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Patch Diseases of Turfgrass Caused by Ectotrophic Fungi are Difficult to Control

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The most important recent advance in turfgrass pathology is the discovery that the underground organs of turfgrasses are commonly attacked by ectotrophic fungi, resulting in destructive patch-type diseases. Ectotrophic fungi are pathogenic fungi that grow over living plant roots as single hypha (a fungal thread) or as ropes of hyphae (runner hyphae).

HISTORY

For decades, the only example of an ectotrophic fungal pathogen on turfgrass was the take-all patch disease of bentgrass caused by *Gaeumannomyces graminis var. avenae*. Not only are roots and rhizomes attacked by the fungus, but also the stolons and stem bases. This disease on bentgrass is rare in California.

Then in the early 1980s. R. Smiley of Cornell University (8) demonstrated that the ectotrophic fungus *Leptosphaeria korrae* caused severe damage to the underground organs of Kentucky bluegrass (necrotic ring spot disease = NRS), and that a second ectotrophic fungal species - which he mistakenly identified as *Phialophora graminicola* - also caused severe damage to the underground organs of *Poa pratensis* and *Poa annua* (summer patch disease).

Subsequently, Landschoot at Rhode Island obtained ten fungal cultures of *P. graminicola* from Smiley and verified the pathogenicity of 9 of the 10 cultures to *Poa annua.* He renamed the fungus *Magnaorthe poae* (5,6), because he was able to demonstrate the formation of the sexual stage of the fungus following mating of compatible isolates in the laboratory. Thus, *M. poae* not *P graminicola.* is the cause of the summer patch disease (SP) of P. *annua*.

Only one of the ten cultures that Landschoot received from Smiley, proved to be *P. graminicola.* It invaded the epidermal and cortical cells of the roots of *Poa* species but was nonpathogenic. This verified the research of Holden (4), who reported that *P. graminicola* infected the outer root tissues of wheat but did not cause damage. That *P. graminicola* does not cause damage is important, because it occurs commonly as runner hyphae on turfgrass roots. This suggests that ectotrophic fungi occur commonly in and on the roots of turfgrass, but that some species are harmless while others cause severe patch-type diseases. This complicates the problem of diagnosis because all patch-type-inducing ectotrophic fungi look very similar.

In 1984 and 1986, Chastagner et al (1) and Worf et al (11) verified that *L. korrae* causes severe damage to the roots of Kentucky bluegrass in Washington and Wisconsin, respectively. In 1984, Endo et al (3) established that the same ectotrophic fungus, L. korrae, was also the cause of spring dead spot (SDS) of bermudagrass in California.

In 1988, Crahay et al (2) verified that *L. korrae* caused SDS on bermudagrass in Maryland but Tisserat et al (9) in the same year, reported that SDS in Kansas was caused by yet another ectotrophic fungus, Ophiosphaerella herpotricha. Also in 1988, Wilkinson (10) reported a destructive patch disease of *Zoysia japonica* in Illinois. He reported that the asexual stage of the causal fungus resembled the asexual stage of *M.* poae. Thus, *M. poae* appears to attack Zoysia as well as *P. annua* and *P. pratensis.* Finally, Landschoot (7) recently reported another ectotrophic fungus, *Gaeumannomyces incrusfans* attacking the roots of *P. annua* in the eastern U.S. These research papers, all published in the 1980s, established that the underground organs of turfgrass commonly harbor ectotrophic fungi that cause patch-type diseases.

DIFFICULTIES IN IDENTIFICATION

What is the situation in California in regard to these five ectotrophic fungi that cause patch-type diseases? We don't know whether they all occur in California, on what species of turfgrasses, and how much damage they may be causing. There are five reasons for this: 1) the newness of the diseases, 2) the shortage of turfgrass pathologists, 3) the lack of literature describing how to isolate these pathogens, how to grow them and how to identify them, 4) the close similarity in appearance of all five fungi renders rapid identification difficult, and 5) identification of all five fungi requires that the sexual stage be produced in pure culture in the laboratory, a very time-consuming (3-6 months) and laborious task.

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SITUATION IN CALIFORNIA

Take-ail patch on bentgrass is very rare in Southern California and has only occasionally been diagnosed in Central California.

L. korrae is a severe SDS (Spring Dead Spot) problem on bermudagrass lawns in the Central Valley south of Fresno but is a rare problem in Southern California. On Kentucky bluegrass, *L. korrae* is a severe NRS (Necrotic Ring Spot) problem in Washington, Wisconsin and the eastern U.S. but its importance and occurrence on bluegrass in California is unknown. In the past in California, the Fusarium crown and root rot disease of Kentucky bluegrass (sometimes mistakenly called the Fusarium blight disease in California) may have been confused with the NRS disease.

M. poae is causing very severe SP (Summer Patch) damage to *P. annua* on golf greens in some states in the north central and eastern U.S. In 1986-1988, a severe disease affecting *P. annua* greens occurred in Central and Southern California following hot, dry weather in summer and fall. Because aerial and underground symptoms of the disease on *P. annua* in California differed from those described for the summer patch disease in the East, we have tentatively been calling the disease "vascular crown and root rot." The cause was finally determined in February 1989 as *M. poae* following successful mating of single California isolates of the fungus with either one of two compatibility types of *M. poae* obtained from Dr. Peter Landschoot of New Jersey.

