UNIVERSITY OF GEORGIA

SEEDED BERMUDAGRASS WATER USE, ROOT AND SHOOT GROWTH UNDER SOIL STRESSES

1995 Research Grant: $13,488
(Third Year of Support)

Dr. Robert N. Carrow
Principal Investigator

Bermudagrasses (*Cynodon* spp.) are drought resistant grasses in many areas of the southern United States. In the Piedmont region, as well as Ultisol and Oxisol soils world-wide, turfgrass root growth can be inhibited by the soil stresses a) high soil strength, and b) acid soil complex, a combination of element toxicities with nutrient deficiencies. Genotypes of bermudagrass may differ in tolerance to these stresses. Objectives of this project were to evaluate eight seeded bermudagrass genotypes from Dr. C. M. Taliaferro's USGA supported breeding program at Oklahoma State University versus two commercial cultivars (AZ common, Primavera) under 3 traffic levels and 3 N-regimes for:

a) Evapotranspiration (ET), rooting/water extraction patterns and shoot responses are being determined under field conditions. These data are essential if the USGA is to substantiate that their turfgrasses are truly superior in drought resistance/water use and have acceptable quality.

b) Basic cultural programs (fertility, traffic tolerance) are being defined.

Results to date:

1. The most rapid establishment was observed for Primavera, 91-2, 91-1, and AZ common, while least were 91-14, 91-12, and 91-3.

2. AZ common and Primavera exhibited some winterkill (i.e., 5-10%), while no winter injury was noted on the experimentals.

3. Cultivars consistently exhibiting higher visual quality and shoot density than AZ common across all N levels (2, 4, and 6 lb N per 1000 ft^2 per year), and at no traffic (except mowing) or soil compaction (by power roller) were 91-3, 91-15, and 91-4.

4. Under the most severe traffic regime (soil compaction plus pressure/tearing on shoot tissues), 91-3 and 91-4 demonstrated improved traffic tolerance, regardless of N level.

Data are under analysis for water relations (ET, water extraction by depth) and rooting by depth.

November 1995

Progress Report

SEEDED BERMUDAGRASS WATER USE, ROOTING AND SHOOT GROWTH UNDER SOIL STRESSES

University of Georgia
Griffin, GA

Dr. Robert N. Carrow
Principal Investigator

1995 Research Grant: $13,488
(Third Year of Support)

The primary objective of the USGA-supported turfgrass breeding programs is to develop grasses with high drought resistance, including low water use (i.e., evapotranspiration, ET) in order to reduce turfgrass water requirements. Also, the USGA states as a goal the development of basic cultural program/adaptation data on turfgrasses to be released. This would insure rapid acceptance of these grasses by golf course superintendents and other growers. The seeded bermudagrass project objectives will result in data directly related to the above-mentioned USGA goals.

a) Evapotranspiration, rooting/water extraction patterns, and shoot responses are being determined under field conditions. These data are essential if the USGA is to substantiate that their turfgrasses are truly superior in drought resistance and have acceptable quality.

b) Basic cultural programs (fertility, traffic tolerance) are being defined.

c) Data obtained in Georgia can be compared to similar data in Oklahoma to determine environmental stability of these grasses with respect to environmental and pest pressures.

In this project, a soil is used that imposes two of the major soil stresses that may inhibit root growth on sensitive genotypes; namely, high soil strength and the acid soil complex (i.e. combination of element toxicities, such as Al and Mn, and/or nutrient deficiencies of Mg, P, and/or K). These stresses are very common on Ultisols and Oxisols. Any bermudagrass genotype able to develop and maintain a deep, extensive root system will have a major drought avoidance advantage. The soil is a Cecil sandy loam (64.1% sand, 19.0% silt, 16.9% clay, and 2.19% organic matter) classified as a clayey, kaolinitic, thermic Typic Kanhapludults (Table 1).

Nine seeded bermudagrass (Cynodon spp.) experimentals from Dr. C. M. Taliaferro's USGA supported breeding program, and two commercial seeded bermudagrass cultivars (AZ common, Primavera) were seeded at 1.25 lb/1000 ft^2 PLS on 8 June 1993. The experimental cultivars were: 91-1, 91-2, 91-3, 91-4, 91-10, 91-12, 91-14, and 91-15. All were in the species *Cynodon dactylon* except 91-15 which was a *Cynodon transvaalensis*.

During establishment in 1993, the grasses received fertilization as follows: 0.5 lb N/1000 ft^2 as 33-0-0 at seeding, 1.0 lb N 1 July (10-10-10), 1.0 lb N (33-0-0) 1 August, 1.0 lb N (10-10-10) 2 September, and 1.0 lb N (10-10-10) on 29 March 1994. Mowing was at 1.0 inch with clippings returned in 1993, but lowered to 0.63 inch in 1994. In October 1993, boxes were installed for TDR soil moisture probes to determine water uptake by the roots from different soil zones and total water uptake (i.e. ET). Once full turf cover was attained for all cultivars, the following treatments were initiated:

a) N-Programs. Annual N levels of 2.00, 4.00, and 6.00 lb N/1000 ft^2 split into equal applications.

b) Traffic.

