

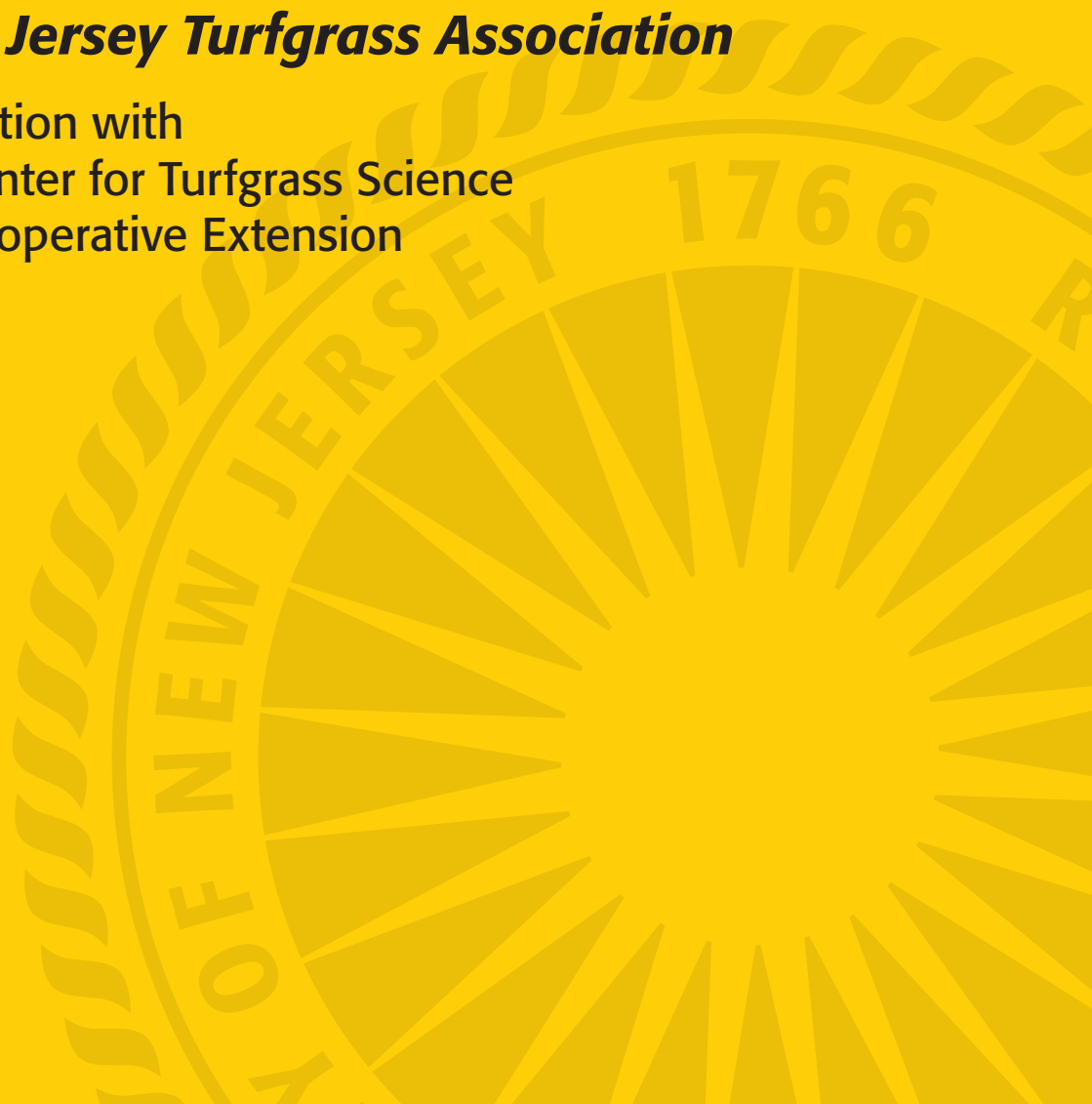
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The Rutgers Turfgrass Proceedings is published yearly by the Rutgers Center for Turfgrass Science, Rutgers Cooperative Extension, and the New Jersey Agricultural Experiment Station, School of Environmental and Biological Sciences, Rutgers, The State University of New Jersey in cooperation with the New Jersey Turfgrass Association. The purpose of this document is to provide a forum for the dissemination of information and the exchange of ideas and knowledge. The proceedings provide turfgrass managers, research scientists, extension specialists, and industry personnel with opportunities to communicate with co-workers. Through this forum, these professionals also reach a more general audience, which includes the public.

This publication includes lecture notes of papers presented at the 2015 GREEN EXPO Turf and Landscape Conference. Publication of these lectures provides a readily available source of information

covering a wide range of topics and includes technical and popular presentations of importance to the turfgrass industry.

This proceedings also includes research papers that contain original research findings and reviews of selected subjects in turfgrass science. These papers are presented primarily to facilitate the timely dissemination of original turfgrass research for use by the turfgrass industry.

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Dr. Ann Brooks Gould, Editor
Dr. Bruce B. Clarke, Coordinator

PERFORMANCE OF PERENNIAL RYEGRASS CULTIVARS AND SELECTIONS IN NEW JERSEY TURF TRIALS

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Perennial ryegrass (*Lolium perenne* L.) is a cool-season, bunch type grass that performs well in a wide variety of soil conditions but thrives in dark, rich soils with a pH between 5 and 8 in regions with mild climates (Paterson, 2002; USDA, 2002). Perennial ryegrass is an important turfgrass because of its ability to germinate quickly, creating an attractive leafy appearance in a short period. It is often used in the southern United States for overseeding dormant lawns, athletic fields, and golf courses. Perennial ryegrass is economically important because it allows for athletic play year-round in areas where warm season turfgrasses go dormant in the winter months. This species is attractive for this purpose because it provides a playing surface during cold weather and dies out in the summer, making way for warm-season grasses to take over.

