effective means for temporarily increasing green speed for a tournament or other special event. Rolling is certainly an option, but requires ownership of or access to a roller. Thus, other options – wet vs. dry mowing and double cutting – were explored. Dry mowing becomes an option when you are faced with a noon-time shotgun start. The speed gained in this study by dry mowing varied with mowing height. The increase was an insignificant 2.4 inches at the 0.120-inch mowing height but increased to 6 inches at a 0.218-inch height of cut. The effect of mowing height on the amount of speed gained by double cutting was just the opposite of dry vs wet mowing. Double cutting at 0.120 inch increased putting green speed an average of 10.6 inches. Double cutting at 0.218 inch increased speed a mere 4.2 inches. The gain in speed achieved with double cutting also depended on bentgrass cultivar. The 'Penncross' greens benefitted the least (8 inches on average). The 'Crenshaw' greens gained the most speed – 13.3 inches on average. 'Providence' greens were intermediate, picking up 9.8 inches of speed when double cut.

Before you get obsessed with tinkering around with putting green speed next season, let's try to put things into perspective. Data analysis in this 7-year study consistently indicated that green speed differences of less than 4 inches are seldom statistically significant. In other words, changes of this magnitude are random, naturally occurring, and inherent in even the seemingly flat putting greens used in this study. Second, recent research has shown that even low handicap golfers cannot detect green speed differences of less than 6 inches. The bottom line then is that you should not get excited when you see the speed of your greens suddenly change by 4 to 6 inches.

Finally, as pointed out by Dr. Beard, consistently keeping greens at tournament speeds has costs that few golf courses have the resources to deal with or consequences that golfers will tolerate. The consequences in this study of mowing at heights required to consistently maintain putting green speeds above 10 feet are summarized in Table 1. Increasing the mowing height did increase clipping weights, at certain times by 15% or more, but over the duration of the study the

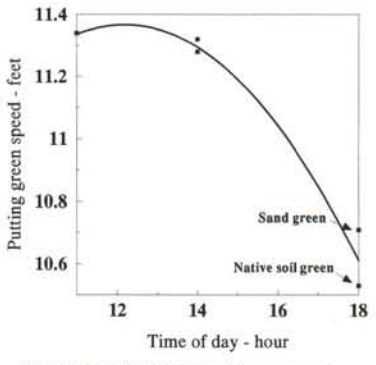

Figure 2. Time-of-day changes in putting green speed.

Table 1. Weekly variation in putting green speed at constant mowing heights.

Mowing height	Type of green	Putting green speed Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7
inch		feet						
0.120	Sand	10.2	11.0	10.9	10.9	10.6	11.6	11.1
	Soil	10.5	11.0	10.8	11.1	10.6	11.2	11.1
0.156	Sand	9.0	9.6	8.9	9.5	9.2	9.7	9.6
	Soil	8.9	9.1	8.7	9.3	9.0	9.5	9.4
0.208	Sand	8.0	8.2	8.1	8.0	7.9	8.2	8.2
	Soil	8.1	8.1	8.0	8.2	8.2	8.0	8.2

Table 2. Time of year influences on putting green speed.

Target speed	Putting green speed 1996 May	1996 August	1997 June	1997 August	1998 June	1998 August	1999 June	1999 July
feet	feet							
8	7.5	8.4	7.2	7.6	7.6	8.6	7.9	8.2
9	9.1	9.9	9.0	9.5	9.6	10.3	9.3	9.4
>10	9.9	10.7	9.7	10.1	10.5	11.6	9.7	10.4

Table 3. Consequences of mowing to maintain putting green speeds consistently >10 feet rather than around 8 or 9 feet.

Putting green property	Change at a speed of: 9 feet	8 feet
Clipping weight	+ 1%	+ 5%
Stand density	+ 10%	+ 12%
Rooting depth	+ 29%	+ 53%
Root weight	+ 25%	+ 52%
Algae invasion	– 87%	– 94%
Dollar spot	+452%	+559%
Traffic tolerance	– 45%	– 54%

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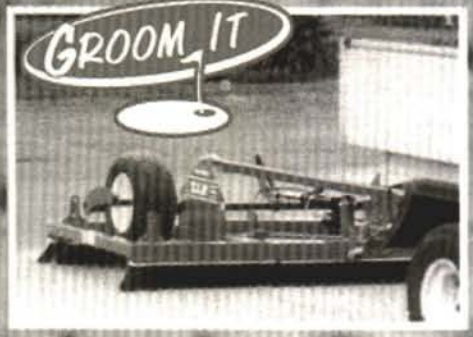