* None (N), except mowing.
* Compaction (C), using a Brouwer Model 230 riding roller with rollers filled with sand plus water to exert a static pressure of 1.0 kg cm^{-2} (14.2 psi). The roller has a smooth surface.
* Wear + compaction (WC), using a differential slip traffic device. This unit was designed based on the differential slip concept (P.M. Canaway, 1982. Simulation of fine turf wear using the DS wear machine and quantification of wear treatments in terms of energy expenditure. J. Sports Turf Res. Inst. 58:9-15); our unit is a riding unit using two studded rollers of 30 inch width that applied 270 lbs per square inch of top surface area of stud versus 296 for the Canaway device. Studs are of 10 mm diameter (top) and 20 mm diameter (bottom). Average static pressure over the stud and roller contact surface is 0.38 kg cm^{-2} versus 0.33 kg cm^{-2} for the Canaway device. Our device uses a 1:33:1 ratio of gears to develop slip and drag. The front roller drive gear is 6 inch radius, while the rear is 8 inch radius.

Traffic treatments were always applied immediately after a heavy rainfall or irrigation and as soon as standing water was not observed. Rates and dates of traffic applications were:

Date	Number Passes (1X = 1 pass over Plot Area)†	
16 May 1994	6X	
26 June 1994	10X	
13 July 1994	8X	
2 August 1994	10X	
28 September 1994	8X	1994 Total = 42X
26 April 1995	10X	
6 June 1995	12X	
17 July 1995	12X	
31 August 1995	10X	1995 Total = 44X

†Observation of the local high school field of the same soil type and with Tifway bermudagrass revealed that 8X with the WC treatment approximates one high school football game played when the soil was between field capacity and saturation (but no standing water). Observations were based on the center of the field during the first games of the season.

Penetration resistance measurements in 1994 illustrate the influence of traffic treatments on soil strength (Table 2). Within the surface 5.0 cm, the WC treatment resulted in the greatest increase in soil strength. Compaction treatment (c) also increased soil strength relative to the N treatment, but to a lesser extent.

Nitrogen fertilization treatments were initiated in April 1994 and continued through 1995 with the following schedule:

Date	N-Carrier
25 April 1994	33-0-0 (ammonium nitrate)
2 June 1994	10-10-10
5 August 1994	33-0-0
26 April 1995	33-0-0
28 June 1995	29-0-0 (urea, SCU)
21 July 1995	29-0-0
1 September 1995	33-0-0

Also, on 13 April 1994, 1.0 lb P_2O_5 per 1000 ft^2 was applied as 0-46-0.

The study is a 10 cultivar X 3 traffic X 3 N-rate traffic factorial in a strip-strip completely randomized block with 3 replications. Main plots (cultivar) were 22 X 4 m . Analyses of data were a) when only cultivar treatment was present - completely randomized block, b) when only cultivars and traffic treatments were sampled at the 4.0 lb N/1000 ft^2 level - a 10 X 3 factorial in a randomized complete strip block, and c) with all treatments, the strip-strip arrangement was used with paired comparisons of cultivars versus AZ common at different traffic and N level combinations.

Some data are still being determined and analyzed (rooting, rhizomes for 1995). All data to date are presented with appropriate statistical analyses. Some discussion of results has been made, but a full discussion will be conducted when all data are available

ESTABLISHMENT PHASE

Coverage.

The summer of 1993 was drier than normal and somewhat warmer. By October 1993 most rapid coverage occurred for Primavera, 91-2, 91-1, and AZ Common, while least were 91-14, 91-12, and 91-3 (Table 3). Coming out of winter, greatest coverage was evident for 91-1, 91-15, and 91-2. Some reduction in turf coverage in April 1994 compared to October 1993 was observed for AZ Common (10%) and Primavera (5%), apparently due to low temperature injury. Increased coverage was noted for 91-14 (19%), 91-12 (7%) and 91-15 (5%), while all others were within ± 3% in coverage.

Spring Greenup.

In early March 1994, 91-15, 91-10, 91-14, 91-4 and 91-3 had a higher spring greenup than AZ Common (Table 3). Part of the slower greenup of AZ Common was due to some winter injury. By 23 March, only 91-15 was significantly better than AZ Common in terms of early spring greenup rate.

Shoot Aspects.

Turfgrass quality in October 1993 was similar across cultivars (Table 4), but in spring 1994, 91-15 exhibited the best visual quality. In late March, 91-2 had better quality than AZ Common and 91-1 showed higher quality in late April. All other cultivars were similar to AZ Common.

Cultivar 91-15, the only Cynodon transvaalensis, had much higher shoot density than the Cynodon dactylon cultivars (Table 4). Other cultivars tending to have greater shoot density than AZ Common during the establishment phase were 91-1, 91-2, and 91-10.