The fourth ectotrophic fungus that has been recently described on *P. annua* only in the eastern U.S. is G. incrustans. According to Landschoot (7) who did not assign the disease a name, the fungus is probably only a minor pathogen causing only slight damage.

The fifth ectotrophic fungus is *O. herpotricha*, the apparent cause of SDS of bermudagrass in Kansas. Whether or not the fungus occurs in California is unknown. Of the five ectotrophic fungi, only three *(G. graminis var. avenae*, *L. korrae* and *M. poae)* are known to occur in California. *G. incrustans* and *O. herpotricha* may occur in California, but will probably be only minor pathogens. This suggests that only *L. korrae* and *M. poae* will be major pathogens of turfgrass in California. The remainder of this paper will therefore be concerned with only these two pathogens.

GENERAL OCCURRENCE OF *L. KORRAE* AND *M. POAE* IN THE U.S.

To date, *L. korrae* occurs mainly on Kentucky bluegrass (NRS) and bermudagrass (SDS), although *P. annua*, fine fescues and annual ryegrass have also been found to be susceptible. On the other hand, M. poae attacks mainly *P. annua* in golf greens (SP), although Kentucky bluegrass and bentgrass have also been found to be susceptible. *L. korrae* is destructive on Kentucky bluegrass in late spring, summer and early fall. but the same fungus on bermudagrass is probably most active in late fall because the fungus is more active in cool weather than the still dormant and weakened bermudagrass. In contrast, *M. poae* appears mainly in the hot summer and early fall because Smiley has shown that the fungus is able to attack the critical vascular tissues of the roots mostly at soil temperatures of 28°C and above. At cooler soil temperatures, *M. poae* tends to be restricted to the epidermal and cortical cells of the root where the fungus apparently causes little damage.

ABOVE-GROUND SYMPTOMS

Generally, the affected plants grow more slowly; the lower leaves first turn yellow green and then become necrotic. In the final stages, entire tillers turn brown and die. The affected plants may thin out gradually or rapidly or die out in variable sized patches, rings or arcs (Figure 1).

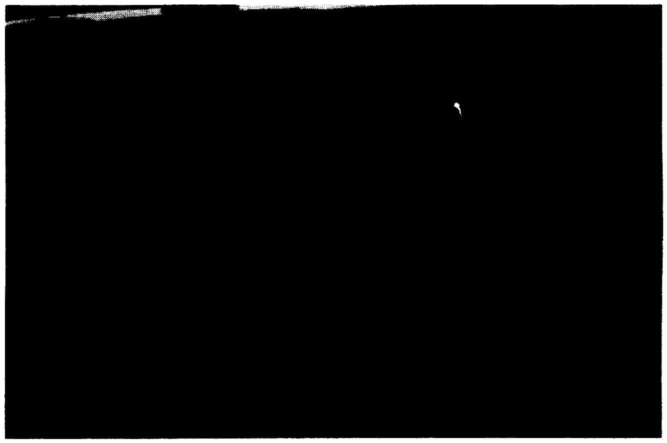

Figure 1. Spring dead spot disease of bermudagrass caused by *Leptosphaeria korrae.* Note the great variation in size of the patches, some of which have grown together.

BELOW-GROUND SYMPTOMS

Three types of symptoms caused by *L. korrae* or *M. poae* may occur below ground. In the first, black or brown, superficial, dry lesions of different sizes and shapes may occur on the primary and/or lateral roots, rhizomes, stolons and crowns (Figure 2). In the second, a brown to black discoloration of the central cylinder or xylem occurs in the primary and/or lateral roots (Figure 3). In the third, a combination of the above two symptoms occurs together so that the brown to black surface lesion covers up the black or brown discoloration of the central cylinder (Figure 2).

Figure 2. *Poa annua* plants affected with the "summer patch" disease caused by *Magnaporthe poae*. Note the brown to black, dry rot of the primary root which also affects the vascular tissues.

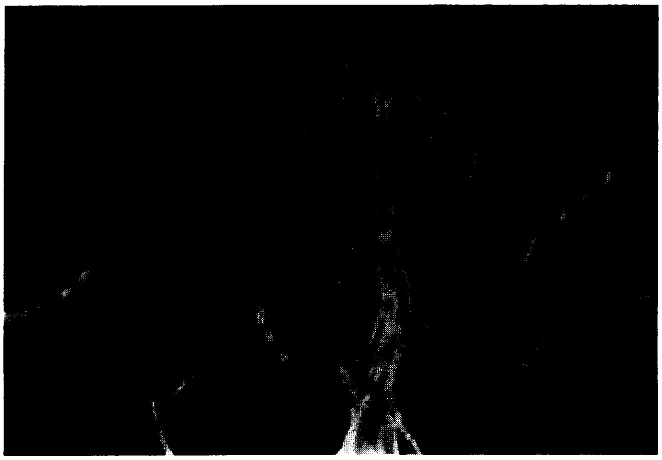

Figure 3. A *poa annua* plant with only the center of the primary root affected with vascular discoloration (central cylinder affected).

