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SUCCESSFUL TURFGRASS SODDINGPRACTICES-Part II*

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In the Summer, 1976, issue of California Turfgrass Culture, Part I of this article covered time of sodding, sod selection, site and soil preparation, sod transplanting, and post-transplanting sod care. This article will complete the topic as presented by Dr. Beard at the Turf and Landscape Institute, April, 1976, at Anaheim.

VI. *Sod Strength Comparisons Among Kentucky Bluegrass Cultivars*

A dimension of sod quality listed in Section II involves adequate sod strength for handling and transplanting. A specific aspect is the comparative sod strength of various species and cultivars. The following discussion presents data comparing the sod strengths of 28 Kentucky bluegrass cultivars.

The Michigan Sod Strength Test was first developed at Michigan State University in 1965. It involves harvesting a sod piece to a uniform depth and placing on a platform, one end of which is permanently secured and the other half which is mounted on rollers. A force is then uniformly applied to the moveable platform. The force in pounds required to tear the sod loose is termed the sod strength. Uniform, repeatable results have been obtained with this technique. The technique has since been adapted for use in sod experimental work at a number of other universities including Rutgers, Rhode Island, Minnesota and Guelph.

A series of sod strength comparisons among cultivars have been conducted on four different plantings made in August of 1968, 1969, 1970 and 1971 at the MSU Muck Experimental Farm. Measurements were taken at three intervals during the growing season for three years following each planting. Thus, a representative evaluation of the sod strength has been obtained. The cultural practices utilized were typical of those used on sod farms in Michigan..

A summary of the relative sod strengths of 28 Kentucky bluegrass cultivars is presented in Table 2.

TABLE 2. Relative sod strengths of 28 Kentucky bluegrass cultivars based on the Michigan Sod Strength Test.

Excellent (130 lb)*	Good (110 to 130 lb)	Intermediate (90 to 110 lb)	Poor (70 to 90 lb)	Very Poor (70 lb)
Nugget	Arista	Prato	Newport	Park
Baron	Belturf	Palouse	Delft	Kenblue
Pennstar	Primo	Campus	Cougar	Atlas
Sydsport	Adorno	Geary	Delta	South Dakota Cert.
Fylking	Merion	Windsor	Captan	
Sodco	A-34		Monopoly	
	S-21			

***Average for three seasonal sod strength measurements made in each of four years on three replications.**

The sod strengths ranged from as high as 135 lbs. to tear to as low as 30 lbs. A minimum of 80 lbs. sod strength is required for sod harvesting and transplant handling. The only disease that was visibly a problem during the experimental period was *Helminthosporium* leaf spot. This disease only occurred on certain susceptible cultivars and drastically affected the sod strength results during periods when the disease was active.

Kentucky bluegrass cultivars ranking superior in sod strength included Nugget, Baron, Pennstar, Sydsport, Fylking, and Sodco. Thus, most of the Kentucky bluegrass cultivars that ranked superior in terms of general turfgrass quality and *Helminthosporium* disease resistance also ranked quite well in terms of sod strength. As a group they ranked better than Merion Kentucky bluegrass which has been the standard for many years.

Experiments were also conducted to evaluate the effects on sod strength from blending various Kentucky bluegrass cultivars. In general, the Kentucky bluegrass blends do not rank as high or as low in sod strength in comparison to highest and lowest individual components. Thus, the blending of Kentucky bluegrass cultivars causes a moderation of extremes in overall sod strength.

VII. *Transplant Sod Rooting Comparisons Among Kentucky Bluegrass Cultivars*

The sods produced under the previously described experimental conditions were also utilized in the Michigan Transplant Sod Rooting Test. Uniform pieces of sod were harvested and transplanted onto a sandy loam soil at the MSU Turfgrass Field Laboratory in East Lansing. The Michigan Transplant Sod Rooting Test involves placing the sod pieces in wood frames under which had been secured a fiberglass screen. The roots grew through the fiberglass screen and into the underlying soil After a period of thirty days, an upward force was applied to the frame containing the sod by means of a pulley system having a mechanical advantage of five. The amount of force required for the sod piece and attached roots to be pulled free from the underlying soil was determined to be the transplant sod rooting characteristic. Three replications in each test gave acceptable uniformity and repeatability of results. The transplant sod rooting test was conducted at three different times during the growing season over a period of four different sodding years. Thus, as in the case of the sod strength evaluations, there is good confidence in the rankings presented in Table 3.

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*From: Proceedings of the 1976 Turf and Landscape Institute, pp. 20.24.

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TABLE 3. Relative transplant sod rooting (pounds to lift*) of 18 Kentucky bluegrass cultivars expressed on a seasonal basis. Based on the Michigan Transplant Sod Rooting Test.

