TURFGRASS RESEARCH CONFERENCE AND FIELD DAY

September 12, 2000

&

LANDSCAPE MANAGEMENT RESEARCH CONFERENCE AND FIELD DAY

September 13, 2000

University of California, Riverside
Cooperative Extension
Dept. of Botany and Plant Sciences
Agricultural Operations

TURFGRASS RESEARCH CONFERENCE AND FIELD DAY

TUESDAY, SEPTEMBER 12, 2000

TURFGRASS RESEARCH CONFERENCE AND FIELD DAY
SEPTEMBER 12, 2000

TABLE OF CONTENTS AND CONFERENCE SCHEDULE

The Development of the University of California, Riverside Plots is Largely Due to the Generosity of the Firms and Organizations Shown Here

Inland Empire Composting

California Sod Producers Association

John Deere

California GCSA

PGA

Western Farm Service

Quality Turf

West Coast Turf

The Andersons

Hunter

Hi-Lo Desert Golf Course Superintendents Assoc.

California Agriculture

Stover Seed Company

NTEP

Gordon Corporation

Western Turf Jacobsen Textron

OMC Lincoln Cushman-Ryan

San Diego Golf Course Superintendents Assoc.

Irrometer

California Turf

Toro

Seeds West Inc.

MWD

Southern California Turfgrass Foundation

Rogers Innovative Inc.

The USGA

Southern California Golf Association

Golf Course Superintendents Association Southern California

Scotts Professional Business Group

Tri-Pro

Golf Course Superintendents Association of America

The Southern California Turfgrass Council

Germain's Seeds

Southland Sod Farms
Exclusive Growers of Genuine Marathon

California Bio-Mass, Inc.
An Recycling and Organics Company

Rain Bird

BIOLOGY AND CONTROL OF CRABGRASS

Clyde L. Elmore[1] and David W. Cudney[2]
[1]*University of California, Dept. of Vegetable Crops, Weed Science Program, Davis, CA 95616*
[2]*Dept. of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124*

Crabgrass is a common name that most everyone knows. There are two species of crabgrass common in California, smooth crabgrass (*Digitaria ischaemum*) and large or hairy crabgrass (*D. sanquinalis*). It is likely that we also have southern crabgrass (*Digitaria ciliaris*). It was introduced from Eurasia and is widespread throughout the United States. Smooth crabgrass is the species most often found in turfgrass. Crabgrass also has many other names including, crowfoot grass. Crabgrass is often thought of being an east coast weed, however it is found in most parts of California except in high elevations and in areas that receive no summer water.

IDENTIFICATION AND LIFE CYCLE

Smooth crabgrass is a low growing, summer annual plant that spreads by seed and from rooting of the culm nodes (joints) that lie on the soil. When unmowed it will be upright to about 6 inches, but it will tolerate mowing in turf at 0.25 inch. It will still produce seed at this height. Seeding leaves are light green, smooth and about ¼ inch long. True leaves are dark green, smooth and the leaf blade is from ¼ to 3/8 inch across and ¾ to 4 inches long and pointed. It often forms patches in lawns and can grow together and form large clumps. The ligule or collar, is small and inconspicuous and without prominent appendages or auricles. The leaf sheath is smooth, however a few hairs may be found on the lower leaf surface and the upper surface is smooth. The inflorescence (flower stalk) has branches which originate from the main stem at 1/8 to ¼ inch apart. The branches are 0.5 to 2.5 inches long at the end of the stalk.

Crabgrass species germinate from January 15 to February 1 in many areas of southern California. Crabgrass dies following a frost, so plants will live from year to year in some areas which does not receive frost in some years. In the central and northern parts of the state, crabgrass may germinate from March 1 to 15. Germination occurs when the soil temperature is from 50 to 55 F for 3 days. Germination continues throughout the summer and into the fall. Germination and growth is favored by weak turf, turf that is over watered, or has frequent light irrigation (daily) rather than infrequent (once a week) deep irrigation. It often is found first in open areas where there is no turf, along sidewalks where the soil may be warmer or around sprinkler heads where turf is mowed closer that in other turf.

Growth rate is greatest when temperatures are from 77 to 86°F and there is good moisture. There does not seem to be restricted light requirement for germination. It has been shown that it will germinate in the dark or in continuous light.

In a study on light quality on germination, it was shown that plants grown in red light had the longest stems, but that plants grown in green light had the most seed heads and the shortest days to flowering.

In field studies on competition with both smooth and large crabgrass, turf-type tall fescue varieties were screened in fall and spring plantings. The tall fescue varieties evaluated included: Fawn, Olympic, Olympic II, Mustang, Mini-mustang, Jaguar II, Jaguar III, Shortstop, Crossfire and Bonsai. Smooth and large crabgrass was seeded into all plots at the time of planting the turf. When the tall fescue was seeded in the fall, all varieties were effective in controlling both crabgrass species at Davis and Santa Clara, CA. When planted in the spring, Fawn tall fescue suppressed smooth crabgrass in the early season but was not effective in summer control. Bonsai was not competitive enough to keep smooth crabgrass from becoming a problem in summer. All other varieties reduced the smooth crabgrass germination and establishment, but did not eliminate the crabgrass. Large crabgrass was reduced with all varieties.

MANAGEMENT

Cultural control. Because crabgrass spreads and reproduces primarily by seed, any cultural operation that reduces seed production will decrease crabgrass. In turf, there are many cultural operations that will increase turfgrass vigor and decrease crabgrass. Select the optimum mowing height of cool season turf during the fall, winter and early spring to increase turfgrass vigor to reduce germination and establishment. Select the proper mowing height for the dominant turfgrass species that you are growing (see Turfgrass Weed Management guidelines). Fertilization can be used to increase the turfgrass vigor and reduce invasion of crabgrass. Fertilizing at the time when the turf will benefit, and the crabgrass won't, will help the turf. Proper timing of fertilization depends upon the turf species grown. Select a turfgrass that is adapted to your local conditions for the most vigorous turf. Irrigation timing and amount can also affect crabgrass germination and growth as mentioned previously.

Chemical control. Crabgrass is easy to control with herbicides applied before it germinates (preemergence herbicides). There are many herbicides available for use either in turf. It is imperative that preemergence herbicides be applied before germination. If DCPA is used it should be applied and into the germination zone before there is a chance of germination. It is not as critical for the other preemergence herbicides. Read the label to make sure the product can be used on your turf type. The following herbicides are available for use in warm season (bermudagrass, zoysiagrass) and cool season grasses (perennial ryegrass, Kentucky bluegrass, tall fescue, fine fescue): dithiopyr, pendimethalin, bensulide, benefin, DCPA, oxadiazon, prodiamine and trifluralin. Oryzalin is also available for use in warm season turf.

Postemergence herbicides, (herbicides applied after crabgrass emergence) can be used when the crabgrass is small. It is easiest to control when the crabgrass is in the 1 to 3 leaf stage. If the crabgrass gets larger, it takes more herbicide for control and there is a greater chance of injury to the turfgrass. The postemergence herbicides methyl arsonic acids (MSMA or CPA) are effective on young crabgrass. Crabgrass can be controlled with one application when in the 1 to 3 leaf stage. If older, then more than one application is required. If temperatures are over 85 F the rate should be reduced or injury to turf can occur. If temperature is higher than 95 F, then application should not be considered. The preemergence herbicide dithiopyr has some post emergence activity (2 to 3 leaf stage). This herbicide should not be considered a post emergence herbicide but just that the suppression of roots from the earlier application will control many seedling crabgrass plants.

By integrating cultural and chemical control in turf plantings, crabgrass should not be a major continuing problem.

STATUS OF HERBICIDE RESISTANCE IN CALIFORNIA

Jodie S. Holt
Dept. of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124

Herbicide resistance is the inherited ability of a plant to survive and reproduce following exposure to a dose of herbicide normally lethal to the wild type. In a plant, resistance may be naturally occurring or induced by such techniques as genetic engineering. Resistance may occur in plants by random and infrequent mutations; no evidence has been presented to demonstrate herbicide-induced mutation. Through selection, where the herbicide is the selection pressure, susceptible plants are killed while herbicide resistant plants survive to reproduce without competition from susceptible plants. If the herbicide is continually used, resistant plants successfully reproduce and become dominant in the population. Thus, the appearance of herbicide resistance in the population is an example of rapid weed evolution.

Background and Status

Herbicide resistance was first reported in 1957. In California, common groundsel (*Senecio vulgaris*) was the first reported herbicide resistant weed species. It was shown to be resistant to herbicides in the triazine chemical class. Since that time, plants of 61 species (42 dicots and 19 monocots) have evolved resistance to the triazine herbicides. Herbicide resistance in plants did not evolve as early as insecticide or fungicide resistance due to fundamental life cycle and genetic differences between plants, insects, and fungi. The delayed appearance of resistant weeds relative to insects and fungi is generally attributed to slower generation time of plants, incomplete selection pressure of most herbicides, soil seed reserve, and plasticity of weedy plants, all of which keep susceptible individuals in a population and thus delay evolution of resistance. The appearance of herbicide resistance in plants is currently increasing at an exponential rate (Figure 1), mirroring the trends previously seen with insecticide and fungicide resistance. In addition to triazine resistance, there are biotypes of over 170 weed species expressing resistance to 16 other herbicide classes. The most common mechanism of action or target site of herbicides that are currently registered in California, their chemical class, and the number of species with biotypes resistant to each herbicide class are summarized in Table 1.

In California, herbicide resistance currently is most widespread in aquatic weeds in rice production (Table 2). Many of these weed species have been selected for resistance to the sulfonylurea herbicide bensulfuron. In addition, there has been one report of triazine resistance as well as two reports of sulfonylurea resistance in a non-crop area. A roadside survey conducted in 1995 and 1996 found that resistance to sulfonylurea herbicides was common in Russian thistle (*Salsola tragus*). Most recently, a rigid ryegrass (*Lolium rigidum*) biotype exhibited resistance to glyphosate in a northern California orchard. Despite these examples, there are fewer reports of resistance in California to date than in other regions of the United States. However, current and pending registrations in California primarily involve herbicides that act on amino acid synthesis (Accent, Pursuit, Shade-Out, and Upbeet). Use of herbicides in this group has selected resistance in many weed species. Since these herbicides lead to rapid selection for resistant weeds, the number of cases in California is expected to increase. In addition, a number of genetically engineered crops that are resistant to specific herbicides will soon be available in California such as Roundup Ready cotton and corn. Sole reliance on the specific herbicide used in these resistant crop varieties will increase the selection pressure for resistance to that herbicide. Herbicide-resistant crops will not be an end-all solution to weed problems and they will lose their effectiveness for weed management if used continuously.

Prevention and Management

There are several factors such as herbicide characteristics, plant characteristics, weed control practices, and production practices that increase the probability of selection for herbicide resistance. Herbicide factors that contribute to the potential for resistance include long soil residual activity, single target site and specific mode of action, and high effective kill of a wide range of weed species. Herbicides with prolonged soil residual activity have a longer time to select for the resistance trait since they will kill most susceptible plants that germinate over a growing season. Herbicides with a single target site controlled by few genes are more likely to encounter plants with mutations for resistance than are herbicides with several modes of action. High effective kill rapidly depletes susceptible genes from the population, resulting in a rapid increase in resistance from few initial plants.

Any management action that reduces the selection pressure for resistance will reduce the rate of resistance evolution. Crop rotation is one of the best tools to prevent resistance. Rotating to another crop allows the use of both chemical and non-chemical methods of control. Manipulation of planting time, crop competitiveness, cultivation techniques, hand weeding and herbicides with different target sites are all possible in a crop rotation system. Farmers and Pest Control Advisors (PCAs) in California use many of the methods listed above to control weeds. These characteristics of California agricultural production are probably the reason that few weed species have evolved herbicide resistance. As highly effective herbicides with the same target site become registered in California in multiple crops of a rotation, the risk of resistance evolution increases. Herbicides with different chemistries and trade names, but with the same target site, can reduce the effectiveness of herbicide rotation. Some common crop rotations include cotton, corn, tomato, sugarbeet and alfalfa. All these crops now have herbicides registered for use that target the same site (ALS). Weed species will evolve resistance rapidly without rotation of herbicides with different target sites.

The use of short-residual herbicides also reduces selection pressure for herbicide resistance. In addition, tank-mixing herbicides with different modes of action (Table 1) can inhibit evolution of resistance, but combinations should be used that broaden the spectrum of weeds controlled as well as control the weed species of major concern. If two herbicides have nearly the same weed control spectrum, it would be better to rotate between them rather than tank-mix the two compounds. It is unlikely, but theoretically possible, to select for resistance to two herbicides simultaneously.

The use of herbicide resistant crops is a new technology with increasingly widespread adoption. In many cases, growers will rely more heavily on a single herbicide in these cropping systems. Such a strategy will likely select for weed biotypes resistant to that herbicide or mode of action. Tank mixing, rotating herbicides, rotating to varieties without the resistance trait, as well as integrating non-chemical control options within the weed management program will reduce the potential for weed biotypes evolving a resistant trait.

Besides crop rotation, the use of certified seed, equipment sanitation, and cultivation and/or hand-weeding all impede resistance evolution. A resistance problem is usually not detected until land managers or farmers observe about 30% weed control failure for a particular species. If these resistant weed patches can be identified early before their populations increase, management practices can be employed to prevent their spread. If weed escapes appear in patterns, such as distinct strips, or if several species normally controlled by the herbicide are present in these skips, then the problem is probably associated with a calibration or application error. However, patches represented by only one escaped species showing no distinctive pattern may indicate a herbicide resistant population. Suspicious areas should be brought to the attention of a Farm Advisor or Extension Specialist, especially if weed populations reoccur in subsequent years following use of the same herbicide.

California weed management will change significantly with the introduction of new herbicides and the advent of herbicide resistant crops. If we maintain a selection pressure through continued use of these new tools, the new tools will soon be rendered ineffective. Adopting proactive management strategies to prevent herbicide resistance conserves important weed control tools. If resistance management strategies are ignored there is the potential that IPM systems may lose flexibility to deal with weed problems.

References

Crites, W. 1990. Strategies for dealing with resistant weed plants. Proceedings of the California Weed Conference 42: 145-149.

Heap, I. M. 2000. International Survey of Herbicide Resistant Weeds. (Online). Available http://weedscience.org/Resistance/resistmodule.asp.

Holt, J. S. 1992. History of identification of herbicide resistant weeds. Weed Technology 6: 615-620.

Holt, J. S., S. B. Powles, and J. A. M. Holtum. 1993. Mechanisms and agronomic aspects of herbicide resistance. Annual Review of Plant Physiology and Plant Molecular Biology 44: 203-229.

Prather, T. S., J. M. DiTomaso, and J. S. Holt. 2000. Herbicide resistance: Definition and management strategies. (Online). Available http://anrcatalog.ucdavis.edu/pdf/8012.pdf.

Prather, T. S., J. M. DiTomaso, and J. S. Holt. 2000. History, mechanisms, and strategies for prevention and management of herbicide resistant weeds. Proceedings of the California Weed Science Society 52: 155-163.

Retzinger and C. Mallory-Smith. 1997. Classification of herbicides by site of action for weed resistance management strategies. Weed Technology 11: 384-393.

Figure 1. Chronological increase in cases of herbicide resistance worldwide by year.

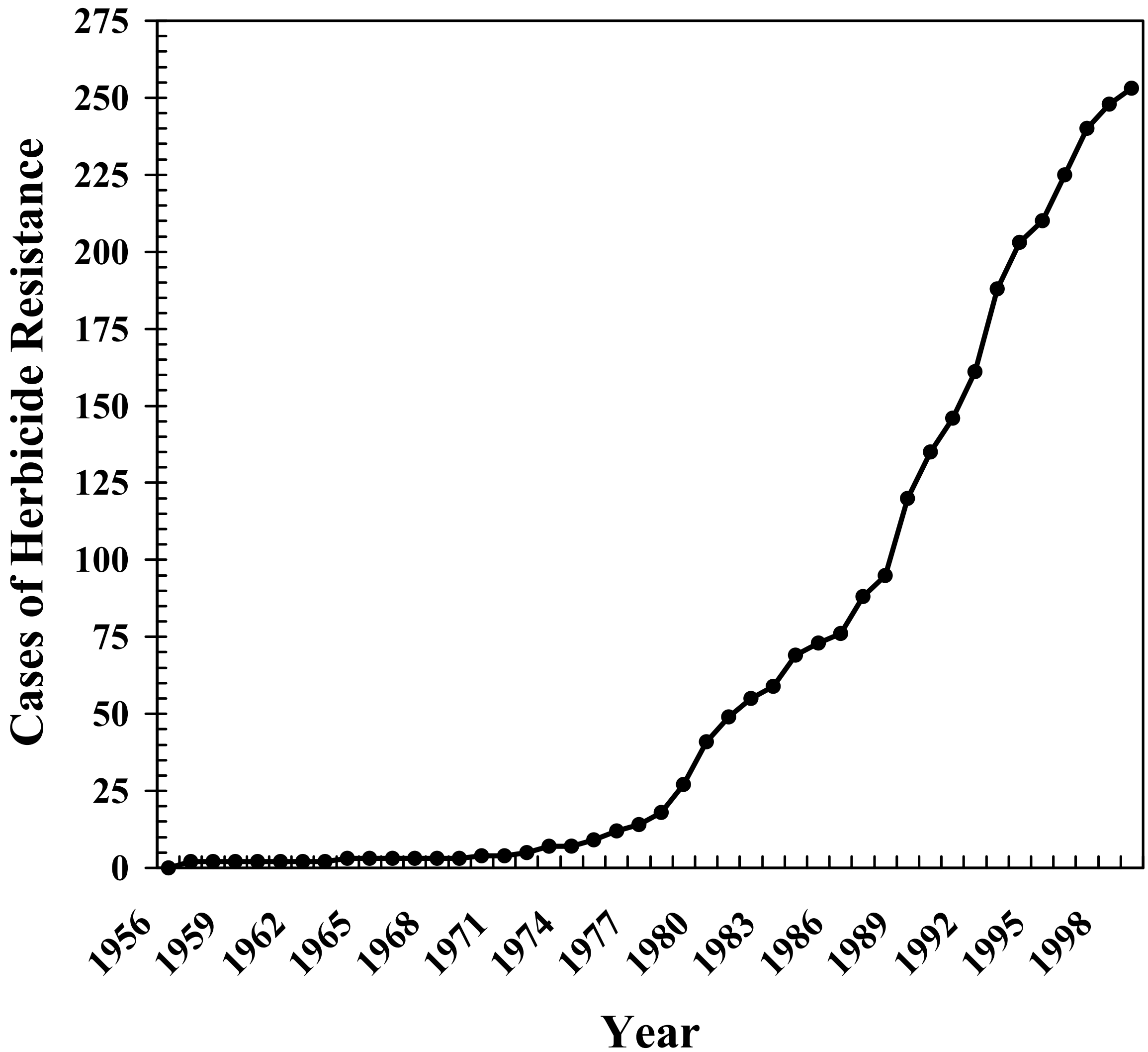


Table 1. Herbicides that are registered for use in California, and their mode of action, chemical class, and number of resistant species found worldwide, in the United States, and in California.

HERBICIDE				NO. RESISTANT SPECIES		
MODE OF ACTION	TRADE NAME(S)	COMMON NAME	HERBICIDE CLASS	WORLD	US	CALIF
Photosystem II inhibitors	Aatrex & others Princep	Atrazine Simazine	Triazines	61	17	1
Branched chain amino acid synthesis inhibitors at ALS (AHAS)	Londax Telar, Glean Oust	Bensulfuron Chlorsulfuron Sulfometuron	Sulfonylureas	63	15	6
Aromatic amino acid inhibitor at EPSP synthase	Roundup, Accord, Rodeo, Touchdown	Glyphosate	Glycine	2	1	1
Lipid synthesis inhibitors at ACCase	Hoelon Fusilade	Diclofop Fluazifop	Aryloxy phenoxy proprionate	21	8	1
Lipid synthesis inhibitors; not ACCase	Sutan Eptam, Eradicane	Butylate EPTC	Thiocarbamates	3	2	1
Mitotic disruptors	Balan Surflan Factor, Treflan	Benefin Oryzalin Trifluralin	Dinitroanilines	9	5	1
Unknown	Avenge	Difenzoquat	Pyrazolium salt	1	1	1

Table 2. Herbicide resistant weeds in California.

Species	**Common name**	**Location**	**Year reported**	**Herbicide**
Senecio vulgaris	Common groundsel	Orchard, asparagus	1981	Atrazine
Lolium perenne	Perennial ryegrass	Roadside, railway	1989	Sulfometuron
Cyperus difformis	Smallflower umbrella sedge	Rice	1993	Bensulfuron
Sagittaria montevidensis	California arrowhead	Rice	1993	Bensulfuron
Salsola tragus	Russian thistle	Roadside	1994	Chlorsulfuron, sulfometuron
Avena fatua	Wild oat	Barley, wheat	1996	Difenzoquat
Ammania auriculata	Redstem	Rice	1997	Bensulfuron
Scirpus mucronatus	Ricefield bulrush	Rice	1997	Bensulfuron
Echinochloa phyllopogon	Late watergrass	Rice	1998	Thiobencarb
Echinochloa phyllopogon	Late watergrass	Rice	1998	Fenoxaprop
Lolium rigidum	Rigid ryegrass	Orchard, roadside	1998	Glyphosate
Echinochloa crus-galli	Barnyardgrass	Cotton	1999	Trifluralin

DISTRIBUTIONS OF PHENOLIC ACIDS AND ALLELOPATHIC POTENTIAL IN TURFGRASS SPECIES

Lin L. Wu
Dept. of Environmental Horticulture, University of California, Davis, CA 95616

Fourteen different phenolic acids were detected in water extracts of buffalograss (*Buchloe dactyloides*) clippings and were examined for their effects on growth of seedlings of annual bluegrass (*Poa annua* L.) and buffalograss (*Buchloe dactyloides*). The tissue phenolic acid concentrations were found to be significantly different among buffalograss varieties examined. Seed germination was not affected by the 6 phenolic acids, but root growth of seedlings was severely inhibited. The allelopathic effects of these phenolic acids seem not species specific, but they act like a broad spectrum premergence herbicide that affect seedling establishment while not affecting established turfgrass

Allelopathic potentials were examined for smooth crabgrass (*Digitaria ischaemum* Schreb.) and tall fescue (*Festuca arundinacea* Schreb.) using seedlings of four cool-season turfgrass species. Smooth crabgrass extracts showed greater seedling growth inhibitory potential than tall fescue extracts for all the four turfgrass species. Ten phenolic acids were found in smooth crabgrass, but only four phenolic acids were detected in tall fescue. Caffeic acid and 3,4,5-trimethoxybenzoic acid, compounds that have strong inhibitory effects, were found in smooth crabgrass but not detected in tall fescue. Smooth crabgrass and tall fescue were co-existing plants in a turfgrass habitat and subjected to identical turfgrass management. Therefore, the detected allelochemical and allelopathy potential differences between these two grass species are intrinsic characteristics.

Four cool-season turfgrass species, perennial ryegrass (*Lolium perenne* L.), Kentucky bluegrass (*Poa pratensis* L.), creeping bentgrass (*Agrosyis palustris* Huds.), tall fescue (*Festuca arundinacea* Schreb.), and four warm-season turfgrass species, zoysiagrass (Zoysia japonica Stued.), bahiagrass (*Paspalum notatum* Flugge.), kikuyugrass (*Pennisetum clandestinum* Hochst ex Chiov.), St. Augustinegrass (*Stenotaphrum secundatum* [Walt.] Kuntze.) were tested for phenolic acid concentrations in their tissue water extracts. The concentrations and number of phenolic acids were found to be different within and between the warm-season and cool-season turfgrass species. Ten phenolic acids were tested for their allelopathic potentials using annual bluegrass seedlings. Under 100 $\mu g\ L^{-1}$ phenolic acid treatments, the seedlings had tolerance ratio of 45 to 80% shoot growth, but only had 0.3 to 36% root growth. Seed germination was not significantly affected by the phenolic acid treatments. The above findings of distribution of allelochemicals in turfgrass species and allelopathic effects of these phenolic acids are potentially useful trait for turfgrass pests management and for turfgrass breeding.