PREVENTATIVE CONTROL

The only method of controlling SP, NRS and SDS is by preventing infections of the underground organs of turfgrass by applications of systemic chemicals to the soil in early spring (and for SDS on bermudagrass in the early fall) at the time the fungus is initiating hyphal growth over the roots. The systemic chemical should be sprayed onto the plants in four gallons of water/1000 sq ft and watered immediately into the root zone with a short sprinkler irrigation. Do not allow the fungicide to dry on the leaves before watering-in. The systemic fungicides must be watered-in because the fungicide does not move down the plant from the foliage to the roots; it moves only upward in the xylem.

Proper watering-in is both difficult and critical because: 1) if the fungicide is a wettable powder, it will tend to get filtered out and therefore diluted by any litter and thatch that is present; 2) yet the water containing the fungicide must be made to penetrate the soil or sand as uniformly and as deeply as possible (1.5 inches) in order to obtain uniform, deep coverage of the roots; and 3) uniform deep coverage of the roots requires just enough water to do the job but not to dilute the fungicide to the point of ineffectiveness. Unfortunately, no watering-in guidelines can be recommended because each area of turf has a different amount of thatch, layering, different soils, different numbers of plants, different amounts of compaction, water repellancy, etc. A dry-run irrigation with water might be attempted in advance to obtain an approximation of the watering-in time that is required. To get around the problem of soil-repellancy, add a detergent.

The next problem is proper timing: when to apply the fungicide. For L. korrae. timing appears to depend upon the species of turfgrass concerned: If the host is Kentucky bluegrass, apply the systemic fungicide from mid-March to mid- May; if the host is bermudagrass, apply the systemic fungicide from October to November. For *M. poae*, apply the systemic fungicide from mid-March through mid-May.

Unfortunately, systemic fungicides only reduce the populations of the pathogens on the roots temporarily and the growth of each pathogen occurs over a rather wide range of soil temperatures that includes many months of the growing season. This suggests the need for multiple applications of systemic fungicides which are very expensive. Fortunately, turf pathologists in the East have frequently found (personal communication) that a single timely application of a systemic fungicide against the summer patch pathogen is sometimes as effective as several applications applied four weeks apart. The unexpected success of a single treatment is surprising, and may be due to the fact that reduction of infection early in the season may result in very significant levels of season-long control.

Since several applications of a soil fungicide four weeks apart are likely to be more effective, on the average, than a single application, this choice should be left to the individual applicator concerned. If several applications are made rather than one, apply successive applications four weeks apart.

The systemic fungicides that appear to be effective (personal communication) against *L. korrae* are Rubigan AS at 2.0 oz/1000 sq ft; Banner, 1.1 EC, at 2.0 fl oz; and Fungo, 50 W, at 4-8 oz. The systemic fungicides effective against *M. poae* are Banner, 1.1 EC, at 4 fl oz/l000 sq ft; Rubigan AS at 4 fl oz; Bayleton 25 DF at 4 oz; Benlate, 50 W, at 8 oz; and Fungo, 50 W, at 8 oz. Bayleton is not effective against *L. korrae* and Benlate is erratic. Banner is not yet registered for use in California. Do not use Rubigan against *P. annua* as it is herbicidal.

POST-DISEASE CONTROL

Control of diseases caused by *L. korrae* or by *M. poae* after infection has occurred and the disease has developed above-ground symptoms is probably not attainable because systemic fungicides appear to be incapable of permanently curing infected plants of fungal diseases. Therefore, application of the above systemic chemicals to turfgrass plants already affected with NRS, SDS, or SP is unlikely to do more than reduce spread to adjacent healthy plants. Since some adjacent plants may already be affected with root rot, but have not yet developed above-ground symptoms, even this limited objective may be difficult to attain.

Therefore, the only control measures that are available for infected plants are those that may help to render the effects of these diseases somewhat less severe and thereby prolong the life of the infected plants. There are many such palliative measures available, because symptoms of the diseases develop above-ground only when root damage below ground becomes severe enough to interfere with the normal growth of the foliage and stems. Examples of such mitigating factors are: 1) weekly fertilization with a very dilute solution of fertilizers to maintain “normal” foliage and root growth of the diseased plants for as long as possible. Phosphorus is probably most important because it is necessary for the formation and growth of new roots. Too much nitrogen must be avoided because it favors foliage growth at the expense of root growth; and 2) the avoidance and/or control of any factor that further stresses or weakens the diseased plants or interferes with their normal functioning such as compacted anaerobic soils, salinity, inadequate water, reduced heights of cut, high temperatures, heavy traffic, aerification, renovation, severely drying winds, and fungal diseases of the foliage that develop on weakened stressed plants (e.g., anthracnose and dollar spot).

