. a water or soil sample] produces a pattern of metabolic activity which should be reflective of the particular microbial community at that point in time.

We have used the BIOLOGÔ test plates to investigate the carbon use patterns of microbial communities in a series of golf greens sampled over a period of months. These analyses have shown that functional patterns as reflected in the range and degree of substrate utilization vary over time, reflecting changes which occur in response to time of year (season), construction (sand, soil, age) and management (water, fertilizer and pesticide use). We are still analyzing the data to determine whether there are specific substrates or substrate groups that can provide a guide to managers about these rhizosphere changes and their potential impact on the associated grass plants. We are also attempting to determine if this technique has some predictive capability to forecast susceptibility to disease and/or aboveground plant responses.

Can We Manage Microbes ?

These kinds of studies begin to tell us something about the way rhizosphere populations behave in response to a variety of external management and climatic perturbations. But are we any closer to actually managing microbial populations for survival ?

There are four general areas where I believe we are making (or could make) some progress in manipulating rhizosphere populations:

- design/construction - the evaluation of new amendments for sand profiles. There has been considerable interest in recent years regarding a variety of inorganic amendments for sand-based profiles. These include zeolites, diatomaceous earth, and calcined clays. These products may contribute to improved aeration porosity, contribute to greater water holding capacity and/or retain nutrients as a consequence of high cation exchange capacities. As a consequence of their impact on the soil environment, such amendments may contribute to improved soil structure and the development of microhabitats which encourage root and microbial development.

- water management - the free draining characteristics of most sand-based greens encourages the regular use of water to ensure that the profile retains sufficient supply of moisture for plant growth. As a result, sand-based turf often receives an abundance of water at intervals more frequent than desirable for either healthy grass or the development of a stable rhizosphere ecosystem. Frequent watering encourages shallower root growth, increased sensitivity to drought and other external stresses, and very likely supports a rhizosphere microbial population which is less resilient.

bial population which is less resilient.

- fertility management - sand-based turf is most responsive to a fertility management program to ensure a relatively uniform supply of nutrients over the growing period. While this can be effectively accomplished on established sand-based systems with a program of controlled release fertilizer applications, there remains the challenge of new construction and the initial establishment phase (up to two years). During this period, the controlled release nutrient supply is often supplemented with soluble sources to create conditions for more vigorous grow-in. Regardless of the source, the potential for leaching losses is higher during this establishment period.

The more rapidly a stand can develop an extensive root system and a healthy associated rhizosphere microbial population, the sooner those leaching concerns may be alleviated. The use of amendments which contribute to retaining nutrients in the profile, and the contribution of organic fertilizers to enhancing microbial population development may improve our ability to move more rapidly toward a stable ecological system in these sand-based turf stands.
Recent reports of experiments with carbohydrate (sugar)-based fertilizers to enhance microbial activity [T. Parent, *Golf Course Management* March 1996. pp. 49-52] reflects the active interest in the industry with respect to enhancing soil microbial function. While we don't have a clear scientific picture of the nature of responses to such management approaches, there is clear potential for a simple management strategy to exert a significant impact on the turf root ecosystem.

- biologicals - A survey of recent turf industry publications will reveal an increasing number of "biological" products for fertility management, as well as disease and pest control. While I suggest some caution in assuming that all such products will necessarily live up to their effective turf production. Research scientists and industry partners are taking a more active role in trying to develop appropriate products to work in conjunction with natural ecological processes, rather than to compete with them. In the intensively managed sand-based profile, this type of ecosystem management will help to create an enhanced rhizosphere environment which will contribute to overall plant health and a more robust turfgrass ecosystem.

The turf management world is changing. Increased regulation, increased emphasis on "natural" turf management, and the continuing pressure of maintaining turf to the (often) unrealstic expectations of user groups make the manager's task a challenging and, at times, unenviable one. Broadening the focus of our management attention to include the root/rhizosphere ecosystem will not necessarily make that task any easier, but it will play a significant role in the development of sustainable turfgrass ecosystems.

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[2] Pacific Turfgrass Research Program, Department of Plant Science, The University of British Columbia, Vancouver, BC, Canada


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Managing Turf for Minimum Water Use

By Richard J. Hull, University of Rhode Island

Available water is rapidly becoming one of the least reliable resources needed to maintain high-quality turf. Municipal water supplies frequently become over taxed during periods of drought and landscape uses often are assigned a low priority. Even in suburban and rural areas, water supplies used to irrigate turf are limited and are in competition for use by agriculture, recreation, industrial and commercial enterprises. It is clearly in the best interest of the turf manager to conserve water whenever possible and to design irrigation programs which provide quality turf with minimum water use.

The conservation of water while maintaining quality turf is something of a contradiction. Grass uses water and healthy vigorous turf uses more water than a thin sickly turf. So, how can the turf manager conserve water aside from avoiding waste through runoff or leaching? Research conducted over the past 15 years has provided a scientific basis for analyzing water use by turf and for modifying management strategies to reduce water consumption without compromising turf quality. This article will consider some of this research and its possible application by turf managers to achieve greater efficiency in water use.

Water Use Efficiency:
How much water does turf need? Most textbooks on water use by crop plants make mention of water requirements. This is the amount of water used by a plant to make a unit of plant tissue. Often water requirement is expressed as kilograms (kg) of water used per each gram (g) of plant produced. Given such a value, one could estimate the water required to maintain a crop of known production rate. In terms of turf, one could estimate water needs if the clipping production rate were known.

