COOPERATIVE EXTENSION UNIVERSITY OF CALIFORNIA

California Turfgrass Culture

Volume 42 1, 2, 3, and 4, 1992

A New, Non-Disruptive Alternative for Kikuyugrass Management in Cool-Season Turf

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Kikuyugrass was introduced into southern California around the 1920's for soil erosion and turf plantings. From its site of introduction kikuyugrass has spread along coastal California to the San Francisco Bay area, south to the Mexican border and interior to the western edges of Riverside and San Bernardino Counties. Many turf areas in the San Francisco Bay area, the central coast, and southern California have been invaded by, and are presently, partially or completely covered by, the warmseasonkikuyugrass.

Kikuyugrass is extremely aggressive, spreading by stolons, rhizomes and seed. Left unmowed, it is a tall, coarse grass with long, (6 to 9 feet), thick (l/3 inch) stolons. The rapid aggressive growth rate and growth habit accounts for its use for pastures in Australia, New Zealand and parts of Africa, as well as its original use in southern California by the Soil Conservation Service for planting waterway banks where rapid water movement was expected during storms.

The growth rate and growth habit also account for the very invasive characteristic of kikuyugrass and the reason for it being considered a weed by turfgrass managers. Other undesirable characteristics include its fairly light green color; its movement into flower, shrub or fence lines; its tendency to produce a deep thatch layer; its silver appearance from filament exertions; and its invasion into putting greens and sand traps. There are currently no cultural or single, selective chemical methods to control kikuyugrass. Complete renovation of the sward has been accomplished commercially. Two methods have been used. The first involves treatment with glyphosate followed by thatch removal, reseeding with desirable turf species, and treatment with preemergence herbicides to control emerging kikuyugrass seedlings. The preemergence herbicide which was used for this purpose in cool-season turf was siduron, which is no longer registered for use in the United States. The second renovation method involves fumigation with methyl bromide followed by thatch removal and reseeding.

Renovation is very costly to perform. Both renovation methods result in loss of turf use for several weeks while new desirable species are reestablished. After renovation, the desired turf species are again subject to a gradual reinvasion with kikuyugrass.

Multiple postemergence applications of MSMA were previously reported to be effective in reducing kikuyugrass invasion. Also, MSMA and triclopyr have been shown to injure kikuyugrass. Sequential applications of postemergence herbicides which injure but do not eliminate kikuyugrass as single applications might be used to suppress the competitive ability of kikuyugrass and allow re-establishment of the desirable species. Sequential applications would have an added advantage of allowing a gradual conversion of kikuyugrass infested swards back to desirable species without loss of turf use. This would result in minimal utility loss and ecological disruption compared with fumigation and renovation.

Procedure I

An initial experiment was established in the city of Ventura, California on August 1, 1989. The site had a mixed sward of perennial ryegrass *(Lolium perenne L.)* and Kentucky bluegrass *(Poa pratensis L.)* which had been invaded by kikuyugrass. Kikuyugrass was uniformly

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distributed (83% of the turf cover) as was the remaining Kentucky bluegrass and perennial ryegrass.

The herbicide treatments consisted of triclopyr (0.5 pound a.i. per A), MSMA (2 pound a.i. per A), and triclopyr plus MSMA (0.5 plus 2.0 pound a.i. per A) applied as both single and three, sequential treatments. The sequential treatments were made at four to five week intervals. Plots were evaluated on November 13, 1989, four weeks after the last sequential treatment. Percent of kikuyugrass control and phytotoxicity to the Kentucky bluegrass/perennial ryegrass mix was estimated relative to the control plots in each replication.

