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Mr. William H. Bengeyfield, National Director
U.S.G.A.-Green Section
Box 3375
Tustin, CA 92681

Dear Bill:

This is a Progress Report for the project "Resistance of Bentgrass to *Phialophora* and *Leptosphaeria*." The project was formalized in May, 1985 and work began shortly thereafter. Two special projects were implemented.

A collection of developmental and commercially available bentgrass entries was solicited from Dr. Joe Duich, Pennsylvania State University. Forty-two entries (15 of which are named cultivars) were received in late July and were placed into the screening process on August 29. The standard screen is conducted for 8 weeks in a controlled-environment chamber, but is shortened or lengthened by one or two weeks when evidence exists that the species under study is, as a group, particularly susceptible or tolerant of the pathogens. In September it was evident that some of the bentgrass entries were very susceptible to infection by these pathogens, but that the group as a whole was likely to be evaluated at the end of 8 weeks. The final report on resistance levels among these bentgrasses should therefore be available by November 30. An example of the anticipated report format is enclosed; it describes results for similar screenings recently completed on some Kentucky bluegrasses and perennial ryegrasses. It is further anticipated that the report to the USGA-Green Section will contain detailed information only on the commercial cultivars, and a synopsis of results on the developmental lines. A fully detailed report of results will be sent to Joe Duich.

Three months of study were also performed in anticipation that we would be conducting a similar screening on vegetatively propagated bentgrass lines to be provided by Dr. Milt Engelke. Methodology for the test was developed and local bentgrass samples were run through the system as a test of its ability to achieve results. We found that mature Seaside bentgrass is quite tolerant of attack by *L. korrae*, but not by *P. graminicola*. This supports our field observations that *P. graminicola* is responsible for causing some of the take-all patch on golf courses in New York. Growth and pathogenesis of *P. graminicola* is favored by high temperatures, and patches caused by this fungus are likely to occur only during hot weather. In contrast, *Gaeumannomyces graminis* var. *avenae* is favored by cool to mild temperatures, and causes patches directly during autumn, winter, and spring. Additionally, patches by this pathogen may first become apparent during summer if sufficient stress is placed upon patches of grass that have had their roots debilitated during cooler seasons, and have been unable to completely replace those roots before the onset of additional environmental and cultural stresses. During hot weather, there is no diagnostic short cut that I am aware of that can quickly distinguish between P. graminicola and G. graminis. The former pathogen does not form perithecia, and the latter only does so during cool weather. In short, we have now identified a fungus that can directly cause take-all patch during the heat of summer, and this is in addition to the indirect expression of symptoms that result from root-pruning caused months or weeks earlier by G. graminis. This can be important because applications of chemicals are more likely to reduce the rate of patch enlargement if pathogenesis is currently in progress than if the predisposed plants are simply expressing their inability to cope with the added stresses being placed upon them at a time when the regenerative capacity of the root system is limited by high temperature. That chemicals will be applied in an attempt to stop patch development is a given factor in greens management, and we now have a slightly better understanding as to why these applications may work in some instances but not in others.

In view of my impending departure from Cornell University, the plant materials were not sent by Milt Engleke, and the project has been terminated. Unused funds for the project are being returned to the USGA-Green Section. I wish to thank USGA for supporting this investigation, and I wish that I had been able to follow it through to a more satisfactory conclusion. My move to Oregon State University has come at an inopportune time for this project. A final report on the bentgrass seedling disease screening study will be forthcoming in early winter.

Sincerely,

Richard

Richard W. Smiley
Associate Professor

RWH:rb

Enclosures

xc: Research Committee

EXECUTIVE SUMMARY

"Resistance of Bentgrass to Phialophora and Leptosphaeria"

Seedlots of 42 bentgrasses are being screened for resistance to two isolates for each of two newly recognized root-infecting fungi; *Phialophora graminicola* and *Leptosphaeria korrae*. These fungi cause summer patch and necrotic ring spot diseases, respectively. The resistance studies are conducted for an 8-week period in controlled-environment chambers. Percentages of plants which survive the test will be reported in early winter. Surviving plants from selected seedlots will be returned to the plant breeder from whom the seed was supplied; this may assist in development of selections with higher levels of resistance. Methodology was also developed to conduct similar screening studies on vegetatively propagated bentgrasses. This research revealed the potential for further complexities to exist in the etiology of take-all patch of bentgrasses, which have been thought to be caused only by *Gaeumannomyces graminis* var. *avenae*. In New York, it is now also known that *P. graminicola* causes a hot weather form of take-all patch on bentgrasses, and this possibility was confirmed during the development of methods for this project, sponsored by the USGA-Green Section. These new findings have relevance to the likelihood that certain disease management strategies will or will not be effective during summer. The project was terminated prematurely because the principal investigator moved to another position.

