USGA TURFGRASS PATHOLOGY RESEARCH

FIFTH ANNUAL PROGRESS REPORT 1991

INDEX

USGA Report November 1991

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Executive Summary

USGA research on resistance of bentgrasses and zoysiagrasses to Pythium and Rhizoctonia blight diseases is completing the fifth year of study. This report covers the period May to November 1991. Progress during the period has centered on assessments of germplasm material from the HTS and NHTS Germplasm Introduction Nursery (GPIN) and new germplasm lines from a genetic crossing block with parental bentgrass lines that include genotypes that are resistant to one or both of the diseases. Virulent isolates of USGA culture collections for both pathogens are being used for the disease resistance screening program.

Plant samples obtained from HTS and NHTS bentgrass field plots were inoculated in the walk-in growth chamber which simultaneously evaluated 720 test cells for resistance to root rot disease caused by Pythium spp. The plant samples represented genotypic segregates of seven varieties in each of the field nurseries. Soil cores containing the plants were placed in growing trays which were partially submerged in

sterile water and inoculated with Pythium aphanidermatum. Observations on the death of the field plugs were recorded over a four week period under high humidity in the laboratory. Root rot resistance among 720 genotypes was greater in the NHTS bentgrass nursery than in the HTS nursery. These observations are consistent with previous observations on Pythium blight visual ratings on the field plots during 1990.

Pythium inoculations of established germplasm lines from a genetic crossing block were made on a greenhouse sand heat bench used for identifying heat stress tolerant bentgrass genotypes. Limited disease ratings which were obtained with plants inoculated on the greenhouse bench required further testing of the genotypes in the walk-in growth chamber. Inoculations in the walk-in chamber using previously established methods with cups gave significantly higher disease ratings on the same genetic material. In contrast to greenhouse studies which allowed only low disease pressure, 38% of the population was susceptible to Pythium foliar blighting four days after inoculation.

I. Introduction:

On 17 February, 1987, the Texas Agricultural Experiment Station and the Texas A&M University Research Foundation accepted research funds as per contract agreement (FPN 5654000) with the United States Golf Association to conduct investigations to develop Rhizoctonia brown patch and Pythium disease resistance in bentgrass and zoysiagrass.

This is a cooperative project with the turfgrass breeding and development efforts for both grasses, under the direction of Dr. Milton C. Engelke also at the Texas A&M University Research and Extension Center at Dallas, Texas. This fifth annual research annual research report is for the period 1 May 1991 to 1 November 1991, and represents the past six months of active research on the cooperative disease assessment project.

II. Project Personnel:

Mr. Shawn Harvanek who was my summer assistant on the USGA project in 1990 returned to college as a full time student last fall and he was replaced this summer by Laura Knoop and more recently by Michael Cotton. Both Knoop and Cotton have been involved in inoculation studies and the determination of root resistance among bentgrass lines from the seven commercial varieties planted in the NHTS and HTS bentgrass nurseries. Laura Knoop returned to high school this fall and Mr. Cotton is continuing the USGA research. Mike is a Plano, TX high school graduate and has been involved with yard work for the past eight years at his church in Richardson. Since joining my staff in September, he has demonstrated excellent abilities in handling equipment and data collection for the pathology project.

III. Pythium Diseases Ongoing Research:

Isolate Collection and Storage:

The USGA Pythium isolate collection was again assembled for yearly long-term preservation through encapuslation of the

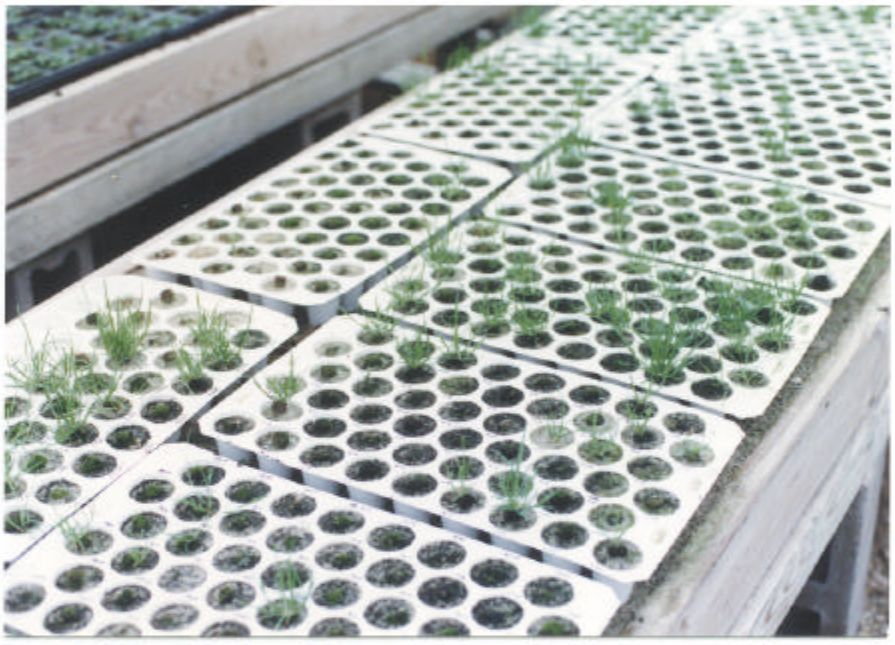

Fig. 1. Surviving bentgrass germplasm lines following root inoculation of 720 plant samples with Pythium aphanidermatum for four weeks.

cultures during the winter months. Several of the Pythium cultures in deionized water vials were not viable which indicates the continual need to make transfers in order to maintain viable cultures. Pythium spp. isolates for most of the collection are more than four years old and new isolates are being sought to increase the availability of pathogenic strains in the collection. At the present time 17 strains of Pythium are being maintained in deionized water vials and on potato-dextrose agar slants in triplicate in order to prevent further losses of the remaining isolates. New isolates of Pythium spp. will be added to the collection as they become available. The pathogenicity of the collection will be determined after collecting more isolates from bentgrass greens where root diseases are a problem. During the summer months, two attempts to characterize the pathogenicity of the present Pythium collection were not successful because of the presence of fungicide residue on Penncross bentgrass which was collected from local golf courses.

Inoculation Studies to Determine Resistance to root rot:

Soil core samples obtained from HTS and NHTS field plots were placed in plastic growing trays with 38 cells/tray (5.5 cm). Collections of field plugs for this experiment yielded some 720 experimental grasses with the sampling of 40 rows of field plots with 18 progeny plants for each variety and field plot area (Fig. 1). The trays containing the cores were placed in a large plastic crisper containing 6.5 cm deep

sterile pond water. Each of the cells containing grass plugs was inoculated with Pythium aphanidermatum (P-24) and incubated under moisture-saturated conditions for several days. The inoculated plants in crispers were placed in the laboratory with 100 fc lighting for 10 days and were subsequently moved to a walk-in inoculation chamber with similar lighting for an additional 13 days at 26 C.

The observations of the root rot study were generally consistent with observations of Pythium blight ratings on the field plots (Tables 1, 2). Both studies indicated a greater resistance to Pythium blight in the NHTS germplasm nursery. The rate of Pythium induced rot and crown death among members of the collection varied considerably. There did not appear to be a single parental line that gave more resistant selections than any other variety (Tables 1, 2). In the screening of genetic materials for this study, 20% of the population of plants demonstrated some resistance to root disease (Table 3). There were more resistant genotypes in the HTS (17%) than the NHTS (22%) field plot nurseries. A question that comes to mind is whether the NHTS or HTS plant nursery gave the most resistance for Pythium in the two studies we conducted. Of genotypes showing no (0%) disease, there were 224 in the NHTS and only 78 in the HTS treated block (Table 3). Of the genotypes showing less than 25% disease, there were 315 for NHTS and 202 for HTS. Of the genotypes showing more than 50% disease symptoms 82 germplasm lines were observed in the HTS nursery while only 26 were observed in the NHTS nursery. These

Table 1. Susceptibility of genetic segregates of seven HTS nursery bentgrass varieties to Pythium root rot (0-3 max) following inoculation with P. aphanidermatum.