RESOURCES FOR TURFGRASS DISEASE DIAGNOSIS

James A. Downer
University of California Cooperative Extension, Ventura County
669 County Square Drive, Suite 100, Ventura, CA 93003

Turfgrasses comprise a significant part of California landscapes. Turfgrasses are used for athletic playing surfaces, in commercial and residential landscapes and in numerous municipal facilities. As with any biological system, turfgrass swards are affected by diseases that compromise their utility and reduce their value in landscapes. Disease management is tied to diagnosis. Unless a good diagnosis is made, a competent management plan for the disease is difficult to develop. Turfgrass diagnosis is difficult. Accurate diagnosis of turfgrass diseases requires information about possible disease agents (pathogens) and about the turfgrass plant itself. Because of our mild climate, California landscapes are able to culture many kinds of turfgrasses. California also has many microclimates and soil types thus creating environments for a diversity of pathogens. Complicating the situation, we now have more turfgrass varieties to chose from, all of which have varying plant disease resistance genetics. Diagnosticians rely on accurate information to help solve the mystery of the plant disease under study. Since turfgrass patch diseases are similar in appearance, a wide variety of information is necessary to complete the diagnosis.

Diagnostic procedures often first involve recognition of symptoms characteristic of a particular disease. There are several sources for picture of diseases common to turfgrass. The American Phytopathological Society has slide sets with excellent pictorial descriptions of various diseases. An interactive compact disk program is also available to help diagnosis turfgrass diseases by classification of symptoms. The CD also features a pathogen list, keys, management recommendations, disease cycles and turfgrass information guides. The CD draws heavily on the Compendium of Turfgrass diseases, 2nd edition for information to power its diagnostic keys (Smiley et al., 1983).

There are many sources of information available on the internet. The best ones are based at Universities throughout the United States. A comprehensive list of turfgrass plant pathology web sites can be found on the plant pathology internet guide book page at: http://www.ifgb.uni-hannover.de/extern/ppigb/ppigb.htm. Purdue has an interesting web site with disease forecasting models and some good descriptive pictures at http://www.btny.purdue.edu/turfcast.fcgi. North Carolina State U. also has an informative site at http://www.ces.ncsu.edu/TurfFiles/pubs/index.html. Some useful images can also be found on the UCIPM web page at http://www.ipm.ucdavis.edu/. The UC page is also helpful in recommending controls for the various diseases. Unfortunately, most of the images at web based sources of information are not of sufficient quality for diagnostic purposes. Also, since turfgrass patch diseases look similar, there is little help found examining low-resolution images on the internet. A more sophisticated approach is necessary. This involves sampling the diseased turf and often, closer examination under microscopes or culturing the pathogen on selective media.

Confirmation of putative diagnoses made in the field by a trained observer often require verification by labwork. Although University pathologists are a great resource, there are no designated turfgrass pathologists in the California University system. There are a variety of private laboratories that provide disease diagnostic services. There are also trained plant pathologists at several of the Agricultural Commissioner's offices in Southern California. A partial list of individuals, agencies and companies providing turfgrass plant pathology services are provided below.

Once the etiology of the disease is understood, control measures can be devised and a disease management plan can be implemented.

Publication Sources

The American Phytopathological Society
1-800-328-7560 (publication sales)
http://www.scisoc.org/

Some Books

Clarke, B. B. and A. B. Gould. 1983. Turfgrass Patch Diseases Caused by Ectotrophic Root-Infecting Fungi. APS press, St. Paul Mn.

Farr, D. F., G. F. Bills, G. P. Chamuris, and A. Y. Rossman. 1989. Fungi on plants and plant products in the united states. APS Pess, St. Paul Mn.

Smiley, R. W. Dernoeden, P. H., and B. B. Clarke. 1983. Compendium of Turfgrass Diseases. 2nd edition. APS Press, St. Paul, MN.

A CD

Schumann, G. L. and J. D. Macdonald. 1997. Turfgrass Diseases Diagnosis and Management APS press, St. Paul, MN.

Laboratories and consultants providing plant pathology services.*

Crop Doctor Laboratories	805-927-7707
Los Angeles County Dept. of Ag. (Jerry Turney)	562 940-7236
EmmyLou Krausman	909-684-1845
PACE Turfgrass Research Institute. (http://www.pace-ptri.com/)	619-272-9897
Pacific Plant Health (Don Ferrin)	909-342-0224
Plant Disease Diagnosis (Luellen Pierce)	925-937-3841
San Diego County of Ag. (Pat Nolan)	619-694-2753
Santa Barbara County Ag. Dept. (Heather Scheck)	805-681-5600
Soil and Plant Laboratories (Paul Santos)	714-282-8777

*This is a partial list of consultants and labs doing business with knowledge about turfgrass pathology. Omission of a laboratory or individual from this list is due to my ignorance. Inclusion on this list does not constitute an endorsement of the individual or laboratory.

A SURVEY OF PROFESSIONAL TURFGRASS MANAGERS IN SOUTHERN CALIFORNIA CONCERNING THEIR USE OF TURFGRASS BEST MANAGEMENT PRACTICES

Grant J. Klein and Robert L. Green
Dept. of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124

Surveys were handed out at the 1998 and 1999 UCR Turfgrass Research Conference and Field Day. There were 191 surveys collected from the 1998 conference and 190 surveys collected from the 1999 conference, for a total of 381 surveys. In 1999, the survey asked the participants if they had answered the survey in the previous year. Responses of "yes" or "not sure" eliminated 76 surveys, leaving a total of 305 surveys as part of the data set.

THE RESPONDENTS

- Primarily mangers of public (government/public property) sites (41%), golf courses (19%), private (commercial/residential) sites (8%) and manufacturers or sales representatives of turfgrass related products (6%).
- Average years of experience in the turfgrass industry: 13 years.
- Vast majority from southern California (88%).
- Decision-makers: a total of 88% indicated they were always or usually responsible for turfgrass management decisions or recommendations at their site.
- Manage grasses such as bermudagrass (82%), tall fescue (57%), ryegrass (56%), kikuyugrass (40%), *Poa annua* (27%), and creeping bentgrass (25%).

FACTORS LIMITING ADOPTION OF BEST MANAGEMENT PRACTICES (BMPS)

The single most common factor which limits the ability of the survey respondents to adopt BMPs is cost or financial limitations (58%). About a third of the respondents also chose employee skill level (37%) and time (35%) as important limitations.

FERTILIZATION AND IRRIGATION PRACTICES

In 1999, two questions were added to the survey which were designed to determine what specific fertilization and irrigation practices were being consistently performed by the respondents.

Fertilization practices:

The majority of respondents indicated that they consistently apply appropriate amounts of nitrogen specific for turfgrass species and requirements of turfgrass use (61%), apply nitrogen based on seasonal growth patterns and need (59%), and apply different combinations of slow- and fast-release nitrogen sources according to seasonal growth and expected rainfall (53%). More than a third (37%) of the respondents also indicated that they conduct soil fertility tests every 1 to 2 years. The least common practices were applying P_2O and K_2O relative to annual nitrogen applied (26%) and avoiding fertilization prior to rain (12%).

Irrigation practices:

The vast majority of respondents (86%) indicated that they consistently check irrigation systems for proper function. Approximately two-thirds also indicated that they consistently adjust irrigation clocks at least every 3 months (68%) and size nozzles for balanced precipitation on rotor systems (62%). About half of the respondents consistently cycle irrigation on slopes to prevent runoff (55%) and irrigate according to weather station or soil moisture sensor data (49%). Only 41% of the respondents indicated they consistently check system operating pressures.

PERCEPTIONS AND COMMITMENT TO BMPS IN TERMS OF DIFFERENT JOB CATEGORIES

The BMPs listed on the survey:

1. Water conservation (ET_o-based water budgets, seasonal adjustments of irrigation clocks, irrigation system checks, etc.)
2. Fertility program development (fertilization based on plant species, type of use, seasonal and climatic requirements, and soil type; use of appropriate fertilizer type, amount and frequency of application)
3. Turfgrass selection (choosing species and cultivars that, for example, require less water, possess more tolerance to stress [including pests] or possess other traits that would result in the successful management of turfgrass)
4. Mowing program development (mowing height/frequency based on species/cultivar requirements, plant growth and/or stress, etc.)
5. Integrated pest management (IPM) (managing the "most healthy" turfgrass as possible via sound agronomic principles as the best prevention to pests, defining threshold pest activity/amount prior to pesticide applications, etc.)
6. Protecting ground water and surface water from potential contamination from turfgrass chemicals and fertilizers
7. Protecting non-target plants, animals and humans from the potential toxic effects of turfgrass chemicals
8. Protecting native habitats during turfgrass construction and maintenance

Range of average scores over all BMPs and all job classifications for the rating categories (all on a 1 to 5 scale):

- Importance: 4.0 to 4.5 (1 = not important and 5 = very important)
- Whether or not they were doing the practice currently: 3.5 to 4.2 (1 = never doing it and 5 = always doing it)
- Whether or not they would be likely to continue or to start doing the practice: 3.7 to 4.4 (1 = not likely and 5 = very likely)
- Difficulty level: 2.7 to 3.2 (1 = easy and 5 = very hard)

Statistical analysis:

- Original responses of 1 to 5 grouped into "low/moderate" (1, 2 or 3) and "high" (4 or 5) categories.
- Respondents grouped based on job category comprising of "advisors" (manufacturers and sales representatives of turfgrass-related products, professional consultants and horticultural advisors, and turfgrass researchers) and "managers" [managers of public (government/public property) and private (commercial/residential) sites, golf courses, and sports turf facilities].
- Managers further grouped into "general" [public (government/public property) and private (commercial/residential) site managers] and "sports turf" (golf course and sports turf managers).

- Chi-square test of independence in a 2 x 2 frequency were used to analyze each of the two categories of respondents ("advisors" vs. "managers" and "general" vs. "sports turf" managers) on the "low/moderate" and "high" responses for each of the eight BMPs.

Results:

Advisors vs. Managers

Very little statistical difference between the advisory and management categories, except for mowing program development and protecting non-target plants, animals and humans from chemicals.

- Only 53% of advisors considered mowing program development to be highly important as compared to 82% of managers. Advisors were also 28% less likely to be frequently implementing mowing programs and 29% less likely to continue or start the practice. Both advisors and managers, however, agreed developing mowing programs is not particularly difficult (only 31% of advisors and 23% of managers considered this practice to be highly difficult).
- Advisors (69%) were less likely to consider protecting non-target plants, animals and humans from chemicals to be highly important than were managers (84%). Similarly, only about half of advisors as opposed to about three-quarters of managers were likely to be frequently implementing the BMP or were likely to continue or start implementing the practice. Both advisors and managers, however, agreed that protecting non-target plants, animals and humans from chemicals is not particularly difficulty (only 28% of advisors and 31% of managers considered this practice to be highly difficult).

General vs. Sports Turf Managers

- General and sports turf managers, overall, considered the BMPs listed to be highly important (averaging 76% to 81%, respectively). The only statistical differences between the two groups were for fertility program development and protecting native habitats during construction/maintenance, both of which sports turf managers considered to be more highly important than general turf managers (differing by 22% and 15%, respectively).
- Sports turf managers were more likely to be frequently implementing the listed BMPs than general turf managers. This was particularly true for fertility program development (48% to 76% for general and sports turf managers, respectively); integrated pest management (41% to 65% for general and sports turf managers, respectively); and protecting water sources from chemicals (48% to 76% for general and sports turf managers, respectively).
- Sports turf managers were more likely to continue or to start implementing the BMPs than general turf managers. This was particularly true for fertility program development (59% to 79% for general and sports turf managers, respectively); integrated pest management (52% to 69% for general and sports turf managers, respectively); and protecting water sources from chemicals (50% to 67% for general and sports turf managers, respectively).
- Both general and sports turf managers, overall, were not statistically different in terms of how they rated the difficulty level for the BMPs listed (less than a third of both general and sports turf managers considered the BMPs to be highly difficult). Moderately more sports turf managers (43%) than general turf managers (30%) considered turfgrass selection to be highly difficult. The same trend held for protecting native habitats during construction/maintenance (40% of sports turf managers and 26% of general turf managers considered the practice to be highly difficult).

TOPDRESSING COMPOST ON TURFGRASS: ITS EFFECT ON TURF QUALITY AND WEEDS

Michelle Le Strange[1] and Pamela Geisel[2]
[1]University of California Cooperative Extension, Tulare and King Counties
2500 W. Burrell Avenue, Ag. Bldg., County Civic Ctr., Visalia, CA 93291-4584
[2]University of California Cooperative Extension, Fresno County
1720 S. Maple Avenue, Fresno, CA 93702

California's Integrated Waste Management Act (AB 939) required California to reduce landfill waste by 50% by the year 2000. This Act mandated that reduction be met through source reduction, recycling and composting. Many municipalities have implemented a green waste pick-up program as one method of solid waste reduction. From this green waste, thousands of tons of compost are generated each year. A three-year field study was conducted on common bermudagrass to evaluate the use of composted green waste for topdressing school ground turf areas, golf courses and community recreation fields, and parks. The goal was to compare compost topdressing with conventional fertilizer applications, determine optimum depth and timing of compost applications, and evaluate the benefits and risks of compost topdressing from cultural and financial perspectives. Turfgrass quality, color, and shifts in weed populations were evaluated. Other parameters measured included clipping yield, total nitrogen content in clippings and soil, organic matter content in soil and the effects on thatch development.

Fertilizer and steer manure treatments were applied to yield 4 lbs. N/1000 sq. ft./year. Steer manure and slow-release fertilizer (34-0-7) was applied annually while ammonium sulfate applications were made quarterly. Compost treatments included single or multiple applications each year. The single application treatments were applied at _1/8, ¼, ½ and 1-inch depths in October of each year. A 1-inch topdressing provided approximately 8 lbs. N/1000 sq. ft./year. Multiple applications included ½ inch of compost applied two times per year and ¼ inch of compost applied four times per year to equal a total of 1 inch of compost applied annually.

Topdressing composted green waste had a positive cultural effect on municipal bermudagrass turf. Results are presented in Table 1. All treated plots were greener in color than the untreated check plots and the onset of winter dormancy was delayed. Turfgrass quality, which included stand uniformity, density, color and overall visual appeal, was significantly improved over the check. The 1-inch compost applications averaged half the number of weeds compared to all other treatments over the three-year period with major reductions in crabgrass in summer. Thatch did not develop as a result of compost applications. However, a layer of organic matter accumulated in the soil profile, which resulted in a mounding effect at the higher rates of compost.

In summary, consistently higher quality turfgrass ratings and lower weed populations were observed with ¼ inch compost topdressed four times per year. A high clipping yield and a mounding effect, however, was also observed with this treatment. Optimally, it may be better to topdress with ¼ inch compost only two or three times a year. Reducing application frequency would lower costs, decrease clipping yield, yet still provide the same positive cultural effect on bermudagrass turf.

Table 1. Compost effect on turf quality, turf color and % weeds

	check[1]	SM	SRF	AS	1/8"	1/4"	1/2"	1"	¼'x4	½"x2	*LSD.05*	*CV %*
a: Turf Quality[2]												
Nov-94	5.1	4.9	5.1	5.4	4.8	5.4	6.0	4.3	5.5	6.0	*1.1*	*20.1*
May-95	4.0	5.1	5.3	5.8	5.1	6.1	5.9	6.9	7.9	6.4	*0.9*	*15.8*
July	2.9	4.0	4.6	4.0	3.9	4.6	5.5	6.2	7.1	5.8	*0.9*	*17.8*
Aug	3.1	5.0	4.1	5.8	4.0	4.8	5.0	5.3	7.6	7.0	*0.8*	*15.6*
Nov	2.9	4.4	4.4	3.9	4.1	4.7	6.5	3.8	5.8	5.9	*1.1*	*22.7*
May-96	3.6	4.9	4.5	5.1	4.6	5.0	5.9	5.6	7.1	6.1	*0.7*	*12.5*
July	4.3	5.0	5.4	6.1	5.0	5.1	5.4	5.8	7.0	3.3	*0.6*	*11.9*
Sept	5.9	5.5	5.9	5.4	6.0	5.5	5.9	5.0	4.9	4.9	*0.9*	*16.6*
Nov	2.8	4.4	3.9	3.8	3.8	4.3	3.4	1.3	6.1	5.0	*0.9*	*24.4*
May-97	2.3	5.5	6.9	3.8	3.8	4.6	5.2	7.1	8.9	7.5	*0.8*	*18.5*
July	2.8	5.3	6.3	4.4	4.3	4.1	4.1	5.5	6.8	5.8	*0.8*	*15.6*
Sept	3.4	6.0	5.1	5.9	4.1	4.9	4.6	6.3	7.6	6.8	*0.8*	*15.1*
Average	**3.6**	**5.0**	**5.1**	**4.9**	**4.4**	**4.9**	**5.3**	**5.2**	**6.9**	**5.9**		
b: Turf Color[3]												
Nov	4.3	5.1	4.3	4.1	5.1	5.4	6.8	7.4	6.1	6.8	*0.9*	*17.0*
Mar-95	3.0	4.3	3.3	3.4	4.0	4.3	5.0	5.6	4.4	5.1	*0.7*	*17.6*
May	3.1	5.4	4.9	5.8	4.8	6.3	7.1	7.6	8.4	7.0	*0.8*	*13.7*
Dec	2.4	4.8	3.8	3.0	3.6	5.9	7.8	8.0	6.9	8.0	*0.4*	*8.3*
Mar-96	1.9	3.4	2.3	2.3	2.8	3.1	4.0	4.5	3.6	4.3	*0.6*	*17.5*
May	3.6	5.3	5.4	5.1	4.3	5.0	5.8	6.4	7.1	5.8	*0.7*	*12.7*
Nov	1.9	4.9	2.9	3.1	3.3	4.1	4.9	4.9	6.5	7.6	*0.9*	*21.3*
Mar-97	3.4	4.5	6.4	5.5	4.0	3.9	4.5	7.6	8.0	7.0	*0.6*	*17.5*
May	3.3	6.5	7.4	3.8	4.1	4.8	5.4	7.6	7.9	7.6	*0.7*	*12.7*
Dec	2.0	3.8	2.1	3.0	2.0	2.4	3.0	4.5	5.0	4.8	*0.4*	*12.5*
Average	**2.9**	**4.8**	**4.3**	**3.9**	**3.8**	**4.5**	**5.4**	**6.4**	**6.4**	**6.4**		
c: Percent Weeds[4]												
Nov	33	26	64	35	53	44	29	0	40	23	*15*	*45*
Mar-95	66	69	74	67	79	71	66	35	77	57	*16*	*24*
July	43	45	40	21	40	34	38	46	16	38	*14*	*38*
Aug	67	43	47	28	58	46	39	41	4	13	*16*	*43*
Nov	40	25	22	28	25	19	6	10	24	13	*18*	*84*
Mar-96	72	68	86	58	89	65	36	24	23	27	*14*	*26*
May	49	48	41	40	44	41	30	30	10	25	*14*	*38*
Aug	72	61	44	63	71	79	85	72	14	28	*15*	*26*
Nov	11	9	9	12	23	9	6	4	7	8	*7*	*74*
Mar-97	77	72	86	83	81	83	39	6	66	24	*17*	*28*
June	83	76	6	58	64	54	64	21	5	32	*16*	*35*
Aug	78	23	21	62	77	70	85	45	10	49	*14*	*27*
Average	**57**	**47**	**45**	**46**	**59**	**51**	**44**	**28**	**25**	**28**		

[1]Treatments: check = untreated, SM = steer manure, SRF = slow release fertilizer, AS = ammonium sulfate, compost applications in inches.
[2]Visual rating scale for quality, where 1 = worst, 9 = best, and 5 = marginally acceptable.
[3]Visual rating scale for color, where 1 = least green and 9 = most green.
[4]Percent surface area of the plot (0-100%) occupied by weeds.

THE EFFECT OF IRRIGATION FREQUENCY ON TALL FESCUE PERFORMANCE

William E. Richie and Robert L. Green
Dept. of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124

Water of suitable quality for landscape irrigation is a precious commodity, particularly in the arid southwestern United States. Growing population and industrialization in many areas has increased water requirements, but water supplies have not increased as readily. Water districts are tapping new sources of affordable water (Marriott, 2000), but the situation highlights a need for water conservation and prudent irrigation practices.

California drought years in the mid-1970's resulted in the imposition of water restrictions. During this time, many turf managers realized that acceptable turf quality could be maintained with reduced, or even deficit irrigation [Deficit irrigation is any level below the turf water requirement of ET_o x K_c. *Irrigation water requirement* is greater than *turf water requirement* because extra water is needed to compensate for irrigation system imperfections]. Subsequent research at the University of California, Riverside sought to provide guidelines for minimum irrigation of turfgrass. Meyer et al. (1985) determined accurate monthly crop coefficients for warm and cool-season turfgrasses and found that 20 to 40% (depending on grass species) of irrigation water could be conserved while maintaining acceptable visual turfgrass quality. This research, in part, led to the California Department of Water Resources recommendation that not more than 80% reference evapotranspiration (hereafter referred to as ET_o) be applied to a landscape site (AB 325). Current best management practices recommend that not more than 100% ET_o per square foot of landscape be applied (BMP 5, CUWCC).

But how often should this water be applied? Turfgrass managers have taught that light frequent irrigation encourages shallow roots, faster turf growth, disease, and weed growth. Their recommendation for many years has been to water just often enough, but with sufficient quantity to replenish the water in the root zone soil and maintain acceptable visual quality. Less frequent, deep irrigation of tall fescue would encourage deep rooting which contributes to the plant's ability to extract water from a larger soil volume (Hagan 1955; Beard 1973; Qian and Fry 1996). The objective of this study was to determine an optimum fixed irrigation frequency or interval for tall fescue grown on native soil in southern California. Specifically, we sought to determine if tall fescue performance could be improved, when irrigated with ((ET_o x monthly K_c x 0.8)/DU)) $\approx$ 80% ET_o in southern California, by changing irrigation frequency. Such information might help turfgrass managers improve tall fescue quality while conserving water.

Results showed that visual quality of tall fescue was best when irrigated two times per week compared to three or four times per week. Furthermore, soil water content was greatest in plots irrigated two times per week. Although local soil and environmental conditions will influence the selection of a specific irrigation frequency, results from this study support the recommendation for less-frequent, deeper irrigation for improved tall fescue quality.

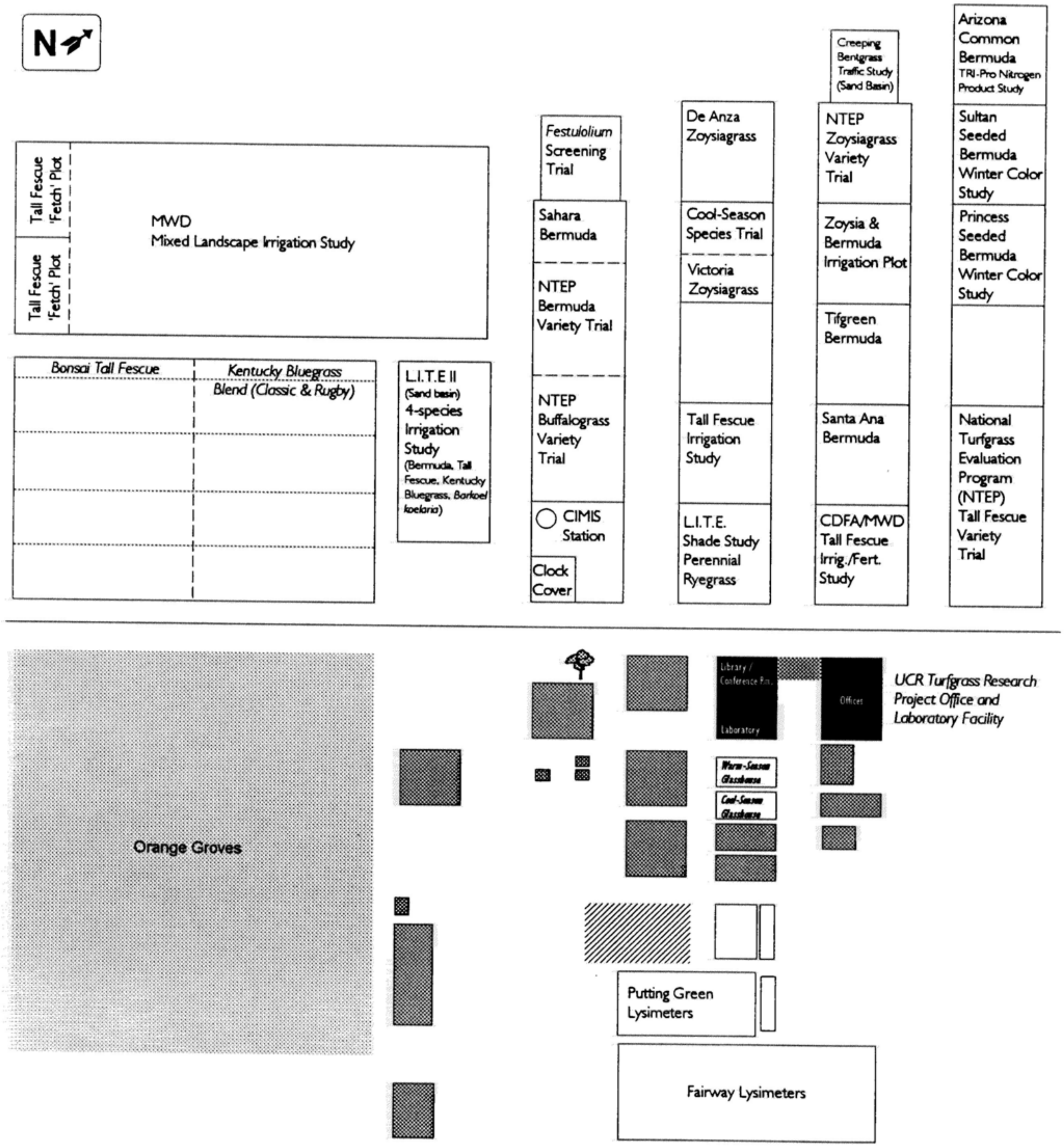
References

Beard, J. B. 1973. Turfgrass: Science and culture. Prentice-Hall, Englewood Cliffs, N.J.
Hagan, R. M. 1955. Watering lawns and turf and otherwise caring for them. pp. 462-467 *In* A. Stefferud (ed.), Water, The Yearbook of Agriculture. USDA.

