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TURFGRASS PATHOLOGY

Disease Resistance in Bentgrasses Cultivars

By Eric B. Nelson

Bentgrasses have been used for golf and other sports turf since the late 1890s. The first reported occurrence of diseases on bentgrasses was in the early 1900s. Since then, the management of an ever-growing number of fungal disease problems has continued to be one of the more difficult aspects of golf turf management. To this day, disease outbreaks are one of the major obstacles to the maintenance of a smooth and aesthetically pleasing playing surface.

Despite the overwhelming problems with disease management in golf turf, little effort has been devoted to the development of bentgrass varieties with high levels of disease resistance. Since the turn of the century, we have continued to maintain a growing and effective arsenal of fungicides that are easy to apply and broad-spectrum in their activity. As a result, breeding efforts have been focused primarily on improving playing qualities, asuming that disease control could be effectively achieved with routine, albeit frequent and sometimes excessive, fungicide applications.

Few breeding efforts have ever been closely linked to pathology programs. Nearly all have been centered in agronomy or plant breeding programs, with only occasional input from turfgrass pathologists. Consequently, criteria used for the selection of improved vari-

TABLE 2. CURRENTLY AVAILABLE BENTGRASS VARIETIES

Creeping Bentgrass *(Agrostis stolonifera)*				
18th Green	Backspin	Carmen	Cato	Century
Cobra	Crenshaw	Emerald	Imperial	Loft's L-93
Lopez	Mariner	National	Penn A-1	Penn A-4
Penn G-2	Penn G-6	Penncross	Penneagle	Pennlinks
Pennway	Princeville	PRO/CUP	Providence	Putter
Regent	Seaside	Seaside II	Sefton	Southshore
SR 1020	SR 1119	Trueline	Trust	Viper
Colonial Bentgrass *(Agrostis tenuis)*				
Allure	Astoria	Bardot	Egmont	Exeter
Highland	SR 7100	Tendenz	Tracenta	
Velvet Bentgrass (Agrostis canina)				
Kingston	SR 7200			

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eties have traditionally been based on agronomic qualities that breeders, rather than pathologists, deem to be important.

Traditional plant disease management strategies involve approaches that:

1) directly reduce or eliminate the activity of pathogens, strategies for which fungicides have been particularly effective

2) alter the environment, usually through cultural manipulations, making conditions less favorable for pathogen activity and more suitable for the growth of the plant; and

3) increase the natural resistance in the plant population.

The missing element in such a comprehensive management strategy has been the deployment of plants with enhanced resistance to these ever-present fungal pathogens. Traditionally in other cropping systems, the use of host resistance has been the first priority strategy for disease management.

Currently, we recognize nearly 30 different diseases affecting bentgrass turf. At least 17 of these are considered major diseases. Yet, of these major diseases, we still lack resistance to some specific diseases and lack broad resistance in many of our modern cultivars (See Table 1).

Although we have been able to learn much over the last few years about resistance in some bentgrass cultivars, few recommendations are typically made regarding the use of such varieties for disease management. Turfgrass managers, in many cases, are not even aware that certain resistant varieties are available and that these varieties can be used logically as a disease management tool and not simply as an agronomically advanced variety.

Rather, most recommendations for the use of bentgrass varieties in golf turf center around the agronomic and playing qualities of the variety with little emphasis on management qualities. The intent of this article is to increase the awareness of the level and spectrum of disease resistance in bentgrass cultivars, with the hope that this will stimulate a greater use of these varieties in turf management programs.

Historical Development Of Bentgrass Varieties

Bentgrasses are cool season grasses that were originally introduced to the United States from Europe or Eurasia. Bentgrasses are generally adapted to cool humid conditions typical of the Northeast, upper Midwest and Northwestern parts of the United States on moderately fertile soils that drain well.

The cultivation of bentgrasses is almost exclusively limited to sports turf applications such on as golf courses, tennis courts and bowling greens. Because of their intended use, bentgrasses must grow under less-than-ideal conditions of low mowing and excessive traffic. Furthermore, they do not withstand prolonged conditions of high moisture and low fertility, conditions commonly encountered on golf course putting greens.

The most commonly used bentgrasses on golf turf are varieties of creeping bentgrass (*Agrostis palustris* = *Agrostis stolonifera*), colonial bentgrass (*Agrostis tenuis*) and velvet bentgrass (*Agrostis canina*). All of the modern varieties of these bentgrasses are propagated from seed.