Relative Ranking	Autumn and spring**	Summer	Overall
Excellent (65 lb)	Campus Belturf Kenblue	Belturf Captan Nugget A-34	Belturf Campus Captan
Good (58 to 65 lb)	Galaxy Monopoly Capta Delta n Park Windsor South Dakota Cert	Campus Galaxy Monopoly Fylking Pennstar	Galaxy Monopoly A-34
Intermediate (51 to 57 lb)	Newport Prato Merion	Newport	Fylking Nugget Newport Kenblue Pennstar
Poor (36 to 50 lb)	Fylking Cougar A-34 Pennstar	Kenblue Delta Merion Windsor	Delta Windsor Prato Merion
Very Poor (35 lb)	Nugget	Prato Cougar Park South Dakota Cert	Park Cougar South Dakota Cert.

*Average of three reps.
**Non-leaf spot periods.

The transplant sod rooting measurements ranged in these studies from as high as 98 lbs. to as low as 15 lbs. with some cultivars not rooting at all due to severe leaf spot infections. The reduced sod rooting capability of certain cultivars caused by *Helminthosporium* leaf spot was a problem primary during the midsummer period.

Decided differences in transplant sod rooting were ob served among the Kentucky bluegrass cultivars (Table 3). Kentucky bluegrass cultivars rankings in the excellent and good categories in terms of transplant sod rooting include Belturf, Campus, Captan, Galaxy, Monopoly, and A-34. Certain leaf susceptible cultivars, such as Kenblue, Delta, and Park, had superior transplant rooting in both the spring and fall periods but ranked quite low during the midsummer periods when leaf spot thinning was severe. On the other hand, a number of improved Kentucky bluegrass cultivars in terms of leaf spot resistance, such as Nugget, Pennstar, Fylking and Merion ranked much lower than desired, particularly during the spring and fall period. Merion actually was grouped in the poor category on a seasonal basis.

These data suggest that it would be desirable when blending Kentucky bluegrasses to include one of the cultivars having superior transplant rooting capability, particularly in the spring and fall period. Even though certain cultivars, such as Kenblue, Delta, and Park, are very susceptible to leaf spot, they do have other characteristics such as good transplant sod rooting, early spring greenup, and late fall color that may contribute certain long term desirable characteristics to a blend of Kentucky bluegrasses. An important consideration in this regard is to not include the leaf spot susceptible cultivars in such large percentages that the leaf spot problem dominates the seasonal performance of the blend.

TURFGRASS VARIETY RESEARCH REPORT 19704975

*V. A. Gibeault, J. Breece, J. Bivins, D. Donaldson, D. Hanson, J. Smith**

It was the objective of a series of turfgrass variety trials to evaluate the performance characteristics of available turfgrass cultivars (1970-71) in several locations in California. The trials were conducted in cooperation with seed companies and local USC facilities such as golf courses and parks.

At each location, site preparation was performed by the cooperating facility. The test arca was tilled and final graded, an irrigation system installed if not already prcscnt, and the varieties were individually hand sown to plots measuring 50 to 100 sq. ft., depending on location. The seeding rates were: Kentucky bluegrass-3 lbs./1000 sq. ft.; Peremiial ryegrass- 10 lbs./1000 sq. ft.; red fescue-6 lbs./1000 sq. ft.; colonial bentgrass-l lb./1000 sq. ft. All varieties for a given species were arranged in a randomized block design with four replications. Following germination, the plots were managed the same as the surrounding turfgrass area. The management practices and soil characteristics for each location are given in Table 1.

The ratings were made for the 1973 calendar year. At that time the plots had been established for at least a two-year period; the grasses were considered mature.

The accumulated data, which exceeded 8,800 observations, were avcragccl for varieties across replications and arranged into cool and warm season performance for each location. The averages presented for cool season were from data taken during the months October through April; warm season averages were from data taken during the months of May through September.

All locations were divided into two climatic categories, coastal locations and coastal valley locations, and results arc presented in this manner for Kentucky bluegrasses, and pcrcnnial ryegrasscs.

The coastal locations arc areas where the climate is primarily dominated by the ocean. Temperatures are moderate throughout the year with cxtrcmc lows in winter of 21-23°F and extreme highs in the summer of 90-97°F. Average summer highs are in the 60-75°F range.

Coastal valleys are less influenced by the coastal climate with resulting summer temperatures but only moderately low temperatures during the winter months. Nigh summer average temperatures are in the 65-79°F range with higher extremes more likely than along the coast. Correspondingly, winter low temperatures will be lower than the coastal location.

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TABLE 1. Soil and management characteristics of each variety test location.