Marriott, K. 2000. EMWD scouting out water for future. The Press-Enterprise Online Edition. http://www.inlandempireonline.com/news/stories/051600. Published May 16, 2000.

Meyer, J. L., Gibeault, V. A., and V. B. Youngner. 1985. Irrigation of turfgrass below replacement of evapotranspiration as a means of water conservation: determining crop coefficient of turfgrasses. p. 357 – 364 *In* F. Lemaire (ed.) Proc. 5th Int. Turfgrass Res. Conf., Avignon. France. 1 – 5 July 1985. INRA Publ., Versailles, France.

Qian, Y. L. and J. D. Fry. 1996. Irrigation frequency affects zoysiagrass rooting and plant water status. HortScience 31:234-237.



UCR Turfgrass Field Station Map
Field Day September 12, 2000

UCR TURF

DEMONSTRATION OF SPECIFIED SANDS FOR ROOTZONE MEDIA

Steven B. Ries and Stephen T. Cockerham
Agricultural Operations, University of California, Riverside, CA 92521-0124

A constructed green or sports field is made of several components: the subgrade, subsurface drainage system, gravel and intermediate layers, etc. The root zone mixture is likely the most important part for achieving the best turf quality. High sand content root zones have, since the 1960's, been the most widely accepted method of putting green construction and high visibility sports turf sites. A high sand content root zone is used primarily because it is so resistant to compaction, drains well, and maintains root air space. But sands are not alike. Though appearing similar, different sands can have different problems and exhibit a large range of particle size analyses, water retention and aeration. This demonstration is designed to familiarize you with the different types of sand used in root zone construction and the field characteristics these sands exhibit.

Two common specifications for sand used in field construction.

USGA[1]		**UC**[2]	
Particle diameter range	**% by weight**	**Particle diameter range**	**% by weight**
> 3 mm	< 3	> 2.0 mm	0
> 1	< 10	1 – 2	< 5
0.25 - 1	> 60	0.5 – 1	< 40
0.15 – 0.25	> 20	0.25 – 0.50	> 40
0.05 – 0.15	< 5	0.05 – 0.25	< 20
< 0.05	< 8	< 0.05	< 2
< 0.002	< 3	0.05 – 1.0	> 90
< 0.15	< 10		

[1] USGA Greens Section Staff. 1993. USGA recommendations for a method of putting green construction. USGA Greens Section Record. March/April.

[2] Davis, W.B. and J.L. Paul. 1985. A guide for evaluating sands for use as a growing medium for high traffic turf. UC Cooperative Extension, Dept of Environmental Horticulture, UC Davis.

RESEARCH ON THE USE OF GREENWASTE COMPOST FOR TURFGRASS MANAGEMENT

George H. Riechers[1], Stephen T. Cockerham[1] and Victor A. Gibeault[2]
[1]*Agricultural Operations, University of California, Riverside, CA 92521-0124*
[2]*Dept. of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124*

We have initiated a study to:

1) provide sound data on the benefits of compost as a soil amendment for turfgrass growth,
2) determine the upper limit for beneficial affects of compost as a soil amendment, and
3) determine the best management practices for turfgrass culture which incorporate compost use.

⇒*Treatments*

Soil amendment treatments with compost incorporated to tiller depth at rates of 0, 4, 8 and 12 yd^3/1000 ft^2 (0, 0.033, 0.066 and 0.099 m^3/m^2, respectively) are replicated 6 times in a random complete block design. Arizona common bermudagrass was recently seeded onto the plots.

After establishment, simulated foot traffic will be applied as a split plot treatment across each main block. Traffic to simulate sports traffic will be applied twice monthly with a Brinkman Traffic Simulator.

If funding can be secured, an additional split plot will test the effects of topdressing with compost or a sand/compost mixture.

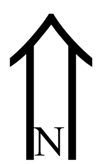
⇒*Data Collection*

During grow-in, rate of establishment will be measured biweekly as percent cover and turf quality. After the plots are established and traffic treatments begin, turf quality will be measured biweekly on a 1 (worst) to 9 (best) scale based on density, color and uniformity of the turf.

Cores will be taken 3 times per year from each subplot for measurement of root/rhizome, thatch and verdure (green stolon and leaf) mass.

Plots will be rated for disease and weed encroachment 3 times per year, or as necessary.

Surface hardness will be measured bimonthly with a Clegg Impact Meter as a measure of surface compaction.



12 yd^3 / K‡	4 yd^3 / K	12 yd^3 / K
Control	12 yd^3 / K	4 yd^3 / K
4 yd^3 / K	8 yd^3 / K	8 yd^3 / K
8 yd^3 / K	Control	Control

12 yd^3 / K	Control	4 yd^3 / K
Control	8 yd^3 / K	12 yd^3 / K
4 yd^3 / K	4 yd^3 / K	8 yd^3 / K
8 yd^3 / K	12 yd^3 / K	Control

‡ 'K' = 1000 sq ft
1 yd^3 / K = ~8.23 * 10^{-3} m^3 / m^2

This project is funded by the University of California Division of Agricultural and Natural Resources as a Project of the Turfgrass Workgroup. Additional support has been provided by *Inland Composting and Organic Recycling; California BioMass;* and UCR Agricultural Operations.

TURFGRASS CULTIVAR EVALUATIONS: UC RIVERSIDE

Victor A. Gibeault and Richard Autio
Dept. of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124

The National Turfgrass Evaluation Program (NTEP) is a non-profit organization that provides leadership in turfgrass evaluation and improvement by linking the public and private sectors of the industry through their common goals of grass development, improvement, and evaluation. Its mission is to provide a mechanism for uniform evaluations; to advance the science of species and cultivar evaluation; to collect and disseminate performance information; and to enhance the transfer and use of information and technology relating to turfgrass improvement and evaluation. Structurally, NTEP is a cooperative effort of the United States Department of Agriculture (at Beltsville, MD) and the Turfgrass Federation, Inc.

The clientele of NTEP are diverse, with varying interests and expectations. To be clientele sensitive, NTPE has identified the following categories of interest groups that interact and benefit from the activities of the program: public and private turfgrass plant breeders; public and private sector researchers; seed distributors; technology transfer educators such as cooperative extension educators and industry technical representatives; other professionals such as seed producers, sod producers, golf course superintendents, grounds managers, sports turf managers, lawn care service operators, landscape contractors, landscape architects and consultants. Homeowners indirectly are influenced by NTEP because the turfgrasses they buy have been tested for performance characteristics in their climate zones.

Most cultivar evaluations are conducted by university turfgrass research and extension programs, but modified studies by private plant breeders are also undertaken. Seed or vegetative material of a turfgrass species is accumulated by the program and sent to cooperating researchers where replicated trials are established. Somewhat standardized establishment and cultural practices are used and they are reported for each site. Data collected on a monthly basis during the growing season are also standardized and usually include a turfgrass quality rating.

Other specific characteristics such as color, texture, spring green-up, density, drought tolerance and disease or weed activity are rated when appropriate. Data are sent to NTEP on an annual basis, statistical analyses performed and annual results are reported by species. Those reports are used as a basis for information transfer to interested clientele.

Four NTEP studies are currently underway at UCR. The plot plans follow, as do national results for the 1999 calendar year for four of the grasses under examination.

1996 NTEP BUFFALOGRASS TEST
Est. 29 July 1996

5	3	2	1	4	10	9
13	6	11	14	8	7	12
1	2	3	5	4	13	10
14	11	8	7	12	9	6
4	1	5	2	3	11	8
10	9	12	6	13	7	14

<u>Seeded</u>

1. CODY
2. TATANKA
3. BAM-1000
4. BISON
5. TEXOKA

<u>Vegetative</u>

6. 91-118
7. 86-120
8. 86-61
9. BONNIE BRAE
10. MIDGET
11. STAMPEDE
12. UC-95
13. 609
14. 378

TABLE 1A. MEAN TURFGRASS QUALITY RATINGS OF BUFFALOGRASS CULTIVARS GROWN AT ELEVEN LOCATIONS IN THE U.S. 1/
1999 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 2/

NAME	AZ1	CA3	FL3	GA1	MD1	MO1	NE1	TX1	TX3	VA1	WA4	MEAN
91-118	6.8	4.9	7.7	4.2	6.4	7.2	7.2	5.7	4.9	6.2	4.1	5.9
* LEGACY (86-61)	6.6	4.3	6.2	4.2	5.4	7.0	6.3	4.1	5.0	6.5	4.9	5.5
* CODY	6.0	4.2	6.9	4.9	5.0	5.7	7.8	3.9	4.9	6.3	4.9	5.5
* TATANKA	6.4	4.4	7.0	4.6	5.1	6.2	6.7	3.4	4.8	5.8	4.9	5.4
* 609	5.9	4.6	7.4	4.7	5.4	6.5	5.6	5.6	5.3	3.8	4.3	5.4
* BONNIE BRAE	6.5	5.1	6.8	3.8	6.0	6.3	4.4	5.3	5.0	5.4	4.2	5.3
* 378	6.5	4.4	6.3	4.2	4.7	7.0	5.7	4.4	5.4	5.1	4.7	5.3
86-120	6.7	4.5	7.2	3.9	5.7	6.3	4.9	4.1	5.0	5.3	4.6	5.3
* STAMPEDE	5.8	4.5	6.8	4.8	6.2	6.8	5.1	5.4	4.7	2.9	3.9	5.2
* TEXOKA	6.5	4.1	6.4	5.0	3.8	6.4	6.4	3.9	4.8	5.2	4.0	5.1
BAM-1000	6.6	4.4	6.6	4.5	4.3	6.4	4.1	3.8	4.8	6.0	4.5	5.1
UCR-95	6.3	5.4	5.7	4.1	5.3	6.2	6.7	4.1	4.3	4.1	3.6	5.1
* BISON	6.8	4.2	6.0	4.9	3.3	6.0	6.4	4.0	4.7	4.8	3.8	5.0
* MIDGET	5.2	4.3	4.9	3.7	4.8	5.8	5.4	3.9	4.0	5.3	3.8	4.6
LSD VALUE	0.8	0.2	1.0	0.5	1.1	0.5	0.6	0.8	0.7	0.7	0.9	0.2
C.V. (%)	7.9	3.1	9.0	6.6	13.4	5.0	6.1	11.5	8.5	8.2	13.4	8.8

* COMMERCIALLY AVAILABLE IN THE USA IN 2000.

1/ TO DETERMINE STATISTICAL DIFFERENCES AMONG ENTRIES, SUBTRACT 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).

2/ C.V. (COEFFICIENT OF VARIATION) INDICATES THE PERCENT VARIATION OF THE MEAN IN EACH COLUMN.

TABLE 1B. MEAN TURFGRASS QUALITY RATINGS OF BUFFALOGRASS (SEEDED) CULTIVARS GROWN AT ELEVEN LOCATIONS IN THE U.S. 1/
1999 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 2/

NAME	AZ1	CA3	FL3	GA1	MD1	MO1	NE1	TX1	TX3	VA1	WA4	MEAN
CODY	6.0	4.2	6.9	4.9	5.0	5.7	7.8	3.9	4.9	6.3	4.9	5.5
TATANKA	6.4	4.4	7.0	4.6	5.1	6.2	6.7	3.4	4.8	5.8	4.9	5.4
TEXOKA	6.5	4.1	6.4	5.0	3.8	6.4	6.4	3.9	4.8	5.2	4.0	5.1
BAM-1000	6.6	4.4	6.6	4.5	4.3	6.4	4.1	3.8	4.8	6.0	4.5	5.1
BISON	6.8	4.2	6.0	4.9	3.3	6.0	6.4	4.0	4.7	4.8	3.8	5.0
LSD VALUE	0.8	0.2	1.0	0.4	0.9	0.5	0.6	0.6	0.8	0.6	0.6	0.2
C.V. (%)	7.6	2.6	9.7	4.8	12.5	5.3	6.3	9.2	9.9	6.5	8.1	7.9

TABLE 1C. MEAN TURFGRASS QUALITY RATINGS OF BUFFALOGRASS (VEGETATIVE) CULTIVARS GROWN AT ELEVEN LOCATIONS IN THE U.S. 1/
1999 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 2/

NAME	AZ1	CA3	FL3	GA1	MD1	MO1	NE1	TX1	TX3	VA1	WA4	MEAN
91-118	6.8	4.9	7.7	4.2	6.4	7.2	7.2	5.7	4.9	6.2	4.1	5.9
LEGACY (86-61)	6.6	4.3	6.2	4.2	5.4	7.0	6.3	4.1	5.0	6.5	4.9	5.5
609	5.9	4.6	7.4	4.7	5.4	6.5	5.6	5.6	5.3	3.8	4.3	5.4
BONNIE BRAE	6.5	5.1	6.8	3.8	6.0	6.3	4.4	5.3	5.0	5.4	4.2	5.3
378	6.5	4.4	6.3	4.2	4.7	7.0	5.7	4.4	5.4	5.1	4.7	5.3
86-120	6.7	4.5	7.2	3.9	5.7	6.3	4.9	4.1	5.0	5.3	4.6	5.3
STAMPEDE	5.8	4.5	6.8	4.8	6.2	6.8	5.1	5.4	4.7	2.9	3.9	5.2
UCR-95	6.3	5.4	5.7	4.1	5.3	6.2	6.7	4.1	4.3	4.1	3.6	5.1
MIDGET	5.2	4.3	4.9	3.7	4.8	5.8	5.4	3.9	4.0	5.3	3.8	4.6
LSD VALUE	0.8	0.3	0.9	0.5	1.2	0.5	0.6	0.9	0.6	0.7	1.1	0.2
C.V. (%)	8.1	3.4	8.6	7.7	13.6	4.8	6.0	12.1	7.7	9.2	15.7	9.2

1/ TO DETERMINE STATISTICAL DIFFERENCES AMONG ENTRIES, SUBTRACT 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).

2/ C.V. (COEFFICIENT OF VARIATION) INDICATES THE PERCENT VARIATION OF THE MEAN IN EACH COLUMN.

1997 NTEP BERMUDAGRASS TRIAL
established 30 June 1997

Varieties 1-18 and 29 are seeded, 19-28 are vegetative

29	4	5	1	6	11	17	18
14	13	3	12	8	7	2	9
17	7	4	15	18	10	16	15
8	2	11	14	9	5	13	29
1	4	6	10	16	3	1	12
3	12	15	13	8	18	14	11
6	29	9	17	16	2	7	10
X	X	X	X	X	X	X	5
22	27	26	23	24	28	X	X
25	20	19	21	20	27	22	25
19	21	23	28	24	26	19	21
24	27	26	22	20	25	28	23

1 Savannah
2 2PST-R69C
3 Princess
4 SW 1-7
5 SW 1-11
6 Jackpot
7 Sundevil II
8 J-540
9 J-1224
10 Shangri La
11 Mirage
12 Pyramid
13 Majestic
14 OKS 95-1
15 Blue-Muda
16 Blackjack
17 Sahara
18 AZ Common
19 Mini-Verde
20 Shanghai
21 CN 2-9
22 OKC 18-4
23 OKC 19-9
24 Cardinal
25 Tift 94
26 Midlawn
27 Tifway
28 Tifgreen
29 Panama

TABLE 1A.

MEAN TURFGRASS QUALITY RATINGS OF BERMUDAGRASS CULTIVARS
GROWN AT NINETEEN LOCATIONS IN THE U.S. 1/
1999 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 2/

NAME	AR1	AZ1	CA3	FL1	GA1	IL2	IN2	KS2	KY1	MD1	MO1	MO2	MS1	NM1	OK1	SC2	TX2	VA1	VA4	MEAN
* TIFSPORT (TIFT 94)	6.8	7.2	4.8	6.1	7.2	7.4	6.8	5.7	7.8	6.9	7.5	5.8	7.8	7.7	7.7	7.6	5.8	5.9	6.6	6.8
OKS 95-1	6.9	6.7	5.1	5.1	6.7	7.2	6.8	7.2	8.1	7.3	7.9	6.3	5.8	7.3	6.9	7.0	5.6	6.5	6.4	6.7
* TIFWAY	6.6	7.0	4.7	5.3	7.3	7.6	6.4	6.1	6.7	7.0	7.2	5.4	7.6	7.8	7.8	7.5	5.9	5.6	6.6	6.6
OKC 18-4	7.6	5.8	5.1	4.8	7.3	7.2	6.8	6.2	7.3	7.0	7.8	5.9	5.6	7.3	7.6	6.8	6.0	5.8	7.1	6.6
* TIFGREEN	6.8	6.3	5.5	5.2	7.4	7.2	6.3	5.3	5.6	7.4	7.9	5.4	6.7	7.6	7.7	7.1	6.0	5.2	6.3	6.5
* PRINCESS	7.2	7.0	4.9	5.5	6.3	6.4	6.4	5.4	7.1	7.3	7.9	5.1	6.4	7.3	6.8	6.6	6.0	6.6	6.6	6.5
* MIDLAWN	7.2	6.6	4.8	3.9	7.4	7.7	6.3	6.2	7.4	6.4	6.6	6.0	5.9	8.0	7.2	6.9	5.8	5.5	6.8	6.4
OKC 19-9	4.9	6.2	4.9	5.1	7.4	6.8	6.8	5.9	6.9	7.9	7.2	5.7	5.7	7.2	7.2	7.0	5.6	4.6	6.9	6.3
CN 2-9	6.4	6.6	4.9	5.5	6.5	6.4	6.4	5.6	4.7	6.8	6.1	5.2	6.8	7.4	7.3	7.9	5.6	4.8	6.4	6.2
* SHANGHAI	7.1	5.7	5.1	3.9	6.6	6.2	5.4	5.9	6.9	7.1	7.8	5.8	5.7	6.4	6.3	6.0	5.3	6.2	6.6	6.1
PST-R69C	6.2	6.0	4.8	5.0	5.8	4.4	4.8	4.9	6.5	7.0	8.1	4.8	5.8	6.9	6.1	6.3	5.6	6.1	6.3	5.9
SWI-11	6.1	6.6	4.8	5.3	6.0	4.7	5.2	4.5	6.3	6.4	7.3	4.6	6.0	7.1	5.8	6.1	5.5	5.8	6.4	5.8
CARDINAL	6.2	6.5	4.4	4.5	6.9	8.1	6.1	6.3	6.3	5.1	4.1	6.1	6.9	6.3	5.1	5.6	5.2	4.1	6.1	5.8
* MINI-VERDE	5.5	6.6	5.5	5.1	7.2	6.4	5.3	3.7	4.9	7.2	4.9	2.0	6.2	7.0	5.4	8.0	5.0	3.4	6.6	5.6
* SAVANNAH	5.6	4.7	4.8	4.2	5.8	3.3	5.5	4.3	6.4	6.8	7.4	4.7	5.1	6.2	5.6	5.5	4.6	5.3	6.4	5.4
* BLACKJACK	5.6	4.6	4.6	3.8	5.9	3.9	4.4	4.9	6.8	6.3	7.5	4.8	5.3	5.8	5.5	4.7	4.7	6.2	6.4	5.4
* MAJESTIC	4.6	4.6	4.9	4.1	6.0	4.7	4.3	5.1	6.8	5.8	7.2	4.7	4.9	6.2	5.8	5.4	4.7	5.7	6.2	5.3
* SOUTHERN STAR (J-1224)	5.5	5.4	4.6	4.3	6.1	3.4	3.7	4.9	5.7	6.5	7.3	4.7	4.8	6.5	5.5	5.6	5.5	5.2	6.1	5.3
J-540	4.9	5.0	4.6	4.0	5.9	3.9	3.9	5.2	6.5	5.9	7.5	4.7	4.8	6.0	5.6	5.0	5.4	5.6	6.4	5.3
* SHANGRI LA	5.5	4.7	4.8	4.3	5.9	3.9	4.0	4.7	6.2	5.8	7.2	4.8	4.9	5.7	5.5	4.8	4.8	5.7	6.3	5.2
* SYDNEY (SWI-7)	5.8	4.3	4.6	4.5	5.5	4.3	4.3	4.5	6.0	5.5	7.2	4.4	4.7	5.5	5.6	4.9	4.9	5.8	6.2	5.2
* PYRAMID	4.7	4.5	4.6	3.9	6.0	3.3	3.9	4.7	6.5	6.1	7.1	4.5	4.6	6.1	5.6	5.1	4.3	5.9	6.1	5.1
* MIRAGE	3.9	4.4	4.6	4.2	6.3	3.4	4.5	4.7	6.5	5.4	7.0	4.7	4.7	5.8	5.4	5.1	4.4	6.0	6.0	5.1
* BLUE-MUDA	4.4	4.8	4.6	4.1	5.6	3.6	4.3	4.6	6.8	4.9	6.8	4.8	5.0	5.9	5.4	4.6	4.7	6.2	6.3	5.1
* SUNDEVIL II	4.4	4.8	4.5	4.1	5.9	4.1	4.6	4.1	5.4	6.2	7.1	4.7	5.1	5.8	5.5	5.1	4.2	5.5	6.1	5.1
* JACKPOT	5.3	4.6	4.8	3.6	6.2	4.2	4.2	3.7	6.5	5.0	6.8	4.5	4.5	5.4	5.3	4.7	4.5	5.4	6.2	5.0
* NUMEX-SAHARA	4.3	4.8	4.5	3.6	5.7	4.0	3.5	4.4	6.8	4.8	7.0	4.3	4.8	5.6	5.6	4.9	4.6	5.8	6.1	5.0
* ARIZONA COMMON	4.4	4.4	4.7	3.3	5.5	3.5	3.3	3.6	6.3	4.6	6.2	4.6	4.5	5.5	5.2	4.8	4.3	4.9	5.8	4.7
LSD VALUE	0.7	0.8	0.3	0.8	0.7	0.9	1.0	0.8	0.7	0.8	0.7	0.5	0.6	0.7	0.3	0.6	0.5	1.1	0.5	0.2
C.V. (%)	7.8	9.3	3.8	10.6	6.4	10.9	11.6	9.5	7.1	7.9	6.4	6.3	6.2	6.3	3.4	6.4	6.1	12.0	5.0	7.7

* COMMERCIALLY AVAILABLE IN THE USA IN 2000.

1/ TO DETERMINE STATISTICAL DIFFERENCES AMONG ENTRIES, SUBTRACT 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).

2/ C.V. (COEFFICIENT OF VARIATION) INDICATES THE PERCENT VARIATION OF THE MEAN IN EACH COLUMN.

TABLE 1B.