Var.	Plot Number	Observation Date 7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
EMERALD HTS	101	1	1	0	0	0	0	0	0	0.3	+
	102	1	1	1	1	1	1	1	1	1	-
	103	1	1	0	1	0	1	1	1	0.8	-
	104	1	1	0	0	0	0	0	0	0.3	+
	105	0	0	0	0	0	0	0	0	0	+
	106	1	1	1	1	1	1	1	1	1	-
	107	0	0	0	0	0	0	0	0	0	-
	108	1	1	0	1	1	1	1	1	0.9	-
	109	1	1	0	0	0	0	0	0	0.3	+
	110	1	1	1	1	1	1	1	1	1	+
	111	1	1	1	1	1	1	1	1	1	-
	112	2	2	1	1	1	1	2	2	0.2	-
	113	1	1	1	0	0	1	1	1	0.8	-
	114	1	1	1	1	1	1	1	1	1	-
	115	2	1	0	0	0	0	1	1	0.6	+
	116	1	1	1	1	1	1	1	1	1	++
	117	1	1	1	1	1	1	1	1	1	++
	118	2	2	2	1	1	1	2	2	0.2	+
PENNEAGLE HTS	201	2	2	2	1	1	1	2	2	0.2	++
	202	2	3	3	2	2	2	3	3	0.2	-
	203	3	2	2	1	1	1	2	2	0.2	-
	204	2	2	1	1	1	1	1	1	1	-
	205	2	2	2	1	1	1	2	2	0.2	-
	206	2	2	1	1	1	1	1	1	1	+
	207	2	1	1	0	0	1	1	1	0.9	-
	208	1	1	1	1	1	1	1	1	1	+
	209	1	1	1	1	1	1	1	1	1	+
	210	2	2	1	1	1	1	1	1	1	-
	211	2	2	1	1	1	1	1	1	1	+
	212	1	1	1	0	1	1	1	1	0.9	-
	213	3	2	2	2	2	1	2	2	2	+
	214	2	2	2	2	2	1	2	2	0.2	-
	215	1	1	1	1	1	1	1	1	1	+
	216	1	1	2	1	1	1	1	1	1	+
	217	1	1	0	1	1	1	1	1	0.9	+
	218	2	2	2	1	1	1	1	2	0.2	-

Table 1. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
ISI HTS	301	2	2	1	1	1	1	1	1	1	+
	302	2	2	2	1	1	1	2	2	0.2	+
	303	1	1	1	1	1	1	1	1	1	-
	304	1	1	1	1	1	1	1	1	1	-
	305	2	3	2	1	1	1	2	2	0.2	-
	306	2	2	2	1	1	1	2	1	0.2	-
	307	2	2	2	1	1	1	2	1	0.2	-
	308	2	2	2	2	1	1	2	1	0.2	+
	309	2	1	2	1	1	1	1	1	1	-
	310	2	2	1	1	1	1	1	1	1	+
	311	3	2	2	1	1	1	2	1	0.2	+
	312	2	2	2	2	1	1	2	1	0.2	-
	313	2	2	2	2	1	1	2	1	0.2	-
	314	2	2	2	2	1	1	2	1	0.2	+
	315	1	2	2	1	1	1	1	1	1	-
	316	2	2	1	1	1	1	2	0	1	-
	317	2	2	2	1	1	1	2	1	0.2	-
	318	1	0	1	1	1	1	1	1	0.9	-
PENNLINKS HTS	401	3	3	2	2	1	1	3	2	0.2	-
	402	2	2	2	2	1	1	3	1	0.2	-
	403	2	2	2	2	1	1	1	0	1	-
	404	2	3	2	2	2	1	1	0	0.2	-
	405	2	2	2	1	1	0	1	1	1	-
	406	2	2	1	1	1	1	2	1	1	-
	407	3	3	3	2	2	1	1	1	2	-
	408	2	2	2	1	1	1	1	1	1	-
	409	2	2	2	1	1	1	1	0	1	-
	410	2	2	2	1	1	1	2	1	0.2	-
	411	2	1	2	1	1	1	2	1	1	-
	412	2	2	1	1	1	1	2	2	0.2	+
	413	1	1	1	1	1	1	1	1	1	-
	414	2	2	1	1	1	1	2	2	0.2	+
	415	3	3	2	2	2	1	3	2	0.2	++
	416	1	1	1	1	1	1	2	1	1	-
	417	1	1	1	1	1	1	1	1	1	-
	418	2	1	1	1	1	1	1	0	1	-
DUCHESS HTS	501	3	3	2	2	2	2	3	0	2	-
	502	1	1	1	1	1	1	1	0	0.9	+
	503	3	2	2	1	1	0	1	0	1	-
	504	2	2	2	1	1	1	1	1	0.4	-
	505	2	2	2	1	1	1	2	2	0.2	+
	506	1	2	1	1	1	1	1	1	1	-
	507	1	1	1	1	1	1	1	0	0.9	-
	508	1	1	1	1	1	1	1	0	0.9	-
	509	2	2	1	1	1	1	2	0	1	-

Table 1. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
	510	1	2	1	1	1	1	1	0	1	-
	511	1	2	2	1	1	1	2	0	1	-
	512	3	3	3	2	2	2	3	3	0.3	-
	513	1	2	1	1	1	1	2	2	1	-
	514	2	2	2	1	1	1	3	2	0.2	-
	515	1	2	1	1	1	1	2	1	1	+
	516	2	2	2	2	1	1	3	2	0.2	+
	517	0	0	0	0	0	0	0	1	0.1	+
	518	1	1	1	1	1	1	2	1	1	-
PROMINENT HTS	601	2	1	1	1	1	1	1	0	1	+
	602	3	2	2	2	2	1	2	0	0.2	++
	603	2	2	1	1	1	1	2	2	0.2	-
	604	1	2	1	1	1	1	1	1	1	-
	605	2	1	1	1	1	1	1	1	1	+
	606	2	1	2	1	1	1	2	0	1	-
	607	2	2	2	1	1	1	2	0	1	-
	608	2	1	2	1	1	1	1	0	1	-
	609	2	0	0	0	0	0	0	0	0.3	-
	610	0	3	2	2	1	1	2	0	1	-
	611	2	2	2	1	1	1	1	0	1	+
	612	1	2	2	1	1	1	2	1	1	-
	613	1	2	1	1	1	1	1	1	1	-
	614	2	1	1	1	1	1	1	1	1	-
	615	1	1	1	1	1	1	1	1	1	-
	616	1	1	1	1	1	1	1	1	1	-
	617	1	1	1	1	1	1	1	1	1	-
	618	2	2	1	2	1	1	1	2	0.2	+
PENNCROSS HTS	701	2	2	2	1	1	1	2	2	0.2	+
	702	3	2	2	1	2	1	2	2	0.2	-
	703	3	3	2	2	2	1	2	2	2	+
	704	2	2	1	1	1	1	1	1	1	-
	705	2	2	2	1	1	1	2	1	0.2	-
	706	2	2	2	2	2	1	3	2	2	-
	707	1	1	1	1	1	1	1	1	1	-
	708	2	2	2	2	1	1	2	2	0.2	-
	709	2	3	2	1	1	1	2	1	0.2	-
	710	0	0	0	0	0	0	1	1	0.3	-
	711	2	2	2	2	1	1	3	2	0.2	+
	712	2	3	2	2	2	1	3	3	2	-
	713	3	2	2	1	1	1	1	1	0.2	-
	714	2	1	1	1	1	1	2	1	1	-
	715	3	2	2	1	1	1	2	2	0.2	-
	716	2	2	2	1	1	1	2	1	0.2	-
	717	2	2	2	1	1	1	2	1	0.2	-
	718	3	3	2	2	1	1	2	1	0.2	-