Perennial ryegrass can also be used as a permanent grass in temperate climates. This species prefers to be planted in full sun but will tolerate low levels of shading. It is often found in mixtures with slower germinating grasses such as Kentucky bluegrass (*Poa pratensis* L.) and the fine fescues (*Festuca* spp.) to help prevent soil erosion during lawn establishment and to increase the traffic tolerance of the turf stand. In mixtures, perennial ryegrass is extremely competitive, and if a high percentage is used, the turf stand will eventually be dominated by this species (Murphy and Mohr, 2002).

In 1967, the first turf-type perennial ryegrass, 'Manhattan,' became commercially available, followed by the release of 'Pennfine' in 1970. Today, many more cultivars have been developed. These cultivars are readily available to turf managers for use

in sports fields as well as home lawns. New cultivars have been improved upon to have increased general stress tolerance, insect and disease resistance, improved mowing quality, dark green color, more uniform leaf texture, and higher shoot density (Murphy and Park, 2004). The development of improved perennial ryegrass cultivars continues at the New Jersey Agricultural Experiment Station as well as at other research facilities.

The center of origin for perennial ryegrass includes Europe, North Africa, and parts of Asia. International collection trips are always underway in an effort to acquire new sources of germplasm. Perennial ryegrass collections have the potential to contain new desirable traits that can then be used to breed the next generation of improved perennial ryegrass cultivars.

Perennial ryegrass is susceptible to an array of diseases such as crown rust (*Puccinia coronata*), stem rust (*Puccinia graminis*), red thread (*Laetisaria fuciformis*), pink patch (*Limonomyces roseipellis*), grey leaf spot (*Magnaporthe grisea*), and dollar spot (*Sclerotinia homoeocarpa*). Crown rust is caused by a fungus where sequential infection of two host plants, called alternate hosts, is needed to complete its complex life cycle. The disease first appears on ryegrass as a yellow flecking on infected leaf blades followed by raised pustules that break through the epidermis of the blade to release spores (Smiley et al., 2005). Stem rust is also an important disease of perennial ryegrass and can cause serious problems in seed production fields. Grey leaf spot is a significant-disease of new perennial ryegrass turf stands and of old stands with poor air circulation. This disease can

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be identified by leaf twist and distortion at the point of infection or by round, tan spots with a dark border on the leaf blade (Smiley et al., 2005). Red thread may be associated with pink patch; the two diseases are commonly found together, but pink patch rarely occurs in the absence of red thread. The symptoms and signs of these two diseases is distinctive; *L. fuciformis* (red thread) produces a pinkish to red mycelium that grows out of infected leaf tips in humid environments, whereas *L. roseipellis* (pink patch) produces pink or red “cotton candy”-like flocks attached to affected leaves. Dollar spot can also be found in perennial ryegrass populations if the weather is hot and humid; hyphae are easily identifiable as a cobweb-like mycelium. Breeding efforts are currently underway to improve resistance to all of these pathogens.

Perennial ryegrasses naturally contain symbiotic fungi, known as endophytes, that live intercellularly within the leaf, sheath, and stem tissues. The presence of this endophyte (*Neotyphodium* sp.) can convey biotic and abiotic stress tolerance in many perennial ryegrasses (van Zijl de Jong et al., 2008). The utilization of ryegrass cultivars containing endophytes can reduce damage from above ground feeding insects, such as billbugs, sod webworm, and chinch bugs, due to the production of toxic alkaloids by the endophytic fungi (Ahmad et al., 1986; Funk et al., 1994). Endophytes are an important tool for turfgrass breeders as a biological control agent in an environment where pesticide regulations are eminent and sustainable turfgrass management is becoming more popular. The endophyte is transferred via seed to offspring, thus seed must be stored under cool, dry conditions post-harvest to retain this beneficial fungus. Turfgrass breeders and researchers are continuing to research the beneficial role of endophytes in turfgrasses.

At Rutgers University we continue to use cycles of selection in single-plot progeny, mowed turf trials and clonal evaluation of spaced plants to breed perennial ryegrasses with improved resistance to pathogens that cause diseases such as gray leaf spot, rust, dollar spot, and red thread. Breeding for tolerance to abiotic stresses such as salinity (at both mature and seedling stages) and drought is underway. The main objective of the perennial ryegrass breeding program is to improve the frequency of traits that will lead to the production of new superior genotypes that are attractive, high yielding, disease tolerant, and tolerant to abiotic stresses.

PROCEDURES

One perennial ryegrass trial was established in 2013 (Table 1), two trials were established in 2014 (Tables 2 and 3), and another two trials were established in 2015 (Tables 4 and 5). All tests were hand sown with 0.88 oz of seed into 3 x 5 ft plots (3.7 lb seed per 1000 ft²) at Adelphia, NJ.

All trials were arranged in a randomized complete block design with three replications, and plots had a 6-inch unseeded border to limit contamination. A spring (April) application of Dimension (dithiopyr) was used to control crabgrass in all trials. A spring application of Rifle (dicamba, dimethylamine salt) and a fall application of Super Trimec (2,4-D) were applied to all trials to control broadleaf weeds.

The annual rate of nitrogen (N) and mowing height for each trial are presented in Table 6. Single applications of fertilizer did not exceed 1.0 lb N per 1000 ft². The amount and timing of N applied to the turf varied to encourage diseases and other stresses. Trials were mowed regularly with reel mowers to maintain a 1.5-inch height of cut. All trials were irrigated when necessary to avoid drought stress.

All trials were rated throughout the growing season for visual turf quality (i.e., overall appearance, turf color, uniformity, density, mowing quality, reduced rate of vertical growth, leaf texture, and damage due to insects and diseases). Other characteristics such as spring green-up, stem rust, dollar spot, and gray leaf spot were rated when significant differences were evident. Most ratings were based on a 1 to 9 scale, with 9 representing the best turf characteristic. Plots were evaluated by a number of turfgrass specialists to reduce the impact of personal bias for particular characteristics. All data were summarized and subjected to an analysis of variance. Means were separated using Fisher's protected least significant difference (LSD) mean separation test.