Location	Use	Soil Analysis PH	P ppm	K ppm	ECe mmhos	Mechanical Analysis Sand	Silt	Clay	Mowing Height	Mowing Frequency	Fert. # N/M/yr.	Irrigation
Walnut Creek Munic. Golf Course, Walnut Creek	Rough area	7.2	14	224	2.0	52	30	18	1 inch	1 per week	4#	Normal
Merritt College, Oakla.nd	Ornamental area	6.1	56	310	1.8	36.7	33.0	30.3	1% "	1 per week	2#	Normal to stress
Overfelt Park, San Jose	Turf area in park	7.2	93	450	1.2	46.5	18.5	35.0	1% "	1 per week	1#	Normal to stress
Hancock College, Santa Maria	Ornamental area	6.7	18	—	1.1	74.5	17.0	8.5	1% "	10 days	3.68#	Normal to stress
Silverado Country Club, Napa	Rough	5.8	16.6	460	0.85	35.5	36.0	28.5	1% "	Weekly	3#	Minimum
Stafford Lake Park, Novato	Turf area in park	4.7	17	220	1.3	47.5	30	22.5	2 "	2 per week	4#	Normal
Balboa Park,	Turf area	....	60	156	2.6	65.7	21.3	13.0	1% :	Weekly	7#	Normal to stress
Adams Park, Lompoc	Turf area in park	—	5.4	67		windblown sand			1% "	10 days	1.65#	Stress

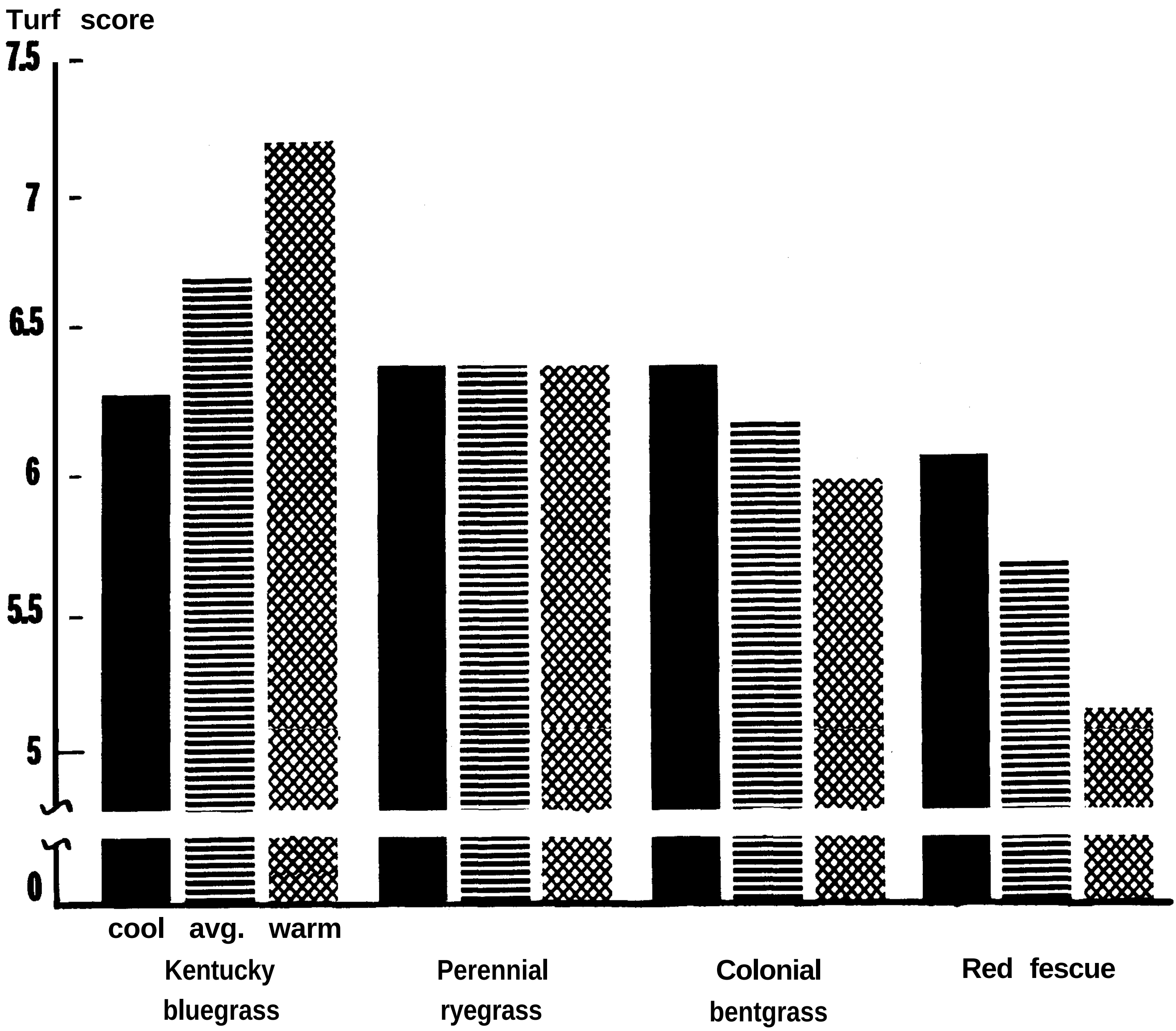

Figure 1. Statewide performance of four turfgrass species for warm and cool months, and yearly average. Each bar represents an average of all varieties, at all locations, and all replications, within each location.

