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The California Environmental Horticulture Industry

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California is now the second most urbanized state in the nation with 91% of its 30 million residents living in urban areas. The state is growing at a rate of 700,000 individuals a year, with population increases largest in southern California, particularly San Diego, San Bernardino, Riverside and Los Angeles Counties. With the exception of San Francisco, all counties have recorded increased residents.

For the state's city-dwellers, California's urban landscapes are as essential to a quality lifestyle as the state's famed coastlines and mountain slopes. Environmental horticulture is consequently a growing part of the state's economy. However, its structure, size and scope have not been well documented. It was the objective of this study to do so, and to quantify the industry's contribution to the economy of California.

Environmental horticulture is broadly defined as the industry which maintains and improves the functional use of plants in populated areas, and enhances ornamental production. It encompasses all non-production uses of plants and the commercial production of nursery and floriculture commodities. It includes the following three functional groups:

1) Production businesses that produce all stages and kinds of ornamental plants from seed to sod, and cuttings to cut flowers; 2) service businesses that research, design, install, sell at the retail level, or care for ornamental plants; and 3) equipment and accessories businesses that produce and sell primary equipment or secondary accessories that support the production and service groups.

The end user is the beneficiary and consumer of this industry. That user can be a homeowner of a single or multi-family dwelling; a commercial enterprise such as a golf course, office building or an apartment complex; or a public agency such as California Department of Transportation (Caltrans) or a state park. Figure 1 diagrams the functional relationships of the industry segments to the end user.

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Principal data acquisition for this study was conducted by the Sacramento-based consulting firm of Dangermond and Associates under the direction of a University of California, Riverside team. Data for production figures was collected by the County Agricultural Commissioners and summarized by the California Agricultural Statistics Service of CDFA. Employment figures were provided by the Census Bureau and the Employment Development Department, and sales volume figures by the State Board of Equalization. Employment and wage statistics were obtained from the California Employment Development Department using Standard Industrial Classification (SIC) statistics. Employment, sales volume figures and other data are for 1987-88.

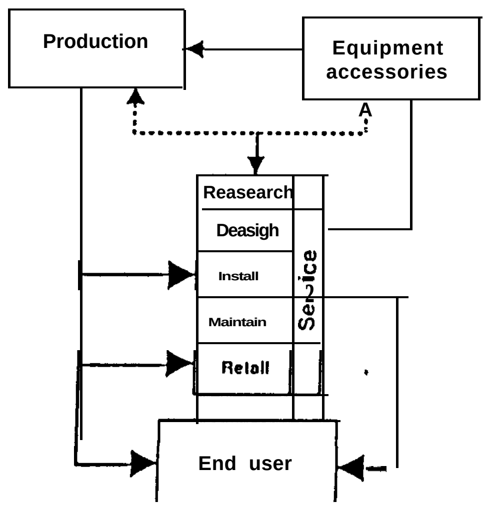

Figure 1. Functional relationships in the environmental horticulture industry

It was found that the production segment accounts for $1.46 billion of product value and the service category was found to generate $4.03 billion in gross receipts. Together, these total $5.5 billion. Wages paid in addition to these two category segments totalled $2.2 billion. Additionally, an equipment category was identified but the value could not be determined with present information. Likewise, industry service segments such as public facilities and golf courses have no available data. It is expected that these areas, along with the equipment and accessories segment, would account for another $2 to $4 billion in value.

The California environmental horticulture industry is huge. It provides the medium for play in many recreational facilities; it modifies the environment to make life easier and more pleasant; and it provides pleasing and functional home landscape. In addition, the industry has a significant direct economic impact on the state and a large indirect impact on the tourist economy.

Each of the industry segments tends to view itself independently from the others so that the self-perception of the whole industry is neither clear nor unified. Also, there are many segments of the industry, such as the turfgrass category, that have insufficient data to accurately depict their economic impact.

Spring Dead Spot Management Alternatives

John Karlik[1]

Spring dead spot (SDS) is a destructive disease of bermudagrass. December through early March dormancy allows colonization by the fungus *Leptosphaeria korrae*, which has been identified as a cause of this disease in California. Found in Australia as well as the United States, SDS can kill virtually an entire turf sward (2). The disease symptoms appear in the spring as bermudagrass comes out of winter dormancy, and usually consist of sharply defined circles 6-18" in diameter of killed turf (Figure 1). Over several seasons, spots may coalesce. Although SDS is an occasional problem in southern California, it has been particularly troublesome in the southern San Joaquin Valley (3). In the Bakersfield area, it is the only disease that causes any appreciable damage to bermudagrass. Seen mostly in residential turf, symptoms of SDS were noticed beginning in the early 1980 time period with activity peaking in 1985-87. Although it became known that the disease can spread by turf movement and the transportation of soil cores, little was known about the management of the disease.