Two additional trials were established July, 199 1 in the coastal region of southern California (Camarillo and Huntington Beach). Prior to treatment, both swards consisted of uniform mixes of approximately 85% kikuyugrass and 15% perennial ryegrass. The Huntington Beach site was mowed to a height of 0.4 inches, raked, and seeded with perennial ryegrass at 9 a.i. per 1000 square feet (cv ‘Manhattan II’) on July 5, 1991. Four weeks later the sward was approximately 75% kikuyugrass and 25% perennial ryegrass, when the first herbicide treatments were made. The Camarillo site was also seeded at 9 pound a.i. per 1000 square feet with perennial ryegrass (cv ‘Manhattan II’), but seeding was done immediately after the first herbicide treatments were made on July 6, 1991. The herbicide treatments at both locations included triclopyr, MSMA, and triclopyr plus MSMA (0.5, 2.0 and 0.5 plus 2.0 pound a.i. per A respectively) as four sequential applications made at four- to five-week intervals. Three weeks after the last herbicide application, percent cover of perennial ryegrass was estimated and an evaluation of the density of the kikuyugrass was made by counting rooted stems larger than 1 inch per square foot.

Results I

MSMA, triclopyr, and MSMA + triclopyr controlled kikuyugrass somewhat initially as single applications, but that effect had declined by the end of the test (Figure 1). Sequential applications of these treatments improved percent control. MSMA and triclopyr applied sequentially were similar in percent kikuyugrass control (52 and 50% respectively). Sequential applications of MSMA + triclopyr controlled kikuyugrass best at the end of the test (88%) There was no injury from any of the treatments to the desired Kentucky bluegrass and perennial ryegrass mix except for slight discoloration and stunting which lasted less than one week afler each application (data not given). The desired species had filled in the areas vacated by kikuyugrass and were dominant in the plots that had received the sequential MSMA plus tliclopyr treatments.

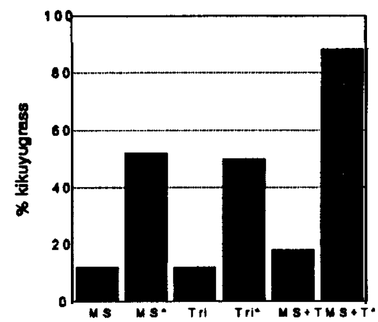

Figure 1. Effect of herbicide treatments on percent kikuyugrass at Ventura, California (November 13, 1989). LSD P=0.05 is 8%. "*" indicate sequential treatments. MS is MSMA, Tri. is triclopyr, and MS+T is MSMA plus triclopyr.

Sequential herbicide treatments in the 1991 trials controlled kikuyugrass and improved percent perennial ryegrass at both the Huntington Beach and Camarillo locations (figure 2 and 3). Sequential applications of triclopyr reduced kikuyugrass density (1.4 and 3.6 compared to 170.8 and 140.1, 1 inch stems per square foot in the untreated plots for Huntington Beach and Camarillo respectively). MSMA reduced kikuyugrass density to 5.8 and 26.4, 1 inch stem per square foot for Huntington Beach and Camarillo respectively.

The percent perennial ryegrass in the plots was inversely proportional to the density of kikuyugrass. Percent perennial ryegrass for sequential applications of triclopyr varied from 95.8 to 85 .0% and MSMA from 92.3 to 66.2% for Huntington Beach and Camarillo respectively. Where kikuyugrass was more completely controlled in the triclopyr plus MSMA treatment, percent perennial ryegrass varied from 98 to 100%.

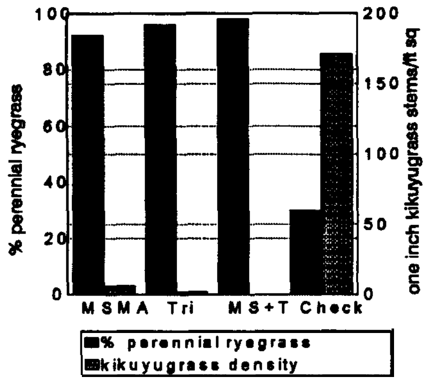

Figure 2. Effects of sequential herbicide treatments on establishment of perennial ryegrass and kikuyugrass density at the end of the 1991 growing season in Huntington Beach. LSD P=0.05 is 14% and 34 stems per square foot for percent perennial ryegrass and kikuyugrass density, respectively.