In summary, coastal locations were designated as Balboa Park, Adams Park, Merritt College, and Stafford Lake. Coastal Valley locations were Hancock College, Overfelt Park, Walnut Creek and Silverado Country Club.

Rating System

A rating system was used to evaluate the variety trials on a periodic schedule. The characteristics that were considered in arriving at a turf score include color, texture, density, pest activity and uniformity.

Turf scores were based on a numerical system ranging from 0 to 10 where 0 represented a completely dead turf sward, or one where the grass was removed by weed competition, and 10 represented an ideal turfgrass stand of that species. To further clarify the rating, the following grouping can be used.

0-3 Indicated a completely unacceptable turfgrass stand with either a very high weed percentage or sward that was composed of mainly dead or dying grass. A turf stand in this range would imply that the species/variety would have to be reestablished.

3-6 The stand was unacceptable aesthetically, however, with correct management practices, it could be improved to a desirable level. There was at least 50% live grass that could "fill in" following a pesticide application, as an example. Reestablishment would not be necessary.

6-10 This range indicated degrees of acceptable turf. Most ratings fell in this range and the factors previously mentioned would be weighed to determine a final score.

Results

The species performance for the cool (October-April) and warm (May-September) months are presented in Figure 1. These results are from all varieties within a species at all locations. Kentucky bluegrass and perennial ryegrass varieties were at eight locations; the colonial bents and red fescues were at five locations.

Kentucky bluegrass had a higher average turf score than the other species tested. It is noteworthy that the bluegrasses had a much higher rating in the warm months than in the cooler months. Perennial ryegrass recorded the same average performance results irrespective of the time of year whereas colonial bentgrass and red fescue had lower turf scores in the warm time of year. This data shows that, under conditions of these evaluations, the best species performance was obtained with Kentucky bluegrass followed in order by perennial ryegrass, colonial bentgrass and red fescue. High temperature adaptability was indicated by Kentucky bluegrass whereas colonial bentgrass and red fescue had poor to very poor turf quality characteristics in the summer months.

Table 2 presents the ranked Kentucky bluegrass variety performance results based on annual average turf scores. Also given is data in terms of plot location (coastal or coastal valley) as well as by time of year (cool vs. warm). There was little difference observed in Kentucky bluegrass variety performance characteristics with varieties grown in coastal versus coastal valley locations. The average turf score for the former was 6.6 in comparison to 6.8 for the latter. The most obvious finding related to higher turf scores that were observed during the warm season and the comparably lower turf scores during the cool time of year. This was true for both coastal and coastal valley locations. This data indicated that in the transitional turfgrass adaptation zones of California, better performance of Kentucky bluegrass can be expected, irrespective of variety, during the warm time of year.

TABLE 2. Ranked Kentucky bluegrass performance results as measured by turf scores for 1973 (O-10 with 10 best).

	Coastal Locations[1]			Coastal Valley[2]			
Variety	Cool[3]	Warm	Yearly Avg.	Cool	Warm	Yearly Avg.	State-wide Average
Victa	6.5	7.6	7.0	6.8	7.7	7.2	7.2
Fylking	6.6	7.7	7.1	6.6	7.6	7.1	7.1
A-34	6.6	6.8	6.7	6.9	7.9	7.4	7.0
Baron	6.4	7.6	7.0	6.6	7.5	7.0	7.0
Prim0	6.5	6.8	6.7	6.7	7.8	7.2	7.0
Sodco	6.8	6.7	6.7	6.7	7.6	7.2	7.0
Cougar	6.4	7.2	6.8	6.6	7.5	7.0	6.9
Pennstar	6.3	7.4	6.8	6.6	7.3	7.0	6.9
Windsor	6.3	7.4	6.9	6.4	7.4	6.9	6.9
Nugget	5.8	7.2	6.5	6.0	7.1	6.6	6.5
Common	6:0	6.7	6.4	6.0	6.7	6.4	6.4
Merion	5.8	6.5	6.2	6.1	7.1	6.6	6.4
Park	6.0	6.9	6.5	6:0	6.8	6.4	6.4
Prato	5.6	6.6	6.1	6.2	7.2	6.7	6.4
Newport	5.8	6.8	6.3	6.0	6.6	6.3	6.3
Campos	5.3	6.4	5.8	5.4	6.4	5.9	5.9
Species Average	6.2	7.0	6.6	6.4	7.3	6.8	6.7

[1]Balboa Park, Adams Park, Merritt College, Stafford Lake Park.
[2]Hancock College, Over-felt Park, Walnut Creek Golf Course, Silverado Country Club.
[3]Cool: Average of data taken during the months October through April.
Warm: Average of data taken during the months May through September.