A series of experiments was begun to investigate management alternatives. These included fungicide trials, use of fertilizers alone or in combination with fungicides, and effects of overseeding with or without soil amendments.

SDS SURVEY

To obtain background information on the disease in the Bakersfield area, a questionnaire was distributed to 160 single family dwellings that had characteristic symptoms of SDS in surrounding turf areas. Eighty-one of the surveys were returned. Questions pertained to the source of the turf, year of establishment, time of appearance of symptoms, cultural practices followed, and any attempted control of the disease.

Tabulation of the questionnaires revealed that cultural practices varied widely, with no obvious correlation with disease development. Attempts at control were varied and ineffective. Turf was purchased from at least 10 outlets and could not be traced to a single source. The time of appearance of the disease ranged from 3 months to 12 years after establishment (Figure 2).

Turf had been reported not to usually be affected by SDS until plants were 2 to 4 years old (2,5). Questionnaire results did not suggest any simple association of management practices with disease incidence.

FERTILIZER AND FUNGICIDE TRIALS

Nitrogen fertilizer and sufficient irrigation promote vigorous bermudagrass growth in late spring and summer. Some individuals in the local turf industry surmised that disease development was retarded by the use of certain fertilizer materials or amendments applied during the growing season.

Two preliminary studies, therefore, were conducted to see if fertilizers or fungicides reduced the severity of SDS symptoms.

In 1986, a fertilizer comparison study was begun on a sward of hybrid bermudagrass showing SDS symptoms in Arvin, CA. Experimental design was a randomized complete block with four replications. Two treatments were selected from local industry recommendations and included slow release fertilizers and soil amendments. Two others were quickly available N sources. Treatments were applied 7 times in 1986-1988, and plots were rated visually 7 times with a final rating in spring 1989. In late 1987, soil samples were taken to compare effects on pH and fertility level.

Although some treatment differences were noted early in the study, differences diminished with time. By 1989, overall disease activity had dropped even on control plots. Soil test results did not show differences between fertilizer treatments.

In 1986, a fungicide trial was conducted on heavily damaged residential turf. Fungicides were tested for activity against SDS in a randomized block design with five replications. The fungicides were not watered in following treatment (Table 1).

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Table 1. Five fungicides applied to an SDS site in Bakersfield on 9/29/86 and 1 1/16/86 with a backpack CO2 sprayer at 15 psi, visually rated 421/87 on a 1-10 scale, with 1 the best appearing turf.

Fungicide	Rate/l000 sq ft	Disease Rating'
benomyl 5OWP	8.0 oz F.	4.0a
diniconazole 25WP	1.0 oz F.	4.2a
fenarimol 1 EC	4.0 fl oz F.	3.8a
myclobutanil 4OWP	5.0 oz F.	4.2a
propiconazol 1.1 EC	4.0 fl oz F.	4.2a
control		3.8a

'Mean separation by Duncan's multiple range test at the 5% level. Means followed by the same letter are not significantly different.

None of the treatments was effective in reducing further damage. It is possible the disease was too advanced to show results from the fungicides.

Because some treatment differences were noted in the early years of SDS invasion at the Arvin site and because some fungicides were reported to show activity against the disease (4) it was decided to combine these treatments. Experiments were conducted for 2 years on a hybrid bermudagrass residential lawn on Mountain Oak Drive and for one year on Pagosa Avenue. A randomized complete block design was used with 4 replications of 4' x 4' plots at the Mountain Oak Drive site and 5 replications of 5' x 10' plots at the Pagosa Avenue site. Plots were rated visually on a l-10 scale with 1 the best appearance with the least amount of disease. In 1989 a pre-transformed rating scale, based on arcsine transformation of percentage data, was used, which more accurately describes observable differences (Tables 2,3,4).

Table 2. Fertilizer and fungicide treatments applied to hybrid bermudagrass on Mountain Oak Drive in Bakersfield, October 2, 1987, and rated March 25, 1988.

Treatment	Rate	Rating'
Fertilizer 8-12-4 + Gypsum	l# actual N/1000 sq ft 20#/1000 sq ft	4.0a
Fenarimol 1EC	4 fl oz F./l000 sq ft	3.7a
Combination (fertilizer. gypsum, and fenarimol)	same rates as above	2.6a
Control		6.2b

*Mean separation by Duncan's multiple range test. Values followed by common letters are not significantly different at the 5% level.

Table 3. Fertilizer and fungicide treatments applied to hybrid bermudagrass on Mountain Oak Drive in Bakersfield, November 1, 1988 and rated March 27. 1989.

Treatment	Rate	Rating'
Fertilizer 8-12-4 + Gypsum	1# actual N/1000 sq ft 20#/1000 sq ft	18a
Fenarimol 1EC	12 fl oz F./l000 sq ft	2.0a
Combination (fertilizer, gypsum, and fenarimol)	same rates as above	1.5a
Control		3.2b

'Mean separation by Duncan's multiple range test. Values followed by common letters are not significantly different at the 5% level.