Table 1. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
PENNLINKS HTS	801	1	1	1	1	1	1	1	1	1	-
	802	1	2	2	2	1	1	2	1	0.2	-
	803	1	1	1	1	1	1	1	1	1	-
	804	2	2	2	1	1	1	2	1	0.2	+
	805	2	2	2	2	1	1	2	1	0.2	+
	806	2	2	1	1	1	1	2	1	1	-
	807	2	2	1	1	1	1	2	1	1	-
	808	0	0	0	0	0	1	1	1	0.4	-
	809	2	1	1	1	1	1	1	1	1	-
	810	1	0	1	1	1	0	1	1	0.8	-
	811	1	1	1	2	1	0	2	1	1	-
	812	2	2	2	2	1	1	2	1	0.2	-
	813	2	1	1	1	1	1	1	1	1	+
	814	2	1	1	1	1	1	1	1	1	-
	815	1	1	1	0	1	1	1	1	0.9	-
	816	1	1	1	1	1	1	1	1	1	-
	817	1	0	0	0	0	0	1	1	0.4	-
	818	1	2	2	1	1	1	2	1	1	+
PENNEAGLE HTS	901	1	1	0	1	1	1	1	1	0.9	+
	902	2	2	1	1	1	1	1	1	1	-
	903	1	1	0	0	1	1	1	1	0.8	+
	904	1	1	1	1	1	1	1	1	1	-
	905	1	2	1	1	1	1	1	1	1	-
	906	1	2	1	1	1	1	1	1	1	-
	907	2	2	1	1	1	1	1	1	1	+
	908	2	1	1	1	1	0	2	1	1	-
	909	3	2	2	2	1	1	1	2	0.2	+
	910	2	2	1	1	1	1	1	1	1	-
	911	1	0	0	1	1	0	1	1	0.6	-
	912	1	0	0	0	1	0	1	1	0.5	-
	913	1	0	0	0	1	0	1	1	0.5	-
	914	1	1	1	1	1	1	1	1	1	+
	915	1	0	0	0	1	0	1	1	0.5	-
	916	1	1	1	1	1	1	1	1	1	+
	917	1	1	1	1	1	1	1	1	1	-
	918	2	2	1	1	1	1	2	1	1	-
PROMINENT HTS	1001	1	1	1	1	1	1	1	1	1	-
	1002	1	1	1	1	1	1	1	1	1	-
	1003	0	0	0	0	0	0	0	1	0.1	-
	1004	1	1	1	1	1	1	1	1	1	-
	1005	1	1	1	1	1	0	1	1	0.9	-
	1006	3	3	3	2	2	2	2	2	0.2	-
	1007	1	0	1	1	0	0	1	1	0.6	-
	1008	2	1	1	1	1	1	1	1	1	-
	1009	1	0	0	1	1	1	1	1	0.8	-
	1010	2	1	1	1	1	1	1	1	1	-

Table 1. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
	1011	0	0	0	0	0	1	0	1	0.3	-
	1012	2	1	1	1	1	1	1	1	1	-
	1013	2	2	1	1	1	1	1	1	1	-
	1014	1	1	1	1	1	1	1	1	1	-
	1015	1	1	1	1	1	1	1	1	1	-
	1016	1	1	1	1	1	1	1	1	1	+
	1017	1	0	1	1	1	1	1	1	0.9	-
	1018	1	1	1	1	1	1	1	1	1	+
EMERALD HTS	1101	0	1	1	1	1	1	1	1	0.9	-
	1102	3	2	1	1	1	1	1	1	1	-
	1103	2	0	1	1	1	1	1	1	1	-
	1104	0	0	0	0	0	0	1	1	0.3	-
	1105	2	2	1	1	1	1	1	1	1	-
	1106	1	1	1	1	1	1	1	1	1	-
	1107	2	1	1	1	1	1	1	1	1	-
	1108	3	2	2	1	1	1	1	1	0.2	-
	1109	2	1	1	1	1	1	1	1	1	-
	1110	2	1	1	1	1	1	1	1	1	-
	1111	1	1	1	1	1	1	1	1	1	+
	1112	2	1	1	1	1	1	1	1	1	-
	1113	1	1	1	1	1	1	1	1	1	-
	1114	1	1	0	1	1	0	1	1	0.8	-
	1115	3	2	2	2	1	1	2	2	0.2	-
	1116	0	0	1	1	1	1	1	1	0.8	-
	1117	0	0	0	0	1	0	1	1	0.4	-
	1118	3	2	2	2	1	1	2	1	0.2	-
PENNCROSS HTS	1201	2	2	1	2	1	1	2	1	0.2	-
	1202	1	1	1	1	1	1	1	1	1	-
	1203	1	1	1	1	1	1	1	1	1	-
	1204	1	1	1	1	1	1	1	1	1	-
	1205	1	1	0	1	1	1	1	1	0.9	-
	1206	2	1	1	1	1	1	1	1	1	-
	1207	2	1	1	1	1	1	1	1	1	-
	1208	0	0	1	0	0	0	0	0	0.1	-
	1209	1	1	1	1	1	1	1	1	1	-
	1210	1	1	1	1	1	1	2	1	1	-
	1211	2	2	2	2	2	1	1	2	0.2	-
	1212	1	1	1	1	1	1	1	1	1	++
	1213	1	1	1	1	1	1	1	1	1	-
	1214	2	1	1	1	1	1	1	1	1	+
	1215	0	0	0	0	0	0	0	0	0	-
	1216	2	1	2	1	1	1	1	2	1	-
	1217	2	1	1	1	1	1	1	1	1	-
	1218	1	1	1	1	1	1	1	1	1	-

Table 1. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
ISI HTS	1301	1	1	1	1	2	1	1	1	1	-
	1302	1	1	1	1	2	0	1	1	1	-
	1303	1	0	0	0	0	0	0	0	0.1	-
	1304	1	0	0	0	0	0	0	0	0.1	-
	1305	1	0	0	0	0	0	0	0	0.1	-
	1306	0	0	0	0	0	0	0	0	0	-
	1307	1	0	1	1	1	0	1	1	0.8	-
	1308	1	1	1	0	1	0	1	1	0.8	-
	1309	1	1	1	1	1	1	1	1	1	-
	1310	0	0	0	0	0	0	0	0	0	-
	1311	2	2	2	1	1	1	1	1	1	+
	1312	1	1	1	1	1	1	1	1	1	-
	1313	1	1	1	1	1	1	1	1	1	+
	1314	2	2	1	1	1	1	2	1	0.4	+
	1315	3	2	1	1	1	1	1	1	0.4	-
	1316	0	1	1	1	1	1	1	1	0.9	-
	1317	0	0	0	0	0	0	0	1	0.1	-
	1318	0	1	1	1	1	1	1	1	0.9	-
DUCHESS HTS	1401	2	1	2	1	1	1	1	1	0.1	-
	1402	0	0	0	0	0	0	0	0	0	-
	1403	0	0	0	0	1	0	1	1	0.4	-
	1404	1	2	1	0	1	1	1	1	1	++
	1405	1	1	1	1	1	1	1	1	1	+
	1406	1	2	2	1	1	1	1	1	0.3	+
	1407	0	0	0	1	0	0	0	0	0.1	-
	1408	1	1	1	0	1	1	1	1	0.9	-
	1409	0	1	1	1	1	1	1	1	0.9	-
	1410	1	0	0	1	0	0	0	0	0.3	-
	1411	0	0	0	0	0	0	0	0	0	-
	1412	0	0	0	0	0	0	1	1	0.3	-
	1413	0	0	0	0	0	0	0	0	0	-
	1414	1	0	0	0	0	0	1	1	0.4	-
	1415	1	0	1	0	0	0	1	1	0.5	-
	1416	1	0	0	0	0	0	0	1	0.3	-
	1417	1	0	0	0	0	0	0	1	0.3	-
	1418	1	1	2	1	1	1	1	1	1	-
PENNEAGLE HTS	1501	1	0	1	1	1	1	1	0	0.8	-
	1502	1	0	0	0	0	0	1	1	0.4	-
	1503	1	1	2	2	1	1	2	2	0.2	-
	1504	2	1	1	1	1	1	1	1	1	+
	1505	1	0	0	0	0	0	0	0	0.1	-
	1506	1	0	0	0	0	0	0	0	0.1	-
	1507	2	2	2	2	1	1	2	1	0.2	-
	1508	0	0	0	0	0	0	0	0	0	-
	1509	2	2	1	1	1	1	2	1	1	-
	1510	1	1	1	1	1	1	1	1	1	-