However, earlier varieties, developed from the 1910s to the 1930s, usually arose from mixtures of South German bentgrasses, were vegetatively propagated. These included such creeping bentgrass varieties as Arlington, C-52, Cohansey, Congressional, Collins, Metropolitan, Norbeck. A limited number of vegetatively propagated varieties were developed after 1960 (e.g. Evansville, Toronto and Washington). During this period, a number of colonial bentgrasses and velvet bentgrasses were also utilized.

Attempts to breed seed-propagated varieties culminated in the release of varieties such as Penncross and Pennlu in 1954, by the Pennsylvania Agricultural Experiment Station. Penncross has since become one of the predominant varieties used for golf turf worldwide. Other varieties such as Pennpar and Seaside soon followed.

Pennpar is notable since it was the first variety to be selected based on its tolerance

TABLE 1. HOST RESISTANCE TO DISEASES AFFECTING BENTGRASS

DISEASE	PATHOGEN	RESISTANT VARIETIES
Major Diseases		
Anthracnose	*Colletotrichum graminicola*	Several
Bipolaris Leaf Spot/Melting Out	B*ipolaris sorokiniana*	Several
Brown Patch	*Rhizoctonia solani*	Several
Copper Spot	*Gleocersospora sorghii*	Several
Curvularia Leaf Blight	various *Curvularia* spp.	None Known
Damping-Off	species of *Pythium, Fusarium*, others	Several (Pythium only)
Dollar Spot	*Sclerotinia homoeocarpa*	Several
Drechslera Leaf Spots	various *Drechslera* spp.	Several
Microdochium Patch	*Microdochium nivale*	Many
Pink Patch	*Limonomyces roseipellis*	None Known
Pythium Blight	various *Pythium* spp.	Several
Pythium Root Rot	various *Pythium* spp.	Tracenta
Red Thread	*Laetisaria fuciformis*	Many
Take-All Patch	*Gaeumannomyces graminis* var avenae	Several
Typhula Blight	*Typhula* spp.	Several
Yellow Patch	*Rhizoctonia cerealis*	Several
Yellow Tuft	*Sclerophthora macrospora*	Several

to Typhula blight. This came at a time when nearly all selections were for agronomic characteristics and not disease resistance. This variety is no longer available.

It has only been in the last ten years that there have been serious efforts to generate improved creeping, colonial and velvet bentgrass varieties. The currently available varieties are listed in Table 2.

Much of the breeding effort has involved traditional crosses with selections for improved agronomic characteristics, such as overall quality, color, texture, density, tillering and seedling vigor.

Only recently has there been additional emphasis on management characteristics such as wear tolerance, thatch accumulation, rooting behavior, frost tolerance, heat tolerance, *Poa annua* invasion, fall aerification recovery, tolerance to recycled water and disease resistance.

The Nature of Resistance in Bentgrasses

The breeding of new bentgrass varieties now involves traditional approaches as well as new biotechnological approaches. Traditional approaches involve selection processes whereby a collection of plants possessing disease resistance is evaluated. Crosses between plants possessing the desirable resistance traits and the progeny of those crosses may also be evaluated for the desired resistance traits. Plants possessing the desired level of resistance are then selected for further crossings.

This process is repeated many times until the resistance traits are clearly expressed. This approach to breeding results in cultivars with enhanced levels of disease resistance, with little known about the actual mechanisms underlying the resistance.

This type of breeding generally results in two types of disease resistance: horizontal resistance or vertical resistance. Horizontal resistance, where a number of different genes control the traits of interest, is usually expressed in many of the initial environmental selections and may also be enhanced through crossing and recurrent selection. This type of resistance is generally more durable, yet it can be influenced by envi-

ronmental conditions and predisposing stress-related factors. Consequently, this type of resistance is more variable from location to location.

Vertical resistance, on the other hand, is generally expressed at a high level and is controlled by one or two genes. This type of resistance is less durable than horizontal resistance since it is relatively easy for different races or biotypes of pathogens to overcome the resistance and become a dominant member of the pathogen population.