MEAN TURFGRASS QUALITY RATINGS OF BERMUDAGRASS (SEEDED) CULTIVARS
GROWN AT NINETEEN LOCATIONS IN THE U.S. 1/
1999 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 2/

NAME	AR1	AZ1	CA3	FL1	GA1	IL2	IN2	KS2	KY1	MD1	MO1	MO2	MS1	NM1	OK1	SC2	TX2	VA1	VA4	MEAN
OKS 95-1	6.9	6.7	5.1	5.1	6.7	7.2	6.8	7.2	8.1	7.3	7.9	6.3	5.8	7.3	6.9	7.0	5.6	6.5	6.4	6.7
PRINCESS	7.2	7.0	4.9	5.5	6.3	6.4	6.4	5.4	7.1	7.3	7.9	5.1	6.4	7.3	6.8	6.6	6.0	6.6	6.6	6.5
PST-R69C	6.2	6.0	4.8	5.0	5.8	4.4	4.8	4.9	6.5	7.0	8.1	4.8	5.8	6.9	6.1	6.3	5.6	6.1	6.3	5.9
SWI-11	6.1	6.6	4.8	5.3	6.0	4.7	5.2	4.5	6.3	6.4	7.3	4.6	6.0	7.1	5.8	6.1	5.5	5.8	6.4	5.8
SAVANNAH	5.6	4.7	4.8	4.2	5.8	3.3	5.5	4.3	6.4	6.8	7.4	4.7	5.1	6.2	5.6	5.5	4.6	5.3	6.4	5.4
BLACKJACK	5.6	4.6	4.6	3.8	5.9	3.9	4.4	4.9	6.8	6.3	7.5	4.8	5.3	5.8	5.5	4.7	4.7	6.2	6.4	5.4
MAJESTIC	4.6	4.6	4.9	4.1	6.0	4.7	4.3	5.1	6.8	5.8	7.2	4.7	4.9	6.2	5.8	5.4	4.7	5.7	6.2	5.3
SOUTHERN STAR (J-1224)	5.5	5.4	4.6	4.3	6.1	3.4	3.7	4.9	5.7	6.5	7.3	4.7	4.8	6.5	5.5	5.6	5.5	5.2	6.1	5.3
J-540	4.9	5.0	4.6	4.0	5.9	3.9	3.9	5.2	6.5	5.9	7.5	4.7	4.8	6.0	5.6	5.0	5.4	5.6	6.4	5.3
SHANGRI LA	5.5	4.7	4.8	4.3	5.9	3.9	4.0	4.7	6.2	5.8	7.2	4.8	4.9	5.7	5.5	4.8	4.8	5.7	6.3	5.2
SYDNEY (SWI-7)	5.8	4.3	4.6	4.5	5.5	4.3	4.3	4.5	6.0	5.5	7.2	4.4	4.7	5.5	5.6	4.9	4.9	5.8	6.2	5.2
PYRAMID	4.7	4.5	4.6	3.9	6.0	3.3	3.9	4.7	6.5	6.1	7.1	4.5	4.6	6.1	5.6	5.1	4.3	5.9	6.1	5.1
MIRAGE	3.9	4.4	4.6	4.2	6.3	3.4	4.5	4.7	6.5	5.4	7.0	4.7	4.7	5.8	5.4	5.1	4.4	6.0	6.0	5.1
BLUE-MUDA	4.4	4.8	4.6	4.1	5.6	3.6	4.3	4.6	6.8	4.9	6.8	4.8	5.0	5.9	5.4	4.6	4.7	6.2	6.3	5.1
SUNDEVIL II	4.4	4.8	4.5	4.1	5.9	4.1	4.6	4.1	5.4	6.2	7.1	4.7	5.1	5.8	5.5	5.1	4.2	5.5	6.1	5.1
JACKPOT	5.3	4.6	4.8	3.6	6.2	4.2	4.2	3.7	6.5	5.0	6.8	4.5	4.5	5.4	5.3	4.7	4.5	5.4	6.2	5.0
NUMEX-SAHARA	4.3	4.8	4.5	3.6	5.7	4.0	3.5	4.4	6.8	4.8	7.0	4.3	4.8	5.6	5.6	4.9	4.6	5.8	6.1	5.0
ARIZONA COMMON	4.4	4.4	4.7	3.3	5.5	3.5	3.3	3.6	6.3	4.6	6.2	4.6	4.5	5.5	5.2	4.8	4.3	4.9	5.8	4.7
LSD VALUE	0.7	0.9	0.3	0.8	0.6	0.9	1.1	0.9	0.8	0.8	0.6	0.5	0.5	0.7	0.4	0.7	0.5	1.2	0.6	0.2
C.V. (%)	8.8	10.8	3.5	11.6	6.3	12.9	15.1	12.0	7.9	7.8	5.4	6.9	6.6	7.3	3.9	7.8	6.5	12.9	5.6	8.6

TABLE 1C.

MEAN TURFGRASS QUALITY RATINGS OF BERMUDAGRASS (VEGETATIVE) CULTIVARS
GROWN AT NINETEEN LOCATIONS IN THE U.S. 1/
1999 DATA
TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 2/

NAME	AR1	AZ1	CA3	FL1	GA1	IL2	IN2	KS2	KY1	MD1	MO1	MO2	MS1	NM1	OK1	SC2	TX2	VA1	VA4	MEAN
TIFSPORT (TIFT 94)	6.8	7.2	4.8	6.1	7.2	7.4	6.8	5.7	7.8	6.9	7.5	5.8	7.8	7.7	7.7	7.6	5.8	5.9	6.6	6.8
TIFWAY	6.6	7.0	4.7	5.3	7.3	7.6	6.4	6.1	6.7	7.0	7.2	5.4	7.6	7.8	7.8	7.5	5.9	5.6	6.6	6.6
OKC 18-4	7.6	5.8	5.1	4.8	7.3	7.2	6.8	6.2	7.3	7.0	7.8	5.9	5.6	7.3	7.6	6.8	6.0	5.8	7.1	6.6
TIFGREEN	6.8	6.3	5.5	5.2	7.4	7.2	6.3	5.3	5.6	7.4	7.9	5.4	6.7	7.6	7.7	7.1	6.0	5.2	6.3	6.5
MIDLAWN	7.2	6.6	4.8	3.9	7.4	7.7	6.3	6.2	7.4	6.4	6.6	6.0	5.9	8.0	7.2	6.9	5.8	5.5	6.8	6.4
OKC 19-9	4.9	6.2	4.9	5.1	7.4	6.8	6.8	5.9	6.9	7.9	7.2	5.7	5.7	7.2	7.2	7.0	5.6	4.6	6.9	6.3
CN 2-9	6.4	6.6	4.9	5.5	6.5	6.4	6.4	5.6	4.7	6.8	6.1	5.2	6.8	7.4	7.3	7.9	5.6	4.8	6.4	6.2
SHANGHAI	7.1	5.7	5.1	3.9	6.6	6.2	5.4	5.9	6.9	7.1	7.8	5.8	5.7	6.4	6.3	6.0	5.3	6.2	6.6	6.1
CARDINAL	6.2	6.5	4.4	4.5	6.9	8.1	6.1	6.3	6.3	5.1	4.1	6.1	6.9	6.3	5.1	5.6	5.2	4.1	6.1	5.8
MINI-VERDE	5.5	6.6	5.5	5.1	7.2	6.4	5.3	3.7	4.9	7.2	4.9	2.0	6.2	7.0	5.4	8.0	5.0	3.4	6.6	5.6
LSD VALUE	0.7	0.7	0.3	0.7	0.7	1.0	0.6	0.4	0.6	0.9	0.9	0.5	0.6	0.5	0.3	0.5	0.5	0.8	0.4	0.1
C.V. (%)	6.4	7.2	4.1	9.1	6.4	8.6	6.2	4.7	5.5	8.1	8.2	5.2	5.5	4.7	2.6	4.3	5.3	9.7	3.9	6.3

1/ TO DETERMINE STATISTICAL DIFFERENCES AMONG ENTRIES, SUBTRACT 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).

2/ C.V. (COEFFICIENT OF VARIATION) INDICATES THE PERCENT VARIATION OF THE MEAN IN EACH COLUMN.

1996 NTEP ZOYSIAGRASS TEST

Est. 29 July 1996

9	12	14	15	11	10	13	16
1	6	5	8	3	18	19	17
XXX	7	2	13	14	18	12	16
3	8	15	10	17	11	19	9
XXX	1	6	2	7	5	YZ3	YZ7
8	3	XXX	5	1	2	6	7
18	14	16	10	17	9	12	19
					13	11	15

<u>Seeded</u>

1. ZEN 500
2. ZEN 400
3. ZENITH
5. J 37
6. CHINESE COMMON
7. Z 18
8. KOREAN COMMON

<u>Vegetative</u>

9. DALZ 9601
10. J 14
11. MIYAKO
12. HT 210
13. DE ANZA
14. VICTORIA
15. EL TORO
16. JAMUR
17. ZEON
18. MEYER
19. EMERALD

TABLE 1A.

MEAN TURFGRASS QUALITY RATINGS OF ZOYSIAGRASS CULTIVARS
GROWN AT SIXTEEN LOCATIONS IN THE U.S. 1/
1999 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 2/

NAME	AR1	CA3	FL1	FL3	GA1	IL2	IN1	KS1	KY1	LA1	MD1	MO1	MS1	TX1	TX3	VA4	MEAN
DALZ 9601	8.0	6.1	5.9	7.5	7.2	7.2	6.5	7.1	7.5	7.1	7.5	5.9	7.8	6.1	4.2	7.1	6.8
* EMERALD	7.7	5.8	5.9	7.7	6.8	7.3	6.9	7.8	5.2	7.3	7.0	6.3	7.5	6.4	5.1	7.1	6.7
* ZEON	7.8	5.7	6.0	7.9	6.5	7.6	6.1	6.7	4.4	7.3	7.5	5.9	7.8	6.2	4.9	7.2	6.6
* EL TORO	6.2	5.5	6.8	7.6	6.4	4.4	4.1	6.5	8.0	6.6	7.1	5.7	5.7	6.0	5.0	6.8	6.1
* JAMUR	6.6	5.3	6.6	7.8	6.1	3.7	4.8	6.5	7.4	6.5	6.8	5.7	5.7	6.1	5.0	6.7	6.1
* VICTORIA	6.3	6.8	6.2	8.0	6.6	6.8	1.1	6.0	4.5	7.0	6.8	3.7	6.7	5.3	4.7	6.9	5.8
* DE ANZA	6.7	6.3	6.4	7.6	6.4	5.8	2.2	4.3	4.5	6.7	7.8	3.4	6.4	5.4	3.9	6.9	5.7
J-14	5.8	4.3	4.5	6.8	5.2	5.1	5.9	6.3	6.9	6.0	6.9	4.4	4.8	5.6	4.0	6.7	5.6
MIYAKO	5.6	4.8	6.1	7.3	6.0	3.0	3.9	5.3	6.4	6.3	6.8	4.4	5.4	5.4	5.0	6.7	5.5
* MEYER	7.0	5.0	3.4	5.0	6.6	5.5	6.7	5.5	5.1	6.8	6.8	3.9	4.9	4.3	3.9	6.8	5.5
* ZEN-400	5.0	4.7	5.1	6.8	5.7	3.7	5.7	6.3	6.4	5.8	6.8	4.8	4.9	4.4	3.3	6.2	5.3
* J-37	5.2	4.7	4.5	6.3	5.5	4.1	5.4	6.3	6.8	5.8	6.3	4.8	4.9	4.6	4.3	6.2	5.3
HT-210	5.8	4.7	5.0	7.4	5.9	6.5	1.0	5.1	.	7.4	3.9	1.5	7.4	5.7	5.1	6.8	5.3
* J-36	5.1	.	4.6	6.6	5.5	3.5	5.1	6.2	6.3	5.7	6.5	4.4	4.8	4.6	4.0	6.2	5.3
* ZEN-500	4.9	4.9	3.4	6.3	5.7	3.6	5.4	4.9	6.9	5.8	6.4	4.1	4.8	5.1	4.2	6.6	5.2
* ZENITH	4.4	5.1	3.9	5.6	5.7	5.3	4.9	5.5	5.3	5.7	6.9	3.7	4.5	4.5	3.8	6.4	5.1
* CHINESE COMMON	4.2	4.5	4.2	5.7	5.4	3.3	4.5	6.0	5.9	5.5	5.9	4.4	4.5	4.5	4.0	5.9	4.9
* KOREAN COMMON	4.1	4.4	4.1	6.3	5.3	2.8	3.9	4.7	5.5	5.2	5.4	2.9	4.4	4.4	4.0	5.9	4.6
* Z-18	.	4.1	3.5	5.3	5.3	.	1.3	5.2	5.5	6.3	5.9	2.2	4.2	.	3.2	6.6	4.5
LSD VALUE	1.4	0.4	0.9	0.6	0.5	1.0	1.0	1.2	1.0	0.4	0.8	1.2	0.6	1.0	1.2	0.4	0.2
C.V. (%)	14.5	5.2	10.4	5.7	4.8	12.5	13.6	12.1	9.4	3.6	7.1	16.6	6.5	11.5	17.6	3.7	9.8

* COMMERCIALLY AVAILABLE IN THE USA IN 2000.

1/ TO DETERMINE STATISTICAL DIFFERENCES AMONG ENTRIES, SUBTRACT 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).

2/ C.V. (COEFFICIENT OF VARIATION) INDICATES THE PERCENT VARIATION OF THE MEAN IN EACH COLUMN.

TABLE 1B. MEAN TURFGRASS QUALITY RATINGS OF ZOYSIAGRASS (SEEDED) CULTIVARS GROWN AT SIXTEEN LOCATIONS IN THE U.S. 1/
1999 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 2/

NAME	AR1	CA3	FL1	FL3	GA1	IL2	IN1	KS1	KY1	LA1	MD1	MO1	MS1	TX1	TX3	VA4	MEAN
ZEN-400	5.0	4.7	5.1	6.8	5.7	3.7	5.7	6.3	6.4	5.8	6.8	4.8	4.9	4.4	3.3	6.2	5.3
J-37	5.2	4.7	4.5	6.3	5.5	4.1	5.4	6.3	6.8	5.8	6.3	4.8	4.9	4.6	4.3	6.2	5.3
J-36	5.1	.	4.6	6.6	5.5	3.5	5.1	6.2	6.3	5.7	6.5	4.4	4.8	4.6	4.0	6.2	5.3
ZEN-500	4.9	4.9	3.4	6.3	5.7	3.6	5.4	4.9	6.9	5.8	6.4	4.1	4.8	5.1	4.2	6.6	5.2
ZENITH	4.4	5.1	3.9	5.6	5.7	5.3	4.9	5.5	5.3	5.7	6.9	3.7	4.5	4.5	3.8	6.4	5.1
CHINESE COMMON	4.2	4.5	4.2	5.7	5.4	3.3	4.5	6.0	5.9	5.5	5.9	4.4	4.5	4.5	4.0	5.9	4.9
KOREAN COMMON	4.1	4.4	4.1	6.3	5.3	2.8	3.9	4.7	5.5	5.2	5.4	2.9	4.4	4.4	4.0	5.9	4.6
Z-18	.	4.1	3.5	5.3	5.3	.	1.3	5.2	5.5	6.3	5.9	2.2	4.2	.	3.2	6.6	4.5
LSD VALUE	1.2	0.3	0.8	0.7	0.5	0.9	1.0	1.0	0.7	0.4	0.8	1.3	0.7	1.2	1.7	0.4	0.2
C.V. (%)	16.4	3.6	12.2	7.0	5.9	14.3	13.9	11.4	7.3	4.6	7.5	20.7	8.8	16.9	27.2	4.1	11.5

TABLE 1C. MEAN TURFGRASS QUALITY RATINGS OF ZOYSIAGRASS (VEGETATIVE) CULTIVARS GROWN AT SIXTEEN LOCATIONS IN THE U.S. 1/
1999 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 2/

NAME	AR1	CA3	FL1	FL3	GA1	IL2	IN1	KS1	KY1	LA1	MD1	MO1	MS1	TX1	TX3	VA4	MEAN
DALZ 9601	8.0	6.1	5.9	7.5	7.2	7.2	6.5	7.1	7.5	7.1	7.5	5.9	7.8	6.1	4.2	7.1	6.8
EMERALD	7.7	5.8	5.9	7.7	6.8	7.3	6.9	7.8	5.2	7.3	7.0	6.3	7.5	6.4	5.1	7.1	6.7
ZEON	7.8	5.7	6.0	7.9	6.5	7.6	6.1	6.7	4.4	7.3	7.5	5.9	7.8	6.2	4.9	7.2	6.6
EL TORO	6.2	5.5	6.8	7.6	6.4	4.4	4.1	6.5	8.0	6.6	7.1	5.7	5.7	6.0	5.0	6.8	6.1
JAMUR	6.6	5.3	6.6	7.8	6.1	3.7	4.8	6.5	7.4	6.5	6.8	5.7	5.7	6.1	5.0	6.7	6.1
VICTORIA	6.3	6.8	6.2	8.0	6.6	6.8	1.1	6.0	4.5	7.0	6.8	3.7	6.7	5.3	4.7	6.9	5.8
DE ANZA	6.7	6.3	6.4	7.6	6.4	5.8	2.2	4.3	4.5	6.7	7.8	3.4	6.4	5.4	3.9	6.9	5.7
J-14	5.8	4.3	4.5	6.8	5.2	5.1	5.9	6.3	6.9	6.0	6.9	4.4	4.8	5.6	4.0	6.7	5.6
MIYAKO	5.6	4.8	6.1	7.3	6.0	3.0	3.9	5.3	6.4	6.3	6.8	4.4	5.4	5.4	5.0	6.7	5.5
MEYER	7.0	5.0	3.4	5.0	6.6	5.5	6.7	5.5	5.1	6.8	6.8	3.9	4.9	4.3	3.9	6.8	5.5
HT-210	5.8	4.7	5.0	7.4	5.9	6.5	1.0	5.1	.	7.4	3.9	1.5	7.4	5.7	5.1	6.8	5.3
LSD VALUE	1.5	0.5	0.9	0.6	0.4	1.1	1.0	1.2	1.3	0.3	0.7	1.0	0.5	0.8	0.7	0.4	0.2
C.V. (%)	13.6	5.8	9.5	4.9	4.0	11.6	13.4	12.5	11.4	2.9	6.7	13.9	5.2	8.2	9.3	3.5	8.8

1/ TO DETERMINE STATISTICAL DIFFERENCES AMONG ENTRIES, SUBTRACT 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).

2/ C.V. (COEFFICIENT OF VARIATION) INDICATES THE PERCENT VARIATION OF THE MEAN IN EACH COLUMN.

1996 NTEP TALL FESCUE TRIAL

est. --Oct. 1997

plot size = 3.5'E-Wx7'N-S

56	76	93	98	99	5	36	71	31	52	16	64	33	1	73	87
80	79	22	38	21	102	55	48	86	45	103	51	59	78	49	112
82	100	96	125	14	97	20	23	111	32	90	92	128	114	122	12
118	4	58	117	109	75	41	28	13	127	123	66	15	50	65	101
29	106	34	24	107	69	95	110	108	120	35	62	94	81	84	37
77	129	115	2	11	10	57	74	42	72	91	39	61	104	44	47
68	46	116	25	54	9	7	119	8	70	3	85	53	40	6	124
27	18	88	19	121	43	126	30	26	63	113	83	17	105	60	89
67	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127
128	129	29	118	60	61	20	8	82	59	6	5	125	115	89	67
70	49	106	80	84	102	72	117	43	40	123	47	122	121	25	56
76	124	78	65	2	103	90	36	21	32	68	104	126	28	99	33
114	54	66	42	14	13	15	129	4	83	111	100	57	81	97	44
27	64	19	7	69	55	116	58	17	92	31	96	48	22	46	23
39	105	120	62	51	79	127	24	75	95	34	74	12	107	11	37
91	77	86	3	41	128	52	18	108	113	63	30	1	88	53	73
101	71	9	45	85	26	10	98	112	16	110	87	109	93	119	50
94	35	38	X	X	X	X	X	X	X	X	X	X	X	X	X

TABLE 1.

MEAN TURFGRASS QUALITY RATINGS OF TALL FESCUE CULTIVARS GROWN IN FULL SUN AT TWENTY-FOUR LOCATIONS IN THE U.S. 1/
1999 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF 2/