Table 1. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
	1511	1	1	1	1	1	1	1	1	1	+
	1512	2	2	1	1	1	1	1	2	1	-
	1513	1	0	0	0	1	1	1	1	0.6	-
	1514	1	1	1	1	1	1	1	1	1	-
	1515	1	2	1	1	1	1	1	1	1	-
	1516	1	1	1	0	1	1	1	1	0.9	-
	1517	1	0	0	1	0	1	1	1	0.6	-
	1518	2	2	2	2	1	1	1	1	0.2	-
PENNCROSS HTS	1601	1	1	1	1	1	1	1	1	1	-
	1602	2	2	2	1	1	1	1	1	11	-
	1603	1	1	1	1	1	1	1	1	1	-
	1604	1	1	1	1	1	1	1	1	1	-
	1605	1	1	1	0	0	1	1	1	0.8	-
	1606	3	2	2	2	2	2	3	2	2	-
	1607	3	2	3	2	1	2	2	2	2	-
	1608	1	1	1	1	1	1	1	1	1	-
	1609	1	1	1	1	1	1	1	1	1	-
	1610	2	2	2	1	1	1	2	1	0.2	-
	1611	2	2	2	1	1	1	2	1	0.2	-
	1612	1	1	1	1	1	1	1	1	1	-
	1613	1	2	1	1	1	1	1	1	1	-
	1614	1	1	1	1	1	1	1	1	1	-
	1615	2	2	2	1	1	1	1	1	1	-
	1616	2	1	1	0	0	0	1	1	0.8	-
	1617	0	0	0	0	0	0	1	1	0.3	-
	1618	0	1	1	1	1	1	1	1	0.9	-
EMMERALD HTS	1701	2	1	1	1	1	1	1	1	1	+
	1702	0	0	0	0	1	0	1	1	0.4	-
	1703	0	0	0	0	0	0	1	1	0.4	-
	1704	0	1	0	1	1	0	1	1	0.6	-
	1705	1	1	0	1	1	0	1	1	0.8	-
	1706	1	1	1	1	1	1	2	1	1	-
	1707	2	2	2	2	1	1	2	1	1	-
	1708	1	2	2	2	1	1	1	1	1	-
	1709	1	2	2	1	1	1	2	1	1	-
	1710	0	1	1	1	1	1	1	1	0.9	-
	1711	1	2	2	1	1	1	2	1	1	-
	1712	2	2	1	1	1	1	1	1	1	-
	1713	0	0	0	0	0	0	0	0	0	-
	1714	1	2	2	1	1	1	2	1	1	-
	1715	1	1	1	1	1	1	1	1	1	-
	1716	1	1	1	1	1	1	0	0	0.8	-
	1717	0	0	0	0	0	0	0	0	0	-
	1718	1	1	1	1	1	1	1	1	1	-

Table 1. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
ISI HTS	1801	2	1	1	0	1	0	1	1	0.9	-
	1802	3	2	2	1	1	1	2	1	0.2	-
	1803	3	2	2	2	1	1	2	1	0.2	-
	1804	3	2	1	1	1	1	1	1	1	-
	1805	1	0	1	0	0	0	1	0	0.4	-
	1806	3	3	2	2	1	1	3	2	2	-
	1807	3	3	2	2	1	1	2	1	0.2	-
	1808	2	2	1	1	1	1	1	1	1	-
	1809	1	1	1	1	1	1	1	1	1	-
	1810	3	2	2	2	1	1	2	2	0.2	-
	1811	1	1	1	1	1	1	1	1	1	+
	1812	1	1	1	1	1	1	1	1	1	-
	1813	0	0	0	0	0	0	0	0	0	-
	1814	2	2	1	1	1	1	1	1	1	-
	1815	1	1	1	1	1	1	1	1	1	-
	1816	2	1	1	1	1	1	1	1	1	-
	1817	1	1	1	1	1	0	1	1	0.9	-
	1818	1	1	0	0	1	0	1	1	0.6	-
DUCHESS HTS	1901	0	0	0	0	0	0	1	1	0.3	-
	1902	2	2	1	1	1	1	2	11	0.4	-
	1903	2	2	1	1	1	1	1	0	1	-
	1904	2	2	1	1	1	1	1	1	1	-
	1905	1	1	1	1	0	1	1	1	0.9	-
	1906	3	3	2	2	2	2	3	1	2	-
	1907	3	3	2	2	2	2	3	1	2	-
	1908	2	2	2	1	1	1	2	1	0.2	-
	1909	2	1	1	1	1	1	1	1	1	+
	1910	2	2	1	1	1	1	3	2	0.2	+
	1911	2	0	1	0	0	0	0	0	0.4	-
	1912	2	2	2	1	1	1	3	2	0.2	-
	1913	0	0	0	0	0	0	0	0	0	+
	1914	1	1	1	1	1	1	1	1	1	-
	1915	3	2	1	1	1	1	2	1	0.2	-
	1916	1	2	1	1	1	1	2	1	1	-
	1917	1	2	1	1	1	1	1	1	1	-
	1918	2	2	2	1	1	1	2	2	0.2	-
PENNLINKS HTS	2001	1	1	1	1	1	1	1	1	1	-
	2002	2	2	1	1	1	1	1	1	1	-
	2003	2	2	1	2	1	1	2	2	0.2	-
	2004	2	2	2	2	1	1	1	2	0.2	-
	2005	2	3	2	2	1	1	2	1	0.2	-
	2006	2	2	2	1	1	1	2	2	0.2	-
	2007	3	2	2	2	1	1	2	2	0.2	-
	2008	2	2	2	2	1	1	2	1	0.2	-
	2009	2	2	1	1	1	1	1	1	1	-
	2010	2	2	1	1	1	1	1	1	1	-

Table 1. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
	2011	1	1	1	1	1	1	1	1	1	-
	2012	2	1	1	1	1	1	1	1	1	-
	2013	1	1	1	0	0	0	0	0	0.4	-
	2014	2	2	2	2	1	1	2	2	0.2	-
	2015	2	2	2	1	1	1	1	1	1	-
	2016	2	2	2	1	1	1	1	1	1	-
	2017	2	2	1	1	1	1	2	1	1	-
	2018	1	1	1	1	1	1	1	1	1	-
PROMINENT HTS	2101	2	2	3	2	2	1	3	2	2	-
	2102	2	2	2	1	1	1	2	1	0.2	-
	2103	2	2	2	1	1	1	1	1	1	+
	2104	1	1	1	1	1	1	1	1	1	-
	2105	1	1	1	1	1	1	1	1	1	-
	2106	2	1	1	1	1	1	1	1	1	-
	2107	2	2	2	1	1	1	1	1	1	-
	2108	3	2	1	1	1	1	1	1	1	+
	2109	3	2	1	1	1	1	1	1	1	-
	2110	2	2	2	2	1	1	2	1	0.2	-
	2111	3	3	2	2	2	1	3	2	2	-
	2112	2	2	2	1	1	1	1	1	1	-
	2113	1	1	1	1	1	1	1	1	1	-
	2114	1	1	1	1	1	1	1	2	1	-
	2115	2	2	1	1	1	1	1	1	1	-
	2116	2	1	1	1	1	1	1	1	1	-
	2117	2	1	1	1	1	0	1	1	1	-
	2118	2	1	2	2	1	1	1	1	1	-

Table 2. Susceptibility of genetic segregates of seven NHTS nursery bentgrass varieties to Pythium root rot (0-3 max) following inoculation with P. aphanidermatum.

Var.	Plot Number	Observation Date 7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
PENNEAGLE NHTS	2201	1	2	2	1	1	1	2	2	0.2	-
	2202	2	3	2	2	2	1	3	2	2	-
	2203	2	2	2	1	1	1	1	1	1	-
	2204	2	2	2	1	1	1	1	1	1	+
	2205	1	1	1	1	1	1	1	1	1	-
	2206	3	2	1	1	1	1	1	1	1	-
	2207	3	2	2	2	2	1	2	2	2	-
	2208	2	2	1	1	1	1	1	1	1	-
	2209	2	1	1	1	1	1	1	1	1	-
	2210	1	1	1	1	1	1	1	1	1	+
	2211	1	2	2	1	2	1	2	2	0.2	-
	2212	2	2	2	2	2	1	2	2	0.2	-
	2213	0	0	0	0	0	0	0	0	0	-
	2214	1	1	1	1	1	1	1	1	1	-
	2215	2	2	1	1	1	1	1	2	1	-
	2216	0	0	0	0	0	0	0	0	0	-
	2217	1	2	1	1	1	1	1	2	1	-
	2218	0	0	0	0	0	0	1	1	0.3	-
PENNLINKS NHTS	2301	1	1	1	1	1	1	2	2	1	+
	2302	3	3	3	3	2	1	3	2	0.3	-
	2303	3	2	2	2	2	1	2	2	2	-
	2304	3	2	2	1	1	1	1	1	0.2	-
	2305	2	1	1	2	1	1	1	2	1	-
	2306	3	2	2	1	1	1	2	1	0.2	-
	2307	2	2	1	2	1	1	2	1	0.2	-
	2308	0	0	0	0	0	0	1	1	0.3	+
	2309	3	3	2	2	1	1	3	2	2	-
	2310	1	1	1	1	1	1	2	1	1	-
	2311	3	3	2	2	2	1	3	2	2	+
	2312	2	1	1	0	0	0	1	1	0.8	-
	2313	1	1	1	1	1	1	1	1	1	-
	2314	2	2	1	1	1	1	1	1	1	-
	2315	2	2	2	1	1	1	2	1	0.2	-
	2316	2	3	2	2	1	2	3	1	2	-
	2317	2	2	1	1	1	1	1	1	1	-
	2318	1	2	1	1	1	1	1	1	1	-
ISI NHTS	2401	2	2	1	1	1	1	2	1	1	+
	2402	2	3	2	2	2	2	3	2	2	+
	2403	3	2	1	1	1	1	2	1	0.2	-
	2404	2	2	1	1	1	1	2	1	1	-
	2405	2	3	2	2	1	1	2	1	0.2	-

