1998 Turfgrass Research Report

Statement of Purpose

The purpose of the Turfgrass Science Team is to bring together faculty, staff, graduate students, industry, funding, and other resources in a way that is convenient to work together in mutual benefit of research, extension, and teaching.

Team Mission

The mission of the Turfgrass Science Team is to develop cultivars, cultural practices, curriculum, and outreach programs that conserve water, reduce pesticide use, minimize environmental impact and enhance the quality of life.

Turfgrass Science Team
University of Nebraska

Team Functions

Research

Extension

Education and Training

Outreach/Liaison

For more detailed information about the Turfgrass Science Team visit our Web page at: http://hort.unl.edu/turf

1998 Turfgrass Research Report

Report Coordinators: R.C. Shearman and M.R. Vaitkus

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Turfgrass Team Members
Faculty

Fred P. Baxendale

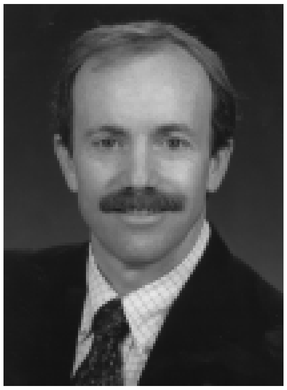
Research Emphasis:
- Investigate the biology, ecology and injury potential of turfgrass arthropods with the goal of developing effective sustainable and environmentally responsible Integrated Pest Management approaches for the insects and mites affecting Nebraska's turfgrasses.

Research Emphasis:
- Enhance understanding of microbial ecology in managed grassland ecosystems, namely golf course putting greens.
- Identify relationships among microbial communities developed in putting greens in response to management history.
- Improve understanding of microbial community development in putting greens, leading to reduced inputs ad disease pressure.

Rhae A. Drijber

Roch E. Gaussoin

Research Emphasis:
- Improve turfgrass weed control practices through integrated turfgrass management practices.
- Enhance understanding of herbicide efficacy.
- Integrate approaches to buffalograss management.
- Study long-term effects of root zone mixes and grow-in on golf green characteristics.



Gregory L. Davis

Research Emphasis:
- Study sustainable landscape systems, plant evaluation under reduced input regimes and landscape plant-site relationships.
- Study small-scale prairie grass and forb establishment management, and landscape suitability.
- Improve understanding of landscape plant water use.

Research Emphasis:
- Assess accurate pesticide application.
- Effects of sprayer calibration and nozzle arrangement on accurate and uniform applications.
- Reduce pesticide inputs.
- Reduce inputs to optimize economic returns.
- Use GPS/GIS technology for site-specific management.

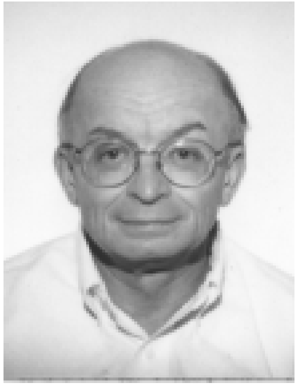
Robert (Bobby) D. Grisso

Garald L. Horst

Research Emphasis:
- Xenobiotic remediation by plants and plant-microorganism systems.
- Pesticide and nutrient fate in relationship to environmental and water quality.
- Turfgrass canopy environmental influence on microorganism ecology.
- Enhanced understanding of environmental quality and sustainability of resource systems.

Research Emphasis:
- Apply integrated pest management for vertebrate species, including moles, voles, ground squirrels, pocket gophers, deer and Canada geese.

Scott E. Hygnstrom

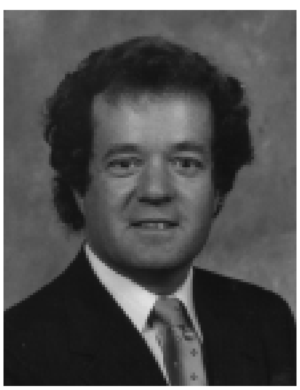


Robert V. Klucas

Research Emphasis:
- Enhance understanding of plant biochemistry with emphasis on nitrogen fixation, leghemoglobin and other plant responses.

Research Emphasis:
- Engineer systems to quantitatively assess turfgrass responses of interest, such as golf ball roll distance and uniformity, shear strength and traffic tolerance.

Michael F. Kocher

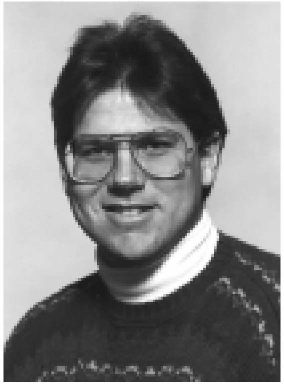


Dale T. Lindgren

Research Emphasis:
- Understand the interactions of wildflowers and warm-season turfgrass when planted in mixtures.
- Evaluate turfgrass cultivars and other turfgrass products for use in west central Nebraska.

Research Emphasis:
- Administrate and facilitate research activities related to the Center for Grassland Studies, including turfgrass development, evaluation and management and seed production practices.

Martin A. Massengale

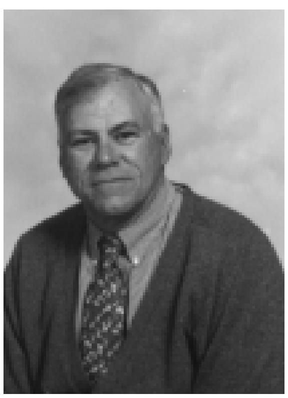


Robert A. Masters

Research Emphasis:
- Study systems approach to the establishment of native grasses and wildflowers, prairie restoration and management and herbicide efficacy evaluation.

Research Emphasis:
- Understand the long-term impacts of golf course putting green grow-in procedures on the soil physical properties associated with putting green performance and function.
- Determine water infiltration rate, air-filled porosity at 40 cm of suction head, total porosity, bulk density and pore size distribution.

William L. Powers



Terrance P. Riordan

Research Emphasis:
- Develop and evaluate improved buffalograss cultivars requiring less water, fertilizer, pesticides and mowing.
- Improve understanding of buffalograss breeding and genetics through traditional and molecular approaches.
- Use of environmentally sensible turfgrasses.

Research Emphasis:
- Study integrated turfgrass management systems for sustainable function and performance, reducing chemical and energy inputs and water conservation.
- Improve understanding of turfgrass wear tolerance, water conservation, drought resistance, potassium nutrition and root growth and development.
- Study turfgrass species and cultivar evaluation for Nebraska and intensively used sites
- Study turfgrass and forage seed production for western Nebraska.

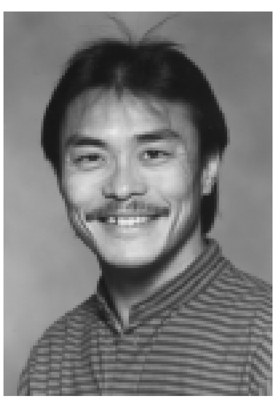
Robert (Bob) C. Shearman

Donald H. Steinegger

Research Emphasis:
- Evaluate ornamental grasses and ground covers.
- Develop sustainable landscape systems.

Research Emphasis:
- Improve disease diagnosis and management.
- Establish disease management systems for dollar spot and brown patch.
- Screen experimental fungicides for turfgrass disease control.

John E. Watkins



Gary Y. Yuen

Research Emphasis:
- Identify microorganisms with potential for biological control of turfgrass diseases.
- Determine mechanisms microbial effects on disease development.
- Understand environmental impacts on pathogenic fungi and applied antagonists, with emphasis on bacteria on leaf spot, brown patch and dollar spot.

Turfgrass Team Members

Support Staff

Leonard Wit	Unit Manager, JSA Turf and Ornamental Research Facility, ARDC
Dan Beran	Graduate Student Ph.D., Prairie Restoration
Jane Christensen	Extension Assistant, Plant Pathology
Shuizhang Fei	Research Associate, Post-Doctorate, Buffalograss Transformation
Kevin Frank	Graduate Student Ph.D., Buffalograss Management
Loren Giesler	Diagnostic Technologist, Plant Pathology
Neil Heckman	Graduate Student M.S., Turfgrass Physiology and Maintenance
Tiffany Heng-Moss	Graduate Student Ph.D., Buffalograss Entomology
Gopalakrishnan Krishnan	Graduate Student Ph.D., Xenobiotic Fate
Anne Streich	Extension Assistant, Horticulture
Cindy Stuefer-Powell	Research Technologist, Agronomy
Wallace Troyer	Technician, Agronomy
Milda Vaitkus	Research Technologist, Turfgrass Management and Physiology
Anthony Weinhold	Technician, Entomology, Graduate Student M.S., Turfgrass Entomology
Steve Westerholt	Technician, Horticulture
Jeff Witkowski	Technician, Horticulture
Taotao Yu	Graduate Student Ph.D., Buffalograss Transformation

Turfgrass and Ornamental
Research Support

AgrEvo USA Co.
American Cyanamid
Arrow Seed
Bailey Nurseries
Barenburg Research
Bayer Chemical Corporation
Big Bear Equipment
Bluebird Nursery Inc.
Campbell's Nursery
Cedar Chemical Company
Country Club of Lincoln Golf Course
Crenshaw Turfgrass Inc.
Deere & Company
Dow AgroSciences
EA Engineering Great Plains
Earl May Seed and Nursery, Limited Partnership
Ecogen
Exmark Mfg. Co. Inc.
Farmland Inc.
Fermenta Plant Protection
FMC Turf and Ornamentals
Garden America Inc.
Golf Course Supt. Assoc. Of America
The Greenkeeper Company Inc.
Greenleaf Nursery Company
Hartmann's Plantation Inc.
Hines Nurseries
Holmes Park Golf Course
Jacklin Seed Co.
Jacobsen/Textron
John Deere Turf Care Inc.
Johnson Seed Co.
Lake County Nursery Inc.
Lesco
Lincoln Water Utilities
Loft's Pedigreed Seed
Mahoney Golf Course
Midwest Turf and Irrigation
Milorganite Company
Monsanto
Mount Arbor Nurseries
National Turfgrass Evaluation Program (NTEP)
Nebraska Department of Environmental Quality
Nebraska Nursery and Landscape Association (NNLA)
NE Golf Course Supt. Association (NGCSA)
NE Professional Lawn Care Assoc. (NPLCA)
NE Turfgrass Foundation (NTF)
North Star Gardens
Novartis
O.J. Noer Turfgrass Foundation
Organix Supply
Oregon State University
Pennmulch
Pickseed West Inc.
Pioneers Golf Course
Plains Tree Farm
Proprietary Seeds
Reams Sprinkler and Supply
Rohm and Haas Co.
Rhone Poulenc Inc.
J. Frank Schmidt and Sons Co.
St. Gabriel Laboratories
The Scotts Company
Seed Research Inc.
Seeds West Inc.
Stock Seed
Terra Industries Inc.
The Toro Company
Todd Valley Farms Inc.
Troy Biosciences
Turf-Seed & Pure-Seed Testing Inc.
United Horticulture Supply
United Seeds
United States Environmental Protection Agency
United States Golf Association
United States Department of Agriculture
University of Nebraska Agricultural Research and Development Center (ARDC)
University of Nebraska Institute of Agriculture and Natural Resources
Valent
Water Center
Willamette Seed & Grain
Williams Lawn Seed
Zajac Performance Seeds
Zeneca Inc.

Weather Summary for the John Seaton Anderson Turfgrass and Ornamental Research Facility

S.R. Westerholt

Near normal temperatures were recorded for the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. through the first half of the growing season and higher than the 13-year average during the second half (Figure 1). Soil temperatures at a depth of 10.2 cm. (4") also reflect the higher air temperatures in the latter half of the growing season, with above average readings starting in August. Growing-degree days (50) (GDD50) data show a below-average accumulation early in the growing season and an above-average accumulation in the second half of the growing season (Figure 2). Precipitation for 1998 was above the 13-year average throughout the growing season. This trend is reflected in the lower evapotranspiration rate (ET) for 1998 (Figure 3).

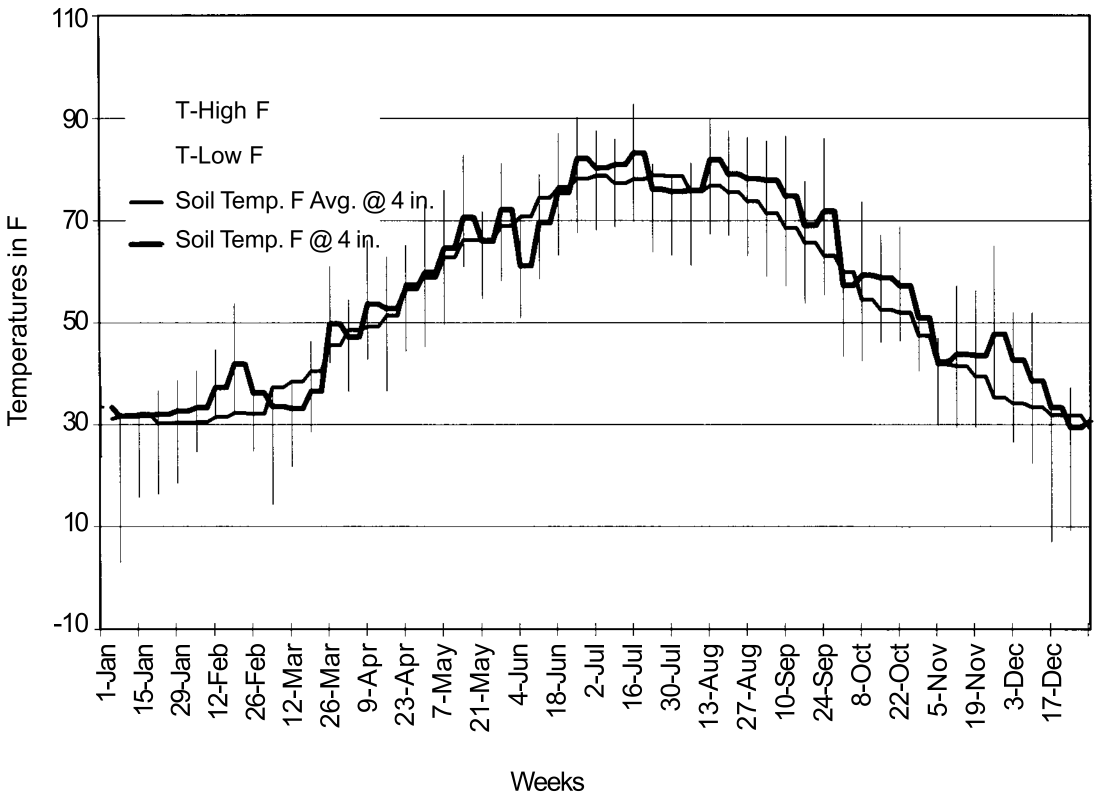


Figure 1. High-low air temperatures from 1998 and comparison of soil temperatures at a depth of 10.2 cm (4") versus the 13-year average at the J.S. Anderson Turfgrass and Ornamental Research Facility at Mead, Neb.

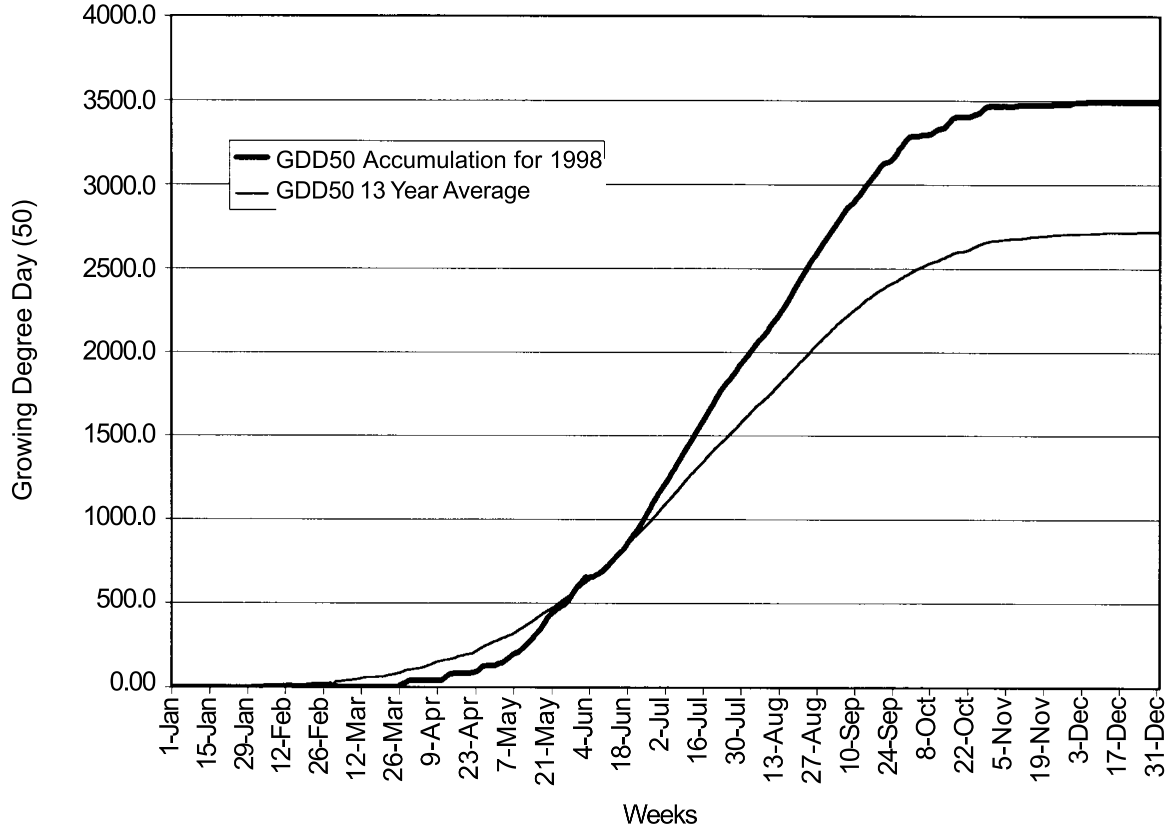


Figure 2. Comparison of Growing-degree days (50) (GDD50) from 1998 and the 13-year average at the J.S. Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

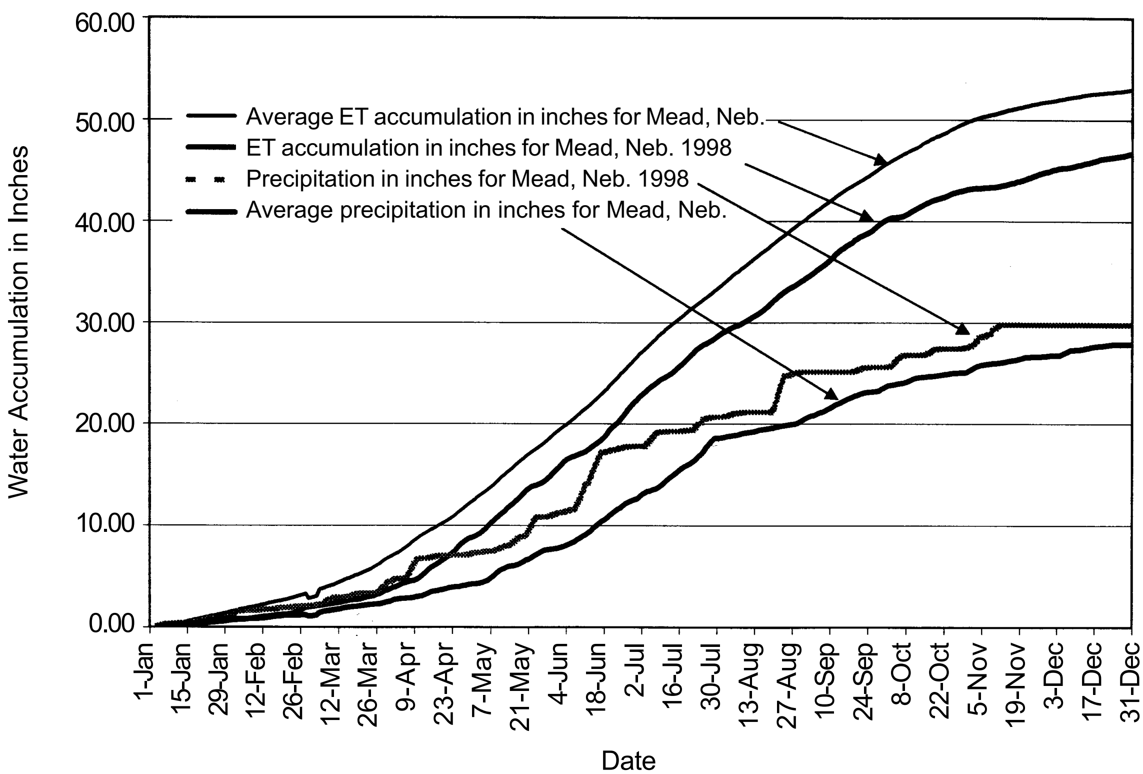


Figure 3. Comparison of precipitation and evapotranspiration (ET) data from 1998 with the 13-year average at the J.S. Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

Growth and Development of Tall Fescue and Smooth Bromegrass in TNT-Contaminated Soil

G. Krishnan, G. L. Horst, S. Darnell and W. L. Powers

Plants are effective and economical remediators of soil, provided they tolerate and resist contaminants. This study was conducted to determine effects of 2,4,6-trinitrotoluene (TNT) in contaminated soils on growth and development of tall fescue and smooth bromegrass.

Former munitions operations in the Nebraska Ordnance Plant (NOP) near Mead, Neb. resulted in environmental and public health hazards. High concentrations of 2,4,6-trinitrotoluene (TNT) and other contaminants are commonly found in areas formerly used for explosives loading, handling and packaging. In the past TNT-contaminated soils were incinerated, a costly and energy-intensive process destroying the soil, leaving ash and mineral residue. Alternatively, processes relying on the ability of plants to take up and, in some plant species, metabolize pollutants to less toxic substances, (phytoremediation) holds promise for low-cost remediation.

Grasses' fibrous root systems have a larger surface area per unit volume of soil than plants with tap roots. This may increase microbial populations, enhancing bioremediation potential. Tall fescue (*Festuca arundinacea* Schreb.) a long-lived perennial, is heat and drought tolerant, tolerates alkaline and saline soils and tolerates postemergence application of several dinitroaniline herbicides such as pendimethalin. Smooth bromegrass (*Bromus inermus* Leyss.), an aggressive cool-season perennial, requires low maintenance, tolerates several herbicides and adapts to a wide range of environments.

The objective of this study was to determine the effect of TNT-contaminated field soils on germination and growth of tall fescue and smooth bromegrass. Plant growth and development as affected by establishing tall fescue and smooth bromegrass in non-contaminated soil on top of TNT-contaminated soil also were evaluated.

TNT-contaminated soil was collected from a ditch at the NOP site where packing line washings were drained at least 40 years ago. Noncontaminated soil was obtained from another NOP location.

Two categories of experiments were conducted. The first included plants growing in contaminated and noncontaminated soil mixed at different ratios to obtain a range of TNT concentrations. The second included plants grown in noncontaminated soil underlain by a contaminated and noncontaminated soil mix.

Noncontaminated and TNT-contaminated soil with similar physical characteristics were mixed at ratios of 40:1, 80:1, 160:1, 240:1, and 320:1 (w/w) to approximate predicted dilution concentrations of 78, 68, 51, 34 and 16 mg TNT L^{-1}. The initial measured leachate concentrations were 52, 42, 32, 24 and 18 mg TNT L^{-1}. Noncontaminated soils with and without plants were included as controls. Containers were filled with 135 g of each soil mix. Containers with soil mix first were saturated by placing them in distilled deionized water for two days. The lower 75 percent of each container was suspended in an insulated cooler and the lid replaced with 7-cm thick insulation material. A 250 mL amber glass bottle was placed under each container to collect leachate. The coolers were placed in a greenhouse and the coolers temperatures were maintained at 20°C by circulating chilled water. Daylight was extended to 14 hours using sodium vapor lamps.

Ten seeds of smooth bromegrass (*B. inermus* cv. Lincoln) or tall fescue (*F. arundinaceae* cv. Rebel Junior) were planted per container and covered with a 2 to 3 mm layer of noncontaminated soil. Grasses were thinned to four per container 13 days after initiation (DAI). After thinning, moisture was maintained in the planting mix by adding 10 mL of distilled deionized water daily to each container and fertilizing once a week with 20:10:20 (NPK) fertilizer at 49 kg N ha^{-1}. Treatments were replicated six times and the experiment repeated twice.

Germination rate was recorded daily until thinning and grass shoot growth was recorded by measuring height of the longest leaf from plant base to tip. Leachate samples from bottles were collected at 20 and 40 DAI. Grasses were harvested eight weeks after planting, and shoot and root dry weight, root length and root surface area were recorded.

Soil samples were collected to estimate soil solution equilibration and TNT concentrations at the start and at the end of the experiment. Similar procedures were used in experiments to investigate noncontaminated soil layered over contaminated soil. As in the above experiment, 75 g of mixed soil in the same ratio was placed in the bottom of the container and 75 g of noncontaminated soil was poured on the top. Grasses were harvested eight weeks after planting. At the end of the experiment, shoot and root dry weight, root length and root surface area were recorded. Treatments were replicated six times and the experiment repeated twice.

A completely randomized design was used in these experiments with tall fescue and smooth bromegrass grown in side by side separate coolers. Analysis of variance was performed (SAS Institute, 1990). Means and Fisher's LSD values (0.05) are reported.

Germination. Germination of both grass species decreased with increasing soil solution TNT concentration (Figure 1 A). Smooth bromegrass germination was reduced by more than 50 percent of the control at TNT concentrations of 24 mg L^{-1} or greater, while tall fescue germination was not reduced by 50 percent until soil solution concentrations were 31 mg TNT L^{-1} or greater. Over the experimental range of soil solution TNT concentrations, tall fescue exhibited greater tolerance to TNT than smooth bromegrass.

Shoot Height. Seedling height at 25 DAI of both grass species decreased as soil solution TNT concentration increased (Figure 1 B). Smooth bromegrass and tall fescue seedling height was reduced by more than 50

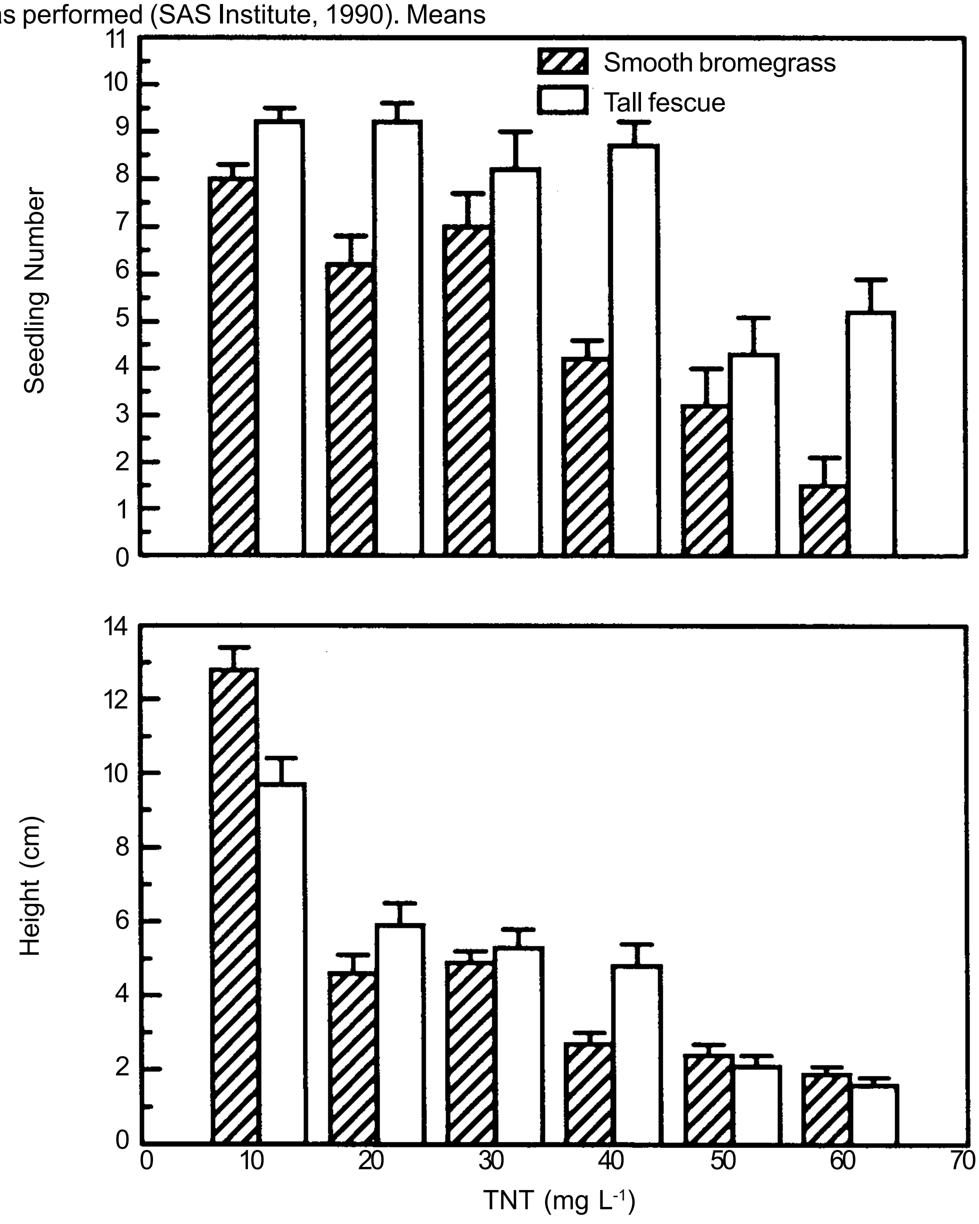


Figure 1. Reduction in germination (A) and top growth height (B) of smooth bromegrass and tall fescue. Vertical bars represent Fisher's LSD values (0.05).

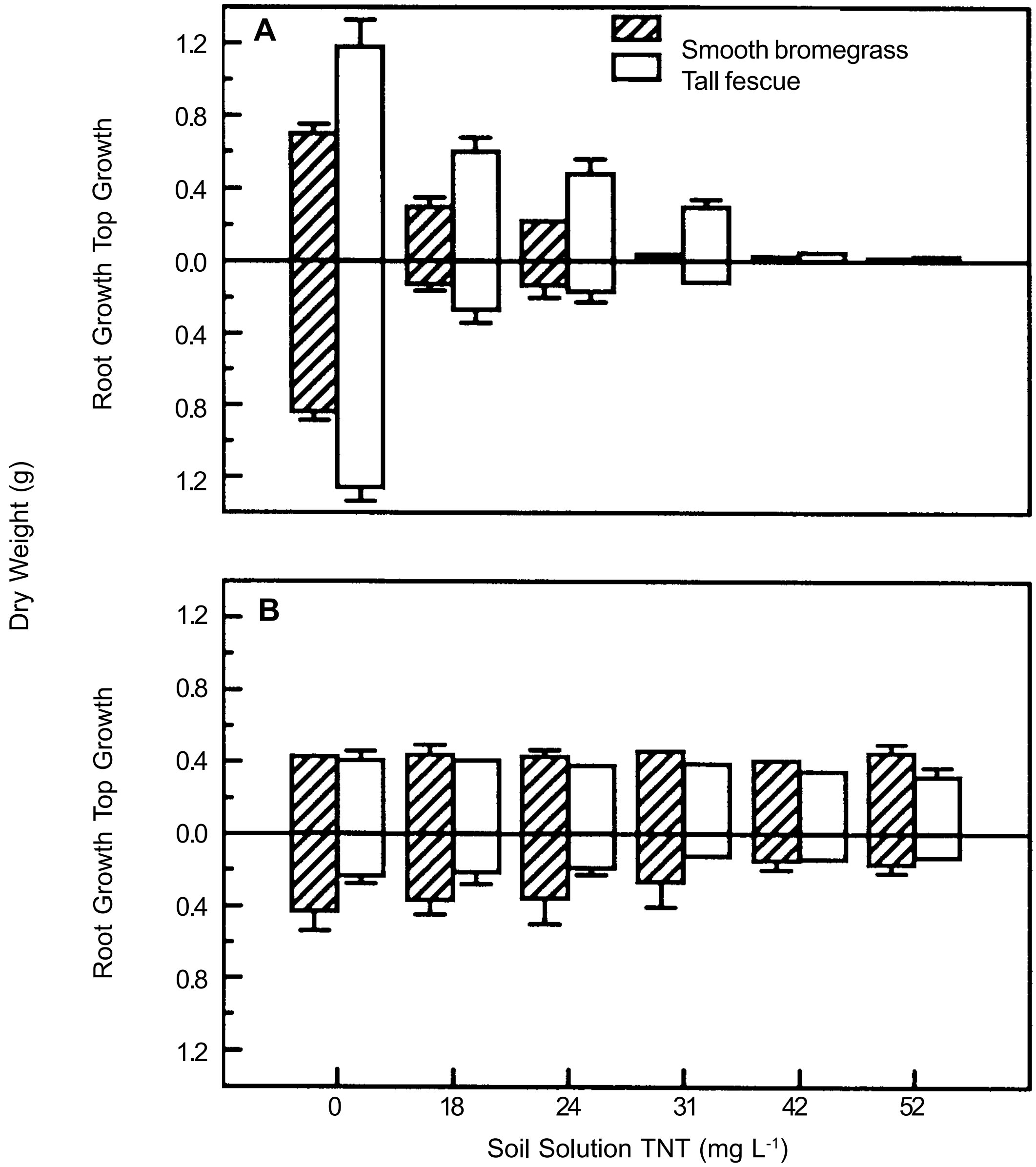


Figure 2. Reduction in shoot and root growth of smooth bromegrass and tall fescue. Soil mix (A) and soil layer (B) experiments. Vertical bars represent Fisher's LSD values (0.05).

and 40 percent, respectively, compared to seedlings growing in noncontaminated soil. Tall fescue seedlings tolerated higher TNT concentrations than smooth bromegrass seedlings. Growth height of both tall fescue and smooth bromegrass were severely affected at soil solution concentrations greater than 24 and 31 mg TNT L^{-1}, respectively.

Dry weight. At 56 DAI seedling shoot dry weight decreased significantly (P> 0.05) as soil solution TNT concentration increased (Figure 2 A). Averaged over the TNT contaminated soil treatments, tall fescue shoot dry weight was 50 percent greater when compared to smooth bromegrass. The low number of germinated seeds and reduced seedling growth at soil solution TNT concentrations above 31 mg L^{-1}, also reduced shoot dry weight production of both species.

Smooth bromegrass and tall fescue top growth dry weight did not significantly decline as soil solution TNT concentration increased in the soil layering experiments (Figure 2 B). Compared to the soil mix experiment, the grasses were tolerant of higher TNT concentrations in the soil layer experiment (Figure 2 A and B). Except for the control treatment, dry weights from both species were similar or higher in the soil layer experiment at all TNT concentrations compared to the soil mix experiment. Grasses beyond the seedling stage of growth may be better able to tolerate higher TNT concentration than young seedlings.

Root area. Root area of both grass species was drastically reduced at all non-contaminated:contaminated soil mix ratios (Figure 3 A). Tall fescue root area was more than 65 percent greater than smooth bromegrass root area as soil solution TNT concentrations increased to 24 mg L^{-1}. Tall fescue root areas were not significantly different above 18 mg L^{-1} TNT. There was no measurable root area of either grass species at soil solution TNT concentrations above 31 mg L^{-1}.

In the soil layer experiments, smooth bromegrass root area was significantly greater than tall fescue at soil solution TNT concentrations up through 24 mg L^{-1} (Figure 3 B). At soil solution concentrations above 24 mg TNT L^{-1}, root area was similar in both species. Below 24 mg TNT L^{-1} there was visible root growth from the non-contaminated soil layer into the contaminated soil, but it was not measurable for either species. These roots were so fine it was impractical to measure them. Smooth bromegrass root area declined up to 24 mg TNT L^{-1}. This may indicate smooth bromegrass roots are more sensitive to TNT than tall fescue.