An indirect method of controlling SP of *P. annua* may be to either sow bentgrass seeds or replace areas of *P. annua* greens that have been killed by *M. poae* with bentgrass sod. This may be effective because we have not yet seen bentgrass plants severely affected or killed by this fungus.

CONCLUDING REMARKS

Ectotrophic fungal root pathogens are an entirely new ball game with regard to management and control because the diseases occur below ground, out of sight, and out of mind. What is particularly bad is that some of these fungi (e.g., L. *korrea*, *M*. poae and G. graminis var. avenue) cause diseases that also affect the vital nutrient- and water-conducting tissues of the root (xylem); therefore, such diseases are very damaging and extremely difficult to control.

Remember, the only method of controlling these diseases is preventative, i.e. to apply preventative applications of certain systemic fungicides to the soil in the spring before appreciable infections occur. Therefore, if your *Poa annua* plants in your greens were affected with root rot in 1988, you should seriously consider applying systemic fungicides as a "drench" to your greens in early spring of 1989.

In conclusion, the authors wish to point out that the results of fungicide control experiments carried out in the spring against summer patch in the eastern U.S. may possibly differ greatly from those carried out in California because of the differences in winter soil temperatures between the two areas. In the very cold eastern U.S., infected plants may possibly recover completely from infections in the winter and early spring. In California, in contrast, infected plants may possibly manifest complete recovery from above-ground symptoms during cooler weather but continue to manifest moderate to mild root infections below ground. In the latter situation, fungicides applied in the spring in California would probably have been ineffective.

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WINTER OVERSEEDING OF COMMON BERMUDAGRASS

John Van Dam, Matthew K. Leonard, and Victor A. Gibeault[1]

Overseeding bermudagrass with a cool-season turf species in the early fall is a common management practice in Southern California. This practice provides winter color while the bermudagrass is dormant and increases the ability of turf to recuperate from wear.

Annual and perennial ryegrass are the two species most widely used in overseeding programs. Annual ryegrass has been heavily used because of its fast germination and low cost. Perennial ryegrass has become very popular on golf courses and other high quality turf sites because it is finer textured and darker green than annual ryegrass. A major problem with perennial ryegrass, however, has been poor spring growth by bermudagrass and ryegrass persistence through the summer.

In order to evaluate ryegrass performance and to test some alternatives to ryegrass, an overseeding study was conducted at the Turfgrass Research Facility, University of California, Riverside.

PROCEDURES

The study was initiated on November 7, 1986, on a two-year-old sward of Arizona common bermudagrass. Premeasured amounts of seed were applied by hand to each plot and then lightly raked to work the seed into the bermudagrass canopy. The turf was not thick enough to warrant vertical mowing prior to overseeding. The plot received frequent, light irrigation for ten days following overseeding and thereafter was irrigated according to CIMIS evapotranspiration estimates. A mowing height of 1.5 inches was maintained with a rotary mower. The following May, irrigation was reduced and mowing height was decreased to 0.75 inch to encourage a transition back to common bermudagrass. In fall, the mowing height was again raised to 1.5 inches. Fertilization consisted of 1 lb N/1000 sq ft every six weeks.

Species and varieties used in the study were: annual ryegrass; 'Caliente,' 'Derby,' 'Elka,' 'Manhattan,' and 'Manhattan II' perennial ryegrass; 'Apache' and 'Rebel' tall fescue; and rough-stalk bluegrass *(Poa trivialis).* Seeding rate for all varieties was 10 lb/1000 sq ft, except for rough-stalk bluegrass, which was seeded at 3 lb/1000 sq ft. One treatment was not overseeded to serve as a control.

Plots were arranged in a randomized complete block design with four replications. Individual plots were 9 ft x 5 ft.

Speed and amount of germination were visually evaluated daily for the first three weeks. Turf quality was rated weekly or biweekly for the remainder of the study.

Results

All overseeded grasses germinated quickly with the ryegrasses and tall fescues more rapidly than rough-stalk grass, as shown in Table 1, 19 days after planting.

Table 1. Visual evaluation of germination of overseeded grasses nineteen days after seeding. l-5 scale with 5 being most grass cover.

Grass	Germination
'Caliente' P.R.*	5.0 A**
'Manhattan' P.R.	5.0 A
Annual Rye	5.0 A
'Derby' P.R.	5.0 A
'Manhattan II' P.R.	5.0 A
'Elka' P.R.	5.0 A
'Rebel' T.F.	4.7 5 AB
'Apache' T.F.	4.5 B
Rough Stalk Blue	4.0 c

*P.R. - Perennial ryegrass; T.F. - Tall fescue.

**Values following by same letter are not significantly different at the 5% level of probability.

Data averaged over the winter months (198687) as presented in Figure 1 show the good performance of all the perennial ryegrasses and annual ryegrass; the tall fescues and rough-stalk bluegrass provided a slower overseeding cover which is reflected in the lower turf quality ratings. By spring, however. the overseeded tall fescues were well established and were comparable to the perennial ryegrasses in quality (Figure 2). Through the spring. the rough-stalk bluegrass contributed color and cover but was not as good as the tall fescues and perennial ryegrasses. By late spring, the annual ryegrass had largely died out with the quality being similar to that of the unseeded bermudagrass.

