Wisconsin Golf Courses Serve as University Experiment Stations

By Dr. Gayle L. Worf

The occasion of this newsletter gives me reason to reflect upon our involvement over the years with the golf course superintendents, and our mutual efforts to serve the state and its people with the production and maintenance of high performance amenity turf. Our high numbers of golf courses and players in the state on a per capita basis speaks of the demands for it.

But we don't have a turf research facility that supports it in the manner typical of most other land grant universities. That was—and still is—the circumstance when we began our relationships over a quarter of a century ago. Had it not been for the character and persistence of a rather large number of superintendents who recognized the situation, we may have had to be content with "borrowed" information from other states that may-or may not-have met Wisconsin's needs.

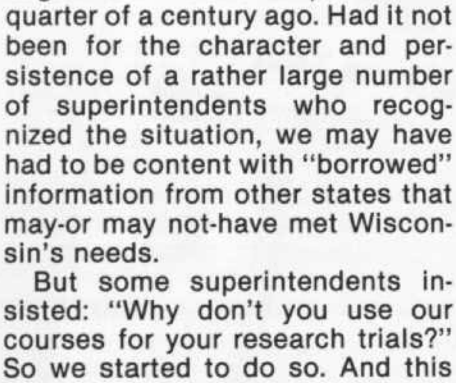
But some superintendents insisted: "Why don't you use our courses for your research trials?" So we started to do so. And this article is a recollection of some of those experiences, as well as an effort to identify some of the progress that has come through those cooperative efforts.

We started out innocently enough, as I recall. We went out to take a look at a disease response taking place in Dr. Jim Love and Roger Larson's fertilizer trials at Maple Bluff. Dollar spot was the disease, and good control was being obtained with the (excessively) highest rates of nitrogen. That started the question about fungicide efficacies. At that time we had Actidione, thiram, mercuries, cadmium, captan, mancozeb, PCNB and a few other lesser compounds available to control turf diseases. Each had their problems and limitations, and two of the main actors were soon destined to be lost by regulatory action for some or all uses in Wisconsin. Daconil and Dyrene were just coming on the market, and superintendents were asking questions about them. So we set up our first replicated trials there in 1965, together with Love and Larson. It was a factorial, involving 0, 3 and 9(!) pounds of N/1000 ft2 as 33-0-0 and 10-6-4. We tested Daconil, Dyrene and Dithane M-45 (Fore) with 6 applications from June 7 to July 27. With all that effort, no disease showed up at all that summer! But it was one of those years for "fall disease." Symptoms developed in mid-September. Very little disease was present in plots receiving 3 and 9 pounds of N. It was severe in the low N plots—evidence of the need for high N by Poa annua. And Daconil and Dyrene treatments had only about half as much infection as non-treated and Fore-treatments—evidence that there is some carryover benefit from summer treatments into the fall season, but not enough to do the job without supplementation.

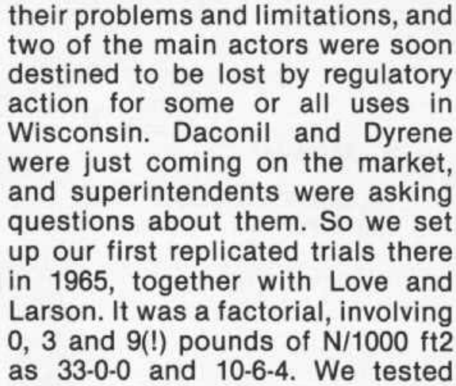
(The absence of expected disease during the season was a pattern often to be repeated in subsequent years, we were to learn later. Reliable prediction of disease outbreaks, which could result in more timely selection and use of chemicals remains one of the most important needs of the golf course industry today.)

That was followed two years later with a Helminthosporium control trial at Nakoma, in cooperation with Pete Miller. At that time we were also trying some remedies for "Fusarium blight."

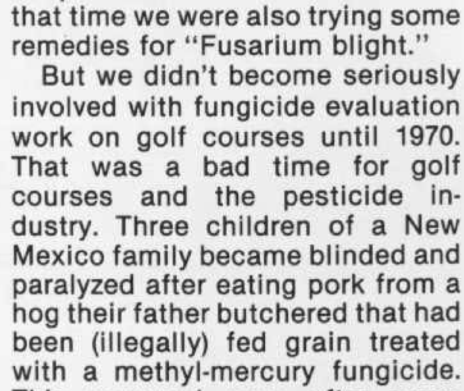
But we didn't become seriously involved with fungicide evaluation work on golf courses until 1970. That was a bad time for golf courses and the pesticide industry. Three children of a New Mexico family became blinded and paralyzed after eating pork from a hog their father butchered that had been (illegally) fed grain treated with a methyl-mercury fungicide. This occurred soon after some other mercury-related calamaties in Pakistan, Japan and Sweden,



Cooperative trials on the golf courses often involve applications with this unit, which has been designed to deliver chemicals uniformly and precisely for comparative evaluations. The next two photographs offer examples.



