President's Message

ENVIRONMENTAL RESPONSIBILITY

By Bill Roberts

The May, 1986 issue of "Golf Course Management" magazine included an article entitled, "Personal Respiratory Protection: Developing an Effective Program." The June issue follows up with a piece devoted to "Personal Protective Clothing: Developing an Effective Program." Both are good, solid articles with timely information and reminders.

Around the first of May I received a call from Lois Latham. A public relations firm from Minneapolis was searching for a location to do some filming, the product to be a "pesticide safety training videotape" being developed jointly by the PLCCA, GCSAA and American Cyanamid. At the end of May we spent a 14 hour day "shooting" location footage. The "video" will be available later this summer. It is an effective, inexpensive piece of training material.

Diazinon registration has been or is about to be cancelled, effectively removing the product from the inventory of any professional Golf Course Superintendent. The focal or "flash point" of the EPA hearings on Diazinon was an alleged incident of abuse of the pesticide in an Eastern state. The alleged incident involved a golf course, a "Golf Course Superintendent" and approximately 100 Canadian geese. The geese are gone and so is that so-called "Golf Course Superintendent."

These instances are just a few examples of a very confusing climate that has been developing over the past couple of years. On the one hand it would appear that the golf course industry has "gotten the idea," to some extent, on the whole issue of proper pesticide usage and is beginning to act instead of reacting to every psuedo-environmental whim expressed at whatever level by whoever with usually a background in who knows what.

Training and education are available through trade magazines and other publications, through a variety of seminars, videotapes and so on. Of course we have all been through the Wisconsin Department of Agriculture, Trade and Consumer Protection Pesticide Certification Training programs. New golf course maintenance facilities are designed and built with the pesticide issue in mind; ventilated, segregated storage areas, appropriate waste removal efforts and so on. One would begin to think we had come a long way since Rachel Carson's *SILENT SPRING*.

But it would also appear that we have a long way to go when one begins to hear stories about "midnight dumping," going "after wildlife and waterfowl," "burying" old and unused materials. We've all heard those stories. And we all know that those activities are unlawful, unethical and, simply, irresponsible and have no place in our profession. Perpetrators should be aware that their actions are at their own risk and will receive no sympathy and even less support from the responsible segment of the industry.

The "bottom line" is that our position to date, both individually and collectively, has not been enough. Although we aren't reacting to the dictates of those who would eliminate our pest management tools any longer, we haven't stepped into the lead on this issue either. We need to go that extra length if we are to control our use of pesticides and, ultimately, our ability to produce the best playing conditions possible.

Among the steps to be taken in order to make a difference, I would suggest several that have already begun to evolve in the national forum including:

a.) support by Golf Course Superintendents to place any and all appropriate materials on EPA's "restricted list;"
b.) increasing educational opportunities for pesticide users, specifically staff members, even if it does cost a club a couple of hundred bucks more each year;
c.) support for enforcement of regulations governing the purchase, application and disposal of all pesticides;
d.) placing greater emphasis on Integrated Pest Management and more specifically defining economic thresholds before applications are made, and
e.) ultimately supporting that long-term research at the state and national level that will lead to pest tolerant turfgrasses.

It is our professional obligation to insure a safe, cost-effective and environmentally clean approach to pesticide usage. Abusers of pesticides have no place in our business but they will survive as long as we don't take charge. They will control our destiny as long as we hold back. Think about it. Let's talk about it. Isn't it time to get out in front?

Jottings From The Golf Course Journal

THE DOG DAYS

By Monroe S. Miller

It happens every year — summer arrives too soon and lasts too long. For some reason I foolishly put the thought of just how difficult they are completely out of my mind during the rest of the year. It's probably some sort of psychological defense mechanism — no person in his right mind could think of summers past and their attending frustrations on the golf course and still be a Golf Course Superintendent. A lot of my friends and neighbors think that it is really wierd that I have such a distaste for the months of July and August. To them, summer life is easier and they enjoy the abundant heat. Summer is a good friend to them; for us it is too often an enemy. They have their highest level of good feeling in the summertime; I am a real grouch on many of the days of summer. For them, summer is vacation time; when did any of you last take a summertime vacation with your family? It is swimming and picnic and camping time for them. It is their season of flowers and gardens. It is a time of baseball, softball and golf. It is a week in Door County, a weekend at Great America or a weekend at Wisconsin Dells. For us summer is a time of too much work, too much tension and too much worry. It is, in fact, anything but the "good ol' summertime." It is a period of abnormal existence, not only for us but for our families as well. And I cannot pretend that I like it all that much.