RESULTS AND DISCUSSION

Results for all trials are presented in Tables 1 to 5. Tests in Tables 1 to 3 were ranked based on their overall turf quality average; tests in Tables 4 and 5 were ranked based on resistance to gray leaf spot. A high quality average is generally indicative of better disease resistance, a darker, bright green color,

higher shoot density, uniformity, finer leaf texture, lower growth habit, improved mowing quality, and less damage due to insects.

Turf Quality

Perennial ryegrass has become a very popular species for home lawns, athletic fields, golf courses, and for overseeding purposes. Substantial improvements have been made to the overall turf quality of perennial ryegrass since the release of the first turf-type cultivars in the 1960s (Huff, 1997). Newer varieties and promising experimental selections such as Pangea GLR, Xcellerator, Provost, PL5 Comp, Evolution, Vision, and Manhattan 6 GLR possess a darker green color, a more uniform appearance, increased density, lower growth habit, cleaner mowing, and a better tolerance of disease and insects. Old cultivars including Royal Green, Spreader III, Double Time, and AGRLP-150 were not rated as high (Tables 1 to 5).

Grey Leaf Spot

Gray leaf spot is an important disease that can cause a leaf blight that kills perennial ryegrass seedlings. Leaves are usually distorted and twisted at the point of infection, forming a characteristic "J"-shaped blade. Gray leaf spot is prevalent during extended periods of high relative humidity and warm temperatures. In the 2014 gray leaf spot trial (Table 2), PL 6 Comp, PPG-PR-241, CU1 Comp, CU2 Comp, and Pizzazz 2 were top performers, while Ragnar, Paragon GLR, Replat GLX, Caddieshack II, Kokomo 2, and Royal Green rated poorly for disease resistance. In the 2015 gray leaf spot trials (Tables 4 and 5), 02BS2 Comp, 021 Comp, 023 Progeny Comp, NP2, PL5 Comp, and PPG-PR 326 were least affected by this disease, whereas Presidio, Divine, Goalkeeper II, Nexus XR and Palmer III proved to be very susceptible.

Establishment

The results of September establishment ratings in Tables 3 and 5 indicate that most cultivars and selections were well established within 2 months of seeding. Seedling establishment and vigor can be affected by factors such as genetics, seed quality and storage, and environmental conditions. Perennial ryegrass is quick to germinate, which helps to suppress weeds and prevent soil erosion. Cultivars such as Sun, Stellar 3GL, Salinas II, Divine, PPG-PR 232, Provost, and Spark established well, while this

characteristic for PPG-PR 339, PG6-14R1, PST-3IP was relatively poor.

Stemminess

Stemminess refers to the number of reproductive stems remaining in mowed turf plots. The lack of reproductive stems allow for a more consistent and visually appealing grass sward. Stemminess continues to be a problem in perennial ryegrass as shown in Table 2. Cultivars with the least stemminess included Amazing A+, Xcellerator, Benchmark, and PPG-PR-241, while stems were more prominent in Double Time, Double Up, Paragon GLR, Saltinas, and Protégé.

SUMMARY

Turf type perennial ryegrass cultivars are some of the most versatile grasses available on the market today. The high traffic tolerance, rapid establishment, and deep green color of these cultivars are extremely important traits that are in high demand in the turf grass seed industry. Although considerable improvements have been made to perennial ryegrasses, increased genetically stable resistance to diseases such as crown rust is still needed. Additionally, increased heat and drought tolerance, cold hardiness, salinity tolerance, and the ability to survive under ice sheets for extended periods are also necessary.

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Table 1. Performance of perennial ryegrass cultivars and selections in a turf trial seeded in September 2013 at Adelphia, NJ.

Cultivar or Selection	-----Turf Quality ¹ -----		
	2014-2015 Avg.	2014 Avg.	2015 Avg.
1 PPG-PR 229	6.5	6.9	6.1
2 PPG-PR 241	6.3	6.5	6.1
3 PPG-PR 245	6.3	6.5	6.1
4 PPG-PR 242	6.3	6.7	5.9
5 PPG-PR 243	6.3	6.6	5.9
6 Evolution	6.2	6.6	5.9
7 PPG-PR 240	6.2	6.2	6.1
8 SR 4650	6.1	6.4	5.7
9 4JPRWA2	6.0	6.0	6.1
10 PPG-PR 232	6.0	6.2	5.7
11 PPG-PR 244	5.9	6.5	5.4
12 Pangea GLR	5.9	6.3	5.4
13 Xcellerator	5.9	6.1	5.6
14 CT7	5.9	6.2	5.5
15 Fastball RGL	5.8	6.2	5.4
16 PPG-PR 196	5.8	6.3	5.2
17 PPG-PR 231	5.8	6.2	5.3
18 RKS	5.7	6.0	5.4
19 Stellar 3GL	5.7	5.9	5.5
20 Pizzazz 2	5.7	5.9	5.5
21 Metolius	5.7	5.9	5.5
22 PPG-PR 193	5.7	6.2	5.2
23 PPG-PR 233	5.7	5.7	5.6
24 PPG-PR 197	5.7	6.3	5.0
25 PR-2-13-Bulk	5.6	6.1	5.2
26 CHT	5.6	5.8	5.5
27 PPG-PR 230	5.6	6.1	5.2
28 PPG-PR 234	5.6	6.1	5.1
29 PPG-PR 239	5.6	5.8	5.4
30 Rinovo	5.6	6.1	5.0
31 PR15K-3-17	5.6	5.8	5.3
32 4JPRWA1	5.6	5.8	5.3
33 4JPRWA	5.6	5.7	5.4
34 Wicked	5.5	5.8	5.2
35 Karma	5.5	5.9	5.1

(Continued)

Table 1. Perennial ryegrass turf trial, 2013 (continued).