Table 4. Fertilizer and fungicide treatments applied to hybrid bermudagrass on Pagosa Avenue in Bakersfield, November 1, 1988 and rated March 27, 1989.

Treatment	Rate	Rating'
Fertilizer 8-12-4 + Gypsum	l# actual N/1000 sq ft 20#/1000 sq ft	2.2ab
Fenarimol 1EC	6 fl oz F./l000 sq ft	3.0b
Combination (fertilizer, gypsum, and fenarimol)	same rates as above	2.0a
Control		4.8c

*Mean separation by Duncan's multiple range test. Values followed by common letters are not significantly different at the 5% level.

In these experiments, addition of either a fertilizer or fungicide was beneficial in reducing severity of SDS symptoms. A fertilizer alone enhanced growth of turf and apparently reduced seventy of SDS. The fungicide reduced disease incidence, but the turf was not as vigorous the following spring. The combination of fertilizer and fungicide gave the best results.

RENOVATION AND OVERSEEDING STUDY

To see what effect fall renovation and overseeding with annual ryegrass has on SDS, an experiment was conducted on a hybrid bermudagrass residential lawn. The lawn had heavy disease pressure as observed by characteristic symptoms. Design was a randomized complete block with four replications of 5' x 10' plots. Plots were rated with a pre-transformed l-10 scale, with 1 the best appearing turf and the least disease (Table 5).

Table 5. Fall renovation and overseeding treatments applied to hybrid bermudagrass turf in Bakersfield October 20, 1988 and rated March 26, 1989.

Treatment	Visual Appearance Rating	Disease Rating'
renovation + topdressing w/steer manure	6.5b	4.2bc
renovation + annual ryegrass	3.5a	1.2a
renovation + topdressing + annual ryegrass	4.0a	2.0ab
control	7.2b	4.5c

*Mean separation by Duncan's multiple range test. Values followed by common letters are not significantly different at the 5% level.

Renovation and topdressing did not significantly improve appearance of bermudagrass over that of the control plots and circles of disease were still obvious. Overseeding with annual ryegrass markedly improved appearance of the turf.

The improvement in appearance from overseeding continued through spring into early summer. Recovery of SDS-affected turf has been seen in the field following renovation and overseeding of annual ryegrass at other sites by landscape managers. In some situations, the improvement in appearance has been dramatic.

DISCUSSION AND CONCLUSIONS

Spring dead spot can be a very destructive disease of bermudagrass. It seems to be most severe in the transition zone of California, where December through early March winter dormancy allows colonization by the fungus. Addition of nitrogen fertilizer to keep turf vigorously growing late in the fall appears to be beneficial. Because winter temperatures in the southern San Joaquin Valley seldom drop below 20F low temperature injury does not seem to be a problem. Fall application of nitrogen improves recovey of damaged areas and the turfgrass can fill in the following spring.

A single application of fenarimol in autumn reduced the severity of SDS. Overseeding with ryegrass also reduced the severity of SDS symptoms. When ryegrass fades with the onset of warmer weather, bermudagrass has already begun to cover any injured areas. Less injury appears to occur in turf overseeded with rye, but this conclusion is tentative.

It has been observed that symptoms may subside or even disappear after several years. In the Bakersfield area, SDS appears to follow a cycle of severity at a given site, increasing in number of disease symptoms for 2-3 years, followed by fewer symptoms for about 2 years, and then final disappearance of the disease. This has been repeatedly observed in the field and was noted during the fertilizer and fungicide experiments. If turf is managed well during the onset of SDS, damage can be minimized. Even if severe injury has occurred, resodding may not be necessay if steps are taken to invigorate remaining turf and prevent further damage.

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Figure 1. Spring Dead Spot symptoms on a bermudagrass home lawn

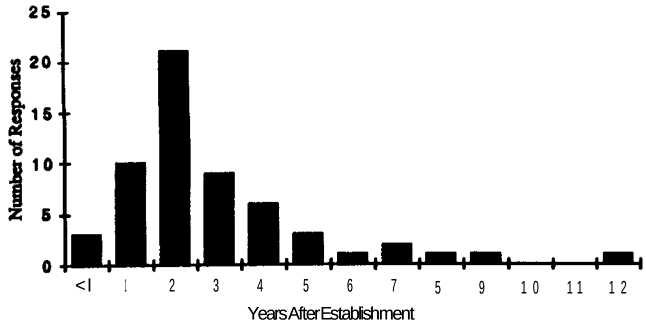

Figure 2. Time to appearance of SDS symptoms after establishment of turf.