Table 2. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
	2406	3	3	2	2	1	1	2	1	0.2	-
	2407	3	2	2	2	1	1	2	1	0.2	-
	2408	3	2	2	1	1	1	2	1	0.2	-
	2409	3	2	1	1	1	1	2	1	0.2	-
	2410	2	2	1	1	1	1	1	1	1	-
	2411	2	1	1	1	1	1	1	1	1	-
	2412	1	2	1	1	1	1	2	1	1	-
	2413	1	2	1	1	1	1	2	1	1	-
	2414	1	2	1	1	1	1	2	1	1	-
	2415	1	2	1	1	1	1	1	1	1	-
	2416	2	2	1	1	1	1	2	1	1	-
	2417	2	2	1	1	1	1	2	1	1	-
	2418	2	0	0	0	1	0	0	0	0.4	-
Prominent NHTS	2501	0	1	1	1	1	1	1	1	0.9	-
	2502	1	1	0	1	1	1	1	1	0.9	-
	2503	1	1	0	1	1	1	1	1	0.9	-
	2504	2	2	1	1	1	1	1	1	1	-
	2505	2	2	1	1	1	1	1	1	1	-
	2506	1	1	1	1	1	1	1	1	1	-
	2507	1	1	1	1	1	1	1	1	1	-
	2508	1	1	1	1	1	1	1	1	1	-
	2509	2	2	2	1	1	1	1	1	1	-
	2510	2	2	1	1	1	1	1	1	1	-
	2511	2	1	1	1	1	1	1	1	1	-
	2512	1	0	0	1	1	1	1	1	0.8	-
	2513	2	2	2	1	1	1	1	1	1	-
	2514	3	2	1	1	1	1	1	1	1	-
	2515	2	2	1	2	1	1	1	1	1	-
	2516	1	1	1	1	1	1	1	1	1	-
	2517	2	1	1	1	1	1	1	1	1	-
	2518	1	1	1	1	1	1	1	1	1	-
PENNCROSS NHTS	2601	3	3	2	2	1	1	1	2	0.2	-
	2602	1	1	1	1	1	1	1	1	1	-
	2603	2	2	2	2	1	1	2	1	0.6	-
	2604	2	2	2	1	1	1	2	1	0.2	-
	2605	1	1	1	1	1	1	1	1	1	-
	2606	3	2	2	2	1	1	2	1	0.2	-
	2607	2	2	1	1	1	1	2	1	1	-
	2608	1	2	1	1	1	1	1	1	1	+
	2609	3	2	2	2	1	1	2	1	0.2	+
	2610	2	2	1	1	1	1	1	1	1	-
	2611	1	2	2	2	1	1	1	2	0.2	-
	2612	2	2	1	2	1	1	1	1	1	-
	2613	1	1	1	1	1	0	1	1	0.9	-
	2614	0	1	1	1	1	1	1	1	0.9	-
	2615	2	2	2	1	1	1	1	1	1	-

Table 2. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
	2616	1	1	1	1	1	1	1	1	1	-
	2617	3	3	3	2	1	1	2	2	2	-
	2618	3	2	2	2	1	1	1	1	0.2	-
DUCHESS NHTS	2701	3	3	3	3	2	2	3	3	0.3	++
	2702	3	2	2	2	1	1	1	1	0.2	-
	2703	3	3	2	2	1	1	2	1	0.2	-
	2704	3	3	2	2	1	1	2	1	0.2	+
	2705	3	3	3	2	2	2	3	3	0.3	-
	2706	2	2	2	1	1	1	2	2	0.2	-
	2707	2	2	2	1	1	1	1	1	1	+
	2708	2	2	1	1	1	1	1	1	1	-
	2709	2	2	2	1	1	1	1	2	0.2	-
	2710	1	2	1	1	1	1	1	1	1	-
	2711	3	2	2	1	1	1	2	1	0.2	+
	2712	2	2	1	1	1	1	1	1	1	-
	2713	1	1	1	1	1	1	2	1	1	-
	2714	1	1	1	1	1	1	1	1	1	-
	2715	3	2	2	1	1	1	1	1	0.2	-
	2716	1	1	1	1	1	1	1	1	1	-
	2717	0	1	1	1	1	1	1	1	0.9	-
	2718	3	2	1	1	1	1	1	1	1	+
EMERALD NHTS	2801	2	2	2	2	1	1	1	1	0.2	-
	2802	0	0	1	1	0	1	1	1	0.6	+
	2803	1	1	1	1	1	1	1	1	1	-
	2804	1	2	1	1	1	1	1	1	1	-
	2805	2	2	2	1	1	1	1	1	1	-
	2806	2	2	2	1	1	1	2	2	0.2	++
	2807	2	1	1	1	1	1	1	1	1	-
	2808	2	2	2	1	1	1	1	1	1	-
	2809	2	2	2	1	1	1	1	1	1	-
	2810	1	2	1	1	1	1	1	1	1	-
	2811	1	3	2	2	2	1	2	2	0.2	++
	2812	2	2	1	2	1	1	2	1	0.2	+
	2813	1	2	2	2	1	1	2	2	0.2	-
	2814	2	2	2	1	1	1	1	1	1	+
	2815	1	1	1	1	1	1	1	1	1	-
	2816	1	1	1	1	1	1	1	1	1	-
	2817	2	3	2	2	1	1	2	1	0.2	-
	2818	1	1	1	1	1	1	1	1	1	-
ISI NHTS	2901	2	3	2	2	2	1	2	1	0.2	-
	2902	2	2	2	1	1	1	2	1	0.2	+
	2903	1	2	2	1	1	1	1	1	1	-
	2904	2	2	2	1	1	1	2	1	0.2	-
	2905	3	3	2	2	1	1	2	2	2	-

Table 2. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
	2906	2	2	1	1	1	1	1	1	1	-
	2907	1	2	1	1	1	1	1	1	1	+
	2908	3	3	2	2	1	1	2	2	2	+
	2909	0	1	0	1	1	0	1	1	0.6	-
	2910	2	2	2	1	1	1	2	1	0.2	-
	2911	2	2	1	1	1	1	2	2	0.2	-
	2912	2	2	1	1	1	1	1	1	1	-
	2913	3	2	2	1	1	1	2	2	0.2	-
	2914	1	1	1	1	1	1	1	1	1	+
	2915	1	2	1	1	1	1	1	1	1	-
	2916	1	1	1	1	1	1	1	1	1	-
	2917	1	1	0	1	1	1	1	1	0.9	-
	2918	2	2	1	1	1	1	1	1	1	-
EMERALD NHTS	3001	2	2	1	1	1	1	1	1	1	-
	3002	1	0	0	0	0	0	0	0	0.1	-
	3003	1	2	1	1	1	1	1	2	1	-
	3004	2	2	2	2	1	1	2	1	0.2	+
	3005	2	2	2	2	1	1	1	1	0.2	-
	3006	3	2	2	1	1	1	1	2	1	-
	3007	3	2	2	2	2	1	2	2	2	-
	3008	2	1	2	1	1	1	1	1	1	+
	3009	2	1	1	1	1	1	1	1	1	+
	3010	3	2	1	1	1	1	2	1	0.2	+
	3011	2	3	2	1	1	1	2	1	0.2	-
	3012	1	1	0	1	1	0	1	1	0.8	-
	3013	1	1	1	1	1	1	1	1	1	+
	3014	2	2	2	2	1	1	2	2	0.2	+
	3015	2	1	1	1	1	1	1	1	1	-
	3016	2	1	1	1	1	1	1	1	1	-
	3017	0	1	0	0	1	1	1	1	0.6	-
	3018	1	1	1	1	1	1	1	1	1	-
DUCHESS NHTS	3101	2	1	1	1	1	1	1	1	1	-
	3102	1	1	1	1	1	1	1	1	1	-
	3103	2	0	0	0	1	1	1	1	0.8	-
	3104	2	2	1	1	1	1	2	2	0.2	-
	3105	2	2	1	1	1	0	1	1	1	-
	3106	3	3	2	2	2	1	2	2	2	-
	3107	1	1	1	1	1	1	1	1	1	+
	3108	2	2	2	2	1	1	2	1	0.2	+
	3109	2	2	2	1	1	1	2	1	0.2	+
	3110	1	2	2	1	1	1	1	1	1	+
	3111	2	2	2	1	1	1	1	1	1	-
	3112	2	1	1	1	1	1	1	1	1	-
	3113	3	3	2	2	1	1	2	2	2	+
	3114	2	1	1	1	1	1	1	1	1	-
	3115	2	2	1	2	1	1	2	1	0.2	-