Cultivar or Selection	-----Turf Quality ¹ -----		
	2014-2015 Avg.	2014 Avg.	2015 Avg.
36 4JPRWA4	5.5	5.4	5.6
37 RAD-PR73	5.5	5.8	5.1
38 Grand Slam GLD	5.5	5.6	5.3
39 2SUPA Bulk	5.5	5.6	5.3
40 PPG-PR 194	5.4	5.7	5.2
41 RAD-PR77	5.4	5.6	5.2
42 Manhattan 6	5.4	5.5	5.2
43 4JPRWA3	5.4	5.4	5.4
44 Sideways	5.3	5.7	4.9
45 Apple SGL	5.3	5.5	5.1
46 PPG-PR 228	5.3	5.4	5.2
47 Benchmark	5.3	5.5	5.1
48 4DTWA	5.2	5.7	4.8
49 Dasher 3	5.2	5.7	4.7
50 Salinas	5.2	5.2	5.2
51 PPG-PR 195	5.2	5.6	4.8
52 2BED Bulk	5.2	5.2	5.1
53 4JPRWA5	5.2	5.4	4.9
54 Triathlon	5.2	5.7	4.6
55 PR 201	5.2	5.3	5.0
56 SR 4600	5.1	5.3	5.0
57 Home Run	5.1	5.4	4.8
58 PPG-PR 238	5.1	5.5	4.7
59 Syn-2BET	5.1	5.3	4.9
60 4MSH	5.1	5.6	4.6
61 PR15K-3-19	5.1	5.2	5.0
62 Phenom	5.1	5.3	4.8
63 Harrier	5.0	5.2	4.9
64 Estelle	5.0	5.0	5.0
65 Zoom	5.0	5.2	4.7
66 PR15K-1-8	5.0	5.2	4.8
67 RBL-1-13-1	5.0	5.2	4.7
68 4CAGL	4.9	5.5	4.4
69 Mighty	4.9	5.1	4.7
70 Protégé	4.9	4.8	5.0

(Continued)

Table 1. Perennial ryegrass turf trial, 2013 (continued).

Cultivar or Selection	-----Turf Quality ¹ -----		
	2014-2015 Avg.	2014 Avg.	2015 Avg.
71 Green Emperor	4.9	4.9	4.9
72 GO-SDG	4.9	5.1	4.7
73 RBL-1-13-3	4.9	5.0	4.7
74 Sox Fan	4.9	5.2	4.5
75 Defender	4.9	5.0	4.7
76 Edge II	4.9	5.1	4.6
77 Calypso 3	4.9	5.2	4.5
78 Slugger II	4.9	4.8	4.9
79 2MEW Bulk	4.8	4.6	5.1
80 Express 2	4.8	4.9	4.7
81 Fiesta 4	4.8	5.1	4.4
82 2TT Bulk	4.7	4.7	4.7
83 SRPR1-3-2	4.7	4.9	4.5
84 PR15K-5-24	4.7	4.7	4.7
85 08-18Lp AB	4.7	5.1	4.3
86 Manhattan 5 GLR	4.7	5.0	4.4
87 Hawkeye 2	4.6	4.8	4.5
88 MSP 3999	4.6	4.5	4.7
89 Evolve	4.6	4.7	4.5
90 Gray Fox	4.6	5.0	4.1
91 RBL-1-13-Bulk	4.6	4.7	4.4
92 RBL-1-13-2	4.6	4.9	4.2
93 11-12PR-10	4.6	4.9	4.2
94 RBL-1-13-4	4.6	4.7	4.4
95 11-12PR-13	4.5	4.6	4.5
96 SRPR1Bulk	4.5	4.6	4.4
97 PPG-PR 237	4.5	4.7	4.3
98 Blazer 4	4.5	4.7	4.3
99 Tailgater	4.5	4.6	4.3
100 PR15K-6-29	4.5	4.6	4.4
101 PSPR-09-3	4.5	4.3	4.6
102 DSL5B-13	4.5	4.8	4.1
103 Nexus XR	4.5	4.4	4.5
104 PR-7-13-Bulk	4.4	4.6	4.3
105 RBL-1-13-10	4.4	4.5	4.3

(Continued)

Table 1. Perennial ryegrass turf trial, 2013 (continued).

Cultivar or Selection	-----Turf Quality ¹ -----		
	2014-2015 Avg.	2014 Avg.	2015 Avg.
106 PR15K-2-10	4.4	4.6	4.2
107 RBL-1-13-12	4.4	4.6	4.2
108 Haven	4.4	4.6	4.2
109 Syn-2MARC3	4.4	4.7	4.0
110 RBL-1-13-11	4.3	4.4	4.3
111 08-20Lp AB	4.3	4.5	4.2
112 PR15K-5-29	4.3	4.4	4.2
113 Silver Dollar	4.3	4.5	4.2
114 SRPR2-3-6	4.3	4.6	4.0
115 SRPR1-4-2	4.3	4.4	4.2
116 Cutter 2	4.3	4.4	4.1
117 PR-1-13-Bulk	4.3	4.7	3.9
118 PRWH2-12	4.2	4.3	4.1
119 11-12PR-7	4.2	4.4	4.0
120 SRPR1-2-3	4.2	4.4	4.0
121 PR15K-2-6	4.2	4.3	4.1
122 11-12PR-5	4.2	4.4	3.9
123 SRPR2Bulk	4.2	4.6	3.8
124 08FTMSESL	4.2	4.1	4.2
125 4DFHM	4.2	4.3	4.0
126 11-12PR-4	4.2	4.3	4.0
127 SRPR2-2-6	4.1	4.5	3.7
128 Charismatic II	4.1	4.3	3.9
129 RBL-1-13-6	4.1	4.1	4.0
130 RBL-1-13-8	4.0	4.0	4.0
131 Nexus XD	4.0	4.0	4.0
132 RBL-1-13-7	3.9	3.9	3.9
133 Cascadia	3.9	4.2	3.5
134 PR15K-7-21	3.9	3.9	3.8
135 MSP 4001	3.8	3.6	4.0
136 Nightsky	3.8	4.0	3.5
137 PNCK-13	3.7	3.8	3.7
138 SRPR2-1-2	3.7	4.0	3.3
139 SRPR2-1-7	3.7	4.1	3.2
140 MSP 4000	3.7	3.6	3.8

(Continued)

Table 1. Perennial ryegrass turf trial, 2013 (continued).