Kentucky Bluegrass Performance on California's Central Coast

Ali Harivandi[1]

We are asked repeatedly why so many turfgrass seed mixtures contain cultivars of Kentucky bluegrass (Poa pratensis L.)? The simple answer is that in most parts of the country, excluding the dry, hot southern one third of the nation, Kentucky bluegrass does the job best. The use of Kentucky bluegrass for turf purposes is so widespread that "lawn" and "Kentucky bluegrass" are practically synonymous. During the past several years, however, due to a prolonged drought in the West, Kentucky bluegrass lawns have become controversial. It is not a particularly drought and heat resistant grass and, if grown in regions with prolonged hot, dry summers, is susceptible to disease and weed invasion. Relatively speaking, Kentucky bluegrass is defined as a "high-maintenance" turf in its water, nutrient and pesticide requirements, more so when grown outside its region of adaptation. Under intensive management, it produces a superior turf sward, unmatched by any other grass species.

In California, although overall use has declined significantly in the past few years, Kentucky bluegrass turf is still used for a variety of purposes. Continual evaluation of cultivars in different regions therefore remains relevant.

A comprehensive variety trial was initiated in 1986 at the University of California Research and Extension

Table 1. Turf quality and quality components ratings for Kentucky bluegrass cultivars grown in Santa Clara, California* (1986-1990).

	Overall Quality	Leaf Texture	Genetic Color	Winter Color	Density			Stripe Rust		% Ground Cover		
					Spring	Summer	Fall	1987	1988	Spring	Summer	Fall
BRISTOL	5.9	6.1	7.8	6.4	5.3	7.1	7.9	1.8	2.7	89	97	97
GLADE	5.8	5.2	6.8	6.2	6.1	7.2	7.3	3.5	3.3	87	97	96
RAM-1	5.8	5.3	6.2	6.1	6.5	7.3	7.1	4.3	3.0	93	95	95
MIDNIGHT	5.7	5.3	7.3	6.7	5.9	7.2	7.7	4.7	3.3	70	93	95
SYDSPORT	5.6	5.4	5.9	5.2	6.9	7.4	7.4	4.0	4.3	95	99	98
CHERI	5.3	5.9	5.7	5.2	6.8	7.0	7.3	4.0	5.0	91	98	98
SOMERSET	5.3	5.2	4.9	4.9	5.8	7.0	7.3	4.2	4.0	86	98	98
WABASH	5.3	5.3	5.0	5.2	6.7	7.3	7.0	2.8	4.0	96	99	98
GEORGETOWN	5.2	5.4	5.5	4.4	6.4	6.7	7.0	2.3	3.0	92	98	97
CYNTHIA	5.1	4.7	5.4	5.2	5.7	6.7	7.0	6.0	3.0	90	97	98
HAGA	5.1	5.3	5.4	4.3	6.5	5.8	7.3	2.5	2.3	96	97	99
PARADE	5.1	5.2	5.8	4.5	6.7	6.3	7.1	2.3	2.0	96	97	99
RUGBY	5.1	5.5	5.2	4.3	5.9	6.8	7.0	3.0	1.7	94	99	99
A-34	5.0	5.3	3.9	4.5	6.4	7.4	7.1	6.0	4.0	92	99	99
ASSET	5.0	5.7	5.1	5.9	5.8	6.2	6.4	4.5	4.3	84	93	97
CHALLENGER	5.0	5.5	6.8	4.8	6.3	6.8	7.0	3.5	4.0	85	94	97
AQUILA	4.9	4.3	4.8	5.9	6.2	6.6	6.6	6.0	6.0	93	98	97
KENBLUE	4.9	4.7	4.1	4.2	6.0	6.8	6.9	2.0	2.7	95	99	98
TRENTON	4.9	5.2	5.0	4.3	5.9	6.2	7.0	2.0	2.0	97	97	99
JOY	4.8	4.8	4.4	4.2	5.7	6.8	6.7	3.2	4.0	94	99	98
NASSAU	4.8	5.1	5.7	5.1	5.3	6.1	6.4	2.8	3.7	77	93	95
S.D. CERT.	4.8	4.7	4.4	4.0	5.7	6.4	6.7	2.7	3.0	96	98	98
JULIA	4.7	5.2	5.0	5.5	6.3	6.8	6.7	4.5	5.7	85	98	95
BARON	4.6	5.5	5.0	4.2	5.6	6.5	6.7	3.5	2.3	87	95	98
ECLIPSE	4.6	5.8	5.8	6.0	5.6	6.9	6.4	4.3	6.0	70	87	87
MYSTIC	4.6	4.5	5.0	4.9	5.2	6.6	6.5	6.3	3.0	65	96	96
IKONE	4.5	5.4	4.7	4.7	5.9	6.2	6.3	4.8	4.7	89	96	96
ABLE I	4.4	5.5	5.9	5.2	5.1	6.0	6.0	5.1	6.3	64	87	91
VICTA	4.4	5.1	4.9	4.6	5.1	6.2	6.5	5.3	4.0	79	97	97
AMAZON	4.3	4.6	4.5	4.8	5.3	6.2	6.5	4.2	6.3	68	86	87
ASPEN	4.3	5.5	5.1	5.1	5.6	6.2	6.0	4.3	4.3	89	94	96
AMERICA	4.1	5.2	5.1	4.8	5.6	6.6	6.5	3.5	5.0	71	81	82
MERIT	4.0	5.4	5.1	4.5	5.3	6.0	6.0	4.8	3.7	76	93	94
BLACKSBURG	3.7	5.4	5.2	4.9	5.1	4.8	5.3	6.1	5.7	62	79	77
MERION	3.3	4.7	4.9	5.2	5.0	4.9	5.1	5.5	7.0	57	59	66
LSD (0.0l)**	0.8	2.4	1.0	1.1	3.2	1.0	0.9	2.0	1.4	25	11	7