I did a little reading to try to find out why the hot days of late summer are called the "dog days of August." I guess I had never given it much thought before, and I just assumed they were so called because I always feel like most dogs look on hot days — tongue hanging out, panting and hoping to make it until sunset. It seems that the real meaning of the phrase comes from the Dog Star, Canicula. Back in Roman times the dog days ran from early July until the second week of August. That was a miserable season for them, a time when ponds stagnated, snakes went blind and dogs went mad. Star gazers, searching the sky for answers to the seasonal misery, found that Canicula was at that time in conjunction with the sun. There wasn't anything that could be done about the movement of the stars, so they simply said Canicula was to blame and urged Romans to make sacrifices to the star and to beware of the mad dogs. The gradual movement of the stars has shifted the dates of Canicula's conjunction, and now the dog days come in late July and August. My speculation on the origin was off the mark because the Romans were not as straight forward and basic in their derivations. I more readily relate to the American Indian name for the month of August — the month of the "Red Moon."

Summer days are so extreme on the golf course. Heat waves build and move in quickly and they stay for several days. The best we can hope for in July and August is a one-night respite of cool rain. Then another heat wave gathers force, sets in and looks for a golf course to victimize. How can anyone enjoy that?

There is really a more fundamental reason why I do not get very excited about summer, a reason that goes beyond the frustration and nervousness that hot days bring to all Golf Course Superintendents. It is something that I see in many of you, something that I sense when we visit at our summer meetings or during telephone conversations many of us have over the intervening days. Summer, especially those really difficult and trying ones, saps and drains off too much of the fierce energy of Golf Course Superintendents. I almost resent it. The unbounded enthusiasm that is manifest in energy directed toward and into our golf courses fades; a lot of our brashness is taken from us, leaving us somewhat different people than we are the rest of the year. The redemption is that in mid-August, as we begin the downhill side of summer, I see it returning in others and in myself. Fortunately we seem to recover quickly from the blinding ordeal that summers can be for us.

Maybe the secret to a more tolerable summer is learning to enjoy certain times and special features of the season. There is no doubt that a tough summer heightens our appreciation for the other seasons. Even winter doesn't seem quite so bad when it follows one of those summers that comes close to "doing in" a Golf Course Superintendent's golf course. For as long as I can remember I've always loved rain — farm fields need showers every bit as much as golf courses do — and when we go for two or three weeks, or more, without a good soaking shower, the one that finally parks over Madison isn't appreciated any more by anyone in the city than it is by me. I've also discovered a deep need for cloudy days and the shade they bring. Shade is a lifesaver for a host of animals, including man. It can really be a lifesaver for a Golf Course Superintendent and for the grass on his golf course. It is demonstrated by the fact that we wear hats, open the door and stay inside the house on a hot day, sit under a tree for a few moments or have canopies on our equipment. We are making use of both natural and man-made shade. I can remember driving to one of our monthly meetings last year. The sun was blazing down as I drove along a stretch of highway. A large moving shadow from a drifting cloud overtook the truck and I felt immediate relief and comfort. I stepped on the gas a little bit and for about ten miles I was able to ride under the awning that cloud provided. It sure was nice, and I am not at all certain that it would have occurred to me to try to stay under it if I didn't suffer in the summer heat and have the resulting love for shade. And I know for sure that I wouldn't have experienced the sense of a sudden lessening of the pressure of the midsummer heat if my daily work at this time of year wasn't so strongly influenced by the summer.

Yes, July and August are tough months.