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increases were less than 5% – hardly great enough to say that an increase in mowing height significantly impacted on costs arising from greater clipping production. Bentgrass stand densities averaged only 10 to 12% greater in greens maintained at speeds of 8 to 9 feet as compared to those maintained at greater than 10 feet. But look at the impact this grass stand reduction and low mowing had on algae invasion. Increasing the mowing height by just 0.036 inch, from 0.120 to 0.156 inch, reduced the percentage of plot area invaded by algae an average of 87%, even when all plots received the equivalent of about 30,000 rounds of golfer traffic per season. Contributing to algae invasion was the 45 to 54% reduction in traffic tolerance of bentgrass mowed to maintain tournament speed.

Another cost of tournament speeds occurs below ground. Bentgrass rooting depths and root weights were reduced substantially, by 25 to 50% or more (Table 3) regardless of bentgrass cultivar. The native soil greens maintained much better root systems than the sand greens, but the percentage reductions due to reduced mowing heights were nearly the same in both. In the sand green, late summer rooting depth often declined to less than 4 inches when mowed to maintain a greater than 10 feet green speed, while depths of 7 to 8 inches were common in greens with speeds of around 8 feet. This difference in root growth can easily trigger an escalation in putting management costs. Typical sand putting greens do not retain enough water in the top 4 inches to prevent bentgrass from wilting on a hot, sunny day. Hand watering to prevent wilting and to treat localized dry spot that now requires use of wetting agents becomes a costly but vital management practice.

The single positive impact of mowing at 0.120 inch or so was on the severity of dollar spot (Table 3). This can be attributed to the impact of mowing height on the amount of leaf tissue where infection can occur. Owing to the great susceptibility of 'Crenshaw' to dollar spot, the 400 to 500% increases in dollar spot at the 8 and 9 feet target green speeds are somewhat misleading. For 'Penncross' and 'Providence', the increases in dollar spot severity were more on the order of 36 to 47%, but still high enough to signal the need for a more intensive use of fungicides.

Clearly, there are many costs associated with maintaining putting greens at tournament speeds. As pointed out by Dr. Beard, few golf courses have the necessary resources. Perhaps even more important is the fact that many golf courses don't have greens whose properties are such that a quality playing surface can be maintained at very low mowing heights regardless of the cultural practices employed. For those of you that are being pressured to move your putting green speeds into the tournament range and keep them there, may this article be of value to you.