More recently, there have been attempts to develop new bentgrass cultivars through *in vitro* culture and genetic engineering approaches (8, 11, 12). Work in Texas and Mississippi is aimed at developing tissue culture techniques for enhancing disease resistance in bentgrasses. Work at Michigan State has shown that a gene from elm trees

TABLE 3. REACTION OF BENTGRASS CULTIVARS TO DOLLAR SPOT

Disease Rating (1-9; 9=no disease)

	State in Which Evaluations Were Performed				
Variety	Michigan	Missouri	New Jersey	South Carolina	Max. Difference Between States
Varieties Most Affected by Regional Differences					
Penn A-4	6.7	5.8	4.8	7.7	2.9
Backspin	5.7	5.7	3.2	6.0	2.8
SR 1020	5.3	6.8	4.0	5.0	2.8
Southshore	6.0	5.7	5.3	8.0	2.7
Cato	6.7	6.7	5.5	8.0	2.5
Penn G-6	6.0	6.0	5.3	7.7	2.4
Penncross	5.7	6.3	6.7	8.0	2.3
Tendenz	6.7	6.2	7.8	8.3	2.1
Imperial	6.0	5.5	4.0	5.0	2.0
Century	5.7	4.0	3.7	5.7	2.0
Crenshaw	5.0	3.3	3.0	4.0	2.0
Pro/Cup	5.3	5.2	5.3	7.0	1.8
Varieties Least Affected by Regional Differences					
Seaside	6.7	6.3	6.3	6.3	0.4
Mariner	6.0	6.0	5.0	5.0	1.0
Penn G-2	6.3	6.0	6.0	7.0	1.0
Penn A-1	7.3	7.2	6.5	7.7	1.2
Lopez	5.7	6.0	4.7	6.0	1.3
Pennlinks	7.0	7.5	6.7	8.0	1.3
Trueline	6.7	5.8	5.3	6.3	1.4
Providence	7.3	7.2	5.8	7.3	1.5
18th Green	4.3	3.2	3.2	4.7	1.5
Regent	6.0	6.0	6.3	7.7	1.7
Max. Diff. Among Varieties	3.0	4.3	4.8	4.0	-

TABLE 4. REACTION OF BENTGRASS CULTIVARS TO BROWN PATCH

Disease Rating (1-9; 9=no disease)

	State in Which Evaluations Were Performed				
Variety	Michigan	Missouri	New Jersey	South Carolina	Max. Difference Between States
Varieties Most Affected by Regional Differences					
Penncross	7.7	8.0	6.2	2.3	5.7
Century	7.3	5.7	6.8	2.7	4.6
Seaside	8.0	6.0	4.1	5.0	3.9
Pro/Cup	8.7	7.0	7.1	5.3	3.4
Tendenz	6.0	2.7	3.4	5.0	3.3
Lopez	8.0	8.0	6.9	5.0	3.0
Imperial	6.7	7.0	6.6	4.0	3.0
Penn A-4	5.7	7.0	7.0	4.3	2.7
Providence	8.0	7.7	6.9	5.3	2.7
Regent	8.0	6.0	6.8	5.3	2.7
Cato	8.3	8.0	6.9	5.7	2.6
Penn G-2	5.0	4.7	7.3	5.7	2.6
SR 1020	7.0	6.0	6.2	5.0	2.0
Southshore	7.7	5.7	6.8	6.7	2.0
Pennlinks	7.7	7.3	6.6	5.7	2.0
Varieties Least Affected by Regional Differences					
Crenshaw	7.0	6.7	6.9	6.7	0.3
Penn A-1	6.7	7.3	6.8	7.0	0.6
18th Green	7.3	6.7	7.3	7.3	0.6
Trueline	6.7	6.3	6.7	5.7	1.0
Mariner	5.7	4.3	5.4	5.7	1.4
Backspin	6.7	5.3	6.4	5.7	1.4
Penn G-6	7.3	7.7	7.4	6.0	1.7
Max. Diff.	3.3	5.3	4.0	5.0	-

encoding a chitinase enzyme that degrades the chitinous cell walls of plant pathogenic fungi, can be successfully introduced into Penncross creeping bentgrass to impart disease resistance to these transformants.

This strategy has been successful in generating disease-resistant plants in other cropping systems and is a fruitful strategy for bentgrass breeding.

Future breeding efforts will likely rely heavily on such techniques and there will be greater emphasis on identifying disease resistance genes for the transformation of bentgrass varieties that currently possess other desirable agronomic qualities.

Why Do We Have So Much Disease On Highly Managed Bentgrasses?

One might ask, "Why do we have so many disease problems on highly managed bentgrasses?" There are at least three reasons. First, bentgrasses on golf courses are typically grown under suboptimal agronomic conditions. For example, bentgrasses on most putting greens are grown under excessively low mowing heights, subjected to excessive traffic from golfers and grooming equipment and can be underfertilized or rolled to maintain ball speeds.