Fungicides are sometimes found to control one disease but not another in the same trials. Dollar spot is evident in the left section, anthracnose in the center, while both are controlled in the section to the right.



The experimental chemical Bay Meb 6447 (later named Bayleton) was the first chemical we observed to have dramatic effects upon the control of summer Poa decline.

and was coinciding with international concerns about DDT and other pesticides.

Work was needed right away to: (1) confirm where mercuries were critically essential to golf course maintenance, and (2) establish alternative treatments where possible.

We felt a panic especially for snow mold control in the state. Trials at Ozaukee, Maple Bluff and Lake Forest golf courses were established. Fortunately for this situation—we picked a bad snow mold year! The trials vividly demonstrated the devastating potential of snow mold. (To this day we admire the understanding and patience of the Maple Bluff membership, but we will never again display the bravery, naivety, and/or audacity to try such large experiments on greens!) We also showed that Dyrene was **not** an acceptable substitute for the mercuries, as was being claimed in states east of us; that chloroneb was a very excellent product—but that it will fail as a replacement for mercury on many courses under severe pressure; and that "snow mold" is simply not the same thing on every golf course or in every year!

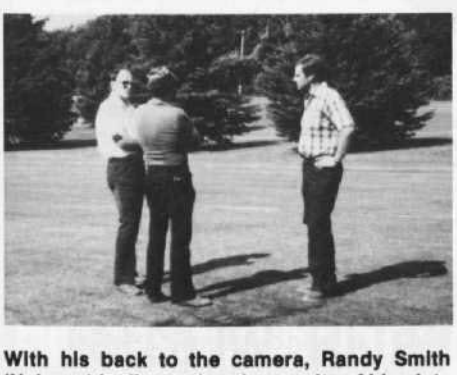
Soon afterward, cadmium and chromium-containing fungicides were nearing a ban (which ultimately occurred in Wisconsin). These three compounds were literally the backbone of disease control on golf courses, and their departure signalled a need for a revolutionary change in pesticide choices. Fortunately, we were entering into a new era of fungicide discovery that could be taken advantage of to develop useful alternatives for the traditional products that had been produced before the modern toxicological and environmental restrictions were in place. People following my generation find it difficult to imagine a world without television or satellites. Younger superintendents may likewise be unappreciative of the fact that the benzimidazoles (Tersan 1991, Fungo 50, etc.), dicarboximides (Chipco 26019, Vorlan), ergosterol biosynthesis inhibitors (Bayleton and Rubigan), and systemic or residual Pythium-controlling products (Subdue, Banol and Aliette) are all products that have been developed and registered for turf in the last dozen years. Of importance to this story is that research conducted on golf course (and other) turf sites in Wisconsin contributed significantly to their ultimate registration and availability.

We've gone back through our records to offer the following summary of "cooperative research stations" (golf courses only) where such research has been conducted:

Year	Location and Research
1965	Maple Bluff Dollar spot
1966	Nakoma Helminthosporium
1970	Lake Forest Snow mold
	Maple Bluff Snow mold
	Ozaukee Snow mold
1971	Maple Bluff Snow mold
	Lake Forest Snow mold
	Wausau Snow mold
1972	Bass Lake Snow mold
	Maple Bluff Snow mold
	Telemark Snow mold
1973	Bass Lake Snow mold
	Maple Bluff Snow mold
	Peninsular State Park Snow mold
	Plum Lake Snow mold
	Telemark Snow mold
1974	Bass Lake Snow mold
	Maple Bluff Snow mold
	Nakoma Snow mold
	Telemark Snow mold
1975	Bass Lake Snow mold
	Blackhawk Helminthosporium
	Maple Bluff Snow mold
	Nakoma Snow mold
1976	Telemark Snow mold
	Wausau Snow mold
1977	Maple Bluff Snow mold
	Telemark Snow mold
1978	Maple Bluff Snow mold; Dollar spot
	Odana Helminthosporium
	Telemark Snow mold
1979	Blackhawk Poa decline
	Buttes des Mortes Snow mold
	Maple Bluff Poa decline, Pythium, Snow mold
	North Hills Pythium
	Odana Helminthosporium
	Ozaukee Dollar spot
	Tuscumbia Dollar spot
1980	Blackhawk Poa decline
	Maple Bluff Poa decline
	Nakoma Dollar spot
1981	Blackhawk Poa decline and Dollar spot
	Lake Geneva Dollar spot
	Maple Bluff Poa decline
	Mascoutin Necrotic ring spot
	Nakoma Dollar spot; Anthracnose
	Oconomowoc Dollar spot
	Tuscumbia Dollar spot; Poa decline
1982	Blackhawk Poa decline; Dollar spot
	Brynwood Pythium
	Chaska Snow mold; Necrotic ring spot
	Maple Bluff Poa decline
	Nakoma Dollar spot; Anthracnose
	North Hills Pythium
	Riverside Poa decline
	Timber Ridge Red thread
	Westmoor Fairy ring
1983	Devil's Head Pythium
	Maple Bluff Pythium
	Nakoma Dollar spot; Anthracnose
	North Hills Pythium
	Tuckaway Dollar spot; Anthracnose
	Wausau Snow mold
	Westmoor Snow mold
1984	Nakoma Dollar spot; Anthracnose
	Oconomowoc Dollar spot; Poa decline; Growth regulator effects
	Wausau Snow mold
	Westmoor Snow mold
1985	Blackhawk Fairy ring
	Camelot Dollar spot; Variety plot
	Nakoma Dollar spot; Anthracnose; Poa Patch disease
	Oconomowoc Dollar spot; Poa deline; Growth regulator effects
	Stevens Point Nematode; Snow mold