NAME	AR1	CA1	CA3	GA1	IA1	IL1	IL2	IN1	KS2	KY1	MD1	ME1	MI1	MO1	MO3	NE1	NJ1	NJ2	OH1	OK1	UT1	VA1	VA4	WA1	MEAN
* REMBRANDT (LTP-4026 E+)	6.4	6.7	6.2	6.7	6.6	6.8	8.0	6.9	6.8	8.3	6.8	6.0	5.7	5.0	6.0	7.0	6.3	5.8	8.1	6.8	5.6	6.3	6.2	6.1	6.5
* MILLENNIUM (TMI-RBR)	6.1	6.7	6.5	6.8	6.7	7.1	8.1	6.8	7.0	7.9	6.8	6.1	5.9	5.0	5.5	6.6	6.8	5.3	8.0	6.6	5.6	5.9	6.3	6.3	6.5
* PICK RT-95	6.3	6.9	6.5	6.8	6.3	6.5	8.0	6.6	6.6	8.3	6.8	6.4	6.0	4.8	6.6	6.9	5.8	5.3	7.8	6.4	5.7	6.4	6.5	6.0	6.5
* PLANTATION (PENNINGTON-1901)	6.2	6.8	6.4	7.3	6.1	6.4	7.1	6.5	6.8	7.9	6.8	6.1	6.0	4.9	6.4	7.1	6.0	5.9	7.9	6.6	6.0	6.2	6.1	6.1	6.5
* MASTERPIECE (LTP-SD-TF)	6.0	7.1	6.1	7.0	6.7	6.5	7.9	6.8	7.0	8.0	7.1	5.6	5.3	4.5	6.2	6.8	6.3	5.3	8.2	6.6	5.7	5.9	6.4	6.0	6.5
* SCORPIO (ZPS-2PTF)	6.1	6.8	6.4	6.7	6.6	6.6	8.0	6.6	6.5	8.0	7.3	5.7	5.7	5.1	6.5	6.4	6.0	5.2	7.8	6.4	5.9	6.0	6.3	6.0	6.4
* COYOTE	5.8	6.6	6.0	6.1	6.3	6.4	7.8	6.6	6.5	7.7	7.3	6.2	5.7	5.0	6.0	6.3	5.8	5.2	8.0	6.7	5.5	6.4	6.3	6.1	6.3
* CROSSFIRE II	5.8	7.1	6.1	6.4	7.0	6.6	7.2	6.7	6.8	7.7	6.2	5.8	5.8	4.8	6.3	6.8	6.1	5.5	7.8	6.6	5.3	5.8	6.2	5.9	6.3
* SHENANDOAH II (WRS2)	6.1	6.7	6.3	6.3	6.3	6.5	7.7	6.5	6.5	7.7	6.8	5.7	5.0	4.9	6.7	6.5	5.5	5.2	7.9	6.9	5.5	6.3	6.4	6.1	6.3
* JAGUAR 3	6.3	6.8	6.1	7.1	6.3	6.1	7.3	6.8	6.7	8.0	6.3	6.2	5.7	3.9	6.3	7.1	5.2	5.3	7.6	6.3	5.3	5.8	6.4	5.9	6.3
MB 212	5.9	6.6	5.9	6.3	6.1	6.3	7.5	6.5	6.7	8.2	6.3	5.9	5.7	4.7	6.1	6.6	5.5	5.2	7.7	6.8	5.5	6.0	6.3	6.0	6.3
* WATCHDOG (PICK FA B-93)	6.0	6.6	6.0	5.8	6.6	6.4	7.1	6.9	6.5	7.8	6.8	6.2	5.7	4.6	5.3	6.3	5.4	5.1	7.7	6.5	5.5	6.1	6.3	5.8	6.2
* OLYMPIC GOLD (PST-5E5)	6.1	6.8	6.1	6.6	5.6	6.1	7.2	6.4	6.9	8.0	6.7	6.1	6.1	4.5	6.3	6.1	4.8	5.1	7.5	6.6	5.3	6.1	6.2	6.0	6.2
DOMINION (PST-5M5)	5.5	6.4	5.9	6.3	5.8	6.1	7.4	6.3	6.6	7.8	6.9	6.0	5.8	4.7	6.4	6.8	4.5	5.0	7.7	6.5	6.0	6.2	6.3	5.8	6.2
* TAR HEEL	5.7	6.6	6.3	6.7	6.7	6.2	7.1	6.4	6.5	7.8	6.4	5.5	5.0	4.6	5.9	6.5	5.5	5.0	7.4	6.5	5.7	6.4	6.3	5.8	6.2
* WOLFPACK (PST-R5TK)	5.1	6.6	6.4	7.0	6.9	6.2	7.4	6.5	6.7	7.7	6.8	5.6	5.5	4.3	5.8	6.5	4.6	5.1	7.4	6.6	5.7	6.1	6.3	5.8	6.2
CU9502T	5.3	6.7	5.9	6.1	5.7	6.4	6.5	6.5	6.7	8.3	7.1	6.1	5.8	4.8	5.8	6.9	5.4	4.6	7.7	6.4	5.5	6.6	6.2	5.8	6.2
* REBEL SENTRY (AA-A91)	5.3	6.5	6.0	6.8	6.7	6.5	7.0	6.4	6.4	7.6	6.6	5.8	5.2	4.7	6.2	6.5	5.4	5.1	7.9	6.6	5.3	5.8	6.3	6.0	6.2
MB 29	6.4	6.4	5.8	6.0	5.6	6.0	6.9	6.3	6.3	8.1	6.6	5.8	5.6	5.0	6.6	6.0	5.0	4.8	7.7	7.0	5.2	6.1	6.2	6.5	6.2
* GAZELLE	5.5	6.8	6.2	5.8	6.3	5.8	7.9	6.9	6.4	7.5	6.0	6.0	5.1	4.7	5.8	6.8	5.7	5.0	7.9	6.5	4.9	6.1	6.4	5.8	6.2
MB 213	6.0	6.3	5.9	6.1	6.3	6.2	6.8	6.4	6.8	7.9	5.8	5.8	5.7	4.7	6.3	6.0	5.3	4.6	7.9	7.0	5.5	5.8	6.2	6.1	6.1
ONCUE (PST-523)	5.9	6.8	6.1	6.7	6.1	6.2	7.3	6.6	6.2	7.5	6.7	5.5	5.1	4.6	5.6	6.7	4.6	5.1	7.7	6.5	5.7	5.7	6.3	5.7	6.1
R5AU	5.8	6.6	6.3	6.7	6.0	6.2	7.2	6.5	6.6	7.4	6.7	5.8	5.2	5.1	5.8	6.0	4.5	4.6	7.6	6.5	6.0	5.8	6.1	5.7	6.1
CU9501T	5.2	6.5	6.2	6.1	6.1	6.0	7.3	6.4	6.7	7.8	6.5	5.9	5.5	4.2	5.8	6.8	5.0	5.0	7.4	6.5	5.5	6.1	6.1	6.0	6.1
* ARID 3 (J-98)	5.9	6.6	5.8	6.5	5.7	6.0	6.5	6.6	6.5	7.5	6.9	5.8	4.9	4.5	6.3	6.7	5.6	4.8	7.7	6.8	5.9	5.1	6.2	5.9	6.1
* BRANDY (J-101)	5.3	6.9	6.0	6.1	6.8	6.2	7.2	6.5	6.3	7.2	5.9	5.5	5.6	5.0	5.9	6.2	5.8	4.1	7.9	6.6	5.0	5.8	6.3	5.9	6.1
* DURANA (MB 211)	5.9	6.5	5.8	5.9	5.5	6.2	7.4	6.3	6.5	8.2	5.9	6.0	6.0	4.5	6.1	6.3	4.7	4.5	7.6	6.8	5.3	5.8	6.2	5.9	6.1
* BONSAI 2000 (BULLET)	4.6	6.7	6.2	6.7	6.1	6.4	7.0	6.5	6.8	7.7	6.7	5.8	5.0	4.0	5.7	6.0	5.7	4.9	7.4	6.4	5.6	5.6	6.2	5.7	6.1
* BRAVO (RG-93)	4.9	6.6	5.7	6.6	6.3	6.0	6.9	6.5	6.5	7.8	6.3	5.9	5.5	4.5	5.6	6.0	5.0	5.0	7.6	6.5	5.1	6.1	6.4	6.0	6.1
OFI-931	5.5	6.2	5.9	6.3	5.4	6.1	6.5	6.7	6.2	7.8	6.3	5.7	5.4	5.0	5.9	5.9	4.6	4.9	7.6	6.7	6.0	6.3	6.2	5.9	6.0
* CORONADO	5.0	6.7	6.4	6.5	6.2	6.0	6.7	6.2	6.3	7.4	5.5	5.8	5.0	4.7	5.8	6.2	5.6	4.7	7.9	6.5	6.0	6.0	6.2	6.0	6.0
ATF-257	5.9	6.9	6.2	6.6	6.1	6.4	7.6	6.3	6.5	7.3	6.7	5.7	5.0	4.0	5.8	6.1	4.1	5.0	7.6	6.3	5.4	5.6	6.3	5.7	6.0
BAR FA 6D	5.6	6.4	6.2	6.3	5.1	6.1	6.3	6.7	6.7	7.8	6.5	5.6	5.7	4.8	5.0	6.0	5.5	4.3	7.9	6.8	5.6	5.5	6.3	6.2	6.0
* SOUTHERN CHOICE	5.4	6.5	6.0	6.1	5.7	6.0	6.5	6.3	6.3	7.2	6.5	5.9	6.0	4.2	5.7	6.6	4.8	5.1	7.4	6.6	5.8	6.0	6.2	5.9	6.0
BAR FA 6LV	5.6	6.5	6.1	6.6	4.9	6.0	6.7	6.5	6.6	7.7	6.0	6.1	5.4	4.8	5.5	5.8	5.4	4.1	7.8	6.7	6.0	5.6	6.2	6.0	6.0
* WYATT (ATF-188)	4.9	6.8	6.0	6.4	5.9	6.4	7.3	6.7	6.1	7.5	6.8	5.7	5.7	4.4	5.5	6.3	5.2	4.9	7.7	6.2	5.1	5.6	6.2	5.6	6.0
MB 28	5.8	6.1	5.6	6.0	5.8	6.0	6.6	6.0	6.4	7.5	6.7	5.6	6.0	4.6	5.8	6.1	5.4	5.0	7.6	7.0	5.2	5.8	6.1	6.2	6.0
MB 215	5.6	6.1	5.7	6.4	5.5	6.0	6.6	6.1	6.5	7.1	6.7	5.6	6.1	4.9	5.6	6.2	4.7	3.8	7.9	6.9	5.7	6.3	6.3	6.1	6.0
* ANTHEM II (TMI-FMN)	4.9	6.5	5.8	6.4	6.2	6.3	7.3	6.3	6.5	7.3	5.8	5.6	6.0	4.0	5.4	6.4	5.4	4.9	7.3	6.4	6.1	5.6	6.3	5.8	6.0
* GENESIS	5.4	6.2	5.8	6.4	6.2	6.0	6.6	6.3	6.4	7.5	6.8	5.2	.	4.6	5.6	6.0	5.1	3.9	7.4	6.8	5.5	6.6	6.2	5.9	6.0
* BARRERA (BAR FA6 US3)	5.3	6.4	6.0	4.9	5.4	6.4	6.7	6.6	6.3	8.3	6.6	5.3	5.6	4.8	5.9	6.3	5.1	4.7	8.0	7.0	5.0	5.3	6.1	6.3	6.0
MB 26	5.8	6.7	6.2	5.4	5.4	6.0	6.3	6.5	6.1	7.9	5.9	6.0	5.0	4.6	6.2	6.3	5.1	4.9	7.8	6.9	4.8	6.1	6.2	6.2	6.0
SR 8210	5.5	6.5	6.2	5.8	6.2	5.9	6.1	6.7	6.3	7.4	6.1	6.0	5.7	4.1	6.4	6.0	4.9	4.8	7.7	6.5	5.5	5.7	6.4	5.8	6.0
* EMPRESS	5.1	6.6	5.8	5.9	6.2	6.3	6.9	6.8	6.3	7.5	6.5	5.4	5.0	4.5	5.7	6.2	4.9	5.0	7.4	6.5	5.8	5.6	6.3	5.9	6.0

TABLE 1. (CONT'D)

MEAN TURFGRASS QUALITY RATINGS OF TALL FESCUE CULTIVARS
GROWN IN FULL SUN AT TWENTY-FOUR LOCATIONS IN THE U.S.
1999 DATA

TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF

NAME	AR1	CA1	CA3	GA1	IA1	IL1	IL2	IN1	KS2	KY1	MD1	ME1	MI1	MO1	MO3	NE1	NJ1	NJ2	OH1	OK1	UT1	VA1	VA4	WA1	MEAN
PST-5TO	5.6	6.6	5.8	6.2	5.1	6.2	6.7	6.4	6.6	7.6	6.4	5.4	5.5	4.6	6.3	6.0	4.7	5.1	7.3	6.6	5.8	5.3	6.3	5.8	6.0
* RED COAT (ATF-038)	5.9	6.6	5.9	6.1	6.2	5.6	6.7	6.7	6.3	7.3	6.5	5.6	5.1	4.4	5.5	6.4	4.5	5.0	7.6	6.5	5.8	6.2	6.2	5.7	6.0
* MUSTANG II	5.8	6.6	5.6	6.6	5.8	6.2	7.7	6.5	6.5	7.2	6.5	5.9	5.5	4.2	5.8	6.2	4.4	4.8	7.5	6.5	5.3	5.3	6.2	5.5	6.0
MB 214	5.6	6.3	6.1	5.7	5.2	6.7	6.6	6.2	6.5	7.6	7.1	5.8	4.9	4.6	5.5	6.3	4.6	4.0	8.2	7.1	5.1	6.0	6.2	6.4	6.0
MB 216	5.8	6.0	5.7	6.2	6.2	5.7	6.3	6.2	6.3	7.2	6.4	5.9	6.1	4.6	6.1	6.1	4.8	4.3	7.7	6.9	5.7	5.7	6.1	6.2	6.0
BAR FA6 US2U	5.8	6.2	6.1	5.1	5.6	5.8	5.8	6.4	6.4	7.7	6.3	6.0	5.8	4.5	5.6	6.6	5.6	4.4	7.9	7.1	5.7	5.4	6.2	6.1	6.0
* REBEL 2000 (AA-989)	6.0	6.4	6.0	6.5	5.6	5.9	6.3	6.3	6.5	7.2	6.1	6.0	5.2	4.3	6.3	6.5	4.6	4.0	7.4	6.7	5.6	6.1	6.3	6.3	6.0
* BARRINGTON (BAR FA6D USA)	4.9	6.6	6.0	6.2	5.1	5.9	6.2	6.7	6.4	7.8	5.9	6.1	5.1	4.3	5.7	6.2	5.7	4.3	7.8	7.0	5.7	5.9	6.2	6.1	6.0
* CHAPEL HILL (TA-7)	4.9	6.0	5.8	6.4	6.0	6.0	6.5	6.2	6.3	7.7	6.7	6.0	6.3	4.9	5.3	6.3	4.5	4.3	7.6	6.6	5.5	6.1	6.2	5.8	6.0
* WILDFIRE (ATF-196)	5.6	6.7	6.2	5.9	5.9	6.0	7.1	6.5	6.2	6.3	6.4	5.4	5.1	4.8	5.5	6.7	5.5	4.9	7.7	6.5	5.1	5.7	6.2	5.6	6.0
AIRLIE (MB 210)	5.0	6.3	5.8	5.8	5.5	6.0	7.3	6.3	6.8	7.5	6.6	6.0	5.8	4.7	5.4	6.2	4.5	4.6	7.4	6.7	5.6	5.7	6.3	5.8	6.0
FINELAWN 5LZ (ZPS-5LZ)	5.9	6.7	6.2	5.4	5.6	6.1	6.8	6.3	6.1	7.3	6.1	4.8	5.1	4.5	6.3	6.0	4.9	5.3	7.8	6.9	5.5	5.9	6.2	5.9	6.0
* APACHE II	5.9	6.4	6.0	6.4	6.0	6.3	6.3	6.3	6.5	7.9	6.3	5.9	4.9	4.2	5.3	6.4	4.8	4.7	7.7	6.4	5.6	5.6	6.3	5.8	6.0
* RESERVE (ATF-182)	5.5	6.4	6.0	7.0	4.7	5.7	7.4	6.5	6.5	7.2	6.8	5.8	5.6	4.4	5.0	6.4	4.4	4.7	7.3	6.5	5.4	6.4	6.2	5.9	6.0
OFI-96-31	5.3	6.4	6.0	5.7	6.0	5.8	6.2	6.5	6.3	7.1	5.6	5.8	5.8	4.8	5.7	6.5	5.0	4.8	7.6	6.7	5.4	6.0	6.1	6.2	6.0
* PIXIE E+	5.0	6.1	5.8	6.0	6.8	6.0	7.1	6.4	6.3	6.7	6.8	5.7	6.1	4.5	5.4	6.0	4.2	4.4	7.5	6.4	5.4	6.3	6.3	6.0	6.0
* BANDANA (PST-R5AE)	5.2	6.9	6.2	6.0	6.0	5.6	7.4	6.4	6.5	7.1	6.3	4.9	5.4	4.7	6.1	6.2	4.4	4.5	7.6	6.5	5.5	5.5	6.3	5.8	6.0
* AZTEC II (TMI-AZ)	4.5	6.8	6.3	6.4	6.2	6.0	6.7	6.6	6.6	7.4	5.5	5.3	5.9	4.4	5.5	6.0	5.1	4.5	7.6	6.5	5.4	5.7	6.3	6.0	6.0
* TF6 (BAR FA6 US6F)	5.4	6.4	5.9	5.6	5.4	5.7	6.0	6.3	6.4	7.5	6.3	5.7	5.4	4.9	6.1	6.1	4.5	4.8	7.8	6.7	6.0	6.0	6.3	5.8	6.0
* TRACER (BAR FA6 US1)	5.8	6.4	6.2	5.6	5.0	5.6	6.9	6.7	6.4	8.2	6.0	5.5	5.0	4.8	5.5	6.3	5.6	4.4	7.8	6.9	5.1	5.1	6.2	6.2	6.0
* CORONADO GOLD (PST-5RT)	5.5	6.7	6.1	6.9	5.8	6.5	6.0	6.4	6.3	7.4	5.5	5.5	6.0	4.6	5.8	5.7	4.8	4.7	7.8	6.5	5.1	5.4	6.2	6.0	6.0
PICK FA XK-95	5.8	6.5	6.0	5.8	5.7	6.4	6.2	6.4	6.3	7.3	5.2	5.1	6.2	4.7	5.7	6.0	5.0	5.0	7.4	6.6	5.3	6.0	6.1	6.0	5.9
OFI-951	5.6	6.5	5.8	5.6	5.3	6.1	6.4	6.5	6.2	7.3	6.5	5.3	5.7	4.7	6.0	6.3	4.8	4.6	7.7	6.6	5.5	5.6	6.4	5.8	5.9
* TULSA	5.2	6.8	6.1	6.3	5.8	6.2	6.8	6.5	6.4	7.2	6.3	5.5	5.6	4.4	5.6	6.2	4.2	5.0	7.3	6.5	5.2	5.7	6.2	5.7	5.9
ISI-TF11	5.1	6.3	5.5	6.0	6.4	6.2	7.1	6.3	6.3	7.6	6.9	5.4	6.1	4.3	5.5	5.7	4.3	4.6	7.3	6.3	5.6	5.8	6.2	5.7	5.9
ISI-TF9	5.0	6.5	5.9	5.8	5.8	6.4	7.2	6.3	6.3	7.8	6.4	5.4	5.9	4.4	5.3	6.1	4.5	4.2	7.6	6.5	5.9	5.5	6.3	5.6	5.9
* SUNPRO	6.0	6.2	6.0	5.7	5.9	6.1	5.7	6.3	5.9	7.8	6.3	5.9	5.2	4.4	5.5	6.5	5.3	4.7	7.6	6.5	5.7	5.3	5.9	6.0	5.9
* DUSTER	5.1	6.5	6.2	5.6	6.4	6.3	6.2	6.5	6.3	7.1	6.9	5.4	5.1	4.4	5.4	6.2	4.2	4.6	7.5	6.5	5.8	5.9	6.2	5.8	5.9
PICK FA N-93	4.7	6.6	6.1	5.3	4.9	5.5	6.9	6.6	6.3	7.6	6.1	5.4	5.5	5.0	6.5	5.6	5.4	4.9	7.9	6.6	5.5	5.4	6.0	6.0	5.9
* LION	5.6	6.2	5.9	5.6	5.8	6.2	6.7	5.9	6.4	7.2	6.0	5.5	6.2	4.5	5.5	5.9	4.4	4.5	7.6	6.9	6.2	5.7	6.3	5.7	5.9
PICK FA 20-92	5.0	6.6	6.1	5.9	5.6	6.0	6.5	6.5	6.3	6.8	6.6	6.2	5.0	4.6	5.6	6.0	4.3	5.3	7.6	6.8	5.2	5.2	6.1	6.3	5.9
* REGIMENT	5.1	6.4	5.5	5.8	6.8	5.8	6.7	6.4	6.2	7.1	6.5	5.4	5.1	4.6	5.7	6.0	4.7	4.8	7.4	6.4	5.5	6.2	6.3	5.5	5.9
* ARID II (J-3)	4.9	6.3	6.0	6.0	6.1	5.7	6.3	6.3	6.5	7.0	5.8	5.7	5.9	4.1	5.9	6.3	5.1	4.6	7.7	6.5	5.3	5.6	6.3	5.8	5.9
* ALAMO E	5.6	6.4	6.2	6.5	6.0	6.1	6.4	6.3	6.3	6.9	6.5	4.9	5.6	4.5	5.4	5.6	5.0	4.7	7.6	6.4	5.0	5.7	6.1	6.0	5.9
* TWILIGHT II (TMI-TW)	4.9	6.6	5.7	6.1	5.5	5.6	7.0	6.1	6.4	7.0	6.8	5.0	5.5	4.7	5.6	5.8	5.1	4.5	7.5	6.5	5.5	5.7	6.2	5.9	5.9
PRO 8430	4.9	6.4	6.0	6.5	6.4	6.3	7.2	6.4	6.3	6.7	6.0	5.4	5.6	4.4	5.1	6.2	4.0	4.0	7.5	6.3	5.4	6.0	6.3	5.6	5.9
SRX 8500	5.3	6.6	5.8	5.4	5.5	6.0	6.2	6.4	6.0	7.5	6.0	5.9	5.2	4.9	5.1	6.4	4.6	4.7	7.6	6.5	5.8	5.5	6.3	5.9	5.9
* BULLDAWG (PICK GA-96)	5.4	6.6	5.8	5.7	5.3	6.0	6.1	6.6	6.3	7.6	6.6	5.6	4.9	4.6	5.4	5.9	4.4	4.9	7.6	6.5	5.2	5.8	6.3	5.7	5.9
ATF-253	4.8	6.6	5.8	6.3	6.2	5.8	7.1	6.1	6.6	7.1	6.7	5.4	5.2	4.5	5.1	5.7	4.8	4.9	7.3	6.5	5.1	5.4	6.1	5.6	5.9
* SAFARI	5.3	6.4	5.5	6.3	6.3	6.3	6.3	6.3	6.5	7.3	6.7	5.4	5.4	4.4	5.7	6.0	3.9	3.8	7.5	6.2	5.8	5.8	6.3	5.3	5.9
OFI-FWY	5.4	6.4	5.8	5.7	5.8	5.9	5.8	6.4	6.1	7.5	6.1	5.4	4.9	4.7	5.3	6.1	5.0	4.2	7.6	6.7	5.7	5.9	6.4	5.6	5.8
* FALCON II	4.8	6.3	5.7	6.1	6.0	6.1	5.7	6.3	6.6	6.9	6.9	5.2	5.6	4.3	5.3	6.4	4.3	4.4	7.6	6.5	5.2	6.1	6.1	5.9	5.8
* SHENANDOAH	5.3	5.8	5.4	6.5	6.3	6.1	6.3	6.2	6.1	7.5	6.4	5.2	5.6	4.1	5.3	6.5	4.1	4.1	7.2	6.4	5.4	6.0	6.3	5.6	5.8
WX3-275	5.4	6.4	5.6	6.3	5.7	6.0	6.9	6.3	6.4	7.5	5.3	5.8	5.7	4.6	5.5	5.4	5.3	4.1	7.6	6.3	4.9	5.4	6.2	5.5	5.8
* RENEGADE	4.9	6.2	6.0	6.0	6.4	5.8	6.0	6.0	6.2	7.2	6.3	5.6	5.2	4.6	5.7	6.2	3.9	4.3	7.6	6.7	5.3	6.2	6.3	5.5	5.8

TABLE 1. (CONT'D)

MEAN TURFGRASS QUALITY RATINGS OF TALL FESCUE CULTIVARS
GROWN IN FULL SUN AT TWENTY-FOUR LOCATIONS IN THE U.S.
1999 DATA
TURFGRASS QUALITY RATINGS 1-9; 9=IDEAL TURF