Table 2. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
	3116	1	0	0	1	1	0	1	1	0.6	-
	3117	2	2	1	2	1	1	1	1	1	-
	3118	0	0	0	0	1	0	0	0	0	-
PENNCROSS	3201	1	1	1	1	1	1	1	1	1	-
NHTS	3202	1	1	1	1	1	1	1	1	1	+
	3203	1	2	1	1	1	1	1	1	1	-
	3204	3	3	1	2	2	1	2	1	0.2	+
	3205	3	2	2	1	2	1	2	1	0.2	-
	3206	3	2	2	1	1	1	1	1	0.2	-
	3207	3	3	2	2	1	1	1	1	0.2	-
	3208	2	2	1	1	1	1	1	1	1	-
	3209	2	2	2	2	2	1	2	1	0.2	+
	3210	3	3	3	2	2	2	3	3	0.3	++
	3211	2	2	2	2	2	1	2	2	0.2	++
	3212	0	0	0	0	1	0	1	1	0.4	-
	3213	1	2	2	2	1	1	2	1	0.2	-
	3214	1	1	1	1	1	1	1	1	1	+
	3215	2	2	2	2	1	1	2	2	0.2	+
	3216	2	2	2	1	1	1	2	2	1	+
	3217	2	2	1	1	1	1	1	1	1	+
	3218	1	1	1	1	1	1	1	0	0.9	-
PROMINENT	3301	2	2	1	1	1	1	1	1	1	-
NHTS	3302	2	2	1	1	1	1	1	1	1	+
	3303	2	2	1	1	1	1	1	2	1	+
	3304	2	1	1	1	1	1	1	1	1	-
	3305	1	1	1	1	1	1	1	1	1	+
	3306	1	2	1	1	1	1	1	1	1	-
	3307	2	2	1	1	1	1	1	1	0.1	+
	3308	1	1	1	1	1	1	1	1	1	-
	3309	2	2	2	1	1	1	1	1	1	-
	3310	1	0	0	1	1	1	1	1	0.8	-
	3311	2	2	2	1	1	1	1	1	1	-
	3312	2	2	2	1	1	1	2	2	0.2	+
	3313	1	1	1	1	1	1	1	1	1	-
	3314	2	1	1	2	1	1	1	1	1	-
	3315	3	2	2	1	1	1	2	1	0.2	-
	3316	2	1	1	1	1	1	1	1	1	-
	3317	3	2	2	1	1	1	1	1	0.2	-
	3318	1	2	1	1	1	1	1	1	1	+
PENNEAGLE	3401	1	1	1	1	1	1	1	1	1	-
NHTS	3402	2	2	2	2	1	1	1	1	0.5	+
	3403	3	3	2	2	2	1	2	2	2	-
	3404	2	2	1	1	1	1	1	1	1	-
	3405	3	3	2	2	2	1	2	2	0.2	-

Table 2. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
	3406	3	2	2	1	1	1	1	1	0.2	-
	3407	3	2	2	2	1	1	2	2	1	-
	3408	3	2	1	1	1	1	1	1	1	-
	3409	2	1	1	1	1	1	1	1	1	-
	3410	2	1	1	1	1	0	1	1	0.2	-
	3411	3	2	2	2	1	1	1	1	1	+
	3412	2	2	2	1	1	1	1	1	1	-
	3413	2	2	1	1	1	1	1	2	1	-
	3414	2	2	1	1	1	1	1	1	0.4	+
	3415	1	0	0	0	0	0	1	1	1	+
	3416	1	1	1	1	1	1	1	1	1	-
	3417	2	2	2	1	1	1	1	1	1	-
	3418	1	1	0	0	0	1	1	1	0.6	-
PENNLINKS NHTS	3501	2	2	1	1	1	1	1	2	1	++
	3502	1	1	1	1	1	1	1	1	1	-
	3503	1	0	1	0	0	1	1	1	0.6	+
	3504	3	3	3	2	2	2	3	2	0.3	-
	3505	3	3	3	2	2	2	3	3	0.3	-
	3506	3	2	2	1	1	1	2	2	0.2	-
	3507	2	2	1	1	1	0	1	1	1	-
	3508	2	2	2	1	1	1	2	1	0.2	-
	3509	1	2	1	1	0	0	1	1	0.9	-
	3510	2	2	1	2	1	1	2	2	0.2	+
	3511	1	1	1	0	1	0	1	1	0.8	-
	3512	1	1	0	0	1	1	1	1	0.8	-
	3513	1	1	1	0	1	1	1	1	0.9	-
	3514	0	1	0	0	0	1	1	1	0.5	-
	3515	1	1	1	0	1	1	1	1	0.9	-
	3516	0	0	0	0	0	0	0	0	0	-
	3517	1	2	1	1	1	1	1	1	1	-
	3518	0	0	0	0	0	0	0	1	0.1	+
EMMERALD NHTS	3601	1	1	1	1	1	1	1	1	1	-
	3602	1	1	1	1	1	1	1	2	1	+
	3603	2	2	1	1	1	1	1	1	1	-
	3604	2	2	2	1	1	1	2	2	0.2	-
	3605	3	3	2	1	1	1	2	1	0.2	-
	3606	2	2	2	1	1	1	1	1	1	-
	3607	1	2	1	1	1	1	1	1	1	-
	3608	1	1	1	1	1	1	1	1	1	-
	3609	1	1	0	1	1	1	1	1	0.9	+
	3610	1	2	2	1	1	1	1	1	1	-
	3611	2	2	2	2	1	1	2	1	0.2	-
	3612	1	2	1	1	1	1	1	1	1	-
	3613	1	2	1	1	1	1	1	1	1	-
	3614	2	2	1	1	1	1	2	2	0.2	-
	3615	2	2	2	2	1	1	1	1	0.2	-

Table 2. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
	3616	2	2	1	2	1	1	1	1	1	-
	3617	2	2	1	1	1	1	1	1	1	-
	3618	1	2	2	1	1	1	1	1	1	-
PENNEAGLE NHTS	3701	2	2	1	1	1	1	1	1	1	-
	3702	1	1	1	1	1	1	1	1	1	-
	3703	1	1	0	0	0	0	0	0	0.3	-
	3704	2	1	1	1	1	1	1	1	1	+
	3705	1	1	0	0	1	1	1	1	0.8	-
	3706	2	2	1	1	1	1	2	1	1	-
	3707	2	2	2	1	1	1	2	2	0.2	+
	3708	2	2	1	1	1	1	1	1	1	-
	3709	1	2	1	1	1	1	1	1	1	-
	3710	1	2	1	1	1	1	1	1	1	-
	3711	1	2	1	1	1	1	1	1	1	+
	3712	3	3	2	2	1	1	2	2	2	+
	3713	1	1	1	1	1	1	1	1	1	-
	3714	2	2	1	1	1	1	1	1	1	-
	3715	1	1	1	1	1	1	1	2	1	-
	3716	1	1	1	1	1	1	1	1	1	-
	3717	2	1	1	1	1	0	1	0	0.9	-
	3718	1	2	2	1	1	1	1	1	1	-
ISI NHTS	3801	2	2	2	2	1	1	2	1	0.2	-
	3802	1	2	2	1	1	1	1	1	1	-
	3803	1	2	2	1	1	1	2	2	0.2	-
	3804	2	3	2	2	2	2	2	2	2	+
	3805	2	1	1	0	0	0	1	1	0.8	-
	3806	1	2	2	1	2	1	2	2	0.2	-
	3807	1	2	1	1	2	1	1	1	1	++
	3808	1	2	1	1	2	1	1	1	1	-
	3809	2	2	1	1	2	1	1	1	1	-
	3810	2	2	1	1	2	1	1	1	1	-
	3811	1	1	0	1	2	1	1	1	1	-
	3812	2	2	2	2	2	1	2	2	0.2	-
	3813	2	2	2	2	2	1	2	2	0.2	-
	3814	1	1	1	1	0	1	1	1	0.9	+
	3815	2	1	2	1	1	1	2	2	0.2	-
	3816	3	2	2	2	1	1	2	2	0.2	-
	3817	0	1	0	0	0	0	1	0	0.3	-
	3818	3	2	2	1	1	1	2	1	0.2	-
PENNLINKS NHTS	3901	2	1	1	1	1	1	1	1	1	-
	3902	2	2	2	2	2	2	2	1	0.2	-
	3903	2	2	1	1	1	1	1	1	1	-
	3904	2	3	2	1	1	1	2	2	0.2	-
	3905	2	3	2	2	2	2	3	3	2	-