Table 3 gives similar data for five varieties of perennial ryegrass. There was a slightly higher average performance of those varieties grown in coastal locations in comparison to the warmer coastal valley locations (6.6 vs. 6.1 respectively). However, there was no difference between the performance characteristics during the warm and cool times of vear at either the coastal or coastal valley locations. This information indicates that better performance, of the varieties testecl, can be expected within the coastal areas of the transitional turfgrass adaptation zone in California. It also indicated that there is not a great fluctuation in species performance between cool and warm times of year.

TABLE 3. Ranked perennial ryegrass performance results as measured by turf scores for 1973 (O-10 with 10 best).

	Coastal Locations[1]			Coastal Valley[2]			
Variety	Cool[1]	Warm	Yearly Avg.	Cool	Warm	Yearlv Avg.	State-wide Average
Pennfine	6.6	7.6	7.1	6.7	6.1	6.4	6.8
Manhattan	6.6	7.0	6.8	6.3	6.3	6,3	6.6
Lamora	6.9	6.7	6.8	6.0	6.5	6.2	6.5
NK-200	6.4	6.4	6.4	6:0	5.6	5.8	6.1
Common	6.0	5.8	5.9	5.9	5.7	5.8	5.8
Species Average	6.5	6.7	6.6	6.2	6.0	6.1	6.4

[1]Balboa Park, Adams Park, Merritt College, Stafford Lake Park.
[2]Hancock College, Overfelt Park, Walnut Creek Golf Course, Silverado Country Club.
[3]Cool: Average of data taken during the months October through April.
Warm: Average of data taken during the months May through September.

Tables 4 and 5 give the results obtained with varieties of red fescue and colonial bentgrass respectively. Both species had lower average turf scores than Kentucky bluegrass and perennial ryegrass; red fescue was definitely the poorest performing species of those tested. In fact, all varieties of red fescue, except Golfrood, had statewide average results below 6.0 which indicated inferior performance. The warm season appearance of both species was poorer than the cool season appearance. This was especially apparent with varieties of red fescue.

TABLE 4. Ranked red fescue performance results as measured by turf scores for 1973 (O-10 with 10 best).

	All Locations[1]		
Variety	Cool[2]	Warm	Statewide Average
Golfrood	6.3	5.7	6.0
Jamestown			5.9
Illahee	6.4	5.3	5.8
Pennlawn	6.2	5.3	5.8
Chewings	6.3	5.1	5.7
Ruby	6.1	5.2	5.7
Highlight	6.2	4.6	5.4
Wintergreen	—	—	5.4
Species Average	6.3	5.2	5.7

[1]Adams Park, Merritt College, Hancock College, Overfelt Park, Walnut Creek Golf Course.

[2]Cool Average of data taken during the months October through Apri 1

Warm: Average of data taken during the months May through September.

TABLE 5. Ranked colonial bentgrass performance results as measured by turf scores for 1973 (0-10 with 10 best).

	All Locations[1]		
Variety	Cool[2]	Warm	Statewide Average
Holfior	6.5	6.3	6.4
Astoria	6.3	6.1	6.2
Highland	6.4	5.9	6.2
Exeter	6.2	5.7	6.0
Species Average	6.4	6.0	6.2

[1]Adams Park, Hancock College, Overfelt Park, Walnut Creek Golf Course, Silverado Country Club.

[2]Cool: Average of data taken during the months October through April.

Warm: Average of data taken during the months May through September.

Summary

Variety trials of four cool season turfgrass species were established in several transitional zone locations throughout California. The varieties were ranked by their performance as measured by turf scores. Also, species performance, as measured by total average variety performance, was discussed in terms of coastal vs. coastal valley locations and cool vs. warm time of year.

EVALUATION OF BIOLOGICAL DETHATCHING MATERIALS

*V. A. Gibeault, R. Baldwin, J. Bivins, D. Hanson**

Three dethatching materials were tested at various turfgrass locations that had a thick thatch. It was found that unde rthe conditions of these trials, the materials tested did not significantly reduce the thatch layer at any location.