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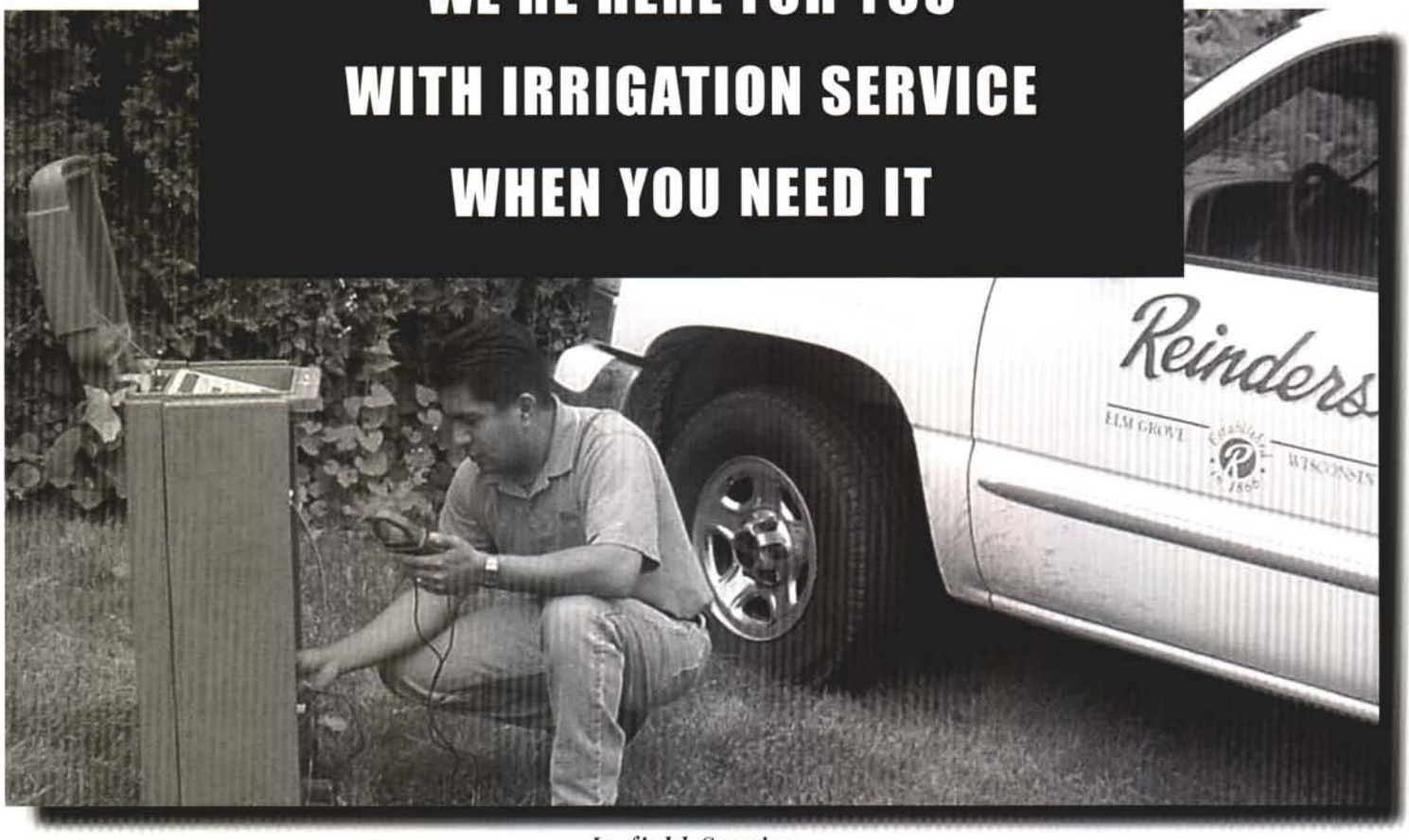

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Alternative Way of Snow Mold Control?

By Geunhwa Jung, *Department of Plant Pathology, University of Wisconsin-Madison*

The snow molds are friends rather than foes. At least I want to look at them in that way. Without them superintendents and researchers would be out of business, particularly in Wisconsin. The snow molds give us enough challenges every spring so that researchers are constantly striving to learn more about the strategies of controlling the snow molds. Another great year for the snow molds may be expected this year due to unusual climate condition, UNFROZEN SOILS covered with a blanket of snow. Factors, including duration of snow cover and low temperature with lots of moisture, which can affect the growth of grasses, and the grass's susceptibility to snow molds, should also affect the severity of snow molds. Therefore, everyone knows the simple equation, no fungicide equals no control of the snow molds.

Snow molds are one of most difficult fungal pathogens to work with from a researcher's point of view because of the complexity of disease development. However, another difficulty is that there are many names for the same disease, which have confused superintendents and researchers. Nomenclature plays a very important role in communicating information among people working in the same area. Therefore, if different names were used, then how are people able to exchange the correct information with each other?

Recently, I had a chance to look through our most important encyclopedia on fungicides called "Turf & Ornamental Reference" for Plant Protection Products (T&OR 2000) in order to gather the fungicide

Table 1. List of fungicides registered for the control of snow molds and their recommended rate, application intervals, and their primary target species of snow molds.