NAME	AR1	CA1	CA3	GA1	IA1	IL1	IL2	IN1	KS2	KY1	MD1	ME1	MI1	MO1	MO3	NE1	NJ1	NJ2	OH1	OK1	UT1	VA1	VA4	WA1	MEAN
* VELOCITY (AA-983)	5.6	6.3	5.7	5.9	4.8	5.6	6.8	6.3	6.5	7.0	5.8	5.9	5.7	4.6	5.9	6.5	3.8	4.0	7.7	6.3	5.2	6.1	6.1	5.9	5.8
* TOMAHAWK-E	4.8	6.5	6.0	5.8	5.1	6.3	6.1	6.2	6.3	7.1	6.7	5.7	4.8	4.5	5.8	6.2	4.6	3.8	7.4	6.5	5.7	6.0	6.2	5.8	5.8
* MARKSMAN	5.4	5.9	5.3	5.8	6.1	6.0	6.4	5.9	6.0	6.7	5.7	5.8	6.5	4.4	5.0	6.4	4.1	4.4	7.4	6.5	6.1	5.8	6.1	5.8	5.8
EA 41	5.4	6.5	5.6	5.3	5.6	6.0	5.9	6.3	6.4	7.1	6.0	5.7	5.3	4.8	6.0	5.3	4.8	4.8	7.7	6.7	4.4	5.7	6.0	6.0	5.8
* COCHISE II	5.7	6.6	5.6	6.4	5.3	6.0	6.5	6.4	6.2	6.8	6.2	5.4	5.2	4.5	5.2	5.9	4.4	4.3	7.4	6.5	5.0	5.7	6.1	5.8	5.8
ATF-022	5.5	6.5	5.4	6.0	5.8	5.9	6.4	6.2	6.5	6.8	6.3	5.7	5.2	4.4	5.3	6.3	3.9	4.3	7.3	6.3	5.6	6.0	5.9	5.4	5.8
ISI-TF10	5.4	6.1	5.8	6.0	5.3	5.6	5.9	6.2	6.2	7.5	5.5	5.7	5.8	4.7	5.3	5.4	4.9	4.1	7.3	6.7	5.4	6.0	6.2	5.8	5.8
* ARABIA (J-5)	5.4	6.4	6.0	5.1	5.1	5.8	5.8	6.6	6.1	7.3	5.6	5.4	5.6	4.5	5.1	5.7	5.1	4.4	7.9	6.6	5.3	5.4	6.3	6.0	5.8
PICK FA 15-92	5.4	6.7	5.8	5.5	5.6	6.2	6.2	6.5	6.0	6.8	4.8	4.8	5.6	4.7	5.7	6.1	5.2	4.6	7.4	6.5	5.3	4.9	6.1	6.1	5.8
* FINELAWN PETITE	4.4	6.1	5.7	6.5	5.7	5.9	5.9	6.1	6.2	7.3	6.2	5.2	5.7	3.9	5.3	5.5	4.6	4.2	7.4	6.7	5.5	6.3	6.1	5.8	5.7
* ARIZONA (PICK FA 6-91)	5.4	6.5	5.6	5.3	4.8	5.5	6.4	6.5	6.3	6.5	6.1	5.7	5.0	4.9	5.8	5.7	4.0	4.3	7.9	6.5	5.7	5.2	6.0	6.1	5.7
GLEN EAGLE (EC-101)	4.9	6.4	5.8	5.9	5.8	5.8	6.0	6.3	6.5	7.5	6.0	5.5	5.4	4.3	5.6	5.2	3.9	4.5	7.5	6.5	5.1	5.8	6.1	5.7	5.7
ATF-020	5.5	6.4	5.9	5.8	4.8	5.6	6.7	6.0	6.3	7.1	6.8	5.6	5.1	3.6	5.5	6.0	3.9	4.3	7.3	6.3	5.2	5.7	5.9	5.8	5.7
* PEDESTAL (PC-AO)	4.4	6.1	5.6	5.6	5.2	5.8	6.0	6.1	6.5	7.8	5.8	5.0	5.5	4.3	5.5	6.5	3.8	4.0	7.6	6.5	5.2	6.2	6.2	5.6	5.7
DP 50-9011	4.7	6.5	5.8	6.3	5.2	5.3	5.7	6.5	6.3	7.3	5.8	5.8	5.2	4.6	5.0	5.9	3.8	3.9	7.8	6.5	5.3	5.6	6.3	5.6	5.7
* LEPRECHAUN	4.8	6.2	5.9	6.2	5.8	5.9	5.5	5.9	6.1	6.8	6.3	5.4	5.2	4.4	5.0	5.8	3.9	4.2	7.4	6.2	5.8	6.0	6.1	5.7	5.7
* COMSTOCK (SSDE31)	5.0	6.0	5.5	6.0	5.6	5.8	5.7	6.1	6.2	7.3	6.1	5.8	5.3	4.3	5.1	5.1	4.3	4.2	7.2	6.3	5.3	6.1	6.2	5.8	5.7
OFI-96-32	4.8	6.1	5.5	6.3	5.6	5.9	6.2	5.6	6.3	7.2	6.2	5.3	5.3	4.2	4.8	5.5	3.9	4.5	7.7	6.4	4.8	6.1	6.1	5.7	5.7
PSII-TF-9	4.9	5.9	5.3	5.8	5.9	5.6	6.1	6.0	6.1	7.0	6.8	5.0	6.0	4.0	4.8	5.6	3.7	4.5	7.1	6.5	5.3	6.3	6.1	5.9	5.7
HELIX (WVPB-1D)	5.1	5.9	5.3	6.3	5.6	6.0	5.7	5.8	6.3	7.1	5.8	4.8	5.5	4.4	5.1	5.8	4.0	4.6	7.3	6.4	5.1	6.1	6.1	5.7	5.6
* EQUINOX (TMI-N91)	4.4	6.4	5.7	6.2	5.2	5.8	5.7	5.8	6.1	6.8	5.9	5.4	6.2	4.3	5.0	5.3	4.0	4.2	7.3	6.6	5.5	5.1	6.2	6.0	5.6
WVPB-1B	4.9	6.1	5.6	6.1	5.2	5.7	6.0	6.2	6.4	6.9	6.3	5.4	4.9	4.3	5.4	5.6	4.0	4.3	7.3	6.3	5.0	5.7	6.1	5.5	5.6
* SHORTSTOP II	5.0	6.6	6.0	4.8	5.6	5.5	5.6	6.2	6.3	6.9	5.5	4.6	4.9	4.2	5.5	6.4	4.6	4.5	7.7	6.2	5.1	5.1	6.1	5.9	5.6
* KITTY HAWK S.S.T. (SS45DW)	4.2	6.3	5.8	5.9	5.7	6.0	6.0	6.2	6.4	7.1	5.2	5.2	5.5	4.3	5.1	5.7	3.8	4.0	7.4	6.3	4.9	5.7	6.1	5.7	5.6
* GOOD-EN (KOOS 96-14)	4.7	5.7	5.1	5.2	5.3	5.6	5.9	5.4	6.3	7.0	7.1	5.2	5.7	4.3	4.8	5.2	4.5	4.7	7.3	6.3	5.0	6.2	6.1	5.7	5.6
SRX 8084	4.5	6.5	5.7	5.9	5.9	5.9	6.1	5.7	6.3	7.3	5.5	5.2	5.5	4.1	4.9	5.9	3.5	4.0	7.2	6.3	5.3	5.4	6.1	5.6	5.6
* WPEZE (WVPB-1C)	4.7	5.7	5.0	5.7	6.1	5.7	5.6	5.8	6.4	7.3	6.7	5.1	5.5	4.0	5.1	4.9	3.4	4.3	7.0	6.3	5.0	6.2	6.1	5.6	5.6
* TITAN 2	4.8	5.7	5.0	6.1	6.8	5.9	6.0	6.0	6.2	7.0	6.7	5.1	5.0	4.0	4.8	5.9	3.5	3.6	6.9	6.1	4.6	5.8	6.2	5.2	5.5
* AXIOM (ATF-192)	4.6	6.1	5.7	5.7	5.5	5.5	6.2	5.8	6.3	6.0	6.3	5.1	5.3	4.5	4.9	5.3	3.4	4.2	7.2	6.4	5.4	5.9	6.2	5.3	5.5
PSII-TF-10	4.6	6.1	5.2	5.5	5.1	5.6	5.9	5.7	6.1	6.9	6.0	5.3	5.3	4.0	5.1	5.7	4.2	4.1	7.2	6.3	5.1	5.4	6.1	5.9	5.5
JSC-1	3.9	5.9	5.4	5.6	5.7	5.7	5.1	5.8	6.1	7.2	6.4	5.3	4.9	3.8	5.4	5.9	3.6	3.9	7.3	6.3	5.5	5.8	6.0	5.5	5.5
JTTFC-96	4.6	6.2	5.4	6.3	5.7	5.5	5.7	6.1	6.0	7.3	6.2	4.9	5.2	4.2	4.6	5.8	3.0	3.9	7.2	6.0	5.4	5.6	6.1	4.9	5.5
PICK FA UT-93	5.1	6.4	5.8	4.8	4.5	5.0	5.3	6.4	6.2	7.2	5.2	5.6	4.7	4.4	5.3	5.8	4.0	4.2	7.6	6.4	5.3	4.8	5.8	5.7	5.5
* BONSAI	4.2	6.1	6.0	5.5	5.2	5.8	5.7	6.2	6.2	6.6	5.5	5.0	5.7	4.3	5.4	5.4	3.3	3.8	7.2	6.2	5.2	5.4	5.8	5.4	5.5
JTTFA-96	4.1	6.0	5.5	5.9	5.4	5.4	5.5	6.3	4.5	6.5	6.1	4.6	5.3	3.3	4.9	5.9	3.2	4.0	7.1	5.9	5.2	5.8	6.1	5.0	5.3
DLF-1	4.1	5.5	4.7	5.8	5.5	5.2	5.1	5.4	6.3	6.4	5.5	4.6	4.6	4.1	4.8	5.3	2.7	3.1	7.0	6.0	4.9	5.5	6.0	5.0	5.1
* ARID	3.9	5.3	5.1	6.1	6.1	4.9	5.2	5.6	5.5	6.4	6.5	4.4	5.2	3.5	4.1	5.5	2.5	2.4	6.6	5.7	5.1	5.6	5.9	4.7	5.1
DP 7952	3.4	5.2	4.3	4.9	6.2	4.9	4.6	5.8	5.6	5.9	6.1	4.9	5.4	4.0	4.3	4.8	2.1	3.1	6.7	5.8	4.8	5.2	5.7	4.9	4.9
AV-1	3.2	5.3	4.8	4.9	5.6	5.1	4.4	5.0	5.4	6.0	5.3	4.5	5.2	3.8	4.3	5.0	2.1	3.0	6.9	6.1	5.0	5.4	5.9	5.0	4.9
* KENTUCKY-31 W/ENDO.	2.9	3.1	4.0	5.7	5.3	3.9	3.3	2.9	4.2	4.6	3.8	3.3	5.6	4.0	2.5	3.3	1.2	1.0	5.2	4.9	3.7	4.1	4.8	3.7	3.8
LSD VALUE	1.0	0.4	0.6	1.1	1.2	0.6	1.0	0.4	0.4	0.6	1.2	0.7	1.1	0.6	0.7	0.7	1.1	0.8	0.5	0.4	1.1	0.8	0.3	0.4	0.2
C.V. (%)	11.3	4.4	6.0	10.3	12.6	6.1	9.8	3.5	4.3	4.9	11.7	8.0	11.9	8.4	7.9	7.7	14.8	10.6	4.1	3.6	12.3	9.0	3.2	4.1	8.2

* COMMERCIALLY AVAILABLE IN THE USA IN 2000.

1/ TO DETERMINE STATISTICAL DIFFERENCES AMONG ENTRIES, SUBTRACT 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).

2/ C.V. (COEFFICIENT OF VARIATION) INDICATES THE PERCENT VARIATION OF THE MEAN IN EACH COLUMN.

EFFECTS OF CULTURAL PRACTICES ON A PUTTING GREEN UNDER SIMULATED TRAFFIC

Stephen T. Cockerham[1], Steven B. Ries[1], and Victor A. Gibeault[2]
[1]*Agricultural Operations, University of California, Riverside, CA 92521-0124*
[2]*Dept. of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124*

A study is being conducted to investigate the effect of selected cultural practices on putting green traffic tolerance. The amount of foot traffic that putting greens receive varies widely, with areas of individual greens on every golf course receiving more than the rest. Managing for traffic is a challenge for turf managers and which cultural practices increase the traffic tolerance and which decrease it would be a useful tool.

Fertilizing with N and K, aerifying, and vertical mowing are practices commonly followed on golf courses. Each of these may have an effect on traffic tolerance and in combination may contribute in a different manner.

A sand root-zone putting green was seeded in June 1999 with 'Cobra' creeping bentgrass (*Agrostis palustris* var. 'Cobra'). Treatments began on July 5, 2000. Treatments are replicated four times in a random complete block design. Evaluations will be visual turf scores, root mass, and total biomass. The study is to be conducted for two years.

Traffic is applied with a self-propelled golf-traffic simulator. The traffic simulator is constructed of differential slip rollers textured with scarified steel hemispheres (notched carriage bolt heads). Traffic is applied to the entire block of plots at the equivalent rate of 225 rounds per day three times per week.

Cultural Treatments

1. N = 8.0 lb./M/yr.
2. K = 8.0 lb./M/yr
3. NK = (8.0 + 8.0)/M/yr
4. Core cultivate (cc) = 3X/yr
5. N+cc = (8.0 lb. + 3X)/yr
6. K+cc = (8.0 lb. + 3X)/yr
7. NK+cc = (8.0 lb. + 8.0 lb. + 3X)/yr
8. Vertical mow (vm) = 3X/yr
9. N+vm = (8.0 lb. + 3X)/yr
10. K+vm = (8.0 lb. + 3X)/yr
11. NK+vm = (8.0 lb. + 8.0 lb. + 3X)/yr
12. cc+vm = (3X + 3X)/yr
13. N+cc+vm = (8.0 lb. + 3X + 3X)/yr
14. K+cc+vm = (8.0 lb. + 3X + 3X)/yr
15. NK+cc+vm = (8.0 lb. + 8.0 lb. + 3X + 3X)/yr
16. Untreated control (with traffic)

N K	N K vm	K vm	N vm cc	N	K vm cc	N K cc	control
vm	K	N K vm cc	K cc	vm cc	N vm	N cc	cc
K vm	vm	N vm	N K vm	K vm cc	vm cc	N vm cc	N cc
cc	control	N K cc	K	N	N K vm cc	N K	K cc
N K	N vm	N K cc	K cc	N	vm	N vm cc	K vm cc
K vm	vm cc	N K vm cc	N cc	control	N K vm	K	cc
vm cc	N K vm cc	N K cc	N vm	vm	cc	K cc	N vm cc
N K vm	control	K	N cc	K vm cc	K vm	N K	N

OVERSEEEDING GRASS VARIETY TRIAL

J. Michael Henry[1], Robert L. Green[2], Jeff Place[3], Nancy Dickens[4], and Cary Lee[5]

[1]University of California Cooperative Extension, Riverside and Orange Counties
21150 Box Springs Road, Moreno Valley, CA 92557-8708
[2]Dept. of Botany and Plant Sciences, University of California, Riverside, CA, 92521-0124
[3]College of the Desert, Palm Desert, CA.
[4]Mountain Vista Golf Course, Palm Desert, CA
[5]Desert Wells Golf Course, Palm Desert, CA.

Introduction:
This preliminary information is a summary of the results from the first year of a two-year study to evaluate grasses for winter overseeding of golf course fairways. This study location is one of ten across the "sunbelt" region of the United States. The purpose of this evaluation is to determine the new grass cultivars that are best suited to the low-elevation desert region of southern California (the Coachella Valley) and similar climatic zones. Besides rating the overall quality of the turfgrass stand monthly, individual ratings for overseed establishment, color, and percent cover were taken at appropriate times during the ten month study period.

Methods and Materials:
Forty-two overseed cultivar treatments were seeded into prepared 'Tifgreen' hybrid bermudagrass fairways at the Mountain Vista Golf Course at Sun City, Palm Desert, CA. on October 1, 1999. These treatments were duplicated in three groups (replicates) on two fairways. Each treatment plot measured 5' x 20' with two foot aisles between plots. The aisles and surrounding fairway was overseeded with the course overseed mix.

The treatments included: individual perennial ryegrass cultivars, individual intermediate ryegrass cultivars, individual annual ryegrass cultivars, perennial ryegrass blends, and perennial ryegrass + intermediate ryegrass mixtures [seeded @ 600 lbs./A]; individual *Poa trivialis* cultivars [seeded a 200 lbs/A]; and individual perennial ryegrass cultivars or perennial ryegrass blends + *Poa trivialis* mixtures (85% perennial ryegrass + 15% *Poa trivialis*) [seeded at 400 lbs./A]. Normal fairway maintenance and management was preformed on the trial areas which were located in play, but out of primary landing areas on par four holes.

Visual ratings were made on a regular schedule with three or four evaluators contributing. A numerical rating scale from 1 to 9 was used with 9 = to perfect or the highest performance and 1 = to dead or the lowest possible rating for particular evaluations. Continuous soil and air temperature readings were collected over the period of the ten-month study. Soil and irrigation water analyses were made on the study site as well.

Results and Conclusions:
Preliminary results and conclusions should be taken with the understanding that weather conditions differ from year to year and they can have an impact on the performance of some treatments. The evaluation team generally agreed that the weather conditions were close to ideal during this first year.

Ratings were grouped by season; fall transition from bermudagrass to overseed species, winter season and spring transition from overseed species back to growing bermudagrass.

In general, the perennial ryegrasses outperformed the annual rye by a wide margin at all seasons of the trial. The *Poa trivialis* cultivars were very slow to establish compared to perennial ryes. They gave lower turf quality ratings in the winter season, but gave equal quality during the spring transition and out lasted the perennial ryes in late spring and into summer. This was an unexpected outcome for *Poa trivialis* as this species is generally considered to have very low heat tolerance.

The following three tables rank the top ten species for selected dates during the fall, winter and spring. These data will be averaged over each season in the final report. Note that species not listed are not necessarily inferior to the ones mentioned and final choices should be made after complete evaluation data are available. Cultivars listed within tables are statistically equal although their scores are different.

Table 1: 18 Nov. '99 rating date. Six weeks after seeding.

Cultivar	Species	Turf Quality Score
Brightstar II	P. rye	7.8
Seville II	P. rye	7.7
First Cut	Inter. Rye	7.7
Brightstar II + Winterplay	P. rye/Poa triv.	7.5
Barlennium	P. rye	7.3
Citation III	P. rye	7.3
MED-007	P. rye blend	7.3
Elfkin	P. rye	7.3
Phantom	P. rye	7.3

LSD, (at 95% level of significance) = 0.7
Note: nine unlisted cultivars were rated 7.2 and all are equal in quality to the highest rated grass from a statistical perspective.

Table 2: 10 Feb. 2000 rating date. Middle of winter period.

Cultivar	Species	Turf Quality Score
Tourstar	P. rye	7.5
Professional's Select	P. rye blend	7.3
Elfkin	P. rye	7.3
Brightstar II	P. rye	7.2
Charger	P. rye	7.2
Paragon	P. rye	7.2
MED-007	P. rye blend	7.2
Leaderboard	P. rye blend	7.2
Top Hat	P. rye	7.2

LSD, (at 95% level of significance) = 1.0
Note: 20 additional cultivar treatments fall into the top group being statistically equal to the # 1 ranked grass.

Table 3: 4 May 2000 rating date. This is about mid-transition between overseed species and bermudagrass. Plots on average were about 70% bermudagrass at this time in the transition period.

Cultivar	Species	Turf Quality Score
Professional Select	P. rye blend	6.8
Elfkin	P. rye	6.8
Mt. View Blend 2	P. rye blend	6.8
Cebeco Blend 1	P. rye blend	6.8
First Cut	Inter. rye	6.7
Winterplay	Poa triv.	6.7
Fiesta 3	P. rye	6.7
Futura 2500	P. rye + Inter. Rye	6.7
Seville II	P. rye	6.7
Prime	P. rye blend	6.7
Mt. View Blend 1	P. rye blend	6.7
Tourstar	P. rye blend	6.7
Marvelgreen Supreme	P. rye blend	6.7

LSD, (at 95% level of significance) = 1.0
Note: 29 additional cultivar treatments fall into the top group being statistically equal to the # 1 ranked grass.

Acknowledgements:
Co-sponsors of this project include the National Turfgrass Evaluation Program, Golf Course Superintendents Association of America, United States Golf Association, U.C. Riverside Turfgrass Research Program, U.C. Cooperative Extension - County of Riverside, College of the Desert.

The research team and co-sponsors wish to acknowledge the contributions and support of the Mountain Vista Golf Course Staff and the Del Webb Corp. Sun City - Palm Desert, California for the test site maintenance and study plot management. Major contributions in time, labor and equipment were provided by UCR Turf Research Lab Staff and College of the Desert Turf Program Students.

HERBICIDE SELECTIVITY AND TOLERANCE

David W. Cudney[1] and Clyde L. Elmore[2]
[1]University of California, Dept. of Botany and Plant Sciences, Riverside, CA 92521-0124
[2]University of California, Dept. of Vegetable Crops, Weed Science Program, Davis, CA 95616

The first herbicides to be developed and used in turf were toxic salts, oils or acids that completely burned all foliage and cleared the area of existing weeds for replanting. New turf was planted and maintained for a few years until it became too weedy again and then the process was repeated. According to University of California Circular 97, published in 1937, spot treatments for weed control were made with gasoline, diesel oils, carbon disulfide, sulfuric acid, and sodium arsenite. The treated areas then were replanted to adapted turf cultivars. Today, better turf cultivars and cultural techniques allow turf to be more competitive with weeds and do a lot towards limiting weed invasion. When weeds do become established, we have over 25 common pre and postemergence, "selective" herbicides that can be used to remove these unwanted invaders from turf without significantly injuring the turf.

Selectivity is the process that allows herbicides to be toxic to weedy species and not kill desirable species such as turf. Selectivity is achieved in many ways. It may be achieved because the turf species do not absorb or transport the herbicide and weeds do, because turf metabolizes and detoxifies the herbicide and weeds do not, or because important metabolic processes are blocked in weeds and not in turf. In some crops like orchards and vines selectivity is often achieved by applying the herbicide only to the weed and avoiding the crop. This is usually not possible in turf. Selectivity is not absolute; turf can be injured by herbicides if herbicide factors or turf conditions are not right. Selectivity can vary with rate of herbicide application, herbicide formulation, turf stress, turf growth stage, and turf type.

Preemergence herbicides kill weeds early in their growth cycles usually before or shortly after emergence. Selectivity in turf is often gained because the turf species is well established and not in vulnerable state for these herbicides but this can change with:

Rate of application: too high and selectivity is decreased and stunting or stand loss of turf can occur – too low and weeds may survive.

Formulation: some formulations of certain herbicides are not appropriate in turf (e.g. oxadiazon wettable powder formulations can injure turf, granular formulations of oxadiazon generally do not).

Placement of herbicide in soil: if herbicide goes too deep, shallow germinating weeds may be missed and herbicide is concentrated in the rooting area of the turf.

Soil texture: preemergence herbicides are more active in sandy, light textured soils, low in organic matter. This has the same affect as high rate of application. To avoid turf injury reduced rates of application are generally recommended on these soils – consult labels for proper rate of application as related to soil.

Stage of growth: Turf should be well established to avoid injury from most of the preemergence herbicides (the exception would be siduron which can be applied to newly established cool-season turf). Weeds are most often controlled before emergence. If weeds have already germinated, control will be poor (there are a few exceptions – dithiopyr and small emerged

crabgrass and pronamide and emerged annual bluegrass in bermudagrass turf, but most often preemergence means just that – before the weeds are present).
Stress: Poor growing conditions, disease, insects, nematodes, and moisture or nutrient deficiency can interact with herbicides to reduce selectivity and injure turf. Avoid herbicide application to stressed turf.

Postemergence herbicides kill weeds after they emerge and are most effective on annual weeds when they are small seedlings. They are most effective on perennial weeds after they first emerge from seeds, before they have a perennial habit and (in the case of translocated herbicides) when they are transporting photosynthate to their growing points and storage structures. Selectivity may be based on many factors including differences in absorption, transport within the plant, and metabolic differences within the plants. Selectivity can be affected by:

Rate of application: to high and the ability of the turf to overcome the effects of treatment might be overcome. One lb. ai/a of 2,4-D amine applied to turf would normally have little effect on most turf species, whereas 4 lbs. of 2,4-D amine might severely stunt turf growth and reduce stand.

Formulation: Postemergence herbicides may be formulated with or without adjuvants to increase their activity (e.g. MSMA is generally formulated with a wetting agent which increases its absorption into plants and at high rates of application reduces its selectivity in turf). Chemical formulations of the active ingredient may vary in their activity (e.g. the ester formulation of triclopyr is more active than the amine formulation).

Stress: Poor growing conditions, high or low temperatures, disease, insects, nematodes, and moisture or nutrient deficiency can interact with herbicides to reduce selectivity and injure turf. Avoid all herbicide applications to stressed turf.

Stage of growth: Turf should be well established to avoid injury from most postemergence herbicides. Annual weeds or perennial weeds germinating from seed should be small and rapidly growing (not under stress). Established perennial weeds are difficult to control with "contact" herbicides such as bromoxynil. Translocated herbicides such as triclopyr and dicamba are most effective on established perennials when they are actively growing and transporting photosynthate to their growing points and storage structures.

Spray coverage: Thorough spray coverage is necessary for "contact" herbicides such as bromoxynil. Translocated herbicides such as 2,4-D and clopyralid also require good coverage, but it is not necessary to thoroughly cover each leaf. Where weed and turf growth is dense, some weeds may escape spray contact necessitating re-treatment. Where weed density is high, weed growth may screen turf foliage from herbicide treatment further increasing turf selectivity. When using herbicides always fallow all label recommendations.

Selectivity is a wonderful concept that allows turf managers to use herbicides to remove unwanted vegetation from turf without significant injury. The result is improved turf quality without the need for complete turf renovation (weed removal and replanting the turf). The following four tables were taken from the March 2000 edition of the UC IPM Guidelines for Turfgrass. The entire publication is available at the University of California Cooperative Extension office (Farm Advisor's Office) in each County. The first two tables relate the sensitivity of the common turf species to both preemergence and postemergence herbicides. The second two tables relate the sensitivity of the common annual and perennial turf weeds to both preemergence and postemergence herbicides.

UC IPM PEST MANAGEMENT GUIDELINES –TURFGRASS

SENSITIVITY OF TURF SPECIES TO HERBICIDES (Reviewed: 3/00, updated: 3/00)

TABLE 1.	PREEMERGENCE														
TURF SPECIES	**ATR**	**BEN**	**BES**	**DCP**	**DIT**	**ISO**	**NAP**	**ORY**	**OXA**	**PEN**	**PRD**	**PRO***	**SID**	**BEN ORY**	**BEN TRI**
bentgrasses	s	s	T	r	r	-	s	s	s	s	s	s	r	s	r
bermudagrass, common	r	T	T	T	T	T	T	R	T	T	T	T	T	t	T
bermudagrass, hybrid	r	T	T	T	T	T	t	r	T	T	T	T	T	T	T
bluegrass, Kentucky	s	T	T	T	T	T	r	s	T	R	R	s	T	s	T
dichondra	s	s	T	s	-	-	T	t	s	t	r	r	-	t	t
fescue, fine	s	T	T	T	R	-	T	s	T	T	T	s	T	s	T
fescue, tall	s	T	T	T	T	T	t	s	T	T	T	s	T	s	T
kikuyugrass	-	t	t	t	-	-	r	-	r	r	t	-	-	-	-
ryegrasses	s	T	T	T	-	T	r	s	R	r	T	s	T	s	T
St. Augustinegrass	t	T	T	T	-	T	s	T	R	-	-	s	-	T	T
zoysiagrass	T	T	T	T	-	T	r	s	R	R	T	s	-	T	T

UPPER CASE LETTERS = Registered for this turf species in California

TABLE 2.	POSTEMERGENCE																
TURF SPECIES	**BTZ**	**BRO**	**CLO**	**DIC***	**DSM**	**FLU**	**GLY**	**HAL**	**MEC**	**MSM**	**PRO***	**TRY**	**24A***	**24E***	**24D* MEC**	**24D* MEC DIC***	**24D* TRY**
bentgrasses	r	r	t	R	r	s	s	T	T	s	s	s	r	s	s	R	s
bermudagrass, common	T	T	t	T	T	s	s	T	T	T	T	r	T	T	T	T	r
bermudagrass, hybrid	T	T	t	T	T	r	s	T	T	T	T	s	T	T	T	T	r
bluegrass, Kentucky	T	T	t	T	T	s	s	T	T	R	s	T	T	T	T	T	T
dichondra	s	s	T	s	r	T	s	-	s	s	r	s	s	s	s	s	s
fescue, fine	T	T	t	T	T	T	s	T	T	T	s	T	T	T	T	T	T
fescue, tall	T	T	t	T	T	s	s	T	T	t	s	T	T	T	T	T	T
kikuyugrass	-	t	-	r	r	s	s	-	r	s	-	s	t	r	t	t	s
ryegrasses	T	T	t	T	T	s	s	T	t	T	s	T	T	T	T	T	T
St. Augustinegrass	T	R	-	s	s	-	s	T	t	s	s	s	s	s	r	s	s
zoysiagrass	T	t	t	R	R	s	s	T	r	T	s	s	r	s	r	r	s

RATINGS LEGEND

S = sensitive	R = relatively tolerant	T = tolerant	- = no information

UPPER CASE LETTERS = Registered for this turf species in California

CHEMICAL LEGEND

ATR = atrazine (Drexel Atrazine)
BEN = benefin (Balan)
BES = bensulide (Presan)
BRO = bromoxynil (Buctril)
BTZ = bentazon (Basagran)
CLO = clopyralid (Stinger, Lontrel)
DCP = DCPA (Dacthal W-75 for Turf)
DIC = dicamba* (Banvel 4-S)
DIT = dithiopyr (Dimension)
DSM = DSMA (Methar)
FLU = fluazifop (Fusilade 2000)
GLY = glyphosate (Roundup)
HAL = halosulfuron (Manage)
ISO = isoxaben (Gallery)
MEC = mecoprop (MCPP)
MSM = MSMA
NAP = napropamide (Devrinol)
ORY = oryzalin (Surflan)
OXA = oxadiazon (Ronstar)
PEN = pendimethalin (Pre-M, Pendulum)
PRD = prodiamine (Barricade)
PRO = pronamide* (Kerb)
SID = siduron (Tupersan)
TRI = trifluralin (Team 2G)
TRY = triclopyr (Turflon)
24A = 2,4-D amine*
24D = 2,4-D*
24E = 2,4-D ester*

COMMENTS: * Permit required from county agricultural commissioner for purchase or use.