A significant thatch layer can restrict air, water and nutrient entry into the soil thereby weakening the desired turfgrass sward. Control of thatch is therefore an important turfgrass management practice. Presently, thatch is controlled with mechanical operations, such as vertical mowing, and by improving the environmental conditions needed for thatch decomposition to occur by soil microorganisms. The latter includes practices such as aerification, topdressing, insuring good drainage, and maintaining favorable pH, moisture and nutrient balance. Recently, several biological dethatching materials have been made available commercially. These products generally contain a dry media that has been innoculated with specific fungi. As advertised, the microorganisms activate upon reaching a favorable soil environment and feed on the dead plant material present thereby reducing the thatch. The objective of the trials reported here was to evaluate the effectiveness of biological thatch control materials under different California conditions.

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Methods

The studies were conducted at Cal Lutheran College, Thousand Oaks (bermudagrass) ; Moorpark College, Moorpark (creeping bentgrass); Vandenberg Village Golf Course, Lompoc (creeping bentgrass); and Half Moon Bav Golf Course at Half Moon Bay (creeping bentgrass). The materials examined were Biodethatch® Thatch Away® and Earth Anew®. Biodethatch® and Thatch Away® are granular products that were applied with either a drop spreader or by hand at the recommended rate of one pound per 1000 sq. ft. Earth Anew®, a liquid, was applied with a pressurized sprayer at the recommended rate of one gallon per 5000 sq. ft. Not all materials were tested at all locations. Plot size varied at each location, however, all locations had four replications with the exception of Half Moon Bay which was not a replicated study.

At Vandenberg Village Golf Course, Biodethatch® was evaluated at three dates of application. The material was applied on March 26, May 28, and August 12, 1975. Treatment dates for the other locations were:

Cal Lutheran — June 26, 1975
Moorpark College — August 17, 1975
Half Moon Bay — April 7, 1975

All locations were aerified prior to application of the tested materials. The turf was irrigated immediately after treatment and normal turfgrass maintenance was provided thereafter.

The degree of thatch control was determined by measuring thatch depth at specific times following treatment. Two methods were used. At Half Moon Bay thatch depth was measured by cutting a cross section in the sample area and measuring the distance from the soil mix to the base of the grass blades. Seven samples were measured in the treated and untreated plots; results are presented as average thatch depth. At Cal Lutheran, Moorpark College and Vandenberg Village, two-inch diameter cores were harvested, the green leaves were removed by clipping, and a constant weight applied to the top of the core. Thatch depth measurements in cm were then made from the soil base to the top of the thatch. The data was analyzed by analysis of variance.

Results

The results are presented in Table 1. There are no significant differences among any of the treatments at the Moorpark College, Cal Lutheran and Vandenberg Village locations. The biological dethatching materials were not effective in reducing thatch under conditions of these tests. The Vandenberg study showed no difference in thatch decomposition when Biodethatch® was applied at three times of the year, indicating that time of treatment did not influence activity. Although the Half Moon Bay location was not replicated, the average data presented showed no decrease in thatch between Biodethatch®-treated and untreated areas on August 7 and December 8, 1975 There was slightly less thatch on August 23, 1976, in the treated plots indicating possible, but not significant, activity.

The lack of thatch reduction with biological thatch control materials as observed in this study supports the results of a trial in Georgia (2). In that study, no thatch reduction was noted on Tifdwarf and Tifway bermudagrass, Emerald Zoysiagrass and centipedegrass four months following treatment. A commercial newsletter (1) indicates that work in Hawaii by Dr. C. Murdock (University of Hawaii) found Biodethatch® and Thatch Away® "to be ineffective in reducing thatch in common bermudagrass tees. Tests were run at Leilehue and Navy Marine Golf Courses for five months using the above materials at 1, 2 and 4 times the suggested rates. No differences in thatch thickness were found at any time." The newsletter does mention, however, that positive results have been observed in the field by some turf managers.

Much more research information is needed regarding biological dethatching materials. In that regard, further trials have been established in California by Dr. Don Lancaster, Area Farm Advisor, Hayward, and the results of those studies will be released as-they are forthcoming.

LITERATURE CITED

1. Anonymous. 1976. Biodethatch Progress Report. Oxyturf News. V.20(10).
2. Burns, R. E. 1975. Dethatching Materials-A Preliminary Trial. The Georgia Turfgrass News. V.VIII, No. 6. pg. 5.

TABLE 1. Thatch Depth at Various Times Following Trial Initiation

	Moorpark		Cal Lutheran		Vandenberg		Half Moon Bay		
	4 mos.[1]	11 mos.	6 mos.	13 mos.	2-24-76[2]	7-27-76	4 mos.	6 mos.	16 mos.
Biodethatch®	1.95	1.32	1.38	1.98			2.9	2.9	3.0
March 26	—	—	—	—	1.82	1.85	—	—	—
May 28	—	—	—	—	1.62	1.90	—	—	—
August 12		1.38	—	—	1.55	1.82	—	—	—
Thatch Away®	1.96	1.28		—	—	—	—	—	—
Earth Anew®	2.04	1.38	1.25	1.88	—	—	—	—	—
Check	N.S.	N.S.	1.25	1.95	1.60	1.82	2.7	2.9	3.7
	. .*		N.S.	N.S.	N.S.	N.S.		no analysis	

[1]Measurements taken at indicated time following treatment.
[2]At Vandenberg, measurements were taken on indicated dates.
***N.S.—Not significantly different at the 5% level of probability.**

UC TURF CORNER

Victor A. Gibeault. Forrest Cress*

FUSARIUM BLIGHT SYMPOSIUM

Fusurium blight on Kentucky bluegrass varieties is a major disease in the midwestern and eastern states, one that remains an enigma to all who work with turfgrasses.