Root dry weight. Recoverable root dry weight was reduced more than 84 percent in smooth bromegrass and 78 percent in tall fescue at the low soil solution TNT concentration of 18 mg TNT L^{-1} (Figure 2 A). Relative to root dry weight in the noncontaminated soil treatment, tall fescue produced 65 percent more root dry weight than smooth bromegrass at soil solution concentrations up to 24 mg TNT L^{-1}. Tall fescue root dry weight production in the 31 mg TNT L^{-1} soil solution treatment was only 8 percent of the noncontaminated soil, and there

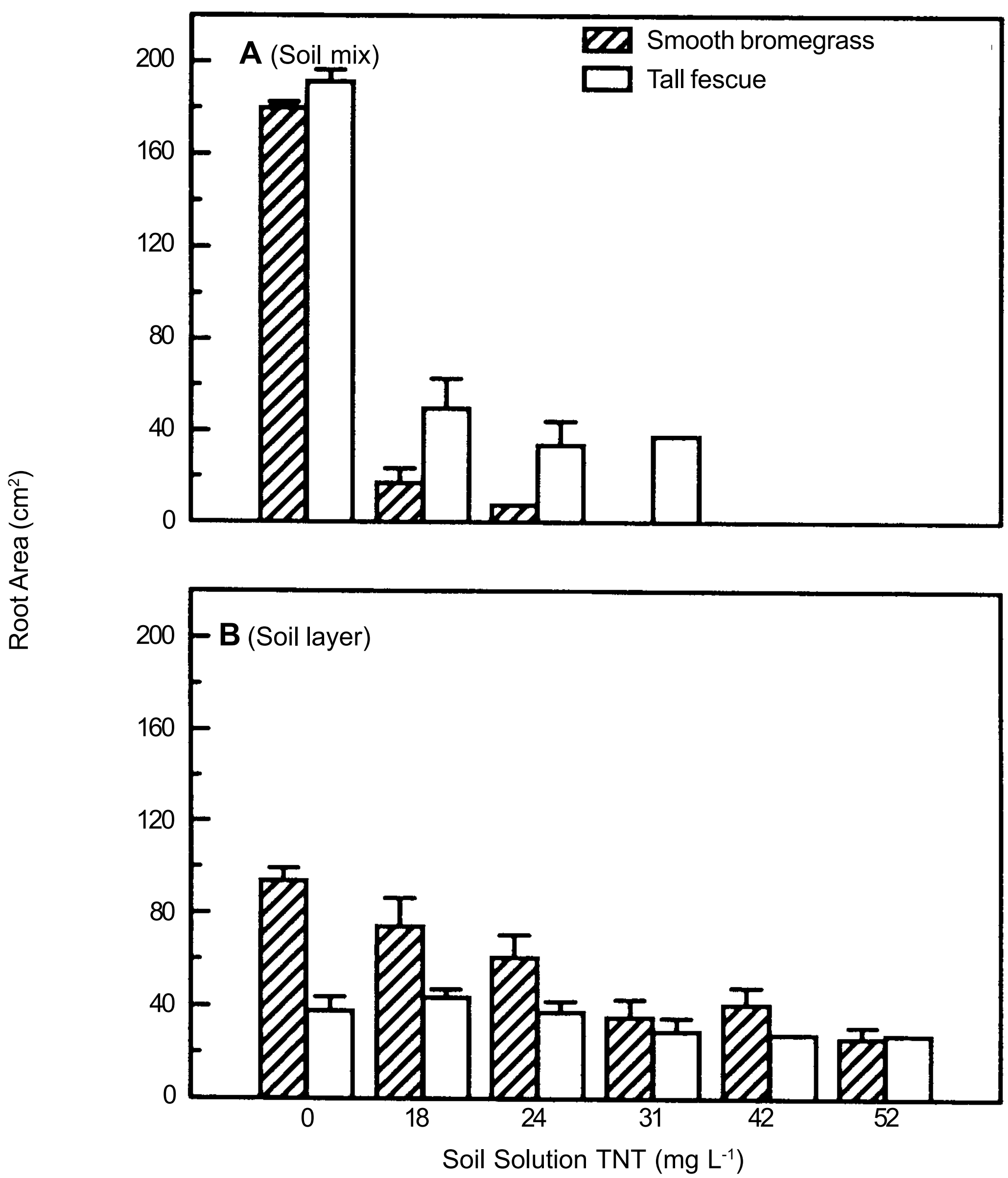


Figure 3. Reduction in root area of smooth bromegrass and tall fescue. Soil mix (A) and soil layer (B) experiments. Vertical bars represent Fisher's LSD values (0.05).

was no recoverable smooth bromegrass root dry weight. There was no recoverable root dry weight from either grass species above 31 mg TNT L^{-1} soil solution.

Greater shoot growth indicates tall fescue tolerated TNT-contaminated soil better than smooth bromegrass. However, smooth bromegrass root area and root dry weight were usually greater than tall fescue. After abiotic treatments to decrease TNT concentrations to less than 20 mg L^{-1}, these grasses may be able to complete soil remediation. However, previous research indicated TNT levels in contaminated soils should be lower than 30 mg L^{-1} for seed germination and initial growth. This research indicates tall fescue and smooth bromegrass can germinate and grow in soils with solution concentrations less than 31 mg TNT L^{-1}. Although the mode of action for TNT phytotoxicity is unknown, it affects root and shoot growth rates. Results from the layer experiment indicate older plants may be able to tolerate higher TNT concentration. Roots of seedlings which germinated close to the container wall were able to grow along the sides between the soil and container at higher concentrations than those from seedlings established in the middle of the containers. It may be roots growing along the container sides were exposed to less TNT as the roots were not always completely surrounded with soil and/or the soil solution. Shoot and root dry weight were not significantly different between species when grown in noncontaminated soils underlain with contaminated soils. It is possible to maintain growth and development of these grasses on soil marginally contaminated soil as demonstrated by the layer experiment.

An Integrated Approach to Creeping Bentgrass Fairway Management

J.E. Watkins, R.E. Gaussoin, R.C. Shearman, M.R. Vaitkus and L.A. Wit

This research was designed to determine the interactive effects of cultivar, irrigation, nitrogen nutrition and fungicide application frequency on bentgrass fairway quality and disease incidence. Although creeping bentgrass is gaining popularity for fairway use, there is little research regarding management systems requirements for its use as a fairway turf. There is research information about specific management practices, such as disease control, mowing height and frequency, nitrogen nutrition and irrigation on bentgrass growth and development, but very little assessing the interactive impacts of these and other practices when put into a systems approach to turf management. The overall objective of this research is to identify a management system(s) that both maintains desired turfgrass quality and playability and minimizes disease injury and, more efficiently uses nitrogen nutrition, fungicide treatments and irrigation practices.

The project location was the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. Plots of Penneagle and SR1020 creeping bentgrass were arranged in a 2x2x3x5 factorial design with treatments replicated three times. Main plots consisted of irrigation treatments of 100 percent ETp or 60/80 percent ETp. Penneagle and SR1020, made up the subplots. Fungicide application frequency and nitrogen nutrition level were the sub, subplots and sub, sub, subplots, respectively.

Plots were initially seeded May 22, 1997, on a Sharpsburg silty clay loam site. Cropping history of the area was bentgrass that was killed with glyphosate and removed. Routine fertilizer, fungicide and irrigation treatments were applied in 1997 to allow the turfs to establish. Table 1 shows the pretreatment soil analysis. Research treatments were initiated in the 1998 growing season.

General maintenance included mowing the turf at 3/8 inch, three times per week. Clippings were removed. Broadleaf weeds were controlled by a postemergent treatment of Trimec (2,4-D; dicamba; mecoprop) herbicide applied at a rate of 3.5 pints per acre in 60 gallons of water per acre in mid-October. Water-soluble potassium was applied at 3 pounds per 1,000 square feet per season in seven monthly increments beginning in May and ending in November. The plot area was aerified in May, 1998 (cores removed) and again in mid-September (cores chopped and returned). The cores were left until the turf on the plugs had died to avoid contamination between cultivars. Turfs were trafficked beginning mid-June and repeated weekly until August 1 using eight passes with the traffic machine per plot. Pre- and post-traffic bulk densities were taken April 4, 1998 and Oct. 13, 1998, respectively.

Nitrogen nutrition treatments consisted of 1.5, 3 or 6 pounds of nitrogen per 1,000 square feet per season

Table 1. Pre-treatment soil analysis (Aug. 13, 1997) for the study on the interactions of irrigation, cultivar, nitrogen nutrition and fungicide application frequency treatments on creeping bentgrass fairway turf.

pH	7.3	CEC (Cmol/kg)	35.2
K ppm	428.0	K (exch) (Cmol/kg)	1.2
Bray P (ppm)	37.4	Na (exch) (Cmol/kg)	0.6
Organic Matter (%)	2.9	Mg (exch) Cmol/kg)	4.8
Na (ppm)	129.0	Ca (exch) (Cmol/kg)	19.2
Cl (ppm)	11.2	S (ppm)	10.7

Table 2. Nitrogen application schedule and rates for the 1998 growing season.

lbs N/1000 ft²/season	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*
1.5	0.21	0.21	0.21	0.21	0.21	0.21	0.21
3.0	0.43	0.43	0.43	0.43	0.43	0.43	0.43
6.0	0.86	0.86	0.86	0.86	0.86	0.86	0.86

applied on the following schedule (Table 2).

While sulfur-coated urea was applied for the initial nitrogen treatment, liquid urea was used for all subsequent treatments to obtain more uniform distribution. The urea is bulked into a 2.5 gallon tank pressurized with CO_2 and applied at 30 psi with a Spray Hawk sprayer fitted with a T-jet 80015 flat fan nozzle.

A tank mix of Chipco Aliette Signature at 4 ounces per 1,000 square feet and Daconil Ultrex at 1.8 ounces per 1,000 square feet was applied to plots on a seven-, 14-, 21- or 28-day schedule using the Spray Hawk sprayer with a T-jet 8002 flat fan nozzle.

Plots were inoculated with *Sclerotinia homeocarpa*, cause of dollar spot, cultured on autoclaved tall fescue seed. Inoculum was applied with a 2.5 foot Gandy drop spreader calibrated to deliver 1.5 pounds of inoculum per 1,000 square feet.

Dollar-spot severity was rated every two weeks from July 1 to Sept. 1. Turf quality was rated monthly.

The data from the 1998 growing season is summarized in Tables 1-4. Turfgrass quality was influenced by both fungicide application frequency and nitrogen nutrition level (Tables 3 and 4). As fungicide frequency decreased from every seven days to every 28 days, there was a significant decrease in turfgrass quality (Table 3). Turfgrass quality was highest at the 6 pounds N per 1,000 square feet per season (Table 4). Although there were significant differences in quality at the July 1 ratings, the turf was still growing in and its overall thinness resulted in lower quality ratings. There was no significant interaction between fungicide application frequency and nitrogen nutrition level.

Dollar spot was severe from mid-July through August. Severity was influenced by the interaction of irrigation, cultivar and fungicide application frequency (Table 5). As fungicide frequency increased dollar-spot severity decreased. There was no significant difference in disease severity between cultivars or between irrigation treatments. A 14- to 21-day fungicide application schedule appeared to hold dollar-spot severity to a moderately light level. These results are not totally unexpected since this is still a young study and the overall interactions of fungicide application frequency, nitrogen nutrition, cultivar and irrigation treatments may become more significantly defined with time. The irrigation treatments were probably negated in 1998 because of excessive rainfall in June and July.

Dollar-spot severity also was significantly influenced by nitrogen level within each irrigation treatment (Table 6). As nitrogen level increased, dollar-spot severity decreased. The highest dollar spot severity was at the 60/80% ETp and 1.5 pounds of nitrogen. This was probably due to a greater stress level on those treatments, and dollar spot is usually more severe on stressed turf.

Creeping bentgrass is becoming more widely used as a fairway turf in the central United States. Many of the cultivars used in fairways are susceptible to diseases such as dollar spot. In fact, in the golf course industry

Table 3. Quality of creeping bentgrass as influenced by fungicide application frequency for year 1998.

Application frequency (days)[a]	*Quality*[b]		
	1 Jul 98	*29 Jul 98*	*26 Aug 98*
7	4.0c	6.4a	7.3a
14	4.5ab	6.1a	6.6b
21	4.5ab	5.7b	5.0c
28	4.8a	5.1c	4.0d
0	4.3bc	4.0d	2.5e
LSD (0.05)	**0.3**	**0.3**	**0.3**

[a]Initiated 30 Jun 98 and terminated 19 Aug 98.
[b]Quality is rated on a scale of 1-9 with 1 being worst, 5 intermediate and 9 best.

today, more dollars are spent to control dollar spot than any other disease. This is reflected in the general concern among golf course superintendents that bentgrass fairways, as compared to other turfgrass species, require more inputs to avoid disease problems and maintain quality and playability. Our research has begun to determine the interactive effects of cultivar, irrigation, nitrogen nutrition and fungicide-application frequency on bentgrass fairway quality and dollar spot incidence and severity. As this study matures, the data should provide golf course superintendents with decision making tools to better maintain bentgrass fairways, while minimizing inputs.

Table 4. Quality of creeping bentgrass as influenced by nitrogen nutrition level for year 1998.

N nutrition level (#N/M/S)	*Quality*		
	1 Jul 98	*29 Jul 98*	*26 Aug 98*
1.5	4.1b	5.2c	4.8c
3.0	4.2b	5.5b	5.1b
6	4.9a	5.8a	5.4a
LSD (0.05)	**0.3**	**0.2**	**0.2**

Table 5. Dollar spot severity (July 29, 1998) as influenced by the interaction of irrigation, cultivar and fungicide application frequency.

Application frequency (days)	*Irrigation*			
	100% ETp		*60/80% ETp*	
	Cultivar			
	Penneagle	*SR1020*	*Penneagle*	*SR1020*
7	1.2[a]	1.1	1.0	1.2
14	1.0	1.8	1.3	1.9
21	1.2	1.9	2.7	1.2
28	3.7	2.4	3.7	4.0
0	6.2	5.1	5.8	6.6

LSD (0.05) within cultivar/within irrigation, between fungicide application frequency = 1.1

LSD (0.05) within fungicide application frequency/within irrigation, between cultivars = 3.6

LSD (0.05) within cultivar/within fungicide application frequency, between irrigations = 2.9

[a]Dollar spot severity is rated on scale of 1-9 with 1 being light, 5 moderate and 9 severe.

Table 6. Dollar spot severity (July 29, 1998) as influenced by the interaction of irrigation and nitrogen nutrition level.

N nutrition level (#N/M/S)	*Irrigation*	
	100 % ETp	*60/80% ETp*
1.5	2.8[a]	3.7
3.0	2.9	2.8
6	2.0	2.2

LSD (0.05) within rows = 1.5

LSD (0.05) within columns = 0.5

[a]Dollar spot severity is rated on a scale of 1-9 with 1 being light, 5 moderate and 9 severe.

Grow-In and Cultural Impacts on United States Golf Association Putting Greens and their Microbial Communities

R.E. Gaussoin, R.A. Drijber, W.L. Powers, R.C. Shearman, M.R. Vaitkus, M. Aslan and L.A. Wit

The overall goal of this project, started in 1996, is to better understand the impact of grow-in procedures on putting green establishment and performance. Impacts on the physical, chemical and microbiological factors associated with the United States Golf Association (USGA) root zones and rhizosphere are emphasized.

The project is being conducted at the University of Nebraska's John Seaton Anderson Turfgrass Research Facility near Mead, Neb. The five-year project is composed of three phases, Construction and grow-in, Microbial community assessments and Grow-in procedure impacts on the long-term performance of the putting green. Phases One and Two span three-year periods. Phase Three will involve experiments repeated over the five years of the project.

Two separate USGA-specification root-zone mixtures — one composed of sand and peat (80/20 ratio) and one a combination of sand, peat and soil, (80/15/5 ratio) — were developed in 1996. Construction materials complied with USGA greens recommendations for physical characteristics and organic matter content. First-year greens were constructed in late summer of 1996, allowed to settle over the winter and were seeded with Providence creeping bentgrass (1.5 lbs/1,000ft^2) on May 30, 1997. Year-two plots were constructed in 1997, allowed to settle over the winter and were seeded on May 27, 1998.

Accelerated and Controlled treatments were applied before and after seeding according to the treatment schedule outlined in Table 1.

Data were collected on: percent vegetative cover; color (1-9=most green); quality (1-9=best quality); ball roll distance (Stimpmeter) and surface hardness (Clegg).

Soil physical properties were also examined in October, 1998. Infiltration rates were measured in the field using a 6" single-ring infiltrometer. Soil cores were sampled and analyzed for water retention and total porosity using pressure plate techniques.

1997 Greens

1. Early season (June 15) vegetative cover was greater for root-zone mix plots containing soil than those without soil; 71 percent vs. 67 percent, respectively (Table 2). There was no effect of grow-in treatment (Table 3). Quality, Pythium damage and color were unaffected by differences in the root-zone mix.

2. High humidity and little precipitation in July resulted in evidence of *Pythium* sp., as well as direct high temperature injury. Pythium damage was evaluated in mid-July on a scale of 1-9, with 9 indicating greatest decline. The accelerated treatment exhibited greater decline than the controlled grow-in (7.5 vs. 3.0) (Table 3). There was no effect of root-zone mix and quality was not adversely affected (Table 2 and 3).

3. A significant interaction between treatments was found for ball roll distance on June 15 (Table 4). The nonsoil root-zone mix with accelerated grow-in treatments had longer ball roll than the controlled or soil-containing mix. Root-zone mix had no effect on ball roll. On most observation dates, grow-in treatment had no effect on ball roll; differences between accelerated (57 cm) and controlled (54 cm) grow-in treatments were observed only on Sept. 24 (Table 5). On all observation dates, the soil-containing root-zone mixture had higher surface hardness than the soil-less mix (Table 6). Surface hardness was not affected by grow-in treatment.

4. Soil infiltration rates in 1998 were not significantly different between root-zone mixes or grow-in treatments.

5. Air-filled porosity at 40 cm hydraulic head did not

Table 1. Establishment and grow-in treatments for GCSAA/USGA greens construction project. (All rates in pounds per 1,000ft^2 unless noted.) John Seaton Anderson Turfgrass Research Facility near Mead, Neb., 1998.

		Accelerated				*Controlled*		
		N	*P*	*K*		*N*	*P*	*K*
Preplant Treatments								
STEP (83113)	16	—	—	—	11	—	—	—
Started (16-25-12)	12	2	3	1.4	6	1	1.5	.7
15-0-29 (8845)	9	1.35	0	2.6	4.5	.7	0	1.3
38-0-0 (8820)	7.25	2.75	0	0	3.6	1.34	0	0
Totals		**6.1**	**3**	**4**		**3.04**	**1.5**	**2**

Postplant Treatments

	Accelerated	Controlled
Starter (16-25-12)	Full rate - weekly	Half Rate - every two weeks
STEP	100#/A	60#/A

(45/90 days post planting)

Mowing	.... 3/8' to 3/16' ....
Verticutting	.... Canopy only (7-10 days) ....
Topdressing	.... Light, frequent (7-10 days) ....
Rolling	One weekly ... Once every two weeks
Disease Control	.... Preventative ....
Insect Control	.... Preventative ....
Weed Control	.... Preemergence; Preventative

Table 2. Cover, quality, pythium damage and color means for USGA/GCSAA greens construction project, 1997 Greens. John Seaton Anderson Turfgrass Research Facility near Mead, Neb., 1998.

1997 Greens	*Cover*	*Quality*	*Pythium damage*	*Quality*	*Color*	*Quality*	*Color*
Root Zone Mix	*6/15*	*7/15*		*9/1*		*9/15*	
Sand/Peat (80:20)	67b	5.8	5.3	6.5	7.2	6.8	6.7
Sand/Peat/Soil (80:15:5)	71a	6.0	5.2	6.5	7.7	6.3	7.2

Data within columns followed by different lower case letters are significantly different based on a LSD (P=0.05).

Table 3. Cover, quality, pythium damage and color means for USGA/GCSAA greens construction project, 1997 Greens. John Seaton Anderson Turfgrass Research Facility near Mead, Neb., 1998.

1997 Greens	*Cover*	*Quality*	*Pythium damage*	*Quality*	*Color*	*Quality*	*Color*
Grow-in Treatments	*6/15*	*7/15*		*9/1*		*9/15*	
Accelerated	69.2	5.7	7.5a	6.2	8.7a	6.8	7.8a
Controlled	68.3	6.2	3.0b	6.8	6.2b	6.3	6.0b

Data within columns followed by different lower case letters are significantly different based on a LSD (P=0.05).

Table 4. Ball roll distance (Stimpmeter) for USGA/GCSAA greens construction project, 1997 Greens. John Seaton Anderson Turfgrass Research Facility near Mead, Neb., 1998.

1997 Greens	*Stimpmeter (June 15, 1998)*	
	Accelerated	*Controlled*
Root Zone Mix	---------------------cm---------------------	
Sand/Peat (80:20)	73 Aa	65 Bb
Sand/Peat/Soil (80:15:5)	68 Bb	67 Bb

Data within rows followed by different upper case letters are significantly different based on a LSD (P=0.05).
Data within columns followed by different lower case letters are significantly different based on a LSD (P=0.05).

Table 5. Ball roll distance (Stimpmeter) for USGA/GCSAA greens construction project, 1997 Greens. John Seaton Anderson Turfgrass Research Facility near Mead, Neb., 1998.

1997 Greens	*Stimpmeter*			
	7/14	*8/14*	*9/24*	*10/14*
Grow-in Treatments	---------------------cm---------------------			
Accelerated	67	71	57a	50
Controlled	67	71	54b	53

Data within columns followed by different lower case letters are significantly different based on a LSD (P=0.05).

differ between root-zone mixes or grow-in treatments (Figure 1) in 1998. Total porosity and bulk density, however, were influenced by root-zone mix (Figures 2 and 3). Total porosity was greater in the sand/peat than in the sand/peat/soil root-zone mix, and, concurrently, bulk density was higher in the sand/peat/soil mix. 1998 values for percent air-filled porosity at 40 cm hydraulic head and bulk density were generally lower than 1997 values, which averaged 30 percent and 1.48 g/cm^3, respectively. Total porosity at 40 cm hydraulic head was slightly greater in 1998 (approximately 48 percent vs. 45 percent in 1997).

1998 Greens

1. Ball roll distance was greater in controlled (52 cm) versus accelerated (41 cm) greens in October (Table 7), while root-zone mix had no effect.

2. Surface hardness was greater in the root mix containing soil than in the soil-less mix (Table 8). Grow-in treatments appeared not to effect surface hardness.

3. Soil infiltration rates, percent air-filled porosity and percent total porosity at 40 cm hydraulic head, and bulk density were not significantly different between root-zone mixes or grow-in treatments (Figures 4, 5 and 6).

Results to date indicate the following:

Microbial biomass was not affected by root-zone mix or grow-in procedure on plots established in 1997. Microbial biomass increased over 200 percent from spring to fall and decreased 40-60 percent as sampling depth increased. Water infiltration from these plots was not affected by root-zone mix or grow-in procedure when measured in 1998.

The following establishment results were similar in plots established in 1997 or 1998:

For two consecutive years it was found higher inputs initially increase cover during grow-in. This increase may not translate to earlier opening for play if environmental stress conditions result in damage to lush, immature turf.

A root-zone mix containing soil will establish quicker and recover from environmental stress faster than a soil-less mix. A soil-containing mix also will be harder and may result in longer ball roll distance.

Addition of soil to the root-zone mix will not affect water infiltration during the establishment year.

Table 6. Surface hardness (Clegg) for USGA/GCSAA greens construction project, 1997 Greens. John Seaton Anderson Turfgrass Research Facility near Mead, Neb., 1998.

1997 Greens	*CLEGG*				
Root Zone Mix	*6/15*	*7/14*	*8/14*	*9/24*	*10/14*
Sand/Peat (80:20)	55	58	61	57	64
Sand/Soil/Peat (80:15:5)	64	70	71	65	75

Data within evaluation dates are all significantly different based on analysis of variance (P=0.05).

Table 7. Ball roll distance (Stimpmeter) for USGA/GCSAA greens construction project, 1998 Greens. John Seaton Anderson Turfgrass Research Facility near Mead, Neb., 1998.

1998 Greens	*Stimpmeter*	
	9/24	*10/14*
Grow-in Treatments	------------*cm*------------	
Accelerated	49	41b
Controlled	53	52a

Data within columns followed by different lower case letters are significantly different based on a LSD (P=0.05).

Table 8. Surface hardness (Clegg) for USGA/GCSAA greens construction project, 1998 Greens. John Seaton Anderson Turfgrass Research Facility near Mead, Neb., 1998.

1998 Greens	*CLEGG*	
Root Zone Mix	*9/24*	*10/14*
Sand/Peat (80:20)	67	79b
Sand/Peat/Soil (80:5:15)	74	91a

Data within columns followed by different lower case letters are significantly different based on a LSD (P=0.05).

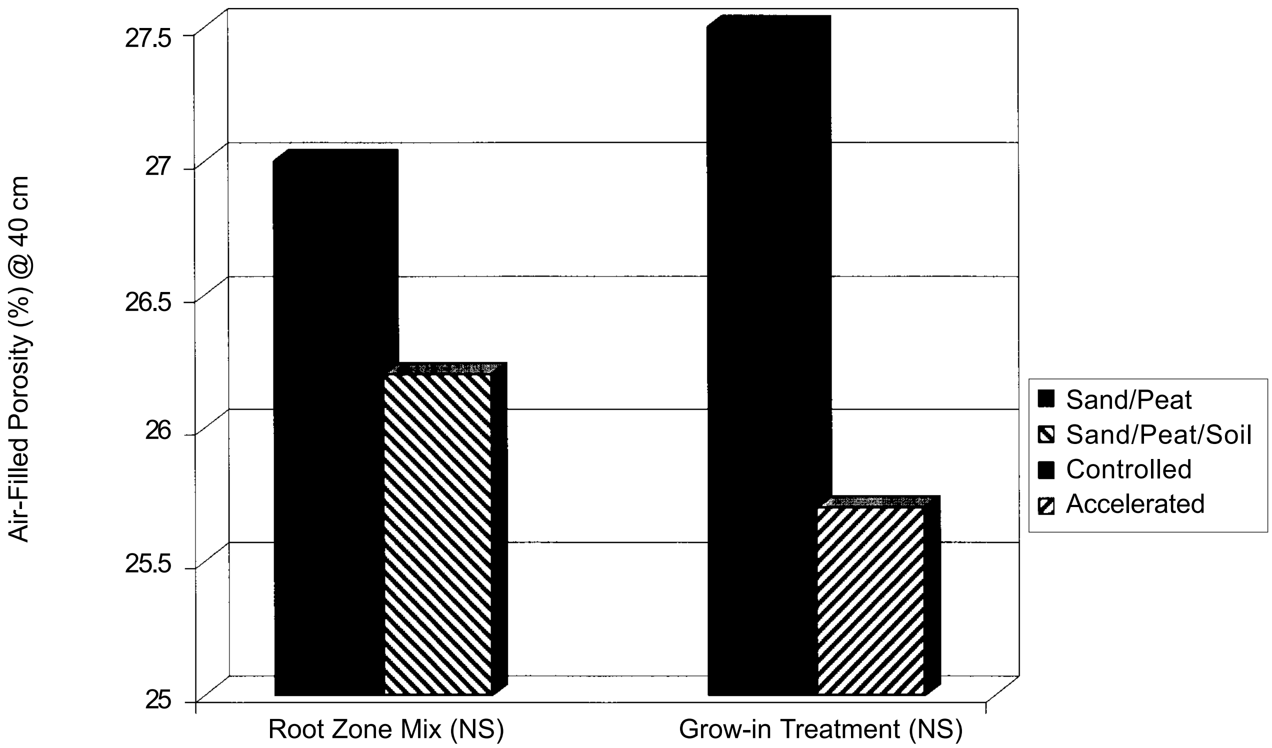


Figure 1. Air-filled porosity (%) at 40 cm hydraulic head, Fall 1998. 1997 Green, Second year soil physical properties. USGA/GCSAA greens construction project. J.S. Anderson Turfgrass Research Facility, Mead, Neb.

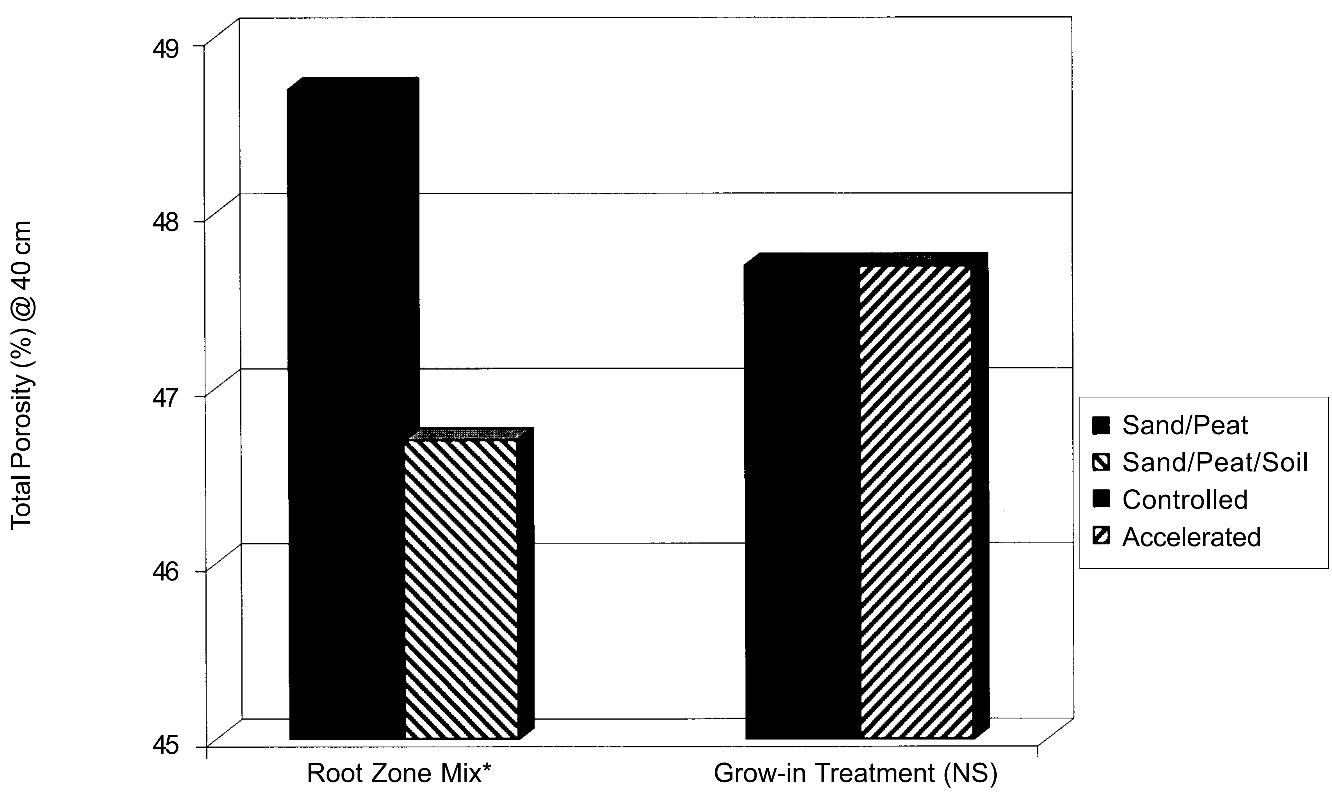


Figure 2. Total porosity (%) at a hydraulic head of 40 cm, Fall 1998. 1997 Green, Second year soil physical properties. USGA/GCSAA greens construction project. J.S. Anderson Turfgrass Research Facility, Mead, Neb. [*LSD (p<0.05) = 0.01]

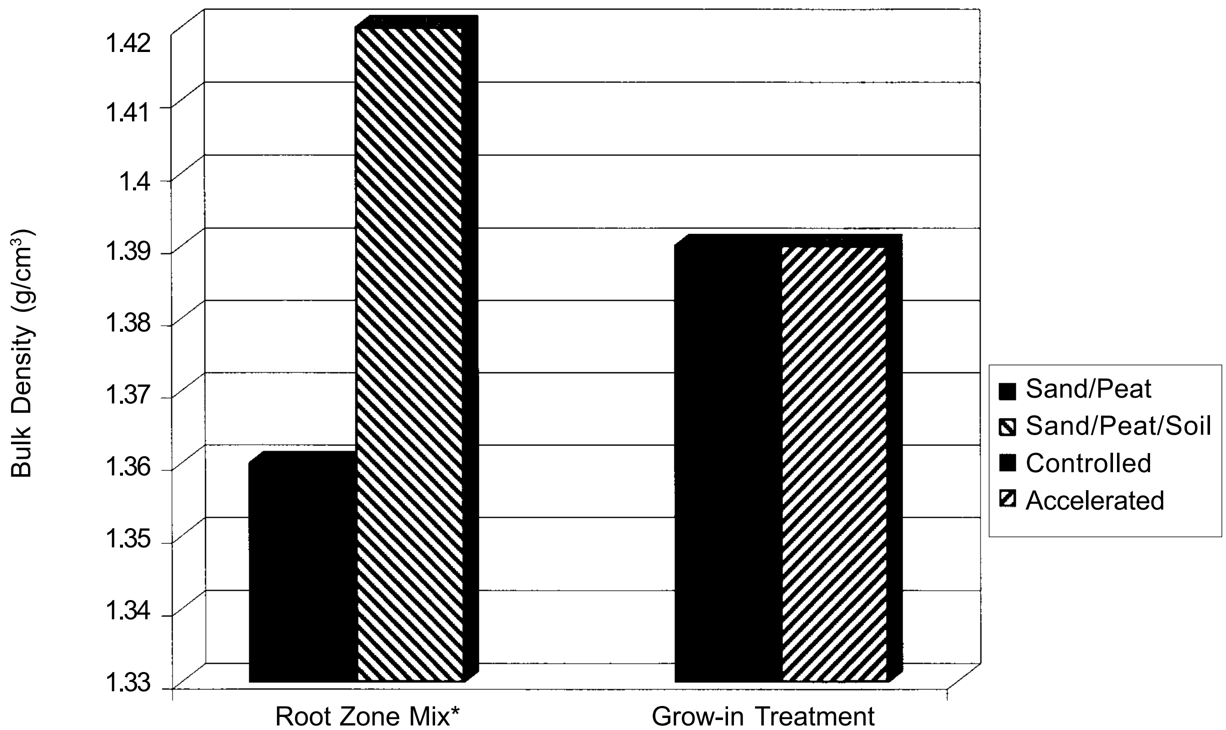


Figure 3. Soil bulk density (g/cm³), Fall 1998. 1997 Green, Second year soil physical properties. USGA/GCSAA greens construction project. J.S. Anderson Turfgrass Research Facility, Mead, Neb. [*LSD ($p<0.05$) = 0.01]

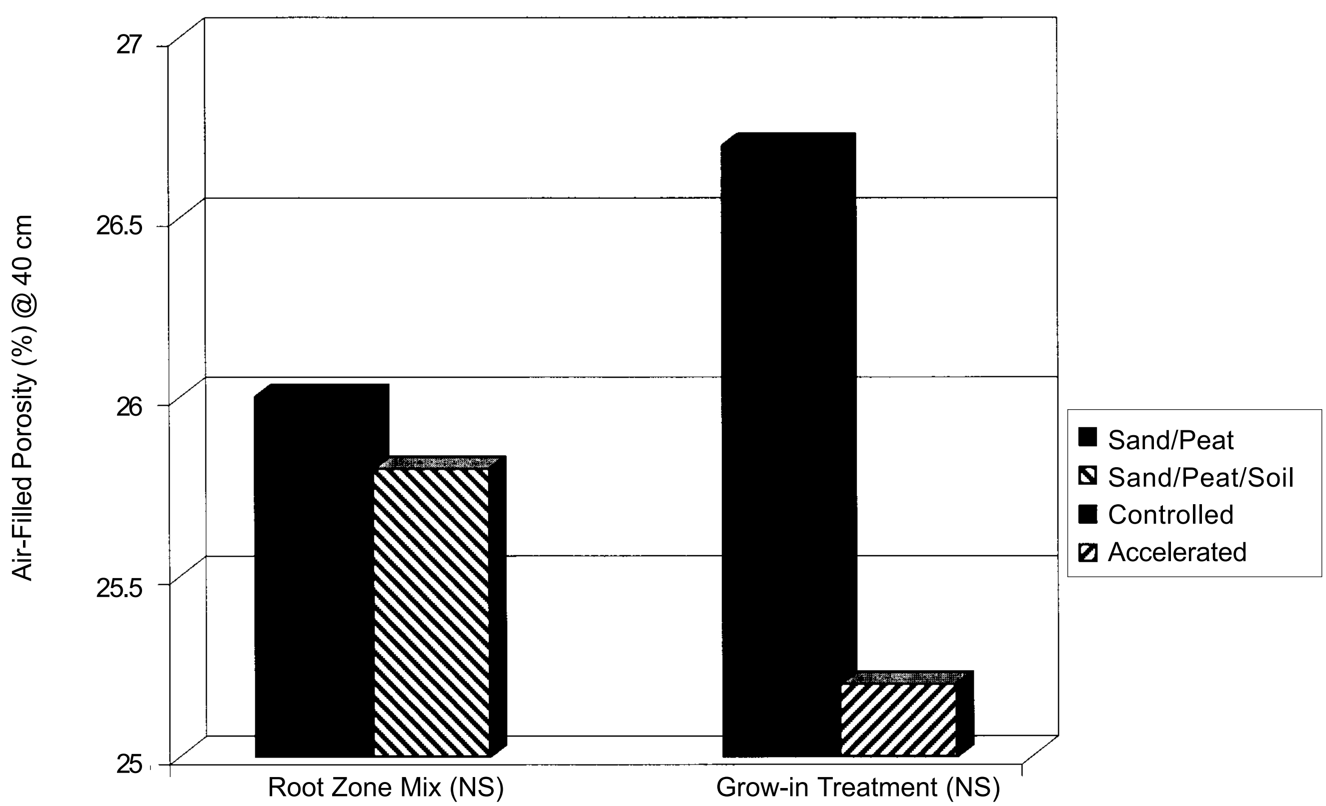


Figure 4. Air-filled porosity (%) at 40 cm hydraulic head, Fall 1998. 1998 Green, First year soil physical properties. USGA/GCSAA greens construction project. J.S. Anderson Turfgrass Research Facility, Mead, Neb.