Additionally, these same grasses are now grown on high-sand-content greens with low water- and nutrient-holding capacity and low levels of microbial activity.

All of these stress factors tend to predispose bentgrass plants to many disease problems. Because of the abundant and effective supply of fungicides, golf course superintendents have traditionally relied on the application of these materials to minimize disease problems, failing to take advantage of the natural resistance mechanisms built into particular bentgrass varieties.

Greater Disease Resistance

Given the level of resistance to various diseases found in bentgrass cultivars, it is important that this resistance be utilized as the first line of defense in the development of a comprehensive disease management program. Not only will the use of these cultivars reduce overall disease severity, but it will also make other control strategies, whether they be cultural, biological or chemical, more effective and longer lasting.

Among the problems in deciding which cultivars to use in a particular area are the regional differences in environmental conditions and predisposing factors for disease development. Another important factor is the inherent response of the cultivar to disease pressures in different regions.

To illustrate this variability, the following two tables (Table 3 and 4) summarize the reactions of various cultivars to Dollar Spot and Brown Patch diseases in various parts of the country. The regions represented are the lower Midwest (Missouri), the upper Midwest (Michigan), the Northeast (New Jersey) and the Southeast (South Carolina).

Regional effects can be seen in some cultivars more than others. In some situations, the differences between regions may be

TABLE 5. REACTION OF BENTGRASS CULTIVARS TO BROWN PATCH

Reaction of Bentgrass Cultivars to Brown Patch When Grown
At Putting Green Height or at Fairway Height in Different Regions, 1994-1997.

Disease Rating (1-9; 9=no disease)

	Columbia, Missouri			North Brunswick, NJ		
Variety	Putting Green	Fairway	Difference	Putting Green	Fairway	Difference
Penn G-6	7.7	2.3	5.4	7.4	7.0	0.4
Penncross	8.0	3.0	5.0	6.2	6.0	0.2
Cato	8.0	3.3	4.7	6.9	7.2	0.3
Crenshaw	6.7	2.0	4.7	6.9	8.2	1.3
18th Green	6.7	2.3	4.4	7.3	8.0	0.7
Pro/Cup	7.0	2.7	4.3	7.1	7.5	0.4
Lopez	8.0	4.0	4.0	6.9	7.7	0.8
Southshore	5.7	2.0	3.7	6.8	7.2	0.4
Seaside	6.0	2.7	3.3	4.1	4.8	0.7
Trueline	6.3	3.3	3.0	6.7	7.8	1.1
Penn G-2	4.7	2.7	2.0	7.3	7.2	0.1
Tendenz	2.7	2.0	0.7	3.4	4.2	0.8
Providence	7.7	7.3	0.4	6.9	7.8	0.9
Max. Diff. Among Varieties	5.3	5.3	-	4.0	3.4	-

nearly as great as the differences among all cultivars (Table 3). For example, some cultivars that perform best against Dollar Spot in the Southeast (e.g., Tendenz, Southshore, Cato, Penncross), may perform in a mediocre fashion in other regions (e.g., Tendenz in the upper Midwest or Southshore and Cato in the Northeast).

On the other hand, other varieties may perform reasonably well across different regions (e.g., Penn A-1, Pennlinks and Providence).

This regional effect is more pronounced for Brown Patch disease in which the differences in disease severity among regions is far greater than the differences among all varieties (Table 4).

For example, cultivars such as Penncross and Century that perform well in the upper Midwest fail miserably in the Southeast. Other varieties such as Crenshaw, Penn A-1 and 18th Green may perform well across all regions.

Another factor to consider in selecting bentgrass cultivars is its intended use, whether it is to be used on putting greens or on fairways or tees. For example, varieties such as Penn G-6, Penncross and Cato perform well against Brown Patch in the lower Midwest when grown under putting green conditions, but become completely susceptible when grown under fairway conditions (Table 5).

In contrast, however, when these same cultivars are grown in the Northeast, they perform equally well on putting greens or fairways. Varieties such as Providence perform well regardless of region and regardless of whether they are grown on fairways or putting greens, whereas the colonial bentgrass Tendenz is highly susceptible regardless of region or cutting height.

TABLE 6. REACTION OF BENTGRASS TO DOLLAR SPOT, BROWN PATCH

Reaction of Bentgrass Cultivars to Dollar Spot and Brown Patch When Grown Under Traffic Stress And Maintained Under Fairway Conditions, Columbia Missouri 1994-1997.