Procedure II

Kikuyugrass-turfgrass competition. A test was conducted at the University of California, Riverside Experiment Station over a two-year period to measure the differences in competitive ability of kikuyugrass and three cool-season turf cultivars: perennial ryegrass (cv 'Manhattan II'), Kentucky bluegrass (an unknown blend), and tall fescue (*Festuca arundinacea* Schreb. cv 'Bonsai').

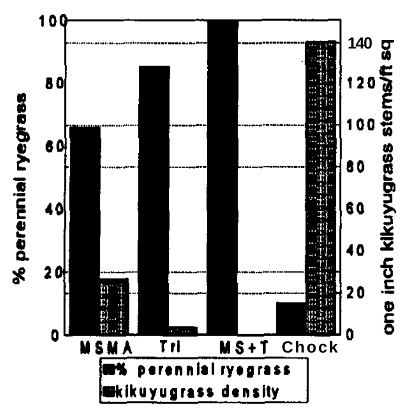

Figure 3. Effects of sequential herbicide treatments on establishment of perennial ryegrass and kikuyugrass density at the end of the 1991 growing season in Camarillo. LSD P=0.05 is 22% and 39 stems per square foot for percent perennial ryegrass and kikuyugrass density, respectively.

Stolons of kikuyugrass were pressed into a well prepared seedbed in October, 1989. A uniform, vigorous kikuyugrass stand had formed by June, 1990. Plugs (4 inch diameter) were then removed from well established sods of the three cool season turf species. Four plugs of each species were placed in separate 5 ft. by 5 ft sections of the kikuyugrass sward. After a six-week establishment period, the plots received their first herbicide treatment. The treatments included triclopyr (0.5 pound a.i. per A), MSMA (2.0 pound a.i. per A), and triclopyr plus MSMA (0.5 plus 2.0 pound a.i. per A), and an untreated control. Three treatments were made in 1990, each at six week intervals (July 14, August 30, and October 16). In 1991, four applications were made at six-week intervals (June 5, July 18, September 2, and October 15). Evaluations were made by measuring plug diameter of the six turf species on November 17, 199 1, at the end of the second year. Kikuyugrass density was also measured by counting the number of rooted stems with lengths of at least 1 inch per square foot.

Results II

Of the three cultivars, tall fescue had greater overall mean plug diameters at the end of the second growing season (5.7 inch). Perennial ryegrass and Kentucky bluegrass both had overall mean plug diameters of 5.0 inch. Competition from the kikuyugrass sod (figure 4) had reduced the plug diameter in control plots to 3 .O, 2.8 and 2.5 inch for tall fescue, perennial ryegrass and Kentucky bluegrass respectively from the original 4 inch plugs.

Sequential herbicide application of triclopyr, MSMA, or triclopyr plus MSMA resulted in reduced kikuyugrass competition and increased plug growth of all turf cultivars (Figure 4). Kikuyugrass density at the end of the experiment was reduced most by sequential treatments of triclopyr plus MSMA (7.3 stems per 1 square foot compared with 203.5 stems per 1 square foot in the control plots).. MSMA and triclopyr sequential treatments reduced density by 74 and 80% (54.4 and 39.0 stems per 1 square foot).

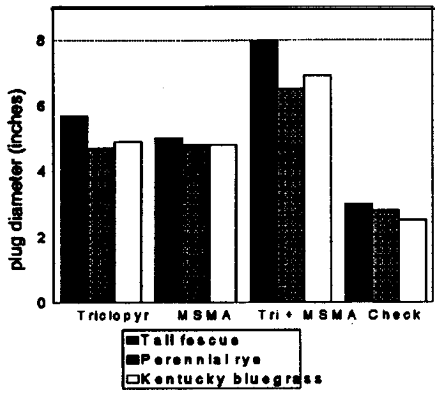

Figure 4. Diameter of three turfgrass cultivars affected by herbicide treatments and kikuyugrass competition at Riverside, California in 1991 at the end of the second year. LSD P=0.05 for all interactions among cultivars and herbicide treatments is 1.5 inches.