Figure 5. Total porosity (%) at 40 cm hydraulic head, Fall 1998. 1998 Green, First year soil physical properties. USDA/GCSAA greens construction project. J.S. Anderson Turfgrass Research Facility, Mead, Neb.

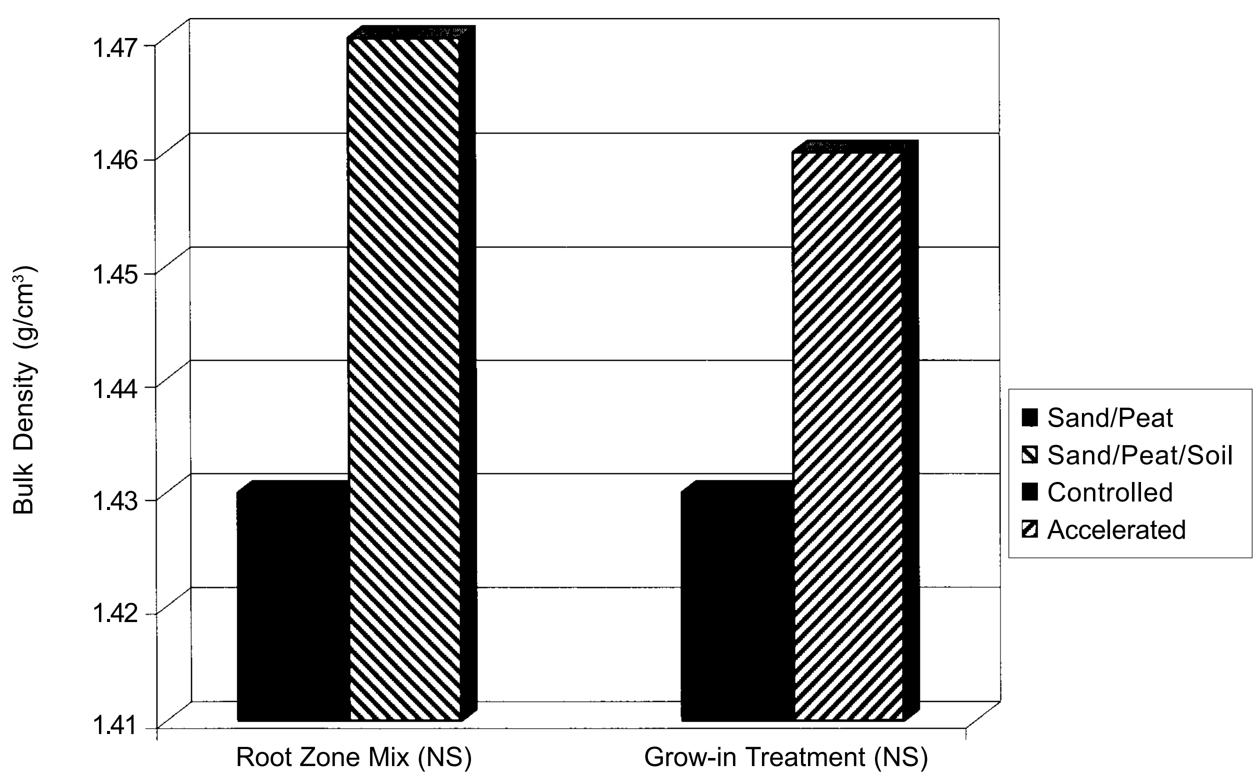


Figure 6. Soil bulk density (g/cm^3), Fall 1998. 1998 Green, First year soil physical properties. USDA/GCSAA greens construction project. J.S. Anderson Turfgrass Research Facility, Mead, Neb.

Nitrogen Fertilization and Mowing Height Effects on Buffalograss

K.W. Frank, R.E. Gaussoin and T.P. Riordan

'Cody', 'Texoka', '378', and NE 91-118 buffalograss genotypes were planted at locations in Nebraska, Utah and Kansas in 1995 to determine the effect of nitrogen fertilization and mowing height on turf-type buffalograsses. The three locations were the John Seaton Anderson Turfgrass Research Facility near Mead, Nebraska, the Rocky Ford Turfgrass Research Center at Manhattan, Kan., and the Greenville Research Farm at Logan, Utah. The soil types at the three sites are a Sharpsburg silty clay loam (fine montmorillonitic, mesic Typic Argiudoll), a Chase silt loam (fine, montmorillonitic, mesic, Aquic, Arquicolls) and a Millville silt loam (coarse-silty, carbonatic, mesic Typic Haploxepolls), respectively.

In 1996 mowing heights of 2.5, 5.1 and 7.6 cm and nitrogen treatments of 0, 2.4. 5, 10 and 20 g N m^{-2} $year^{-1}$ were imposed to identify best management practices for turf-type buffalograss. Nitrogen rates were applied as a split application, with the first application in early June and the second application six weeks later in mid-July. The nitrogen source was a polymer coat, 36N-3P-7K. Immediately following nitrogen applications, plots were irrigated with 1.3 cm water. Plots were mowed weekly and clippings collected.

Turfgrass quality, density, uniformity and color were rated visually on a scale from 1-9. The rating scale for quality, density and uniformity can be described as 1 being poor and 9 excellent. Turfgrass color was rated from 1-9 with 9 being dark green and 1 straw brown. Ratings were taken every two weeks starting two weeks after nitrogen treatment (WAT) and continued until buffalograss quiescence in the fall.

Experimental design for each location is a randomized incomplete block design and treatment design is a split-split-plot design. Main plot is buffalograss entry, split plot is mowing height and split-split plot is nitrogen level.

Statistical analysis indicated locations and years should be analyzed separately. From 1996 to 1998, buffalograss quality and color ratings decreased for the 0 and 2.4 g N m^{-2} treatments (Table 1.) Turfgrass quality and color decreased for the 5 g N m^{-2} treatment from 1997 to 1998. At the 10 and 20 g N m^{-2} treatment, turfgrass quality increased each year from 1996 to 1998. These trends suggest that although buffalograss may not initially respond to nitrogen applications, it improves after several years of management with nitrogen applications.

There was a significant entry X mowing height interac-

Table 1. Buffalograss quality and color ratings for nitrogen rates at the Nebraska site two weeks after the second nitrogen application for 1996-1998.

Nitrogen Rate	*Quality*			*Color*		
(g N m^{-2} $year^{-1}$)	*1996*	*1997*	*1998*	*1996*	*1997*	*1998*
0	5.7†	4.8	3.3	5.6‡	4.9	3.2
2.5	5.8	5.6	4.5	5.7	5.6	4.2
5	5.9	5.9	5.2	5.9	5.9	5.1
10	6.1	6.4	6.4	6.1	6.4	6.0
20	6.2	6.6	7.3	6.3	6.6	6.6
LSD (0.05)	0.2	0.2	0.2	0.1	0.1	0.1

†Buffalograss quality rated from 1-9, with 9 = excellent and 1 = poor.
‡Buffalograss color rated from 1-9, with 9 = dark green and 1 = straw brown.

Table 2. Quality ratings for Entry X mowing height at the Nebraska site at two weeks after the second nitrogen application for 1996-1998.

Entry	*Mowing Height*		
1996	*2.5 cm*	*5.1 cm*	*7.6 cm*
NE 91-118	5.9[†] Ab	6.2 Aa	6.0 Bb
378	5.8 Ab	6.2 Aa	6.2 Aa
Cody	5.5 Bb	6.2 Aa	6.2 Aa
Texoka	5.2 Cc	5.9 Bb	6.1 Aa
1997			
NE 91-118	6.0 Aa	6.0 Aa	5.6 Bb
378	6.0 Aa	6.2 Aa	5.6 Bb
Cody	5.6 Ba	6.0 Aa	5.9 Aa
Texoka	5.2 Cb	6.1 Aa	6.1 Aa
1998			
NE 91-118	5.3 Ab	5.9 Aa	5.2 Bb
378	5.4 Ab	5.9 Aa	5.8 Aa
Cody	4.8 Bb	5.6 Aba	5.4 Aba
Texoka	4.0 Cb	5.3 Ba	5.3 Ba

Means within columns followed by the same capital letter are not significantly different (p=0.05; LSD).
Means within rows followed by the same small letter are not significantly different (p=0.05; LSD).
[†]Buffalograss quality rated from 1-9, with 9 = excellent and 1 = poor.

tion for buffalograss quality at two weeks after the second nitrogen application at the Nebraska site in 1996, 1997 and 1998. At the Nebraska site, NE 91-118 and 378 had the highest quality ratings at the 2.5 cm mowing height in each year from 1996 to 1998 (Table 2). Cody and Texoka had poor quality ratings at the 2.5 cm mowing height all years. There were no differences in turfgrass quality between the 5.1 and 7.6 cm mowing heights in 1998 for Texoka, Cody or 378. Turfgrass quality of NE 91-118 was highest at the 5.1 cm mowing height.

This research indicates buffalograss response to nitrogen applications may be minimal the first year after establishment, but after several years displays significant improvements in turfgrass quality and color. Mowing height and nitrogen rate recommendations for 378 and NE 91-118 are 2.5 or 5.1 cm mowing heights and a nitrogen rate of 10 g N m^{-2} $year^{-1}$. Recommendations for Cody and Texoka are 5.1 or 7.6 cm mowing heights and a nitrogen rate of 10 g N m^{-2} $year^{-1}$.

Buffalograss Management in Fairway Trials

S.R. Westerholt

Using buffalograss as the primary grass on golf courses dates back to the 1930s. Although recommended for low-maintenance golf courses, recent studies have shown buffalograss can perform well under high maintenance conditions with very low mowing heights. In order for buffalograss use to increase under these conditions, proper management practices need to be identified. For that reason, a low-mowing maintenance study was established in 1998.

A research trial was established on a Sharpsburg silty clay loam soil during June, 1998. Eight buffalograss cultivars, consisting of four seeded and four vegetative types, were established in 15' by 30' plots with three replications. Seeded buffalograss types were seeded at a 10 g/m^{-2} (2 lb/M) rate. The vegetative types were established on 41 cm (16 inch) centers. A starter fertilizer was applied at 5 g N/m^{-2} (1 lb N/M) at planting. Light irrigation was applied daily for two weeks after planting to facilitate uniform germination of the seeded types and establishment of the plugs, after which no additional irrigation was applied. Weed control consisted of one application of Simazine at 1 qt/M.

Mowing began in early August and continued weekly at a 7.6 cm height. Percent plot coverage was rated in September to evaluate the growth rate of seeded and vegetative cultivars. Management treatments will begin in 1999.

Seeded cultivars Cody and Texoka were the quickest to establish (Table 1). NE86-118 was the quickest of the vegetative cultivars to establish. FW-3 showed good coverage as a seeded type. Although half the entries exhibited less than 50 percent coverage by September, all plots were nearly completely covered by December. The trial areas should be ready for management treatments schedule for the summer of 1999.

Table 1. Percent plot coverage of seeded and vegetative cultivars established at Mead, Neb.

Cultivar	*Establishment method*	*Percent coverage**
Cody	Seeded	73.3
Texoka	Seeded	63.3
NE86-118	Vegetative	60.0
FW-3	Seeded	50.0
NTG7	Seeded	43.3
NE86-120	Vegetative	36.7
NE86-61	Vegetative	33.3
NE-378	Vegetative	30.0
Mean		48.8
LSD (.05)**		11.5

*Percent coverage ratings are on a scale of 1-100%
**Mean separation using Fisher's LSD, $P \leq 0.05$.

Evaluation of Buffalograss for Low Mowing and Wear Tolerance

S.R. Westerholt, P.G. Johnson and T.P. Riordan

Buffalograss is most commonly grown for high mowing heights and low-maintenance situations. In recent years, we have evaluated the species for use on golf course fairways in arid regions with water shortages. We have found buffalograss does quite well at mowing heights as low as 1.4 cm (5/8"). Our oldest plot in this evaluation has been mowed to 1.4 cm for five years and has continually provided a high-quality, low-maintenance fairway-type turf.

Since initiation of the buffalograss program at Nebraska, it has also been considered tolerant to traffic and wear. However, very little information existed on buffalograss tolerance to wear under golf course fairway conditions. A simulated wear study was initiated on this area to evaluate buffalograss performance under three levels of wear using a wear-simulation machine. The use of the wear simulator provides information on tolerance levels to expect, potential cultivar variation and expected wear recovery.

A cultivar evaluation trial was established in June 1993. The area has received 20 g N/m^{-2}/yr (4 lbs N/M/yr) and no supplemental irrigation since establishment. The trial was maintained at 6.3 cm (2.5") mowing height until 1996, and was gradually lowered to 1.4 cm (5/8"). Although the area exhibited unevenness in 1997, it still provided good evaluations. In 1997, data was collected for low-mowing tolerance. In 1998, spring color and quality data were collected prior to wear treatments of two, four and eight passes with the wear simulator. Color and quality were evaluated on a 1 to 9 scale, with 1 being poor and 9 excellent.

Low mowing evaluations

The female clone NE92-135, which outperformed all other entries in 1997, performed very well in 1998, along with female clone NE92-31 (Table 1). Both cultivars had very good spring color and quality. Two male cultivars, NE92-141 and NE92-116, performed the best overall in 1998. All seed-established cultivars exhibited average color and quality characteristics and were not statistically different. The trial did have a number of new, good male clones as well as female clones that were to improve in quality.

Wear tolerance evaluations

Wear-tolerance treatments with the wear-simulation machine began the last week in June and continued weekly until the end of summer. Results of these treatments provided valuable insight on buffalograss wear tolerance and potential acceptance as a fairway grass (Table 2). Medium and low traffic conditions showed little to no effect on the overall performance of buffalograss. The high-trafficked treatment did exhibit significant damage to some individual plots, but overall did not destroy the turf. Recovery from injury was complete within seven days of the wear treatment. More impressively, wear treatment recovery was just as rapid through high temperature and low moisture conditions.

When individual turf plots began to show varying amounts of damage, wear damage data was collected and analyzed. Results indicated male and monoecious clones exhibited the most damage. (It should be noted that only three clones in this trial were monoecious, and therefore, did not have as large of a representative sample). Female clone wear tolerance was significantly better than male, but was not good as the seeded types.

Table 1. Low mowing† evaluation, established

1993 (Mead, Neb.).

Selection Name	Gender	Spring Color 5/14/98	Spring Quality** (5/14/98)
90-504-jk	Seed	5.3	6.7
90-501-jk	Seed	4.3	5.7
90-503-jk	Seed	4.7	5.7
90-502-jk	Seed	5.0	5.7
93-537-97	Seed	5.3	5.7
92-116	Male	6.0	6.0
92-137	Male	6.3	6.0
92-141	Male	7.0	6.0
90-157	Male	5.0	5.7
92-103	Female	4.7	6.3
92-125	Female	6.3	6.3
91-116-tr	Female	3.3	6.0
91-114-dd	Female	3.7	6.0
92-104	Female	6.0	6.0
92-115	Female	4.7	5.7
92-135	Female	6.7	5.3
92-31	Female	6.7	5.3
Mean		4.9	4.7
LSD (.05)		1.2	1.7

†Plot maintained at 1.4-cm (5/8") mowing height, 2 times per week, 20 g N/m^{-2}/yr (4 lbs N/M/yr) fertilizer, no supplemental irrigation.
*Color ratings on a 1-9 scale, with 1= brown and 9=very dark green
**Quality ratings on a 1-9 scale, with 1=poor and 9=excellent

Table 2. Wear-tolerance of buffalograss cultivars as related to gender.

Gender	Adjusted means	Probability† table: Monoecious	Female	Male	Seeded
Monoecious	3.6	—	.72	.41	.23
Female	3.4		—	.02	.05
Male	4.0			—	.01
Seeded/mixed sex	2.9				—

Wear simulation machine treatments††	*Monoecious*	*Female*	*Male*	*Seeded*
8 Passes	6.3 A*	5.3 A	6.7 A	4.8 A
4 Passes	2.3 B	2.7 B	3.6 B	2.7 B
2 Passes	2.0 B	2.0 C	2.3 B	1.3 C

†Probability of > |T| to test the hypothesis LSMeans (I) = LSMeans (j).
††Ratings on a 1-9 scale, with 1=no damage and 9=heavy turf damage.
*Means within the same column with the same letter are not significantly different.

Influence of Trinexapac-ethyl (Primo®) on Direct Heat Tolerance of Kentucky Bluegrass Vegetative Tissue

N.L. Heckman, G.L. Horst and R.E. Gaussoin

Cool-season grass stands often are thinned or lost due to summer heat damage. Trinexapac-ethyl (Primo®) is a plant growth regulator used to reduce clipping yields and stress on turf. A technique used to evaluate direct heat damage to vegetative tissue is to expose tissue to high temperatures and measure the amount of electrolyte leakage. This research evaluated the effect of Primo on the direct heat tolerance of two Kentucky bluegrass (*Poa pratensis* L.) cultivars.

Kentucky bluegrass cultivars Huntsville and Midnight were vegetatively propagated from samples taken at the John Seaton Anderson Research Facility near Mead, Neb. Samples were grown for five months in a greenhouse with temperatures ranging between 15°C and 24°C and supplemental lighting of 14-hour days. Samples were watered daily and mowed at 2.5 inches (6.5 cm) weekly. Fertilizer was applied weekly at 0.125 lb nitrogen/1,000 ft^2(29.7 kg nitrogen ha^{-1}). Two weeks before the heat treatments, four pots of each cultivar were treated with 0.6 oz Primo®/1,000 ft^2 (0.23 kg trinexapac-ethyl ha^{-1}). After trinexapac-ethyl application, samples were moved to a growth chamber at 23°C day/19°C night. Four days before heat treatments, temperatures were raised 4°C day/3°C night. One day before applying heat treatments, the temperature in the growth chamber was held at 35°C to acclimate the tissues. Thirty-six samples of 20, 0.75 inch (2 cm) basal leaf segments from fully expanded leaves that had grown since the application of trinexapac-ethyl were randomly collected from each treatment. Samples were placed in test tubes and rinsed three times with distilled water. The test tubes were capped with aluminum foil to prevent dehydration during heat treatment. All samples received heat treatments in a water bath of 50°C to determine the time needed to allow 35, 50 and 65 percent electrolyte leakage at a constant heat shock temperature. Samples were removed from the water bath in 15 minute intervals over two hours. Immediately after exposure, 10 mL of 25°C deionized distilled water was placed in each test tube. The tubes were incubated at 25°C for 18 hours. After incubation, conductivity was measured. Test tubes then were autoclaved for 12 minutes to kill tissues and release all electrolytes. The samples were brought to 25°C and conductivity again was measured. The percent of the total electrolytes released was calculated by taking the initial conductivity/ conductivity after autoclave * 100. The times that caused 35, 50 and 65 percent electrolyte leakage were derived and analysis of variance was preformed on the four treatments. Fishers Protected Least Significant Difference was used to separate means.

There was a sigmoidal relationship between the percentage of electrolyte leakage and time of exposure a 50°C for all four treatments (Figure 1). The time that caused 35, 50 and 65 percent electrolyte leakage was greater for Huntsville than Midnight, showing Huntsville is more tolerant of direct heat damage. However, trinexapac-ethyl showed no effects on the direct heat tolerance of either cultivar (Table 1).

Table 1. Predicted time in minutes of Kentucky

bluegrass leaf exposure at 50°C required for 35 ($Time_{35}$), 50 ($Time_{50}$) and 65 percent ($Time_{65}$) of the total electrolyte leakage to occur.

Treatment	*$Time_{35}$*	*$Time_{50}$*	*$Time_{65}$*
Midnight Untreated	41.5	54.7	69.1
Midnight Treated	40.8	53.1	65.5
Huntsville Untreated	63.7	83.1	103.1
Huntsville Treated	61.6	80.0	97.5
$LSD_{0.05}$	**8.9**	**10.5**	**12.0**

†Predicted time means derived from four electrolyte leakage curves.

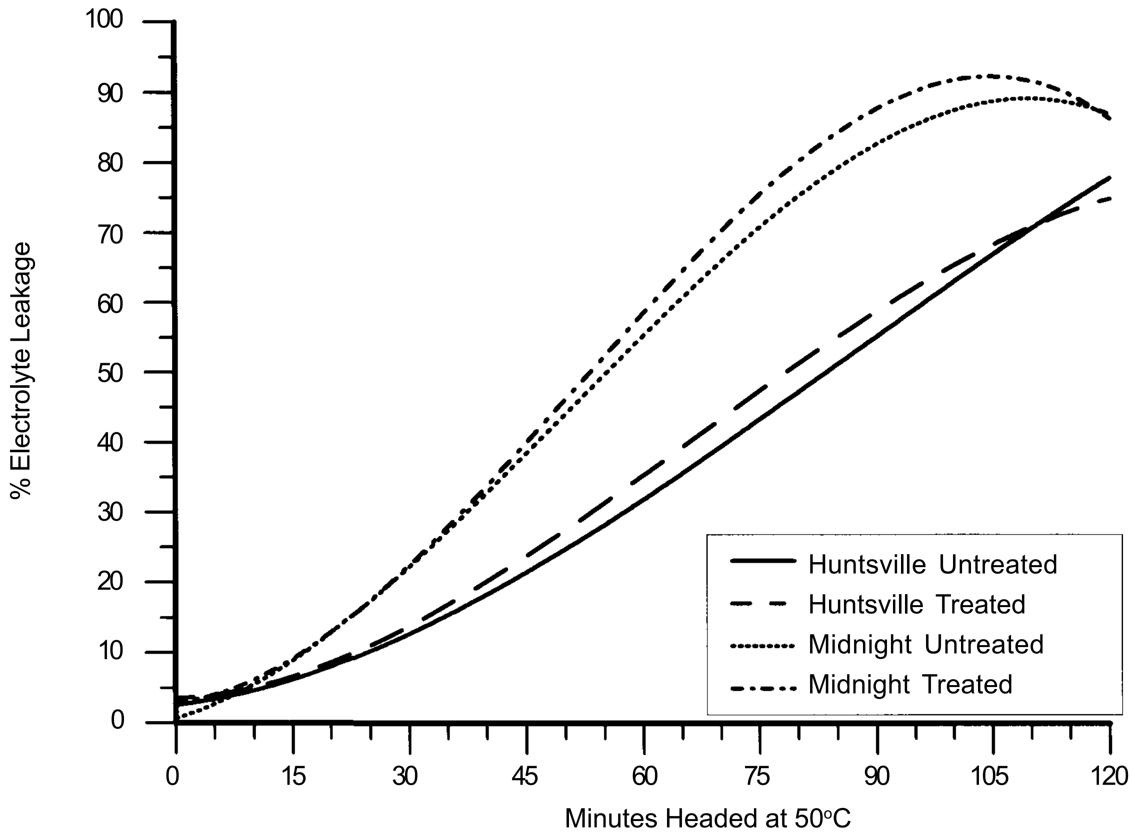


Figure 1. Relationship between the percentage of electrolyte leakage from vegetative tissue and the time exposed to 50°C of two trinexapac-ethyl treated and untreated Kentucky bluegrass cultivars.

Effect of Trinexapac-ethyl (Primo®) on Sod Pallet Storage and Handling

N.L. Heckman, G.L. Horst and R.E. Gaussoin

Kentucky bluegrass (*Poa pratensis* L.) is the most predominant cool-season grass used in North American sod production. In the sod industry, it is important to have adequate sod quality, consisting of both sod tensile strength and the ability to regrow. Heat accumulation within the stored sod pallet is one of most serious negative influences on sod quality. This can result in a less-dense sod, which may require netting to avoid tearing during transplanting. Heat accumulation in the pallet also can lead to plant death and unusable sod.

Kentucky bluegrass sod with a blend of America, Apex, Eclipse and Midnight cultivars was grown at Todd Valley Farms near Mead, Neb. on a Sharpsburg silty clay loam soil. On May 24, 1998, sod was treated with 0.6 oz Primo®/1,000 ft^2 (0.23 kg trinexapac-ethyl ha^{-1}). Sod was harvested on June 2, 1998, with a mechanical sod cutter into 20 by 40 inch (51 by 102 cm) sections 0.75 inches (1.9 cm) deep.

Sod was immediately stacked on pallets. Each pallet had 40 rows of sod, with each row consisting of 40 by 40 inches (102 cm by 102 cm) of sod. Nine pallets contained grass treated with trinexapac-ethyl and nine pallets were controls. Thermocouples were placed in six treated and six control pallets as they were stacked. Thermocouples were arranged so a vertical shaft was placed directly in the center of the pallet housing thermocouples at the depths of 12 and 36 inches (30.5 and 91.5 cm) from the bottom of the pallet. A horizontal shaft was placed on row 20 and housed thermocouples at 1, 4, 8 and 12 inches (2.5, 10.2, 20.3 and 30.5 cm) from the center of the pallet. The thermocouples were connected to a data logger and hourly temperature readings were taken.

At 24, 48 and 72 hours after harvest, sod tensile strength from rows 22 and 23 was measured. Sections of sod about 13.5 by 20 inches (34 by 51 cm) were placed on the sod table and strapped securely with a nylon band. Half of the sod section was on a stationary grate, the other half on a mobile grate, and the grates were pulled apart until the sod tore and the maximum force recorded. Three replicates were tested from each pallet. Regression analysis was used to analyze the sod temperature data, while student's pair t-test was used to detect differences in sod tensile strength.

Sod pallet temperatures at all thermocouple placements were significantly less in the sod pallets treated with trinexapac-ethyl than the untreated pallets (Figures 1-6). More heat accumulation was found in the center of the pallet compared to thermocouple placements further from the center. Sod tensile strength was greater at 24 hours after harvest for sod treated with trinexapac-ethyl as compared to the control sod (Table 1). At 48 and 72 hours after harvest, all sod was severely injured from internal heat and sod tensile strength was not significantly different.

Primo significantly decreased heat accumulation within a sod pallet. Sod tensile strength was also increased before plant death occurred. This experiment will be repeated to confirm these results.

Table 1. Mean sod tensile strength in pounds measured at 24, 48 and 72 hours after harvest.

	Hours after harvest		
Treatment	*24*	*48*	*72*
Primo	144.6	67.1	12.4
Control	110.8	44.2	25.9
P-value	**0.03**	**NS**	**NS**

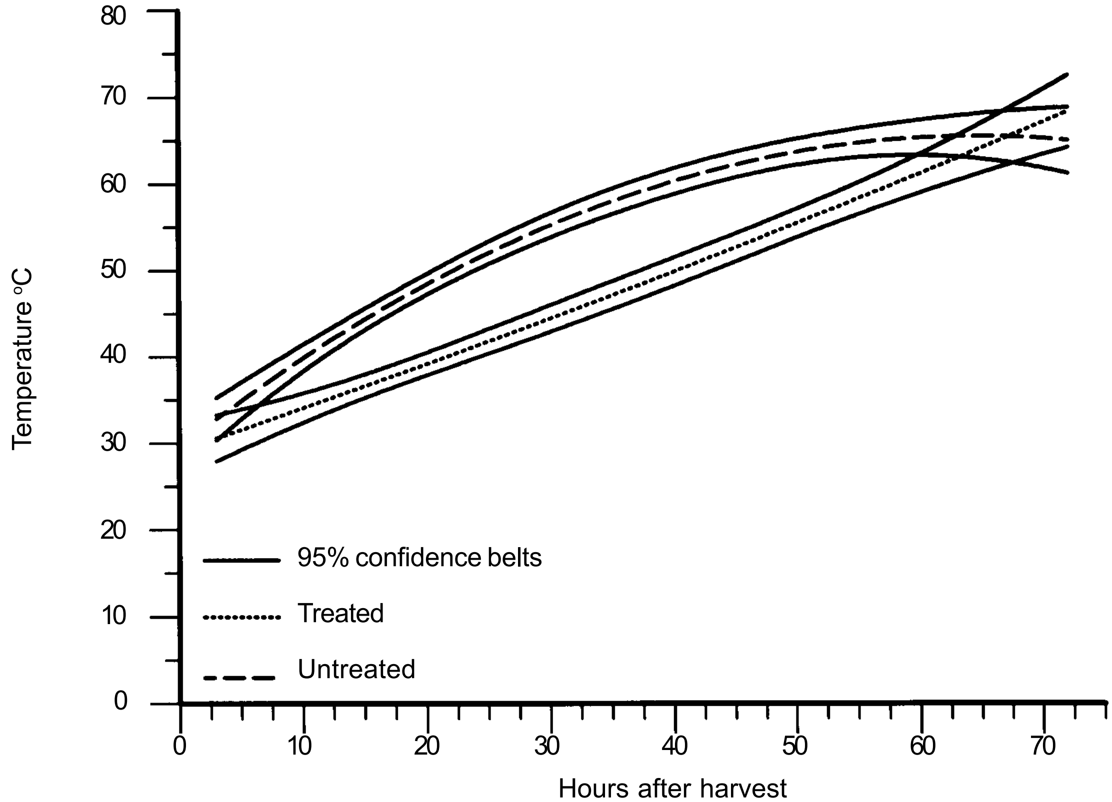


Figure 1. Comparison of trinexapac-ethyl treated and untreated sod pallet temperatures at 2.5 cm horizontally from the center of the pallet from three to 72 hours after harvest.

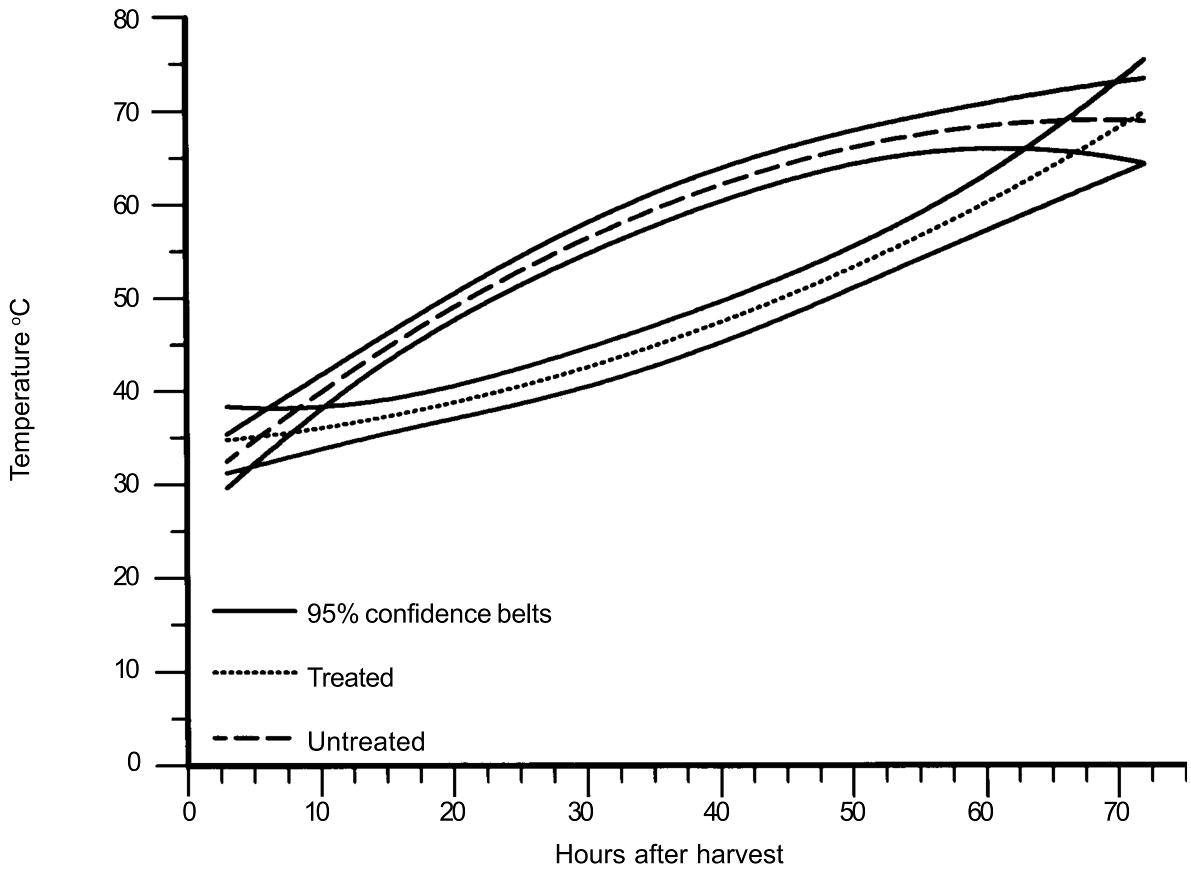


Figure 2. Comparison of trinexapac-ethyl treated and untreated sod pallet temperatures at 10.2 cm horizontally from the center of the pallet from three to 72 hours after harvest.