Cultivar or Selection	-----Turf Quality ¹ -----		
	2014-2015 Avg.	2014 Avg.	2015 Avg.
141 4STD3-13	3.7	3.5	3.9
142 Double Up GLS	3.7	4.2	3.1
143 PRWH4-12	3.6	3.7	3.4
144 PRWH 11-3	3.5	3.6	3.5
145 Double Time	3.5	3.9	3.1
146 DKDHPR-1-13-Bulk	3.5	3.7	3.3
147 Charismatic	3.4	3.4	3.3
148 PPG-PR 200	3.2	3.4	3.0
149 Brighstar SLT	3.2	3.1	3.4
150 Royal Green	3.2	3.0	3.4
151 Quebec	3.1	3.1	3.1
152 TAG-DP14	3.1	3.2	3.0
153 Spreader III	3.0	2.8	3.2
154 Churchill	2.8	2.6	3.1
155 AGRLP-150	1.8	1.7	1.9
LSD at 5%=	0.6	0.6	0.7

¹9 = best turf quality

Table 2. Performance of perennial ryegrass cultivars and selections in a turf trial seeded in September 2014 at Adelphia, NJ.

Cultivar or Selection	Turf Quality ¹ 2014-2015 Avg.	Gray Leaf Spot ² 2014 Avg.	Stemminess ³ June 2015 Avg.
1 PL 2 Comp	6.0	6.3	4.7
2 Xcellerator	5.9	6.7	6.3
3 PPG-PR-244	5.7	6.0	5.7
4 Pangea GLR	5.6	6.3	5.0
5 CU 1 Comp	5.5	7.0	5.0
6 Pizzazz 2	5.5	7.7	5.3
7 PPG-PR-241	5.5	7.3	6.0
8 PPG-PR-243	5.5	7.0	5.7
9 PL 3 Comp	5.5	6.0	4.0
10 SPP Comp	5.5	5.7	5.0
11 CP 2 Comp	5.5	6.7	5.0
12 CT 1196 AR94	5.4	7.0	4.0
13 Benchmark	5.4	5.7	6.3
14 PL 4 Comp	5.3	6.3	5.0
15 Amazing A+	5.3	4.7	6.7
16 Metolius	5.3	5.7	5.7
17 CL 307	5.3	6.7	4.3
18 CU 2 Comp	5.3	7.3	4.3
19 Fastball RGL	5.3	6.0	5.7
20 Stellar 3GL	5.3	6.3	5.7
21 PPG-PR-233	5.2	6.3	4.3
22 Sox Fan	5.2	5.3	4.3
23 APR 2291	5.2	6.0	5.3
24 Granslam GLD	5.2	6.7	5.7
25 PPG-PR-240	5.2	5.7	5.3
26 Slugger II	5.2	4.7	5.0
27 Apple SGL	5.1	4.7	5.7
28 Exacta II	5.1	6.7	5.0
29 FEC3	5.1	6.0	4.0
30 PL 6 Comp	5.1	7.3	5.0
31 PPG-PR-234	5.1	5.0	4.7
32 SPV Comp	5.1	5.3	3.7
33 PL 5 Comp	5.1	6.3	5.0
34 PPG-PR-232	5.1	6.0	5.7
35 CT 1196WILD	5.1	4.7	4.3

(Continued)

Table 2. Perennial ryegrass turf trial, 2014 (continued).

Cultivar or Selection	Turf Quality ¹ 2014-2015 Avg.	Gray Leaf Spot ² 2014 Avg.	Stemminess ³ June 2015 Avg.
36 PST-2A12	5.0	6.3	4.3
37 PST-2REB	5.0	5.0	3.7
38 Green Emperor	5.0	5.3	5.3
39 PPG-PR-197	5.0	5.7	5.3
40 PPG-PR-230	5.0	5.7	5.3
41 PST-2BDT	5.0	5.7	4.7
42 SPM Comp	5.0	6.3	3.7
43 CS1	5.0	4.0	7.0
44 Pasco	5.0	4.7	4.7
45 GO-SDG	5.0	5.0	4.5
46 Green Supreme	4.9	5.7	4.7
47 Triathlon	4.9	5.0	6.7
48 GO-DGR	4.9	4.3	4.3
49 PPG-PR-196	4.9	5.3	5.0
50 PPG-PR-229	4.9	6.0	5.3
51 PPG-PR-194	4.9	6.0	5.0
52 PPG-PR-231	4.9	6.7	5.0
53 Gray Fox	4.8	4.7	4.0
54 PPG-PR-195	4.8	5.0	5.7
55 Radiance	4.8	6.0	5.0
56 CUT Comp	4.8	6.7	4.0
57 PPG-PR-193	4.8	6.0	5.3
58 RICS	4.8	5.3	4.7
59 La Quinta	4.7	5.0	4.0
60 PPG-PR-228	4.7	5.7	4.7
61 PPG-PR-237	4.7	4.7	5.7
62 Sunrise	4.7	3.7	3.7
63 CT 1196AR95	4.7	6.3	3.7
64 Manhattan 6	4.7	5.0	3.7
65 Monterey 4	4.7	4.0	5.7
66 PPG-PR-238	4.7	4.7	3.7
67 Rinvo	4.7	4.0	5.0
68 CP 1 Comp	4.6	6.3	3.3
69 Frontier	4.6	4.3	4.7
70 Green/Royal/Artic	4.6	4.0	4.0

(Continued)

Table 2. Perennial ryegrass turf trial, 2014 (continued).