Conclusion

The results of this research can be integrated into a kikuyugrass management program. Where cool season species such as perennial ryegrass, tall fescue or Kentucky bluegrass are in a mixed sward with kikuyugrass, sequential applications of a combination of MSMA and triclopyr can be used to reduce the density and competitiveness of kikuyugrass. This will allow reinvasion of the desired cool season species. These applications should be timed so that they are made just as the Kikuyugrass is recovering from the previous herbicide treatment. This has normally occurred at about six week intervals. Care should be taken not to apply herbicides when the turf is under drought or high temperature stress. Some reseeding of the cool season species may be necessary during the reestablishment process if the initial cool season stand is not adequate or uniform. Reseeding should be done immediately after an herbicide application. This allows the cool season species to emerge and gain some size prior to the next herbicide treatment. This is important because postemergence herbicides can reduce growth and vigor of newly emerging grasses. Once the desired species is reestablished through sequential herbicide treatment and reseeding, proper management of that species to keep it competitive together with an occasional herbicide treatment as needed should prevent kikuyugrass reinvasion.

The manufacturer of triclopyr has altered labeling information to include multiple applications of triclopyr and triclopyr plus MSMA for kikuyugrass control in cool-season turf.

Acknowledgment

This research and continuing research with kikuyugrass control involving additional herbicides and turf species is being supported by The Northern and Southern California Golf Associations.

The Competition of Tall Fescue and Perennial Ryegrass with Kikuyugrass

Victor A. Gibeault, Stephen T. Cockerham, David W. Cudney and Matthew K. Leonard

A study was conducted at the University of California Agricultural Experiment Station at Riverside to evaluate the competitive nature of two cool season turfgrasses with kikuyugrass and to examine the influence of seeding rate and vertical mowing regarding their competitiveness. A sward of kikuyugrass established in 1989, using vegetative propagules obtained from a campus lawn, served as the study site. Soil at the site is a Hanford fine sandy loam with a neutral pH.

On September 27, 1990, prior to overseeding, selected portions of the kikuyugrass sward were vertical mowed using a tractor mounted hammerknife mower. The kikuyugrass in these areas was reduced to a network of surface stolons. On October 1, 1990, designated plots were overseeded with either 'Mojave' turf-type tall fescue or 'Manhattan' perennial ryegrass at rates of 0, 10, or 20 pounds per 1000 square feet. Sprinkler irrigation kept the plot moist until the seed germinated and became established, at which time the normal irrigation schedule was resumed. The plot was mowed weekly at a height of 2 inches with a rotary mower. Clippings were removed.

Plots were periodically monitored for kikuyugrass content and general turf quality. Kikuyugrass content was determined using a visual rating of percent grass in three, one-square foot subsamples obtained from a randomly placed samplii frame. The subsample results were averaged for further analysis. Quality ratings were based on the color, texture, density and uniformity of the turfgrass sward.

Results

It was found that there was no influence of the renovation treatment on percent of kikuyugrass or turfgrass quality for any rating dates. The renovation treatment was not needed to insure an acceptable overseeding of the cool season grasses and it did not influence the ultimate effect of the overseeded grasses on the percent kikuyugran present over time. Overseedmg the cool season grasses directly into a kikuyugrass stand provided an equal ability for the cool season species to compete and perform, under the conditions of this study. Also, it was found that seeding rate did not greatly influence the competition of the overseeded cool-season grasses with kikuyugrass .

The most noticeable treatment in this study with kikuyugrass was species selection. There were highly significant differences between tall fescue and perennial ryegrass with tall fescue better suppressing the kikuyugrasses.

Concerning turfgrass appearance, there was no significant difference with seeding rates and renovation treatment on the turfgrass quality of the grasses in this study. Overall, there was a consistent significantly better quality performance of tall fescue over perennial ryegrass for the duration of this study. This was attributed to the similar texture and color of tall fescue and kikuyugrass, which resulted in a more uniform turfgrass sward. In contrast the fine-textured perennial ryegrass and the coarser-textured kikuyugrass resulted in sward of less desirable quality.