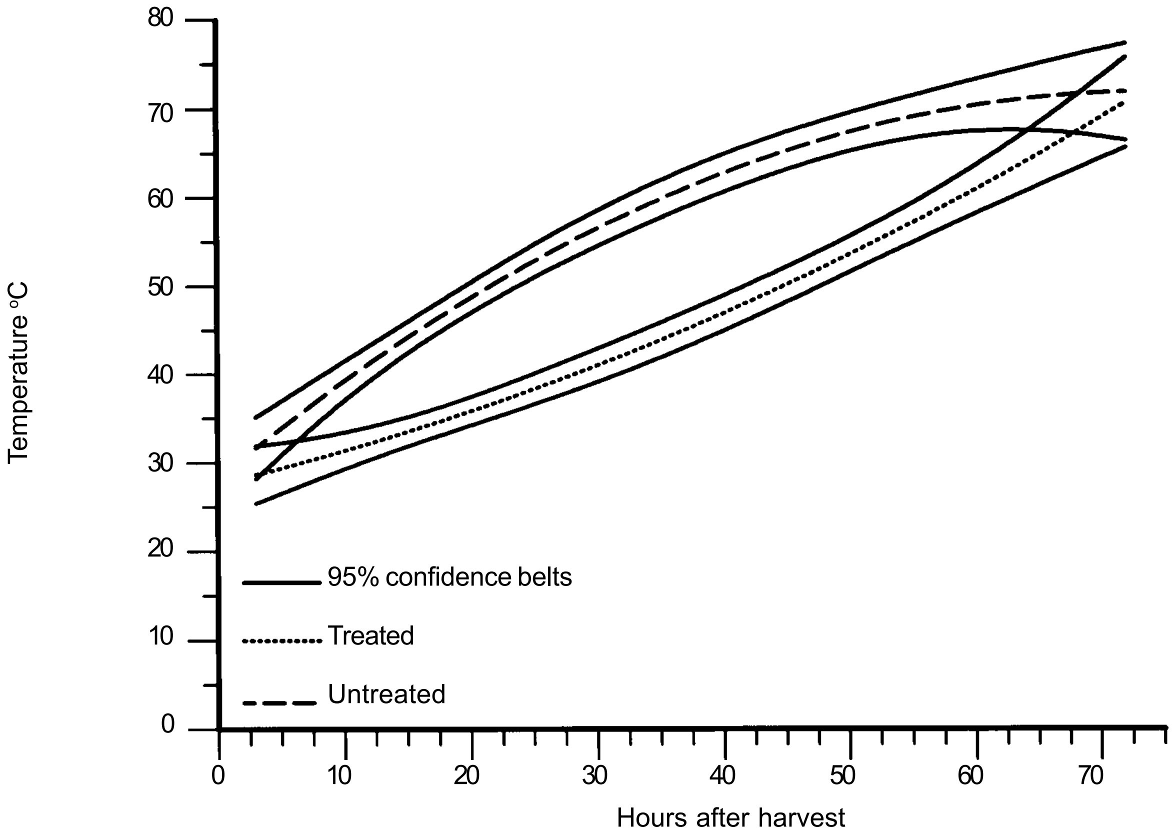


Figure 3. Comparison of trinexapac-ethyl treated and untreated sod pallet temperatures at 20.3 cm horizontally from the center of the pallet from three to 72 hours after harvest.

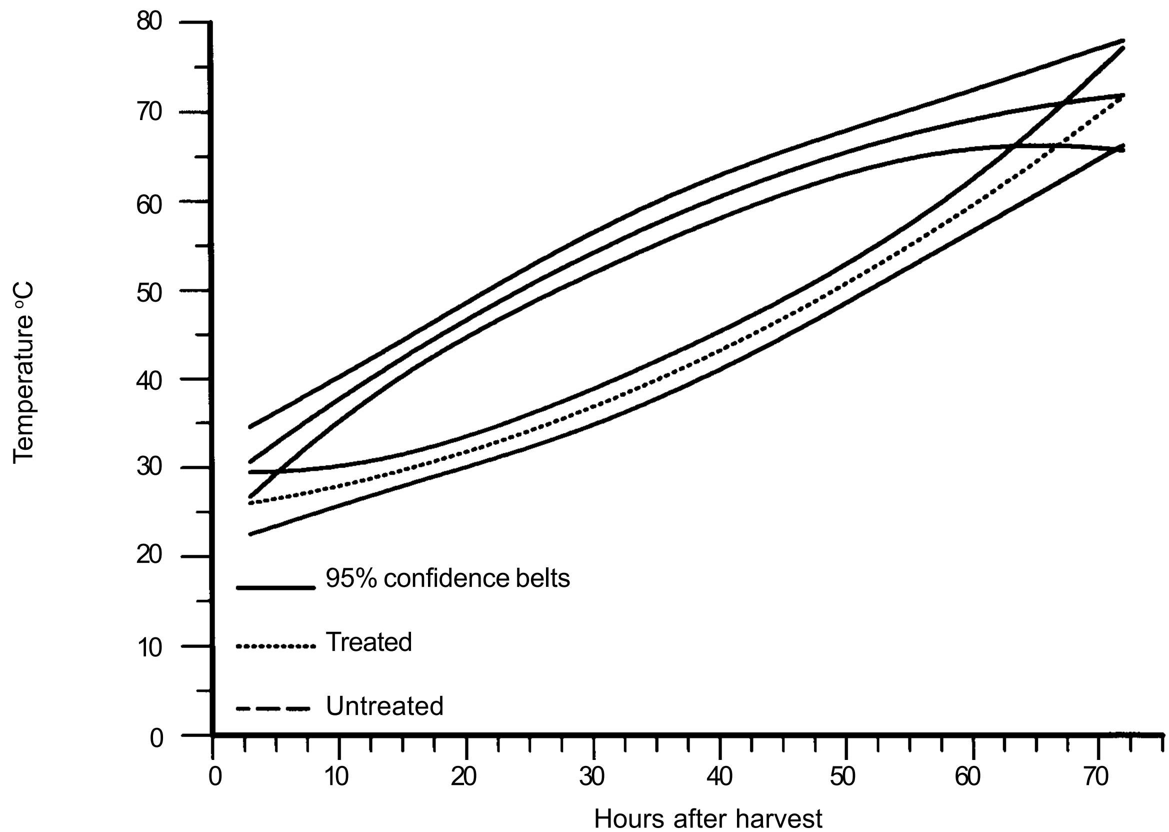


Figure 4. Comparison of trinexapac-ethyl treated and untreated sod pallet temperatures at 30.5 cm horizontally from the center of the pallet from three to 72 hours after harvest.

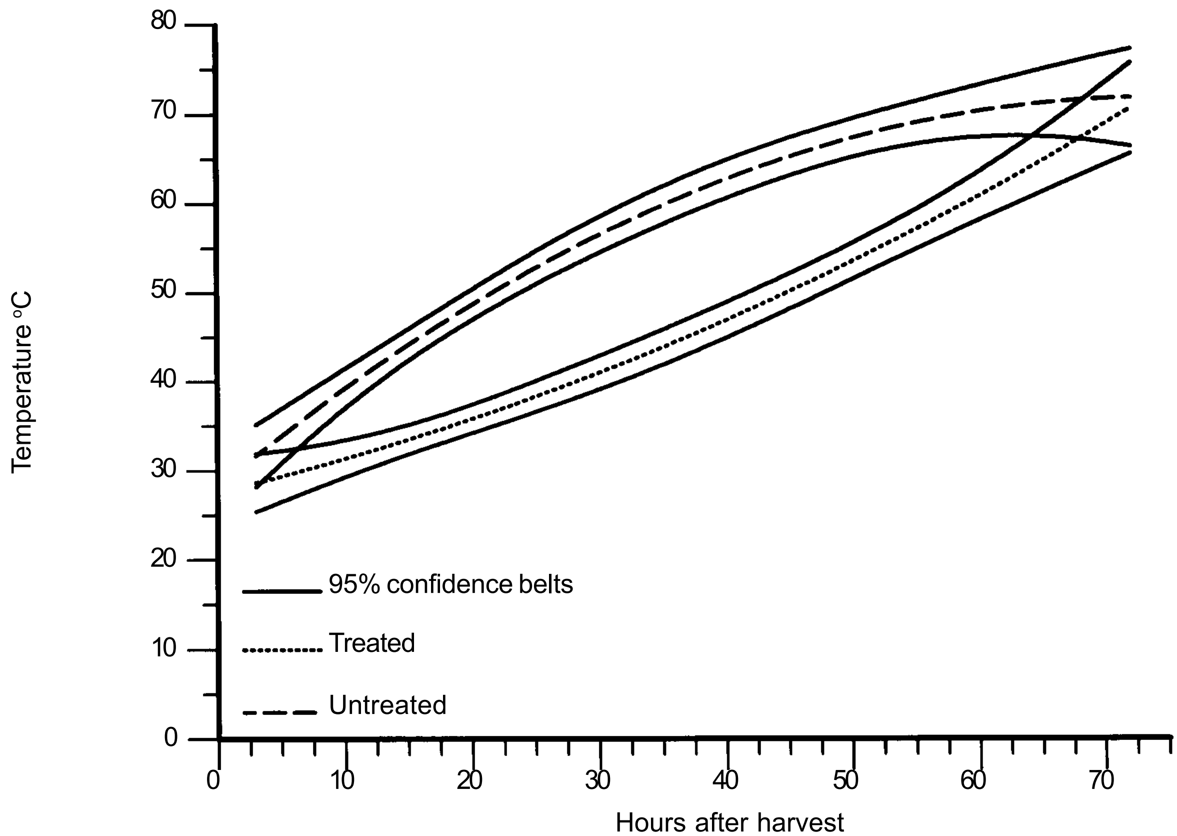


Figure 5. Comparison of trinexapac-ethyl treated and untreated sod pallet temperatures at 30.5 cm vertically from the center of the bottom of the pallet from three to 72 hours after harvest.

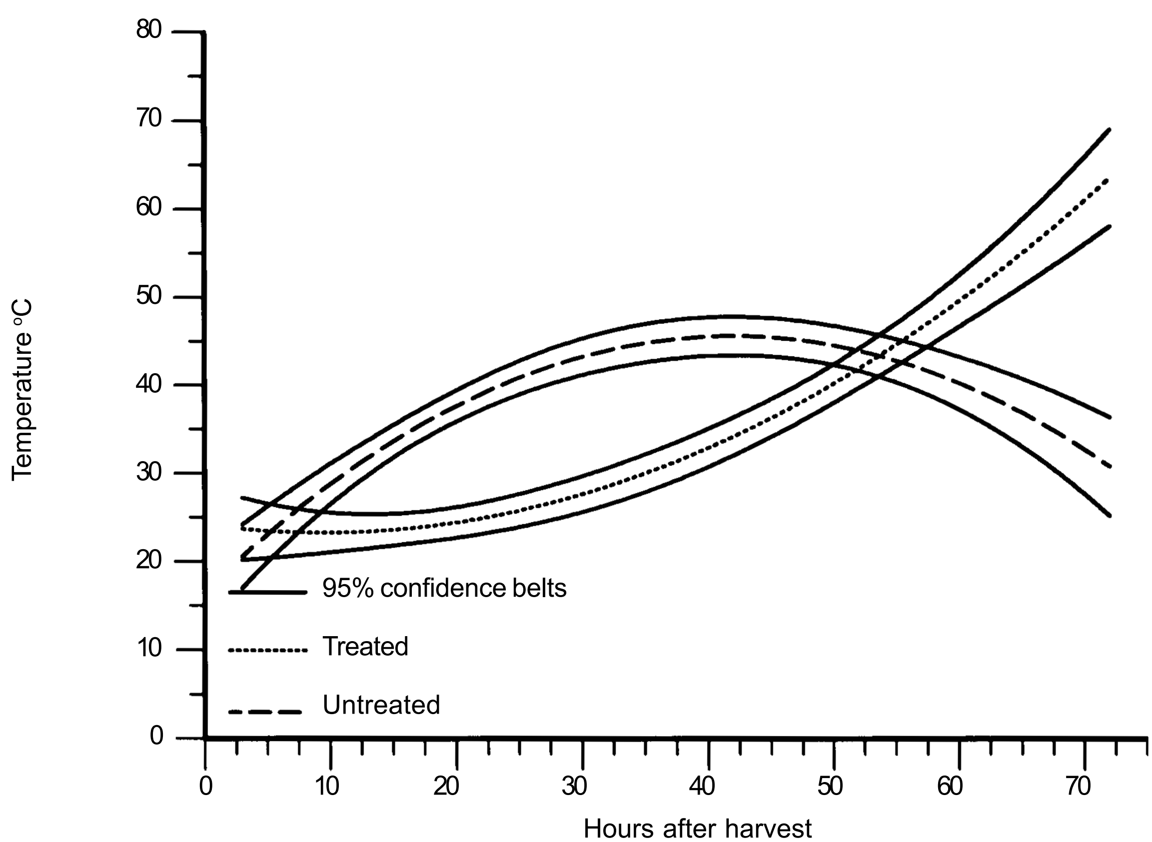


Figure 6. Comparison of trinexapac-ethyl treated and untreated sod pallet temperatures at 91.5 cm vertically from the center of the bottom of the pallet from three to 72 hours after harvest.

A Comparison of Slow-Release, Coated Potassium Sources for Effects on Kentucky Bluegrass Fairway Turfgrass Performance, Tissue Nutrient Content and Soil Nutrient Status

R. C. Shearman, R. E. Gaussoin and M. R. Vaitkus

Potassium nutrition plays an important role in minimizing turfgrass stress injury from heat, cold, drought and traffic. Golf course superintendents and other turfgrass managers recently have increased potassium use in their turfgrass nutrition programs. More recently, slow-release sources of potassium have been developed for use in turfgrass nutrition programs. This study was initiated in the spring of 1996 to determine the effects of slow-release potassium on Kentucky bluegrass fairway turfgrass performance, tissue nutrient content and soil nutrient status.

The study was conducted on a 4-year old Kentucky bluegrass turf, maintained under fairway conditions. It was mowed at 0.5 inches four to five times weekly with clippings removed. Plots were core-cultivated in early May each year and soil cores were removed to minimize potential nutrient treatment contamination. Plots were irrigated daily at 80 percent ETp from April through October. Herbicides, fungicides and insecticides were applied on an as-needed basis.

The experimental design was a randomized complete block. Treatment plots (6' X 6') were muriate of potash (KCl), V-cote (60% CWIK) and V-cote (80% CWIK) at rates of 2, 4 and 6 lbs K/1,000ft^2/season and an untreated control. Coated KCl was the source of potassium use in the V-cote materials. Potassium treatments were applied using a Gandy drop-type spreader. Applications were made in mid-June of 1996, 1997 and 1998. Nitrogen was applied at a rate of 4 lbs/1,000ft^2/season divided into 1.0 lb/1,000ft^2 applications in mid-May and mid-October and 0.5 lb/1,000ft^2 applications in mid-June, July, August and September. Soil test results indicated no additional phosphorous was required.

Plant tissue was sampled at the middle (July 22) and at the end (October) of the growing season. Clippings were harvested with an 18 inch reel mower set at 2.5 inches. One mower pass through the center of each plot was made and clippings were bagged, dried 24 hours at 70^{o}C and then sent to the University of Nebraska Soil and Plant Analytical Laboratory.

Potassium sources and application rates had very little effect on turfgrass quality during the course of this study (Table 1). In 1997, turfgrass quality in July and August was improved by applications of the V-cote (80% CWIK) slow-release, coated potassium source. Muriate of potash (KCl) and the V-cote (60% CWIK) source were inconsistent in influencing turfgrass quality ratings. Slow-release potassium sources had reduced foliar burn potential when compared to the water soluble, muriate of potash source (Figure 1). Potassium in plant tissue increased with application rate and was greater with the V-cote (80% CWIK) treatments (Figure 2). The V-cote (60% CWIK) performed similarly to the KCl treatment. The improved slow-release characteristics of the 80 percent CWIK material was beneficial in metering out the potassium, keeping it available for plant uptake. In soils with high exchangeable and non-exchangeable potassium levels, it is apparent slow-release potassium sources are beneficial in keeping higher levels of K^+ in the soil solution and available for plant uptake. Plant calcium levels decreased by nearly 0.1 percent with increasing potassium application of V-cote (80% CWIK) (Figure 3). Soil chlorine levels increased by nearly 15 ppm with the 80 percent CWIK treatment (Figure 4).

Table 1. The effects of potassium source and ap-

plication rate on Kentucky bluegrass turfgrass fairway quality† on three dates in the 1997 growing season. J.S. Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

Date	*7/1/97*		
K Treatment lbs/1,000ft²/season	*K Source*		
	KCl	*Vcote, 60% CWIK*	*Vcote, 80% CWIK*
0	7.9 Aa††	7.0 Aa	7.0 Ab
2	7.3 ABa	6.9 Ba	8.2 Aa
4	5.9 Bb	6.0 Bb	8.0 Aab
6	5.2 Cb	6.5 Bab	8.0 Aab

Date	*7/23/97*		
K Treatment lbs/1,000 ft²/season	*K Source*		
	KCl	*Vcote, 60% CWIK*	*Vcote, 80% CWIK*
0	6.7 Aa††	5.0 Bb	5.0 Bb
2	6.8 Aa	7.1 Aa	7.2 Aa
4	6.8 Aa	6.7 Aa	7.5 Aa
6	6.5 Ba	6.6 Ba	7.8 Aa

Date	*8/13/97*		
K Treatment lbs/1,000 ft²/season	*K Source*		
	KCl	*Vcote, 60% CWIK*	*Vcote, 80% CWIK*
0	7.7 Aa††	7.0 Bb	7.0 Bb
2	7.6 Aa	7.6 Aa	8.0 Aa
4	7.6 Aa	7.7 Aa	7.9 Aa
6	7.7 Aa	7.6 Aa	8.0 Aa

†Turfgrass quality is based on a 1-9 visual rating scale, with 1= poorest, 6=acceptable, and 9=best
††Means within rows followed by the same capital letter are not significantly different based on LSD ($p \leq 0.05$)
Means within columns followed by the same lower case letter are not significantly different based on LSD ($p \leq 0.05$)

Figure 4. Soil chlorine (Cl) levels as influenced by potassium (K) source and application rate (10/13/98).

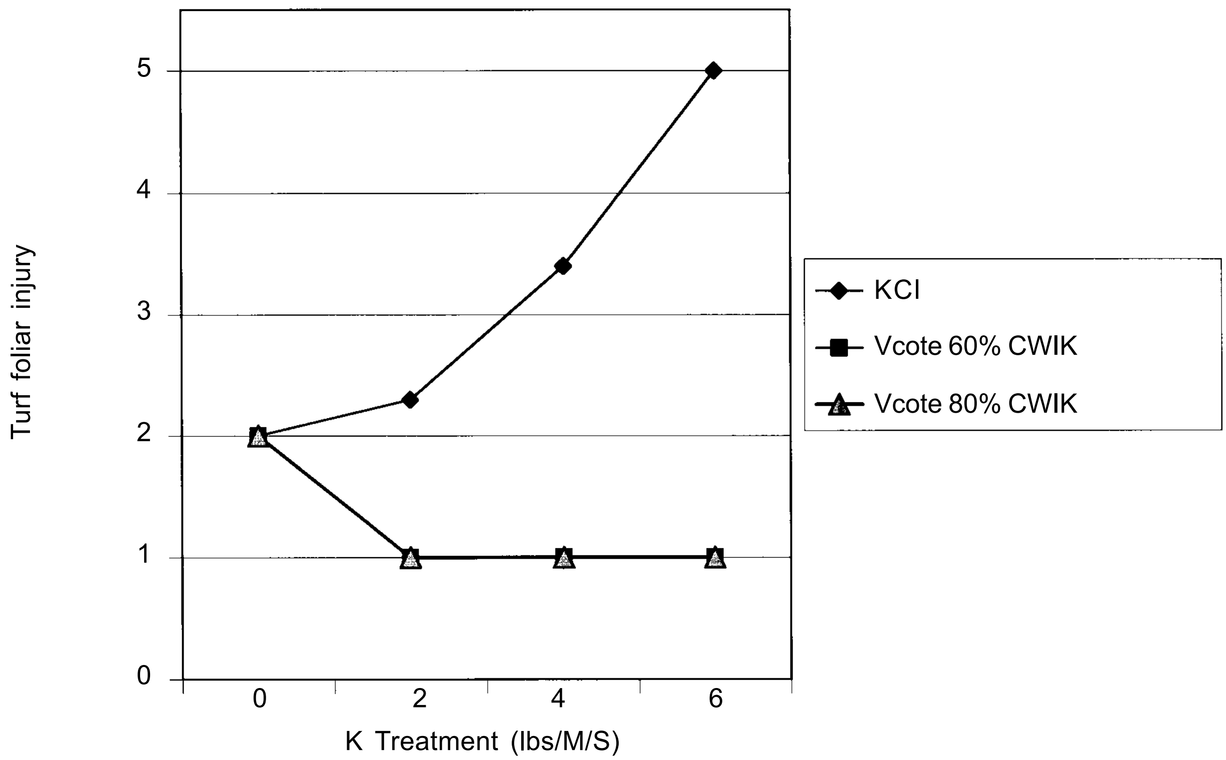


Figure 1. Turf foliar Injury as influenced by potassium (K) source and application rate (7/26/96). Ratings are based on a 1-9 visual rating scale, with 1= least and 9 =greatest foliar injury.

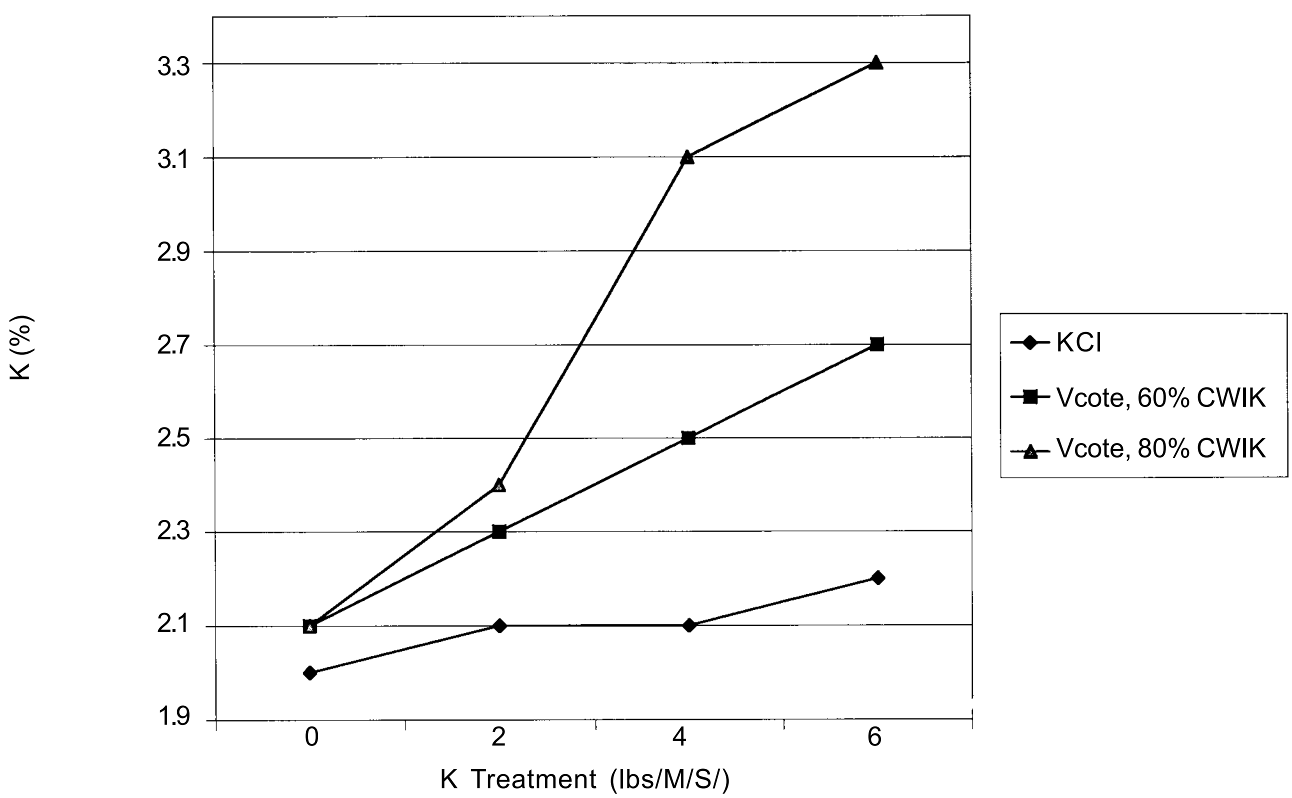


Figure 2. Plant tissue potassium (K) content as influenced by the potassium source and application rate (7/22/98).

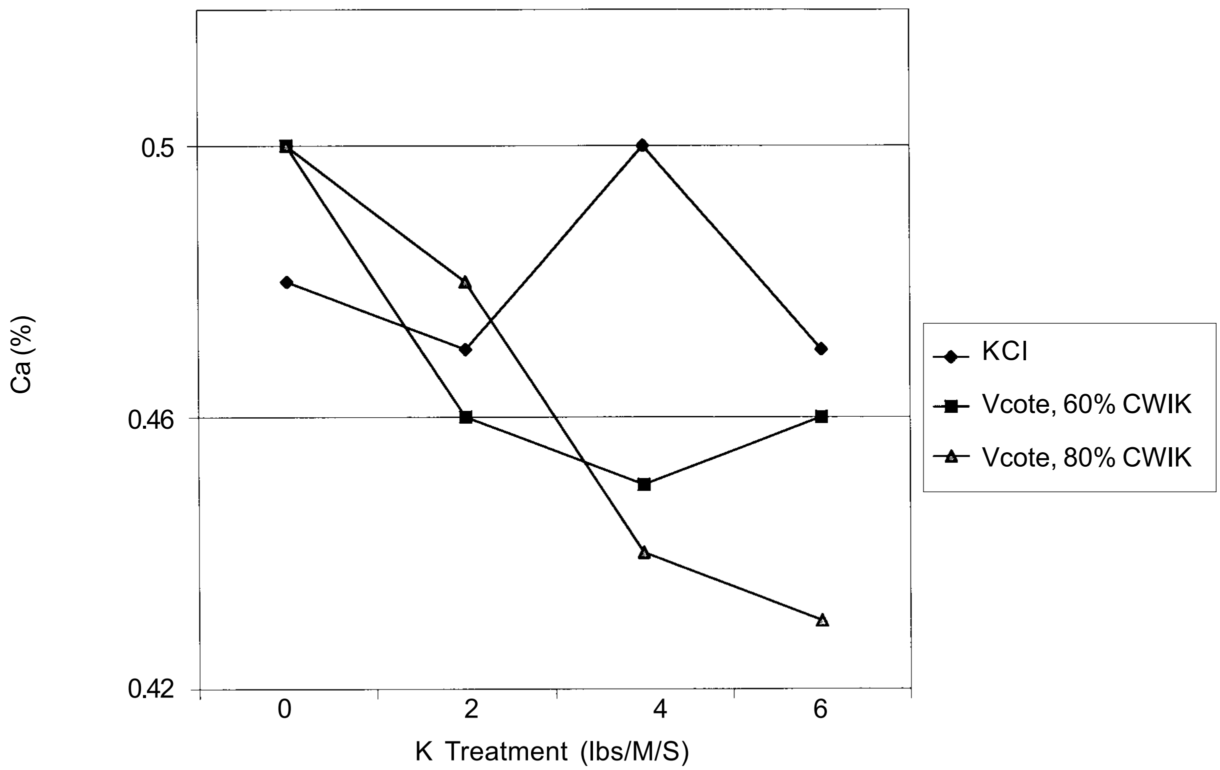
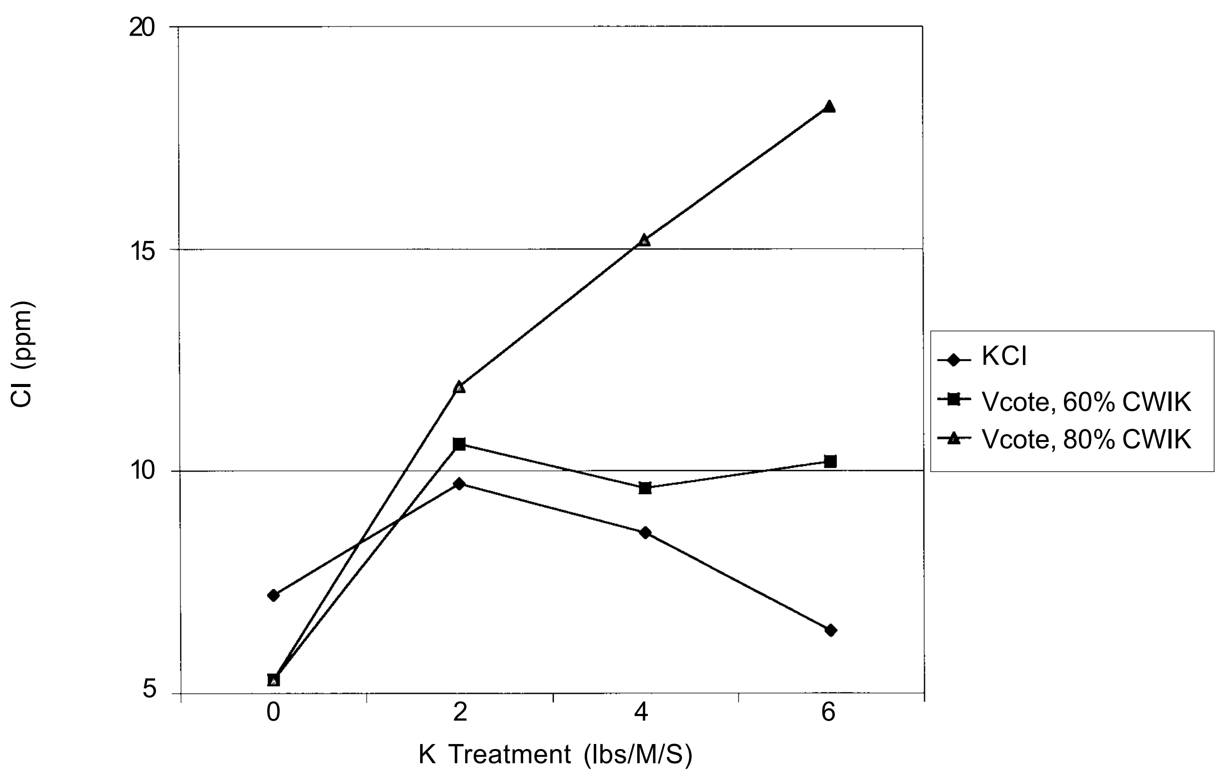


Figure 3. Calcium (Ca) content of plant tissue as influenced by potassium (K) source and application rate (7/22/98).



1998 Preemergence Herbicide Evaluations

R.E. Gaussoin and M.R. Vaitkus

Research was conducted in 1998 to evaluate 15 preemergent herbicide treatments for annual grass control in Kentucky bluegrass. The research site was a 3-year-old blend of Kentucky bluegrass at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. The site was overseeded with hairy crabgrass (Digitaria sanguinalis) in 1996 and 1997.

The experimental area was maintained at a 2.5 in. mowing height and irrigation was applied as needed to prevent stress. Soil type was a Sharpsburg silty clay loam (fine, montmorillonitic, mesic Typic Argiudoll), with 3.4 percent organic matter, a bulk density of 1.38 g/cm^3 and a pH of 6.8. Plot size was 3 feet by 6 feet. The experimental design was a randomized complete block with three replications, including 14 herbicide treatments and an untreated control.

Treatments were applied on April 24, 1998. Weather during application was sunny, 75°F, 29%RH, with a brisk (15 mph) south wind; soil temperature was 59°F. Split application and postemergence (<2 leaf stage) treatments were applied June 9, 1998. Weather was partly sunny, air temperature during application was 60°F, with 87%RH and an 8 mph breeze from the northwest; soil temperature was 60°F. Postemergence treatments (2-4 leaf stage) were applied June 15, 1998. Weather during application was partly sunny, 66°F, 84%RH, with a moderate (10 mph) north-northwest wind and a soil temperature of 65°F. On all dates, liquid treatments were applied with a CO_2-driven backpack sprayer equipped with a single 8002VS flat fan nozzle and calibrated to deliver 40 gal/A at 30 psi. Granular applications were applied with a shaker can.

No turf injury was observed in any of the treatments. Crabgrass germinated in early August and weed control evaluations were made 45 days after treatment (DAT); and eight, 12 and 16 weeks after treatment (WAT). Data were analyzed using the Pesticide Research Manager (PRM) analysis program.

All products significantly controlled crabgrass for up to 12 WAT, although there was variability between them (Table 1). Percent control varied from less than 50 to 95 percent. At 16 WAT, most treatments, with the exception of BRC520 (40 WG, 0.24 lb ai/A), BRC996 (2 SL. 0.375 lb ai/A) and BRC520 (40 WG, 0.24 lb ai/A), still showed significant crabgrass control.

Table 1. Crabgrass Control. Preemergence herbicide evaluation. John Seaton Anderson Turfgrass Research Facility near Mead, Neb.

Treatment	*Timing of Treatment*	*Formulation*	*Rate lb ai/A*	*% Crabgrass Control*[1]			
				45 DAT	*8 WAT*	*12 WAT*	*16 WAT*
TEAM PRO	Preemergence	0.86 GR	1.5	93ab[2]	88ab	80ab	65abc
TEAM PRO	Preemergence	0.86 GR	1.5 split[3]	95a	93a	93a	80abc
TEAM Pro	Preemergence	0.86 GR	2.0	95a	78abc	80ab	88ab
PENDIMETHALIN	Preemergence	0.86 GR	1.5	90ab	83ab	83ab	73abc
PENDIMETHALIN	Preemergence	0.86 GR	1.5 split	95a	83ab	80ab	65abc
PENDIMETHALIN	Preemergence	0.86 GR	2.0	88ab	80ab	80ab	70abc
DIMENSION	Preemergence	0.09 GR	0.25	85abc	73abc	80ab	43cde
DIMENSION	Preemergence	0.09 GR	0.38	93ab	85ab	93a	93a
BARRICADE	Preemergence	0.22 GR	0.38	63bc	60bc	60bc	65abc
BARRICADE	Preemergence	0.22 GR	0.50	70abc	48c	63abc	65abc
BRC520	Preemergence	40 WG	0.24	55c	48c	48c	13def
BRC996	Preemergence	2 SL	0.375	65abc	65abc	58bc	5ef
BRC520	Postemergence (<2 leaf)	40 WG	0.180	88ab	88ab	75abc	50bcd
BRC520	Postemergence (2-4 leaf)	40 WG	0.24	73abc	70abc	63bc	15def
PENDULUM	Preemergence	60 WG	2.0	70abc	65abc	78ab	48bcd
Untreated Control				0d	0d	0d	0f
LSD (0.05)				**31**	**32**	**28**	**42**

[1]Control estimated visually on a 0-100% scale, with 0= no control and 100= 100% control.
[2]Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple means technique.

1998 Postemergence Broadleaf Herbicide Trial - Sprayable Products

R. E. Gaussoin and M. R. Vaitkus

Research was conducted in 1998 to evaluate 15 postemergence herbicide treatments for broadleaf weed control in Kentucky bluegrass. The efficacy of Millennium Ultra, Horsepower, DTDA, XRM-5202, research-numbered compounds and Confront was compared to a traditional three-way herbicide (Riverdale's Triplet).

The experimental area was an 8-year-old blend of Kentucky bluegrass (Merit, Baron, Touchdown, Adelphi) at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. Mowing height was maintained at 2.5 in. and irrigation was applied as needed to prevent stress. The soil type was a Sharpsburg silty clay loam (fine, montmorillonitic, mesic Typic Argiudoll), with 2.2% organic matter, a bulk density of 1.38 g/cm^3 and a pH of 7.2. Prevalent weed species were dandelion (*Taraxacum officinale*), white clover (*Trifolium repens*) and ground ivy (*Glechoma microcarpa*). The experimental design was a randomized complete block with three replications comprised of 15 herbicide treatments and an untreated control. Plot size was 3 feet by 6 feet.