SUSCEPTIBILITY OF WEEDS TO HERBICIDE CONTROL **(Reviewed: 3/00, updated: 3/00)**

TABLE 3.	PREEMERGENCE														
ANNUAL WEEDS	**ATR**	**BEN**	**BES**	**DCP**	**DIT**	**ISO**	**NAP**	**ORY**	**OXA**	**PEN**	**PRD**	**PRO***	**SID**	**BEN ORY**	**BEN TRI**
barnyardgrass	C	C	C	C	C	N	C	C	P	C	C	C	C	C	C
bluegrass, annual	C	C	C	C	C	N	C	C	C	C	C	C	N	C	C
burclover, California	C	N	N	N	-	C	C	P	C	P	P	N	N	P	P
chickweed, common	C	P	N	P	C	C	C	C	N	C	C	C	N	C	C
crabgrass, large	P	C	C	C	C	N	C	C	C	C	C	C	C	C	C
crabgrass, smooth	P	C	C	C	C	N	C	C	C	C	C	C	C	C	C
cudweed	C	N	N	N	-	C	N	N	N	N	N	N	N	N	N
filarees	P	N	N	P	-	C	C	P	C	N	N	N	-	C	C
foxtail, yellow	P	C	C	C	C	N	C	C	C	C	C	C	C	C	C
geranium, cutleaf	-	-	N	N	P	C	-	C	-	C	C	-	N	C	C
goosegrass	P	P	C	P	P	N	P	C	P	C	C	P	P	C	C
henbit	C	N	N	N	P	C	N	P	C	P	P	-	-	C	C
knotweed, prostrate	C	C	N	P	C	C	C	C	C	C	C	C	-	C	C
lettuce, prickly	C	N	N	N	-	C	P	P	C	P	P	N	-	P	P
mallow, little (cheeseweed)	C	N	N	N	-	-	P	P	C	P	P	P	N	P	P
medic, black	C	N	N	N	-	C	N	N	N	N	N	N	N	N	N
oxtongue, bristly	N	N	N	N	-	C	N	N	N	N	N	N	N	N	N
pearlwort, birdseye	-	P	N	-	-	C	-	C	N	C	-	-	-	C	C
pigweed, redroot	C	C	C	P	P	C	C	P	C	P	C	C	-	P	P
pimpernel, scarlet	C	C	N	C	-	C	C	C	C	C	C	-	-	C	C
purslane, common	C	C	N	C	C	C	C	C	C	C	C	C	-	C	C
ryegrass, Italian	P	C	C	P	C	N	P	C	N	C	C	C	-	C	C
soliva (spurweed)	C	N	N	N	-	-	C	P	C	P	P	N	-	P	P
speedwell, Persian	-	C	N	P	-	C	-	C	-	C	C	-	-	C	C
spurge, spotted	C	N	N	P	C	C	N	C	P	C	P	N	-	C	C
swinecress	-	N	N	N	-	-	C	-	-	P	-	N	-	-	-
PERENNIAL WEEDS															
bermudagrass	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
bindweed, field	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
catsear, common	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N
chickweed, mouseear	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N
clover, white	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N
daisy, English	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
dallisgrass	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
dandelion	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
dock, curly	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
healall (selfheal)	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
kikuyugrass	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
knotgrass	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
kyllinga, green	P	C	C	C	C	C	C	C	C	C	C	P	-	C	C
nutsedge, purple	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
nutsedge, yellow	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
plantain, broadleaf	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
plantain, buckhorn	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
red sorrel	P	N	N	N	N	N	N	N	N	N	N	N	N	N	N
smutgrass	C	C	N	P	C	C	C	C	C	C	C	C	-	C	C

RATINGS LEGEND

C = control P = partial control N = no control - = no information

CHEMICAL LEGEND

ATR = atrazine (Drexel Atrazine)
BEN = benefin (Balan)
BES = bensulide (Presan)
DCP = DCPA (Dacthal W-75 for Turf)
DIT = dithiopyr (Dimension)
ISO = isoxaben (Gallery)
NAP = napropamide (Devrinol)
ORY = oryzalin (Surflan)
OXA = oxadiazon (Ronstar)
PEN = pendimethalin (Pre-M, Pendulum)
PRD = prodiamine (Barricade)
PRO = pronamide* (Kerb)
SID = siduron (Tupersan)
TRI = trifluralin (Team 2G)

COMMENTS

* Permit required from county agricultural commissioner for purchase or use.

SUSCEPTIBILITY OF WEEDS TO HERBICIDE CONTROL **(Reviewed: 3/00, updated: 3/00)**

TABLE 4.	POSTEMERGENCE																
ANNUAL WEEDS	**BTZ**	**BRO**	**CLO**	**DIC***	**DIT**	**DSM**	**FLU**	**GLY**	**HAL**	**MEC**	**MSM**	**TRY**	**24A***	**24E***	**24D* MEC**	**24D* MEC DIC***	**24D* TRY**
barnyardgrass	N	N	N	N	-	N	C	C	N	N	C	N	N	N	N	N	N
bluegrass, annual	N	N	N	N	P	N	N	C	N	N	N	N	N	N	N	N	N
burclover, California	-	N	C	C	-	N	N	C	N	C	N	P	P	P	C	C	C
chickweed, common	-	P	C	C	-	N	N	C	N	C	N	P	P	C	C	C	C
crabgrass, large	N	N	N	N	C	C	C	C	N	N	C	N	N	N	N	N	N
crabgrass, smooth	N	N	N	N	C	C	C	C	N	N	C	N	N	N	N	N	N
cudweed	N	N	-	C	-	N	N	C	N	C	N	-	N	P	P	P	P
filarees	-	C	P	C	-	P	P	P	-	-	N	-	C	C	C	C	C
foxtail, yellow	N	N	N	N	-	-	P	C	N	N	-	N	N	N	N	N	N
geranium, cutleaf	-	-	-	C	-	N	N	C	N	C	N	C	C	C	C	C	C
goosegrass	N	N	N	N	-	N	C	C	N	N	C	N	N	N	N	N	N
henbit	C	-	C	C	-	N	N	C	N	C	N	-	P	C	C	C	C
knotweed, prostrate	-	-	-	C	-	N	N	P	N	C	N	-	P	C	C	C	C
lettuce, prickly	-	C	-	C	-	N	N	C	N	C	N	-	C	C	C	C	C
mallow, little (cheeseweed)	-	C	C	C	-	N	N	P	N	C	N	-	C	C	C	C	C
medic, black	-	N	C	C	-	N	N	P	N	C	N	C	P	P	C	C	C
oxtongue, bristly	-	N	C	C	-	N	N	C	N	C	N	P	C	C	C	C	C
pearlwort, birdseye	-	-	-	C	-	N	N	C	-	C	N	-	-	-	-	C	-
pigweed, redroot	C	C	-	C	-	N	N	C	-	C	N	C	C	C	C	C	C
pimpernel, scarlet	-	-	-	C	-	N	N	C	-	C	N	C	C	C	C	C	C
purslane, common	C	C	-	C	-	N	N	C	-	C	N	C	C	C	C	C	C
ryegrass, Italian	N	N	N	N	-	N	C	P	-	N	N	N	N	N	N	N	N
soliva (spurweed)	-	C	C	P	-	N	N	C	-	C	N	-	C	C	C	C	C
speedwell, Persian	-	-	-	-	-	N	N	C	-	-	-	N	N	N	P	P	N
spurge, spotted	-	C	-	P	-	N	N	C	-	P	N	C	P	P	P	P	C
swinecress	-	C	-	P	-	N	N	C	-	N	-	-	N	N	P	P	P
PERENNIAL WEEDS																	
bermudagrass	N	N	N	N	N	N	C	C	N	N	N	N	N	N	N	N	N
bindweed, field	N	N	N	P	N	N	N	P	N	N	N	P	P	P	P	C	P
catsear, common	N	N	C	C	N	N	N	C	N	P	N	-	C	C	C	C	C
chickweed, mouseear	N	N	C	C	N	N	N	C	N	C	N	-	P	P	C	C	C
clover, white	N	N	C	C	N	N	N	P	N	C	N	C	P	P	C	C	C
daisy, English	N	N	P	P	N	N	N	C	N	N	N	N	N	N	N	P	P
dallisgrass	N	N	N	N	N	C	P	C	N	N	C	N	N	N	N	N	N
dandelion	N	N	C	P	N	N	N	C	N	P	N	P	C	C	C	C	C
dock, curly	N	N	-	C	N	N	N	C	N	N	N	C	P	P	P	P	C
healall (selfheal)	N	N	-	P	N	N	N	C	N	-	N	P	N	N	N	C	P
kikuyugrass	N	N	N	N	N	P	C	C	N	N	P	N	N	N	N	N	N
knotgrass	N	N	-	N	N	N	C	C	N	N	N	N	N	N	N	N	N
kyllinga, green	N	N	N	N	N	P	N	C	P	N	P	N	N	N	N	N	N
nutsedge, purple	N	N	N	N	N	N	N	P	C	N	P	N	N	N	N	N	N
nutsedge, yellow	P	N	N	N	N	P	N	P	C	N	P	N	N	P	N	N	N
plantain, broadleaf	N	N	C	P	N	N	N	C	N	P	N	P	C	C	C	C	P
plantain, buckhorn	N	N	C	P	N	N	N	C	N	P	N	P	C	C	C	C	P
red sorrel	N	N	C	C	N	N	N	C	N	N	N	-	N	N	P	C	P
smutgrass	-	-	-	C	-	N	N	P	N	C	N	-	P	C	C	C	C
velvetgrass, German	N	N	N	N	N	N	P	C	N	N	N	N	N	N	N	N	N
woodsorrel, creeping	N	N	N	N	N	N	N	C	N	P	N	C	N	N	N	P	C
yarrow, common	N	N	-	C	N	N	N	C	N	P	N	-	P	C	P	C	P

RATINGS LEGEND

C = control   P = partial control   N = no control   - = no information

CHEMICAL LEGEND

BRO = bromoxynil (Buctril)
BTZ = bentazon (Basagran)
CLO = clopyralid (Stinger, Lontrel)
DIC = dicamba* (Banvel 4-S)
DIT = dithiopyr (Dimension)
DSM = DSMA (Methar)
FLU = fluazifop (Fusilade 2000)
GLY = glyphosate (Roundup)
HAL = halosulfuron (Manage)
MEC = mecoprop (MCPP)
MSM = MSMA
TRY = triclopyr (Turflon)
24A = 2,4-D amine*
24E = 2,4-D ester*

COMMENTS: *Permit required from county agricultural commissioner for purchase or use.

LANDSCAPE MANAGEMENT RESEARCH CONFERENCE AND FIELD DAY

WEDNESDAY, SEPTEMBER 13, 2000

SPONSORED BY:

UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

UNIVERSITY OF CALIFORNIA, RIVERSIDE, DEPT. OF BOTANY & PLANT SCIENCES

UNIVERSITY OF CALIFORNIA, RIVERSIDE, AGRICULTURAL OPERATIONS

LANDSCAPE MANAGEMENT RESEARCH CONFERENCE AND FIELD DAY
SEPTEMBER 13, 2000

TABLE OF CONTENTS AND CONFERENCE SCHEDULE

WEED MANAGEMENT IN GROUND COVERS

Clyde L. Elmore
University of California, Dept. of Vegetable Crops, Weed Science Program, Davis, CA 95616

Ground covers are ornamental plants that are used to develop masses of plant material in the landscape. These plants are used for color, erosion control, filler plants, and for weed control. Most ground covers are perennial and often they are woody or semi-woody plants. They may be very low growing (1 to 2 inches) to generally less than two feet in height. Periodically these plants are used around trees or shrubs or they may be planted in large areas. They do not work well as single plants because they spread and sometimes are invasive.

Weed management in ground covers starts with the correct site preparation before planting. The soil should be free of perennial weeds. If perennial weeds are present, they should be controlled before planting. This will reduce the amount of weeds (either growth from the perennial structures or from seedlings) in the new planting. It is critical to control weeds to reduce competition from them during the establishment period. This time period will vary by plant species and site, but often it is 2 to 6 months after planting. Once the ground cover is well established, the plants are usually competitive to annual weeds and weed control is less of a concern. If the cover is damaged and there are holes that allow light to reach the soil, then weeds will be a problem. Weeds are removed by hand pulling or hoeing within the first month after planting. Weeds should be removed when they are small, thus they do not compete with the ground covers. Mulches do not work well in most plantings if the ground cover is expected to root at the nodes to form a tight cover.

Preplant herbicides can be used to reduce the weed seedbank in the soil before planting. If the site is flat enough to be cultivated, one procedure that has been effective is to irrigate the site to germinate the weeds, then cultivate to kill them. This process can be done more than once to reduce the potential for large numbers of weeds. It is possible to germinate the weeds, then apply a post emergence herbicide to kill the weeds, without cultivating to bring weed seeds to the surface to germinate before planting. This is also a good time to eradicate clumps of perennial weeds.

Preemergence herbicides can be used in many ground covers after planting. Once the planting has been in the soil for 2 weeks, a preemergence can be used to kill emerging weeds. Often this one application may be enough to keep the weeds controlled until the planting is established. In some of the ornamental species that are slower to establish, a second weeding and application of a preemergence may be necessary. Hoeing around these young plants can sometimes damage the root system and slow establishment. Examples of herbicides that are useful in some ground cover species include: DCPA (Dacthal), napropamide (Devrinol), oryzalin (Surflan), pendimethalin (Pre-M, Pendulum), isoxaben (Gallery) and prodiamine (Barricade). Each ornamental species needs to be matched to the herbicide so that the plants are not injured. The two most commonly used herbicides seem to be oryzalin and pendimethalin. Also, the weed species need to be matched to the herbicide for the greatest control. Since each of these herbicides are selective on different ornamental species, it also should be noted that not all weeds will be controlled with any one herbicide. Sometimes herbicides are combined to give a broader spectrum of weed control.

There are few ways to control broadleaf weeds in ground covers using herbicides after the weeds have emerged. Grass weeds can be controlled selectively in most ground covers with sethoxydim (Poast), or fluazifop (Fusilade). Most grasses can be controlled except annual bluegrass and fine or hard fescues with these products. The nutsedge species (yellow and purple nutsedge) are not controlled with these treatments.

There are several new herbicides that have not been evaluated in ground covers. These herbicides are not registered on these crops. They do have research data on some other crops that they may be of value in ornamentals. The herbicides dithiopyr (Dimension), flumioxazin, clopyralid (Lontrel), and lactofen (Cobra) were evaluated in six ground cover species at Davis. Pendimethalin was added to the dithiopyr as a combination treatment. Herbicides were applied either preemergence over newly planted rooted plants or post emergence about 2 weeks after planting. The plants evaluated were *Hypericum calycinum*, *Hedera helix*, Gazania 'Copper King', *Aptenia cordifolia*, and *Myoporum parvifolia*.

The Gazania was injured severely with clopyralid at three rates, whereas the Hypericum was tolerant. Flumioxazin was safe to use on Myoporum and Aptenia. The dithiopyr was also tolerant to several species and should be a product that can be used in ornamentals. Clopyralid is not effective on grass weeds and some species of broadleaves, such as field bindweed. Flumioxazin gave excellent control of broadleaf weeds but is weak on grasses as a preemergence herbicide. The combination of dithiopyr and pendimethalin severely suppressed field bindweed at this location. Effects on the individual species will be discussed in more detail at the conference.

DO TREES NEED TO BE FERTILIZED?
Evaluation of Landscape Tree Fertilization Recommendations

Gary W. Hickman
University of California Cooperative Extension, San Joaquin County
420 South Wilson Way, Stockton CA 95205

Many universities, tree organizations and standards groups have published recommendations for landscape tree fertilization. This includes the International Society of Arboriculture, American National Standards Institute, University of California, and others. In many cases, these recommendations are not based on field research of ornamental trees in the landscape. Some fertilization rates are apparently based on fertilizer manufacturer labels or on container nursery trees. One study referenced as a source of research data was conducted in Illinois. (Neely et al., 1970). Unfortunately, this trial did not give the initial soil nitrogen concentrations for use on a comparative basis. It is also interesting to note that the only nitrogen rate used in this study was 6 pounds per 1000 sq. ft. However, some recommendations using this as a data source call for 2 to 4 or 3 to 6 pounds without providing additional research to support these lower rates. The purpose of these trials was to evaluate fertilizer recommendations for ornamental trees in the California landscape.

Summaries

Newly Planted Oak- Growth of valley oak (*Quercus lobata*) trees was not improved by slow-release or soluble fertilizers applied at planting time, nor by a single application of soluble fertilizer one year after planting. The native soil, with nutrient levels typical of newly developed residential and park areas in the region, provided adequate nutrition for good tree growth over the term of the 3-year study. Reference: Journal of Environmental Horticulture, 10(4): 242-244. Dec. 1992. E. Perry, G.W. Hickman.

Newly Planted Chinese Pistache and Established Valley Oak – Trials were conducted to determine the effect of applied soluble nitrogen fertilizer on growth of valley oak (*Q. lobata*) and Chinese pistache (*Pistacia chinensis*). The fertilizer treatments did not result in increases in trunk diameter growth in either species over the 16-month period of the study. Reference: Journal of Arboriculture; 24 (3): May 1998. E. Perry, G.W. Hickman.

Established Fremont Cottonwood and Coast Live Oak- Treatments were slow release fertilizer, or soluble (urea) fertilizer at a rate of four pounds nitrogen per 1000 square feet, or untreated controls applied to 5-year-old *Populus fremontii* and *Quercus agrifolia*. Eight months after treatment, there were no significant differences in diameter growth among treatments. This trial will continue up to 2 years after treatment.

Two-year old European Hornbeam, Red Oak, Chinese Hackberry – Rates of nitrogen tested are 0 pounds, 3 pounds and 6 pounds per 1000 sq. ft. Trial began in May 2000 on *Carpinus b. 'Fastigata'*, *Quercus rubra* and *Celtis sinensis.*

RED GUM LERP PSYLLID UPDATE

John N. Kabashima
University of California Cooperative Extension, Orange and Los Angeles Counties
7601 Irvine Blvd., Irvine, CA 92718

THE FOLLOWING IS FROM A WEBSITE PREPARED BY **Dr. Donald L. Dahlsten, Center for Biological Control, University of California, Berkeley. Created on 08/04/00. Web page: http://www.cnr.berkeley.edu/biocon/dahlsten/rglp/index.htm**

The Red Gum Lerp Psyllid, a new pest of Eucalyptus species in California

Donald L. Dahlsten and David L. Rowney, University of California at Berkeley, College of Natural Resources, Center for Biological Control

The red gum lerp psyllid, a new pest on California's eucalyptus trees, was discovered in 1998 in Los Angeles County, and has currently spread throughout much of the state. The psyllids, small insects that suck sap from leaves, are, like the eucalyptus, native to Australia. They are causing leaf damage and drop, resulting in branch die back and death to suppressed trees. Psyllids also produce a sticky substance called honeydew, which drops to the ground on cars and sidewalks.

Background

The red gum lerp psyllid, *Glycaspis brimblecombei* (Homoptera: Psylloidea; Spondyliaspididae) has recently been discovered in California, and is the first lerp psyllid to make its way from Australia to California. It is apparently a new North American record . It was discovered on red gum *Eucalyptus* in Los Angeles County in June of 1998 along a freeway in El Monte and several of the trees were heavily infested. Ray Gill of the Calif. Dept of Food and Agriculture identified the psyllid and the identification confirmed by Daniel Burckhardt, a Swiss psyllid specialist. It was found in Northern California on 24 July, 1998 at the Ardenwood Farm East Bay Regional Park, Fremont. Since that time it has also been found on the Stanford campus in Palo Alto and at many other locations in the around the Bay Area.

As of 1 July, 2000 all counties in California have reported the psyllid's presence except for a few counties in the extreme northwest, north, and northeast of the state.

Some of the Eucalyptus species have been heavily attacked and this has resulted in heavy leaf drop. The large amount of honeydew produced results in blackened foliage due to sooty mold. These psyllids form a lerp, which is a secretionary structure produced by the nymphs from honeydew as a protective cover. 'Lerp' is a term derived from an aboriginal Australian language describing this cover. There are eight host species of Eucalyptus known in Australia including *E. camaldulensis (=E. rostrat*a) (river red gum), *E. blakelyi* (Blakely's red gum), *E. nitens* (shining gum or silver top), *E. tereticornis* (forest red gum), *E. dealbata* (tumbledown red gum), *E. bridgesiana* (apple box), *E. brassiana* (Cape York red gum), and *E. mannifera* (Brittle gum). However, the psyllid has been recorded on 27 species of Eucalyptus in California, including *E. camaldulensis (=E. rostrat*a), *E. rudi*s, *E. globulu*s, *E. diversicolo*r,and *E. sideroxylo*n. Damage occurs to only a few species, with *E. camaldulensis* the worst.

The immediate response by communities has been to look for a chemical pesticide, but the efficacy of current products is in doubt and no one in the California has any long-term experience with chemical control of this insect. Based on the number of infestations in many areas of the state this could result in the heavy use of chemicals in those urban areas where red gums are commonly used as ornamentals. The development first of a monitoring program and then a biological control program would reduce the pesticide load in the environment. Both of these activities are socially acceptable, and as we have found with the elm leaf beetle project, monitoring alone can reduce the use of pesticides. If the program is as successful as the recent blue gum psyllid project, no pesticides will be necessary.

Pre-existing Natural Enemies

We have observed several lady bird beetles (Coccinellidae) feeding on the psyllid: the Asian lady beetle, two spotted lady beetle, and convergent lady beetle. Also we have observed minute pirate bugs (Anthocoridae), green lacewings (Chrysopidae), brown lacewings (Hemerobiidae), syrphid flies (Syrphidae), and spiders feeding on the pyllids. We have also observed several bird species, including chestnut-backed chickadees *(Poecile rufescen*s) and bushtits *(Psaltriparus minimu*s), feeding on infested trees.

Biological Control

In August 1999, Dahlsten explored in Australia for natural enemies of the lerp psyllid in three areas that are similar in climate to California coastal areas: Sydney, Melbourne, and Adelaide. Eight species of *Psyllaephagus* (encrytid parasitoid wasps) were reared from lerp psyllid mummies in our quarantine facility at UC Berkeley. One of these, *P. bliteu*s,has proven to be specific to the lerp psyllid and is approved for release as a biological control agent. It is now being reared and released in California at sample sites throughout the state. Current availability is restricted as the rearing facility gears up for mass production.