KENTUCKY BLUEGRASS (Poa pratensis L.)
Necrotic ring spot; Leptosphaeria korrae
Summer patch; Phialophora graminicola

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RESISTANCES OF KENTUCKY BLUEGRASS TO ROOT ROTS BY LEPTOSPHAERIA KORRAE AND PHIALOPHORA GRAMINICOLA, 1985: Eighty-one entries in the National Turfgrass Evaluation Program's (NTEP) 1980 Kentucky Bluegrass Test were screened in the greenhouse for seedling resistance to root rots caused by L. korrae and P. graminicola. The tests were conducted in 196-Cavity Seedling Trays (Slater Supply Co., Inc. Farmingdale, N.Y.), having plastic cavities 2.5 x 2.5 x 7.6 cm. The bottom 2 cm of each cavity was filled with a greenhouse soil mix (sandy loam + peat + sand), and the soil mix was covered with a 2-cm layer of very fine, white playbox sand. Three units of fungal inoculum were placed on the sand, and were covered by a 1-cm layer of sterile coarse gravel. Twenty seeds of Kentucky bluegrass were then placed on the gravel and were covered by an additional 1-cm layer of gravel. One unit of inoculum consisted of one autoclaved perennial ryegrass seed that was then infested with the test fungus, and then air dried and stored until needed. The test fungi included two isolates of L. korrae (#114 and 236) and two of P. graminicola (#57-84 and 197); 4 replicates of each bluegrass entry were tested against each of the 4 test fungi. Seedlings were watered daily and mowed at 2-cm height once each week. Plants were incubated at 20 C for 65 days in the L. korrae tests, and at 20 C for 34 days and then 29 C for an additional 18 days in the P. graminicola tests. Photon flux densities were about 280 uM during the 14-hr photoperiods in each growth chamber. At the end of the tests the surviving plants were counted, removed from the cavity containers, and then the roots were washed and inspected for presence of the test fungus. Numbers of surviving plants in the fungus-infested cavities were compared with those in the non-infested controls, and data is not reported for grass entries which failed to achieve 40% stand establishment in the non-infested controls. The described screening procedure is considered a severe test of seedling resistance to these pathogens.

Seeds of four entries (PSU-150, Somerset [SH-1], K3-162, and Barblue) in the National Test were not supplied. Many of the bluegrass entries did not germinate well in this test that was conducted 5 yr after the seeds were deposited into the NTEP program by their producers. The numbers of entries meeting the qualification of 40% germination and stand establishment were 53 in the L. korrae test, and 19 in the P. graminicola test; seed germinability dropped markedly between tests, possibly due to local seed storage conditions. Variability (sometimes in an extreme form) often existed for resistance levels expressed by a single bluegrass entry to the two isolates of each fungus species tested. The mean for tests with the two isolates is reported here; it is unimportant that a grass cultivar is resistant to one strain of a root-infecting fungus if it is also very susceptible to infection by another strain. None of the bluegrass entries ranked within the best 5% against both isolates of either pathogen, or within the top 10% for both isolates of L. korrae. Only Eclipse and Fylking ranked within the top 15% for both isolates of L. korrae; Ram 1, Nugget, S-21, and Charlotte ranked within the top 25%. Escort was within the best 10% of entries tested against both isolates of P. graminicola. Bono was within the top 15%, and Birka and Touchdown were within the top 25%. None of the Kentucky bluegrasses was ranked within the top 25% of entries in tests conducted against both pathogens, but seed germinability was poor in seedlots of several cultivars that are thought to perform well against both diseases in the field.