Treatments in the following tables were applied on May 11, 1998 with a CO_2-driven backpack sprayer equipped with a single 8002V flat fan nozzle and calibrated to deliver 40 gal/A at 30 psi. Weather during application was partly cloudy, 68°F, 73%RH, with a moderate (15 mph) south, southeast wind and a soil temperature of 60°F. Weed control (0-100% scale) was evaluated weekly for eight weeks after treatment (WAT).

No turf injury was observed in any treatment. Product differences were observed for percent weed control of dandelion (Table 1), white clover (Table 2) and ground ivy (Table 3) on all observation dates. Triplet weed control for all three species was significantly greater than the control on all observations, but showed differences when compared to other products.

Dandelion weed control at 8 WAT was greatest for RDL 202, Dissolve (O), Millenium Ultra, Triplet, RDL 211 and RDL 414 (Table 1). Control of dandelion by other products did not differ significantly from control at 8 WAT. Triplet performed significantly better than MCPP (O) on all observation dates and better than Horsepower, DTDA and 2,4-DP at 7 and 8 WAT.

Products showing significant control of white clover at 8 WAT were Confront, RDL 414, Millenium Ultra, RDL 202, XRM 5202, RDL 211, Triplet, Dissolve (O), Horsepower and 2,4- DP (R) (Table 2). The highest rates ($\geq$ 90%) of control were achieved by Confront, RDL 414, Millenium Ultra and RL 202. Triplet weed control was better than MCPP (O) at 7 and 8 WAT, but poorer than Millenium Ultra, Confront, RDL 202 and RDL 414 at 4 to 8 WAT and RDL 211 and XRM 5202 at 7 and 8 WAT.

All products controlled ground ivy to some degree at 1 WAT, but for many products, the effect was short-lived (Table 3). By 8 WAT, only DTDA, XRM 5202, Confront, Triplet, RDL 211, RDL 414 and Dissolve (O) showed any significant control, with only Dissolve (O) and Confront providing control greater or equal to 50 percent. Percent weed control by Triplet was only 30 percent by 8 WAT, greater than MCPP(O) (at 2 to 8 WAT) and MCPP (R) (at 3 to 8 WAT), but poorer than Confront (5 to 7 WAT).

These results show individual product performance varied with weed species. Triplet, RDL 211, RDL 414 and Dissolve (O) provided significant control of all species by 8 WAT, while Millenium Ultra and RDL 202 showed best control of dandelion and white clover. XRM 5202 and Confront showed significant control of white clover and ground ivy at 8 WAT. Use of herbicides to control broadleaf weeds must, therefore, be tailored to specific situations and target species.

Table 1. Percent (%) weed control of dandelion. 1998 Postemergence broadleaf herbicide trial. John Seaton Anderson Turfgrass Research Facility near Mead, Neb.

		% Weed Control							
Product	*Rate[1]*	*1 WAT[2]*	*2 WAT*	*3 WAT*	*4 WAT*	*5 WAT*	*6 WAT*	*7 WAT*	*8 WAT*
Milennium Ultra	2.5	70a*	73a	60abc	53ab	80ab	67ab	63abc	60abc
Horsepower	2.5	60ab	33bc	7de	10bc	13ef	3f	3e	0e
DTDA	2.5	63ab	73a	30b-e	30abc	23def	17def	13e	10e
XRM 5202	3.5	73a	67a	67ab	40abc	53a-e	23c-f	27cde	23cde
Confront	2.0	50abc	53ab	43a-e	67a	37c-f	17def	23de	17de
Triplet	3.25	73a	73a	67ab	50ab	53a-e	53a-d	53a-d	53a-d
RDL 202	1.66	60ab	63ab	57abc	67a	83a	80a	80a	80a
RDL 211	3.0	63ab	83a	50a-d	50ab	57a-d	57abc	53a-d	53a-d
RDL 414	3.0	57abc	73a	60abc	60a	67abc	50a-e	53a-d	50a-d
MCPP (R)	3.0	37bc	17cd	30b-e	3c	23def	23c-f	23de	17de
MCPP (O)	3.0	27cd	7cd	10de	3c	10f	10f	10e	10e
2,4 - DP (R)	3.0	50abc	7cd	7de	3c	20def	13ef	13e	7e
2,4 - DP (O)	3.0	43abc	20cd	17cde	13bc	37c-f	27c-f	33b-e	27b-e
Dissolve (R)	4.0	67ab	63ab	37a-e	70a	40b-f	37b-f	37b-e	37b-e
Dissolve (O)	4.0	67ab	83a	77a	73a	70abc	70ab	67ab	63ab
Control		0d	0d	0e	0c	0f	0f	0e	0e
LSD (0.05)		**33**	**31**	**45**	**45**	**41**	**38**	**39**	**38**

[1]All rates are in pints product per acre, except RDL 202, which is lbs product per acre
[2]WAT (Weeks after Treatment)
* Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple comparison technique.

Table 2. Percent (%) weed control of white clover. 1998 Postemergence broadleaf herbicide trial. John Seaton Anderson Turfgrass Research Facility near Mead, Neb.

		% Weed Control							
Product	*Rate[1]*	*1 WAT[2]*	*2 WAT*	*3 WAT*	*4 WAT*	*5 WAT*	*6 WAT*	*7 WAT*	*8 WAT*
Milennium Ultra	2.5	57ab*	63ab	83abc	97a	97a	90a	90a	90a
Horsepower	2.5	50abc	57ab	83abc	50cd	57c	43cd	43cd	43bc
DTDA	2.5	40abc	60ab	57cd	53cd	33c	30cde	30cde	30bcd
XRM 5202	3.5	57ab	40b	70a-d	80ab	93ab	87ab	87ab	87a
Confront	2.0	60ab	60ab	93ab	93a	97a	97a	97a	97a
Triplet	3.25	47abc	40b	63bcd	63bc	61bc	53bc	53c	53b
RDL 202	1.66	57ab	70a	87ab	100a	93ab	90a	90a	90a
RDL 211	3.0	53ab	63ab	83abc	87ab	93ab	87ab	87ab	87a
RDL 414	3.0	63a	73a	83abc	97a	97a	90a	93a	93a
MCPP (R)	3.0	33bc	37b	27ef	10ef	30cd	30cde	30cde	27bcd
MCPP (O)	3.0	23cd	50ab	27ef	13ef	32cd	20cde	20de	17cd
2,4 - DP (R)	3.0	57ab	57ab	43de	47cd	49c	37cd	43cd	43bc
2,4 - DP (O)	3.0	50abc	53ab	57cd	33de	35c	17de	27cde	27bcd
Dissolve (R)	4.0	63a	60ab	57cd	50cd	29cd	27cde	30cde	30bcd
Dissolve (O)	4.0	53ab	47ab	60bcd	50cd	58c	53bc	57bc	53b
Control		0d	0c	0f	0f	0d	0e	0e	0d
LSD (0.05)		**28**	**28**	**27**	**26**	**33**	**34**	**32**	**33**

[1] All rates are in pints product per acre, except RDL 202, which is lbs product per acre
[2]WAT (Weeks after Treatment)
* Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple comparison technique.

Table 3. Percent (%) weed control of ground ivy. 1998 Postemergence broadleaf herbicide trial. John Seaton Anderson Turfgrass Research Facility near Mead, Neb. University of Nebraska, 1998.

		% Weed Control							
Product	*Rate[1]*	*1 WAT[2]*	*2 WAT*	*3 WAT*	*4 WAT*	*5 WAT*	*6 WAT*	*7 WAT*	*8 WAT*
Milennium Ultra	2.5	60a*	37bcd	47abc	33a-e	31d-g	27c-g	23d-h	17cd
Horsepower	2.5	67a	53ab	33bcd	40a-d	31d-g	27c-g	17e-h	17cd
DTDA	2.5	33b	57ab	40a-d	33a-e	45b-e	40b-e	40b-e	37abc
XRM 5202	3.5	63a	50ab	57ab	53a	58a-d	50a-d	47a-d	37abc
Confront	2.0	47ab	40bc	47abc	57a	76a	73a	67a	50a
Triplet	3.25	50ab	43abc	50abc	33a-e	41c-f	37b-e	33c-f	30abc
RDL 202	1.66	60a	33bcd	53abc	40a-d	37c-f	33b-f	33c-f	27a-d
RDL 211	3.0	63a	40bc	57ab	47abc	73ab	60ab	57abc	47ab
RDL 414	3.0	67a	53ab	60ab	47abc	38c-f	33b-f	30def	30abc
MCPP (R)	3.0	37b	23cde	13de	3ef	13fgh	7fg	3gh	0d
MCPP (O)	3.0	37b	13de	13de	3ef	3gh	3g	3gh	0d
2,4 - DP (R)	3.0	67a	37bcd	17de	47c-f	27e-h	17efg	20e-h	17cd
2,4 - DP (O)	3.0	63a	43abc	27cde	10def	13fgh	7fg	13fgh	10cd
Dissolve (R)	4.0	63a	47abc	40a-d	20b-f	31d-g	23d-g	27d-g	20bcd
Dissolve (O)	4.0	63a	67a	67a	50ab	63abc	53abc	60ab	53a
Control		0c	0e	0e	0f	0h	0g	0h	0d
LSD (0.05)		**22**	**24**	**28**	**31**	**30**	**28**	**27**	**27**

[1]All rates are in pints product per acre, except RDL 202, which is lbs product per acre
[2]WAT (Weeks after Treatment)
* Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple comparison technique.

1998 Broadleaf Herbicide Trial - Granular Weed and Feed

R. E. Gaussoin and M. R. Vaitkus

Research was conducted in 1998 to evaluate seven postemergence herbicide treatments for broadleaf weed control in Kentucky bluegrass. The effectiveness of several new broadleaf weed and feed products when applied to both damp and dry foliage were compared to the industry standard.

The experimental area was an 8-year-old Kentucky bluegrass (Merit, Baron, Touchdown, Adelphi) at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. Turf was maintained at a 2.5 inch mowing height and irrigation was applied as needed to prevent stress. Prevalent weed species were dandelion (*Taraxacum officinale*), white clover (*Trifolium repens*) and ground ivy (*Glechoma microcarpa*). The soil type was a Sharpsburg silty clay loam (fine, montmorillonitic, mesic Typic Argiudoll), with 2.2% organic matter, a bulk density of 1.38 g/cm^3 and a pH of 7.2. Plot size was 3 feet by 6 feet. The experimental design was a randomized complete block with three replications comprised of seven herbicide treatments and an untreated control, applied in two timings.

Treatments in the following table were hand-applied on May 14, 1998, about four hours apart. Weather during the wet application was cloudy, 74°F, 78%RH, with a moderate (16 mph) south/southeast wind and a soil temperature of 66°F. During the dry application, conditions were partly sunny, 82°F, 62%RH, with a moderate (16 mph) south/southeast wind and a soil temperature of 71°F. Weed control was evaluated on a 0-100 percent scale at seven, 14, 28, 35 and 49 days after treatment (DAT). Data were analyzed using the MSTAT Microcomputer Statistical Program.

No turf injury was observed in any of the treatments. There were no significant differences between wet and dry applications for dandelion and white clover control, but ground ivy control was significantly greater for wet applications at 28, 35 and 49 DAT (Table 2). An interaction of treatment type (wet or dry) and individual products for ground ivy was observed at 7 DAT. On that date, Dissolve Ultra showed greater control than almost all other products when applied to wet foliage. Its efficacy was also significantly greater in the wet vs. dry application (Table 2). Over the course of this trial, ground ivy control was minimal (≤50%) and only two products, Dissolve Ultra and Turf Builder +2, showed any significant control by 49 DAT (Table 3).

All products showed significant dandelion and white clover control on all observation dates (Tables 4 and 5). Turf Builder+2, Millennium Ultra and XRM 5202 showed the greatest amount of dandelion control at 49 DAT (Table 4). All products except Horsepower showed good (>60%) control of white clover at 49 DAT (Table 5).

Table 1. Percent (%) ground ivy control* at seven, 14, 28, 35 and 49 days after treatment (DAT). Wet and dry application main effects. 1998 Broadleaf herbicide trial - granular weed and feed. John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

Treatment	*7 DAT (5/20/98)*	*14 DAT (5/27/98)*	*28 DAT (6/28/98)*	*35 DAT (6/18/98)*	*49 DAT (7/7/98)*
Wet	24	40	37	34	31
Dry	18	20	12	9	7
LSD (0.05)	**ns**	**ns**	**12**	**13**	**13**

* Evaluated on a scale of 0-100%, with 0= no control and 100%= total control.

Table 2. Percent (%) ground ivy control* seven days after treatment (7 DAT). Interaction of wet/dry application and product. 1998 Broadleaf herbicide trial - granular weed and feed. John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

Product	*Rate (lbs/A)*	*wet*	*dry*
Millennium Ultra	156.82	33	20
Trupower	156.82	30	17
Dissolve	156.82	23	20
Dissolve Ultra	156.82	50	13
Horsepower	156.82	17	10
XRM 5202	156.82	20	27
Turf Builder +2	156.82	20	37
Blank 27-2-8	128.15	0	0

* Evaluated on a scale of 0-100%, with 0= no control and 100%= total control.
LSD_1 ($p \leq 0.05$) within rows = 23.2
LSD_2 ($p \leq 0.05$) within columns =20.0

Table 3. Percent (%) ground ivy control* at 7, 14, 28, 35, and 49 days after treatment (DAT). 1998 Broadleaf herbicide trial - granular weed and feed. John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

Product	*Rate (lbs/A)*	*14 DAT (5/27/98)*	*28 DAT (6/12/98)*	*35 DAT (6/18/98)*	*49 DAT (7/7/98)*
Millennium Ultra	156.82	35ab**	17bc	12bc	10bc
Trupower	156.82	33ab	22abc	20abc	22abc
Dissolve	156.82	35ab	32ab	27ab	20abc
Dissolve Ultra	156.82	45a	43a	38a	37a
Horsepower	156.82	18bc	10bc	8bc	7c
XRM 5202	156.82	35ab	30ab	27ab	20abc
Turf Builder +2	156.82	40ab	42a	40a	35ab
Blank 27-2-8	128.15	0c	0c	0c	0c
LSD (0.05)		**22**	**25**	**26**	**26**

* Evaluated on a scale of 0-100%, with 0= no control and 100%= total control.
**Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple comparison technique.

Table 4. Percent (%) dandelion control* at seven, 14, 28, 35 and 49 days after treatment (DAT). 1998 Broadleaf herbicide trial - granular weed and feed. John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

Product	*Rate (lbs/A)*	*7 DAT (5/20/98)*	*14 DAT (5/27/98)*	*28 DAT (6/12/98)*	*35 DAT (6/18/98)*	*49 DAT (7/7/98)*
Millennium Ultra	156.82	68ab**	63ab	67a	60ab	67ab
Trupower	156.82	55ab	63ab	55ab	48ab	40b
Dissolve	156.82	65ab	63ab	63ab	57ab	58ab
Dissolve Ultra	156.82	62ab	63ab	65a	60ab	60ab
Horsepower	156.82	50b	42b	33b	30bc	42b
XRM 5202	156.82	60ab	87a	61ab	62a	62ab
Turf Builder +2	156.82	73a	82a	80a	75a	75a
Blank 27-2-8	128.15	0c	0c	0c	0c	0c
LSD (0.05)		**19**	**27**	**31**	**30**	**30**

* Evaluated on a scale of 0-100%, with 0= no control and 100%= total control.
**Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple comparison technique.

Table 5. Percent (%) white clover control* at seven, 14, 28, 35 and 49 days after treatment (DAT). 1998 Broadleaf herbicide trial - granular weed and feed. John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

Product	*Rate (lbs/A)*	*7 DAT (5/20/98)*	*14 DAT (5/27/98)*	*28 DAT (6/12/98)*	*35 DAT (6/18/98)*	*49 DAT (7/7/98)*
Millennium Ultra	156.82	60ab**	78a	83ab	83ab	83ab
Trupower	156.82	50ab	62a	72ab	72abc	85a
Dissolve	156.82	65a	60a	68ab	60bc	62bc
Dissolve Ultra	156.82	63ab	63a	70ab	72abc	75abc
Horsepower	156.82	43b	63a	63b	57c	58c
XRM 5202	156.82	63ab	80a	87a	85a	87a
Turf Builder +2	156.82	68a	72a	78ab	72abc	73abc
Blank 27-2-8	128.15	0c	0b	0c	0d	0d
LSD (0.05)		**20**	**23**	**22**	**25**	**22**

* Evaluated on a scale of 0-100%, with 0= no control and 100%= total control.
**Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple comparison technique.

Roundup Pro + Scythe, Broadcast Applications

R.E. Gaussoin and M.R. Vaitkus

Research was conducted in 1998 to determine the best broadcast application (gallons per acre (GPA)), for a Roundup Pro + Scythe tank mix, and to compare Roundup Pro + Scythe with Roundup Pro alone and Scythe alone. The research site was a 4-year-old blend of Kentucky bluegrass at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. Weeds present were mature stands of primarily dandelion (*Taraxacum officinale*) and spotted spurge (*Euphorbia maculata*).

The experimental area was maintained at a 2.5 in. mowing height; precipitation provided the only moisture. The soil type was a Sharpsburg silty clay loam (fine, montmorillonitic, mesic Typic Argiudoll), with 3.4 percent organic matter, a bulk density of 1.38 g/cm^3 and a pH of 6.8. Plot size was 0.5 feet by 5 feet. The experimental design was a randomized complete block with three replications comprised of five tank mixtures of various volumes of Roundup Pro + Scythe, Roundup Pro alone, Scythe alone and an untreated control. The five tank mixtures of Roundup Pro + Scythe corresponded to 20, 40, 50, 80 and 100 gallon per acre (GPA) spray volumes.

Treatments were applied on July 7, 1998. Weather during application was sunny, 85°F, 68%RH, with a moderate (8 mph) north breeze and a soil temperature of 85°F. All treatments were applied with a CO_2-driven backpack sprayer equipped with a single 8002VS flat fan nozzle and calibrated to deliver the specified spray volume at 30 psi. All treatments were easy to mix and spray. Evaluations for weed control were made at two, seven, 35 and 90 days after treatment (DAT). Data were analyzed using the Pesticide Research Manager (PRM) analysis program.

At 2 DAT the 20-80 GPA Roundup Pro + Scythe treatments showed greater weed control than Roundup Pro alone, Roundup Pro + Scythe at 100 GPA and the untreated control. At 7 DAT, all treatments except Scythe alone showed greater control than the untreated check, with Roundup Pro + Scythe 20-60 GPA treatments showing greater control than the 80 and 100 GPA Roundup Pro + Scythe treatments. The 40 and 60 GPA Roundup Pro + Scythe treatments, along with Roundup Pro alone, had the greatest control at 35 DAT and 90 DAT. Scythe alone showed zero control at 35 and 90 DAT.

Table 1. Percent weed control[1]. Roundup pro + scythe, broadcast applications. Applied July 7, 1998 at the J.S. Anderson Turfgrass and Ornamental Research Facility. Mead, Neb.

			% Weed Control			
Treatment	*Rate*	*GPA[2]*	*2 DAT[3] 7/9/98*	*7 DAT 7/15/98*	*35 DAT 8/12/98*	*90 DAT 10/1/98*
Roundup Pro	2 qts/A	50	0e*	63ab	90a	63a
Roundup Pro + Scythe	2 qts/A + 3% v/v	20	73a	87a	73c	23bc
Roundup Pro + Scythe	2 qts/A + 3% v/v	40	60b	87a	90a	67a
Roundup Pro + Scythe	2 qts/A + 3% v/v	60	33c	87a	87a	63a
Roundup Pro + Scythe	2 qts/A + 3% v/v	80	13d	53bc	80b	50ab
Roundup Pro + Scythe	2 qts/A + 3% v/v	100	10de	40bc	77bc	40ab
Scythe	3% v/v	50	27c	30cd	0d	0c
Untreated Check			0e	0d	0d	0c
LSD (0.05)			**10**	**33**	**7**	**28**

*Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple comparison technique.
[1]Weed control rated on a 0-100% scale, with 0=no control and 100=total weed control.
[2]GPA = gallons per acre.
[3]DAT = days after treatment.

Roundup Pro + Scythe, Trim and Edge Applications

R.E. Gaussoin and M.R. Vaitkus

Research was conducted in 1998 to determine the best tank mix ratio of Roundup Pro + Scythe, and to compare Roundup Pro + Scythe with Scythe alone and Finale. The research site was a 4-year-old blend of Kentucky bluegrass at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. Primary weeds were dandelion (*Taraxacum officinale*) and spotted spurge (*Euphorbia maculata*).

The experimental area was maintained at a 2.5 in. mowing height and the only moisture came from precipitation. The soil type was a Sharpsburg silty clay loam (fine, montmorillonitic, mesic Typic Argiudoll), with 3.4 percent organic matter, a bulk density of 1.38 g/cm^3 and a pH of 6.8. Plot size was 0.5 feet by 5 feet. The experimental design was a randomized complete block with three replications comprised of 10 herbicide treatments and an untreated control.

Treatments were applied on July 7, 1998. Weather during application was sunny, 85°F, 68%RH, with a moderate (8 mph) north breeze and a soil temperature of 85°F. All treatments were applied with a CO_2-driven backpack sprayer equipped with a single 8002VS flat fan nozzle and calibrated to deliver 40 gal/A at 30 psi. There were no problems handling, mixing or spraying the treatments. Evaluations for weed control were made at two, seven, 28, 49 and 90 days after treatment (DAT). Data were analyzed using the Pesticide Research Manager (PRM) analysis program.

All treatments, except Roundup Pro alone and Finale, showed significant weed control at 2 DAT. Weed control varied from 30 percent for the Roundup Pro + Scythe(1%v/v + 1%v/v), to 100 percent for the Roundup Pro + Scythe(2%v/v + 4%v/v), Scythe alone, and Reward. All products showed weed control greater than or equal to 90 percent at 7 DAT. Weed control by Scythe alone and Reward alone were lower than other treatments at 28 and 50 DAT, and were not significantly different from the control at 90 DAT. Weed control of other treatments decreased over time, but still remained greater than or equal to 60 percent by 90 DAT.

Table 1. Percent weed control[1]. Roundup Pro + Scythe, trim and edge applications. Applied July 7, 1998 at the J.S. Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

		Percent weed control				
Treatment	*Rate*	*2 DAT[2] 7/9/98*	*7 DAT 7/14/98*	*28 DAT 8/4/98*	*50 DAT 8/25/98*	*90 DAT 10/1/98*
Roundup Pro	2% v/v	0d*	90c	100a	97a	70a
Roundup Pro + Scythe	1% v/v +1% v/v	30c	90c	100a	93a	77a
Roundup Pro + Scythe	1% v/v +1.5% v/v	63b	97ab	97a	90a	67a
Roundup Pro + Scythe	1% v/v +2% v/v	83ab	93bc	100a	87a	57a
Roundup Pro + Scythe	2% v/v +2% v/v	90a	100a	100a	91a	60a
Roundup Pro + Scythe	2% v/v +3% v/v	97a	100a	100a	83a	63a
Roundup Pro + Scythe	2% v/v +4% v/v	100a	100a	100a	87a	63a
Scythe	5% v/v	100a	100a	83c	43b	17b
Finale	3% v/v	3d	100a	100a	93a	83a
Reward	0.5 gal pr/100gal	100a	97ab	90b	40b	7b
Untreated Check		3d	0d	0d	0c	0b
LSD (0.05)		**23**	**5**	**4**	**15**	**31**

*Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple comparison technique.

[1]Evaluated on a scale of 0-100%, with 0=no control and 100%=total weed control.

[2]DAT = days after treatment.

Roundup Pro + Thiazopyr (Mandate 2E) Evaluations

R.E. Gaussoin and M.R. Vaitkus

Research was conducted in 1998 to determine the rate of Thiazopyr that provides residual or preemergence weed control equal to Surflan, and to determine the spectrum of weeds controlled and the length of weed control. The research site was a fallow area at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. Weeds present were mature stands of predominantly dandelion (*Taraxacum officinale*), spotted spurge (*Euphorbia maculata*), hairy crabgrass (*Digitaria sanguinalis*), tumble pigweed (*Amaranthus albus*), redroot pigweed (*Amaranthus retroflexus*), marestail (*Conyza canadensis*) and perennial ryegrass (*Lolium perenne*).

The experimental area was maintained at a 2.5 inch mowing height and precipitation provided the only moisture. The soil type was a Sharpsburg silty clay loam (fine, montmorillonitic, mesic Typic Argiudoll), with 3.4 percent organic matter, a bulk density of 1.38 g/cm^3 and a pH of 6.8. Plot size was 0.5 feet by 5 feet. The experimental design was a randomized complete block with three replications including seven treatments of Roundup Pro, alone and in combination with Mandate 2E and Surflan and an untreated control.

Treatments were applied on June 24, 1998. Weather during application was sunny, 84°F, 61%RH, with a moderate (13 mph) south breeze and a soil temperature of 75°F.
All treatments were applied with a CO_2-driven backpack sprayer equipped with a single 8002VS flat fan nozzle and calibrated to deliver 40 gal/A at 30 psi. The Surflan treatments posed a few mixing problems as it stuck to the glass pipette and didn’t rinse out easily, making precise measurement difficult. Evaluations for weed control were made at 14, 30, 60 and 90 days after treatment (DAT). Only preemergence control was observed. Data were analyzed using the Pesticide Research Manager (PRM) analysis program.

At 14 and 30 DAT all treatments showed high (>93%) and significant weed control (Table). At 60 and 90 DAT, Roundup Pro alone had significantly lower weed control than all other treatments. Roundup Pro + Mandate 2E (3.0 lbs ae/A + 0.25 lbs ai/A) also showed significantly lower weed control than Roundup Pro + Mandate 2E (3.0 lbs ae/A +1 lb ai/A) and Roundup Pro + Surflan (3.0 lbs ae/A + 4 lbs ai/A). All Roundup Pro Mandate 2E and Surflan mixtures provided significant weed control at 60 DAT ($\geq$70%) and 90 DAT (>63%).

Table 1. Percent preemergence weed control[1], Roundup Pro + Thiazopyr (Mandate 2e) evaluations. Applied June 24, 1998 at the J.S. Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

		% Weed Control			
		14 DAT[2]	*30 DAT*	*60 DAT*	*90 DAT*
Treatment	*Rate*	*7/7/98*	*7/22/98*	*8/25/98*	*9/24/98*
Roundup Pro	3.0 lbs ae/A	97a*	97a	27c	37c
Roundup Pro + Mandate 2E	3.0 lbs ae/A 0.25 lbs ai/A	97a	97a	70b	63b
Roundup Pro + Mandate 2E	3.0 lbs ae/A 0.50 lbs ai/A	93a	93a	83ab	77ab
Roundup Pro + Mandate 2E	3.0 lbs ae/A 0.75 lbs ai/A	93a	93a	87ab	80ab
Roundup Pro + Mandate 2E	3.0 lbs ae/A 1.00 lbs ai/A	100a	100a	90a	83a
Roundup Pro + Surflan	3.0 lbs ae/A 2.0 lbs ai/A	93a	93a	83ab	80ab
Roundup Pro + Surflan	3.0 lbs ae/A 4.0 lbs ai/A	97a	97a	93a	90a
Untreated Check		0b	0b	0d	0d
LSD (0.05)		**9**	**9**	**18**	**19**

* Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple comparison technique.
[1]Percent weed control evaluated on a 0-100% scale, with 0-no weed control and 100=total weed control.
[2]DAT = days after treatment.

The Effect of DIMENSION Herbicide on Turf Quality

R.E. Gaussoin and M.R. Vaitkus

Research was conducted in 1998 to evaluate the effects of DIMENSION herbicide on turfgrass quality. The research site was a 2-year-old USGA-specification research green seeded to Penncross and Providence creeping bentgrass at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. Treatments consisted of two formulations of DIMENSION applied one to three times over the course of the growing season. This was the second year of the study.

The bentgrass turf was mowed to maintain a 0.125 inch (1/8 inch) height and vertically mowed and topdressed every two to three weeks. The experimental design was a randomized complete block with three replications comprised of seven herbicide treatments, a fertilizer treatment and an untreated control as split plots on two varieties of creeping bentgrass. Plot size was 3 feet by 6 feet.

Treatments were applied on April 29, June 18 and Aug. 12, 1998. Liquid treatments were applied with a CO_2-driven backpack sprayer, equipped with a single 8002VS flat fan nozzle and calibrated to deliver 40 gal/A at 30 psi. Granular applications were applied by hand. All treatments were watered-in following application. On April 29 weather was cloudy, with air temperature of 49°F, 89%RH, a slight north breeze at 9 mph and a soil temperature of 50°F. Weather during the July 18 application was sunny, 77°F, 44%RH, with a moderate northwest breeze of 18 mph and a soil temperature of 78°F. On Aug. 12, weather was mostly sunny, 77°F, 68%RH, with a slight south breeze of 4 mph and a soil temperature of 74°F.

Observations were made seven-14, 21-28 and 45-60 days after treatment (DAT) following each herbicide application. Turf injury, quality and density, as well as incidence of dollar spot, which became evident in August, were evaluated. Data were analyzed using the MSTAT statistical analysis program.

Residual turf injury from 1997 was still evident during observations following the first herbicide applications in April (Table 1). Plots receiving three applications of DIMENSION in 1997 had the highest rates of turf injury and lowest turf quality and density. Growing conditions were favorable in May and June and turf recovery was observed. Following the second treatment application, only the Dimension/2 and Dimension/3 EC treatments at 7-14 DAT showed any turf injury (Table 2). Overall turf quality and density also improved, with most treatments showing acceptable (≥6.0) quality and densities of 80 percent or greater.

During July and August sustained high temperatures in the 80s and 90s, along with little precipitation, contributed to the incidence of dollar spot and a subsequent decrease in turf quality and density. Although turf injury was not significant, the harsh conditions resulted in overall unacceptable (<6.0) turf quality (Table 3). Turf density also decreased, although treated plots had higher densities than the untreated control at seven-14 and 45-60 DAT. An interaction of cultivar and treatment showed higher turf quality at 21-28 DAT for Penncross treatments receiving two and/or three applications (Table 4). Turf density at 45-60 DAT showed this same trend (Table 5). Dollar spot was highest in plots receiving only one EC treatment or the fertilizer check at 21-28 DAT and lowest in plots receiving two or three applications at 45-60 DAT. (Table 6).

Table 1. Turfgrass injury[1], quality[2] and density[3] fol-

lowing the first herbicide application on April 29, 1998. The Effect of DIMENSION herbicide on turf quality. John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

			Turf Injury			*Turf Quality*			*Turf Density*		
Treatment/No. of Applications	*Formulation*	*Rate (lb ai/A)*	*7-14 DAT[4]*	*21-28 DAT*	*45-60 DAT*	*7-14 DAT*	*21-28 DAT*	*45-60 DAT*	*7-14 DAT*	*21-28 DAT*	*45-60 DAT*
DIMENSION/ 1	1 EC	0.5	2.5C*	2.0C	2.3C	4.3Ab	4.0Bc	5.0Cd	7.5Ab	7.5Ab	7.5Bc
DIMENSION/ 2	1 EC	0.5	3.2Bc	2.3C	2.2Cd	3.8B	4.0Bc	5.0Cd	6.8B	6.8Bc	7.3Bc
DIMENSION/ 3	1 EC	0.5	5.0A	5.0A	4.0A	3.0C	2.7D	4.0E	5.7C	5.8D	6.3D
DIMENSION/ 1	0.25 FG	0.5	2.7Bc	1.7c	1.7de	4.3ab	5.0a	5.2c	7.7a	7.7a	7.7b
DIMENSION/ 2	0.25 FG	0.5	2.5c	2.2c	1.8cde	4.5a	4.7abc	5.0cd	7.7a	7.7a	7.5bc
DIMENSION/ 3	0.25 FG	0.5	3.5b	3.3b	3.0b	3.8b	3.8c	4.5de	7.0ab	6.7c	6.8cd
Fertilizer Check	39 GR	65	3.3bc	1.7c	1.0f	3.8b	4.8ab	6.8a	6.8b	7.5ab	8.8a
Untreated			2.5c	2.0c	1.3ef	4.7a	4.2abc	6.2b	7.7a	7.3abc	8.5a
LSD (0.05)			**1.0**	**0.9**	**0.7**	**0.7**	**0.9**	**0.6**	**0.8**	**0.7**	**0.7**

*Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple means technique.
[1]Turfgrass injury evaluated on a scale of 1 to 9, with 1 equal to no injury and 9 equal to strawed turf.
[2]Turfgrass quality evaluated on a scale of 1 to 9, with 1 equal to the poorest quality turf and 9 equal to the highest quality turf.
[3]Turfgrass density evaluated on a scale of 1 to 9, with 1 equal to 0-10% turf density and 9 equal to 90-100% turf density.
[4]DAT = Days after treatment.

Table 2. Turfgrass injury[1], quality[2] and density[3] following the second herbicide application on June 18, 1998. The Effect of DIMENSION Herbicide on Turf Quality. John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

			Turf Injury			*Turf Quality*			*Turf Density*		
Treatment/No. of Applications	*Formulation*	*Rate (lb ai/A)*	*7-14 DAT[4]*	*21-28 DAT*	*45-60 DAT*	*7-14 DAT*	*21-28 DAT*	*45-60 DAT*	*7-14 DAT*	*21-28 DAT*	*45-60 DAT*
DIMENSION/ 1	1 EC	0.5	1.8bc*	2.2	1.7abc	5.2	5.8	7.0bc	7.3bc	7.8	8.2abc
DIMENSION/ 2	1 EC	0.5	2.5ab	2.3	2.0ab	5.3	5.3	6.5c	7.5abc	7.7	7.8c
DIMENSION/ 3	1 EC	0.5	3.2a	3.0	2.2a	4.5	5.2	6.7bc	6.8c	7.2	8.0bc
DIMENSION/ 1	0.25 FG	0.5	1.2c	1.3	1.0c	6.2	6.7	7.8a	8.2ab	8.7	8.8a
DIMENSION/ 2	0.25 FG	0.5	1.5c	1.7	1.3bc	5.8	6.0	7.3ab	8.2ab	8.2	8.8a
DIMENSION/ 3	0.25 FG	0.5	1.7bc	1.8	1.3bc	5.8	5.7	7.3ab	8.2ab	7.8	8.3abc
Fertilizer Check	39 GR	65	1.2c	1.3	1.0c	6.3	6.7	7.3ab	8.5a	8.5	8.7ab
Untreated			1.3c	2.3	2.0ab	5.7	5.2	6.5c	8.2b	7.8	8.3abc
LSD (0.05)			**0.9**	**ns**	**0.8**	**ns**	**ns**	**0.8**	**1.0**	**ns**	**0.7**

* Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple means technique.
[1]Turfgrass injury evaluated on a scale of 1 to 9, with 1 equal to no injury and 9 equal to strawed turf.
[2]Turfgrass quality evaluated on a scale of 1 to 9, with 1 equal to the poorest quality turf and 9 equal to the highest quality turf.
[3]Turfgrass density evaluated on a scale of 1 to 9, with 1 equal to 0-10% turf density and 9 equal to 90-100% turf density.
[4]DAT = Days after treatment.

Table 3. Turfgrass injury[1], quality[2] and density[3] following the third herbicide application on August 12, 1998.