There is of course a fundamental problem with the concept of water requirement. This is evident from the data presented in Table 1. The cool-season grasses experienced a 29% increase in their water requirement when grown in a dry climate compared to humid conditions. The warm-season grasses experienced a slightly larger 35% increase in water requirement when dry and humid conditions are compared. Obviously, there is no true water requirement involved here but simply the quantity of water lost by the plant during the time needed to produce a gram of dry matter. Because more water is lost per hour under dry conditions than under humid, a different amount of water would be lost while the plant synthesizes a gram of dry matter under differing humidities.

The difference in water requirement between cool-season and warm-season grasses also makes one question the importance of this value. Cool-season grasses use about three times more water while producing a gram of dry matter than do warm-season grasses. This difference between grass types remains relatively constant even when atmospheric humidity levels are varied (Table 1). Warm-season grasses are more efficient in fixing carbon dioxide (CO_2) from the atmosphere than are cool-season grasses for reasons explained in an earlier article (Hull, 1996). Again, water use is determined by the time required for enough CO_2 to be fixed to make a gram of plant not by any inherent fixed relationship between plant growth and water usage. This lack of a strict relationship between water use and plant growth is fortunate for the turf manager. It means that measures taken to minimize water use may have no effect on the growth or performance of turfgrasses. This is even more the case for turf management than for field crop production because dry matter accumulation is much less important in turf culture than it is where a large crop yield is the major criterion of success. Most turf managers will experience little grief if their turf produces fewer clippings and less thatch. Thus, managing turf for minimum water use can be a goal with little concern over undesirable side-effects. The only possible area of concern might be heat build-up in the turf and that will be considered later.

Evapotranspiration:
The process of water loss from turf or any plant community is called evapotranspiration (ET). It consists of two elements:
evaporation of water from the soil surface and transpiration of water from leaf and stem surfaces. In a dense turf, little if any soil is exposed to the atmosphere so soil evaporation is a minor component of water loss; most water loss results from transpiration. Therefore, reducing water use by turf comes down to minimizing transpiration. What controls transpiration from plants and by how much can it be

controlled? The basic physics behind transpiration and its role in plant function were recently discussed elsewhere (Hull, 1996). Briefly, water moves from regions of high water potential (concentration) to regions of low water potential. Plant tissues normally constitute a site of high water potential while the atmosphere normally has a low water potential. The magnitude of difference in water potential between two areas provides the energy for water movement and pretty much determines the rate of water loss.

TABLE 1

Water requirements of plants as influenced by atmospheric water content (relative humidity).**

Plant	Plant type*	Water requirement Humid air	Dry air
		g water/g dry matter	
Wheat	c-s	826	1052
Barley	c-s	758	1037
Rye	c-s	875	1100
Rice	c-s	585	743
Average		**761**	**983**
Millet	w-s	267	386
Sorghum	w-s	223	297
Corn	w-s	210	263
Average		**233**	**315**

*c-s = cool-season grass, w-s = warm-season grass
** Based on data reported by Levitt (1980)

That explains the difference in water use between humid and dry conditions presented in Table 1. When the air is humid, the water potential gradient between grass leaves and the atmosphere is not so great and the energy driving transpiration water loss is less. This translates into a lower rate of water loss. By contrast, dry air presents a large water potential difference between leaf tissues and the atmosphere, much diffusive energy is available and water loss rates are large. Consequently, turf managed

TABLE 2

Evapotranspiration rates of cool- and warm-season turfgrasses grown in the field in the eastern and western U.S.

Turfgrass	Grass type*	East	West
		mm water/day	
Ky. bluegrass	c-s	3.71	5.33
Per. ryegrass	c-s	3.71	6.44
Tall fescue	c-s	3.62	6.85
Average		**3.7**	**6.2**
Bermudagrass	w-s	3.12	5.06
St. Augustine	w-s	3.32	5.66
Zoysiagrass	w-s	3.52	5.66
Average		**3.3**	**5.4**

1 (RI) Aronson et al. 1987 4 (NB) Sheaman 1989
2 (GA) Carrow 1995 5 (NB) Kopec et al. 1983
3 (NB) Sheaman 1986 6 (TX) Kim & Beard 1988
*c-s = cool-season grass, w-s = warm-season grass

in an arid climate will always experience greater ET rates than the same turf grown where humidity tends to be higher.

This effect of humidity on water losses from turf is evident if you compare ET rates reported from the humid eastern U.S. with those from more arid western states (Table 2). Water loss rates in the western states (Nebraska and Texas) were 68% and 64% greater than those reported from eastern states (Georgia and Rhode Island) for cool- and warm-season grasses, respectively. Using a larger data set than presented in Table 2, cool-season grasses were found to lose 75% more water in the west than in the east while warm-season grasses grown in the west lost 46% more water than eastern grown grasses. These grasses were grown under comparable conditions where water was not limiting, so the principal differences in ET between east and west were relative humidity, solar intensity and prevalence of wind. All these factors strongly influence transpiration rates as we shall see shortly.