The tiny stingless *P. bliteus* wasp female lays an egg in a psyllid nymph. The egg hatches and the wasp larva consumes the psyllid nymph. We expect the wasps to spread readily throughout the area of psyllid infestation.

Contacts:
Email address: donaldd@nature.berkeley.edu, daver@uclink4.berkeley.edu
Phones: 510-642-3639, 643-5325, 642-8414
Insect Biology, ESPM, 201 Wellman Hall #3112, Berkeley, CA 94720-3112

QUANTIFYING THE IRRIGATION NEEDS OF SHRUBS

David A. Shaw
University of California Cooperative Extension, San Diego County
5555 Overland Ave., Bldg. 4, San Diego, CA 92123

NOTES:

ROOT ROT MANAGEMENT IN THE LANDSCAPE

James A. Downer
University of California Cooperative Extension, Ventura County
669 County Square Drive, Suite 100, Ventura CA 93003

Root rots are perhaps the most damaging diseases of landscape plants. All landscape plants are affected at all growth stages. From seedlings to adult specimens, from grasses to woody ornamental plants, none are immune to the effects of root rot. Root rots are caused by biotic disease agents (pathogens) or are abiotic, caused by an environmental factor. Root rots are insidious and pervasive. Afflicted plants often go unnoticed until the disease is quite advanced. Early onset of root rot is usually not displayed as symptoms in above ground parts because most plants have excess roots and can lose quite a few before showing symptoms. As root rot progresses, symptoms develop on above ground portions of the plant. As root functions shut down, selective absorption and regulation of mineral nutrient uptake are compromised. Mineral nutrient deficiency symptoms will occur if the progress of the disease is slow enough. As root rot worsens, leaves at the top of woody-ornamental plants thin and growth stops, giving a stunted appearance to trees. At some point, physiological wilt occurs and the leaves become flaccid. Irrigation does not correct the wilt. Defoliation and death soon follow.

Diagnostics

The expression of root rot symptoms is not always predictable. This is because the disease can progress rapidly bypassing some symptoms or manifest itself as a more chronic sub-lethal decline. With *Phytophthora cinnamomi* (the fungus causing root rot of avocado and many woody ornamental plants) the disease functions either as a feeder root rot or a basal canker causing rapid wilt and death. The feeder root rot may **not** display obvious symptoms—reduced growth rate, reduced yield, fewer flowers, etc. When the fungus causes a canker of the main stem of a woody plant, it may collapse so rapidly that the wilt is not noticed, the leaves dry and hang on the plant. Confirmation of biotic causes of root disease is possible by observation of signs and symptoms on the affected plants. This usually requires some follow-up work in the lab to identify the putative pathogen. Since *Phytophthora* diseases rarely have visible hyphae, the organism must be cultured to confirm its presence. Although monoclonal antibody test kits are available for some of these pathogens they often provide erroneous or dubious results.

The diagnostic process for abiotic root rots is similar to the one discussed above. The symptoms are the same but there are no signs of fungi. Samples sent for lab work come up negative for pathogens. Diagnosis is usually made by discovery of an adverse environmental factor. Sometimes saturated soil has a characteristic anaerobic smell when soil cores are removed from the affected area. Soil tainted by natural gas leaks is usually a dull blue-grey color.

Etiology of root rot

Bacterial and viral pathogens rarely cause root rot. Fungi are the most common root rot organisms. There are many fungi that cause some kind of root rot on plants worldwide. Ornamental plants are also affected by a variety of fungi, however, the number of organisms causing serious and significant amounts of disease in California is limited. In many cases the diseases appear like root rots but are crown or collar rots or seedling damping off diseases that affect the main stem or root (radicle) upon emergence from the seed. Nematodes (phyto parasitic worms) also cause root rots and are involved in disease complexes with fungi. Fungi seem to be somewhat selective in the kinds of plants they affect. *Phytophthora* does not infect turfgrass, while *Pythium* (a related fungus) is a major turfgrass pathogen. Although *Armillaria* is commonly regarded as a disease of woody plants I have seen it infect palms, bamboo, succulents, tree ferns and begonias. It has a very wide host range and is often very pathogenic.

Fungal Pathogen	Host Range
Armillaria	Woody and some herbaceous plants
Sclerotina	Herbaceous plants and turfgrasses
Rhizoctonia	Seedling diseases and turfgrasses
Phytophthora	Woody and herbaceous plants - not turfgrasses
Pythium	Turfgrasses and herbaceous plants – not woody plants
Fusarium	Herbaceous plants

Abiotic factors causing root rot are numerous. The most common cause of root rot is due to the creation of anoxic conditions in soil by flooding. This is frequently the result of over-irrigation. Oxygen is necessary for the normal respiration of root systems and although oxygen is lower in concentration in soils than in the atmosphere, it is still essential for root growth. Water displaces oxygen from the soil and dissolved oxygen in water is not adequate to supply most root systems. Oxygen depletion can also occur when woody plants are buried under fill soils, when fill soils are compacted, when compaction is excessive around non-filled sites, or when a natural gas leak occurs underground. Excessive salinity in soil can also burn roots and cause root rot. Curiously short-term exposure to many of these abiotic factors which causes root rot can also predispose roots to pathogens that cause root rot.

Control of root rot

- Control of root rot diseases involves many methods and in the final approach all methods may be necessary to deal with the disease.

- The first approach is **Exclusion**. Don't bring any root rot onto your property. Since many root rot pathogens are not native inhabitants of our soil, we can prevent root disease by excluding them from the landscape. This means buying plants from a clean nursery, not buying stock that has "suppressed" root rot organisms in the container. The most abundant source of root rot diseases is nurseries. Once disease is present in the landscape (it usually is) we must attempt to limit its spread.
- **Sanitation**: Reduction of inoculum by disposal of diseased plants and plant parts is sometimes helpful. *Armillaria* requires a large source of inoculum to infect new plants so removing old infected stumps and root pieces is helpful in limiting new infections.
- Use plant **Resistance** when possible. Avoid very susceptible cultivars or species of plants that are susceptible to the pathogens on site. If available, chose root rot resistant species.
- With woody ornamental plants, use wood chip mulches in concert with gypsum applications. This may limit disease caused by *Phytophthora cinnamomi*.
- Adjust irrigation cycles to provide "drying out" periods.
- Leach soils to reduce salinity.
- Reduce compaction zones around woody ornamentals and turfgrasses with physical treatments to the soil (core aeration) or mulches.
- Install drainage lines so soil will not become saturated.
- **Therapy**: use eradicative or suppressive fungicides to suppress or kill the pathogen (see examples below).

Fungicide recommendations are available on the internet at the UCIPM site (http://www.ipm.ucdavis.edu/PMG/selectnewpest.home.html). One of the problems with finding fungicide recommendations is that they are devised for agronomic crops or commercial turfgrass. There are fewer options for the wide diversity of ornamental plants found in landscapes. The following are some fungicides listed for disease control from the UCIPM web site.

With every possible tool, it is still impossible to defeat root rot once it is in the your soil, thus, if we can exclude the fungus at least for a time, we save tremendous time and effort in the fight against this problem.

References

Agrios, G. N. 1997. Plant Pathology 4^{th} ed. Academic Press. San Diego, CA.

Erwin, D. C. and O. K Ribeiro. 1996. Phytophthora Diseases Worldwide. The American Phytopathological Society Press, St. Paul, MN.

GLASSY-WINGED SHARPSHOOTERS AND THE PATHOGENS THEY VECTOR

Heather S. Costa and Carmen Gispert
Dept. of Entomology, University of California, Riverside, CA 92521-0124

The following is a modified version of information related to the GWSS that was partially extracted from a website prepared by the Office of University Relations: http://www.ucr.edu/news/gwss/:

The glassy-winged sharpshooter. The glassy-winged sharpshooter, *Homalodisca coagulata* , is native to the southeastern United States. It was first found in California in 1990. It is a large insect, almost a half-inch (12 mm) in length. It is a dark brown to black. Its head and back are stippled with either ivory or yellowish spots. It receives its name from its transparent wings. The glassy-winged sharpshooter can fly up to one-quarter of a mile and frequently appears on plants in high numbers. The insect is able to survive winter temperatures dipping as low as 20 degrees Fahrenheit. The insect overwinters as an adult. It begins laying egg masses from late February through May. The year's first generation matures as adults from May through August. The year's second generation begins as egg masses laid from June through September. It is this generation that produces the next year's offspring. The glassy-winged sharpshooter has an extremely wide host plant range. Photos of the glassy-winged sharpshooter are available at: http://danr.ucop.edu/news/MediaKit/photos/default.shtml.

Pierce's disease. Pierce's disease is caused by a bacterium, *Xylella fastidiosa*. The bacterium blocks the xylem, the water- and nutrient-conducting vessels of plants. The typical symptom is for leaves on the plant to begin to dry or to scorch. Infected vines can die in as little as one to two years. Strains of *X. fastidiosa* in California can also cause diseases such as almond leaf scorch and oleander leaf scorch in other plant species. Pierce's disease has been present in California for many years. In the late 19th century, Pierce's disease decimated 40,000 acres of grapes in the Anaheim, California. It was dubbed Anaheim disease, but the name was later changed to Pierce's disease after Newton Pierce, who studied the infection. The incurable plant disease has appeared on and off ever since, but its spread was limited. The principal carrier, or vector, was the blue-green sharpshooter, a weak, small insect not able to fly much further than three feet. Photos of disease symptoms are available at: http://nature.berkeley.edu/xylella.

How the glassy-winged sharpshooter spreads Pierce's disease. The glassy-winged sharpshooter is a voracious eater. It can consume 10 times its body weight in liquids per hour. Sharpshooters can acquire the *X. fastidiosa* bacterium from infected plants and transmit it to healthy plants while feeding. Once the adult stage of the insect acquires the bacterium it remains in its mouth parts throughout its life, which can last over 6 months. In some host plants, such as grape, the bacteria can spread systemically and cause disease. Once in the plant, the bacteria multiply and block the xylem, or water-conducting vessels of the plants. Plants eventually develop symptoms of dry or scorched leaves, particularly in mid-summer.

What is UCR doing? Researchers at UCR have been working on the glassy-winged sharpshooter for several years. Scientists from the university's Entomology Department are:

- Pursuing non-pesticide biological control of the glassy-winged sharpshooter by introducing a natural enemy - a tiny stingless wasp found in Mexico and Texas, that is successfully reducing populations of the sharpshooters there.
- Researching potential use of physical barriers to prevent the glassy-winged sharpshooter from spreading.
- Investigating whether currently available pesticides will be effective in controlling sharpshooter populations.
- Identifying the plants that serve as sources of bacterium for sharpshooter vectors.

What is being done elsewhere?

A chronology of glassy-winged sharpshooter efforts: http://plant.cdfa.ca.gov/gwss/gwmreCurrent.htm

Host list of plants: http://plant.cdfa.ca.gov/gwss

MIXED LANDSCAPE IRRIGATION RESEARCH FINDINGS

William E. Richie[1] and Dennis R. Pittenger[2]
[1]Dept. of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124
[2]University of California Cooperative Extension, Central and Southern Region
Dept. of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124

Future water conservation strategies for Southern California will likely center on specific water budgets for each irrigated landscape site. Thus, there is a need to develop a means for accurately estimating irrigation needs of mixed landscape plantings based on reliable scientific data. Three species of landscape plant materials (Bradford pear, spring cinquefoil, and tall fescue), planted as monocultures and in all possible combinations, are being evaluated for performance under two irrigation regimes of 100% ET_o (ET_o x monthly K_c/DU) and 70% ET_o (ET_o x monthly K_c x 0.7/DU) at Riverside, CA.

Plant visual and physiological measures of performance include the following:

Bradford pear: Yearly height and caliper changes, leaf water potential and transpiration rate, canopy temperature.

Spring cinquefoil: Visual ratings for quality, density, and drought-induced wilt, leaf water potential.

Tall fescue: Visual ratings for quality, color, drought-induced wilt and brown tissue, clipping yield and clipping water content

Additionally, soil water content is measured in all plots using time domain reflectometry (TDR), and in full turf and full groundcover plots using neutron scattering. Collected data is subjected to statistical analysis to identify significant differences in plant growth and plant physiological properties caused by plant combinations or irrigation treatments. Various weather parameters also are being measured and will be used to calculate evapotranspiration in selected plots. These measurements include solar radiation, air temperature, relative humidity, and wind speed.

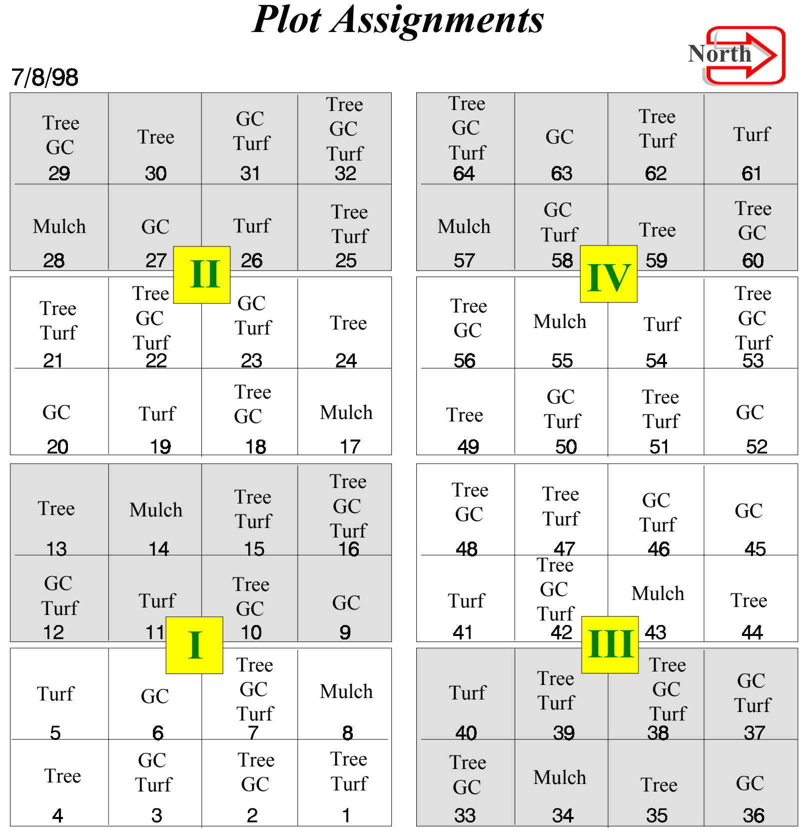
Generally speaking, reduced irrigation (70% ET_o) is causing water stress on all plant materials and is manifested in the following: reduced tree height, lower (more negative) plant water potential (tree and groundcover) and reduced visual quality (turf and groundcover). The combination of plant species also is affecting individual species' growth and performance. Annual increase in tree height is lowest in trees growing in groundcover alone and trees in these plots are typically the most water stressed. Canopy volumes are greatest in trees growing alone (surrounded by soil). Groundcover visual quality is highest when growing alone or in combination with turfgrass; any combination with a tree reduces groundcover quality and leads to more wilting and browning of leaves between irrigation events. Turfgrass visual quality is not significantly affected by plant combination.

Data from this study suggest that the combination of plant species in the landscape can have effects on the growth and performance of the individual species that are as important as those of irrigation amount. There may be unique interactions of irrigation amount and species combination that impact a landscape's performance. Further data collection should make it possible to determine how planting combination can influence a landscape's response to applied water and provide information to help implement landscape irrigation BMPs.

Irrigation Needs of Mixed Landscapes

Metropolitan Water District of Southern California

Plot Assignments



Note: Subplots measure 20 x 20 feet and are separated by 3-foot alleys. Irrigation main plots measure 43 x 89 feet and are separated by 5-foot alleys.

≅ 100% ETcrop/DU

≅ 70% ETcrop/DU

NON-TRADITIONAL WEED CONTROL TECHNIQUES

Cheryl A. Wilen
University of California Cooperative Extension, Statewide IPM Project
5555 Overland Avenue, Bldg. 4, San Diego, CA 92123

Weeds can be controlled in a variety of ways, both chemically and non-chemically. The following are some methods of weed control that may be used in landscape situations. The advantage of these methods is that they use less herbicide than traditional chemical applications or the herbicides are applied in such a way that off site movement, such as drift, is minimized.

Chemical

Wick applicators

Technique: Concentrated herbicide is absorbed by a wick, usually made of cotton or sponge. The herbicide is then applied to weeds by wiping them with the saturated wicks.

Use: Can be used to control weeds growing above the desired species (e.g. dallisgrass). Can be used even when winds are high because there is little danger of drift. Should be used with postemergent herbicides that translocate such as 2,4-D or glyphosate.

Cut stump method

Technique: Concentrated translocatable herbicide is applied to stump of a woody tree or vine to keep it from resprouting. The herbicide is usually applied very soon after the plant is cut. Most common methods include spraying the stump or painting the herbicide on. Treatment must be done soon after the cut is made so that there is adequate movement of the herbicide into the plant. If the cut portion of stump is allowed to dry, the cells will not take up the herbicide.

Use: This method is used when the species has a tendency to sprout from the base after being cut.

Tree injection

Technique: A small amount of a translocatable herbicide is injected into a woody species (usually a tree) through spaced cuts made around the trunk with an ax or hatchet or tree injector a small amount of herbicide placed in each cut. Cuts are made only into the phloem (the area right under the bark). The herbicide can be injected by a syringe or sprayed into the cut with a sprayer.

Use: Controls larger trees. Can use this method to cover a large number of trees in an area quickly.

KlipKleen

Technique: A small plastic bottle is attached to pruning shears. The bottle has a metal tube at the base which dispenses a one or 2 drops of concentrated herbicide on the inner side of the blade when open. As the shear closes on the stem, the herbicide is wiped onto the cut stem where it can be translocated throughout the plant.

Use: For removing woody plants or vines in a small area. Stems should be less than ½″ in diameter.

Controlled Droplet Applicators

Technique: A rotary spray nozzle creates a uniform droplet size and pattern. The nozzle is small cup that spins and the spray solution is forced out of the cup. The size of the droplets is determined by the speed that the nozzle spins. For herbicides, larger droplets (250 microns) are better and these are obtained at a slower speed. Smaller droplets are produced at the fast setting. The flow rate at the low setting is 60 ml/minute (about 2 oz/minute). Total spray volume needed is much lower than conventional sprays, typically only about 1-4 gal/A.

Use: Good for areas where it is difficult to carry a lot of water. Because the spray pattern is only a hollow cone, it must be used in areas where that shape is acceptable such as general cleanup and strip spraying. This technology is better for foliar applied herbicides (postemergent) than soil applied herbicides (preemergent).

Non-Chemical

Propane flamer

Technique: Flamers are portable gas torches that produce intense heat (about 2,000°F). ***Flamers are not used to burn the vegetation!!*** Flaming works by using "boiling" the water in the cells of the plant until they burst.

It is difficult to see the effect of flaming immediately as it often takes a few minutes for the cells to collapse. One also needs to travel slowly to kill the weeds, the rate is about 1-2 mph. To test whether the method is working, press a treated leaf lightly between a finger and thumb. If there is an imprint on the leaf than cell damage has occurred. A 5-gallon gas tank will provide enough fuel for 3 to 6 hours of burning.

Use: This method is very effective for controlling small annual weeds. Only do this in an irrigated area or during a rainy time of year.

Safety:

Don't flame if you have any debris or wood around

Don't flame if winds are more than 3 mph

Avoid conifers & flammable residue such as pine needles, mulch, etc.

RESEARCH ON PALM ROOT SYSTEMS

Donald R. Hodel[1] and Dennis R. Pittenger[2, 1]
[1]University of California Cooperative Extension, Los Angeles County
2 Coral Circle, Monterey Park, CA 91755
[2]University of California Cooperative Extension, Central and Southern Region
Dept. of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124

Palms are woody monocots characterized by the production of simple, fibrous, adventitious roots from the base of the trunk. Large mature specimens can often be transplanted successfully with a relatively small root ball. However, many large specimen palms do not survive transplanting or they require an inordinate length of time to reestablish. Transplanting failures resulting in replacement can equal or exceed 30% in some installations. Inconsistencies in commercial establishment of date palm offshoots in the field are also a problem.

Little is known about the distribution and growth of palm roots in relation to the survival and reestablishment of field-grown trees after they are transplanted. While it is widely believed that cut palm roots die back to the trunk and are replaced by new roots originating from the trunk base, research here and in Florida suggests cut roots of many palm species frequently branch from a point behind the removed apex and continue growing. Regeneration of new roots from the base of the trunk also appears to be important for establishing transplants of most palm species.

Bibliography

Brochat, T. K. and H. M. Donselman. 1984. Regrowth of severed palm roots. J. Arboric. 10: 228-240.

Broschat, T. K. and H. Donselman. 1990. Regeneration of severed roots in *Washingtonia robusta* and *Phoenix reclinata*. Principes 34(2): 96-97.

Donselman, H. M. 1991. Planting a palm tree. Gainesville, FL: University of Florida IFAS, Cooperative Extension Service Fact Sheet ENH-46.

Hodel, D. R. 1996. Planting palms correctly for vigorous, attractive growth and fewer problems. Turf Tales Magazine 3(1): 10-11. Southern California Turfgrass Council.

Hodel, D. R., A. J. Downer, and D. R. Pittenger. 1998. Palm root regeneration. Proc. Landscape Below Ground II Workshop, March 5-6,1998, San Francisco. D. Nealy and G. Watson eds. Champaign, IL: International Soc. Arboriculture.

Meerow, A. W. and T. K. Broschat. 1996. Transplanting palms. Gainesville, FL: University of Florida IFAS, Cooperative Extension Service Circular 1047.

Meerow, A. W. 2000. Betrock's guide to landscape palms. Hollywood, FL: Betrock Information Services.

Tomlinson, P. B. 1990. The structural biology of palms. Oxford: Clarendon Press.

EFFECTIVE TREE PLANTING PRACTICES

Dennis R. Pittenger[1] and George Ash[2]
[1]University of California Cooperative Extension, Central and Southern Region
Dept. of Botany and Plant Sciences, University of California, Riverside, CA 92521-0124
[2]CLP, Casa Verde Landscape Corp., Alta Loma, California

The establishment and long-term performance of a landscape tree depend on how it is planted. A transplanted tree must establish a spreading root system into the surrounding soil in order to assure survival and avoid stress. Over the past several years, research has shown that successful tree transplanting will be achieved by following these practices:

1. Inspect the root system looking for diseased or damaged roots and for roots with structural flaws ("J" roots and girdling roots); reject trees with serious root system problems and remove roots with minor problems. Be certain the root ball is thoroughly moist at the time the tree is planted.
2. Dig a planting hole that is *at least* 2 to 3 times the width of the root ball and wider in settings with heavy clay or compacted soil.
3. Plant the tree "high" by digging the hole about 1 to 2 inches less than the depth of the root ball, no deeper.
4. Backfill the planting hole with *unamended* soil dug from the hole; amendments are not as important as digging a large planting hole.
5. Settle the backfill by applying water when the hole is about one-half filled and again when it is completely filled.
6. Do not cover the top surface of the root ball with other soil.
7. Create a shallow watering basin slightly wider than the planting hole by forming a small levee outside the perimeter of the hole.
8. Keep the entire root ball and the soil just beyond it moist; apply frequent irrigation if necessary to achieve this.
9. Maintain a weed- and turf-free zone over and just beyond the planting hole.
10. Apply a 2- to 4-inch deep layer of coarse organic mulch over the root ball and the soil out to the levee; keep mulch 4 to 6 inches away from the trunk.

After the tree is planted, do not prune it other than to remove damaged, dead, or pest infested stems. A soluble form of nitrogen fertilizer may be applied to the surface of the planting hole about one month or longer after transplanting.

Bibliography

Bevington, K. B. and W. S. Castle. 1985. Annual root growth pattern of young citrus trees in relation to shoot growth, soil temperature and soil water content. J. Amer. Soc. Hort. Sci 110:840-845.

Gilman, E. F. and R. C. Beeson. 1996. Production method affects tree establishment in the landscape. J. Environ. Hort. 14:81-87.

Preaus, K. B. and C. E. Whitcomb. 1980. Transplanting landscape trees. J. Arboriculture 6:221-223.

Watson, G. W., E. B. Himelick, and E. T. Smiley. 1986. Twig growth of eight species of shade trees following transplanting. J. Arboric. 12:241-245.

Watson, G. W and G. Kupkowski. 1991. Soil moisture uptake by green ash trees after transplanting. J. Environ. Hort. 9:226-227.

Watson, G. W., G. Kupkowski, and K. G. von der Heide-Spravka. 1992. The effect of backfill soil texture and planting hole shape on root regeneration of transplanted green ash. J. Arboriculture 18:130-135.