The Effect of DIMENSION Herbicide on Turf Quality. John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

			Turf Injury			*Turf Quality*		*Turf Density*	
Treatment/No. of Applications	*Formulation*	*Rate (lb ai/A)*	*7-14 DAT*[4]	*21-28 DAT*	*45-60 DAT*	*7-14 DAT*	*45-60 DAT*	*7-14 DAT*	*21-28 DAT*
DIMENSION/ 1	1 EC	0.5	1.7	1.7	1.2	5.2	5.0	8.5abc*	7.8
DIMENSION/ 2	1 EC	0.5	1.8	2.0	1.3	5.3	5.3	8.2bcd	7.8
DIMENSION/ 3	1 EC	0.5	2.0	2.2	1.8	5.3	5.2	8.0cd	8.2
DIMENSION/ 1	0.25 FG	0.5	1.2	1.0	1.3	5.7	5.2	9.0a	8.3
DIMENSION/ 2	0.25 FG	0.5	1.3	1.2	1.0	5.5	5.3	8.8ab	8.3
DIMENSION/ 3	0.25 FG	0.5	1.7	2.2	1.8	5.0	5.2	8.5abc	7.8
Fertilizer Check	39 GR	65	1.3	1.0	1.3	5.8	5.2	8.8ab	7.8
Untreated			2.5	2.3	2.0	4.5	4.0	7.7d	7.3
LSD (0.05)			ns	ns	ns	ns	ns	0.7	ns

* Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple means technique.
[1]Turfgrass injury evaluated on a scale of 1 to 9, with 1 equal to no injury and 9 equal to strawed turf.
[2]Turfgrass quality evaluated on a scale of 1 to 9, with 1 equal to the poorest quality turf and 9 equal to the highest quality turf.
[3]Turfgrass density evaluated on a scale of 1 to 9, with 1 equal to 0-10% turf density and 9 equal to 90-100% turf density.
[4]DAT = Days after treatment.

Table 4. Turfgrass quality[1], interaction of cultivar and treatment, 21-28 days after the third herbicide application on August 12, 1998. The Effect of DIMENSION Herbicide on turf quality. John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

Treatment/No. of Applications	*Formulation*	*Rate (lb ai/A)*	*Penncross*	*Providence*
DIMENSION/ 1	1 EC	0.5	4.3	6.3
DIMENSION/ 2	1 EC	0.5	4.3	6.0
DIMENSION/ 3	1 EC	0.5	6.0	5.7
DIMENSION/ 1	0.25 FG	0.5	4.0	6.3
DIMENSION/ 2	0.25 FG	0.5	6.0	6.3
DIMENSION/ 3	0.25 FG	0.5	5.0	4.3
Fertilizer Check	39 GR	65	4.3	6.0
Untreated			3.0	6.0

LSD_1 ($p \leq 0.05$) within rows = 5.3
LSD_2 ($p \leq 0.05$) within columns = 1.5

Table 5. Turfgrass density[1], interaction of cultivar and treatment, 45-60 days after the third herbicide applica-

tion on August 12, 1998. The Effect of DIMENSION Herbicide on turf quality. John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

Treatment/No. of Applications	*Formulation*	*Rate (lb ai/A)*	*Penncross*	*Providence*
DIMENSION/ 1	1 EC	0.5	6.7	7.3
DIMENSION/ 2	1 EC	0.5	7.3	8.0
DIMENSION/ 3	1 EC	0.5	7.0	7.7
DIMENSION/ 1	0.25 FG	0.5	6.3	7.7
DIMENSION/ 2	0.25 FG	0.5	7.3	7.7
DIMENSION/ 3	0.25 FG	0.5	8.0	7.0
Fertilizer Check	39 GR	65	6.7	7.7
Untreated			6.0	7.0

LSD_1 ($p \leq 0.05$) within rows =3.1
LSD_2 ($p \leq 0.05$) within columns = 0.8

[1]Turfgrass quality evaluated on a scale of 1 to 9, with 1 equal to the poorest quality turf and 9 equal to the highest quality turf.
[2]Turfgrass density evaluated on a scale of 1 to 9, with 1 equal to 0-10% turf density and 9 equal to 90-100% turf density.

Table 6. Dollar Spot[1] following the third herbicide application on August 12, 1998. The effect of DIMENSION herbicide on turf quality. John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

Treatment/No. of Applications	*Formulation*	*Rate (lb ai/A)*	*Dollar Spot 21-28 DAT[2]*	*45-60 DAT*
DIMENSION/ 1	1 EC	0.5	3.2ab*	3.3a
DIMENSION/ 2	1 EC	0.5	2.2def	2.3bc
DIMENSION/ 3	1 EC	0.5	1.7ef	2.3bc
DIMENSION/ 1	0.25 FG	0.5	3.0abc	3.0ab
DIMENSION/ 2	0.25 FG	0.5	2.7bcd	2.5bc
DIMENSION/ 3	0.25 FG	0.5	1.5f	1.8c
Fertilizer Check	39 GR	65	3.5a	3.0ab
Untreated			2.3cde	3.3a
LSD (0.05)			**0.8**	**0.7**

* Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple means technique
[1]Turfgrass injury evaluated on scale of 1 to 9, with 1 equal to no injury and 9 equal to strawed turf.
[2]DAT = Days after treatment.

1998 Yellow Nutsedge Herbicide Evaluations

R.E. Gaussoin and M. R. Vaitkus

Research was conducted in 1998 to evaluate weed control and turfgrass sensitivity to a post-emergence experimental compound. The research site was a 16-year-old Kentucky bluegrass home lawn with a healthy yellow nutsedge (*Cyperus esculentus*) population in Lincoln, Neb.

The experimental area was maintained at a 2.5 in. mowing height and irrigation was applied as needed to prevent stress. The experimental design was a randomized complete block with three replications, comprised of two rates of the experimental compound (BRC996), a commercial standard herbicide treatment (Manage) and an untreated control.

Postemergence treatments were applied on June 4, 1998. Weather during application was cloudy, 56°F, 56%RH, with a slight (6 mph) north breeze and a soil temperature of 62°F. All treatments were applied with a CO_2-driven backpack sprayer equipped with a single 8002VS flat fan nozzle and calibrated to deliver 40 gal/A at 30 psi.

Evaluations for weed control (0-100 percent scale) were made at two, four, six, eight, 10, 12 and 14 weeks after treatment (WAT). Data were analyzed using the Pesticide Research Manager (PRM) analysis program. All three products showed similar and significant control of nutsedge starting at 4 WAT and continuing throughout the trial.

Table 1. Percent (%) nutsedge control[1]. 1998 yellow nutsedge herbicide evaluations.

			Percent control						
Product	*Form*	*Rate lb ai/A*	*2 WAT[2] 6/19/98*	*4 WAT 7/3/98*	*6 WAT 7/17/98*	*8 WAT 7/31/98*	*10 WAT 8/14/98*	*12 WAT 8/28/98*	*14 WAT 9/11/98*
BRC996	2 SL	0.25	63a*	100a	94a	92a	90a	86a	86a
BRC996	2 SL	0.375	67a	83a	83a	80a	75a	77a	77a
Manage	75 WG	0.047	71a	100a	100a	100a	100a	98a	98a
Control			0a	0b	0b	0b	0b	0b	0b
LSD (0.05)			**89**	**29**	**32**	**33**	**29**	**38**	**38**

* Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple comparison technique.
[1]Evaluated on a scale of 0-100%, with 0 = no control and 100% = total control.
[2]WAT = Weeks after treatment.

Right-of-Way Weed Control

R.E. Gaussoin and M.R. Vaitkus

Research was conducted in 1998 to determine the most effective Vanquish mix partners for controlling annual and perennial weeds on right-of-ways. The research site was a weedy area at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. Dominant species were Pennsylvania smartweed (*Polygonum pensylvanicum*), smooth brome (*Bromus inermis*), yellow sweetclover (*Melilotus officinalis*), common vetch (*Vicia sativa*), dandelion (*Taraxacum officinale*), wild alfalfa (*Psoralea tenuiflora*) and ragweed (*Ambrosia artemisiifolia*).

The experimental area was neither mowed and nor irrigated. The soil type was a Sharpsburg silty clay loam (fine, montmorillonitic, mesic Typic Argiudoll), with 3.4 percent organic matter, a bulk density of 1.38 g/cm^3 and a pH of 6.8. Plot size was 3 feet by 6 feet. The experimental design was a randomized complete block with three replications comprised of a Vanquish (alone) treatment, five treatments of Vanquish mixed with other herbicides and an untreated control.

Treatments were applied on July 15, 1998. Weather during application was sunny, 77^{o}F, 73%RH, with a moderate (8 mph) south wind and a soil temperature of 79^{o}F. Treatments were applied with a CO_2-driven backpack sprayer equipped with a single 8002VS flat fan nozzle and calibrated to deliver 40 gal/A at 30 psi. Evaluations for weed control were made at five days after treatment and at one, two, three, four and 10 weeks after treatment (WAT). Data were analyzed using the MSTAT statistical analysis program.

All treatments showed significant weed control five days after treatment (Table). Vanquish/Hi-Dep (2,4-D), Vanquish/Escort and Vanquish/Transline weed control was significant at various times during the period of one to four WAT, while the Vanquish/Accord treatment showed consistent and high weed control ($\geq$50%) over the entire test. The Vanquish/Accord treatment was the only one to exhibit significant weed control at 10 WAT. The Vanquish/Premier treatment showed very high weed control ($\geq$80%) up to 4 WAT. Weed control by the Vanquish/Accord and Vanquish/Premier treatments was significantly higher than weed control by any other treatment throughout the study.

Table 1. Right-of-way weed control. Treated July 15, 1998 at the John Seaton Anderson Turfgrass Research Facility near Mead, Neb.

		Percent weed control[1]					
Treatment	*Rate*	*5 DAT*[2] *(7/20)*	*1 WAT*[3] *(7/22)*	*2 WAT (7/29)*	*3 WAT (8/4)*	*4 WAT (8/12)*	*10 WAT (9/24)*
Vanquish	1.5 pt pr/A	23c[4]	20cd	20bc	21bc	21bc	3ab
Vanquish Escort	1.5 pt pr/A 0.5 oz pr/A	20c	20cd	23bc	36b	36b	3ab
Vanquish Transline	1.5 pt pr/A 5.0 oz pr/A	23c	20cd	27bc	39b	35b	3ab
Vanquish Hi-Dep (2,4-D)	1.5 pt pr/A 1 qt pr/A	30c	33c	30b	27bc	31b	10ab
Vanquish Accord	1.5 pt pr/A 1 qt pr/A	50b	60b	80a	97a	97a	50a
Vanquish Premier	1.5 pt pr/A 2.5 lbs pr/A	80a	90a	87a	90a	86a	33ab
Untreated		0d	0d	0c	0c	0c	0b
LSD (0.05)		**19**	**22**	**27**	**28**	**23**	**49**

[1]Visually estimated on a 0-100% scale, with 0 equal to no control and 100 equal to 100% control.
[2]Days after treatment (DAT)
[3]Weeks after treatment (WAT)
[4]Means within columns followed by different letters are significantly different based on the Least Significant Difference (LSD) multiple means technique.

Evaluation of Fungicides for Control of Brown Patch, 1998

J.E. Watkins and L.A. Wit

Brown patch affects all commonly cultivated turfgrasses in Nebraska, but perennial ryegrass, tall fescue, and bentgrass are the three species most seriously affected. Hot, humid weather in July and August promote disease development. Classical symptoms on higher-cut turfs are light brown, circular patches that may be up to 2 feet in diameter. Individual leaf blades develop gray lesions with dark brown margins.

Fungicides applied either on a preventive or curative schedule offer an important means of controlling brown patch.

Plots were located on a blend of perennial ryegrasses at the John Seaton Anderson Turf and Ornamental Research Facility near Mead, NE. Plots were mowed three times weekly at a height of 0.62 in and maintained at 80 percent ETp. Pre-emergence weed control was with pendimethalin at 1 1/2 lbs/acre applied April 20, 1998. Sulfur-coated urea (32-0-0) was applied June 6, 1998 at 1 lb N/1,000 sq ft. The experimental area was inoculated in late June and again in late July with *Rhizoctonia solani* cultured on sterilized tall fescue seed. The inoculum was delivered with a drop spreader calibrated to deliver 1 1/2 lbs inoculum/1,000 sq ft. After inoculation the area was covered with Seed Guard (A.M. Leonard, Inc., Piqua, OH) for 48 hours to raise humidity and encourage disease development. Seed Guard is a white spun-bound polypropylene material used in turfgrass establishment to increase seed germination. Fungicide treatments were applied to 25 sq ft plots using a CO_2 pressurized (30 psi) backpack sprayer with a T-jet No. 8002 flat fan nozzle. The sprayer was calibrated to deliver 5 gal spray solution per 1,000 sq ft. Three replications per treatment were arranged in a randomized complete block design. Precipitation was above normal April through June and below normal July and August. Temperatures and humidities were near normal in June and above normal July through September.

Disease severity was moderate during July and August. Although the inoculum was applied uniformly with a drop spreader, disease development was not uniform across the plot. There were significant differences among treatments, and turfgrass quality was significantly (negatively) correlated with disease severity. The Heritage 50WG at 0.2 oz applied every 14 days and a tank mix of Bayleton 50DF at 0.25 oz plus Heritage 50WG at 0.2 oz applied every 21 days provided the best control with the lowest disease severity and highest quality ratings.

Table 1. Effects of fungicide treatments and appli-

cation interval on the development of brown patch on perennial ryegrass.

		July 29, 1998**		Aug. 19, 1998	
Treatment and rate of product/1,000 ft²	*Application frequency (days)**	*Brown patch severity*	*Turfgrass quality*	*Brown patch severity*	*Turfgrass quality*
Chipco 26GT 2SC, 4 fl oz	14	4.7	3.7	3.7	3.7
Heritage 50WG, 0.2 oz	14	2.0	6.0	1.0	6.0
ProStar 70WP, 2.25 oz	14	4.3	4.0	4.7	4.0
ProStar 70WP, 1.5 oz + Banner MAXX 14.3%, 0.5 fl oz	14	2.7	5.3	2.7	5.3
Banner MAXX 14.3%, 1 fl oz	14	2.0	5.7	2.0	5.7
Eagle 40W, 0.6 oz	14	4.0	4.3	3.0	4.3
Bayleton 50DF, 0.25 oz + Daconil Ultrex 82.5 WDG, 1.8 oz	14	5.3	3.0	5.3	3.0
Lynx 45WP, 0.25 oz + Daconil Ultrex 82.5 WDG, 1.8 oz	14	4.3	4.0	3.3	4.0
Bayleton 50DF, 0.25 oz + Heritage 50WG, 0.2 oz	21	2.0	6.3	1.3	6.3
Lynx 45WP, 0.25 oz + Heritage 50WG, 0.2 oz	21	3.7	4.7	2.0	4.7
Heritage 50WG, 0.4 oz + Daconil Ultrex 82.5 WDG, 1.8 oz	28	2.7	4.7	1.3	4.7
Untreated check		5.7	2.7	5.7	2.7
LSD ($P \leq 0.05$)		**2.7**	**2.6**	**2.3**	**2.1**
Correlation coefficients comparing quality with disease		**-0.97**		**-0.97**	

*Treatments were initiated July 1, and the final treatments applied Aug. 12.
**Disease rating scale is based on a 1 (lowest severity) to 9 (highest severity) and is a prevalence rating of the percent of the plot with disease symptoms. Quality is rated on a scale of 1 (lowest quality) to 9 (highest quality).

Evaluation of Fungicides for Control of Dollar Spot, 1998

J.E. Watkins and L.A. Wit

Dollar spot is one of the most persistent diseases of golf course turfs in North America. More money is spent by golf courses on the control of dollar spot than for any other disease. On home lawns and other turfs, dollar spot affects the aesthetic appearance and value, but usually does not threaten the turf's survival.

High-value turfs, such as golf greens and tees, should be treated with fungicides on a preventive program.

Plots were located on a Penncross creeping bentgrass turf at the John Seaton Anderson Turf and Ornamental Research Facility near Mead, Neb. The experimental area was inoculated in early June with *Sclerotinia homoeocarpa* cultured on sterilized tall fescue seed. The inoculum was applied with a 4-ft wide Gandy drop spreader calibrated to deliver 1 1/2 lbs tall fescue inoculum per 1,000 sq ft. Plots were mowed three times per week at a height of 0.62 in and maintained at 80 percent ETp. The plot area was treated with Heritage at 0.4 oz/1,000 sq ft on July 9 to prevent brown patch. Fungicide treatments were applied to 25 sq ft plots using a CO_2 pressurized (30 psi) backpack sprayer with a T-jet 8002 flat fan nozzle. The sprayer was calibrated to deliver 5 gallons of spray solution per 1,000 sq ft. Four replications per treatment were arranged in a randomized complete block design. Precipitation was above normal during May and June, and below normal July and August. Temperatures and humidities were near normal May and June, and above normal July and August.

Disease development on the plots was severe. There were significant differences among fungicide treatments and turfgrass quality was negatively correlated with disease. The treatments ProStar 1.5 oz plus Banner MAXX, 0.5 fl oz; Banner MAXX, 1 fl oz; Lynx, 0.28 oz; Eagle, 0.8 oz and Lynx, 0.28 oz plus Daconil Ultrex, 1.8 oz provided the best dollar spot control with the lowest disease severity and highest quality ratings.

Table 1. Control of dollar spot on creeping

bentgrass with fungicides applied on a 14-day schedule.

Treatment and rate of product/1,000 ft²	*Application frequency (days)**	*July 22, 1998***		*Aug. 26, 1998*	
		Brown patch severity	*Turfgrass quality*	*Brown patch severity*	*Turfgrass quality*
ProStar 70WP, 2.25 oz	14	6.8	2.0	9.0	1.0
ProStar 70WP, 1.5 oz + Banner MAXX 14.3%, 0.5 fl oz	14	1.0	6.8	1.0	6.8
Banner MAXX 14.3%, 1 fl oz	14	1.0	6.5	0.8	7.0
Eagle 40W, 0.8 oz	14	1.0	7.0	1.0	6.5
Bayleton 50 DF, 0.25 oz + Daconil Ultrex 82.5 WDG, 1.8 oz	14	2.0	5.3	1.0	6.5
Lynx 45WP, 0.28 oz + Daconil Ultrex 82.5 WDG, 1.8 oz	14	1.5	6.0	1.0	6.8
Bayleton 50 DF, 0.25 oz	14	2.0	5.3	1.3	6.0
Lynx 45WP, 0.28 oz	14	1.3	6.3	1.0	6.3
Daconil Ultrex 82.5 WDG, 1.8 oz	14	4.5	3.3	6.5	3.3
Untreated check		4.5	2.5	9.5	1.0
LSD ($P \leq 0.05$)		**1.2**	**1.2**	**0.5**	**1.0**
Correlation coefficient comparing quality with disease		**-0.92**		**-0.97**	

*Treatments were initiated July 10, with the final treatment applied August 19.
**Disease rating scale is based on a 1 (lowest severity) to 10 (highest severity) and is a prevalence rating of the percent of the plot with disease symptoms. Quality is rated on a scale of 1 (lowest quality) to 9 (highest quality).

Evaluation of Fungicides for Control of Pythium Blight

J.E. Watkins and L.A. Wit

Pythium blight occurs when temperatures and humidities remain above 90 for several consecutive days. Under these conditions, the disease develops rapidly causing severe loss of turf. Although turfs are affected by Pythium blight, perennial ryegrass and bentgrass grown under a high maintenance programs are most affected.

Timely application of a fungicide before disease development is necessary to prevent serious turf injury. Once active, the disease is difficult to bring under control with curative fungicide treatments.

Seven fungicide treatments were applied to plots of a perennial ryegrass blend at the John Seaton Anderson Turf and Ornamental Research Facility near Mead, Neb. Twenty-five sq ft plots were replicated four times in a randomized complete block design. Plots were mowed three times per week at a height of 0.62 in and maintained at 80 percent ETp. One and a half lb/acre of pendimethalin were applied April 20 for preemergence weed control. Sulfur-coated urea (32-0-0) was applied June 19 at 1 lb N/1,000 sq ft. The experimental area was inoculated July 8 and Aug. 19 with *P. aphanidermatum* cultured on sterilized tall fescue seed and applied with a 4-ft wide Gandy drop spreader calibrated to deliver 1 1/2 lbs tall fescue inoculum per 1,000 sq ft. After inoculation the plot area was covered with Seed Guard (A.M. Leonard, Inc., Piqua, OH) for 7 days to raise humidity and encourage disease development. Seed Guard is a white spun-bound polypropylene material used to increase seed germination. Fungicide applications were initiated July 8 and repeated every 21 days until Aug. 19. Products were applied with a CO_2-pressurized (30 psi) back-pack sprayer with a T-jet 8002 flat fan nozzle at a delivery rate of 2.5 or 5 gal spray solution per 1,000 sq ft. Precipitation was above normal during May and June, and below normal July and August. Temperatures and humidities were near normal May and June, and above normal July and August.

Disease severity was moderate, but not uniform, across the plot area. However, there were significant differences among treatments, and turfgrass quality was negatively correlated with disease severity. Application of Aliette Signature at 8 oz/1,000 sq ft resulted in the lowest disease severity and highest turfgrass quality.

Table 1. Control of Pythium blight on perennial ryegrass using a preventive fungicide program.

Treatment and rate of product/1,000 ft^2	Application frequency days	Aug. 26, 1998 Pythium blight severity	Turfgrass quality
Banol 6EC, 2 fl oz	21	2.8	6.3
Banol 6EC, 2 fl oz**	21	3.3	5.5
Banol 2EC, 1.3 fl oz**	21	3.0	5.5
Banol 2EC, 1.3 fl oz + Heritage 50WG, 0.2 oz**	21	2.3	6.8
Heritage 50WG, 0.4 oz**	21	3.8	5.0
Subdue MAXX 2EC, 0.8 fl oz	21	2.5	6.3
Aliette Signature 80WP, 8 oz	21	1.8	6.8
Untreated check		3.8	5.8
LSD ($P \leq 0.05$)		**1.9**	**1.7**
Correlation coefficient comparing quality with disease		**-0.95**	

*Disease rating scale is based on a 1 (lowest severity) to 9 (highest severity) and is a prevalence rating of the percent of the plot with disease symptoms. Quality is rated on a scale of 1 (lowest quality) to 9 (highest quality).
**Applied at a delivery rate of 2.5 gal spray solution/1,000 sq ft; all other treatments were applied at a spray solution rate of 5 gal/1,000 sq ft.

Black Cutworm Control Using CONSERVE in Combination with Selected Additives

T.M. Heng-Moss, F.P. Baxendale and A.P. Weinhold

This study was conducted at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. The turf (100% creeping bentgrass) was maintained at a mowing height of 0.375 inches. Thatch accumulation (finger compressed) in the plot area was 0.50 inches. Field conditions at the study site were: soil type, silty clay loam; soil organic matter, 3.5 percent; soil pH, 6.5; water pH, 7.0. Environmental conditions at the time of application, (June 10) were as follows: soil moisture 26 percent by wt; air temperature 75°F; soil temperature 70°F; relative humidity 77 percent; wind direction and velocity 162° at 13 mph. Each 1 x 8 ft plot contained three, 8 inch diameter x 12 inch deep PVC pots sunk to the rim in the soil. The experimental design was a randomized complete block (RCB) with three replications. Bentgrass sod plugs were installed into pots one week before black cutworm (BCW) inoculation. Twenty (< one inch in length) black cutworms were placed in each infestation pot one day before insecticide applications. An 8-inch plastic barrier was installed around the pots to prevent BCW escape, and bird netting was installed over the pots to avert predation. Insecticides were applied June 10. Liquid insecticides were applied using a CO_2 sprayer with a TeeJet® 8002 nozzle at 30 psi and delivering 87 gpa. The test area was not irrigated for 24 hours following applications. Product efficacy was evaluated seven days after treatment (DAT) (June 17) by mixing 0.5 oz Lemon Dawn® per gallon of water and applying the solution to each pot until 1/2 inch was standing in the pot. Larvae that moved to the grass surface within 30 minutes were collected and counted.

All insecticides provided statistically significant reductions in BCW numbers when compared to the untreated control. There were no statistically significant differences between insecticides. No phytotoxicity was observed.

Table 1. Mean black cutworm (BCW) numbers and percent control following application of CONSERVE in combination with selected additives.

Treatment/Formulation	*Rate (lbs ai/A)*	*Mean BCW/0.35 ft²*	*% Control*
Talstar 10WP	0.10	0.0a*	100.0
Conserve + X-77 1SC	0.26 + 1%v/v	0.3a	97.8
Conserve + Agra-Dex 1SC	0.26 + 1%v/v	0.7a	95.6
Conserve1SC	0.26	1.0a	93.5
Conserve + urea 1SC	0.26 + 5.5	1.3a	91.3
Untreated Control		15.3b	0

*Means followed by the same letter are not significantly different (p = 0.05; LSD=6.14).

Effect of Application Timing of Selected Insecticides for Control of Bluegrass Billbug

F.P. Baxendale, A.P. Weinhold and T.P. Riordan

This study was conducted at the University of Nebraska Agricultural Research and Development Center near Mead, Neb. The turf (100% Kentucky bluegrass) was maintained at a mowing height of 2.5 inches. Thatch accumulation (finger compressed) in the plot area was 0.50 inches. Field conditions at the study site were: soil type, silty clay loam; soil organic matter, 3.5 percent; soil pH, 6.2-6.6; water pH, 7.0. Environmental conditions at the times of application, (May 13, June 22, and July 1) were as follows: soil moisture by wt 15, 20 percent, and NA, respectively; air temperatures 84, 79 and 81°F; soil temperatures 74, 75 and 86°F; relative humidity 52, 64 and 50 percent; wind directions and velocities 144° at 19 mph, 192° at 5 mph and 85° at 4 mph. Plots were 6 ft x 10 ft and the experimental design was a randomized complete block (RCB) with four replications. Liquid insecticides were applied using a CO_2 sprayer with a TeeJet® 8002 nozzle at 30 psi and delivering 87 gpa formulation. Plots were irrigated with 0.125 inches of water following application. Post-treatment precipitation totaled 11.21 inches. Treatments were evaluated July 10 (58, 18 and nine DAT) by removing three, 8-inch diam turf-soil cores (1.05 ft^2 total area) to a depth of 3 inches, and visually examining the soil and thatch for surviving billbug larvae.

All products, regardless of application date, provided statistically significant reductions in bluegrass billbug (BB) numbers when compared to the untreated control. Mach 2 applied early (May) and mid-season (June) provided numerically higher reductions in billbug larvae than the late season application. No phytotoxicity was observed.

Table 1. Effect of application timing of selected insecticides on mean bluegrass billbug (BB) numbers and percent control.

Treatment	*Formulation*	*Application Date*	*Rate*	*Mean BB (per 1.05*	*% Control*
Merit	75WP	June	0.3 ai/A	1.8a*	93.1
Mach 2	2SC	May	1.5 ai/A	4.0a	84.2
Mach 2	2SC	June	1.5 ai/A	4.0a	84.2
Naturalis O	7%	June	1.0 oz/1000 ft^2	4.8a	80.2
Naturalis O	7%	June	0.5 oz/1000 ft^2	5.0a	80.2
Mach 2	2SC	July	1.5 ai/A	7.0a	72.3
Untreated Control				25.3b	0

*Means followed by the same letter are not significantly different (p = 0.05; LSD=6.65).

High Pressure Injection of Liquid Insecticides for Control of Southern Masked Chafer Larvae

A.P. Weinhold, F.P. Baxendale and R.D. Grisso

This study was conducted in Lincoln, Neb. on two golf courses. The turf at both sites consisted of a blend of 50 percent Kentucky bluegrass and 50 percent perennial rye. The turf at the sites was maintained at a mowing height of 2.5 inches (rough) and 5/8 inches (fairway). Thatch accumulations (finger compressed) at both sites were 0.5 to 0.75 inches. Field conditions at both the study sites were: soil type, silty clay loam; soil organic matter, 4 percent; soil pH, 6.2; water pH, 7.0. Environmental conditions at the time of application for sites 1 and 2 were as follows: soil moisture by wt, 20 percent and 17 percent respectively; air temperature 79°F and 80°F; soil temperature 80°F and 80°F; relative humidity 62 percent and 70 percent; wind direction and velocity 136° at 5 mph and 116° at 3 mph. Plots were 4 ft x 4 ft and the experimental design was a randomized complete block (RCB) with six replications at each site. Applications were applied on August 12 at site 1 and on August 13, 1998 at site 2 using a John Deere RZI 700 high pressure liquid injection system. Injections were conducted at a linear speed of 1 mph using 60°/ 0.32 inch orifice, dual port nozzles operating at 12 pulses/sec. Injection pressure was 5,000 psi and liquid was applied at a volume of 6 gal of solution/ 1,000ft^2. The 16 nozzles (evenly spaced at 3 inches along the length of the injector manifold) were adjusted to alternating 45° angles. Insecticide injections were applied in either one or two 90° passes across plots. No irrigation was applied following applications. Post-treatment precipitation totaled 3.94 inches. Treatments were evaluated Sept. 10 (29 days after treatment (DAT) and Sept. 3 (22 DAT) at sites 1 and 2, respectively. Assessment of white grub control was determined by removing from each evaluation plot six, 8-inch diameter turf-soil cores (2.10 ft^2 total area) to a depth of 3 inches and counting the number of surviving grubs. Since ANOVA determined there were no significant differences between locations, the data were pooled and analyzed using Proc GLM.

All treatments provided a statistically significant reduction in white grub numbers when compared to the untreated control. Although there were no statistically significant differences among treatments, increasing the number of passes appeared to provide better control. No phytotoxicity or unacceptable turf injury was observed.

Table 1. Mean numbers of southern masked chafer larvae and percent control following high pressure injection of liquid insecticides (August 1998).

Treatment/Formulation	*Rate (lbs ai/A)*	*# of Passes*	*Mean grubs/2.10ft^2*	*% Control*
Mach 2SC	1.5	2	0.0a*	100.0
Oftanol 2E	2.0	2	0.4a	98.5
Oftanol 2E	2.0	1	0.4a	98.5
Mach 2SC	1.5	1	0.6a	97.7
Scimitar CS	0.15	2	3.4ab	87.0
Scimitar CS	0.15	1	8.5b	67.6
Untreated Control			26.2c	0

*Means in a column followed by the same letter are not significantly different (p = 0.05; LSD= 7.5).

Fungicide Evaluation for Control of Rust, Mildews, and Leaf Spot on Blackeyed Susan and Geranium

A.M. Streich, J.E. Watkins and D.H. Steinegger

A new ornamental fungicide program will begin in the summer of 1999. Fungicide treatments will be conducted on blackeyed susan (*Rudbeckia fulgida*) and geranium (*Pelargonium hortorum*) for control of mildew (*Erysiphe* sp. and *Sphaerotheca* sp.), rust (*Puccinia* sp.) and leaf spot (various sp.).

Each trial will have 15 x 15 ft plots with three replications. Plots will be arranged in a randomized complete block design. Each geranium plot will consist of 15 geraniums and each blackeyed susan plot will have nine blackeyed susans. Plots will be at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. Heavy fertilization, covering of plants and night watering will be done to help promote disease incidence. Fungicide applications will begin in late June or early July and will be repeated twice thereafter. Products will be applied with a CO_2-pressurized backpack sprayer with a flat fan nozzle.

1998 Results from the 1994 National Perennial Ryegrass Trial

M.R. Vaitkus, R.C. Shearman, J.E. Watkins and L.A. Wit

The National Perennial Ryegrass trial was planted in September, 1994 at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. The seeding rate was 5.0 lbs/1,000 ft^2. The trial contains 96 entries planted in a completely randomized block design with three replications. Plot size is 3 feet by 5 feet. A severe winter following seeding caused extensive winter kill and the entire trial was interseeded in May, 1996.

Soil type is a Sharpsburg silty clay loam (fine, montmorillonitic, mesic Typic Argiudoll) with a pH of 7.0 and 3.5 percent organic matter. Turf height is maintained at inch and is mowed four to five times weekly. Nitrogen and potassium are applied at 6.0 lbs N and K/1,000 ft^2 per year; phosphorous is applied at 1.0 lb P/1000 ft^2 per year. Irrigation is adjusted twice weekly to maintain an application rate of 80 percent ETp. Pendimethalin is applied annually at label-recommended rates for crabgrass control. Postemergence herbicides are applied as needed. No fungicides or insecticides are applied. In 1998, weekly traffic treatments were imposed from early April through October.

In 1998, spring green-up, genetic color and leaf texture, as well as monthly turfgrass quality were evaluated (Table 1). In July, brown patch (*Rhizoctonia solani*) was detected and rated.

Overall cultivar performance reflected the favorable spring, but harsh summer growing conditions. Mean turfgrass quality peaked in June (at 6.8), then declined throughout the remainder of the growing season (Table 1). Individual cultivars also demonstrated seasonal differences in turfgrass quality, as well as genetic color, leaf texture and density. Mean quality ratings of individual cultivars ranged from 6.9 to 2.3, with 47 cultivars having overall mean quality ratings exceeding 6.0, the acceptable fairway turfgrass quality rating level. Mean genetic color and density were high (>7.3) and 16 cultivars exhibited low to very low ($\leq$ 2.0) brown patch incidence rating.

Table 1. 1994 NTEP Perennial Ryegrass trial — 1998 Data. J.S. Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

	Color[1]	*Texture[2]*	*Density[3]*			*Quality[4]*							*Brown Patch[5]*
Cultivar	*6/25*	*6/25*	*4/30*	*7/28*	*10/2*	*4/30*	*5/19*	*6/25*	*7/28*	*8/25*	*10/2*	*Mean*	*7/22*
RPBD	8.0	8.3	9.0	8.3	9.0	7.3	7.0	8.0	7.0	5.0	7.0	6.9	3.0
Calypso	7.3	8.3	9.0	7.7	9.0	7.3	8.0	6.7	5.7	5.7	7.3	6.8	2.7
ZPS-2NV	7.0	8.0	8.7	7.7	9.0	7.0	7.0	7.7	6.3	5.3	7.3	6.8	1.7
Prizm	7.3	9.0	9.0	8.3	9.0	8.0	6.3	7.3	6.3	5.7	6.3	6.7	2.3
MB 42	7.3	8.3	9.0	7.3	9.0	7.7	6.7	7.3	5.7	6.0	6.7	6.7	3.3
MB 43	8.0	8.7	9.0	7.3	9.0	7.3	6.0	7.3	6.0	5.7	7.7	6.7	2.7
PST-2FF	7.7	8.3	9.0	8.0	9.0	7.0	6.3	5.7	7.0	6.0	7.7	6.6	1.7
BAR USA 94-II	7.7	8.0	9.0	8.3	8.7	6.7	7.3	7.7	5.7	5.3	6.7	6.6	3.0
SRX 4400	7.0	8.3	9.0	8.0	9.0	6.3	6.3	7.0	6.0	6.3	7.3	6.6	2.7
PST-2R3	6.7	7.0	9.0	8.0	8.7	7.7	6.7	7.3	5.3	5.3	6.7	6.5	3.0
ISI-MHB	7.5	8.5	8.8	7.8	9.0	6.8	6.8	7.3	5.8	5.8	6.8	6.5	2.0

Table 1. (Continued).