Not included are the many that have contributed other forms of insight into turf health, including some demonstration treatments, samples and observations. And we

(Continued on page 38)



With his back to the camera, Randy Smith (Nakoma) is discussing the results of his plots with two chemical representatives from Kansas City. They ultimately decided to label products in accordance with Wisconsin experiences.

The plots have served extension functions, too. Ray Knapp and Glenn Dahl, former student assistant, were awaiting fellow golf course superintendents to view Ray's plots when this photograph was taken at Tuckaway.

(Continued from page 35)

suspect that we've missed some important cooperators along the way. But from the above one can begin to appreciate that the state's golf courses do, indeed, serve an integral role in the business of figuring out what's needed for turf disease identification and control.

We shouldn't lose sight of the fact that these sites not only have provided a research site, they've also played an important extension role, too. Most of these have been observed by other superintendents in informal or formal settings. The information is a basis for much of the disease control recommendations. And Camelot and Oconomowoc have served as the hosts for the Turfgrass Field Days for the past two summers.

We hope the proposed turf research station becomes a reality someday. It would save a lot of travel time; we could conduct different types of research than we can now—and it should be safer than dodging golf balls, too! But I suspect that some work would still remain on these very special kinds of "University Research Stations.

It's an impressive list of cooperators. We appreciate it!

Biological Control of Soilborne Plant Disease

By Dr. Jennifer L. Parke

In the plant pathologist's black bag are several strategies for controlling plant disease. These include traditional methods of chemical control (fungicides, fumigants), the use of disease-resistant plant varieties, sanitation to limit disease spread, and modification of cultural practices to create an environment less conducive to disease. Although each strategy is useful, there are occasions when none of these methods is effective or economically feasible in solving disease problems. For instance, fungicides are expensive, often require multiple applications, present some degree of environmental hazard, and with repeated use can result in development of pathogen populations which are resistant to the fungicide. It is in these situations that an alternative control strategy such as biological control should be considered.

Biological control uses living organisms, or metabolites produced by living organisms, to combat plant pathogenic fungi, bacteria, viruses, or nematodes. This process occurs naturally in many soils; just as plant species compete with one another for light, nutrients, and water, so do microorganisms compete for nutrients, oxygen, and microsites. Microorganisms have evolved complex "weaponry" for this competition, including antibiotics and special chelating molecules that bind certain soil nutrients very tightly to prevent their utilization by other microorganisms. In fact, the field of medicine has exploited this intense natural competition among soil microorganisms in the use of antibiotics to fight human pathogens; streptomycin, produced by the soil microorganism **Streptomyces**, is one example. Microorganisms can also act as predators or parasites, digesting or invading propagules of plant pathogens, decreasing their viability and their potential to cause disease.

The competition between soil microorganisms is most intense in the area immediately surrounding plant roots called the rhizosphere ("rhizo" = root), because it is here that most of the sugars and organic acids they use for food are leaked from roots to the soil. Each microorganism is vigorously competing for this limited source of nutrients to the extent that plant roots are densely covered by fungi and bacteria, many of which are actually beneficial to plant growth. Because of this intense competition it is unusual that a single pathogenic organism can gain a strong enough "foothold" to cause disease; it is rare to see root disease epidemics in soils which support a large and diverse rhizosphere population of microorganisms. However, in soils in which microbial populations are low, either because the soil is sandy, low in organic matter, or treated with a biocide, this depleted rhizosphere population is less able to prevent an aggressive pathogen from dominating the root zone.

Biological control makes use of microbial antagonism, either by restoring a large and diverse rhizosphere population by cultural means, or by finding and adding back one or more strains of microorganisms which antagonize a particular pathogen. In some cases, antagonistic bacteria have been mass-produced, then added as a seed coating, much as the nitrogen-fixing bacterium **Rhizobium** is added to alfalfa, pea, and bean seed to improve plant growth. Other modes of application include adding microorganisms to soil as a drench, as a dry powder, or as pellets. Biological control agents reproduce in the rhizosphere, and give protection against plant pathogens approaching the root. Biological control has been suc-