Disease Rating (1-9; 9=no disease)

	Dollar Spot			Brown Patch		
Variety	No Traffic	Traffic	Difference	No Traffic	Traffic	Difference
Southshore	6.8	5.8	-1.0	2.0	8.0	6.0
18th Green	6.2	5.4	-0.8	2.3	8.3	6.0
Penn G-2	5.9	5.6	-0.3	2.7	8.3	5.6
Penn G-6	6.4	5.7	-0.7	2.3	7.7	5.4
Pro/Cup	6.8	5.9	-0.9	2.7	7.7	5.0
Crenshaw	4.7	3.4	-1.3	2.0	6.7	4.7
Trueline	6.6	5.6	-1.0	3.3	8.0	4.7
Seaside II	7.6	6.3	-1.3	3.3	8.0	4.7
Cato	6.8	5.6	-1.2	3.3	7.7	4.4
Penneagle	6.7	5.8	-0.9	2.7	6.3	3.6
Seaside	7.1	5.6	-0.5	2.7	5.7	3.0
Lopez	7.0	6.0	-1.0	4.0	6.7	2.7
SR 7100	7.7	5.6	-2.1	7.3	5.0	-2.3
Penncross	6.9	5.9	-1.0	3.0	5.3	2.3
Tendenz	7.9	5.9	-2.0	2.0	3.0	1.0
Providence	7.7	5.6	-2.1	7.3	8.3	1.0
Exeter	7.4	5.8	-1.6	3.7	4.7	1.0
Tiger	7.8	5.9	-1.9	2.0	2.7	0.7
Max. Diff.	3.2	2.9	-	5.3	5.3	-

Research is now revealing the importance of stress factors on the reaction of certain bentgrass cultivars to different diseases. For example, from studies conducted in Columbia, Missouri, it was shown that the reaction of bentgrasses cultivars to brown patch can be dramatically affected by traffic stress (Table 6), whereas reactions to dollar spot are not severely affected. In all cultivars tested, imposing traffic stress greatly increased the severity of brown patch, with varieties such as Southshore, 18th Green, Penn G-2 and Penn G-6 being most severely affected. Varieties such as Providence were least affected.

These studies reveal the important impacts of such stress factors on the expression of diseases resistance. Much more research is needed to determine the impacts of these and other management factors on the resistance of improved bentgrass cultivars to important diseases, particularly under putting green conditions. This will be an important area for pathologists to collaborate with breeders.

Resistance Among Bentgrass Cultivars to Damping-off Diseases

Additional disease problems occur on bentgrasses during new turf establishment or overseeding operations. These stand establishment problems occur because of the ubiquitous presence of seed rotting pathogens such as *Pythium*, *Rhizoctonia* and *Fusarium* species combined with ideal environmental conditions for their activity. Factors affecting these important diseases have been described previously.

Among the most important damping-off pathogens are species of Pythium. The more aggressive species are *P. graminicola*, *P. aphanidermatum*, *P. aristosporum*, *P. vanterpoolii*, *P. myriotylum*, *P. tardicrescens* and *P. volutum*. All of these highly aggressive isolates are generally more virulent to creeping bentgrass seedlings at warm temperatures (28 to 32 C) rather than at cooler temperatures (16 C).

Work at Cornell University has demonstrated a wide range of reactions of various bentgrass cultivars to different damping-off Pythium species (Figure 1 and 2).

Our laboratory studies have focused on two of the more important damping-off pathogens in turfgrasses: *Pythium aphanidermatum* and *P. graminicola*. Each of these species is capable of inducing high levels of damping-off in susceptible species. As is clear from the results presented in Figures 1 and 2, there are certain varieties that possess some level of resistance to each of the individual species.

However, the cultivars that are resistant to *P. aphanidermatum* are not the same cultivars that are resistant to *P. graminicola*. For example, National, Penn G-1, Putter, Tiger and Viper were the most resistant cultivars to damping-off incited by *P. aphanidermatum*. However, Penn G-1 and Putter were highly susceptible to *P. graminicola*. Similarly, Backspin, Exeter, LCB703, Lopez and Seaside II were the most resistant to *P. graminicola*. Note that all of these cultivars except Seaside II were highly susceptible to *P. aphanidermatum*.

In field studies conducted in Washington, Bardot and National were the most resistant varieties to damping-off. Based on our laboratory studies, National and Viper have the greatest levels of resistance to both damping-off pathogens.