Cultivar	Color[1] 6/25	Texture[2] 6/25	Density[3] 4/30	7/28	10/2	Quality[4] 4/30	5/19	6/25	7/28	8/25	10/2	Mean	Brown Patch[5] 7/22
Riviera II	8.0	8.0	9.0	8.3	9.0	6.7	5.7	7.7	6.3	5.7	7.0	6.5	2.3
Pick Lp 102-92	8.3	8.7	9.0	7.3	9.0	7.7	6.3	8.3	5.3	5.0	6.3	6.5	2.7
ZPS-PR1	7.0	7.7	9.0	8.0	9.0	6.3	7.0	7.0	6.0	6.0	6.3	6.4	2.3
Accent	6.3	6.7	9.0	8.3	9.0	6.7	7.0	5.3	6.7	6.0	6.3	6.4	2.0
Cutter	7.0	7.7	8.3	8.3	9.0	6.3	5.7	7.0	6.3	6.0	6.7	6.3	2.0
Esquire	7.7	8.3	9.0	7.0	8.0	7.0	7.0	6.7	5.7	4.7	7.0	6.3	2.0
PST-GH-94	7.7	8.3	9.0	8.3	8.7	6.7	6.0	7.0	6.3	5.3	6.7	6.3	2.7
ZPS-2ST	8.0	8.3	9.0	8.7	8.3	7.0	6.0	7.3	6.7	5.3	5.7	6.3	2.0
ZPS-2DR-94	8.0	8.3	9.0	8.0	8.7	7.0	6.0	7.0	6.0	5.7	6.3	6.3	2.7
MVF-4-1	7.0	8.3	9.0	7.3	9.0	7.0	5.7	7.0	5.7	5.7	7.0	6.3	2.7
TopHat	7.3	7.7	9.0	8.3	8.3	7.0	7.0	7.0	6.7	4.3	6.0	6.3	2.3
MB 47	7.7	8.3	9.0	7.3	8.7	7.0	6.7	7.0	5.3	5.7	6.3	6.3	2.3
Elf	7.7	7.3	8.7	8.3	8.0	6.3	6.7	6.3	7.3	5.3	5.7	6.3	1.0
Divine	7.3	8.0	9.0	8.3	9.0	6.3	6.0	7.0	6.0	5.7	6.7	6.3	2.3
MB 1-5	7.7	8.0	9.0	7.3	9.0	7.3	7.0	7.3	5.3	4.7	6.0	6.3	3.3
MB 46	8.0	7.3	9.0	7.3	9.0	7.7	7.0	6.0	5.0	5.0	7.0	6.3	4.0
BAR Er 5813	7.0	8.0	8.7	9.0	8.3	7.0	6.0	6.7	6.0	5.7	6.0	6.2	2.0
Brightstar	7.7	7.7	9.0	7.3	9.0	7.3	6.7	7.3	5.0	4.7	6.3	6.2	4.3
MB 44	8.0	8.7	9.0	7.3	8.7	7.0	6.3	7.0	5.0	5.7	6.3	6.2	4.3
Precision	7.7	8.0	8.7	8.0	9.0	6.0	6.3	7.0	6.0	5.0	6.7	6.2	3.7
J-1706	8.3	7.3	9.0	8.0	8.3	6.7	6.7	6.3	5.7	5.7	6.3	6.2	3.3
Pick PR 84-91	7.3	8.3	9.0	8.3	9.0	7.0	6.0	8.0	5.7	4.3	6.3	6.2	2.0
WVPB-93-KFK	7.3	8.3	8.7	8.0	8.3	6.7	5.3	7.3	6.3	4.7	6.7	6.2	2.3
KRF-94-C7	7.0	7.3	9.0	8.7	8.7	7.3	5.7	5.7	6.3	6.0	6.0	6.2	2.0
MB 45	7.7	7.3	9.0	7.3	9.0	6.7	6.7	6.7	5.7	5.0	6.3	6.2	3.0
APR 124	8.0	7.7	8.7	7.7	8.3	7.0	6.3	8.0	6.0	4.0	5.7	6.1	2.7
Pick 928	7.7	8.0	8.7	7.3	8.7	6.7	6.7	6.3	6.0	5.0	6.3	6.1	3.0
MB 41	7.3	7.7	9.0	7.7	9.0	7.0	6.3	6.3	4.7	6.0	6.3	6.1	3.3
Achiever	8.0	8.7	8.7	7.3	8.7	6.0	5.3	7.0	5.3	6.3	6.7	6.1	3.0
Med 5071	6.7	8.0	8.7	8.3	8.7	7.0	6.3	5.7	6.3	5.0	6.3	6.1	1.7
PST-2FE	7.7	8.0	8.7	8.0	8.3	6.7	6.3	7.0	6.3	4.3	6.0	6.1	2.0
Assure	7.0	8.0	8.7	8.0	8.7	6.3	5.0	7.3	6.0	5.7	6.3	6.1	2.7
SRX 4200	6.3	8.0	8.3	7.3	8.7	6.3	6.7	6.3	5.7	5.3	6.3	6.1	2.3
LRF-94-MPRH	8.0	8.0	9.0	8.0	8.7	7.0	6.3	6.3	5.7	4.7	6.7	6.1	3.3
Navajo	7.0	8.3	9.0	7.3	8.7	7.7	6.0	7.7	4.7	4.0	6.3	6.1	4.0
SRX 4010	8.0	8.3	9.0	7.7	9.0	6.3	5.7	7.3	5.3	5.7	6.0	6.1	2.3
APR 106	6.7	7.3	9.0	8.7	9.0	6.3	6.3	6.3	6.3	5.3	5.7	6.0	1.7
Laredo	6.7	8.3	9.0	7.7	8.3	7.3	6.3	6.7	5.7	4.3	5.7	6.0	2.7
PC-93-1	7.3	7.7	8.7	7.7	8.7	6.0	5.3	7.0	5.3	5.7	6.3	6.0	3.7
Advantage	7.3	7.7	9.0	7.7	8.3	7.0	6.3	7.7	5.3	3.3	6.3	6.0	2.7
WVPB 92-4	7.3	7.7	8.7	7.0	8.7	5.3	6.0	7.3	5.3	6.0	5.7	6.0	3.3
Vivid	7.7	7.7	8.3	7.0	8.7	6.0	6.0	6.3	5.7	5.7	6.0	5.9	1.3
WX3-93	8.0	8.3	9.0	7.7	8.0	7.0	7.0	7.3	5.0	4.0	5.3	5.9	3.3
OMNI	7.0	8.0	9.0	6.7	9.0	6.3	6.7	7.7	4.7	4.7	5.7	5.9	4.0
J-1703	7.3	7.3	9.0	7.0	8.7	6.7	6.0	6.3	5.3	4.7	6.3	5.9	3.3
PST-2DGR	6.7	8.3	8.7	8.3	8.7	6.3	5.7	7.0	5.3	5.0	6.0	5.9	1.7
LRF-94-B6	8.0	8.7	9.0	7.7	8.7	7.0	4.7	7.3	5.3	5.0	6.0	5.9	2.0
LRF-94-C8	8.3	8.0	9.0	7.3	8.3	7.0	5.0	7.3	5.3	5.3	5.3	5.9	2.7
KOOS 93-6	8.0	8.0	9.0	8.3	8.0	6.3	6.3	6.3	6.0	5.0	5.3	5.9	2.7
PS-D-9	6.3	7.0	9.0	7.7	8.7	6.3	5.7	6.3	5.3	5.3	6.0	5.9	3.0
PST-28M	7.3	8.0	8.3	7.3	8.7	6.0	5.7	7.0	5.7	5.3	5.3	5.8	3.0

Table 1. (Continued).

Cultivar	Color[1] 6/25	Texture[2] 6/25	Density[3] 4/30	Density[3] 7/28	Density[3] 10/2	Quality[4] 4/30	Quality[4] 5/19	Quality[4] 6/25	Quality[4] 7/28	Quality[4] 8/25	Quality[4] 10/2	Quality[4] Mean	Brown Patch[5] 7/22
CAS-LP23	7.3	8.3	8.7	7.7	8.7	6.7	5.7	7.3	5.0	4.3	6.0	5.8	4.0
PSI-E-1	8.0	8.0	9.0	7.3	8.7	6.7	5.0	6.0	5.0	5.7	6.3	5.8	4.0
Edge	7.7	8.0	8.7	7.0	9.0	5.3	5.7	6.7	4.7	6.0	6.3	5.8	4.3
PST-2DLM	7.7	8.7	8.7	8.0	8.0	6.7	6.3	7.0	5.7	3.7	5.3	5.8	3.7
WVPB-PR-C-2	7.0	8.0	9.0	7.3	9.0	6.3	5.7	7.0	5.7	4.3	5.7	5.8	2.3
Saturn	7.3	8.7	8.7	8.0	9.0	5.3	5.3	6.0	5.7	5.7	6.7	5.8	3.3
TMI-EXFLP94	7.3	8.3	9.0	7.7	8.3	5.7	6.0	7.3	5.3	4.7	5.7	5.8	3.3
Manhattan III	6.7	6.3	8.7	8.0	8.7	6.3	6.0	4.3	5.7	5.7	6.3	5.7	2.7
Imagine	7.3	7.7	9.0	8.0	8.3	6.7	7.3	6.0	5.3	3.7	5.3	5.7	2.7
PST-2M3	7.7	7.7	8.3	8.0	8.0	6.7	5.7	7.0	5.3	4.0	5.3	5.7	2.7
Nobility	7.0	7.7	8.7	7.7	8.3	6.0	5.7	5.7	6.0	5.3	5.3	5.7	2.3
Quikstart	7.7	8.7	8.7	8.0	9.0	5.7	4.7	7.3	5.7	5.0	5.3	5.6	3.0
DLP 1305	6.3	7.3	9.0	7.3	8.3	6.3	6.0	5.7	5.7	5.0	5.0	5.6	2.3
Morning Star	7.3	8.0	8.7	7.0	8.7	5.7	4.7	6.7	5.7	5.3	5.7	5.6	3.3
Express	7.3	8.3	8.3	6.7	8.3	5.3	5.0	7.3	4.7	5.0	6.0	5.6	2.7
WX3-91	7.0	8.7	9.0	7.0	8.0	6.0	5.7	6.7	4.7	5.0	5.3	5.5	3.0
PST-2ET	7.0	7.3	8.3	7.0	8.7	5.3	4.7	7.0	5.0	5.7	5.7	5.5	2.7
PST-2CB	7.0	8.0	8.7	7.3	8.7	5.0	5.0	6.3	5.0	5.0	6.7	5.5	2.7
Dancer	6.3	7.0	9.0	5.0	7.7	6.0	6.7	6.3	4.7	3.3	5.0	5.4	6.0
Williamsburg	6.3	7.0	9.0	7.7	8.7	5.7	5.0	6.0	5.3	5.0	5.3	5.4	2.7
ISI-R2	8.0	8.5	9.0	7.0	8.5	5.0	5.0	7.0	4.5	5.5	5.0	5.4	1.5
Stallion Select	6.3	7.7	8.3	7.3	8.7	5.3	4.7	5.7	5.0	5.3	6.0	5.3	4.7
Nighthawk	6.7	8.3	9.0	7.3	8.7	5.7	5.3	6.3	4.7	4.3	5.3	5.3	4.3
APR 131	6.3	8.0	9.0	7.3	8.3	5.3	5.3	5.7	5.3	4.7	5.3	5.3	3.7
Nine-O-One	8.0	7.3	8.7	7.0	8.0	5.7	5.3	6.3	5.0	4.7	4.7	5.3	3.3
Lesco-TWF	6.7	7.3	8.7	7.0	8.7	5.7	5.0	6.7	4.7	4.0	5.3	5.2	4.0
Pegasus	6.7	8.3	8.7	7.0	8.0	5.7	5.3	6.7	4.7	4.0	5.0	5.2	4.7
KOOS 93-3	7.3	7.3	8.3	7.0	8.0	5.3	4.7	6.7	4.7	4.3	5.0	5.1	4.7
APR 066	6.7	7.3	8.7	7.0	8.3	5.3	5.7	6.3	4.7	4.0	4.0	5.0	4.7
Pennfine	5.7	7.7	7.7	6.7	7.0	4.3	4.0	6.7	4.7	4.3	4.0	4.7	4.0
DSV NA 9401	7.0	7.3	8.7	6.3	7.0	5.3	4.0	6.3	4.0	2.3	3.7	4.3	7.0
DSV NA 9402	6.3	9.0	9.0	7.3	7.0	4.7	4.3	6.0	4.3	2.7	3.7	4.3	6.0
Figaro	6.3	7.0	8.0	6.0	6.0	5.3	4.3	5.3	4.0	3.0	3.0	4.2	6.7
Linn	7.0	7.3	6.0	1.0	3.7	2.7	2.0	5.7	1.0	1.3	1.0	2.3	5.7
MEAN	**7.3**	**7.9**	**8.8**	**7.7**	**8.5**	**6.4**	**5.9**	**6.8**	**5.5**	**5.0**	**5.9**	**5.9**	**3.1**
LSD (0.05)	**1.5**	**1.6**	**0.6**	**1.2**	**0.8**	**1.3**	**1.3**	**2.2**	**1.4**	**1.2**	**1.4**	**0.7**	**2.2**

[1]Color rating scale 1-9, with 9=darkest.
[2]Leaf textured rating scale 1-9, with 9=most desirable textured.
[3]Turfgrass density scale 1-9, with 9=greatest density.
[4]Turfgrass quality scale 1-9, with 9-highest quality.
[5]Brown patch rating scale 1-9, with 1=no disease and 9=totally diseased.

1998 Results from the 1995 National Kentucky Bluegrass High and Low Maintenance Trials

M. R. Vaitkus, R. C. Shearman and L. A. Wit

The High and Low Maintenance Kentucky Bluegrass trials were planted in late-September, 1995, at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. The seeding rate was 2 lbs./ 1,000 ft^2. Cultivars were planted in a completely randomized block design with three replications and a plot size of 3 feet by 8 feet. Soil type was a Sharpsburg silty clay loam (fine, montmorillonitic, mesic Typic Argiudoll) with a pH of 7.2 and organic matter at 1.5% - 1.9%. A severe winter following planting caused extensive winter kill and both trials were interseeded in April 1996. These trials will continue through the year 2000.

Medium/high input trial

This trial contains 103 entries. Turf height was maintained at 3 inches during the establishment year of 1996 and lowered to 5/8 inch in succeeding years. Turfs are mowed four to five times weekly throughout the trial. Nitrogen and potassium are applied at 4.0 lbs. N and 4.0 lbs. K/1,000 ft^2/ growing season. Phosphorous is applied at 1.0 lb. P/1,000 ft^2/growing season. Irrigation is adjusted twice weekly to maintain an application rate of 80% ETp. Pendimethalin is applied annually at label-recommended rates for crabgrass control; postemergence herbicides are applied only as needed. No fungicides or insecticides are applied. In April weekly traffic treatments were initiated and continued through October.

In 1998, genetic color, leaf texture and seasonal stand density, as well as monthly turfgrass quality, were evaluated (Table 1). Iron chlorosis and Dollar Spot (*Sclerotinia homeocarpa*) were also evaluated following occurrence in July and September, respectively. Cultivar performance in 1998 reflected the relatively mild spring and harsh summer growing conditions (Table 1). Turfgrass densities were well above the acceptable rating of 6.0 and only decreased slightly during mid-summer. Mean turfgrass quality ranged from 3.9 to 7.5, with only 27 cultivars having overall mean quality ratings above 6.0 (a turfgrass quality rating of 6.0 is considered unacceptable). Monthly mean quality ratings were all below 6.0. The incidence of iron chlorosis was slight (1.0-4.0) in most cultivars, with only two, Shamrock and Kenblue, showing ratings greater than 6.0 (an unacceptable level). Only three cultivars, BAR VB 6820, DP 37-192 and Baruzo, had Dollar Spot ratings that were greater than 6.0.

Low input trial

The Low input trial contains 21 cultivars. Turf height is maintained at 3 inches and turfs are mowed once weekly. Fertilization is limited to the application of nitrogen at 1.0 N lb./1,000 ft^2./growing season. Irrigation is adjusted twice weekly to maintain an application rate of 60% ETp. Pendimethalin is applied annually for crabgrass control at label-recommended rates. Postemergence herbicides were applied in the fall, 1997 and will be applied again in fall, 1999. No other postemergence herbicide applications will be made; no fungicides or insecticides will be applied. Weekly traffic treatments were initiated in early April and will last through October.

Genetic color, leaf texture and seasonal stand density, as well as monthly turfgrass quality, were evaluated in 1998 (Table 2). Mean monthly cultivar densities were all above 6.0, but showed seasonal trends; they were high in April and October, but were lower during July. Mean quality ratings were low, with only three cultivars having acceptable (>6.0) ratings (BAR VB 3115B, Eagleton, and BH 95-199). Three cultivars had dollar spot ratings greater than or equal to 6.0 in July, while five showed unacceptable ratings in September.

Table 1. 1995 Kentucky Bluegrass NTEP trial - Me-

dium/High Input - 1998 Data Summary. J.S. Anderson Turfgrass Research Facility near Mead, Neb.

Cultivar	Color[1]	Texture[2]	Density[3]			Quality[3]								Iron Chlorosis[5]	Dollar Spot[6]
	6/25	6/25	4/30	7/28	10/2	4/30	5/19	6/25	7/28	8/25	10/21	1/16	Mean	7/28	9/2
NJ 1190	5.7	8.0	9.0	8.7	9.0	9.0	7.7	7.0	8.3	6.3	6.7	7.7	7.5	2.0	2.3
ZPS-2572	8.7	7.7	9.0	9.0	9.0	6.0	7.0	6.3	7.3	7.0	7.0	6.7	6.8	1.0	1.0
MED-18	8.3	8.3	9.0	8.3	9.0	5.7	6.0	6.3	7.0	7.3	6.7	7.7	6.7	1.0	1.0
J-1576	8.0	7.3	8.7	8.7	9.0	6.7	7.0	6.3	7.0	6.3	6.0	7.3	6.7	1.0	1.7
TCR-1738	8.7	7.3	9.0	8.3	9.0	6.3	7.3	5.3	7.3	7.0	5.7	7.3	6.6	1.3	1.3
J-257	7.0	8.3	9.0	8.7	8.7	6.7	7.0	7.7	6.7	4.3	6.3	7.3	6.6	1.0	3.3
BLACKSBURG	8.0	7.3	8.7	8.7	9.0	6.7	6.7	6.7	7.0	6.3	6.0	6.7	6.5	1.3	1.7
AWARD	8.0	8.0	8.7	8.7	9.0	5.7	7.0	6.3	6.7	6.0	6.0	7.3	6.4	1.7	2.0
NUGLADE	7.7	7.3	8.3	9.0	8.7	5.7	6.3	6.0	7.0	6.0	6.0	8.0	6.4	1.0	2.0
LIMOUSINE	6.3	9.0	9.0	9.0	8.0	7.0	6.3	6.0	7.3	5.0	5.7	7.7	6.4	1.0	4.0
UNIQUE	6.0	7.7	8.7	9.0	9.0	6.3	6.3	5.0	6.0	6.3	7.0	7.7	6.4	3.7	1.0
PLATINI	7.0	7.7	9.0	9.0	9.0	8.0	6.7	6.3	6.3	5.3	6.0	6.0	6.4	3.0	2.3
MED-1497	8.7	7.0	9.0	8.3	9.0	6.3	6.7	5.7	5.7	6.0	5.7	8.0	6.3	1.3	1.7
J-1567	8.0	7.7	9.0	9.0	8.7	6.3	6.0	5.7	6.3	6.7	5.7	7.0	6.2	1.3	2.3
PST-B2-42	7.3	7.0	9.0	8.7	8.7	5.3	6.0	5.3	6.3	6.7	6.0	8.0	6.2	1.3	1.3
PST-A7-245A	6.7	7.0	9.0	8.3	8.0	7.0	7.3	7.0	5.7	4.3	6.0	6.3	6.2	4.3	4.7
BA 81-270	6.0	6.7	9.0	8.0	9.0	7.0	7.0	6.0	5.3	4.7	6.3	7.0	6.2	4.3	2.3
BARTITIA	7.0	8.7	9.0	8.7	7.3	6.3	7.0	7.3	7.0	4.7	4.3	6.3	6.2	1.7	5.0
J-1561	8.7	7.0	8.3	8.7	8.7	5.0	6.0	5.7	6.7	7.0	6.0	6.7	6.1	1.7	1.7
AMERICA	6.7	8.0	8.7	8.3	9.0	5.7	6.0	5.3	6.3	6.3	5.7	7.3	6.1	1.7	1.7
PICK 8	7.7	7.7	8.7	8.0	8.7	6.0	5.7	6.7	6.7	6.0	5.7	6.0	6.1	1.0	1.7
J-1936	8.0	7.7	8.3	8.3	9.0	6.7	7.0	5.7	6.3	6.0	5.3	5.7	6.1	2.3	1.3
BAR VB 5649	6.7	8.3	9.0	8.7	9.0	7.7	7.0	5.7	7.0	4.7	5.7	5.0	6.1	1.0	3.7
NJ-GD	5.7	8.0	9.0	8.3	8.7	6.7	6.7	6.0	5.7	5.7	5.7	6.0	6.1	3.3	1.0
PST-638	7.3	6.7	9.0	8.0	8.7	6.0	6.0	5.7	5.3	6.7	6.0	6.7	6.0	1.0	1.3
CONNI	6.0	8.3	9.0	9.0	7.7	7.0	7.7	6.7	6.0	5.7	4.3	5.0	6.0	2.0	4.7
PST-B3-180	6.3	8.0	8.3	8.0	8.7	5.7	5.7	5.0	6.0	7.3	6.0	6.3	6.0	1.0	1.3
PICK 3561	7.0	8.0	9.0	8.7	8.3	6.0	6.7	6.0	6.0	5.3	5.7	6.0	5.9	2.7	3.0
CHATEAU	6.7	6.0	9.0	7.7	9.0	6.7	6.0	5.0	5.3	5.0	6.3	7.0	5.9	2.7	3.3
PST-BO-141	6.3	7.0	8.3	9.0	9.0	5.0	5.7	4.7	5.7	6.3	6.3	7.7	5.9	3.3	1.0
SHAMROCK	5.3	8.3	9.0	8.7	9.0	7.0	7.0	5.3	4.7	5.7	5.0	6.3	5.9	7.0	1.0
HV 242	6.7	8.3	9.0	8.3	8.0	7.0	6.7	5.7	5.7	5.3	5.0	5.7	5.9	2.3	3.3
ALLURE	6.7	6.0	9.0	7.7	8.3	6.3	6.3	5.7	5.0	4.7	6.0	7.0	5.9	2.3	3.3
J-2582	6.7	7.3	8.7	8.0	8.7	6.0	5.3	5.7	5.7	6.0	6.0	6.3	5.8	2.3	2.0
BA 75-490	6.7	7.7	8.7	8.7	9.0	6.7	5.3	6.0	5.7	5.7	6.3	5.3	5.8	1.3	1.7
CHALLENGER	7.0	8.0	9.0	8.0	9.0	6.3	6.3	6.3	4.7	5.3	5.7	6.0	5.8	3.0	1.0
MIDNIGHT	8.0	7.3	8.7	8.3	8.0	5.7	6.3	6.0	6.0	5.3	5.0	6.3	5.8	1.3	3.3
HV 130	7.3	8.0	9.0	8.7	8.7	5.3	6.3	6.7	6.3	5.0	5.3	5.7	5.8	2.0	2.0
PRINCETON 105	7.0	7.7	8.3	8.0	8.7	5.3	6.0	6.7	6.0	5.3	5.3	5.7	5.8	1.3	3.0
BAR VB 233	7.0	7.7	9.0	8.7	8.7	6.7	6.3	5.7	5.3	5.0	5.0	6.3	5.8	3.0	2.3
LPT-621	5.3	8.0	9.0	7.7	8.7	6.3	6.3	5.0	5.3	5.7	5.3	6.3	5.8	3.3	1.0
PICK-855	6.3	9.0	9.0	9.0	8.7	5.0	5.7	6.3	7.3	5.0	5.3	5.7	5.8	3.3	3.7
PST-A418	7.7	6.0	8.3	7.3	9.0	6.0	6.3	5.0	5.3	6.0	5.7	6.0	5.8	1.3	1.3
JEFFERSON	5.7	6.3	8.7	7.7	9.0	6.7	5.7	5.0	5.3	6.3	6.3	5.0	5.8	2.7	1.7
CALIBER	6.7	6.7	8.7	8.0	8.7	6.0	5.7	5.7	5.3	6.0	6.0	5.3	5.7	1.7	2.0
BAR VB 3115B	5.3	7.7	9.0	8.3	9.0	6.7	7.3	6.0	4.3	4.7	5.0	6.0	5.7	5.0	2.0
PST-B0-165	6.3	7.0	9.0	8.0	8.7	7.3	6.3	5.7	5.3	4.0	5.7	5.7	5.7	3.0	3.3
CARDIFF	7.0	7.3	8.7	8.7	8.0	5.7	5.7	6.0	6.0	6.3	5.0	5.3	5.7	1.0	1.7
SR 2109	6.3	7.0	8.3	8.3	9.0	5.7	6.0	6.0	5.3	6.0	5.0	5.7	5.7	4.0	1.0
ZPS-2183	7.7	6.7	8.3	7.3	8.7	5.7	5.3	5.3	5.7	5.7	5.3	6.7	5.7	1.7	2.0
NUSTAR	6.7	8.0	8.7	8.3	8.7	5.7	6.0	6.0	6.0	5.0	5.0	5.7	5.6	2.7	3.7
COVENTRY	6.0	6.0	9.0	8.0	7.7	6.3	5.7	5.3	5.0	4.7	5.3	7.0	5.6	4.3	3.7
BA 76-372	5.7	6.3	9.0	7.3	8.7	6.0	6.0	6.0	4.7	5.3	5.7	5.3	5.6	4.3	1.3
WILDWOOD	7.0	8.3	8.3	8.7	8.3	4.7	5.7	6.3	6.3	5.0	4.3	6.7	5.6	1.3	3.7
SR 2109	6.0	8.3	8.3	9.0	8.0	5.0	6.0	6.3	6.3	5.0	4.7	5.7	5.6	1.7	4.3

Table 1. (Continued)

Cultivar	Color[1] 6/25	Texture[2] 6/25	Density[3] 4/30	7/28	10/2	Quality[3] 4/30	5/19	6/25	7/28	8/25	10/21	1/16	Mean	Iron Chlorosis[5] 7/28	Dollar Spot[6] 9/2
NJ-54	6.0	7.0	8.3	8.3	9.0	5.7	6.0	6.0	6.0	4.7	5.3	5.3	5.6	1.3	4.0
ASCOT	7.0	7.3	8.0	8.3	9.0	5.3	4.7	5.7	5.7	6.0	5.0	6.3	5.5	1.0	1.3
BA 81-227	6.0	6.0	9.0	7.3	9.0	6.0	6.0	5.3	5.0	4.7	5.7	6.0	5.5	4.0	2.7
PST-A7-60	7.7	8.0	8.7	9.0	7.3	4.3	6.0	7.3	7.0	4.7	4.3	5.0	5.5	2.0	4.3
J-155	7.3	7.3	8.0	8.7	8.0	5.0	5.7	5.7	6.0	5.3	5.0	5.7	5.5	1.0	2.0
SR 2000	8.0	6.3	9.0	7.0	9.0	6.0	6.3	5.3	4.7	5.7	5.3	5.0	5.5	3.0	1.3
HAGA	5.3	7.3	9.0	7.3	8.7	6.0	5.7	5.3	4.7	5.7	5.3	5.7	5.5	2.3	2.3
SODNET	7.7	8.0	8.3	8.7	6.7	6.3	6.7	6.0	6.0	4.3	3.7	5.3	5.5	1.3	5.3
NIMBUS	5.7	6.7	8.0	8.0	8.3	5.0	6.3	6.7	5.0	5.7	4.3	5.3	5.5	2.0	3.3
VB 16015	8.3	7.0	8.3	7.7	8.3	5.7	5.3	5.0	5.0	5.0	6.0	6.0	5.4	1.0	1.7
BARONIE	6.0	6.0	9.0	7.7	9.0	6.3	5.3	4.3	4.7	5.7	5.7	6.0	5.4	3.3	1.3
CLASSIC	5.3	6.3	8.7	7.3	8.3	6.0	5.3	4.7	5.7	5.7	5.3	5.3	5.4	2.7	1.7
ECLIPSE	6.0	6.7	8.7	7.7	8.7	5.7	5.0	4.7	5.3	5.7	5.7	5.7	5.4	2.3	1.7
MED 1580	6.0	8.3	9.0	8.3	8.3	5.7	5.3	5.3	6.3	5.0	4.7	5.0	5.3	1.7	3.7
ZPS-309	6.7	7.7	8.7	9.0	8.0	5.7	5.0	5.7	6.0	4.7	5.0	5.3	5.3	1.3	4.3
BA 75-163	6.7	6.7	8.0	7.7	9.0	5.3	6.0	5.0	5.3	5.3	5.0	5.0	5.3	2.7	1.7
BA 73-373	7.0	7.3	7.7	8.0	8.3	5.0	5.3	4.7	5.3	5.3	5.7	5.7	5.3	1.3	2.0
BA 81-058	6.3	6.3	8.3	7.7	8.3	5.7	5.0	5.3	4.7	5.7	5.0	5.3	5.3	2.7	1.3
H86-690	7.3	7.7	8.3	8.3	9.0	5.7	5.7	5.0	5.3	5.7	5.0	4.7	5.3	1.0	1.0
PST-P46	7.3	7.0	8.3	8.0	8.3	5.0	5.7	5.0	5.0	6.0	5.0	5.3	5.3	1.3	2.7
BAR VB 6820	7.3	8.0	8.3	8.3	7.7	5.7	6.3	6.0	6.0	4.0	3.7	5.0	5.2	1.0	6.7
GLADE	7.7	7.3	8.0	8.3	8.0	4.7	6.0	5.3	5.7	5.0	5.3	4.7	5.2	1.3	4.3
LIVINGSTON	5.3	6.0	9.0	8.0	8.7	5.7	5.0	5.0	5.7	5.0	5.0	5.3	5.2	3.0	1.7
MED-1991	7.3	7.7	7.7	8.0	8.3	5.0	5.3	5.3	5.3	5.3	5.0	5.0	5.2	2.0	1.7
BA 75-173	7.3	7.0	7.3	8.0	8.7	5.0	5.3	5.0	5.0	5.0	5.3	5.3	5.2	2.3	1.3
LTP-620	5.7	6.3	8.0	7.7	8.7	5.7	4.7	4.7	4.7	5.3	5.3	5.7	5.1	4.0	1.3
LIPOA	7.3	7.0	8.3	8.7	7.0	5.0	5.7	5.7	5.7	4.7	3.7	5.3	5.1	1.0	5.7
BA 81-220	7.3	6.0	7.7	7.7	8.3	4.3	5.3	5.0	5.3	5.3	5.0	5.3	5.1	1.7	2.0
BA 77-702	6.3	6.0	8.0	7.7	7.7	4.0	5.3	5.3	5.7	4.7	5.0	5.3	5.1	2.7	4.3
SRX 22O5	6.0	7.3	8.3	7.7	7.3	5.3	6.0	6.3	5.0	4.3	3.3	5.3	5.1	4.0	4.3
BA 79-260	7.0	6.3	8.3	8.0	8.3	5.7	4.7	4.0	5.0	6.0	5.0	5.0	5.1	4.0	1.7
BA 87-102	7.3	7.0	7.7	8.0	8.7	5.0	5.0	5.3	5.3	5.3	4.7	5.0	5.1	1.7	1.3
ZPS-429	5.7	6.0	8.0	7.7	8.3	5.7	4.3	4.3	6.0	5.3	4.3	5.3	5.1	2.7	1.3
MARQUIS	7.0	6.3	8.0	8.3	7.7	4.7	5.3	5.0	6.0	5.0	4.0	5.3	5.0	1.3	4.3
SR 2100	6.0	6.0	8.0	8.0	8.0	6.0	5.3	4.7	5.0	5.3	4.7	4.3	5.0	2.7	1.7
A88-744	7.0	7.0	8.7	7.3	8.7	5.0	5.7	4.3	4.7	5.0	4.7	5.3	5.0	3.0	1.7
BARON	6.7	6.7	8.0	8.0	8.3	4.7	4.7	4.7	5.7	5.3	4.3	5.3	4.9	2.3	2.7
ABBEY	6.7	6.3	8.0	8.0	8.3	4.7	5.0	5.0	5.7	4.7	4.7	5.0	4.9	2.0	3.0
BA 76-197	5.0	6.0	8.7	8.0	8.3	5.0	5.0	4.7	5.3	5.3	4.7	4.7	4.9	5.7	1.7
RAVEN	7.0	6.3	7.7	7.3	7.7	4.3	5.0	5.3	5.0	5.0	4.0	5.7	4.9	2.0	2.7
COMPACT	5.3	7.3	8.3	8.0	8.7	5.0	5.3	5.0	5.0	4.7	4.7	4.3	4.9	1.7	3.0
UNKNOWN	7.0	6.0	7.7	8.0	8.3	5.0	5.0	4.3	5.0	4.3	5.0	5.3	4.9	1.3	3.7
FORTUNA	6.7	7.0	7.7	8.0	8.0	4.7	4.7	4.7	5.7	5.0	4.3	5.0	4.8	1.3	2.7
BA 81-113	7.0	5.7	7.0	7.3	8.3	4.0	4.3	4.7	5.0	5.3	4.7	5.0	4.7	3.0	2.0
BA 70-060	7.0	6.3	7.3	8.0	8.3	4.0	4.7	5.0	5.0	4.7	4.3	4.7	4.6	1.0	3.0
DP 37-192	7.0	7.7	8.0	9.0	6.3	4.7	5.0	5.3	5.0	3.3	2.7	4.3	4.3	1.0	7.0
SIDEKICK	5.7	5.0	8.0	7.3	7.7	5.0	4.3	3.3	4.3	3.7	4.0	5.3	4.3	4.0	5.0
KENBLUE	4.0	8.3	7.7	7.7	7.3	4.7	4.3	3.3	4.3	3.3	3.7	5.0	4.1	6.7	5.7
BARUZO	6.7	7.0	7.7	7.7	6.7	4.3	4.7	4.3	4.3	3.0	3.0	3.7	3.9	1.3	6.3
Mean	**6.8**	**7.2**	**8.5**	**8.2**	**8.4**	**5.7**	**5.9**	**5.5**	**5.7**	**5.4**	**5.2**	**5.9**	**5.6**	**2.3**	**2.6**
LSD (0.05)	**0.8**	**1.1**	**0.7**	**0.9**	**1.1**	**1.4**	**1.1**	**1.2**	**1.1**	**1.3**	**1.5**	**1.5**	**0.7**	**2.5**	**2.3**

[1]Color rating scale 1-9, with 9=darkest color.
[2]Leaf texture rating scale 1-9, with 9=most desirable texture.
[3]Turfgrass density 1-9 scale, with 9=greatest density.
[4]Turfgrass quality 1-9 scale, with 9=highest quality.
[5]Iron chlorosis 1-9 scale, with 9=greatest severity.
[6]Brown patch rating 1-9, wih 1=no disease and 9=greatest severity.

Table 2. 1995 NTEP Kentucky Bluegrass Low Input Trial - 1998 Data Summary. J.S. Anderson Turfgrass Research Facility near Mead, Neb.