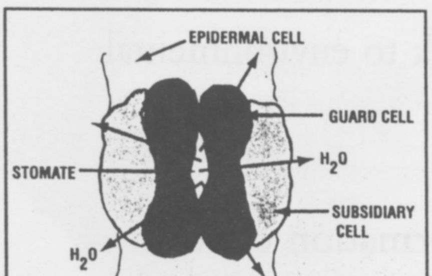
It is also evident from Table 2 that differences in ET among grass species were much less than differences between climatic conditions. Variation among species growing in the humid east was 3% for cool-season grasses and 13% for warm-season grasses. Under drier conditions, variation among cool-season grasses was greater at 28% but remained the same for warm-season species at 12%. This suggests that genetic variables influencing ET rates may be expressed more clearly under conditions which favor greater water loss. Put another way, environmental conditions influence water loss due to ET more than morphological or physiological properties of the grass.

A marked difference between cool-season and warm-season grasses was not evident under eastern conditions. The greater ET rates for cool-season grasses as reported by Beard (1973) were expressed more when grasses were growing under conditions favoring high water loss. In the east, cool-season grasses lost 3% more water to ET than did warm-season grasses (based on a larger data set than presented in Table 2). However, under dry western conditions, cool-season grasses transpired 23% more than their warm-season counterparts. It appears that when cool-season grasses are grown outside their natural climatic range, they compensate for the hot dry conditions by transpiring more water.

Stomates and Their Function: Leaves do not transpire throughout their surface. Most of the leaf is covered by a waxy cuticle which seals the leaf and resists water loss.

However, since gas exchange with the atmosphere is essential for normal leaf function (photosynthetic CO_2 influx & O_2 efflux), openings in the leaf surface must be provided. These openings result when specialized epidermal cells (guard cells) become turgid and form an opening called a stomate (Fig. I). Stomates provide an avenue by which the leaf interior spaces can exchange gases with the atmosphere. Stomates form in the morning light when guard cells accumulate potassium ions (K+) from adjacent subsidiary and epidermal cells. These ions, along with various organic anions (malate-2) synthesized within the guard cells, reduce the water potential in these cells so water flows into them from surrounding cells. This "blows up" the guard cells causing a stomatal pore to form between them (Fig. 1). It is through these pores that gases, including water vapor, move between the leaf and its surrounding atmosphere.

Figure 1: Stomate



In the evening twilight, the process is reversed and guard cells lose solute ions and water to surrounding cells, they become "deflated" and the stomate closes. Thus, gas exchange between leaves and atmosphere occurs in most plants primarily during the daytime. Leaves lose water mostly when stomates are open which is why transpiration occurs mainly during the day.

When plants are subjected to drought stress, the guard cells may be unable to reduce their water potential below that of surrounding cells; they lose water, become flaccid and the stomate closes. This frequently occurs during the heat of mid-day and is a common way for the plant to reduce water loss when transpiration exceeds the rate of water delivery from roots (Hull, 1996). Even when soil water is abundant, midday transpiration may be so great that guard cells lose turgor, stomates close and gas exchange between leaf and atmosphere is suspended for a few hours. This conserves water but it also impedes photosynthesis and causes leaves to heat.

Water conservation in turf management comes down to reducing transpiration but not stopping it. After all, transpiration serves two valuable functions. It provides a water stream by which nutrients absorbed by roots are carried to the stems and leaves where they are needed to support growth and cell function. Also, the evaporation of water from the surfaces of cells within a leaf draws heat from the leaf causing it to cool or at least not become as hot as it would if water was not being lost. The temperature difference between turf and an adjacent asphalt drive on a bright day offers some idea of the cooling caused by ET. There are also good physiological reasons why it is desirable to prevent grass from becoming too hot.

While transpiration from turfgrass is essential, it may be reduced without causing harm to the plants and thereby conserve water. However, reducing ET is easier said than done. To attempt an ET reduction, it is important to understand those factors which contribute to or regulate water loss from leaves.

Factors Controlling ET:
Since transpiration depends on the water potential gradient between the interior of a leaf and the surrounding atmosphere, anything which tends to reduce the size of that gradient will lower transpiration rates. The interior spaces of a leaf are surrounded by wet cell walls so the air in the leaf is assumed to be saturated (100% relative humidity). Based on that assumption, the water potential gradient between leaf and air is always directly proportional to the prevailing relative humidity of the atmosphere. There is not much a turf manager can do to change the basic physics behind water evaporation but anything which holds a layer of humid air over a leaf surface will lower the water potential gradient and reduce the ET rate. So, while the water potential difference between a wet leaf and dry atmosphere is beyond control, the distance over which that gradient is extended can be managed. Several factors are involved.

Boundary Layers:
Surrounding a leaf or any object suspended in the air, is a layer of air that is largely unstirred. This layer results from attraction of air molecules to molecules of the leaf surface. Such attractions are not

strong but they do reduce the motion of air molecules (kinetic energy) creating a zone of still air called a boundary layer. The thickness of this layer depends upon the amount of air turbulence (wind) and the presence of protuberances from the leaf surface which further reduce air movement. An uneven cuticle surface or leaf hairs or ridges all tend to increase the thickness of boundary layers.

