UNIVERSITY OF CALIFORNIA, RIVERSIDE TURFGRASS RESEARCH PROGRAM

Better Turf Thru Agronomics

UCRTRAC Newsletter, November 1996

Putting Turf in a Retractable-Roof Baseball Stadium for the First Time -- A Novel Challenge

'De Anza' zoysiagrass, a newly patented UCR release, outperformed other varieties tested in the simulated traffic and light-restricted conditions of the new ballpark.

UCR Superintendent of Agricultural Operations **Steve Cockerham** is spearheading research to figure out for the first time how to put natural turf in a retractable-roof stadium that can withstand restricted light and still provide a durable, playable, and attractive sports turf surface for the future baseball games of the Arizona Diamondbacks, a new franchise.

The new stadium, Bank One Ballpark, which is under construction, will have a retractable roof, allowing open air in spring and fall and air-conditioned comfort for fans during the hot Arizona summer, which presents some novel problems and opportunities with respect to turf selection.

UCR scientists have built a field structure to provide the same shade restrictions as the stadium, with tenebrous periods representing homestands for a simulated baseball season.

"The first phase of our experiments showed that zoysiagrass would have the adaptability to low light while having good traffic tolerance. Zoysias performed better in restricted light than Tifgreen 419 bermudagrass, the standard in outdoor baseball fields, and better than Manhattan II perennial rye. 'De Anza' zoysiagrass, a newly patented UCR release, was selected for its quick establishment, rapid growth rate, and recovery from injury. It outperformed a pretty zoysia from Texas A&M, DAL-Z 8502, in our simulated traffic and light restriction studies," Cockerham said.

During the second-phase of experiments this year, Cockerham and colleagues are investigating minimum light requirements of turf used for baseball; if artificial and reflected light can supplement light needs; how air movement or the lack of it affect turf growth; and how recovery from injury can be enhanced under the playing conditions at the new stadium. Results are expected before the turf is installed in the ballpark.

UCR researchers have been at the forefront of sports turf research and traffic tolerance for a decade. The "Brinkman traffic simulator" was developed at UCR in the 1980s to simulate the wear and tear of football and baseball games, thereby providing critical information about how different turf species and varieties stand up to the punishment of cleats.

Cockerham is cooperating with **Vic Gibeault**, UCR Cooperative Extension Environmental Horticulture Specialist, **Mike Henry**, Cooperative Extension Turf Advisor in Riverside and Orange Counties, and UCR staff. Gibeault and former UCR scientist **Matt Leonard** patented 'De Anza' zoysia in 1995.

Black Turfgrass Ataenius Damage Thresholds

Since bentgrass greens in desert golf courses are vulnerable to injury from black turfgrass ataenius (BTA) beetles (*Ataenius spretulus*), UCR entomologists have determined when damaging populations are likely to be present and have identified an economic injury level superintendents can use to implement control measures.

"The threshold levels for damaging populations of BTA on bentgrass in the low desert region of California are 5-7 larvae per square foot, which is much lower than in other parts of the country. Our results may be related to the extremely stressful conditions of the desert in mid-summer and the limited ability of the plant to acquire the moisture it needs with insect-damaged roots," said **Ken Kido** and **Tim Paine**, UCR entomologists.

Depending on temperature, 2 to 3 generations of BTA occur per year in the desert. The first generation can appear as early as April or as late as July, they said. Three generations were recorded in 1994, two in 1995.

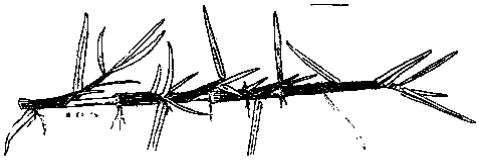
Beetle larvae feed on turf roots, limiting the turf's ability to absorb water and to maintain an adequate moisture balance under stressful conditions. Stressed turf becomes wilted and dies in irregular patches.

Early detection and control are vital. Selected insecticides combined with good cultural practices will minimize damage, they said.

The first reports of injury to turf in California by BTA occurred in 1987 in Coachella Valley golf courses. Since then, damaging pest populations have spread to all Southern California counties.

Growth and Development of Kikuyugrass: An Invasive Weed on Golf Courses and Lawns

The success of unwanted kikuyugrass in golf courses and lawns is not due to lack of management skill; rather, it is the physiology of kikuyugrass that increases its fitness over indigenous turf species.