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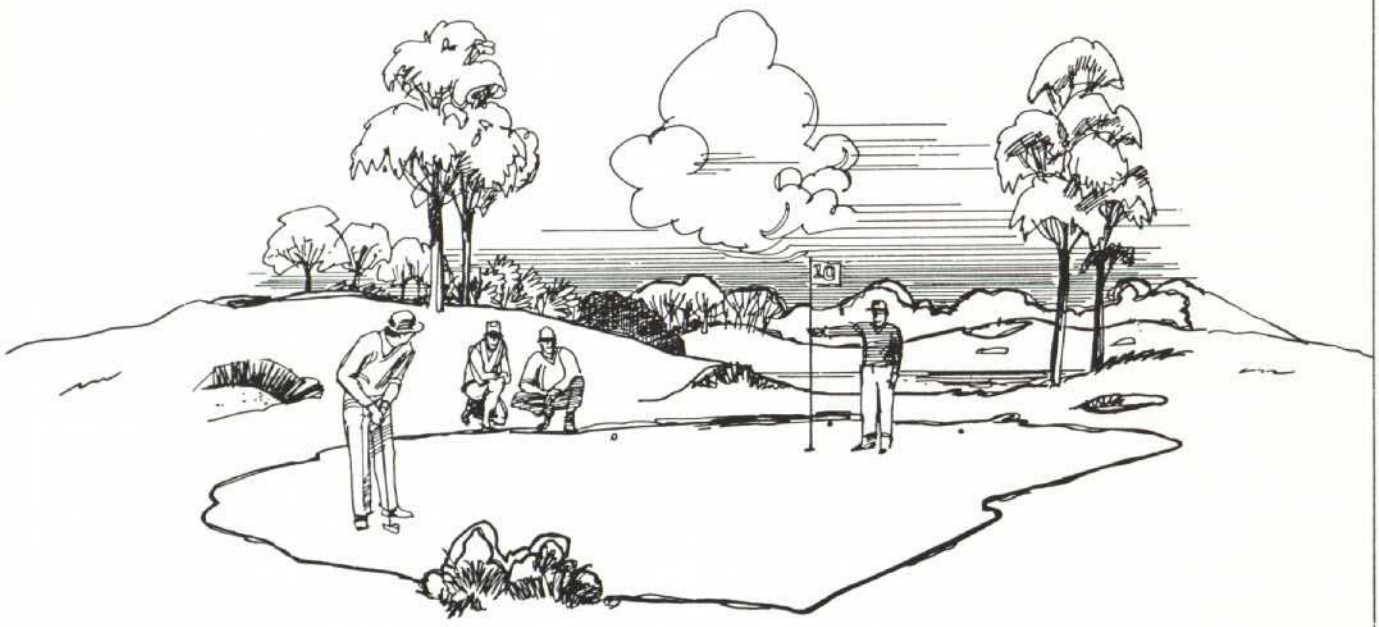

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Gayle L. Worf

GAYLE L. WORF: VAUGHAN-BASCOM PROFESSOR OF PLANT PATHOLOGY

R. E. Vaughan, namesake of the Vaughan-Bascom Professorship.

In 1984, James S. Vaughan and his wife Kay established an Endowment Fund with the University of Wisconsin Foundation for a Vaughan-Bascom Professorship in Plant Pathology in memory of R. E. Vaughan. James Vaughan's father, R. E. Vaughan, received his graduate training in the newly formed Department of Plant Pathology, at the University of Wisconsin. His graduate student stipend was from the Wisconsin Canners' Association. In 1914, he joined the faculty as Wisconsin's and possibly the nation's first extension plant pathologist. After Vaughan's retirement in 1949, Earl K. Wade became the next extension plant pathologist. The addition of a second extension plant pathologist occurred in 1963 when Gayle L. Worf joined the faculty.

The Board of Regents approved the appointment of Dr. Worf to Vaughan-Bascom Professorship in June 1984. In addition to the title, this professorship provides about $5,000/year for Dr. Worf to use to enhance his research and extension program.

Gayle L. Worf was raised on a farm near Garden City, Kansas and received his B.S. and M.S. degrees from Kansas State University in Agronomy and Plant Pathology, respectively. From 1955-1958, he served as County Agent in Ness County, Arkansas before returning to graduate studies at the University of Wisconsin. He completed his Ph.D. degree requirements in 1961 in Plant Pathology and accepted a position as Assistant Professor of Plant Pathology at Iowa State University. In 1963, he returned to the Department of Plant Pathology at the University of Wisconsin as Assistant Professor where he had extension responsibilities for all field and forage crops and certain ornamental crops. In time, assistance was provided to relieve him of direct responsibility for forage and field crops, and eventually his area of emphasis shifted entirely to turf, ornamentals and urban forestry. With current downsizing operations at the University of Wisconsin, Dr. Worf is again being asked to assume extension responsibilities for field and forage crops.

Professor Worf has provided exceptional leadership to the turf and urban forestry industry of the State. His research on turf diseases has lead to controls for snow mold and identification of the causal agent of necrotic ring spot as **Leptosphaeria korrae** rather than **Fusarium** as originally thought. In all of his activities, he has been sensitive to the needs of growers and will continue his commitment to the turf industry of the State.