Cultivar or Selection	Turf Quality ¹ 2014-2015 Avg.	Gray Leaf Spot ² 2014 Avg.	Stemminess ³ June 2015 Avg.
71 PST 2040	4.6	4.3	4.7
72 Singular	4.6	4.0	4.7
73 Ingles Sun	4.6	5.7	4.0
74 Artic Green	4.5	4.7	5.0
75 Spreader/Arctic-X block	4.5	5.0	4.7
76 Protégé	4.5	5.3	3.0
77 Confetti III	4.4	3.7	4.3
78 Goalkeeper II	4.4	4.0	5.7
79 Top Gun II	4.4	3.7	4.7
80 Green EmperorxRoyal Green	4.4	4.3	4.0
81 GO-SDB	4.4	4.0	3.5
82 Charismatic II	4.3	4.0	3.7
83 PPG-PR-200	4.3	3.7	6.3
84 Revenge GLX	4.2	3.7	3.7
85 Accent II	4.2	3.7	4.7
86 JS 501	4.2	3.7	4.3
87 Panther	4.2	3.7	4.0
88 Haven	4.2	3.7	4.0
89 Saltinas	4.1	5.3	3.0
90 Belize	4.1	3.7	3.7
91 Secretariat II	4.1	3.7	4.0
92 Barbados	4.0	3.7	4.3
93 Kokomo 2	3.9	3.3	3.7
94 GO-OM3	3.8	3.7	3.7
95 Replat GLX	3.8	2.7	5.0
96 Caddieshack II	3.7	3.3	4.0
97 Double Up	3.7	5.0	3.0
98 Paragon GLR	3.7	3.0	3.3
99 Ragnar	3.5	3.3	3.7
100 Ragnar II	3.5	3.7	4.0
101 Double Time	3.1	5.3	2.0
102 Royal Green	2.9	2.3	4.0
LSD at 5%=	0.6	1.5	1.2

¹9 = best turf quality²9 = least disease³9 = least stemminess

Table 3. Performance of perennial ryegrass cultivars and selections in a turf trial seeded in September 2014 at Adelphia, NJ.

Cultivar or Selection	Turf Quality ¹ 2015 Avg.	Establishment ² Sept. 2014 Avg.
1 PL5 Comp	5.2	6.7
2 Evolution	5.0	7.3
3 2BDT	5.0	6.3
4 RAD-PR79	5.0	8.0
5 APR9709	5.0	7.7
6 2LTD	4.9	7.7
7 Xcellerator	4.9	7.7
8 RAD-PR84	4.9	6.0
9 RAD-PR86	4.9	6.7
10 PPG-PR 300	4.9	6.0
11 Salinas II	4.8	8.7
12 NP2	4.8	8.3
13 APR9707	4.8	7.3
14 PG3-14-R2	4.8	7.3
15 PG3-14-R10	4.8	7.0
16 PPG-PR 270	4.8	7.0
17 Rinovo	4.8	6.7
18 TB-C13-R8	4.8	6.3
19 Expedite 307	4.7	7.3
20 Syn-2FOX-13	4.7	6.7
21 APR 2291	4.7	7.7
22 PG3-14-R1	4.7	6.7
23 PG3-14-R4	4.7	6.7
24 2SHRP	4.7	6.0
25 APR9702	4.6	8.0
26 NP3	4.6	8.0
27 PPG-PR 231	4.6	7.7
28 Pangea	4.6	7.3
29 HE 231 63432-14	4.6	6.7
30 PPG-PR 301	4.6	6.7
31 Premium	4.6	6.7
32 2FIND	4.6	6.3
33 PPG-PR 232	4.6	8.3
34 2SURV	4.6	6.0
35 FEC3	4.5	8.0

(Continued)

Table 3. Perennial ryegrass turf trial, 2014 (continued).

Cultivar or Selection	Turf Quality ¹ 2015 Avg.	Establishment ² Sept. 2014 Avg.
36 PG3-14-R7	4.5	8.0
37 Grand Slam	4.5	8.3
38 Stellar 3GL	4.5	8.3
39 PPG-PR 289	4.5	7.3
40 PG3-14-R6	4.5	6.7
41 PPG-PR 229	4.5	6.3
42 PPG-PR 234	4.5	8.0
43 APR9703	4.5	7.7
44 PPG-PR 228	4.5	7.7
45 2ETS	4.5	7.3
46 Syn-2MAS	4.5	5.7
47 021 Comp	4.4	8.0
48 PPG-PR 271	4.4	7.0
49 APR9708	4.4	7.3
50 Panther GLS	4.4	6.7
51 CT-7	4.4	7.7
52 APR9701	4.4	7.0
53 2DR9	4.4	6.3
54 CP-68	4.3	9.0
55 PPG-PR 233	4.3	7.0
56 2TFC	4.3	6.7
57 Estelle	4.3	5.0
58 Syn-2SUR4	4.3	7.7
59 Manhattan 6 GLR	4.3	7.3
60 PG3-14-R9	4.3	7.3
61 PPG-PR 230	4.3	7.3
62 PG3-14-R3	4.3	6.7
63 Benchmark	4.3	7.3
64 2AG4	4.3	7.0
65 PG3-14-R8	4.3	7.0
66 RKS	4.2	7.7
67 2ED1	4.2	7.3
68 Manhattan 6 GLR	4.2	7.0
69 Soprano	4.2	6.7
70 PPG-PR 283	4.2	7.7

(Continued)

Table 3. Perennial ryegrass turf trial, 2014 (continued).