Percent cover of the overseeded grasses, as presented in Figures 3 and 4, supports the turf quality observation during the transition period. The annual ryegrass and rough-stalk bluegrass provided significantly less cover than the perennial ryegrass and tall fescue varieties.

During the summer months the tall fescue varieties mixed very well with the common bermudagrass (Figure 5). The similarities of color and texture of these species resulted in a very uniform sward of pleasing appearance. The perennial ryegrasses Manhattan and Elka and rough-stalk bluegrass gave the poorest summer appearance because of nonuniform turf stands.

In Fall 1987 the turf scores again reflected the perennial ryegrass and tall fescue overseeding reestablishment (Figure 6). The percent cover during November 1987 (Figure 7) and January 1988 (Figure 8) clearly showed the increase in the cool season grasses during the second winter season. Only annual ryegrass gave no winter color or cover the second winter; even rough-stalk bluegrass provided a high percent cover and acceptable overseeding appearance the second season.

To determine the relative competitive ability of the cool season species and varieties against common bermudagrass, in July 1988 the cool season grasses were removed by selective herbicide treatment. Immediately after removal, the percent bermudagrass cover was rated. The results are given in Figure 9. In ranked order, the most competitive cool season grasses were Rebel tall fescue; Caliente and Manhattan II perennial rye; Apache tall fescue, Derby, Elka and Manhattan perennial ryegrass; and rough-stalk bluegrass.

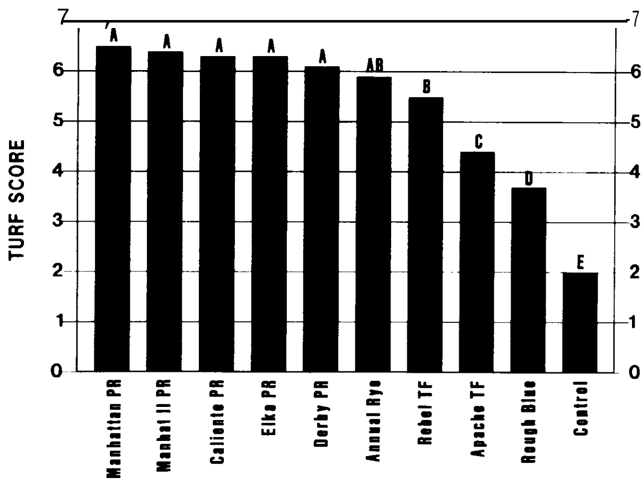

Figure 1. Winter turfscore averages (1986-87) of overseeded annual ryegrass. five perennial ryegrasses, two tall fescues and rough stalk bluegrass.

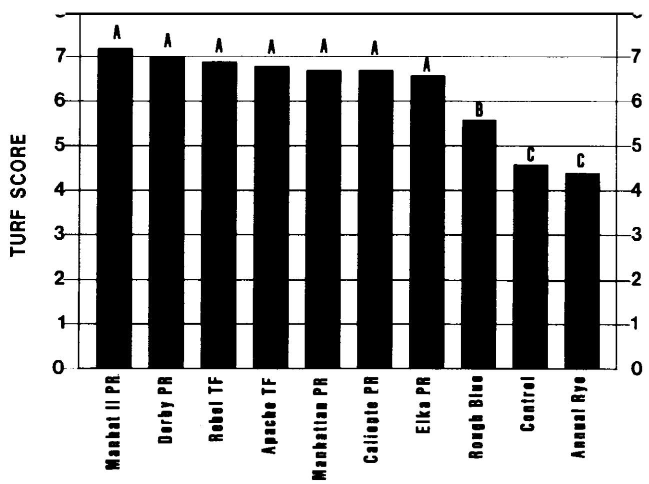

Figure 2. Spring turfscore averages (1987) of overseeded grasses.

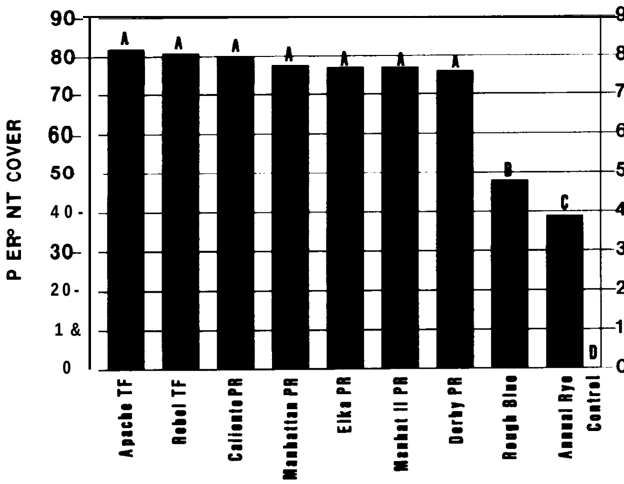

Figure 3. Percent overseeded grass cover on April 24, 1987.