Table 2. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
	3906	3	3	2	2	1	2	3	2	2	+
	3907	2	2	1	1	1	1	2	1	1	-
	3908	2	2	2	1	1	1	1	2	0.2	-
	3909	1	1	1	1	1	1	1	1	1	-
	3910	2	2	1	1	1	1	1	1	1	-
	3911	1	1	1	1	1	1	1	1	1	-
	3912	2	1	1	1	1	1	2	1	1	-
	3913	1	1	1	1	1	1	2	1	1	+
	3914	0	0	0	0	0	0	0	0	0	+
	3915	1	1	1	1	1	1	2	1	1	+
	3916	1	1	1	1	1	1	1	1	1	+
	3917	1	1	0	0	1	1	1	1	0.8	-
	3918	1	1	1	0	1	1	1	1	1	+
DUCHESS NHTS	4001	1	0	0	1	0	0	1	1	0.5	-
	4002	2	1	1	1	1	0	1	1	1	+
	4003	1	1	0	1	0	0	1	1	0.6	+
	4004	2	2	2	1	1	1	1	1	1	-
	4005	2	2	2	1	1	1	1	1	1	-
	4006	1	1	1	1	1	1	1	1	1	-
	4007	2	2	1	1	1	1	1	1	1	-
	4008	1	1	1	1	1	1	1	1	1	+
	4009	1	1	1	1	1	1	1	1	1	-
	4010	2	1	1	1	0	1	1	1	1	+
	4011	1	1	1	1	1	0	1	0	0.8	-
	4012	3	3	2	2	2	1	3	2	2	++
	4013	1	2	1	2	1	1	2	1	1	++
	4014	2	2	1	1	1	1	2	1	1	-
	4015	1	1	1	1	1	1	1	1	1	-
	4016	1	1	0	1	0	0	1	1	0.6	+
	4017	3	3	3	1	1	1	3	1	2	-
	4018	3	3	2	2	1	1	3	2	2	-
PROMINENT NHTS	4101	0	1	1	1	1	1	1	1	0.9	-
	4102	2	3	2	2	2	1	3	2	2	++
	4103	2	2	1	1	1	1	1	1	1	+
	4104	1	1	1	1	1	0	1	1	0.9	+
	4105	2	3	2	2	1	1	3	2	2	-
	4106	1	1	1	1	2	1	1	1	1	+
	4107	1	1	1	1	1	1	1	1	1	-
	4108	1	1	1	1	1	1	1	1	1	-
	4109	2	2	2	2	1	1	2	1	0.2	+
	4110	1	1	1	1	1	1	1	1	1	-
	4111	2	2	1	1	1	1	2	1	1	-
	4112	2	2	2	1	1	1	2	1	0.2	+
	4113	3	3	2	2	1	1	3	2	2	+
	4114	1	1	1	1	1	1	1	1	1	-
	4115	1	2	1	1	1	1	2	1	1	-

Table 2. Continued:

Var.	Plot Number	7/19	7/22	7/23	7/24	7/25	7/26	7/29	8/2	Mean Dis.	Root Rot 30d
	4116	2	2	1	1	1	1	2	1	1	-
	4117	2	2	2	2	1	1	2	2	0.2	-
	4118	0	1	1	1	1	1	1	1	0.9	-

Table 3. Comparision of field plot Pythium foliar disease ratings for HTS and NHTS nurseries and resistant Pythium root rot ratings 1990-91.

		Foliar Disease Rating Category				
		No Disease	Less Than 25%	More Than 50%	Total	Root Rot Resistant
EMERALD	HTS	11	26	14	51	11
	NHTS	30	50	6	86	13
PENNEAGLE	HTS	13	33	11	57	13
	NHTS	29	51	1	81	10
ISI	HTS	11	35	11	57	10
	NHTS	36	54	2	92	8
PENNLINKS	HTS	12	33	11	56	7
	NHTS	35	53	4	92	10
DUCHESS	HTS	17	30	10	57	11
	NHTS	38	48	5	91	14
PROMINENT	HTS	10	26	15	51	7
	NHTS	23	45	8	76	13
PENNCROSS	HTS	4	19	10	33	5
	NHTS	30	56	0	86	11

The total number with no disease in HTS field plots is 78 and the number in NHTS plots is 221.

The total number with less than 25 percent disease in HTS field plots is 202 and the number in NHTS plots is 315.

The total number with more than 50 percent disease in HTS field plots is 82 and the number in NHTS is 26.

The total number with RRR (+) in HTS field plots is 64 and in NHTS plots is 79.

observations are consistent with previous field observations on Pythium blight ratings which indicated a greater potential for Pythium resistance in the NHTS germplasm nursery.

There does not appear to be a correlation with particular varieties for resistance to Pythium foliar blight and the apparent resistance to root rot (Table 3). Representative genotype selections showing resistance to Pythium sp. inoculations are shown in Table 4. The parental variety 'Duchess' appeared to have slightly more root rot resistant genotypes than other parent varieties in the study.

Inoculation Studies to Determine foliar resistance:

Inoculation studies were also used to determine Pythium blight resistance among populations from a genetic crossing block utilizing parental lines with Pythium resistance from previous studies. Inoculations with Pythium spp. were conducted on a sand heat bench used by the breeding program to identify heat tolerant clones of bentgrass (Fig. 2). Each grass plug was inoculated with one or two strains of Pythium spp. and covered with plastic sundae cup lids to insure high humidity for five to seven days. After seven days, observations were made to determine the susceptibility of the strains of bentgrass in the genetic crossing block.

Results of heat bench inoculations in the greenhouse were disappointing because of the low level of disease obtained (Table 5). The results indicate that 10-25% of the synthetic lines were susceptible to Pythium spp. Inoculation of the

Table 4. Nursery, field plot number and parent variety of bentgrass germplasm lines showing apparent resistance to Pythium root rot.

Source Nursery	Field Plot Number		Root Rot [a] Rating	Percent [b] Disease	Parent Variety
HTS	505	05-17	+	0	DUCHESS
HTS	1404	04-08	++	0	DUCHESS
HTS	2806	06-15	++	5	EMERALD
HTS	3009	09-13	+	0	EMERALD
HTS	310	10-19	+	10	ISI
HTS	311	11-19	+	15	ISI
HTS	213	13-20	+	10	PENNEAGLE
HTS	914	14-13	+	0	PENNEAGLE
HTS	602	02-16	++	0	PROMINENT
HTS	415	15-18	++	15	PSU126
NHTS	2701	01-16	++	-	DUCHESS
NHTS	3107	07-12	++	10	DUCHESS
NHTS	3109	09-12	++	0	DUCHESS
NHTS	4002	02-03	++	0	DUCHESS
NHTS	4013	13-03	++	0	DUCHESS
NHTS	2806	06-15	++	5	EMERALD
NHTS	3807	07-05	++	5	ISI
NHTS	201	01-20	++	10	PENNEAGLE
NHTS	4102	02-02	++	0	PROMINENT
NHTS	2609	09-17	+	10	PENNCROSS

a/ Root Rot Rating + = resistant, ++ = very resistant.

b/ % Disease = Pythium blight field ratings 1990.