PLANT DISEAS

USING THE SILVER BULLET TO GET TO THE ROOT OF THE PROBLEM

By Dr. Jo Handelsman

One of the greatest challenges of the plant pathologist is to quickly and accurately diagnose disease. We usually start with a sick plant that has some generic symptoms: brown, yellow or wilted leaves, stem lesions, rotting roots. . . . . .In all, not very informative about the causal agent. To identify the agent that is responsible for the symptoms, and prescribe an appropriate treatment, laborious microscopy, culturing, and plant inoculations are used. Often, the diagnosis takes days or weeks to complete. By then, the patient may be dead and may have spread the disease to its neighbors.

Imagine if, instead of these slow methods, we could simply drop the sick plant into a liquid, shake it up, and WHAMMO!!! the liquid would turn a different color depending on which pathogen was present. How quickly we could nip diseases in the bud with the right treatment if we could complete a diagnosis in a few minutes, instead of a few weeks.

Many plant pathologists are developing such rapid diagnostic methods. The major tool that we have available is the monoclonal antibody. This is an antibody, developed in a mouse, that has exquisite specificity for a particular plant pathogen—either viral, bacterial or fungal. Because of their high degree of specificity, monclonal antibodies have been dubbed, "Silver Bullets." In a diagnostic assay, if the silver bullet finds its target, then the assay mixture turns a characteristic color.

Monoclonal antibodies are made by an interesting process. Mammals contain an immune system that involves antibodies that recognize foreign invaders. If an animal is injected with a plant pathogen, it will mount an immune response to the pathogen. This will involve turning on the synthesis of antibodies in specialized cells called "B cells," which are present in the spleen. The problem faced by the plant pathologist is how to separate the antibodies against the plant pathogen from all of the antibodies in the animal. An ingenious solution to this problem was developed in the '70's. A group of scientists found that, instead of trying to purify the antibody, they could purify the individual B cells that produce the antibody of interest, since each B cell can only produce a single antibody. The B cells are fused with cancer cells so that they can be grown in culture in the laboratory. The fused cells secrete the antibody, which can be collected and used to assay for plant pathogens.

Monoclonal antibodies have been called the Silver Bullets for a variety of medical uses. They are being used to tag tiny packets of medicine that are delivered to particular cells in the body, such as cancer cells. By putting such an "address" on the medicine, it can be targeted to the cells of interest and won't go to other cells in the body that it might harm. Monoclonal antibodies are also used to detect miniscule amounts of proteins in the blood that can be indicative of diseases, abnormal conditions, or pregnancy.

Now it is time for the plant pathologists to use the silver bullets to diagnose diseases simply and rapidly. The tests may be so easy to perform that the grower could perform the diagnosis with a kit, and treat the disease accordingly. The next few years will bring exciting changes in the way that plant disease diagnosis is performed, and monclonal antibodies, the silver bullets of modern biology, will play an important role in these changes.

Editor's Note: Dr. Jo Handelsman joined the Plant Pathology Department last year as an Assistant Professor. A native of the metropolitan New York City area, Dr. Handelsman received a B.S. degree from Cornell in 1979 and a Ph.D. from the UW—Madison in molecular biology in 1983. She studies the genetics and biochemistry of specificity and the antagonism of bacterial pathogens.

THE STATE OF THE ART OF TURF DISEASE DIAGNOSIS OR IS THERE DISPAIR IN THE PLANT PATHOGEN DETECTION CLINIC?

By Mary Francis Heimann, O.S.F.

There are two crops that most diagnosticians dread the most. One of these is turf. Diagnosis of turf diseases is almost like Russian roulette; sometimes after hours of work on a specimen we would like a to take a pistol to our heads; provided, of course it is loaded with water. A good drenching washes away sweat and tears of exasperation.

Since this is for the "Grass Roots" publication let me start with the roots. Usually they appear in one of three stages. They are: 1) brown and rotted, 2) white and healthy, and 3) half and half—some dead and some alive. If they fall into category 2, I can continue on to look at the crown. If the roots are rotted, I ask what could have caused this condition. The little fungus chomping away at

E DIAGNOSIS

root tissue does not hold up a sign with its name on it. So I make a water mount of the tissue and what do I find: Usually my little banana shaped friends with inside cross walls are there and say "Hi, we're **Fusarium** spores. Try to guess if we have caused this state of affairs or if we are covering up for one of our other fungus friends."