Kentucky Bluegrass	Survival[1] P. graminicola	Survival[1] L. korrae	Kentucky Bluegrass	Survival P. graminicola	Survival L. korrae
A-20	-[2]	-	Lovegreen	-	-
A-20-6	-	-	Majestic	-	-
A-20-6A	-	-	Mer PP 43	1.8 (15)	34.9 (18)
A-34	-	-	Mer PP 300	-	34.5 (19)
Adelphi	-	-	Merion	-	-
Admiral	-	-	Merit	-	31.4 (24)
America	-	-	Midnight	-	22.5 (37)
Apart	-	7.5 (52)	MLM-18011	-	25.0 (31)
Argyle	3.6 (13)	34.3 (20)	Mona	-	26.7 (29)
Aspen	-	14.6 (46)	Mosa	-	12.5 (48)
BA-61-91	-	15.1 (45)	Monopoly	-	41.8 (8)
Banff	-	-	Mystic	0 (19)	37.3 (15)
Baron	-	24.6 (32)	N535	-	-
Bayside	-	40.2 (11)	Nassau	-	23.0 (35)
Birka	36.0 (4)	38.6 (13)	NJ 735	20.9 (6)	12.3 (49)
Bonnieblue	-	-	Nugget	-	44.0 (5)
Bono	52.7 (1)	37.5 (14)	Parade	-	22.6 (36)
Bristol	-	-	Piedmont	-	-
CEB VB 3965	-	29.6 (25)	Plush	-	24.1 (33)
Cello	-	10.8 (51)	PSU-150	-	-
Charlotte	-	42.0 (7)	PSU-173	-	-
Cheri	-	27.7 (27)	PSU-190	8.1 (11)	39.9 (12)
Columbia	-	-	RAM-1	12.7 (9)	53.5 (1)
Dormie	0 (19)	18.8 (40)	Rugby	-	15.5 (44)
Eclipse	-	50.7 (2)	S-21	0 (19)	49.2 (4)
Enmundi	8.5 (10)	27.6 (28)	Shasta	-	-
Enoble	-	40.9 (10)	South Dakota Common	-	25.6 (30)
Escort	52.5 (2)	5.7 (53)	SV-01617	-	17.5 (42)
Fylking	-	50.0 (3)	Sydsport	-	-
Geronimo	-	18.8 (40)	Touchdown	40.7 (3)	34.1 (21)
Glade	13.0 (8)	43.1 (6)	Trenton	-	19.4 (39)
H-7	-	-	Vanessa	-	13.0 (47)
Harmony	-	-	Vantage	-	-
Holiday	-	-	Victa	23.3 (5)	41.3 (9)
I-13	-	-	Wabash	-	35.7 (17)
K1-152	0.7 (16)	24.1 (33)	Welcome	19.4 (7)	20.5 (38)
K3-178	-	-	WW Ag 463	-	10.9 (50)
K3-179	-	29.4 (26)	WW Ag 478	-	15.9 (43)
Kenblue	-	-	WW Ag 480	-	-
Kimono	6.1 (12)	32.1 (22)	225	3.1 (14)	36.7 (16)
			239	-	31.5 (23)

[1] Percentage survival of seedlings in fungus-infested cavities, as compared to non-infested controls. Numbers in parenthesis indicate the ranking position within columns, with 1 = highest seedling survival rate.
[2] Missing data indicate that fewer than 40% of the seeds planted in the uninoculated controls produced seedlings. Data for these tests are excluded because they were considered to be unduly biased by the poor seedling establishment rate.

PERENNIAL RYEGRASS (Lolium perenne L.)
Necrotic ring spot; Leptosphaeria korrae
Summer patch; Phialophora graminicola

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RESISTANCES OF PERENNIAL RYEGRASSES TO ROOT ROTS BY LEPTOSPHAERIA KORRAE AND PHIALOPHORA GRAMINICOLA, 1985: Thirty-eight entries in the National Turfgrass Evaluation Program's (NTEP) 1982 Perennial Ryegrass Test were screened in the greenhouse for seedling resistance to root rots caused by L. korrae and P. graminicola. The tests were conducted in 196-Cavity Seedling Trays (Slater Supply Co., Inc., Farmingdale, N.Y.), having plastic cavities 2.5 x 2.5 x 7.6 cm. The bottom 2 cm of each cavity was filled with a greenhouse soil mix (sandy loam + peat + sand), and the soil mix was covered with a 2-cm layer of very fine, white playbox sand. Three units of fungal inoculum were placed on the sand, and were covered by a 1-cm layer of sterile coarse gravel. Twenty seeds of ryegrass were then placed on the gravel and were covered by an additional 1-cm layer of gravel. One unit of inoculum consisted of one autoclaved perennial ryegrass seed that was then infested with the test fungus, and then air dried and stored until needed. The test fungi included two isolates of L. korrae (#114 and 236) and two of P. graminicola (#57-84 and 197); 4 replicates of each ryegrass entry were tested against each of the 4 test fungi. Seedlings were watered daily and mowed at 2-cm height once each week. Plants were incubated at 20 C for 74 days in the L. korrae tests, and at 20 C for 15 days and then 29 C for an additional 51 days in the P. graminicola tests. Photon flux densities were about 280 uM during the 14-hr photoperiods in each growth chamber. At the end of each test the surviving plants were counted, removed from the cavity containers, and then the roots were washed and inspected for presence of the test fungus. Numbers of surviving plants in the fungus-infested cavities were compared with those in the non-infested controls. Since the colonization of perennial ryegrass entries by L. korrae differed, a root blackening index (1 = completely blackened root system; 9 = completely white roots) was assigned to further separate the resistances of platns in that test. The described screening procedure is considered a severe test of seedling resistance to these pathogens.