KIKUYUGRASS *Pennisetum clandestinum*
Drawing courtesy of Tom Yutani

By comparing the growth and development of kikuyugrass (*Pennisetum clandestinum*) with that of two common turf species, tall fescue (*Festuca arundinacea*), a cool-season species, and St. Augustinegrass (*Stenotaphrum secundatum*), a warm-season species, UCR scientists have identified several ecophysiological mechanisms that enable kikuyugrass to become an invasive weed.

"Our results suggest that *P. clandestinum* is a successful weed in Mediterranean climates as a result of its capacity to photosynthesize over the full range of temperatures found in those climates, its rapid growth during warm weather and its apparent tolerance to moderately cool temperatures," said **Cheryl Wilen**, Extension Integrated Pest Management Advisor, and **Jodie Holt**, UCR Plant Physiologist, in their recent journal article in *Weed Research*.

At leaf temperatures of 77 - 104°F, kikuyugrass had the highest photosynthesis rates: It increased biomass and leaf area more rapidly than St. Augustinegrass and tall fescue. Below 77°F, its photosynthesis rates were intermediate between the other two grasses.

Kikuyugrass maintains higher rates of photosynthesis at cooler temperatures than those normally associated with most C_4 [warm-season] grasses and accumulates a large amount of leaf area during warmer intervals, resulting in a plant that is more photosynthetically productive on a whole-plant basis than other C_3 [cool-season] or C_4 grasses grown under similar conditions, Wilen and Holt said.

Kikuyugrass allocates progressively more of its additional biomass to leaf production, thereby increasing phostosynthetic capacity, rather than partitioning it to non-photosynthesizing storage tissue; thus, it has a competitive edge for displacing turf species that allocate about equal portions of dry weight to roots, stems, and leaves (tall fescue) or that allocate biomass disproportionately to stems (St. Augustinegrass). See Fig. 1 on page 3.

Kikuyugrass tolerates cold temperatures better than other warm-season grasses and continues to produce new shoots when other warm-season grasses have become dormant, although at a slow rate.

Despite its aggressive weediness, kikuyugrass can be beneficial as a forage crop and for erosion control. It has been introduced into many countries for these purposes, but in the past 75 years, since its introduction into California from its native African highlands, kikuyugrass has become an invasive weed in irrigated cropland, pastures, orchards, and turf, despite efforts to control it mechanically or chemically.

Grants from the Northern and Southern California Golf Associations provided financial assistance for this research.

Kikuyugrass Spreads Mainly by Clonal Propagation

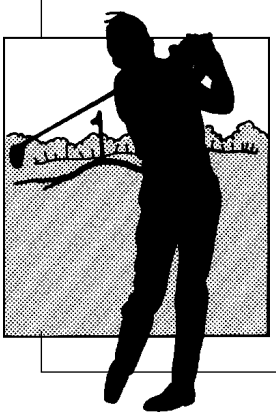
Kikuyugrass spreads primarily by clonal propagation in California golf courses, say UCR scientists, who investigated the importance of seeds versus vegetative propagules in its establishment.

Kikuyugrass is a "facultative sexually spreading species," similar to other weedy species, such as johnsongrass, which has implications for kikuyugrass control, says project leader **Cheryl Wilen**, Integrated Pest Management Advisor. "Attempts to remove kikuyugrass by destroying the established plant may allow seeds in the thatch or soil to germinate and recolonize the area," she says.

Despite its reputation as one of the worst weeds worldwide, relatively little research has been done on kikuyugrass to examine its invasion and spread. An aggressive, perennial species that can reproduce clonally and rapidly via stolons and rhizomes, kikuyugrass can also spread via seeds, but typically does not flower unless mowed.

Golf courses in Palo Alto, Nipomo, and Riverside were sampled. At all three locations, the kikuyugrass showed low genetic variability, which is consistent with reproduction primarily by clonal propagation. The results showed that where open areas exist, genetic variability is higher, suggesting that the opportunity for spread initially via seeds can occur.

Starch gel electrophoresis, which elucidates genetic variability, was the laboratory technique used. Results were analyzed using a computer program that calculates genetic diversity, which indicates the underlying reproduction pattern. In a population that reproduces only by vegetative means, identical zymograms (band patterns in the starch gel) are expected for the enzyme systems tested; whereas, in a population maintained by seeds, different zymograms are expected, indicating the presence of genetic variability due to random mating.