The significance of leaf boundary layers becomes evident if you remember that the steepness of the water potential gradient between the saturated leaf interior and the adjacent atmosphere determines the rate of water loss. This gradient operates at open stomates and that is where a boundary layer plays its role. When molecules of water vapor exit a stomate, they increase the humidity of the atmosphere immediately surrounding the stomatal opening. The more humid that boundary layer of air becomes, the more the water potential gradient is reduced. Therefore, the thicker the boundary layer, the more humidity it will retain and the more it will "insulate" the stomatal pore from additional water loss. In theory, if the leaf boundary layer became saturated (100% relative humidity) there would be no net diffusion of water vapor through a stomate and there would be no transpiration.

Of course, so long as the atmosphere is not saturated, the boundary layer will lose water to it and water vapor molecules will diffuse through the stomates; there will be measurable transpiration. Thus anything that increases the boundary layer of a leaf will tend to reduce the rate of transpiration.

Canopy Resistance:
Grass stand factors that contributed to thick boundary layers and reduced ET rates are collectively termed canopy resistance. The term implies that water lost by ET encounters several resistances as it passes through and exits the turf canopy. Kim and Beard (1988) evaluated 12 turf-grasses for ET rates and related those rates to six morphological characteristics of the grasses. They found that ET rates were depressed by high shoot density and relatively horizontal leaf orientation. Both of these properties would restrict air movement within a turf canopy, promote thick boundary layers around the leaves and reduce ET. Individual plants having a low leaf area caused by a slow vertical leaf growth rate and a narrow leaf texture also contributed to reduced ET rates.

An earlier study by Feldhake et al. (1983) was consistent with these findings. They noted a 15% increase in ET from grass mowed at two inches compared with grass mowed at 0.75 inches. The higher cut would expose more leaf surface to the air and promote greater transpiration rates. Monthly applications of nitrogen fertilizer also increased ET by 13% over turf fertilized once in the spring. The additional nitrogen would stimulate leaf growth rate and that is positively correlated with greater ET. Mowing height and nitrogen fertilizer also can influence drought avoidance through their impact on root growth as we will show later. Evapotranspiration increased linearly with solar radiation (light intensity) due to the greater energy available at high light to evaporate water.

A clear connection between leaf extension rate and ET has not always been observed. Beard et al. (1992) failed to find a significant relationship between leaf growth rate and ET for 24 well-watered bermudagrass cultivars. Significant differences in both ET rates and leaf growth were observed but no correlation between the two was evident. Green et al. (1991) also did not show a correlation between leaf growth and ET for 11 zoysiagrass genotypes or for ten St. Augustinegrass selections (Atkins et al. 1991). On the other hand, Shearman (1989) found a strong correlation between rates of ET and leaf extension for 12 perennial ryegrasses. Similar correlations have also been found between other measurements of shoot growth and ET rates for tall fescue (Bowman and Macaulay 1991).

It may be that leaf extension rate of stoloniferous warm-season grasses does not have the same effect on turf canopy architecture as it does for bunch type cool-season grasses. In any event, abundant evidence supports the idea that ET rates are influenced by canopy resistance factors and these can be influenced by management.

Drought Avoidance Through Water Acquisition:
While reducing turf ET is one way of using water more efficiently, an equally important approach is to use all the water available. The upper one to two feet of soil contains most of the water available to turfgrass plants. That water is only available to the grass if its roots can reach it. Consequently, any management practice which will increase root growth should also en-

able turf to avoid drought stress between rain events or irrigations. In an earlier TGT article (Hull 1996), we discussed turf management strategies which promote root growth. The extent and health of turf roots clearly are influenced by mowing, fertilizing, pest management and other management variables. What may not be as evident is the connection between rooting patterns and water use efficiency. The criterion most commonly used to evaluate root effects on water use is the avoidance of drought injury when water is withheld. Leaf firing and wilting are early signs of drought stress and the time interval after water withdrawal when these symptoms appear is an indication of drought avoidance. Obviously such a measure integrates all water use efficiency factors including root properties but, when drought avoidance time is correlated with individual plant measurements, it is possible to determine which contributes most to the delay in drought symptoms.

In a recent report, Carrow (1996) evaluated six tall fescue cultivars and found drought resistance was linked most with late summer root length density (cm of root per cm^3 of soil) in the eight-inch to two-foot soil depth. Late summer total root length also contributed to drought resistance and ET variation was the third factor. In other words, drought resistance in tall fescue, which is in fact mostly drought avoidance, was enhanced most by the maintenance of an extensive functional root system and variations in ET played a secondary role. A similar study from Arizona (Marcum et al. 1995) investigated 25 zoysiagrass cultivars and species and attempted to correlate rooting characteristics with drought resistance. They too found that average maximum root depth, total root weight and number of roots in the eight-through sixteen-inch soil depths were all positively related to turf performance under deficit irrigation. Again, those plants, that maintained a root system which effectively mined the soil profile for available water, were able to avoid drought stress and maintain acceptable turf even under irrigation scheduling that did not replace potential ET.

The amount of root produced by turf-grasses is basically controlled by the genetic potential of the plants, but these are strongly influenced by environmental conditions including management practices. The ability of a turfgrass to sustain an effective root system throughout the heat of summer is critical to drought resistance and efficient water use. Warm-season grasses have less trouble maintaining summer root growth but cool-season grasses normally lose a large portion of their roots during the hottest summer months. Proper management can ease this problem but not prevent it. Thus cool-season grasses invariably become more drought sensitive and less efficient in water use as the season progresses due primarily to a declining root system.