Summary

This study evaluated the competitiveness and quality performance of two cool season species that were overseeded at two seeding rates to kikuyugrass, with and without renovation prior to overseeding. It was found that the choice of species was of most importance in the resulting percent kikuyugrass and turfgrass quality. Tall fescue was superior to perennial ryegrass as the overseeding species. Renovation prior to overseeding had no influence on the criteria examined and seeding rate had a very limited influence on percent kikuyugrass or turfgrass quality.

Acknowledgment

This project was supported by the Northern and Southern California Golf Association.

Turf-Type Tall Fescue Performance In California's Central Coast

Ali Harivandi and William L. Hagan [1]

A native of Europe, tall fescue *(Festuca arundinacea* Schreb.) is a bunch-type perennial with coarse-textured leaves which is adapted to a wide range of soils, and is essentially a cool-season grass but intolerant of extreme temperatures. It does particularly well in the transition zones (regions where cool-and warm-humid, or cool- and warm-semiarid climates meet) and in southern portions of the cool-humid region. Although moderately heat tolerant, tall fescue forms a non-uniform, patchy turf under extremely high temperatures, and therefore cannot compete with aggressive warm-season grasses like bermudagrass *(Cynodon spp.).* Nor is it recommended for the northernmost and southernmost portions of California or the high altitudes of the state's mountain regions, because of its sensitivity to temperature extremes.

The tall fescue root system can penetrate as deep as 4 feet under optimum conditions, but is generally concentrated in the top 6 to 12 inches of the soil. It is propagated by seed and, where a dense unifrom stand is desired, seeding rates of 7-10 pounds per 1,000 square feet are recommended. It is also

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widely available as sod. Recommended mowing height for tall fescue is in the range of 1.5 to 3 inches. It generally does not tolerate cutting closer than 1.5 inches.

Tall fescue has good drought and shade resistance and is moderately tolerant of submergence, waterlogged conditions, salinity, and sodicity. It does not produce stolons and although some strains may produce very short rhizomes, they do not result in significant spreading of the grass.

Due to its wide range of adaptability, tall fescue is used for a variety of turf purposes, such as athletic fields, parks, cemeteries, playgrounds, roadsides, airfields, waterways, slopes, and home lawns. With the introduction of improved cultivars, use of this grass has rapidly expanded.

Evaluations

In March, 1988, a trial was initiated at the U.C. Bay Area Research and Extension Center in Santa Clara to evaluate tall fescue cultivars as well as several experimental varieties. They were tested for turfgrass suitability in the central coast of California, an area of "transition zone" climate. The seed of these grasses were supplied by the National Turfgrass Evaluation program, sponsored by the United States Department of Agriculture.

Sixty-four cultivars were seeded on March 1988, at a rate of 4.5 pounds per 1,000 square feet in 25-square-foot plots and replicated three times in a randomized, complete block design. Analysis of the soil, a silt loam, at the beginning of the study indicated favorable pH, a safe salinity level, and adequate phosphorus and potassium.

Routine maintenance of the plots consisted of total annual application of 4 pounds per 1,000 square feet nitrogen from ammonium nitrate (applied twice in the spring and twice in the fall), mowing at 2 inches, and irrigation as needed. Plots were not exposed to any appreciable traffic, and no herbicide, fungicide, or insecticide was applied. The trial ran for four years, ending in December 1991.

During the evaluation period, plots were visually rated, monthly or seasonally as relevant, for color, density, weeds, disease and insect activity, and overall quality. At the end of the study, thatch measurements were conducted using a 4-inch diameter golf cup-cutter to remove one turf plug per each plot. Using a ruler, thatch thickness was measured from two sides of each plug, the average of which was recorded as thatch thickness for the plot. Table 1 summarizes combined data for the four-year evaluations.

At the trial site, average monthly soil temperatures ranged from a low of 43.8°F in December to a high of 75.00° F in August, with measurements taken at a depth of 4 inches. Average monthly air temperatures also were lowest in December at 39.5° F; the highest average monthly air temperature was 81.3° F in August. According to temperatures given in Table 2, this is a moderate temperature area.