Chemical family	Common names	Trade name	Snow molds					
			Typhula blight				Microdochium patch	
			Speckled Snow Mold		Gray Snow Mold		P ink Snow Mold	
			Rate	Appl interval	Rate	Appl interval	Rate	Appl interval
Carbaximide	Flutolanil	ProStar® 70WP			3.0—4.5			
					GSM (Typhula spp.)		PSM (*Fusarium nivale)*	
Demethylation Inhibitors (DMI)	Triadimefon	Bayleton®50			2	One or two appli	1-2	One or two appli
					GSM/T. Blight (*T. incarnata*)		PSM/F. patch (*Microdochium nivalis*)	
	Fenarimol	Rubigan A.S.	8.0	1 or 2 days	8.0	1 or 2 days	8	1 to 2 days
			GSM/Typhula blight (*T. incarnata*)(*T. ishikariensis*)			F	. patch/PSM (*Gerlachia nivalis*)	
	Propiconazole	Banner® MAXX®			2-4	One application	2-4	One applicaiton
					GSM (Typhula spp.)		PSM (*Microdochium nivale*)	
	Myclobutanil	Eagle® WSP					0.6-1.2	One application
							PSM (Fusarium patch)	
Dicarboximides	Vinclozolin	Touche EG			2 preventive	10 to 21 days	2 preventive	10 to 21 days
					4 curative	10 to 21 days	4 curative	10 to 21 days
					GSM		Fusarium patch and PSM	
		Curalan® EG			1			
					GSM (*T. incarnata*)		F. patch & PSM (Microdochium)	
	Iprodione	Chipco® 26019			2-4	One or two appli	2-4	One or two appli
					GSM (Typhula spp.)		PSM (*Microdochium nivalis*)	
Dithiocarbamatges and Carbamates	Mancozeb	Dithane® WF					9.6-12.8	2 to 6 weeks
							Fusarium Snow Mold	
		Junction®					4-8	2 to 6 weeks
							Fusarium Snow Mold	
		Fore®					6-8	
							Fusarium Snow Mold	
		Mancozeb DG					6-8	2 to 6 weeks
							Fusarium Snow Mold	
Strobilurins	Azoxystrobin	Heritage®	0.7	One application	0.7	One application	0.7	One application
			0.4	14 days	0.4	14 days	0.4	14 days
			GSM/Typhula Blight (*T. incarnata*, *T. ishikariensis*)				PSM (*Microdochium nivale*)	
	Trifloxystrobin	Compass™					0.25	Late fall
							PSM	
Benzimidazole	Thiophanate-methyl	Cavalier 50 WSB					2	
							PSM (*Microdochium nivale*)	
Nitriles	Chlorothalonil	Manicure™ 6 Flowable® Turf Care®			13.6-27.2 pounds	One application	13.6 pounds	In combination
					GSM by Typhula spp.		PSM (Gerlachia or Fusarium patch)	
		Daconil Ultrex®			13.6-27.2 pounds	One application	13.6 pound	In combination
					GSM by Typhula spp.		PSM (Gerlachia or Fusarium patch)	
		TwoSome™	16	One or more	16	One or more	16	One or more
			Typhula blight/GSM (*T. incarnata*)(*T. ishikariensis*)				Fusarium patch/PSM (*M. nivalis*)	
Aromatic Hydrocarbons	Quintozone (PCNB)	Engage® 75W			8	One application	8	One application
					GSM by Typhula spp.		PSM (*Fusarium nivale*)	
		Terraclor®			13.6-27.2 pounds	One application	8	One application
					GSM (Typhula spp.)		PSM (*Fusarium nivale*)	
		Turfcide®400			12			
					GSM (*T. incarnata*)		PSM (*Fusarium nivale*)	
		Revere™ 10G			5-10	One application	5-10	One application
					GSM (Typhula spp.)		PSM (*Microdochium nivale*)	

The information in this table was abstracted from Turf & Ornamental Reference for Plant Protection Products, 2000. Rate is based on fl. oz/1000 sq. ft. unless specific information is provided. Additional directions of tank mix with other products for the control of snow molds were not included in the table due to the limitation of a space. Abbreviations: GSM (gray snow mold), PSM (pink snow mold), F. patch (Fusarium patch), T. blight (Typhula blight), *M. nivalis* (*Microdochium nivalis*), and spp. (species).

Table 2. Scientific and common names of snow molds caused by fungal pathogens.

	Typhula blight					
		T. ishikariensis				
Scientific name	*T. incarnata*	var. *ishikariensis*	var. *canadensis*	var. *idahoensis*	*Microdochium nivale*	
Common name	Gray snow mold	Speckled snow mold			Pink snow mold	Fusarium patch

Nomenclature was adapted from Smith et al. (1989) and Smiley et al. (1992).

information labeled for snow mold control. I discovered a few interesting findings (Tables 1 and 2). First of all, there were a series of both scientific and common names used for the same snow mold. Some of them may be due to misspellings made in the printing process. However, I firmly believe that a majority of them was due to the lack of knowledge about the disease. Here are some instances that I discovered from the T&OR 2000. For example, what exactly does "gray snow mold (*Typhula* spp.)" mean (Table 1)? Does it mean all of Typhula species (*T. ishikariensis*, *T. incarnarta*, and *T. phacorrizha*), both *T. ishikariensis* and *T. incarnarta*, or just one of the three species? In some cases, either *T. ishikariensis* or *T. incarnarta*, or both were clearly mentioned. Another example is about pink snow mold. The name like *"Gerlachia"* and *"Fusarium nivale"* still appears in spite of the fact that the name for pink snow mold has been revised to the genus *"Microdochium"* (Smiley et al., 1992) (Table 1). As researchers learn more about the snow molds, things such as the nomenclature must be corrected.