*The values are averages of monthly and quarterly ratings from 1986 through 1990. The rating scales are:
- Overall quality (turfscore): 1-9; 9 - Ideal turf.
- Leaf texture: 1-9; 9 - Finest texture (narrowest leaf blade).
- Color: 1-9; 9 - Darkest green color.
- Winter color: 1-9; 9 - Darkest color due to least amount of leaf dormancy.
- Density: 1-9; 9 - The densest stand of turf in various ssasons.
- Stripe rust: 1-9; 9 - Highest leaf rust infestation.
- X Ground cover: 0 - 99; 99 - Plots completely covered with the grass. This component evaluates pathogenic and/or environmental effects causing partial or complete death of turfgrass in a plot.

**LSD Value: To determine statistical difference among cultivars, subtract one cultivar's mean from another cultivar's mean. Statistical differences occur when this value is larger than the corresponding LSD value. If the difference between the mean values for two cultivars within the same column is not greater than the corresponding LSD, then the two cultivars are statistically the same for that specific quality component.

[1]Area Turf Advisor, Alameda, Contra Costa and Santa Clara Counties

Center in Santa Clara to study the suitability of several Kentucky bluegrass cultivars under Bay Area environmental conditions.

This report summarizes data from a (four year) study concluded in 1990. This study was financed by the Northern California Turfgrass Council, Golf Course Superintendents Association of Northern California, and University of California Cooperative Extension. Grass seed was supplied by the National Turfgrass Evaluation Program, sponsored by USDA.

Thirty-five cultivars (Table 1) planted in March 1986 were rated monthly through 1990 for overall quality (turfscore) as well as individual quality components: color, density, leaf texture, uniformity and stripe rust (Puccinia striiformis) infestation. Rate of seeding for all varieties was 2.2 lb/l,000 sq. ft.

All plots were in full sun and mowed at 2 inches, with clippings returned, and fertilized with 4 pounds of nitrogen per 1,000 ft.2 per year. Irrigation was based on 80% ET measured from an aboveground Class A evaporation pan. During the term of this study, plots were irregularly sprayed with herbicides to control broadleaf weed infestion. No dethatching or disease or insect control was practiced. Table 2 summarizes climatological data for Santa Clara, California, for the duration of the study.

Table 1 presents overall results at the end of the fourth year. Ratings are the average of the 4 years' monthly and quarterly ratings (1986 through 1990). Ratings were based on a scale from l-9, with 9 representing the most superior variety in terms of overall or component quality, except in the case of stripe rust, where 9 represents the highest infestation and therefore lowest quality.

Review of data reveals the following concerning the use of Kentucky bluegrass for lawn purposes under climatological conditions of the Central Coast of California (Table 2):

- Almost all cultivars performed very well during spring and fall months. They did not perform as well in winter, and showed severe heat/drought stress during summer months, which poor seasonal performance affected overall rating of all cultivars. Apparently, an irrigation regime of 80% ET (evapostranspiration) is not sufficient to ensure a high quality stand of Kentucky bluegrass during the summer.
- Although cultivars varied in their leaf texture (leaf blade width), the irrigation was not statistically significant.
- Cultivars were significantly different in overall quality, genetic color, winter color, summer and fall density and stripe rust infestation.
- Although cultivars remained green and performed well during the winter months, they all experienced low levels of low temperature leaf dormancy in winter.
- Although several cultivars exhibited high resistance to stripe rust, most are susceptible to this pathogen and may require periodic fungicide treatment.

Table 2. Average monthly air and soil temperatures in Santa Clara, CA. (1986-90).

	Air Temperature °F			Soil* Temperature °F		
	Ave. Max.	Ave. Min.	Mean	Max.	Min.	Mean
January	59.4	42.4	50.9	53	46	49.5
February	62.4	44.4	53.4	57	47	52.0
March	67.2	46.1	57.0	60	53	56.5
April	72.9	51.0	62.0	66	59	62.5
May	75.3	53.9	64.6	70	61	65.5
June	76.8	57.3	66.1	72	66	69.0
July	62.0	56.7	70.4	74	69	71.5
August	61.4	59.8	70.6	75	70	72.5
September	79.3	57.2	66.3	73	67	70.0
October	76.3	54.6	65.5	69	61	65.0
November	67.3	46.0	56.7	61	51	56.0
December	59.0	40.9	50.0	54	45	49.5

*Soil temperature measured 4 inches below surface. Maximum and minimum are highest and lowest for the months.