Soil conditions can play an important part in determining drought resistance of turfgrasses. A plant may be genetically disposed to producing a deep root system but if the presence of toxic elements or an impenetrable soil restrict root growth, the potential for drought resistance may never be realized. Carrow (1996) evaluated drought resistance in seven turfgrasses common to the southeastern U.S. These were grown in an acid soil of high density (high soil strength) and rated for drought resistance and rooting characteristics. He found that those grasses which tolerated the hostile soil conditions and produced a deep root system (Tifway bermudagrass & Rebel II tall fescue) exhibited greater drought resistance than grasses which experienced root suppression (Meyer zoysiagrass & common centipedegrass). Under the conditions of this test, Meyer zoysiagrass produced only 4% of the root length density observed in Tifway bermudagrass. This did not agree with results from root column studies where grasses were grown in sand or clay granules, a near ideal rooting medium. Consequently, when managing turf for efficient water use, the entire system must be considered. The soil environment may be as important in determining water use as the grasses selected or the management employed.

Irrigation for Optimum Water Use Efficiency:

The findings discussed above have been utilized to design irrigation practices which maximize water use efficiency while preserving high-quality turf. One principle on which these programs are based is discussed and illustrated by Aronson (1986). As the soil dries following the withholding of water, the ET rates remain relatively constant for the first eight days after which they decline rapidly for another eight days when they level off prior to their final decline which results in serious injury or death.

Grasses vary in the time when ET decreases. Chewings fescue maintained its water-sufficient ET rate 2-3 days longer than Kentucky bluegrass probably reflecting its somewhat lower average ET rate and more conservative use of water.

More importantly, the period of initial decline in ET causes no injury to the grass if water is restored before ET drops to less than half its normal rate. That means irrigation can be delayed for several days after ET rates begin to decrease with no damage to the turf. In short, irrigation scheduling can be set to apply less water than ET models would predict was lost. Basing irrigation, not on anticipated ET but rather on soil moisture potential, allows a savings of from 1/4 to 1/3 the water normally applied. This approach has been used successfully in most climates and is easily adapted to computerized automated irrigation systems. Irrigation is called for by tensiometers installed in the soil which activate the system whenever the soil moisture potential drops below a preset point. Irrigation is set to deliver only about 2/3 of the water which would have been lost through ET from well watered turf. In this way, the turf is maintained much of the time under mild drought stress. Mild drought stress actually makes turf more drought resistant because stressed roots send hormonal signals to the shoots causing growth to slow and transport to roots of photosynthetic products (sugars) to increase (Hull, 1996). This promotes root growth especially deep rooting because growth is stimulated in those roots which have most water available (deep roots). Thus deficit irrigation scheduling not only conserves water, but it promotes a turf that is better able to avoid drought stress.

The turf manager clearly is not at the mercy of water suppliers. Significant water conservation can be practiced which may result in as much as a 50% reduction in water use without compromising turf quality. To practice water conservation turf management effectively, it is good to be familiar with the principles, both physiological and agronomic, on which such management is based. This I have tried to do here, but more comprehensive discussions are available in some of the references cited below and in technical publications available from irrigation system suppliers. References cited are listed below.

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HEAR TODAY....GONE TOMORROW

By Hollie L. Bahen, M.S. Audiologist

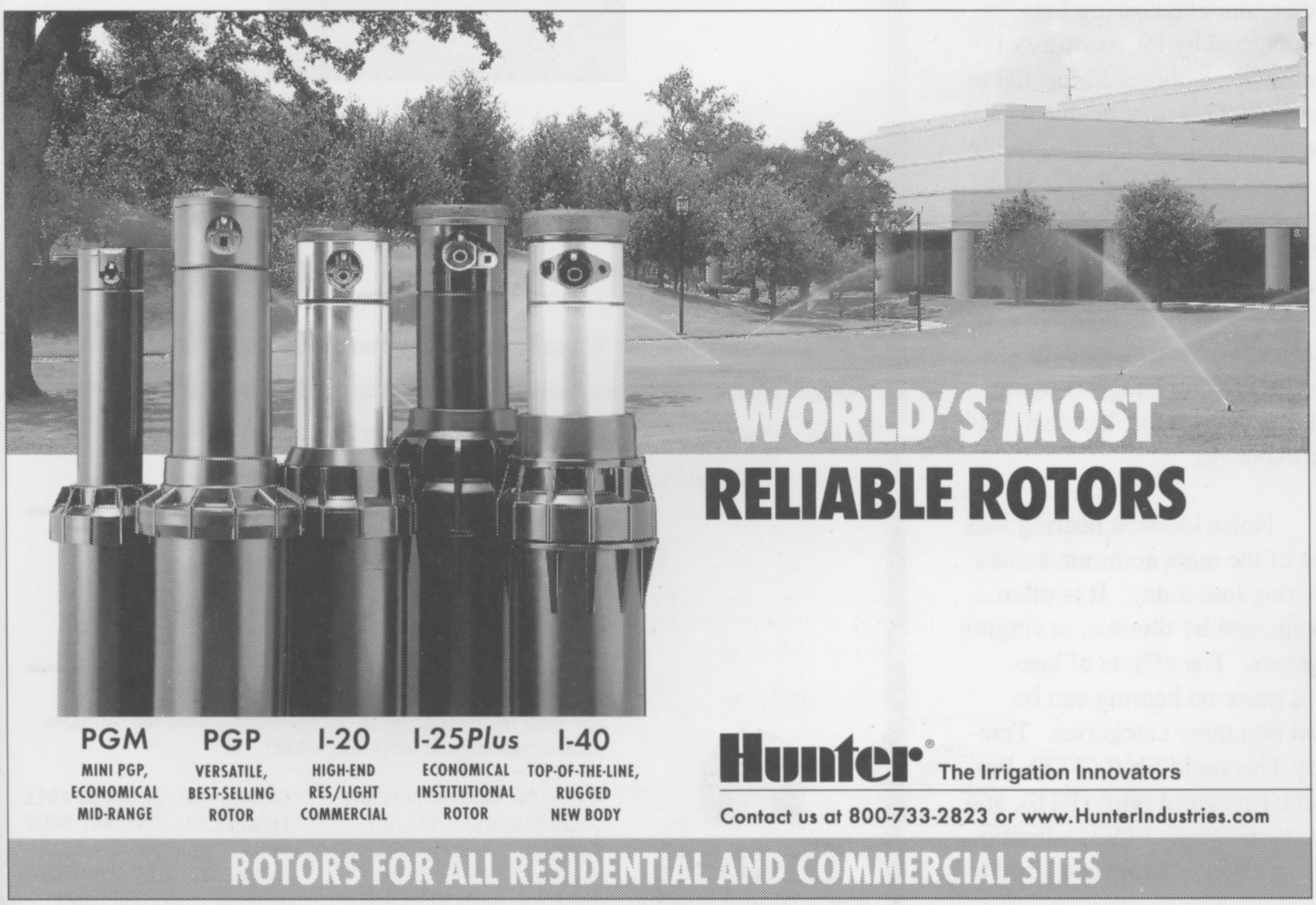
We've all heard the saying, "You don't know what you've lost until it's gone." This certainly holds true with hearing loss. Hearing is often taken for granted. The progression of most hearing loss is gradual and therefore not noticed until the loss is severe, especially if the hearing loss is induced by exposure to hazardous noise. Unfortunately, once the hearing is gone, the only treatment for noise induced hearing loss is management through the use of hearing aids. The good news is that many types of hearing loss, specifically noise induced hearing loss, can be prevented.