There are bacteria galore upon which some wiggly nematodes are feeding. Or are they feeding just on the bacteria and dead tissue? The answer to this is to act a bit like a traffic cop. I put on the red light, in this case a bit of heat on the slide. This gets them to slow down. They have to be quiet enough to see whether or not they have stylets. (These are little "spears" with which they pierce the root cells.) If I apply too much heat, I cook them, and while the bacteria might like par-boiled nemas for lunch, I don't gain much insight into the problem. If my heating technique has become skilled and I find that the nematodes are without stylets I can cross them from my list of suspects. If they do have stylets, then I have another game to play. It's called threshold guessing or speculation. Are there enough present to have really caused the root problem? To solve this involves a trip up to fourth floor for a conference with Dr. Ann MacGuidwin. In my enthusiasm I may have

(Continued on page 8)

APPLICATIONS OF PLANT DISEASE DETECTION KITS FOR TODAY'S TURF MANAGER

By Dr. Sally A. Miller

One of the many challenges faced by managers and growers of turfgrass, ornamental plants and other high value crops is the timely and accurate diagnosis of plant diseases. Many diseases are caused by highly aggressive pathogens that can cause severe damage within a short time after symptoms are spotted. Other diseases develop more slowly but in the end may be just as devastating. Often, diagnosis is hindered by the absence of 'classic' symptoms. Pathogens may also infect and colonize plants but fail to induce symptoms until environmental conditions favor disease development. Until recently, few analytical tools have been available to assist the turf manager in detecting and diagnosing plant diseases. However, advances in biotechnology during the past decade have made it possible to develop rapid, specific, user-friendly tests for the detection of pathogens in plants, soil, and water. Such tests utilize antibodies in formats designed to take advantage of the unique properties of these 'reagents': their ability to recognize and bind to specific substances such as components of plant pathogens. One of the most popular types of assay is the enzyme-linked immunosorbent assay (ELISA), in which the pathogen-detecting antibodies are tagged with an enzyme. When an appropriate substrate is added to the reaction mixture, a positive reaction is visualized by a color change as substrate is converted to a colored product. There are a number of different types of assay formats that are applicable to plant disease diagnosis. One that has been developed recently is the dipstick assay. In this assay, the reactive end of the dipstick is incubated in the sample extract with the enzyme-tagged antibody solution, washed, then transferred to substrate. A positive reaction is indicated by the deposition of insoluble colored product onto the dipstick. Semi-quantitative results can be obtained by comparing the color of the dipsticks to known standards. Quantitative results are obtained by using an inexpensive, field-adaptible reflectometer that measures the intensity of the color on the dipstick. Dipstick assays can be carried out rapidly, often in a few hours.

Plant disease detection kits should be viewed as tools for managing agronomic practices. They can provide a turf manager with information that will help him or her to make the right choice of disease control remedy. Some of the decisions are: selection of pesticides and timing of pesticide applications, selection of plant varieties, and use of cultural control practices. For the turf manager, the availability of such kits will make it possible to diagnose plant diseases quickly and accurately, often before symptoms are present. Where symptoms are indistinct or confusing, kits can be used to confirm a preliminary diagnosis based on the appearance of the plant and/or signs of the pathogen. Used in conjunction with crop and weather data and forecasting systems, the kits will make it easier to predict the occurrence of disease outbreaks in a variety of crops.

Once diagnostic tests are widely available, they will plan an integral role in crop management. The primary components of the assays, the antibodies, can be produced for most plant pathogens, and in the coming years more and more tests will become available as part of the crop manager's arsenal against plant disease.

Editor's Note: Dr. Sally Miller was raised in Ohio and received her B.Sc. degree in 1976 from Ohio State University with an undergraduate major in biology. Her interests in graduate studies included mechanisms of disease resistance in alfalfa and she graduated with a Ph.D. degree in Plant Pathology from the University of Wisconsin—Madison in 1982. Currently, she is Unit Head of Plant Pathology Research for Agri-Diagnostics Associates, Cinnaminson, NJ. Her responsibilities included the development of diagnostic kits for detection of turf pathogens.

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taken the stairs to fourth floor. After our conference I wait for the elevator. It's easier to ponder what was meant by the "perhaps, perhaps not" answer while standing quietly during my descent back to the clinic.