ACKNOWLEDGEMENTS

The author wishes to thank the Northern California Turfgrass Council and the Golf Course Superintendents Association of Northern California for their financial support of this trial.

An Evaluation of New Bermudagrasses

V. A. Gibeault, S. Cockerham and R. Autio'

Bermudagrass (Cynodon spp.) is a warm season grass that grows best under extended periods of high summer temperatures and mild winters. In California the bermudagrass adaptation zone includes the low elevation areas from the Mexican border to the north end of the Sacramento Valley. Bermudagrass can also be grown successfully along the southern California coast and in certain interior climate zones surrounding San Francisco Bay. Bermudagrasses are low water using and highly drought resistant turfgrasses in comparison to cool season grasses, and they are comparatively pest free. Because of their "low-input" characteristics, their use is expected to increase in areas where they are adapted.

The two kinds of bermudagrass grown in California include common bermudagrass (C. ***dactylon)*** and hybrid, or improved, bermudagrass (C. dactylon x C. ***transvaalensis).*** Common bermudagrass, a seed variety that has naturalized throughout the warmer parts of the United States, was introduced from Africa or Asia. It is a rather coarse textured, medium green grass that spreads by stolons, rhizomes and seed to form a moderately dense turf. It is often used when minimum-managed turf is required, however, if well maintained, a turf of good quality will result.

The hybrid bermudagrasses vegetatively propagated cultivars, were developed from crosses of common and African bermudagrasses.

They have several advantages over the common type. They are finer textured, denser grasses that are carpet-like in appearance and are rapid in their recovery from injury. Hybrid cultivars are considered to be higher maintenance grasses.

Because there are many new bermudagrass cultivars that have not been previously evaluated in California, it was the objective of two studies reported here to determine the turfgrass quality characteristics of commercially available cultivars and experimental lines of common and hybrid bermudagrasses.

The two bermudagrass studies were established in May 1986 at the South Coast Field Station in Irvine, California and at U.C. Riverside Agricultural Operations in Riverside, California. Methods of establishment were the same at each location: 1 in. plugs were placed on 1 ft. centers in 10 ft. x 10 ft. plots. At each site the plots were mowed weekly at 3/4 in., fertilized with 1 lb. N per 1000 ft^2 every 6 weeks during the growing season and irrigated as needed based on evaluation from an onsite CIMIS (California Irrigation Management Information System) weather station.

Plots were evaluated monthly for overall turf quality. Turf quality ratings considered color, texture, density, uniformity, and pest activity. A l-9 rating system was used with 1 representing dead turf and 9 representing ideal turf.

Other ratings included leaf texture (leaf blade width at collar) in May 1990; thatch thickness in May 1990; and visual scalping patterns in August 1987, August 1989 and July 1990.

Most grasses were vegetatively propagated. Those common types that were established from seed included NMS 1 (Numex-Sahara), NMS 2, NMS 3, NMS 4, NMS 14, Guymon and Arizona Common. Those grasses that were commercially available on a national level in 1991 included Arizona Common, Guymon, Midiron, NMS 1 (Numex-Sahara), Santa Ana, Texturf 10, Tifgreen, Tifway, Tifway II, Tufcote, and Vamont.

RESULTS

The annual average performances for five years of 32 cultivars of bermudagrass grown at U.C. Riverside and the U.C. South Coast Field Station at Irvine are given in Table 1. The seeded, common types performed at lower levels of quality than the vegetative types at both locations and there was little difference among the performance of the seeded grasses. Over the period of the study, the top performing grasses at U.C. Riverside were Santa Ana, E 29, A 22, Tifway, and Tifway II. The lowest performing vegetative propagated cultivars were NM 72, NM 507, and NM 375. The top performing bermudagrass cultivars at the South Coast Field Station included MSB 10, Tifway, Tifway II, Santa Ana, and MSB 30. The lowest performing vegetative bermudagrasses at the field station were Vamont, NM 72, NM 375 and RS 1.

In general, the cultivars gave higher annual performance ratings at the Irvine location than at the Riverside location. This was due to their better winter performance. Irvine, being more coastal, has moderate winter temperatures. Therefore, the bermudagrasses held color longer in the autumn, came out of dormancy earlier in the winter/spring, and, for some cultivars, stayed green year-round. This resulted in higher average performance ratings on an annual basis and for the five year average. Of course, during the summer months the performance ratings were similar for both locations.