Noise exposure has become one of the most common complaints and health hazards in industry today, the turf industry is no exception. Not only can noise exposure cause permanent hearing loss, it has also been known to effect other aspects of daily performance. For example hazardous noise can cause interference with speech communication, interruption of concentration, and even decrease of task performance. There is also Physiologic links to stress, fatigue, and headaches. With proper hearing protection and awareness of the effect of noise can have on hearing, permanent noise induced hearing loss can be avoided.

Prevention begins by implementing a Hearing Conservation Program (HCP). This is an easy way for both employer and employee to monitor and protect themselves from unnecessary hearing loss or future litigation as a result. The first step in any Hearing Conservation Program (HCP) is to identify the source of hazardous noise, if any. This may be as simple as observing the work environment and asking a few questions. Do you have difficulty communicating while in noise, or do you have to raise your voice for someone to hear you? Do you experience ringing in your ears (tinnitus) after working around the noise? If any of these things happen you should have a HCP. Noise surveys/analysis may also be performed to evaluate if the levels of noise present are at hazardous levels. Through the use of sound level meters and dosimeters, measurements can determine if the noise levels exceed those allowable by OSHA. OSHA guidelines recommend protection against effects of nose levels that exceed 85 decibels(dB) over an hour TWA (time weighted average) day. A decibel is a logarithmic ratio of sound pressures or powers. It is used to define what is perceived as loudness of sound. For example, in the turf industry, a mower can reach 90-95dB, chippers and leaf blowers can reach 105-110dB. Following OSHA guidelines, these levels are potentially hazardous without proper hearing protection. To determine an individuals noise exposure, a dosimeter can be worn. This small recording device can be placed on the collar or hat of a worker to determine the exposure for a sample period of time. Some areas of activity may routinely exceed the OSHA allowable sound levels, whereas others may fall significantly below the regulations.

Once it is determined that hazardous noises are present in the work place, the second aspect of the hearing conservation program is to control or abate the noise. This can be achieved through engineering controls or redesign of equipment. This is the most effective form of control because it eliminates the noise at the source. Unfortunately this may be costly and often technologically not feasible. Therefore administrative controls can be implemented. This can be achieved through rotation of employees through the noisy areas, periodic breaks, and modification of employees schedules. These options may not be feasible either due to employee training or schedules. This leads to perhaps the most simple aspect of a HCP, hearing protection devices and audiometric testing (Audiograms).

The monitoring of hearing and the use of hearing protection involves active participation from both the employee and employer. Routine hearing tests, (audiograms), should be performed annually. A baseline hearing test should be included with pre-employment physicals or on the date of hire and then repeated each year. An annual audiogram will monitor the employees hearing indicating whether or not hearing loss is present and if so what degree and



what type of hearing loss exists. The ear is divided into three parts, The outer ear is the most visible portion of the ear and consists of the Pinna, the ear canal and the ear drum. The second part is the middle ear which holds three tiny bones called the ossicles. The inner ear includes the cochlea. This is a fluid filled, snail like structure that houses the hair cells that transmit messages to the nerves and the brain. There are approximately 15,000 hair cell in the cochlea. When they are damaged, the sound cannot be transmitted to the nerves properly. Once these hair cells are damaged they do not regenerate and the result is permanent hearing loss.