By what else could the root rot have been caused? Well, **Helminthosporium** can do this but it is terrific at "hide and seek." It hardly ever produces spores for me to see in a water mount of the root tissue. So I set about isolating. However, when looking into the tissue I may have spotted what looks like **Pythium** reproductive spores, as well as something that looked like **Rhizoctonia**. So instead of looking only for **Helminthosporium** I have to allow for these other creatures to grow if they are part or all of the problem. So I pull out several selective media with each medium containing certain "goodies" that each particular fungus likes most.

In the meantime, I move on up to the crown of the plant. Before I concentrate totally on the crown I should mention a fourth stage of affected root tissue. This stage has its partner in the crime of creating turf problems. That partner is the crown of the plant. When these two parts die they do not behave like good dead tissue and make themselves available as food for the decomposers. No, they form a pesky relationship, and become thatch. What does thatch do? Well, it lies there under the grass plant and defies the living roots to try to penetrate. And you and I know what can happen to a shallow rooted grass plant when a bit of stress occurs. It goes "phfff" and crosses over to the enemy thatch to join its forces. It also complicates celar-cut symptom expression.

I return to the crown. It frequently is affected by many organisms. It is a disease of the crown that causes yellow patch, brown patch, Fusarium patch, necrotic ring spot patch, summer patch, ad finitum. I'm certain someday we'll have winter patch, spring patch, blue patch, and, and. . .

How do I know which fungus causes which patch? I examine the crowns and aha, there I find dark runner hyphae with certain characteristics. I conclude I am looking at a case of necrotic ring spot (NRS). But, the hyphae of **Philalophora** are very smiliar, and the hyphae of **Gaeumannomyces** are also very similar, to **Leptosphaeria** which is the causal fungus of NRS. How do I find out with certainty which it is? I can give the isolate to Jana Stewart, because she has tricks at which she is adept and she can get the hyphae to produce spores. These spores will give away the fungus' name. But herein lies a problem. Jana can do this, but the fungus does not eat at a fast food restaurant. It eats slowly and sporulates slowly. Jana might be able to tell me which one it is around Christmas time. So on what basis do I give the client a satisfactory diagnosis? The bases are on other clues such as what we know about the frequency or presence of the other fungi in Wisconsin, on the symptoms and on the background information that the client gives, and on which turf grass species we found which fungus.

Other crown diseases are possible. **Helminthosporium** can be a crown disease as well as one that affects the roots, and one that has a leaf spotting phase. Since only rarely can we find these spores, we most often diagnose this disease on the basis of a number of symptoms along with information supplied by the client. **Rhizoctonia** can attack the crown. This fungus can be readily seen with the microscope. However, sometimes it is present without being the primary culprit. I must also rely on symptoms, both those I see and again, those the client reports.

Leaf diseases are also possible. They are easy! If I look at the fruiting bodies (pycnidia) of **Ascochyta** or **Septoria** on the leaf blade with the use of a dissecting scope they both look exactly the same! However, it **is** easy to distinguish between the two with a compound microscope. Their spores are unique, and very different in character.

Symptoms, signs and "gut feelings" all come into play in diagnosis. It's well to remember that plant disease diagnosis is really often plant pathogen detection. If the specimen is dead, I cannot do an autopsy. Dead tissue is rapidly invaded by secondary organisms that hide or tell the primary pathogen to "get lost." I need diseased, but living tissue with which to work. Another point; if I have a headache, I do not send a wisp of my hair to the doctor. I take my whole self. Very frequently leaf symptoms are simply telling us that something is going wrong somewhere else. An adequate sample is the first step towards successful diagnosis. One or two four-inch squares or round plugs of turf taken from the interface where healthy grass meets affected grass are necessary. A fresh sample, packaged in such a way that the soil has not broken up, resulting in soil particles covering the leaf blades, is also necessary. A few grass leaves torn off and taped to a piece of paper test my since of humor. A "happy" sample keeps the diagnostician happy!

I've touched on a few turf diseases. This has not been meant as a lesson in plant pathology. I've tried to show what happens when a turf specimen enters the lab. If I look at each entry as a problem to be solved it can lead to dispair. If each entry is a challenge to be met, then it is all in a day's fun.