In the words of a Pennsylvania State University plant pathologist, *Fusarium* blight is regarded as an "impossible monster" by golf superintendents with bluegrass fairways. From the view of the research scientist, it poses a frustrating challenge.

Last year, seven top turfgrass researchers from across the nation took part in a symposium on *Fusurium* blight. Their discussion summarized our current knowledge on the subject, including general areas of agreement and controversy as to the causal nature of the disease.

Participating in the symposium were: Houston B. Couch of Virginia Polytechnic Institute and State University; Herbert B. Cole, Jr. of Pennsylvania State University; R. E. Partyka of Chem-Lawn Corp., Columbus, Ohio; A. J. Turgeon of the University of Illinois; J. M. Vargas, Jr. of Michigan State University; C. Reed Funk of Rutgers University; William A. Meyer of Turf-Seed Inc., Hubbard, Ore.; and F. H. Berns of Warren's Turf Nursery, Palos Park, Ill.

Introduction

The infectious agents involved in the disease, research has shown, are races and strains of the *Fusurium* fungus

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which interact with different species and strains of grass. Research to date indicates that a variety may show good resistance in one place and susceptibility in another.

In general, it is assumed that Fusarium organisms are present in most turf areas and that infection is related to stress conditions.

During the symposium discussion, there was general agreement that warm air and soil temperatures, soil moisture stress, high nitrogen fertility, thatch accumulation, turfgrass age and turfgrass variety play major roles in disease development.

Researchers disagree as to whether the predominant problem of Fusurium blight is a foliar blight phase or a root and crown rot infection phase. The present California view is that only crown and root rot are involved. In the East some see foliar blight as the principal problem while others maintain that a nematode-root complex is a prime factor.

Symptoms

Past research has shown that the total syndrome of Fusurium blight of turfgrasses consist of two phases: (1) blighting of the leaves, and (2) a crown and root rot.

First symptoms of the disease are the appearance of light green patches 2 to 6 inches in diameter. Under favorable conditions, these patches can change color in 36 to 48 hours to a dull reddish brown, then to tan, and finally to a light straw color. In later stages of disease development, circular patches of blighted turfgrass 1 to 3 feet in diameter commonly appear. Eastern researchers have reported that these light tan to straw-colored patches often have reddish-brown margins 1 to 2 inches wide with center tufts of green, apparently unaffected grass, this combination producing a distinctive "frog eye" effect. According to observations to date, the ring or frog eye seldom or never occur in the Far West.

Turfgrass plants affected primarily by the root-rot phase of the disease are stunted, pale green in color and don't recover readily from mowing or adverse weather conditions. Their roots are characterized by a brown to reddish brown rot. As the disease progresses, these roots darken. During periods of relatively high soil moisture, the pinkish growth of *Fusarium roseum* and *F. tricinctum* can be seen on the root and crown tissue near the soil surface.

The role of plant parasitic nematodes in *Fusurium* blight disease remains highly controversial to date. Some research findings indicate that nematodes are the dominant pathogen, not a fungus. Other findings indicate that nematodes play little or no role in the disease.

Disease cycle

Both *F. roseum* and *F. tricinctum* have been reported to be transmitted on turfgrass seed. They also are known to be able to survive in soil as saprophytes. These two sources are the main reservoirs for disease infection in newly seeded stands of turfgrass. The main sources of inoculum in established turfgrass are dormant mycelium in plants infected the previous season and thatch that has been colonized by the pathogens. Leaves are infected both by germinating spores and by mycelium from the saprophytic growth of the pathogens on the thatch and other organic matter. The most common area of penetration of foliage by the pathogens appears to be cut ends of the leaves.

Optimum conditions for disease development

F. roseum and *F. tricinctum* have been shown to vary in their temperature requirements for optimum pathogenicity. As a general rule, the foliar stage of *Fusarium* blight is most severe during prolonged period of high atmospheric humidity with daytime temperatures of 80°F to 95°F and night air temperatures of 70°F or above. Usually, development of the disease is greater in turfgrass when its soil moisture content has been allowed to drop to the permanent wilting level. Turfgrass grown under deficient calcium nutrition is more susceptible to *Fusarium* blight than well-nourished turfgrass. Incidence and severity of the disease, according to most research reports, has been reported to be greatest in turfgrasses under high nitrogen fertilization.