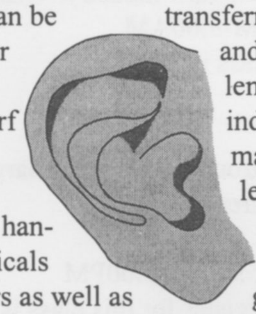
There are two basic types of hearing loss. The first type is called conductive hearing loss. This is caused by the inability of the sound to easily reach the nerve of hearing. This may be due to wax in the ear canal, fluid in the middle ears, or perforated ear drum. The second type of hearing loss is sensorineural hearing loss. This is caused by damage to the cochlea hair cells and is permanent loss. Sensorineural hearing loss may be the result of such things as aging, ototoxic medications, heredity, and noise exposure.

Noise induced hearing loss is one of the most common causes of hearing loss today. It is often accompanied by tinnitus, or ringing in the ears. The effects of hazardous noise on hearing can be placed into three categories. Temporary Threshold Shift (TTS), Permanent Threshold Shift (PTS), and Acoustic trauma. TTS is a temporary reduction of hearing caused by noise. It is usually short in duration and the hearing will usually return within ½-1 hour. This commonly occurs when leaving a concert or after using heavy equipment. However, repeated temporary threshold shifts result in permanent shifts, or permanent hearing loss. PTS occurs with repeated exposure to high intensity noise for many years. It is not possible for the hearing to recover as it does in TTS. Acoustic trauma is a single, high intensity event, such as an explosion, that results in permanent hearing damage. The intensity level exceeds the capacity of the ear structure and causes a break down of the system. The middle ear may suffer damage to the ossicles or possibly a ruptured ear drum.

Audiograms are a method of monitoring hearing and can identify when TS and OTS occur. An audiogram measures the employees ability to hear different tones or pitches as well as how loud the sound had to be for it to be heard. Noise induced hearing loss typically effects the high frequencies most significantly. This becomes essential in speech communication since most consonants are predominantly high frequency. The consonant sounds are responsible for providing the differentiation of words and their meaning, for example. "mouth" versus " mouse". If you were to incur a high frequency hearing loss, it would become very difficult to hear the subtle differences between these words. It also makes listening in noisy or group environments very difficult.

In addition, it is important to recognize recreational hazardous noise. Many employees incur hearing loss from other sources of noise away from the job, such as military experience, previous employment, hobbies, hunting or heredity. Without a baseline audiogram and annual audiograms, it is not possible to attribute the loss to any other source which leaves the liability with the current employer if no previous evaluations are available. Baselines and annual audiograms are a way to protect both parties should there ever be a question as to liability. Every employee should also be aware that he or she has the right to access his or her records and any sound surveys as specified in WAC-296-62-09041. In today's litigious society it is important for both the employer and employee to be aware of his or her rights.

Once you have established annual monitoring of the hearing through audiograms, it is crucial to wear hearing protection to reduce the effects of the noise and possible damage to the hearing. There are two types of protection available, ear plugs and ear muffs. There are advantages and disadvantages to each type. It is important that employees be provided with options in order to find a type most beneficial for their needs. Ear plugs can be small foam, rubber or even custom fitted. They must be inserted correctly or they are not effective. They tend to be comfortable, convenient, and cost effective. However, they can pick up dirt or grease that can be transferred to the ear and cause problems. In the turf industry this may be a problem when handling chemicals and fertilizers as well as grease from the equipment. Plugs are often difficult for supervisors to see for monitoring effective use. Custom plugs can be obtained and are available in multiple color combinations that may allow for easier visualization by supervisors. Custom plugs also tend to be more comfortable, but cost may be a concern depending on the number of employees. Muffs are also popular and effective for reducing noise. They tend to be one size fits all and can be easily seen for monitoring purposes. Some muffs are incorporated onto hard hats which may serve a dual purpose for safety. Muffs are generally more expensive than plugs which may also be a cost issue. When working in warm environments muffs may be uncomfortable and can be bulky or cumbersome when working in small environments. They are not as easily stored or carried as plugs. No matter what type of hearing protection is provided, it is imperative that the employees have training on use and insertion. The best hearing protector is one that is worn and worn properly. Employees should also be encouraged to wear their hearing protection outside of work for noisy activities or hobbies such as hunting. Woodworking, power tools etc.



It cannot be stressed enough how important it is to protect hearing. Once you have sensorineural hearing loss, there is no cure. Once it's gone, it's gone and the only "cure" is to manage the hearing loss with a hearing loss with a hearing aid. Hearing aids have made great advances in their technology but there is still not one to replace normal hearing!

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EDMONDS COMMUNITY COLLEGE
Edmonds, Washington
SUMMER SCHEDULE
TURF MANAGEMENT\GREENKEEPING

HORT 255 TURF ID & CULTURE

Identify turf grasses commonly used for Pacific Northwest golf courses, sports fields and residential settings. Understand the cultural practices which are best suited for each variety.