Table 2 presents leaf width, thatch depth and scalping data that helps characterize the cultivars. Tifgreen, MSB 20, CT 23, and NM 43 were very narrow bladed, fine textured grasses. In comparison, RS 1, NM 375, Vamont, MSB 30 and the seeded cultivars had wider leaf blade widths and were coarser textured cultivars.

Those grasses with the highest thatch accumulation included MSB 30, MSB 10, and Tifway II. Low thatch producers were the coarser textured, more open cultivars such as NM 375, Numex-Sahara, NMS 14, and NMS 2.

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Also, A 29 and FB 119 had comparatively low thatch levels.

Scalping was noted when severe. During the three rating times, the cultivars that exhibited most scalping, on average, were CT 23 and Santa Ana. Periodic scalping was noted for other fine textured cultivars as well. The least scalping was noted with the open, coarser textured cultivars such as Vamont, RS 1, MSB 30, and Arizona Common.

In conclusion, bermudagrass is a well adapted turfgrass for California. This study examined commercially available and new cultivars for performance characteristics at two southern California locations. Good average annual turf quality was noted with established cultivars such as Santa Ana, Tifway and Tifway II. Several new cultivars deserve further consideration for use in California, including NM 471 and NM 507 (coastal), E 29, MSB 10 and MSB 30, and A 22.

Table 1. Turf performance of thirty-two cultivars of bermudagrass at two locations for a five-year period. 1-9 with 9 best.

	1986		1987		1988		1989		1990		5-Year Average	
Cultivar	UCR	SCFS	UCR	SCFS	UCR	SCFS	UCR	SCFS	UCR	SCFS	UCR	SCFS
CT 23	5.9	6.5	5.4	5.7	5.5	5.3	5.9	5.4	5.9	5.6	5.7	5.7
NM 43	4.7	6.4	5.0	5.9	6.1	5.4	5.4	5.4	5.8	5.6	5.4	5.7
NM 72	3.8	6.0	4.6	4.7	5.0	5.0	4.9	4.9	5.1	5.2	4.7	5.2
NM 375	4.5	5.4	4.4	4.9	5.6	5.4	5.2	5.2	5.6	5.4	5.1	5.3
NM 471	3.8	6.8	5.2	6.2	5.4	6.0	5.9	5.9	6.0	6.1	5.3	6.2
NM 507	4.3	6.7	5.0	6.0	5.0	6.1	5.8	6.0	5.6	6.2	5.1	6.2
Vamont	5.2	5.1	5.1	4.8	5.9	5.1	5.4	5.1	5.3	5.2	5.4	5.1
E 29	5.7	6.2	5.4	5.9	6.5	6.1	6.2	5.6	5.7	5.6	5.9	5.9
A 29	5.1	5.9	5.2	5.6	5.9	5.6	5.8	5.5	5.5	5.5	5.5	5.6
RS 1	5.0	5.3	5.1	5.3	5.8	5.3	5.3	5.1	5.7	5.5	5.4	5.3
MSB 10	5.4	6.6	4.9	6.2	5.7	6.7	6.4	6.9	6.3	6.9	5.7	6.7
MSB 20	5.8	6.3	5.5	5.9	6.0	5.5	5.3	5.5	5.5	5.7	5.6	5.8
MSB 30	4.4	5.9	4.4	6.5	5.8	6.5	6.3	6.0	5.8	6.5	5.3	6.3
A 22	6.1	5.6	5.3	5.3	6.4	5.7	5.9	5.3	5.9	5.5	5.9	5.5
Texture 10	5.0	5.7	4.9	6.0	5.5	5.8	5.2	5.8	5.5	5.5	5.2	5.8
Midiron	3.8	5.9	4.9	5.6	6.0	5.9	5.7	5.7	5.8	5.9	5.2	5.8
Tufcote	4.7	5.6	5.2	5.2	5.9	5.5	5.7	5.1	5.7	5.7	5.4	5.4
Tifgreen	5.2	6.5	5.1	5.5	5.8	5.4	5.3	5.4	5.6	5.7	5.4	5.7
Tifway	5.8	7.1	5.3	6.4	5.5	6.1	6.1	6.3	6.4	6.7	5.8	6.5
Tifway II	5.8	6.7	5.5	6.3	5.8	6.4	6.2	6.4	6.4	6.4	5.9	6.4
Sahara	4.6	4.5	4.4	4.5	4.9	4.9	5.0	4.9	5.1	5.2	4.8	4.8
NMS 2	5.0	4.6	4.9	4.2	5.1	4.9	4.7	4.8	5.1	5.1	5.0	4.7
NMS 3	3.5	5.8	4.4	5.0	4.7	5.2	5.5	5.1	5.5	5.3	4.1	5.3
NMS 4	4.2	5.4	4.1	4.7	4.7	5.1	5.1	5.1	5.3	5.5	1.7	5.1
NMS 14	4.8	4.6	4.5	4.4	5.1	5.0	4.7	5.0	1.8	4.9	4.8	4.8
Ariz. Common	4.4	4.3	4.5	4.2	5.0	4.8	4.6	4.6	4.9	4.8	4.7	4.5
Guymon	3.3	4.3	4.4	4.1	5.0	4.5	4.9	4.7	5.2	4.6	4.6	4.4
FB 119	6.3	6.0	4.6	5.0	5.0	5.0	5.3	4.9	5.2	5.44	4.9	5.3
C 19	•	[illegible]	[illegible]	5.	5.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C 84	•	•	[illegible]	[illegible]	5.5	[illegible]	5.9	5.3	5.4	5.4	5.4	5.5
Tifgreen II	:	:	5.2	5.1	6.0	5.4	5.8	5.0	6.4 5.5	5.7	6.1	6.4 5.1
Santa Ana			5.3	6.5	6.3	6.4	6.4	6.2		6.3		
LSD ***	1.5	0.6	0.7	**	0.5	0.4	0.4	0.3	0.4	0.3		