Seeds were not supplied for nine of the entries in the National Test; including Blazer, Manhattan II, Omega, NK 80389, NK 79307, NK 79309, Linn, Delray, and Repell. The survival mean for tests against both isolates of each fungus species is reported here. None of the ryegrass entries ranked within the best 5% against both isolates of either pathogen, or within the top 10 and 15% for both isolates of L. korrae. Pennant, Pennfine, All Star and Gator ranked within the top 25% for both isolates of L. korrae. Fiesta was within the best 10% of entries tested against both isolates of P. graminicola, Palmer and Acclaim were within the top 15% and Mom Lp 702 and M-382 were within the top 25%. None of the perennial ryegrasses was ranked within the top 25% of entries in tests conducted against both pathogens.

	Survival[1]		
Perennial Ryegrass	P. graminicola	L. korrae	Root Blackening[2]
Acclaim	53.4 (1)	71.0 (17)	.58 (23)
All-Star	1.8 (32)	87.5 (2)	.53 (32)
Barry	30.7 (10)	49.4 (37)	.48 (36)
Birdie II	16.5 (24)	55.4 (34)	.55 (26)
BT-1	33.3 (9)	74.7 (14)	.60 (17)
Cigil	0 (38)	49.0 (38)	.53 (29)
Citation	7.0 (28)	65.7 (24)	.53 (29)
Citation II	11.0 (27)	76.5 (11)	.53 (31)
Cockade	0.6 (33)	55.9 (33)	.49 (34)
Cowboy	3.5 (31)	71.2 (16)	.58 (20)
Crown	15.9 (25)	76.6 (10)	.63 (15)
Cupido	0 (38)	61.1 (28)	.65 (10)
Dasher	0 (38)	63.6 (27)	.54 (27)
Derby	22.6 (19)	72.7 (15)	.70 (1)
Diplomat	21.1 (20)	66.6 (22)	.59 (19)
Elka	27.0 (14)	76.3 (12)	.69 (2)
Fiesta	48.8 (3)	70.6 (18)	.58 (21)
Gator	14.1 (26)	92.4 (1)	.58 (21)
HE-168	4.2 (30)	65.6 (25)	.66 (8)
HE-178	17.7 (22)	81.5 (3)	.63 (16)
HR-1	30.2 (12)	68.6 (21)	.67 (7)
M-382	34.0 (8)	77.8 (7)	.64 (11)
Manhattan	0 (38)	59.7 (30)	.47 (37)
Mom Lp 210	5.8 (29)	58.2 (31)	.49 (34)
Mom Lp 702	40.5 (5)	70.0 (19)	.69 (2)
Mom Lp 736	16.7 (23)	54.3 (36)	.60 (17)
Mom Lp 792	26.5 (15)	75.0 (13)	.64 (11)
Palmer	48.9 (2)	57.2 (32)	.57 (24)
Pennant	18.7 (21)	78.2 (5)	.69 (5)
Pennfine	37.5 (6)	80.9 (4)	.64 (14)
Pippin	27.2 (13)	60.2 (29)	.56 (25)
Prelude	23.9 (18)	77.5 (9)	.69 (4)
Premier	30.7 (10)	65.2 (26)	.46 (38)
Ranger	0 (38)	77.8 (7)	.64 (13)
Regal	26.3 (16)	69.7 (20)	.53 (28)
SWRC-I	25.6 (17)	55.2 (35)	.66 (8)
WWE-19	40.7 (4)	77.9 (6)	.69 (6)
Yorktown II	34.9 (7)	65.8 (23)	.53 (32)

[1] Percentage survival of seedlings in fungus-infested cavities, as compared to non-infested controls. Numbers in parenthesis indicate the ranking position within columns, with 1 = highest seedling survival rate.
[2] Root blackening (1 = totally black; 9 = completely white) index is the ratio of ratings for plants inoculated with L. korrae to the uninoculated controls. Numbers in parenthesis indicate the ranking position within columns, with 1 = least discolored root system.