Cultivar or Selection	Turf Quality ¹ 2015 Avg.	Establishment ² Sept. 2014 Avg.
71 GO-14-PRG-EE	4.2	6.3
72 2PDA	4.2	8.3
73 Panther H2o	4.2	7.3
74 2ACR	4.2	7.0
75 Pizzazz II	4.2	6.3
76 Monterey 4	4.1	8.7
77 Secretariat II	4.1	7.7
78 PPG-PR 238	4.1	7.3
79 Top Gun II	4.1	7.0
80 2A12	4.1	6.0
81 TB-43-2-R6	4.1	8.7
82 APR9710	4.1	8.0
83 PPG-PR 268	4.1	7.0
84 Tailgater	4.1	6.7
85 MSP 3985 Artic Green	4.1	5.7
86 Fastball RGL	4.1	8.3
87 Ringles	4.1	7.7
88 Pacifi Gem	4.1	7.3
89 MSP 4011	4.1	6.3
90 NP1	4.0	7.3
91 Green Supreme	4.0	7.0
92 Accent II	4.0	6.7
93 PPG-PR 237	4.0	6.7
94 SMP Comp	4.0	6.7
95 Quicksilver	4.0	9.0
96 Sunrise	4.0	7.7
97 PPG-PR 282	4.0	7.3
98 PG3-14-R5	4.0	7.0
99 Amazing A+	4.0	6.7
100 Home Run	4.0	8.7
101 Protégé GLR	4.0	7.3
102 Salinas II	4.0	7.3
103 Manhattan 5 GLR	4.0	7.0
104 Expedite 307	4.0	6.3
105 Exacta II	4.0	5.7

(Continued)

Table 3. Perennial ryegrass turf trial, 2014 (continued).

Cultivar or Selection	Turf Quality ¹ 2015 Avg.	Establishment ² Sept. 2014 Avg.
106 APR9711	3.9	8.3
107 APR9712	3.9	7.7
108 MSP 3976 Green Emperor	3.9	8.3
109 Apple SGL	3.9	8.0
110 224	3.9	7.3
111 Gray Fox	3.9	7.3
112 GO-14-PRG-LOW	3.9	6.3
113 MSP 4020	3.9	6.0
114 2MAX	3.8	7.7
115 La Quinta	3.8	7.7
116 Palmer III	3.8	7.3
117 Sox Fan	3.8	7.3
118 APR9705	3.8	6.3
119 Cascadia	3.8	6.3
120 Brightstar SLT	3.8	7.7
121 PPG-PR 269	3.8	6.0
122 PST-2M20	3.8	6.0
123 APR 2116	3.7	8.7
124 JS501	3.7	7.0
125 Divine	3.7	8.0
126 PG6-14-R7	3.6	8.3
127 2RDY	3.6	7.7
128 Defender	3.6	7.7
129 PG6-14-R3	3.6	7.7
130 Silver Dollar	3.6	7.3
131 APR9704	3.6	7.0
132 APR9706	3.6	7.0
133 APR 2105	3.6	8.7
134 Sun	3.6	8.3
135 PUS Comp	3.6	7.7
136 PS4	3.6	7.3
137 MSP 3998 Royal Green	3.5	9.0
138 PG6-14-R2	3.5	7.7
139 Charismatic II	3.5	8.0
140 Saltinas	3.5	7.3

(Continued)

Table 3. Perennial ryegrass turf trial, 2014 (continued).

Cultivar or Selection	Turf Quality ¹ 2015 Avg.	Establishment ² Sept. 2014 Avg.
141 Replay GLY	3.5	7.0
142 2REB	3.5	7.3
143 PG6-14-R4	3.5	7.0
144 PG6-14-R5	3.5	7.0
145 Revenge GLX	3.5	7.0
146 PPG-PR 236	3.5	6.7
147 PPG-PR 272	3.4	6.3
148 PG6-14-R8	3.4	7.0
149 APR 2190	3.3	8.7
150 3IP	3.3	5.0
151 Double Up GLS	3.2	5.0
152 PG6-14-R6	3.1	6.0
153 PG6-14-R1	2.7	5.3
LSD at 5% =	0.6	1.7

¹9 = best turf quality

²9 = best establishment

Table 4. Performance of perennial ryegrass cultivars and selections in a turf trial seeded in September 2015 at Adelphia, NJ.

Cultivar or Selection	Gray Leaf Spot ¹ Sept. 2015 Avg.	Turf Quality ² 2015 Avg.
1 02BS2 Comp	8.7	6.3
2 021 Comp	8.7	6.7
3 023 Progeny Comp	8.7	7.1
4 NP2	8.7	7.7
5 PL5 Comp	8.7	7.4
6 FP1 Comp	8.3	6.7
7 02BS4 Comp	8.0	6.8
8 022 Comp	8.0	6.9
9 NP3	8.0	6.5
10 CU2 Comp	8.0	7.1
11 02BS3 Progeny Comp	7.7	6.2
12 NP1	7.7	6.1
13 023 Clone Comp	7.7	6.5
14 FP6 Comp	7.7	6.8
15 02BS1 Comp	7.3	6.0
16 UF4 Comp	7.3	5.6
17 FP2 Comp	7.3	6.7
18 CP2 Comp	7.3	6.2
19 PUS Comp	7.0	5.9
20 UF3 Comp	7.0	5.2
21 FP3 Comp	7.0	6.2
22 Amazing A+	7.0	6.2
23 Green Supreme	7.0	5.9
24 FP4 Comp	6.7	5.9
25 RKS	6.7	5.5
26 UF2 Comp	6.3	5.4
27 Haven	6.3	5.0
28 FP5 Comp	6.0	5.7
29 USR Comp	5.7	5.2
30 02BS3 Clone Comp	5.7	5.2
31 UF1 Comp	5.0	5.1
32 Revenge GLX	4.7	4.2
33 Caddieshack II	2.7	2.5
34 Monterey 4	2.3	3.0
35 Replay	2.3	2.6

(Continued)

Table 4. Perennial ryegrass turf trial, 2015 (continued).

Cultivar or Selection	Gray Leaf Spot ¹ Sept. 2015 Avg.	Turf Quality ² 2015 Avg.
36 Sunrise	2.3	2.9
37 Nexus XD	2.3	3.6
38 Goalkeeper II	2.0	2.1
39 Nexus XR	2.0	3.3
40 Palmer III	2.0	2.6
LSD at 5% =	1.6	1.2

¹9 = least disease

²9 = best turf quality

Table 5. Performance of perennial ryegrass cultivars and selections in a turf trial seeded in September 2015 at Adelphia, NJ.