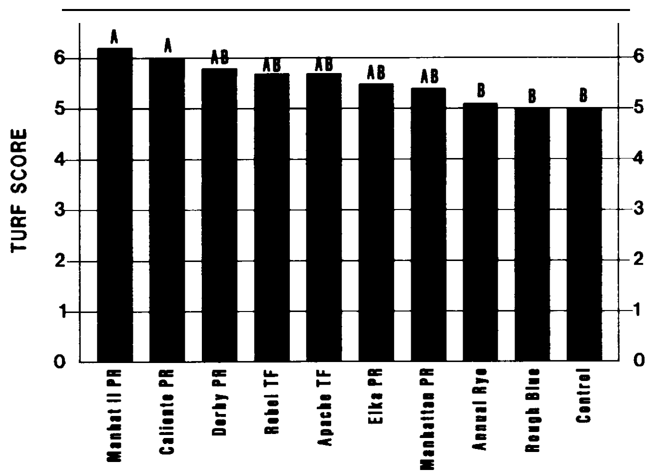

Figure 6. Fall turfscore averages (1987) of overseeded grasses.

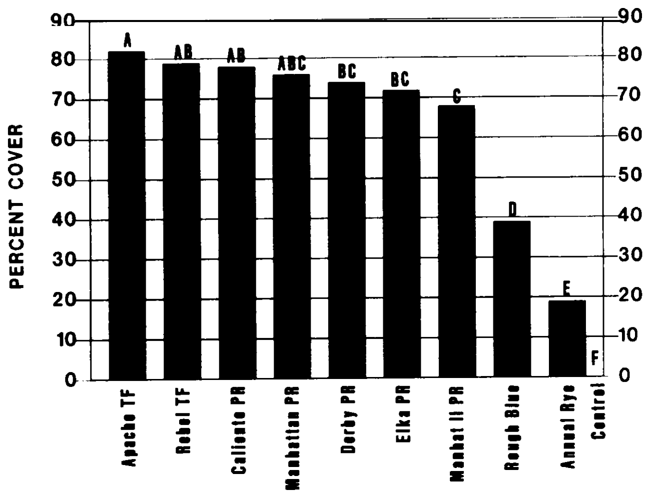

Figure 4. Percent overseeded grass cover on May 15, 1987.

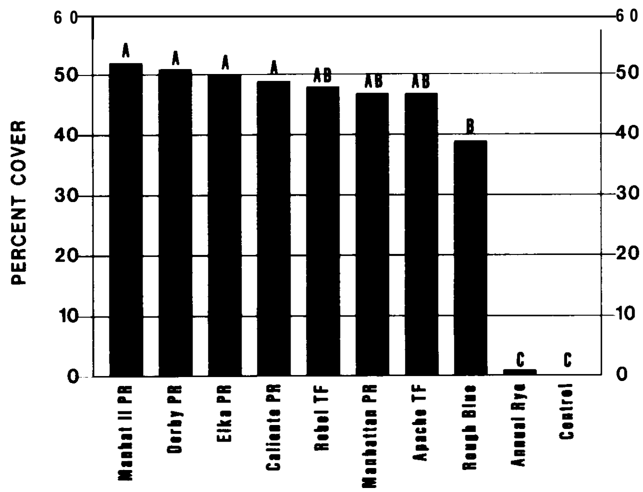

Figure 7. Percent overseeded grass cover on November 11, 1987.

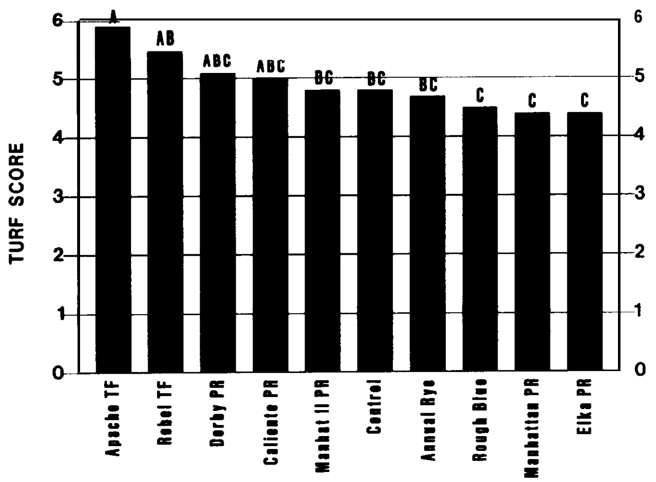

Figure 5. Summer turfscore averages (1987) of overseeded grasses.