Editor's Note: Mary Francis Heimann is a native of Chilton, Wisconsin. She has an undergraduate major in Horticulture at the University of Wisconsin, as well as a B.A. in Biology from Cardinal Stritch College in Milwaukee. She also received a M.S. in Plant Pathology with a minor in Horticulture from the University of Wisconsin—Madison. Mary Francis has many years of experience as worker and supervisor of greenhouse and grounds at St. Francis Convent in Milwaukee, and four years of teaching Biology on the secondary level. She joined the staff of Plant Pathology as plant disease diagnostician in June, 1977.

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THE SUPERINTENDENT'S LIBRARY:
The Second Shelf

By Michael Semler

If you have ever spent any time in a bookstore and gone through the endless shelves of books, you may know the situation with which I am faced. The number of books in print on a given subject can be innumerable. I have found this to be true on the topic of golf course management. In my journeys the past few weeks I have found more books than I will ever possibly read, or own for that matter. I hope in these articles that I will do an adequate job of discerning some of the best books from the rest of them.

In the first part of this series I gave what I felt were the priority books for the Superintendents' Library. In this article I will give the "Second Shelf" or the priority books for the Superintendent's Library. tions and may be worthy of consideration if money is not limited for your personal library.

As I stated before, of primary consideration in managing turfgrass is managing the soil. Another excellent, general soils text is:

Soil Science
Author: R. I. Housenbuiler
1985 Cost $27.00

He covers all aspects of soils and does an excellent job on soil fertility. In my opinion, owning a second or third text on soils is a good decision and Housenbuiler's is certainly a worthy addition.

Managing turfgrass for golf courses is a varied and complicated talent. We, as managers of turfgrass, cannot ever have too many books relating to turf. One classic book which should be included is:

Principles of Turfgrass Culture
Author: John Madison
1978 Cost $25.00

It provides some good detail on all aspects of turf culture, not just for golf courses. We are golf turf managers as a priority but a good overall background in turf management is also necessary.

Included in the top shelf was a text on specific turfgrass diseases. In addition to this I would include a good overall text on Plant Pathology. This text would have to be:

Plant Pathology
Author: George M. Agrios
1978 Cost $25.00

It covers all aspects of general Plant Pathology including fruits, vegetables, ornamentals, and serves as an excellent reference manual for the wide ranging field of plant pathology. A good turf manager must have an adequate background for a good understanding of plant diseases.

Another excellent text on diseases of turfgrass which I feel is noteworthy is:

Management of Turfgrass Diseases
Author: Joseph Vargas
1981 Cost $25.00

It identifies turfgrass diseases by description and illustration. It also includes a complete approach to healthy turf and practical management strategies for golf courses, lawns and more.

In the first article I gave books for managing and identifying insect pests and their problems. Since I feel background information is just as important as being able to recognize and solve the problem I would include:

Introduction to the Study of Insects
Authors: Borer, DeLong and Tripplehorn
1982 Cost $42.00

This book has classification and general insect morphology as its strong points and will enhance your knowledge of insects.

Our ornamental plants play an increasingly popular role in our overall golf course management programs. Keeping them healthy and beautiful is then also essential. To aid us in this process I would recommend:

Diseases and Pests of Ornamental Plants
Author: P. O. Perone
1978 Cost $32.50

It covers all plant materials and their most significant problems and control measures for them to help maintain their health and beauty.

In addition to keeping our ornamentals beautiful we must consider the care and selection of flowers and bedding plants. Nothing adds more color and beauty to a course or club entrance than a well designed and well placed flowerbed. Three helpful books in identifying flowers and their characteristics are:

Taylors Guide to Gardening Annuals (Perennials) (Bulbs)
Author: Taylor
1986 Cost $14.95 each

These three books give excellent pictures of all the flowers, as well as growth habits, characteristics and the best environments for maximum flowering and growth. I feel they are welcome additions because you may find some worthy substitutes for more dramatic color and arrangement.

Just as having a strong background in soils is important, we must be well versed in the structure, function and classification of plants. For example, how could we understand bacterial wilt if we didn't know the difference between the xylem and phloem cells. A solid background in biology is essential. For this I would recommend:

Biology of Plants
Authors: Curtis, Raven and Evert
1983 Cost $36.00

An excellent, in-depth text covering the biology of plants and classification of them. Also included is a good selection of pictures and electron micrographs as visual aids.

Since weeds are always an unwelcome sight on a golf course, I am including a book which will help us identify both broadleaf and grass weed species. For this I would recommend:

Weeds of the North-Central United States
University of Illinois — Urbana
Ag. Bulletin Publication 772
1981 Cost $15.00