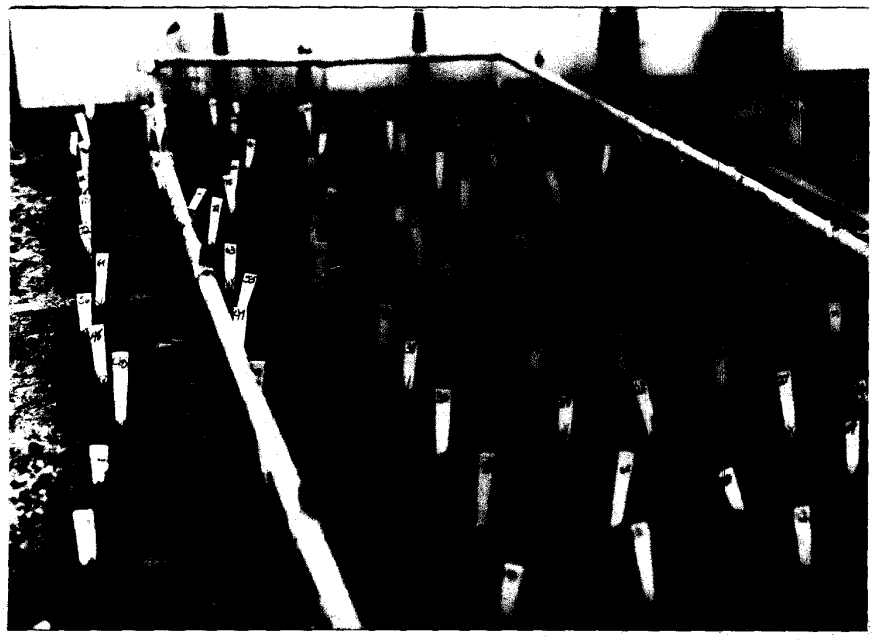

Fig. 2. Greenhouse heat bench inoculation area used for inoculation of segregates of a bentgrass genetic crossing block containing parental lines with resistance to Pythium blight.

Table 5. Pythium induced foliar blighting on a greenhouse heat bench among members of a genetic crossing block with parental lines showing resistance to Pythium blight.

VARIETY	6-18-91 MEAN % DISEASE *	9-29-91 MEAN % DISEASE
p-4	31.00 a b	7.6
2784	33.33 a	15.0
n8-3	16.00 b c	15.0
n16-4	8.00 c	8.3
p-1	3.33 c	5.6
p-3	1.67 c	0
n7-3	2.67 c	11.7
n13-1	3.33 c	6.0
3285	15.00 b c	14.7
n8-4	10.00 c	10.0
n8-2	7.33 c	10.7
n7-4	1.67 c	9.0
n7-2	3.67 c	7.7
n15-1	9.33 c	6.0
n15-4	6.00 c	6.7
p-2	3.33 c	6.6
n8-1	3.33 c	11.7
n5-1	0.00 c	5.0
n16-3	3.33 c	8.3
n16-1	4.00 c	10.0
n15-3	1.00 c	10.7
n15-2	9.33 c	0.0
n14-3	1.67 c	1.0
n14-1	3.67 c	3.3
n13-2	1.67 c	3.3
2922	4.00 c	1.7
n7-1	2.67 c	3.3
n6-4	0.00 c	4.3
n6-3	0.00 c	8.3
n6-2	1.00 c	10.0
n6-1	0.33 c	0.0
n5-4	0.00 c	1.7
n5-3	1.00 c	40.0
n5-2	0.00 c	6.0
n16-2	1.67 c	5.0
n14-4	0.00 c	1.7
n14-2	0.00 c	6.7
n13-4	0.00 c	0.0
n13-3	0.00 c	7.0
3276	0.00 c	6.7

* Means followed by the same letter are not statistically different by DNMRT .05%.

same genetic population was performed in the walk-in inoculation chamber to determine possible differences in disease reactions under more refined environmental conditions. The environmentally controlled inoculations gave a greater percent disease reaction among replications (Table 6). Generally the same genetic lines were susceptible in both studies however, the walk-in chamber inoculations were much easier to determine because of the extensive growth of Pythium mycelial threads in the foliar canopy (Fig. 3b). Both of the inoculations generally support the observation that the variety Penncross is more susceptible than most of the experimental genotypes tested, however, there is variability among the data of both experiments.

IV. Rhizoctonia Diseases Ongoing Research:

Rhizoctonia Isolate Collection:

Turfgrass Rhizoctonia isolates are now being maintained in long term storage in small perscription vials (3 drams) on PDA at a temperature of 20 C. The collection is the larger of the two being maintained for the research program. Some of the Rhizoctonia spp. isolates develop a leathery crust on the surface of the culture which makes it very difficult to obtain subcultures for use in inoculation studies. For this reason, transfers from the isolate collection are being made at 6-month intervals to insure survival of isolates in the Rhizoctonia collection.

The pathogenicity of 25 Rhizoctonia solani isolates

Table 6. Pythium blight ratings on inoculated genotypes obtained from a genetic crossing block with disease resistant parental lines.

	A	B	C	Mean	*
P-1	0	0	0	0	a
P-3	0	0	0	0	a
N15-4	0	0	0	0	a
N13-2	0	0	0	0	a
N13-4	0	0	0	0	a
N8-2	0	0	0	0	a
N6-2	0	0	0	0	a
N6-3	0	0	0	0	a
N6-4	0	0	0	0	a
N5-2	0	0	0	0	a
N5-4	0	0	0	0	a
N16-1	5	0	0	1.7	a
N14-2	0	0	5	1.7	a
3276	5	0	0	1.7	a
N15-1	0	0	7	2.3	a
N16-2	10	0	0	3.3	a
N8-4	0	10	0	3.3	a
N15-2	15	0	0	5	a
N14-1	5	0	10	5	a
N14-3	0	0	15	5	a
N8-3	15	0	0	5	a
N7-3	0	0	15	5	a
2922	5	0	10	5	a
3285	10	5	0	5	a
N15-3	5	20	0	8.3	a
N16-3	0	30	0	10	a
N14-4	40	0	0	13.3	a
N7-4	40	0	0	13.3	a
N6-1	0	0	40	13.3	a
N5-1	10	10	20	13.3	a
N7-1	40	5	0	15	a
N13-1	0	20	30	16.7	a
P-4	50	0	30	26.7	a b
N16-4	0	80	0	26.7	a b
N5-3	90	0	0	30	a b
N13-3	10	0	80	30	a b
N7-2	5	0	90	31.7	a b
N8-1	90	5	25	40	a b
P-2	0	80	50	43.3	a b
2784	90	5	90	61.7	b

* Means followed by the same letter are not statistically different by DNMRT .05%.

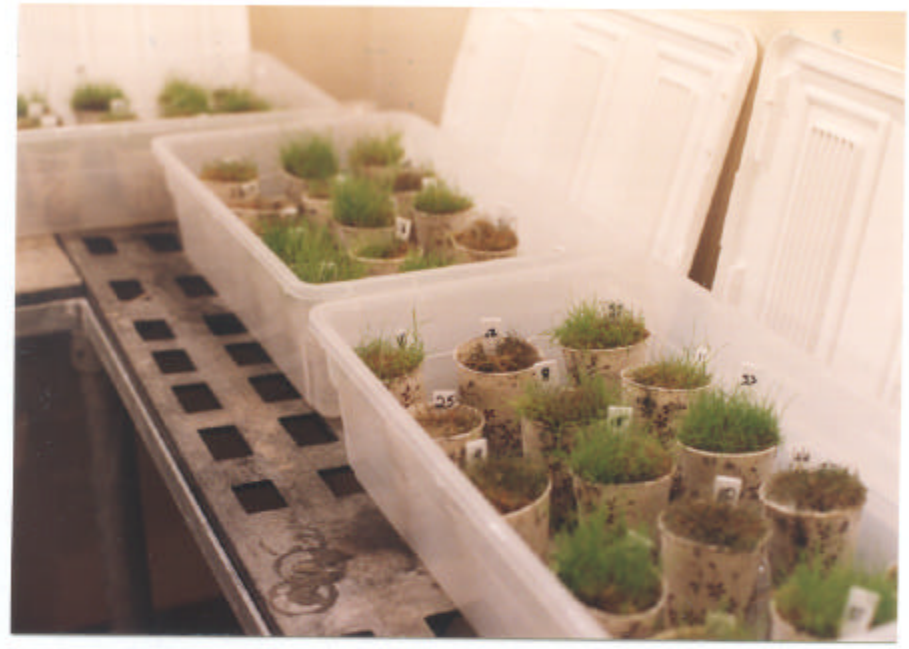

Fig 3 a,b. Disease activity in the walk-in chamber among members of a bentgrass genetic crossing block containing parental lines with resistance to Pythium blight.

resembling AG2-2 was determined in greenhouse inoculation studies during 1990. Agar cultures of the fungal isolates were prepared on PDA agar in petri dishes where the fungi were allowed to colonize for four days prior to subculturing the collection on potato-dextrose agar in 3-dram perfume bottles. Inoculations are now in progress to determine the pathogenicity of Rhizoctonia isolates on members of the genetic crossing block used in the Pythium blight study described herein.