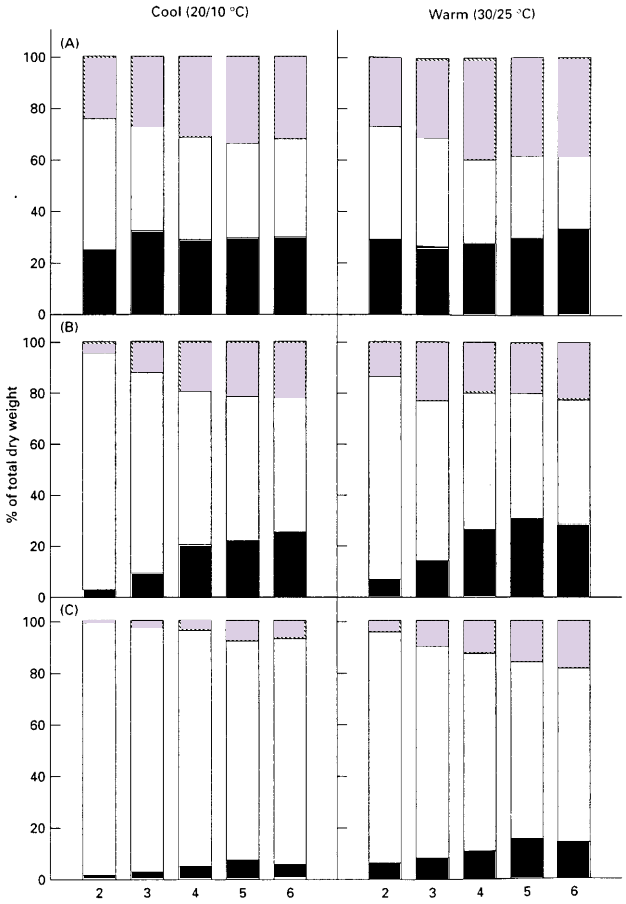


Fig. 1. Dry matter partitioning of *F. arundinacea* (a). *P. clandestinum* (b) and *S. secundatum* (c) grown under cool or warm temperatures. Leaves; stem; , roots. Used with permission.

Sequential Herbicide Applications Provide Effective Control of Kikuyugrass

Sequential treatments of MSMA, triclopyr (Turflon), fenoxaprop (Acclaim) and quinclorac (Drive) provided effective control of kikuyugrass in cool-season turf when applied every 5 to 6 weeks over a 5-month period under experimental conditions in four Southern California locations.

Two-way herbicide combinations applied sequentially reduced kikuyugrass to less than 1% of the sward. The best single treatment reduced kikuyugrass from 80% to less than 5% of the sward.

"This control method has the advantage of reestablishing the desired species slowly, without loss of site use during the process. The competitive edge shifts from weedy kikuyugrass to the desired species, allowing it to reestablish, " said **Dave Cudney**, UCR Cooperative Extension Weed Scientist.

Triclopyr or triclopyr plus MSMA is labeled for kikuyugrass control in cool-season turf. Repeat treatments of MSMA alone are currently the only registered method of reducing kikuyugrass vigor in warm-season turf, Cudney said.

Experiments were conducted over a 5-year period in Riverside, Ventura, Huntington Beach, and Costa Mesa by Cudney with UC Cooperative Extension colleagues **James Downer**, **Michael Henry**, and **Vic Gibeault**.

Two New Products Show Promise for Chemical Edging of Turf

Cimectacarb and glufosinate were effective in experimental trials.

Results of preliminary research at UCR show that glufosinate (Finale) and cimectacarb (Primo) provide promise as chemical alternatives to repeated mechanical edging and hand removal of aggressive, stoloniferous grasses, such as bermudagrass, zoysiagrass, St. Augustinegrass, and kikuyugrass, which often extend their growth into ornamental beds, tree wells, and sidewalks in landscaped areas.

Glufosinate is a rapidly acting "contact" foliar herbicide not yet registered in California. Cimectacarb is a turf growth regulator.

"It appears that both of these products may have a place in chemical edging -- glufosinate for a quick burn back and cimectacarb for slowing regrowth after an initial mechanical edging. A second mechanical edging should not be necessary when using cimectacarb," said **Dave Cudney**, Cooperative Extension Weed Scientist at UCR.