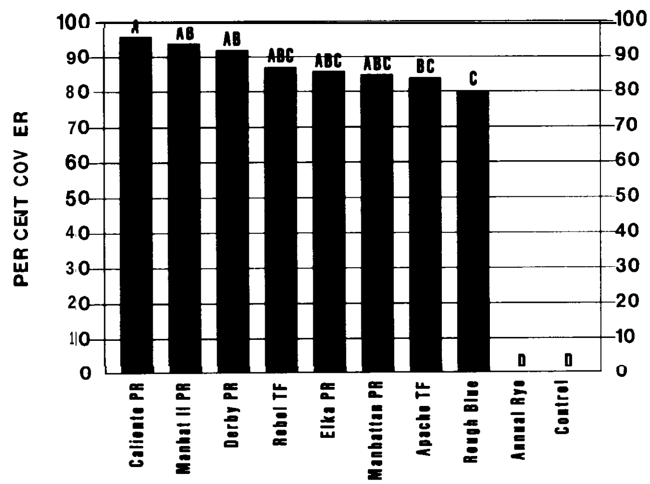

Figure 8. Percent overseeded grass cover on January 4, 1988.

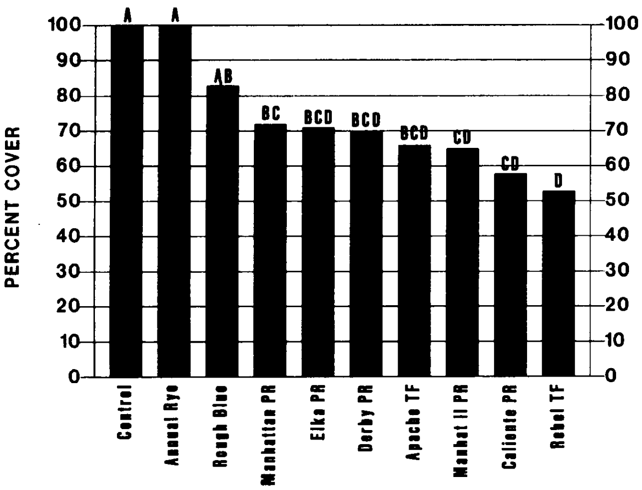

Figure 9. Percent bermudagrass cover on July 27, 1988.

CONCLUSION

In summary, the persistence of overseeded perennial ryegrass for more than the first season has been noted previously. This study clearly demonstrated the persistence of turf type tall fescues and the good compatibility of the tall fescues with common bermudagrass. Tall fescues were noted to have a slower initial overseeding response than the perennial ryegrasses. This study also showed the differences among varieties of perennial ryegrass. Manhattan and Elka perennial ryegrass were less competitive than Derby, Manhattan II and Caliente during the summer months, but all were sufficiently persistent to give good cover the second overseeding season.

This is a decided advantage for sites that desire a multiyear mix of cool and warm season grasses, but a disadvantage if a one season overseeding is desired. Annual ryegrass was the only grass tested that did not persist into the second winter season. These results demonstrated the poor performance of rough-stalk bluegrass as an overseeding species.

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COOL SEASON TURFGRASSES FOR RECREATIONAL TURF - VARIETY PERFORMANCE

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The demand on sports facilities by our large, urbanized, leisure-oriented clientele has been and will continue to be dramatic. The fields that serve this clientele must provide good playing surfaces that are safe for the users. Good surfaces are those that are uniform in color, density and texture; those that are capable of being clipped at a suitable height for the particular game; those that are free from pest activity and those that are firm, tough and wear-resistant yet sufficiently "giving" to cushion players. Players, coaches, parents and adult users are demanding that these surfaces be safe for the intended activity.

If this seems like a tall order, it is! Filling this entails applying basic agronomic practices: choosing the right grass and soil, constructing the facility correctly, then maintaining the turf cover with proper mowing, fertilization, irrigation, coring and thatch control practices. These steps will fail, however, if fields are overused by too many activities, and grooming and recovery time is insufficient.

Three basic factors should govern the selection of a turfgrass for a sports facility. First, the grass must be adapted to the local environment, with the components of onsite soil and climate taken into consideration. A well-adapted species and variety of that species will give a good quality turf of high recuperative ability and a turf of reduced pest susceptibility. Second, the grass selection should account for the use the facility will receive. Specialized sports use as well as intensity of use are important considerations. Third, the intensity or level of management that can be provided should strongly influence grass selection.

With the cool season turfgrasses, tremendous improvements have been made recently in perennial ryegrass and tall fescue. Varieties of excellent color, texture, density, disease resistance and overall stress tolerance are available. The studies reported here were designed to evaluate the performance characteristics of varieties of perennial ryegrass and tall fescue that were grown at the University of California, Riverside. Most varieties were in the National Turfgrass Variety Evaluation Program.

Plots Installed and Managed

The tall fescue and perennial ryegrasses were seeded in October 1984 at a rate of 5.3 lb per 1000 sq ft, to 25 sq ft plots. Each grass was replicated three times. Upon establishment, the grasses were mowed at 1/2 inches with a rotary mower, fertilized with 1 lb N per 1000 sq ft about every six weeks during the active growing season, (Spring, Summer, Fall) and irrigated based on calculated water use.

The plots were rated monthly for turf appearance, which included color, texture, density, uniformity and pest activity. A l-9 rating scale was used with 9 representing an ideal turfgrass stand and 1 representing a dead turf sward. Results of grand averages are presented in ranked order for turf quality.