	Color	*Texture*	*Density*			*Quality*								*Dollar Spot*	
Cultivar	*6/25*	*6/25*	*4/30*	*7/28*	*10/2*	*4/30*	*5/19*	*6/25*	*7/28*	*8/25*	*10/2*	*11/16*	*Mean*	*7/22*	*9/2*
BAR VB 3115B	6.0	7.7	9.0	7.0	8.7	6.0	6.7	6.3	5.0	5.7	6.3	7.3	6.2	4.3	3.0
EAGLETON	5.0	6.3	9.0	7.0	8.7	5.0	5.3	6.3	5.7	5.7	6.0	8.3	6.1	3.0	2.3
BH 95-199	7.0	6.3	9.0	7.3	8.3	5.3	5.7	6.3	6.0	6.0	5.7	7.7	6.1	1.7	2.7
BARONIE	6.0	7.7	9.0	7.3	8.0	5.7	5.7	5.7	6.0	5.7	6.0	7.0	5.9	2.7	3.3
PST-B9-196	6.0	5.0	8.7	6.7	8.3	6.0	5.7	6.0	4.7	5.3	5.7	7.7	5.8	2.0	2.7
CANTEBURY	5.7	7.3	8.7	7.3	8.0	5.7	5.7	5.3	5.0	5.0	5.7	7.7	5.7	2.7	4.0
ZPS-429	6.3	7.0	8.3	7.3	8.0	5.0	5.0	6.0	5.7	5.0	5.7	7.3	5.7	2.3	3.7
BARON	7.0	7.0	8.0	7.7	7.7	5.3	5.3	5.7	6.0	5.0	5.3	7.0	5.7	2.0	3.3
BLUE STAR	7.3	7.0	7.7	7.0	8.0	5.3	5.0	5.7	5.7	5.0	5.0	6.7	5.5	2.0	4.3
VB 16015	8.0	7.0	8.0	6.7	7.7	4.3	4.7	6.7	5.0	5.7	5.0	6.7	5.4	1.7	2.3
CALIBER	6.0	7.3	8.7	6.3	8.3	5.3	5.3	6.3	3.3	4.0	6.3	6.3	5.3	5.7	4.7
BARTITIA	7.0	8.3	8.3	7.0	7.3	4.3	5.0	6.0	4.7	4.3	5.7	7.0	5.3	3.7	5.7
BAR VB 5649	7.0	7.3	9.0	4.7	7.3	5.7	5.3	5.3	3.7	3.3	5.7	7.0	5.1	6.3	5.7
BAR VB 233	7.0	7.7	9.0	5.3	7.0	6.0	5.7	5.7	4.3	3.3	4.3	6.0	5.0	6.0	5.3
PST-A7-60	7.0	8.3	8.3	6.7	7.3	3.0	5.0	6.3	4.7	4.3	4.3	6.7	4.9	4.0	4.7
LIPOA	7.0	8.7	7.3	5.3	7.0	4.0	4.3	6.0	4.7	3.3	5.0	6.7	4.9	4.3	6.0
BAR VB 6820	7.0	8.0	8.0	5.7	7.0	4.0	4.7	6.0	4.3	3.7	4.0	5.3	4.6	4.3	5.0
BARUZO	7.0	8.0	7.3	6.0	6.0	4.3	4.3	5.7	3.7	4.7	3.3	5.3	4.5	2.0	6.0
KENBLUE	5.3	9.0	8.0	6.0	7.3	5.3	4.3	4.0	3.0	2.7	4.7	5.0	4.1	5.7	6.7
SOUTH DAKOTA	5.3	9.0	8.3	6.0	7.0	4.7	3.7	5.3	4.7	2.7	3.3	4.3	4.1	5.0	6.3
MTT 683	7.0	8.7	8.0	4.3	6.0	4.3	5.0	4.3	2.7	3.0	3.3	5.3	4.0	7.7	6.7
Mean	**6.5**	**7.6**	**8.4**	**6.4**	**7.6**	**5.0**	**5.1**	**5.8**	**4.7**	**4.4**	**5.1**	**6.6**	**5.2**	**3.8**	**4.5**
LSD (0.05)	**0.5**	**0.9**	**0.7**	**1.8**	**1.5**	**1.2**	**1.3**	**1.4**	**0.4**	**1.2**	**1.5**	**1.3**	**0.6**	**2.4**	**1.5**

1998 Results from the 1996 National Tall Fescue Trial

M. R. Vaitkus, R. C. Shearman, J. E. Watkins and L. A. Wit

The National Tall Fescue trial was established in September, 1996 at the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. The seeding rate was 4.0 lbs/1,000 ft^2. The trial contains 130 cultivar entries planted in a completely randomized block design with three replications. Plot size is 4 feet by 5 feet.

Soil type is a Sharpsburg silty clay loam (fine, montmorillonitic, mesic Typic Argiudoll) with a pH of 6.7, with 3.6% organic matter. Turf is maintained at a height of 1.5 inches and is mowed twice weekly. Nitrogen is applied at 4.0 lbs N/1,000 ft^2 per year; phosphorous and potassium are applied according to soil test results. Irrigation is adjusted twice weekly to maintain an application rate of 60 percent ETp. Pendimethalin is applied annually at label-recommended rates for crabgrass control. Postemergence herbicides are applied only as needed. No fungicides or insecticides are applied.

1998 Evaluations

In 1998, genetic color, leaf texture, turfgrass density and monthly turfgrass quality were evaluated (Table 1). In July, brown patch (*Rhizoctonia solani*) occurred and also was rated. Statistical analyses of monthly observations showed considerable variation among cultivars (Table 1). The mean turf color rating was relatively high (7.1), with most cultivars rating greater than 7.0. Only four cultivars (Jaguar 3, Arid, AV-1, and KY-31 w/endo) had unacceptable ratings below 6.0. Texture ratings were also relatively high, with a mean of 7.0; only six cultivars had ratings below 6.0. Cultivars also demonstrated seasonal differences in turfgrass density and quality. April densities were all high, ranging from 7.3 to 9.0. In July and October, density ratings decreased slightly and one cultivar (KY-31 w/ endo) had unacceptable (<6.0) ratings. Mean cultivar quality ratings were relatively low, ranging from 2.8 to 6.9. Only 57 cultivars had acceptable ($\geq$ 6.0) mean quality ratings in 1998. Early in the season (through June) quality ratings were acceptable, with monthly means greater or equal to 6.0. Ratings dropped off in July and by October only 45 cultivars had acceptable quality ratings. Almost all the cultivars exhibited low to very low (i.e. severity ratings of $\geq$7.0) brown patch incidence ratings: Only three (Gazelle, Pick FA UT-93, and Regiment) had higher ratings.

Table 1. 1996 NTEP Tall Fescue trial at the J.S.

Anderson Ornamental and Turfgrass Research Facility near Mead, Neb. 1998 Data.

	Color[1]	Texture[2]	Density[3]			Quality[4]							Brown Patch[5]
Cultivar	*6/25*	*6/25*	*4/30*	*7/28*	*10/2*	*4/30*	*5/19*	*6/25*	*7/28*	*8/25*	*10/2*	*Mean*	*7/22*
Crossfire II	7.3	7.3	9.0	8.3	8.0	7.7	7.7	8.0	5.7	6.3	5.7	6.9	4.0
SRX 8500	7.0	7.3	8.7	8.3	9.0	6.7	7.7	7.0	6.0	5.7	7.7	6.8	4.3
Southern Choice	7.3	7.3	9.0	8.3	8.7	7.3	6.3	7.7	6.3	7.0	6.0	6.8	4.7
AA-A91	7.3	8.0	9.0	8.0	8.7	7.0	6.3	7.7	6.0	6.7	7.0	6.8	6.0
CU9502T	7.3	7.7	8.7	8.3	9.0	6.7	6.3	7.7	5.3	6.3	7.7	6.6	4.7
Empress	7.0	7.7	9.0	8.0	9.0	7.3	6.7	7.7	6.0	6.0	6.0	6.6	4.3
LTP-4026 E+	7.0	8.0	8.3	8.7	9.0	6.7	7.0	6.7	6.7	5.3	7.3	6.6	3.7
ATF-257	6.7	7.0	9.0	7.3	8.7	8.0	6.7	6.3	6.0	6.7	6.0	6.6	3.7
ATF-196	7.3	8.0	8.3	8.3	9.0	6.3	7.0	7.7	6.3	5.3	7.0	6.6	4.3
Pennington-1901	7.3	8.0	8.7	8.7	8.3	6.7	6.7	6.7	6.3	6.0	7.0	6.6	4.0
AA-983	7.3	8.0	8.7	8.7	8.3	7.7	7.3	7.7	5.3	5.0	6.3	6.6	4.7
ATF-038	7.3	7.3	8.3	8.3	8.7	6.3	6.0	7.3	6.3	6.7	6.7	6.6	3.3
Tomahawk-E	6.7	6.7	9.0	7.7	9.0	7.0	7.0	6.7	5.7	5.7	7.0	6.5	5.3
J-98	7.7	7.3	9.0	8.3	8.7	7.3	7.3	7.0	5.7	5.7	6.0	6.5	5.3
BAR Fa6 US3	7.7	8.0	8.7	8.3	7.7	7.0	7.7	7.0	6.0	5.7	5.3	6.5	4.3
BAR Fa6 US1	7.0	8.3	9.0	8.3	8.3	7.0	7.7	8.3	5.0	5.3	5.3	6.5	4.7
Pick RT-95	7.3	8.0	8.7	9.0	8.0	7.3	7.0	8.3	6.0	4.3	5.7	6.4	4.0
MB 213	8.0	7.3	9.0	7.7	8.3	7.3	6.3	7.0	4.7	6.7	6.7	6.4	5.0
Sunpro	7.0	8.0	9.0	8.3	9.0	7.3	7.3	7.3	4.7	5.7	6.0	6.4	6.0
PST-5M5	7.0	7.7	9.0	8.7	9.0	6.7	7.0	7.3	5.3	5.3	6.7	6.4	3.3
MB 26	7.3	7.7	9.0	7.7	7.7	7.3	7.7	7.0	5.7	5.0	5.7	6.4	4.7
Pick FA 6-91	7.3	7.7	8.7	8.3	8.0	7.0	6.3	6.3	6.3	6.7	5.7	6.4	4.3
Coyote	7.7	7.0	9.0	7.7	8.3	7.0	7.0	6.7	5.7	5.7	6.3	6.4	5.7
MB 211	7.7	6.7	8.3	8.0	8.7	7.0	6.3	6.0	6.0	6.3	6.7	6.4	3.3
BAR FA 6LV	7.0	8.0	8.3	7.7	8.0	6.7	7.0	7.7	5.0	6.0	5.7	6.4	5.0
ZPS-2PTF	7.0	7.7	8.0	8.0	9.0	6.0	7.0	7.7	5.3	5.3	6.7	6.3	5.0
LTP-SD-TF	7.0	8.0	8.3	8.3	8.7	6.0	6.3	7.3	6.0	5.3	7.0	6.3	4.3
Gazelle	7.7	8.7	8.7	8.7	9.0	6.7	6.7	7.7	5.0	4.7	7.3	6.3	7.3
BAR Fa6D USA	8.0	8.0	9.0	8.0	8.3	7.0	6.3	7.7	5.7	5.3	5.7	6.3	5.0
PST-523	6.7	7.0	8.3	8.0	8.7	6.3	6.3	6.7	5.7	6.3	6.3	6.3	3.3
J-3	7.7	7.0	8.3	7.3	8.3	6.3	6.7	6.3	5.7	6.3	6.3	6.3	5.3
PST-5E5	7.0	6.3	8.3	7.3	8.7	6.3	6.3	5.3	6.3	7.0	6.0	6.2	3.0
WRS2	8.0	7.3	9.0	8.7	8.3	7.0	6.7	6.3	6.0	5.0	6.3	6.2	3.7
MB 212	7.3	7.0	8.3	7.3	9.0	6.3	6.3	6.7	5.7	6.3	6.0	6.2	3.0
Shortstop II	7.3	8.0	8.7	8.0	9.0	7.0	6.3	7.3	5.0	5.7	6.0	6.2	5.0
OFI-FWY	7.3	7.7	9.0	7.0	7.7	6.7	6.3	7.7	5.0	5.7	6.0	6.2	5.3
Marksman	7.0	7.0	9.0	7.3	8.3	7.3	6.7	6.3	5.3	5.7	5.7	6.2	5.3
MB 215	7.3	7.3	8.7	7.7	7.7	6.7	7.3	6.3	5.7	5.7	5.7	6.2	5.0
BAR FA 6D	7.0	8.3	9.0	8.3	8.0	7.0	6.7	8.3	5.0	4.7	5.7	6.2	5.7
pro 8430	6.3	7.0	8.3	7.0	8.3	7.0	6.0	6.7	5.7	5.7	6.0	6.2	3.3
OFI-931	8.0	7.3	9.0	7.7	8.0	7.0	6.0	6.7	5.7	6.3	5.3	6.2	4.3
ISI-TF9	7.0	6.3	8.7	8.0	8.0	7.0	5.7	5.7	6.7	5.7	6.3	6.2	3.0
TMI-RBR	7.0	8.0	8.3	7.7	8.0	6.7	6.0	6.7	5.0	6.0	6.7	6.1	4.7
J-101	7.7	7.3	8.0	7.7	8.3	6.3	6.7	6.7	5.3	5.3	6.3	6.1	5.3
Pick FA 20-92	7.0	8.3	9.0	8.7	8.0	6.7	6.7	7.0	5.7	5.3	5.0	6.1	4.7
OFI-951	7.3	7.7	8.7	7.7	8.0	6.7	7.0	7.7	4.0	4.7	6.3	6.1	7.0
CU9501T	7.7	8.0	8.3	8.3	7.0	6.7	6.7	8.0	4.3	4.7	6.0	6.1	6.0
PST-R5TK	7.0	7.0	8.7	8.0	8.0	6.7	6.0	6.3	6.3	5.3	5.7	6.0	4.0
Pick FA XK-95	7.0	7.0	8.7	7.0	8.0	7.0	6.0	6.3	5.3	5.3	6.0	6.0	5.7
PSII-TF-10	7.3	6.7	8.7	7.7	8.0	6.7	6.0	6.0	5.7	5.7	6.0	6.0	4.0
ZPS-5LZ	7.7	7.3	8.3	8.0	8.3	6.0	6.7	7.0	5.3	5.0	6.0	6.0	5.7
OFI-96-31	7.7	7.3	8.3	8.0	7.3	6.3	5.3	7.0	5.7	6.3	5.3	6.0	4.0

Table 1. (Continued).

	Color[1]	Texture[2]	Density[3]			Quality[4]							Brown Patch[5]
Cultivar	*6/25*	*6/25*	*4/30*	*7/28*	*10/2*	*4/30*	*5/19*	*6/25*	*7/28*	*8/25*	*10/2*	*Mean*	*7/22*
Bullet	6.7	7.7	8.7	7.7	8.7	7.0	5.7	7.3	5.0	4.7	6.3	6.0	5.0
AA-989	7.0	7.7	8.7	7.3	8.3	7.0	5.0	6.0	5.3	6.3	6.3	6.0	3.7
Pick GA-96	6.7	8.0	9.0	8.3	8.0	7.0	6.7	7.0	5.0	4.3	5.7	6.0	5.3
TA-7	7.3	7.3	8.7	7.3	8.0	6.7	5.7	6.7	5.0	5.3	6.3	6.0	6.3
Pixie E+	7.3	7.3	8.7	8.0	8.0	6.7	5.7	7.0	6.3	4.7	5.7	6.0	5.0
Falcon II	7.0	6.7	8.7	7.3	8.3	6.3	5.7	6.7	6.0	5.7	5.3	5.9	5.0
MB 214	7.7	7.3	8.7	8.0	8.0	6.3	6.0	7.3	5.0	5.0	6.0	5.9	5.7
MB 210	7.3	6.3	8.3	7.7	8.7	6.3	5.7	5.0	6.0	6.0	6.7	5.9	4.3
ATF-188	6.7	7.7	8.7	8.3	8.7	7.0	5.7	6.3	5.0	6.0	5.7	5.9	5.0
Shenandoah	6.3	7.0	9.0	8.0	7.7	6.0	6.0	6.3	5.7	6.0	5.3	5.9	6.0
BAR Fa6 US2U	7.3	7.0	8.0	8.0	7.3	6.0	6.3	6.7	5.3	6.0	5.0	5.9	3.7
Coronado	7.0	7.0	9.0	7.3	7.7	7.3	6.3	6.3	5.0	5.0	5.3	5.9	6.0
WX3-275	7.3	7.0	8.3	7.7	7.0	7.0	6.0	6.7	5.7	5.0	5.0	5.9	3.3
Renegade	6.7	7.0	8.7	8.3	8.0	6.3	6.3	6.3	6.0	5.0	5.3	5.9	4.0
Mustang II	7.0	7.7	7.7	8.3	8.7	5.3	6.3	7.7	5.3	5.0	5.7	5.9	5.0
Pick FA B-93	7.3	8.0	9.0	8.3	7.3	7.3	6.7	7.7	5.0	3.7	5.0	5.9	5.3
Pick FA 15-92	7.7	7.7	8.7	8.3	7.3	7.0	6.0	7.3	4.7	5.3	5.0	5.9	5.3
Tulsa	7.0	7.0	8.3	7.7	8.0	6.0	6.7	6.3	5.3	5.0	6.0	5.9	5.3
Apache II	7.3	7.3	8.3	8.3	8.0	6.0	6.3	7.0	5.3	5.3	5.3	5.9	3.3
Duster	7.0	7.0	9.0	8.3	8.0	7.0	6.3	6.3	5.7	5.0	5.0	5.9	5.0
PC-AO	7.3	6.7	9.0	7.0	8.0	6.7	5.7	5.3	5.7	5.7	6.3	5.9	4.3
ATF-182	6.7	7.0	8.3	7.3	8.0	6.3	6.0	6.0	6.0	5.3	5.7	5.9	3.7
Bonsai	7.0	7.3	8.7	8.3	8.0	6.7	5.7	6.3	5.3	5.3	5.7	5.8	6.3
Cochise II	7.3	7.0	8.3	7.7	7.7	7.3	5.7	6.3	5.7	5.0	5.0	5.8	5.7
EC-101	7.0	6.3	9.0	7.3	8.0	6.7	5.7	5.7	6.3	5.3	5.3	5.8	4.0
TMI-AZ	6.7	7.0	9.0	7.7	7.7	6.7	6.0	6.7	4.7	5.3	5.7	5.8	5.0
ATF-022	6.7	7.7	8.7	7.3	8.0	6.3	5.7	6.3	5.7	5.3	5.7	5.8	3.7
SRX 8084	6.7	7.0	8.7	7.0	8.3	7.0	5.0	6.0	5.7	5.3	5.7	5.8	4.0
Pick FA N-93	7.7	7.0	8.7	7.7	7.7	7.0	6.0	6.7	4.7	5.0	5.3	5.8	5.7
MB 216	7.7	7.0	8.7	7.3	8.0	6.3	6.0	6.3	5.0	5.3	5.7	5.8	4.7
ATF-020	7.0	8.0	8.7	7.7	7.7	6.7	6.0	6.3	5.3	5.0	5.3	5.8	3.7
Jaguar 3	4.7	7.3	8.7	9.0	8.0	6.7	7.0	7.3	4.7	3.7	5.0	5.7	5.0
Pick FA UT-93	7.0	8.0	8.3	7.3	7.7	6.7	7.0	6.7	4.0	4.7	5.3	5.7	7.3
WVPB-1D	7.3	6.7	8.7	7.3	8.3	6.3	5.7	5.3	5.7	6.0	5.3	5.7	4.3
SR 8210	7.0	7.0	8.7	7.7	8.0	7.0	6.7	6.7	4.3	4.7	4.7	5.7	4.3
Lion	7.3	6.7	8.3	7.0	7.7	6.0	5.7	5.7	5.7	6.0	5.0	5.7	6.0
Titan 2	6.0	7.0	8.7	7.3	7.7	6.7	5.7	5.7	6.0	5.7	4.3	5.7	4.0
ISI-TF11	6.3	6.0	8.3	7.0	7.7	6.7	5.3	5.3	5.7	5.7	5.3	5.7	3.0
MB 28	7.7	7.0	8.7	7.3	8.0	6.7	6.0	6.0	5.0	4.7	5.7	5.7	4.0
JSC-1	6.7	6.7	8.7	7.0	7.3	6.7	5.3	5.3	6.0	5.7	5.0	5.7	2.7
TMI-FMN	7.3	7.0	8.7	7.3	7.7	7.0	5.7	6.3	5.3	4.3	5.3	5.7	3.3
Regiment	7.0	6.7	8.3	7.3	8.0	6.0	6.0	6.3	4.0	5.7	6.0	5.7	7.3
BAR FA6 US6F	7.3	6.7	9.0	8.0	7.3	6.7	6.0	6.0	5.3	4.7	5.0	5.6	6.3
Koos 96-14	6.7	7.0	9.0	7.3	7.3	6.7	6.0	6.0	5.3	5.3	4.3	5.6	3.3
DP 50-9011	7.0	7.0	8.7	8.0	8.0	6.7	5.7	6.0	5.0	5.3	5.0	5.6	5.3
EA 41	7.3	6.7	8.3	7.3	8.0	7.0	5.7	5.3	5.3	4.7	5.3	5.6	5.7
Safari	6.3	6.3	8.0	7.3	8.0	6.7	5.3	5.3	4.7	5.0	6.0	5.5	5.0
Finelawn Petite	7.3	6.7	7.3	6.7	7.7	5.7	5.3	5.7	5.0	5.7	5.7	5.5	5.3
Alamo E+	7.3	7.7	7.7	7.7	7.7	6.3	6.0	7.0	4.7	4.3	4.7	5.5	6.3
ATF-253	6.7	7.0	8.3	7.7	7.7	6.7	5.7	6.0	5.3	4.7	4.7	5.5	5.7
MB 29	7.3	7.3	8.7	7.7	7.7	6.7	6.0	6.0	5.0	3.7	5.3	5.5	4.3

Table 1. (Continued).

	Color[1]	Texture[2]	Density[3]			Quality[4]							Brown Patch[5]
Cultivar	*6/25*	*6/25*	*4/30*	*7/28*	*10/2*	*4/30*	*5/19*	*6/25*	*7/28*	*8/25*	*10/2*	*Mean*	*7/22*
Genesis	7.3	6.3	9.0	7.3	7.3	6.7	4.7	5.7	5.0	5.7	5.0	5.4	4.0
Leprechaun	6.3	6.3	8.7	7.3	8.0	6.7	5.0	5.7	4.3	5.7	5.3	5.4	5.0
Tarheel	7.3	7.0	8.0	7.7	7.3	6.0	5.7	6.3	5.3	4.3	5.0	5.4	4.3
PST-R5AE	7.3	6.3	9.0	6.7	8.3	6.7	5.3	4.3	5.0	5.7	5.7	5.4	5.3
SSDE31	7.0	6.3	8.7	7.7	8.0	6.7	5.3	5.3	5.0	5.0	5.0	5.4	3.7
Arid	5.7	5.7	8.0	6.7	8.0	6.0	4.7	5.3	5.0	5.7	5.7	5.4	4.7
PSII-TF-9	6.7	6.3	8.0	6.7	7.7	6.0	5.3	5.0	5.0	5.7	5.0	5.3	4.7
TMI-TW	7.3	6.3	8.7	7.0	7.3	6.3	5.3	5.0	5.0	5.3	5.0	5.3	4.7
R5AU	7.3	6.0	8.0	7.0	7.7	6.0	5.3	4.7	5.3	5.0	5.7	5.3	3.3
J-5	7.3	7.3	8.3	7.3	7.0	7.0	6.0	6.3	4.3	4.0	4.3	5.3	6.0
OFI-96-32	6.3	6.3	9.0	7.0	7.7	7.0	5.3	5.7	5.0	4.7	3.7	5.2	4.0
WVPB-1B	7.3	6.7	8.3	7.0	7.7	6.0	4.7	5.0	6.0	4.3	5.3	5.2	3.3
Monarch	7.0	6.0	8.0	7.0	7.7	5.7	5.0	5.0	5.7	5.0	4.7	5.2	3.3
SS45DW	7.0	6.0	8.0	7.7	8.0	5.7	5.3	5.7	4.0	5.0	5.3	5.2	5.3
JTTFC-96	6.3	5.0	8.3	6.7	8.0	6.0	4.7	4.7	5.0	6.0	4.7	5.2	3.7
DLF-1	6.7	6.3	8.7	6.7	7.3	6.7	4.7	5.3	5.0	4.7	4.7	5.2	4.7
PST-5TO	7.0	6.7	7.7	7.7	7.7	5.0	5.0	5.7	5.3	4.3	5.3	5.1	3.7
ISI-TF10	7.0	6.0	8.7	7.0	7.3	6.7	5.0	4.7	4.7	4.7	5.0	5.1	5.0
PST-5RT	7.3	6.7	8.3	7.3	7.0	6.3	4.7	5.0	5.3	4.0	5.0	5.1	4.7
WVPB-1C	6.7	6.3	8.0	6.3	8.0	5.7	5.3	4.7	4.7	4.7	5.3	5.0	3.7
RG-93	7.0	6.0	8.0	6.7	7.3	5.7	5.0	4.7	4.7	4.3	5.3	4.9	5.7
ATF-192	6.7	5.3	8.3	6.0	7.3	6.3	4.3	4.3	5.0	5.0	4.7	4.9	3.7
JTTFA-96	6.0	5.7	8.0	6.3	7.0	6.3	3.3	5.0	4.0	4.7	4.3	4.6	6.3
AV-1	5.7	5.7	8.3	6.0	7.0	5.7	4.3	4.3	4.7	4.3	4.0	4.5	4.7
DP 7952	6.3	5.7	8.3	5.7	7.0	5.3	4.0	5.0	4.0	4.0	4.3	4.5	5.7
TMI-N91	7.0	6.3	7.3	6.0	6.7	5.0	4.3	4.3	4.7	4.3	4.0	4.4	4.0
KY-31 w/endo	5.0	2.7	8.0	4.0	5.0	5.0	2.7	1.7	2.7	2.7	2.0	2.8	2.3
Mean	**7.1**	**7.0**	**8.5**	**7.6**	**8.0**	**6.6**	**6.0**	**6.3**	**5.3**	**5.3**	**5.6**	**5.9**	**4.7**
LSD (0.05)	**1.0**	**1.3**	**1.0**	**1.2**	**1.1**	**1.7**	**1.1**	**1.5**	**1.6**	**1.6**	**1.6**	**0.7**	**2.5**

[1]Color rating scale 1-9, with 9=darkest color.
[2]Leaf texture rating scale 1-9, with 9=most desirable texture.
[3]Turfgrass density 1-9 scale, with 9=highest density.
[4]Turfgrass quality 1-9 scale, with 9=highest quality.
[5]Brown patch rating 1-9, with 1=no disease and 9=greatest severity.

1998 Results from the 1996 National Buffalograss Trial

S.R. Westerholt, P.G. Johnson, and T.P. Riordan

The 1996 buffalograss trial was planted at 11 sites around the country including the John Seaton Anderson Turfgrass and Ornamental Research Facility near Mead, Neb. Nation-wide results can be viewed on the World Wide Web at: http://hort.unl.edu/NTEP/.

The top performers in the NE test were NE91-118 and NE86-61 (Table 1). Bonnie-Brae was best overall of the non-Nebraska cultivars in this test. The southern-adapted types, especially diploid varieties like Stampede and UCR-95, did not survive the winter well in Nebraska and most were replanted to Texoka to maintain a uniform turf area. Cultivar 609 also winter killed in 1997. It was re-established by plugs from surviving 609 and its ratings reflect this re-establishment.

The seeded varieties showed little differentiation during the first year of this study. However, in 1998 the turf types began to show improvements over the common types like Texoka. Although Tatanka and Bison showed slow establishment in 1996, their performances were not effected. Both cultivars exhibited good color and quality characteristics.

Table 1. 1996 National buffalograss trial[†], 1998 results. J.S. Anderson Turfgrass and Ornamental Research Facility near Mead, Neb.

Selection Name	*Est.*	*Spring color*	*Fall color*	*Average color*	*Spring quality*	*Fall quality*	*Average quality*
91-118	Veg	6.0	5.7	5.8	7.0	7.0	7.0
86-61	Veg	7.3	7.3	7.3	7.0	7.0	7.0
‘378’	Veg	7.0	7.0	7.0	7.0	6.7	6.8
91-181	Veg	7.3	7.0	7.2	7.0	6.7	6.8
Bonnie-Brae	Veg	6.7	6.0	6.3	6.3	7.0	6.7
86-120	Veg	6.3	6.3	6.3	6.3	6.3	6.3
93-181	Veg	6.3	5.7	6.0	6.3	6.0	6.2
Midget	Veg	6.0	5.0	5.5	5.7	6.0	5.8
93-170	Veg	5.0	5.0	5.0	1.3	3.3	2.3
Stampede	Veg	—	—	—	—	—	—
‘609’	Veg	—	3.0	2.0	1.0	2.7	1.8
UCR-95	Veg	—	—	—	—	—	—
Mean		**5.2**	**5.3**	**5.3**	**4.9**	**5.3**	**5.1**
LSD		**2.2**	**1.0**	**.48**	**1.1**	**.84**	**.51**
Cody	Seed	6.0	6.0	6.0	6.3	5.7	6.0
Tatanka	Seed	6.0	5.7	5.9	6.3	5.3	5.9
BAM-1000	Seed	5.3	5.7	5.5	5.3	6.0	5.7
Bison	Seed	6.3	6.7	6.5	5.0	6.0	5.5
Texoka	Seed	5.0	5.3	5.2	4.7	5.7	5.2
Mean		**5.7**	**5.9**	**5.8**	**5.5**	**5.7**	**5.6**
LSD		**5.9**	**1.5**	**2.1**	**2.6**	**1.9**	**1.4**

[†]Plot maintained as a low maintenance turf: 6.4 cm. (2.5") mowing height, mowed 1-2 times per month, fertilization 5 g N/m^{-2}/yr (2 lb N/M/yr), with no supplemental irrigation.
* Color rated on a 1 to 9 scale, with 1=brown/yellow and 9=very dark green
** Quality rated on a 1 to 9 scale, with 1= poorest quality and 9=excellent quality

Adaptation of Crabapples in Nebraska

D.H. Steinegger and J.W. Watkins

Many diminutive flowering trees are not hardy in Nebraska. One notable exception is the ornamental crabapple tree (*Malus*). By carefully selecting both planting site and cultivar, flowering crabs can be enjoyed statewide. Crabapples are adapted to a wide range of soil types, including heavy loams. The soil should be well-drained, with a pH between 6.0 and 6.8 (slightly acidic).

Although crabapples are susceptible to a number of diseases, the four most significant are cedar-apple rust (*Gymnosporangium juniperi-virginianae*), fire blight (*Erwinia amylovora*), scab (*Venturia inaequalis*) and powdery mildew (*Podosphaera leucotricha*).

Cedar-apple rust, scab and powdery mildew are fungal diseases, while fire blight is a bacterial disease. All are endemic to Nebraska. Scab, cedar-apple rust and powdery mildew are less common in western Nebraska, where fire blight is the predominant disease. Scab and cedar-apple rust are the major crabapple diseases in both central and eastern Nebraska.

Because of its susceptibility to apple scab, the crabapple “Indian Summer”, previously recommended for Nebraska, is no longer recommended.

Low Input Sustainable Turfgrass (LIST) Regional Trials

G.L. Davis and J. Schimelfenig

The University of Nebraska is one of 12 regional universities evaluating various turfgrass mixtures for water conserving and reduced environmental impact situations. The objective of this long-term study is to examine the effect on turf quality of mixing species with two superior LIST species, tall fescue and sheep fescue (determined in earlier LIST studies).

The study was established during Sept. 1997. Glyphosate was applied to eradicate existing site vegetation, the site was tilled and the seedbed was prepared and fertilized (1-2-1) at 1/2 lb. N/1,000 ft^2. The seed mixtures (Table 1) were prepared and the legumes were inoculated before addition to the seed mixtures. Three replicates of each mixture were hand-sown into 7' X 7' plots. The plots received supplemental irrigation only during fall, 1997. The treatments (mixtures) were arranged in a randomized complete block experimental design.

Routine maintenance of the plots consists of mowing at 3.5 inches at two-week intervals and one application of sulfur-coated urea at the rate of 1 lb. N/1,000 ft^2 during the fall each year. Clippings are returned. Since the establishment period, the plots have received no supplemental irrigation.

Initial establishment rate, turf quality and weed encroachment are being documented and evaluated. These data were collected in October 1997, and April, July and October 1998.

Establishment was acceptable across the plots during the first fall (Table 2). Because of tall fescue's comparatively fast germination rate, mixtures containing tall fescue produced the most consistent early cover and had higher overall quality into the following summer. Plots containing tall fescue alone or in mixtures generally appeared higher in quality through the first year of the study. Interestingly, the combinations of clovers with tall fescue generally exhibited a dark green color, possibly because of the added benefit from nitrogen fixation from the legumes. The combination of tall fescue and clovers also had unique, somewhat appealing contrast in textures. Although sheep fescue had acceptable quality from fall through the spring, its summer quality was significantly lower than the other species.

This study will continue for five years to gather as much information as possible about the long-term performance of these mixtures and their suitability for harsh situations and/or sites receiving minimal maintenance.

Table 1. Species and seeding rates for LIST Project mixtures.

	Species	*Seeding Rate[1] (lb/1,000 ft^2)*
1.	Sheep Fescue	4
2.	Tall Fescue	5
3.	Sheep Fescue/Tall Fescue	2/3
4.	Sheep Fescue/Tall Fescue/Kentucky Bluegrass	1.5/3.0/0.5
5.	Sheep Fescue/White Clover	4/0.10
6.	Sheep Fescue/Red Clover	4/0.14
7.	Sheep Fescue/Birdsfoot Trefoil	4/0.25
8.	Tall Fescue/White Clover	5/0.10
9.	Tall Fescue/Red Clover	5/0.14
10.	Tall Fescue/ Birdsfoot Trefoil	5/0.25
11.	Sheep Fescue/Tall Fescue/White Clover	2/3/0.10
12.	Sheep Fescue/Tall Fescue/Red Clover	2/3/0.14
13.	Sheep Fescue/Tall Fescue/Birdsfoot Trefoil	2/3/0.25
14.	Tall Fescue/Creeping Red Fescue/Birdsfoot Trefoil/Perennial Ryegrass	3/1/0.25/1

[1]Seeding rates are based on recommendations from *Forages* (fifth edition) by Barnes, Miller and Nelson. Combined rates approximate 4 or 5 lb/1,000 ft^2.

Table 2. First Year Evaluations of Low Input Sustainable Turfgrass Performance at the J.S. Anderson Research Facility near Mead, Neb.

	Establishment[1]				*Quality[2]*			
Species/mixture	*Oct. 1997*	*April 1998*	*July 1998*	*Oct. 1998*	*Oct. 1997*	*April 1998*	*July 1998*	*Oct. 1998*
Sheep Fescue	69.3	79.3	65.0	78.3	6.6	6.6	2.5	5.1
Tall Fescue	86.7	89.0	71.7	76.7	7.3	7.3	5.7	5.8
Sheep Fescue/Tall Fescue	78.3	85.7	72.7	83.3	6.8	6.8	5.7	5.7
Sheep Fesc./Tall Fesc./K. Bluegrass	79.7	85.7	92.0	94.0	6.9	6.8	6.9	6.6
Sheep Fescue/White Clover	70.0	77.3	63.3	78.3	6.8	6.7	3.4	5.9
Sheep Fescue/Red Clover	69.0	78.3	83.3	83.3	6.8	6.7	4.2	4.5
Sheep Fescue/Birdsfoot Trefoil	69.7	79.7	90.0	81.7	6.7	6.7	4.8	3.0
Tall Fescue/White Clover	86.0	86.7	86.3	86.7	7.4	7.4	7.1	6.1
Tall Fescue/Red Clover	86.0	88.7	88.3	88.3	7.5	7.6	6.3	6.7
Tall Fescue/ Birdsfoot Trefoil	83.0	87.0	83.3	80.0	7.4	7.4	7.1	5.5
Sheep Fesc./Tall Fesc./White Clover	78.7	83.0	87.7	87.7	6.8	6.8	6.5	6.6
Sheep Fesc./Tall Fescue/Red Clover	80.3	82.7	91.0	87.7	7.1	7.0	6.3	5.5
Sheep Fesc./Tall Fesc./Birdsfoot Trefoil	79.3	81.7	89.3	84.0	7.5	7.4	6.1	4.9
Tall Fesc./Creeping Red Fesc./Birdsfoot Trefoil/Perennial Ryegrass	91.3	93.7	89.3	86.7	7.8	7.9	5.6	5.3
LSD (.05) [3]	**9.6**	**7.7**	**19.1**	**16.3**	**0.6**	**0.6**	**1.3**	**1.9**

[1]Establishment = % Plot Coverage
[2]Quality rating scale 1-9, with 9 most desirable overall quality.
[3]To determine statistical differences among mixtures, subtract one entry's mean from another entry's mean. Statistical differences occur when this value is larger than the corresponding LSD value.