Overall quality ratings are based on evaluation of all turfgrass quality components combined into one turf score. As indicated by the overall ratings, most of the newly developed cultivars produced as significantly higher quality turf than did the older cultivars. The same conclusion emerges from review of the individual quality components. The newer cultivars had a darker green color and produced a denser stand of grass.

No disease or insect activity was detected on any of the cultivars during this study. Minor weed invasion occurred on a few of the plots. Virtually, no thatch developed on any of the plots over the term of this study, indicating that, at least within a few years after planting, thatch should not be a problem with tall fescue stands.

The results of this study supported our previous findings that newly developed tall fescue cultivars are well suited for use as turf under central coastal California conditions, characterized as a "transition zone" climate. These new cultivars perform significantly better as turfgrasses under such conditions than do old cultivars. Since all tall fescue cultivars competed well with weeds and none were affected by the area's common diseases and insects, this grass also may be considered an efficient species to maintain as far as pest control and pesticide use are concerned.

Acknowledgment

The authors wish to thank Northern California Turfgrass Council and the Golf Course Superintendents Association of Northern California for their financial support of this study.

TABLE 1. Turf quality and quality components ratings for turf-type tall fescue cultivars grown in Santa Clam, California* (1998-1991).

Name	Overall Quality	Winter Color	Density Spring	Density Summer	Density Fall
BEL 86-2	6.9	6.0	7.6	8.1	7.2
HUBBARD 87	6.9	5.8	7.7	7.9	7.3
MURIETTA	6.9	6.0	7.7	8.1	7.7
AZTEC	6.8	5.6	7.7	7.4	7.6
MONARCH	6.8	5.8	7.7	7.2	7.3
SHENANDOAH	6.8	5.6	7.8	7.8	7.3
GUARDIAN	6.8	5.2	7.9	7.8	7.7
SILVERADO	6.8	5.7	8.0	7.7	7.1
ARRIBA	6.8	5.8	7.6	8.2	7.5
AVANT1	6.7	5.7	7.7	8.0	7.3
CROSSFIRE	6.7	5.5	7.8	7.9	7.6
WRANGLER	6.7	5.5	7.7	7.9	7.5
PE-7	6.6	5.5	7.6	7.9	7.3
AMIGO	6.6	6.0	7.7	7.9	7.3
SAFARI	6.6	5.8	7.8	7.7	7.4
OLYMPIC II	6.6	5.8	7.6	8.0	7.3
TRAILBLAZER	6.6	5.7	7.6	7.5	7.3
BONANZA	6.5	5.8	7.6	7.1	7.4
BRAHMA	6.5	5.5	7.7	7.7	7.3
PHOENIX	6.5	5.7	7.6	7.6	7.3
SHORTSTOP	6.5	5.5	7.4	7.0	7.2
MAVERICK II	6.5	5.5	7.7	7.6	7.3
PST-5AG	6.5	5.8	7.6	8.0	7.1
BARNONE	6.4	5.8	7.6	7.3	7.2
CIMMARON	6.4	5.5	7.4	7.1	6.9
JB-2	6.4	6.0	7.4	7.1	6.7
ANTHEM	6.4	5.2	7.7	7.6	7.3
AUSTIN	6.4	5.3	7.4	7.3	7.2
EMPEROR	6.4	5.3	7.7	7.1	7.3
ELOURAOO	6.4	5.7	7.6	7.3	7.0
REBEL II	6.4	5.8	7.4	7.9	6.9
TAURUS	6.4	5.5	7.4	7.1	7.5
THOROUGHBRED	6.4	5.3	7.4	7.7	7.1
ADVENTURE	6.3	5.8	7.4	7.3	6.7
CHIEFTIAN	6.3	5.7	7.3	7.1	7.0
JAGUAR II	6.3	5.5	7.4	7.3	7.2
TWILIGHT	6.3	5.3	7.4	7.4	7.0
VEGAS	6.3	5.5	7.4	7.4	7.0
WINCHESTER	6.3	5.7	7.4	7.4	7.2
APACHE	6.2	5.5	7.4	7.3	7.1
BEL 66-l	6.2	5.0	7.3	7.4	7.1
MESA	6.2	5.2	7.7	7.4	7.2
COCHISE	6.2	5.5	7.3	7.1	6.9
REBEL	6.2	5.7	7.1	7.3	7.1
TRIBUTE	6.2	5.5	7.3	7.7	7.2
ARID	6.1	5.7	7.4	7.2	6.8
CAREFREE	6.1	5.2	7.5	7.4	7.3
FINELAWN 5GL	6.1	5.5	7.6	7.1	6.6
JAGUAR	6.1	5.5	7.2	7.1	7.1
PST-5AP	6.1	5.5	7.2	7.1	6.9
TRADITION	6.1	5.7	7.6	7.4	7.1
OLYHPIC	6.0	5.5	7.2	7.1	7.0
SUNOANCE	6.0	5.3	7.6	7.4	7.0
TRIDENT	6.0	5.8	7.1	6.9	6.8
FINELAWN I	5.8	5.2	7.4	7.1	6.4
TITAN	5.8	5.2	7.6	6.9	6.8
FALCON	5.7	5.7	7.1	6.5	6.3
TIP	5.7	5.3	7.1	6.8	6.7
WILLIAMETTE	5.7	5.7	7.3	6.8	6.7
RICHMOND	5.6	5.2	6.8	6.7	6.8
PACER	5.5	5.2	6.9	6.7	6.4
FATIMA	5.3	4.8	6.9	6.4	6.2
AQUARA	5.3	5.5	6.9	6.6	6.7
KY-31	4.7	4.8	6.2	5.8	5.3
LSD VALUE**	0.3	0.6	0.6	0.7	0.6