Another important piece of information presented in Table 1 is that there are only a few fungicides, such as Rubigan, Heritage, and TwoSome, actually labeled for the control of *T. ishikariensis* species. In fact, our preliminary research results indicated that *T. ishikariensis* is the predominant species causing snow mold in Northern Wisconsin and in other areas where the snow cover stays longer. Also, *T. ishikariensis* is generally associated with snow mold outbreaks, where fungicide applications have failed.

In this article, I attempted to summarize the names of the snow molds used in the T&OR 2000 so that Wisconsin superintendents will have a better idea of the fungicides available for a specific snow mold species and better communication between researchers, superintendents, and chemical representatives (Table 2).

Two names, pink snow mold and Fusarium patch were agreed upon by researchers and were maintained because of phases of a disease caused by *Microdochium nivale* (Fr.) Samuels & I.C. Hallett (Smiley et al., 1992). Smiley et al. (1992) also described the reason for keeping two names for pink snow mold: 1) the names do not fully and always describe the diseases, the pinkish color on the margin of the diseased patch, 2) the disease is not always related with the snow, and 3) the pathogen name has been renamed several times, from the genus *Fusarium* to *Gerlachia* and then to *Microdochium*. The authors also suggested that pink snow mold is for the description of disease associated with snow cover. In contrast, *Fusarium* patch is for the description of the disease without snow cover. For example, in May in Southern Wisconsin *Fusarium* patch can be a problem as *Microdochium nivale* can be active and cause death of turfgrass.

For more practical information on snow mold fungicides, please schedule in advance to visit one of five snow mold field days sometime spring of 2002.

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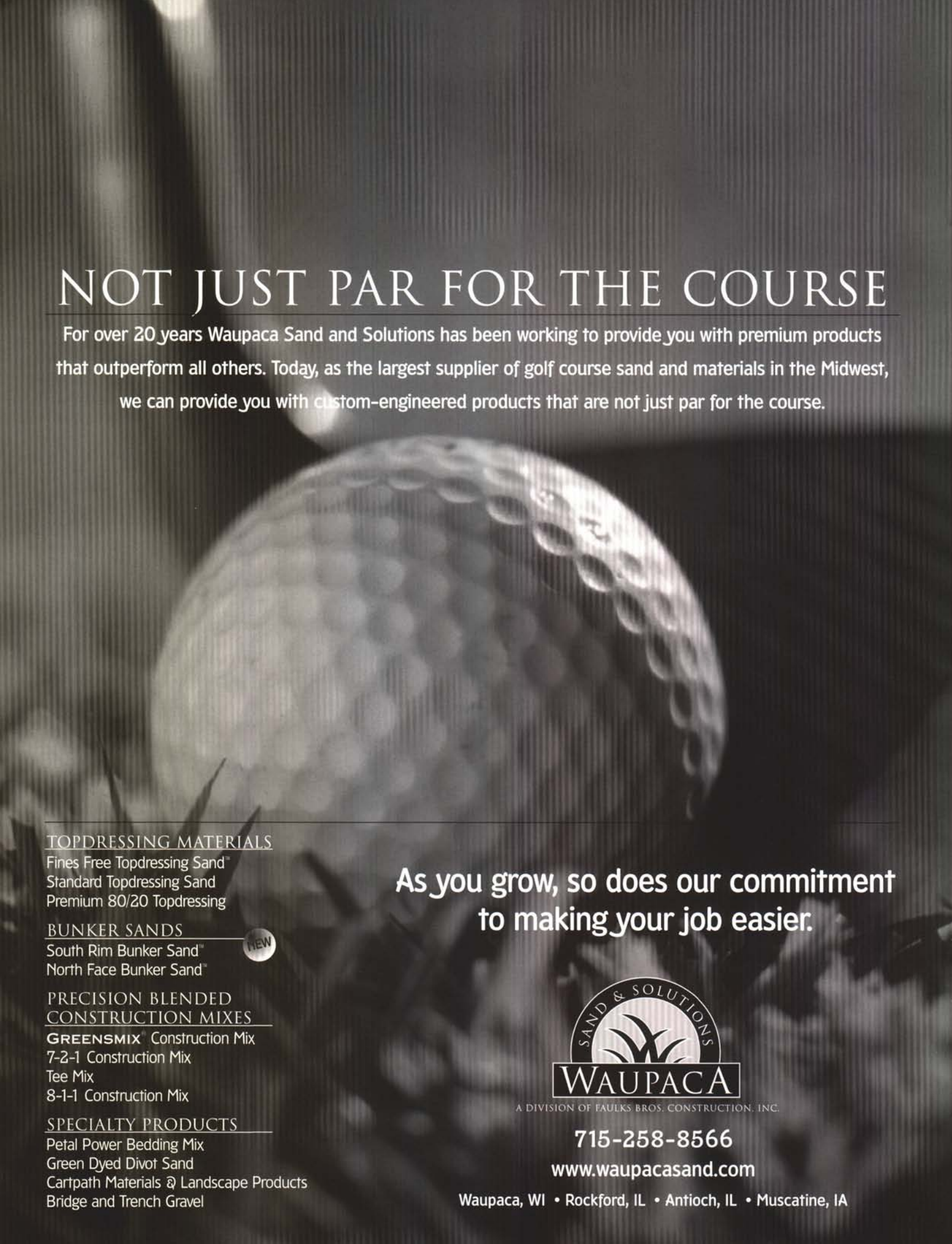