Glufosinate reached its maximum effect in 5 days and the effect persisted for 45 days. Cimectacarb stopped turf growth throughout the 50-day trial period with little discoloration.

Experimental trials began last year at UCR, one day after the 'Santa Ana' hybrid bermudagrass was mowed to a uniform height of 0.75 inches. Treatments were the commonly used rates of diquat, cacodylic acid, glyphosate, glufosinate, and cimectacarb. Phytotoxicity (burn back) ratings were made over a 50-day period.

For the past 20 years, glyphosate (Roundup) has been the product of choice for chemical edging, but dieback usually occurs beyond the desired location, Cudney said.

Recycled Water for Turf Irrigation: A Valuable Resource for Professionals

A trained professional manager who closely monitors water quality and irrigation scheduling is equipped to use recycled water effectively on turf, even though it has lower quality than potable water, says **Jess Evans**, graduate student in UCR's Department of Botany and Plant Sciences, who studied the risks and benefits for a comprehensive report. Using effluent water on turf may help conserve potable water for human consumption and may help conserve costs, he says.

Reclaimed water typically has higher nutrient content and salinity than fresh water, higher sodicity, higher concentrations of potentially toxic ions, and higher pH.

- ***Potential Nutrient Benefits to Turf***

  The use of effluent water on turf can reduce the need for commercial fertilizer because the water contains significant levels of nitrogen, phosphorus, and potassium compared to potable water. The fertilization schedule and nutrient concentrations applied will need to be adjusted.

- ***Salinity***

  Bermudagrass is fairly tolerant of saline conditions due to its salt-excreting glands, characteristic of the *Cynodon* genus, but many species used for winter overseeding are sensitive to salinity, measured as electrical conductivity (EC) or total dissolved solids in the soil solution. With overseeded grasses, when the soil solution EC exceeds 3 dS/m, turf is adversely affected.

- ***Sodicity***

  While higher sodicity levels can cause phytotoxicity in plants, the indirect effects of high sodium ion (Na^+) concentrations on soil structure are also a major concern because they reduce soil permeability, disperse soil colloids, and cause loss of soil structure, leading to reduced aeration and decreased water infiltration. These factors are commonly expressed as the sodium adsorption ratio (SAR), which is a mathematical determination of the Na^+ ion concentration in relation to the concentrations of calcium (Ca^{2+}) plus magnesium (Mg^{2+}) ions.

  Recycled water with a SAR > 9 can cause severe permeability problems when applied to fine-textured soils, Evans said. Turfgrass grown in sandy soil can tolerate a higher SAR, in part because the excess Na^+ leaches without harming soil structure. Since many modern putting greens are constructed with a sand base, irrigation water with less than optimal Na^+ concentration can be used, but more frequent applications of soil amendments, such as gypsum, may become necessary to prevent the adverse effects of excess Na^+ on permeability.

- ***Potentially Toxic Elements***

  Besides sodium, recycled water contains several other ions in concentrations that can cause phytotoxity, such as boron, chloride, and some heavy metals (also known as trace elements), but since turf is intensively managed and mowed frequently, many symptoms associated with ion toxicities are not observed in turf. Trees and shrubs are more sensitive. Boron is a typical constituent of effluent water because it is an ingredient in many soaps and detergents. Leaf tip necrosis is the most common toxicity symptom, but seen rarely in turf. The high shoot and root densities in turf aid in removing pollutants from wastewater.

  The alkaline pH of arid soils in Southern California prevents potentially toxic ions in effluent water, such as aluminum (Al^{3+}) and manganese (Mn^{2+}), from posing a threat because they are not soluble at the pH of most soils in the area.

- ***Potential Risks to Human Health***

  The potential risk to human health caused by bacteria and viruses in effluent water is an important factor. Effluent water is subjected to two or three treatment processes prior to being released for use as irrigation water, but to reduce risks, superintendents can irrigate with effluent water at night when no humans are present, thereby delaying contact. Pathogen survival decreases with increasing temperatures and exposure to UV radiation in sunlight.

Better Turf Thru Agronomics is prepared for the delegates and membership of UCRTRAC. The intent is to present summaries of turfgrass research results and topical information of interest to the Southern California turfgrass industries. The newsletter is edited by Vic Gibeault and Deborah Silva and designed by Brad Rowe, UCR Publications.