Cultural practices

There are two fundamental approaches to controlling *Fusurium* blight in Kentucky bluegrass, the turfgrass shown to be most susceptible to the disease under field conditions: (1) environmental-oriented and (2) plant-oriented measures.

The environmental-oriented approach entails adjusting the cultural program by avoiding excessive nitrogen fertilization during spring and summer, providing adequate moisture for turfgrass survival during stress periods through irrigation, performing appropriate cultivation practices to control thatch and alleviate soil compaction, and applying effective fungicides properly.

The plant-oriented approach involves the introduction of superior Kentucky bluegrass varieties that do not appear to be adversely affected by *Fusurium* fungi under local conditions.

Susceptibility of turfgrasses

In greenhouse studies, bentgrasses have been the most prone to the disease. However, in the field *Fusurium* blight has been primarily a disease of bluegrass fairways of golf courses and intensively managed bluegrass home lawns. The fescues have shown the most resistance to the disease.

(Editors' note: Most researchers who have worked on the *Fusarium* blight problem would agree that more needs to be known about all aspects of the disease and its control before it can be regarded with any less concern than it is today.)

("Fusarium Blight of Turfgrasses-An Overview," by H. B. Couch, "Factors Affecting Fusarium Blight Development," by H. Cole, Jr., "Factors Affecting Blight in Kentucky Bluegrass," by R. E. Partyka, "Effects of Cultural Practices on Fusarium Blight," by A. J. Turgeon, "Role of Nematodes in the Development of Blight,?' by J. M. Vargas, Jr., "Developing Genetic Resistance to Fusarium Blight," by C. R. Funk, and "Techniques for Determination of Blight Susceptibility," by W. A. Meyer, Weeds, Trees and Turf, July 1976.)

CROWN. TILLER AND RHIZOME CHARACTERISTICS OF KENTUCKY BLUEGRASS CULTIVARS

Data from recent experiments at Cornell University show how a particular turfgrass cultivar compares with others in crown type and tiller and rhizome development. The values obtained could be used as aids in recognizing off-type plants in a seed lot.

The studies were conducted to detect seedling characteristics that can be used in addition to characteristics described previously for making cultivar purity determinations, These previously described characteristics include anthocyanin development in leaf blades and sheaths, leaf blade width, foliar color, plant height, and development of chlorosis.

Seed of 26 cultivars and 6 experimental lines were planted in inert sand and grown in a growth chamber for 6 weeks with continuous light. A complete nutrient solution was used, and temperature was kept at 24°C.

Tillers of some cultivars grew horizontally 1 cm or more before turning upward, forming a spreading crown. Tillers of others grew upward with little or no lateral spread to form a compact crown. Other cultivars tended to be intermediate in crown type.

Cultivars with spreading crowns could be distinguished from those with compact crowns. Likewise, contrasting types in regard to tiller or rhizome number could be distinguished from each other.

("Crown, Tiller and Rhizome Characteristics of Kentucky Bluegrass Cultivars," by L. W. Nittler and T. J. Kenny, Agronomy Journal, Vol. 68, Mar-Apr 1976.)

USE OF MUNICIPAL SEWAGE SLUDGE FOR ROOTING OF GRASS CUTTINGS

Activated, digested sewage sludge from municipalities is generally available today at little or no cost for use on areas such as established turf.

Because of the large differences in sludges from various disposal plants, particularly their heavy metals content, some afford more potential use in turf areas than others.

An investigation of the feasibility of rooting grass cuttings in this medium was completed recently at the University of Georgia.

Cuttings of bermudagrass, centipedegrass and zoysiagrass were rooted in activated, digested sludge from sewage plants serving an industrial area and a residential area. The sludge from the former had a much higher heavy metal content than the latter.

The number of roots developed on bermudagrass cuttings rooted in sludge from the plant serving the industrial area was but 80% of those rooted in the residential area plant and total root length was 22% of those cuttings rooted in the residential sludge. The difference between root production by centipedegrass cuttings in the two sludges was much greater than for the bermudagrass.

Both sludges were inferior to the soil controls as rooting media. Data from this investigation imply that the heavy metals in the industrial sludge may have retarded root formation on the grass cuttings since large differences in metal content of the two sludges were noted, as mentioned above.

Zoysia had a few roots formed, even in soil making comparisons ditlicult. However, the same trend as for the bermudagrass and centipedegrass did appear to be present, according to the Georgia researchers who conducted the study.

("Effect of Municipal Sewage Sludge on Rooting of Grass Cuttings," by R. E. Burns and F. C. Boswell, Agronomy Journal, Vol. 68, March-April 1976.)

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