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Environmental Complacency

By Dr. Frank S. Rossi, *Department of Ornamental Horticulture, Cornell University*

When Rachel Carson penned the now-famous *Silent Spring*, she addressed one aspect of American life wrought with ignorance regarding pesticide use and environmental quality. The outrage stirred by Silent Spring provoked the anger created by the "cranberry scare" of 1959.

Cranberry growers applied a pesticide during the growing season in defiance of Food and Drug Administration (FDA) restrictions. The pesticide found at low levels in the cranberry supply was suspected of causing cancer. These events had a profound and enduring effect on the public consciousness. In many parts of the country, this concern persists today.

The golf industry experienced a similar *Silent Spring* event with publications from the United States Government General Accounting Office in 1988 asking the question, "Are the Hazards of Lawn Care Pesticides Underestimated?"

Then in 1989 the Attorney General of New York published "Toxic Fairways: The Risk of Groundwater Contamination from Golf Courses." Jay Feldman and his organization, National Coalition Against the Misuse of Pesticides (NCAMP) and other activists seized the moment to confront the golf industry.

The initial response from the industry was defensive. The 1992 GCSAA conference held a packed session for thousands for golf course superintendents to hear from Mr. Feldman and officials from the EPA. The following year the GCSAA invited Michael Fumento, author of *Science Under Siege* who reported the results of topical searches he conducted on "golf courses" and "cancer."

"Golf courses *fight* cancer, as professional tournaments raise funds," Fumento proclaimed with the results of his search. The crowd erupted and you could sense that the golf course superintendents wanted this crisis over. Still, information was lacking regarding the fate of pesticides and nutrients applied to turf.

The United States Golf Association embarked on an important research initiative to more thoroughly understand the influence of golf turf management on environmental quality. The environment under investigation was air and water quality. Concurrently, Ron Dodson was introducing a program to the golf industry that assisted the golf course superintendent with environmental management. Ron was also the driving force behind the Wildlife Links Research Program that investigated the influence of golf turf management on wildlife. The research information was on its way, and now there would be a mechanism for implementation.

Environmental Evolution

The USGA held a symposium at a 1998 meeting of the American Chemical Society to discuss the decade of USGA-funded environmental research. As a member of the Research Committee at the time, it was a unique experience to hear from the leading researchers in our field and then to have their work in a Symposium Book published in 2000.

The opening chapter authored by Mike Kenna and Jim Snow provides an excellent overview of the research. In the concluding section they state, "university research shows that most pesticides used on golf courses have a negligible effect on the environment." This has been the cry of golf course superintendents since the research has been completed.

Audubon International programs for new and existing golf courses has grown over the last decade, but still represents about 10 percent of all courses in the U.S. In fact the number of fully certified courses is well below five percent of all courses. Most courses are either not

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