It should be noted that the same species that cause damping-off in bentgrass seedlings are also the same species that cause root rots and foliar blights in established turf. It is possible that the resistance expressed at the seedling stage may also be expressed in the field.

However, in a limited field study, the most statistically resistant cultivar to Pythium root rot incited by *P. graminicola* was Tracenta. Viper and Egmont also performed reasonably well.

Choosing the Right Variety

Given all of the above information, how can you choose the best variety for your particular site? First, check results of the National Turfgrass Evaluation Program

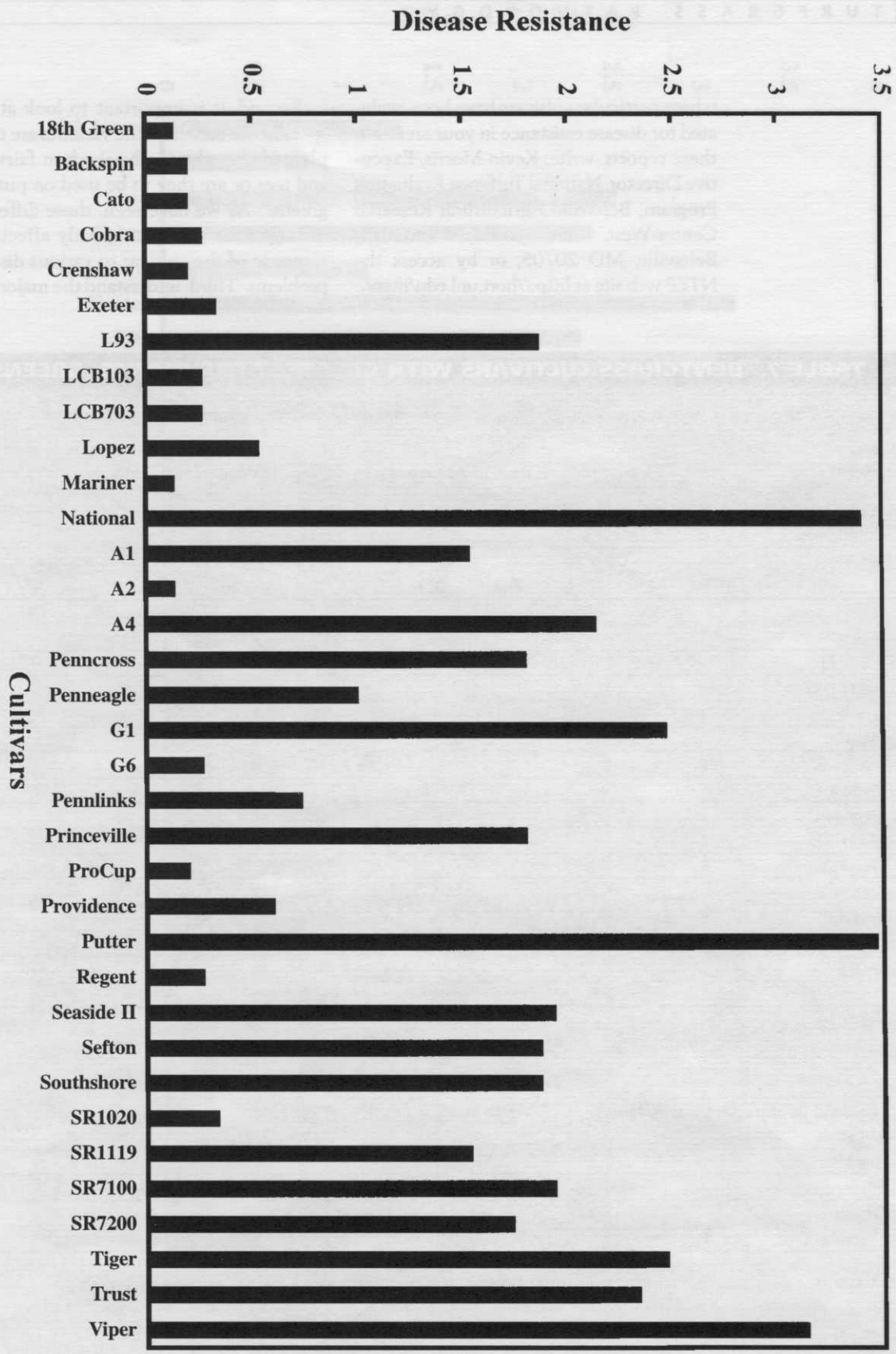

Figure 1. Reaction of bentgrass cultivars to Pythium damping-off caused by Pythium aphanidermatum. Resistance measured on a scale of 0-5 for which 5 = maximum resistance (i.e., no disease)

where particular cultivars have been evaluated for disease resistance in your area. For these reports, write: Kevin Morris, Executive Director, National Turfgrass Evaluation Program, Beltsville Agricultural Research Center-West, Building 002, Room 013, Beltsville, MD 20705, or by access the NTEP web site at http://hort.unl.edu/ntep/.