Turf color was rated periodically, again on a l-9 scale with 9 being dark green and 1 being light green color. Results are presented in Tables 1 and 2.

[1]Extension Environmental Horticulturist and Staff Research Associate, UC Riverside, respectively

Table 1. Tall Fescue Variety Performance and Turf Color, University of California, Riverside

Variety	Turfscore1	Turf Color2
Trailblazer	7.3	7.8
Rebel II	6.7	6.9
Jaguar	6.7	6.7
Wojave	6.6	7.0
Mustang	6.6	7.0
Rebel	6.6	6.7
Apache	6.5	7.0
Bonanza	6.5	7.0
Arid	6.5	7.0
Olympic	6.5	7.0
Trident	6.5	7.0
Adventure	6.5	6.7
Falcon	6.4	6.7
Rinelawn 5GL	6.4	6.7
Brookston	6.4	6.0
Houndog	6.3	6.3
Maverick	6.3	6.3
Syn-GA-l	6.3	6.3
Williamette	6.2	6.7
Pacer	6.1	6.7
Tempo	6.0	6.7
Finelawn X	5.9	6.7
NK 82508	5.9	6.0
Chesapeake	5.8	5.7
Clemfine	5.6	5.3
Barcel	5.5	5.0
NK 81425	5.5	5.0
Festorina	5.3	5.3
Johnstone	5.3	5.3
Ky-31	5.3	5.3
Her Fa 83-l	5.3	5.0

1Turf score: l-9 with 9 best. Grand average of monthly color: for ratings 1-9 with 91985, darkest 1986 and 1987. green.

Table 2. Perennial Ryegrass Variety Performance and Turf Color, University of California, Riverside.

Variety	Turfscore[1]	Turf Color[2]
CT-I	7.4	7.4
Palmer	7.3	7.2
M382	7.2	7.4
citation	7.2	7.2
Tara	7.2	7.0
Omega	7.2	7.0
CBS-II	7.1	7.5
Blazer	**7.1**	7.4
Manhattan	**7.1**	7.4
Prelude	7.0	7.5
HR 1	7.0	7.5
Gator	7.0	7.5
SWRC-1	7.0	7.4
NK 80389	7.0	7.0
Repell	7.0	6.6
Birdie II	6.9	7.5
All star	6.9	7.0
Premier	6.8	7.5
Fiesta	6.8	7.4
Pennant	6.8	7.4
Ranger	6.8	7.0
Derby	6.8	7.0
Barry	6.8	6.8
Diplomat	6.8	6.5
Omega	6.7	7.0
P2	6.7	7.0
Yorktown II	6.7	6.6
LP702	6.6	7.4
Acclaim	6.6	7.4
Dasher	6.6	7.2
Al Star	6.6	7.2
Ovation	6.6	6.8
LP792	6.6	6.8
Cowboy	6.6	6.6
HE168	6.6	6.0
Citation	6.5	7.2
Crown	6.5	7.0
Elka	6.4	6.5
HE178	6.4	6.4
Manhattan	6.4	6.4
Regal	6.3	7.3
Delray	6.3	7.0
Cupido	6.3	6.5
NK 79307	6.2	7.6
Cockade	6.2	6.6
Pennfine	6.1	6.6
cigil	6.0	6.4
LP2109	6.0	5.8
NK 79309	5.8	7.0
WWE19	5.6	6.0
Servo	5.4	6.0
Pippin	5.4	5.0
Agree	5.0	4.5
Linn	4.9	5.5

1Turf score: 1-9 with 9 best. Grand average 2 of monthly ratings for 1985 and 1986. Turf color: l-9 with 9 darkest green.

WARNING ON THE USE OF CHEMICALS

Pestlcldes are poisonous Always read and carefully follow all precautions and safely recommendations given on the container label Store all chemicals in their original labeled containers in a locked cabinet or shed, away from lood or feeds. and out of the reach of children unautorizd persons *pets and* livestock

Recommendations are based on the best infromation currently available and treatments based on them should not leave residues exceeding the tolerance establishted for any particaula chemical Confine chemicals to the area being treated THE GROWER IS LEGALLY RESPONSIBLE for esidues on his crops as well as for problems caused by drift from his property to other properties or crops

Consult your County Agricultural Comissioner for correct methods *of disposing of leftover* spray material and empty containers Never burn pesticide containers.

PHYTOTOXICITY: Certain chimicals may cause palnt injury if used at the wrong stage of plant development or when temperatures are too high Injury may also result from excessive amounts or the wrong forumlaiton or from mixing incompatible materials Inert Ingredients such as wetters spreaders *emulisires* diluents and solvents, can cause plant injury Since formulations are often changed by manufacturers, it is possible that plant inury may occur even though no injury was noted in pervious seasons

NOTE Progress reports give experidmental data that should not be considered as recommedations for use Until the products and the uses given appear on a resistered pesticidw label or other legal sup plementary direction for use, it is illegal to use the chemicals as dsescrbied

Correspondence concerning *Califoria Turfgrass Culture* should be sent to:

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