*The values are averages of monthly and quarterly ratings from 1966 through 1991 The rating scales are:
- Overall quality (turfscore): 1-9; 9 = Ideal turf.
- Winter color: 1-9; 9 = Darkest color due to least amount of leaf dormancy.
- Density: l-9; 9 = The densest stand of turf in various seasons.

**LSD Value: To determine statistical differences 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 canponent.

TABLE 2. Average monthly air and soil temperatures in Santa Clara, CA. (1988-1991).

Month	Air Temperature °F			Soil Temperature °F		
	Ave. Max.	Ave. Min.	mean	Ave. Max.	Ave. Min.	mean
January	45.0	41.9	43.5	51.0	44.0	47.5
February	45.6	43.9	44.8	55.3	45.0	55.6
March	64.7	48.6	56.7	60.0	51.3	55.7
Apri 1	72.0	51.3	61.7	64.8	57.3	61.1
May	72.0	53.7	63.3	68.8	60.0	64.4
June	77.8	57.0	67.4	70.5	64.5	67.5
July	83.0	60.0	71.5	74.0	69.0	71.5
August	81.3	60.1	30.1	75.0	70.0	72.5
September	79.5	56.6	68.1	72.5	67.3	69.9
October	77.5	54.3	65.9	69.8	59.2	64.5
November	67.4	45.9	56.7	59.8	50.5	55.2
December	59.0	39.5	49.3	51.5	43.8	47.7

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

WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all percautions and safety recommendations given on the container label. Store all chemicals in their original labeled container in a locked cabinet 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 RESPONISBLE for residues on his crops as well as for problems caused by drift from his property to other properties or crops.

CoMult your Country Agricultural Commissioner for correct methods of disposing of leftover spray material and empty containers. Never burn pesticide containers.

PIIYTOTOXICITY Certain chemicals may cause plant injury if used at the wrong stage of plant development or when temperatures are too high. Injury may also reslult from excessive amounts of the wrong formulation or from mixing incopatible materials. Inert ingredients, auch as wetters, spreaders, emulsifiers, diluents, and solvents, CM cause plant injury. Siis formulations are often changed by manufacturers, it is possible that plant injury may occur, even though no injury was noted in previous seasons.

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

CALIFORNIA TURFGRASS CULTURE EDITORIAL COMMITTEE

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