Second, it is important to look at the specific site on which the varieties are to be planted. Are they to be used on fairways and tees or are they to be used on putting greens? As we have seen, these different management units can greatly affect the response of the cultivar to various disease problems. Third, understand the major dis-

TABLE 7. BENTGRASS CULTIVARS WITH GREATEST RESISTANCE, GREENS

Bentgrass Cultivars with the Greatest Levels of Disease Resistance Grown Under Putting Green Conditions*

Variety	AN	BP	CS	DS	LS	PB	PRR	PSM	TAP	TB	YP
Creeping Bentgrass *(Agrostis stolonifera)*											
18th Green		X	X		X						
Backspin											X
Carmen									X		
Cato		X									
Cobra						X		X			
Emerald						X		X		X	
Loft's L-93		X		X				X		X	X
Lopez	X							X		X	
Mariner					X			X			
National		X						X			
Penn A-1	X			X							
Penn A-4	X										
Penn G-6	X	X									
Penncross			X								
Pennlinks			X					X			
PRO/CUP		X			X	X					
Providence		X		X	X						X
Putter						X			X		
Southshore											X
SR 1020								X	X		
Trueline					X						X
Viper		X									
Colonial Bentgrass *(Agrostis tenuis)*											
Allure				X						X	
Bardot				X				X		X	
Egmont				X						X	
Tendenz			X	X						X	
Tracenta							X	X	X	X	

* Varieties not listed either have no demonstrated resistance to the diseases listed in the table or are not among the most resistant based on NTEP trials

** AN = anthracnose, BP = brown patch, CS = copper spot, DS = dollar spot, LS = Drechslera leaf spots, PB = Pythium blight, PRR = Pythium root rot, PSM = pink snow mold, TAP = take-all patch, TB = Typhula blight, YP = yellow patch.