1919 T 0.5 Michels, B HRT 107 Sat 8:00AM-1:00PM One Day Only
Meets 7/12/97 The last day to register for this class is 7/11/97

HORT 255 REVNOVATION OF TURF AREAS

Renovation of sports fields, residential and commercial sites and other turf areas. Guest speakers
1940 W 1.0 Michels, B HRT 107 Sat 8:00AM-5:00PM One Day Only
Meets 8/9/97 The last day to register for this class is 8/8/97

HORT 255 TURF AND IPM

Integrated post and plant management geared to the turf industry. WSDA Re-certification credits pending
1947 V 1.0 Michels, B HRT 107 Sat. 8:00AM-5:00AM
Meets 7\26\97 The last day to register for this class is 7/25/97

HORT 289 LARGE SCALE IRRIGATION

Broad overview of the design, maintenance, and troubleshooting of large scale irrigation systems and the importance of water flow and drainage systems to large turf areas.

1954 S 3 HRT 109 Thurs 5:00PM-9:00PM
Meets beginning 6/26/97 The last day to register for this class is 6/20/97
For more information on these class offerings, call 206/640-1739.

CENTRAL OREGON COMMUNITY COLLEGE - LANDSCAPE & TURFGRASS MANAGEMENT PROGRAM

Dave Wienecke, Central Oregon Community College, states that COCC offers a 2-year degree with academic study based on the program offered at Michigan State University, which has turned out high quality superintendents. The program has high academic standards.

This coming fall, Dave says, COCC is planning to offer a new professional golf management program for business operations. COCC has a GCSAA student chapter and internships are available through the Landsacpe & Turfgrass Management Program.

A listing of Fall classes will appear in the Summer issue of Turfgrass Topics.

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Through this partnership, Evergro will offer customers an expanded line of products and a team of turf professionals committed to providing the most advanced products available. At Evergro's new 18,000 sq. ft. warehouse and showroom in Woodinville, Washington, customers will have a one-stop location for all their turfgrass needs. Customers can contact one of Evergro's inside sales specialists at 206/486-6387 or 1/888-383-7476.

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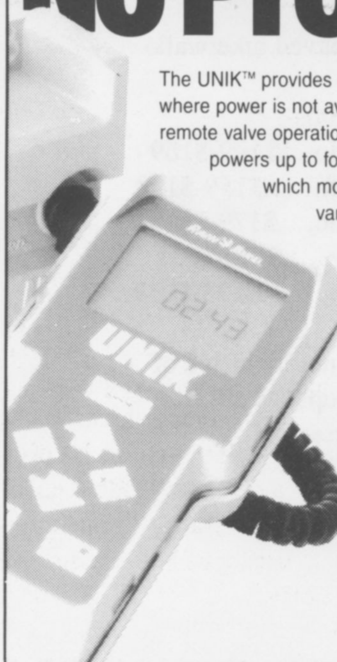

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GCSA that has been held, according to many. Significant changes are on the horizon!!

We want to publicly thank the Washington State Golf Association for the first installment of their 1997 contribution to the T.U.R.F. program in the amount of $35,000. We look forward to a long synergistic relationship with the WSGA.

The Washington Junior Golf Association's 1997 membership application reads, in part …"1 dollar of your dues goes to support Northwest Turfgrass Research.." Their first installment in the amount of $1,000 is greatly appreciated and we thank the Junior Golfers in Washington for their support.

The 51st Northwest Turfgrass Association Conference at Sunriver Resort will be a major topic in the Summer Issue of *Turfgrass Topics*, scheduled to be in your hands by late July-early August. Sunriver has always been a favorite conference site for NTA members. Some Sunriver amenities include:

- 3 - 18 hole golf courses - The Roy L. Goss Tournament for Research will be held at Crosswater, the *1995 Golf Digest Best New Resort Course*, designed by Bob Cupp and John Fought.
- More than 30 miles of paved bike/walking paths
- Lodge Village guest rooms-
    - 2 bedroom Condo….$149-$169
    - 2 bedroom w/loft…....$159-$179
    - 3 bedroom Condo….$179-$205
    - 3 bedroom home…..$195-$225
    - 4 bedroom home…….$235-$259

    The rates above are not inclusive of the current 12% occupancy tax and local recreation assessment.
- Canoeing
- Horseback riding
- Tennis - 29 Courts

The 51st Conference Program will include presentations by:

- Peter Landschoot, Ph.D., Pennsylvania State University, "Shedding Some Light on Anthracnose Basal Rot" and "Using Compost to Improve Turf Performance"
- Paul Backman, M.A., new Research Assistant, Washington State University, Puyallup
- John Bodenhamer, Executive Director, Pacific Northwest Golf Association and Washington State Golf Association.
- Bob Shearman, Ph.D., University of Nebraska, Executive Director, National Turfgrass Evaluation Program (NTEP), "NTEP Now and In The Future" and "Managing Intensively Trafficked Turfs"
- New Washington State University Researcher (Dr. Stan Brauen's replacement)
- Gwen Stahnke, Ph.D., Washington State University
- Tom Cook, Associate Professor, Oregon State University
- Bob Cupp, Cupp Design, designer of Pumpkin Ridge and Crosswater golf courses
- Larry Gilhuly, Western Director, USGA Green Section
- For the Ladies' program and entertainment, Dr. Larry Helms returns

And much, much more!!! Be looking for your Summer Issue of *Turfgrass Topics* with registration forms and more details.

I will leave you with a Quarterly Quote: "There is no use whatever trying to help people who do not help themselves. You cannot push anyone up a ladder unless he is willing to climb himself." -Andrew Carnegie

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Northwest Turfgrass Association
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