Cultivar or Selection	Gray Leaf Spot ¹ Sept. 2015 Avg.	Turf Quality ² 2015 Avg.	Establishment ³ Sept. 2015 Avg.
1 PPG-PR 326	8.7	7.0	5.3
2 PPG-PR 329	8.3	6.4	5.0
3 PST-2A12	8.0	6.9	6.0
4 Provost	8.0	6.1	7.0
5 Spark	8.0	6.4	7.0
6 Vision	8.0	6.3	6.0
7 PPG-PR 344	8.0	6.1	4.3
8 PPG-PR 307-S	8.0	6.2	5.3
9 PST-2BDT	7.7	5.0	5.0
10 Evolution	7.7	5.8	6.7
11 PPG-PR 320	7.7	5.8	5.7
12 PPG-PR 331	7.7	5.3	4.7
13 PPG-PR 335	7.7	5.9	5.0
14 PPG-PR 342	7.7	4.7	3.7
15 PPG-PR 352	7.7	6.0	4.3
16 PPG-PR 363	7.7	4.9	4.0
17 PPG-PR 229	7.7	5.4	6.0
18 PST-2PDA	7.3	5.5	6.7
19 Manhattan 6 GLR	7.3	5.7	6.7
20 PST-Syn-2FXA	7.3	6.1	6.7
21 Premium	7.3	5.8	6.0
22 Intenese	7.3	5.3	6.0
23 PPG-PR 343	7.3	4.7	3.3
24 PPG-PR 350	7.3	5.5	3.3
25 PPG-PR 353	7.3	5.4	4.3
26 Stellar 3GL	7.3	5.5	6.0
27 PPG-PR 306-C	7.3	6.2	6.0
28 PPG-PR 307-C	7.3	6.2	5.0
29 PPG-PR 310	7.3	5.7	4.0
30 PPG-PR 317	7.3	5.9	5.0
31 PPG-PR 319	7.3	6.2	5.7
32 PL2	7.0	5.2	5.3
33 PPG-PR 328	7.0	5.3	5.3
34 PPG-PR 338	7.0	6.0	3.7
35 PPG-PR 339	7.0	5.6	3.0

(Continued)

Table 5. Perennial ryegrass turf trial, 2015 (continued).

Cultivar or Selection	Gray Leaf Spot ¹ Sept. 2015 Avg.	Turf Quality ² 2015 Avg.	Establishment ³ Sept. 2015 Avg.
36 PPG-PR 348	7.0	4.9	3.3
37 PPG-PR 240	7.0	5.1	5.3
38 PPG-PR 305-C	7.0	5.4	6.3
39 PPG-PR 305-S	7.0	5.3	6.0
40 PPG-PR 306-S	7.0	6.2	4.7
41 Benchmark	6.7	5.0	6.3
42 PPG-PR 349	6.7	4.5	4.7
43 PPG-PR 241	6.7	5.3	5.0
44 PPG-PR 309	6.7	5.3	6.0
45 PPG-PR 318	6.7	5.4	6.3
46 PST-2FIND	6.3	5.9	5.3
47 PST-2REB	6.3	4.6	6.0
48 PPG-PR 243	6.3	5.0	4.7
49 PPG-PR 315	6.3	5.8	5.7
50 PST-2DR9	6.0	4.2	6.3
51 PST-Syn-2FOXY	5.7	5.3	5.0
52 02BS1	5.7	5.3	5.0
53 Sox Fan	5.7	4.0	8.0
54 Defender	5.7	4.3	6.0
55 PPG-PR 242	5.7	4.6	4.3
56 PST-2LTD	5.3	4.1	5.3
57 PST-2SURV	5.3	4.2	6.7
58 Benchmark	5.3	4.6	7.0
59 PST-2AG4	5.0	3.8	5.7
60 PST-2ED1	5.0	4.3	6.0
61 Manhattan 5 GLR	5.0	4.7	6.3
62 Pistol	5.0	4.3	7.0
63 Primary	4.7	4.5	6.7
64 LCP-186	4.7	4.2	5.3
65 PST-2ETS	4.3	4.1	6.0
66 PST-2TFC	4.3	4.2	6.7
67 Estelle	4.3	3.7	6.3
68 Gray Fox	4.3	4.0	6.7
69 CP-68	4.3	4.1	6.0
70 Tailgater	4.3	3.5	6.3

(Continued)

Table 5. Perennial ryegrass turf trial, 2015 (continued).

Cultivar or Selection	Gray Leaf Spot ¹ Sept. 2015 Avg.	Turf Quality ² 2015 Avg.	Establishment ³ Sept. 2015 Avg.
71 PST-2RDY	4.0	3.6	6.0
72 PST-3IP	4.0	3.0	4.7
73 PST-Syn-2MAS	4.0	3.8	5.0
74 Silver Dollar	4.0	3.6	7.0
75 Cascadia	3.7	3.2	6.7
76 PST-2SHRP	3.3	3.3	6.0
77 Citation Fore	3.0	3.0	7.0
78 Play Fast	2.7	3.0	7.7
79 Prominent	2.7	3.2	6.3
80 Salinas II	2.7	2.4	9.0
81 Presidio	2.3	2.7	5.3
82 Divine	2.3	2.0	8.7
LSD at 5%=	1.4	1.0	1.8

¹9 = least disease

²9 = best turf quality

³9 = best establishment

Table 6. Yearly nitrogen (N) applied and mowing height (Ht) on fine fescue tests established at Adelphia, NJ.

	2014		2015	
	Ht ²	N ¹	Ht	Nt
Table 1 (2013).....	1.75	1.5	2.75	1.5
Table 2 (2014 Gray leaf spot test).....			3.07	1.5
Table 3 (2014).....			3.00	1.5
Table 4 (2015 Gray leaf spot test).....			0.50	1.5
Table 5 (2015 Gray leaf spot test).....			0.50	1.5

¹Annual N applied (lb/1000 ft²)

²Mowing height in inches