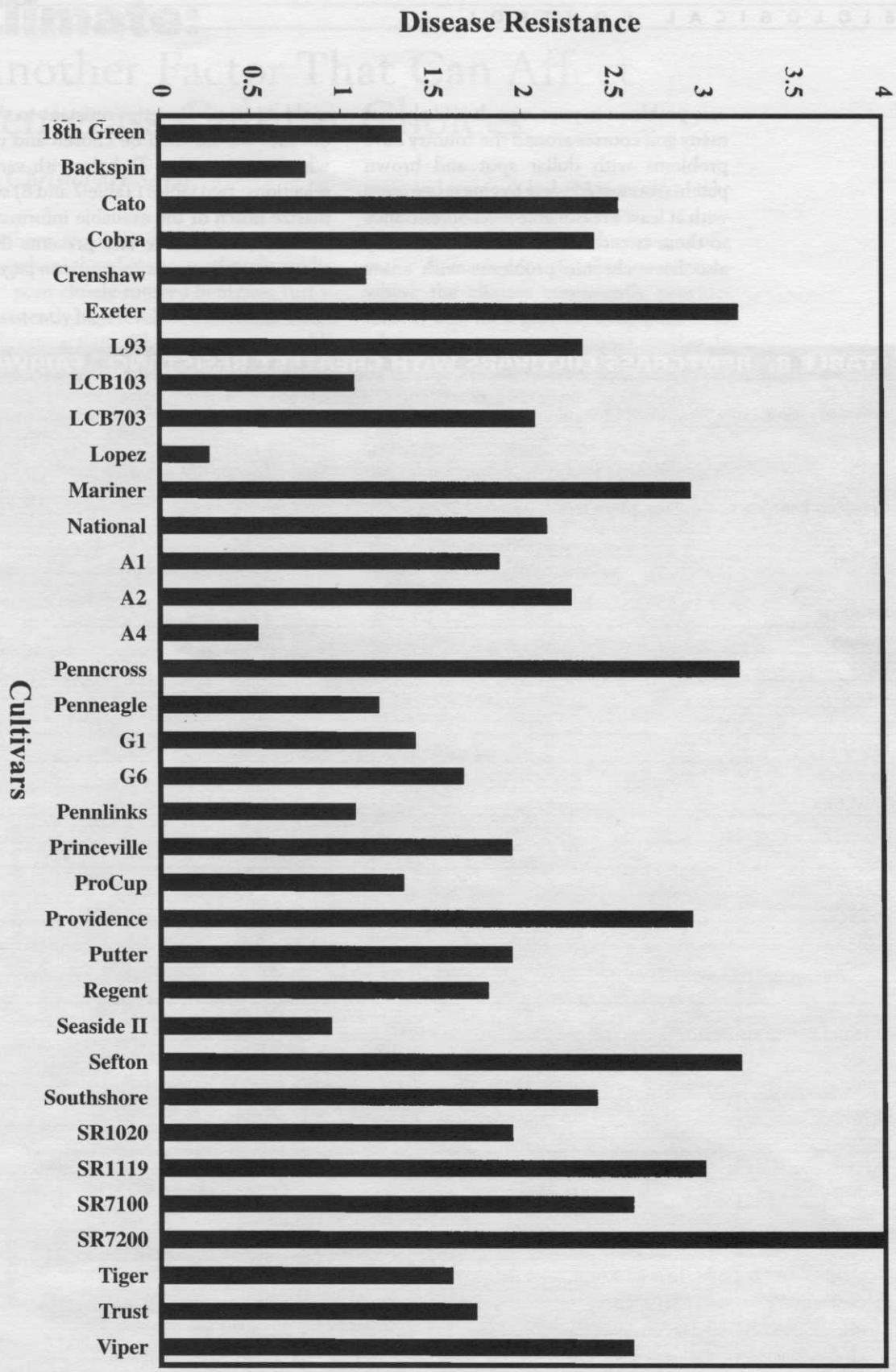

Figure 2. Reaction of bentgrass cultivars to Pythium damping-off caused by Pythium graminicola. Resistance measured on a scale of 0-5 for which 5 = maximum resistance (i.e., no disease)

ease problems in your area. It is likely that many golf courses around the country have problems with dollar spot and brown patch. You would want to choose varieties with at least a reasonable level of resistance to these two diseases. Some course may also have chronic problems with snow mold diseases. Varieties resistant to these diseases should then be chosen and used where appropriate. To help with variety selections, two tables (Table 7 and 8) summarize much of the available information on disease resistance and presents those

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TABLE 8. BENTGRASS CULTIVARS WITH GREATEST RESISTANCE, FAIRWAY

Bentgrass Cultivars with the Greatest Levels of Disease Resistance Grown Under Fairway/Tee Conditions*

Variety	AN	BP	CS	DS	LS	PB	PSM	RT	TAP	TB
Creeping Bentgrass *(Agrostis stolonifera)*										
18th Green		X								X
Carmen					X		X	X		
Cobra					X		X			
Crenshaw					X			X		
Emerald							X	X		
Lopez		X			X		X	X		
Penn G-2									X	
Penn G-6	X									
Penncross					X		X			
Penneagle					X		X	X		X
PRO/CUP								X		
Providence	X							X		
Putter								X	X	
Seaside II				X						
SR 1020							X			
Tiger				X			X			X
Trueline		X					X			
Viper							X	X		
Colonial Bentgrass *(Agrostis tenuis)*										
Allure									X	
Bardot				X					X	
Egmont				X					X	
Exeter				X						X
SR7100				X						X
Tendenz				X						X
Tracenta				X					X	

* Varieties not listed either have no demonstrated resistance to the diseases listed in the table or are not among the most resistant based on NTEP trials

** AN = anthracnose, BP = brown patch, CS = copper spot, DS = dollar spot, LS = Drechslera leaf spots, PB = Pythium blight, PSM = pink snow mold, TAP = take-all patch, TB = Typhula blight, YP = yellow patch.

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varieties with the greatest known levels of resistance to the diseases indicated.

Keep in mind that the specific level of resistance expressed at your site can be affected by many different environmental and cultural factors and the variety you choose may not be highly resistant to all strains of the various pathogens. However, the use of these varieties should ensure that you are taking advantage of the full range of control options as part of your disease management program.

Again, the use of the cultivars should enable all of your other disease management practices to work more effectively, where it will be an important component of a sustainable turf management program.

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