* Entries not included in analysis.
** Entries 1-27 LSD=04; for all others LSD=0.6.
***To determine statistical differences between entries, substract one entry's mean from another entry's mean. Statistical differences occur when this value is larger than the corresponding LSD value (LSD 0.05).

Table 2. The leaf width, thatch depth and scalping ratings of 32 bermudagrass cultivars grown at UC Riverside.

			Scalping*		
Cultivar	Leaf Width (mm)	Thatch Depth (mm)	1987 UCR	1989 SCFS	1990 UCR
CT23	1.3	21.8	2.3	4.3	5.7
NM 43	1.3	24.0	5.0	6.7	8.0
NM 72	1.9	21.4	6.0	6.7	8.3
NM 375	2.3	19.6	7.0	6.0	7.7
NM 471	1.8	22.0	4.0	7.0	7.7
NM 507	1.7	22.0	5.7	6.7	8.3
Vamont	2.2	20.6	7.7	6.7	9.0
E 29	1.7	23.8	6.7	5.7	8.3
A 29	1.7	19.8	7.0	6.3	8.0
RS 1	2.5	20.1	7.0	6.7	9.0
MSB 10	1.3	26.0	4.7	5.7	6.7
MSB 20	1.1	23.2	4.7	6.7	8.0
MSB 30	2.2	27.6	7.7	8.0	9.0
A 22	1.6	21.5	6.3	5.7	6.7
Texturf 10	2.1	23.8	6.0	6.3	9.0
Midiron	1.8	22.1	5.0	6.0	7.7
Tufcote	1.7	21.1	6.7	3.3	7.3
Tifgreen	1.1	20.5	5.7	6.3	8.7
Tifway	1.5	24.8	3.7	5.0	7.0
Tifway II	1.5	27.2	5.0	4.3	6.3
Sahara	2.0	16.5	7.0	5.7	8.3
NMS 2	2.2	19.8	6.0	6.3	8.7
NMS 3	1.8	22.2	4.3	5.3	7.3
NMS 4	2.0	21.1	6.0	5.3	8.0
NMS 14	2.3	19.4	7.0	5.7	9.0
Ariz. Common	2.1	20.6	6.3	5.0	8.0
Guymon	2.6	20.1	7.3	7.0	8.7
FB 119	1.8	16.6	5.0	4.7	7.0
C 19	1.7	21.2	6.3	7.0	8.0
C 84	1.7	29.3	4.7	6.7	8.0
Tifgreen II	1.5	24.0	6.0	5.7	8.3
Santa Ana	1.7	23.7	3.7	3.7	5.7
LSD **	0.3	4.5	2.6	1.6	0.9

* Scalping: 1-9 with 9 representing no scalping; 1 being most severe defoliation.
**To determine statistical differences between entries, subtract one entry's mean from another entry's mean. Statistical differences occur when the value is larger than the corresponding LSD value (LSD 0.05).

WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in their original labeled containers in a locked cabine or shed, away from food or feeds. and out of the reach of children. unauthorized persons. pets. and livestock

Recommendations are based on the best information currently available, and treatments based on them should not leave residues exceeding the tolerance established for any particular chemical Confine chemicals to the area being treated. THE GROWER IS LEGALLY RESPONSIBLE for residues on his crops as well as for problems caused by drift from his property to othe properties or crops.

Consult you County Agricultural Commissioner for correct methods of disposing of leftover spray material and empty containers. Never bum pesticie containers.

PHYTOTOXICITY: Certain chemicals may cause plant 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 formulation or from mixing incompatible materials. Inert ingredients. such as wetters. spreaders. emulsifiers, dilents, and solvents. can cause plant injury. Since formulations are often changed by manufacturers, it is possible that plant injury may occur. even though no injury was noted in previous seasons.

NOTE: Progress reports give experimental data that should not be considered as recommendations for use. Until the products and the uses given appear on a registered pesticide label or other legal, supplementary direction for use, it is illegal to use the chemicals as described.

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