MATURE PHASE

Visual Quality

Visual quality data obtained prior to initiation of traffic and N level treatments are in Table 4, while ratings after imposing traffic and N treatments are presented in Tables 5 (ANOVA), 6 (NR_L, NR_Q), 7, 8, 9, and 10 (Summary table). Significant main treatment effects (i.e., cultivar, traffic, N level) were apparent on all dates except one for N level (Table 5). Cultivar x traffic interactions were significant on 7 out of 11 rating dates, which indicates that differences in traffic tolerance are present.

Cultivar x N level interactions were observed on 7 out of 11 dates, indicating seeded bermudagrasses respond differently to increasing N. The significant NxT interaction implies that applied N influences traffic tolerance. Cultivars exhibiting the strongest response to increasing N were 91-2 (10 significant NR_{Linear} responses out of 11 dates), AZ common (7), and 91-4 (6) (Table 6). Least responsive to applied N were 91-15 (2), 91-3 (3), and Primavera (3). However, 91-15 and 91-3 did not respond to increasing N because of very good quality even at low N.

Table 10 summarizes treatment effects on visual quality. The "none" traffic regime simulates homelawn or general ground situations. Across all N levels, 91-3, 91-15, and 91-4 consistently had significantly higher visual quality than AZ common.

With compacted (C) soil conditions, cultivars exhibiting greater visual quality than AZ common varied somewhat with N level. Those that performed well at all N levels were 91-3, 91-15, and 91-4. The WC traffic treatment was most severe due to causing highest surface compaction (Table 2) and greatest pressure/tearing action on the turf. Consistently, at all N levels 91-3 and 91-4 performed best. Interestingly, 91-1 tended to improve relative to AZ common as increasingly severe traffic was imposed, indicating that it had good traffic tolerance.

Shoot Density

Data on shoot density are presented in Tables 4, 11 (ANOVA), 12 (NR_L, NR_Q), 13, 14, 15, and 16 (Summary). Many responses were similar to the visual quality responses.

Color

Color data and statistics are found in Tables 17 (ANOVA), 18 (NR_L, NR_Q), 19, 20, and 21.

Rhizomes

Rhizome production information is in Table 22.

Water Relations

Evapotranspiration data averaged across 39 days in 1994 and 1995 revealed that cultivar differences occurred (Table 23) with Primavera and 91-15 exhibiting 27% higher ET than AZ common. Water extraction by soil depth data are found in Tables 24, 25, and 26. Cultivars extracting significantly greater water from the 21 to 60 cm zone than AZ common during dry-down periods were 91-1, 91-15, and Primavera (Table 25). Only one dry-down period resulted in leaf firing and the data are in Table 17 (ANOVA), 18 (NR_L, NR_Q), and 27.

Root Growth

Data for 1994 are presented in Tables 28 and 29. Root analyses for 1995 are in process.

Table 1. Soil chemical analyses for the soil used in the study, reported by soil depth.

Chemical Property	Sample Depth Oct 1992				Sample Depth Sep 1994			
	0-10 cm	10-20 cm	20-30 cm	30-40 cm	0-10 cm	10-20 cm	20-30 cm	30-40 cm
Soil pH	6.04	6.35	6.33	6.43	4.94	5.75	6.07	6.27
Base Cations (meq. 100 g^{-1})								
Ca	2.69	2.84	2.53	2.19	1.64	2.39	2.47	2.56
Mg	.54	.55	.58	.62	.24	.41	.59	.65
K	.33	.21	.18	.19	.15	.19	.22	.19
Na	.04	.04	.06	.17	.04	.04	.03	.04
Acid Cations (meq.100 g^{-1})								
H	2.66	2.31	2.56	2.71	3.47	2.43	2.53	2.70
Al	.01	.00	.01	.01	.19	.07	.03	.03
CEC (meq. 100 g^{-1})	6.27	5.95	5.92	5.89	5.73	5.53	5.87	6.17
Base Sat. (%)	57	61	57	54	36	55	56	56
Ex. Nut. (ppm)†								
P	28H	25H	11M	4L	22H	20M	9L	3L
K	108H	71M	52M	60M	109H	126H	132H	107H
Ca	625H	658H	538H	446H	434H	590H	565H	472H
Mg	76H	73H	69H	80H	32M	67H	76H	79H
Or.Mat. (% wt.)	1.19	.87	.74	.45	2.76	2.12	1.45	1.07

† Rankings are: L = low, M = medium, H = high. These are based on current UGA recommendations using Mehlich I extractant for extractable nutrients.

Table 2. Penetration resistance by soil depth in response to traffic treatment.

Traffic Treatment	28 July 1994			27 Sep. 1994		
	2.5 cm	5.0 cm	10.0 cm	2.5 cm	3.0 cm	10.0 cm
	N cm^{-2}					
None	169	247	307	196	289	389
Compaction	179	279	356	256	374	420
Wear+Comp.	257	318	360	270	360	424
LSD (.05)	67	66	60	49	45	90
Sign. F-test	*	†	.12	*	**	.54
CV (%)	15	10	8	9	6	10

Table 3. Coverage (1993, 1994), and spring greenup (1994) of seeded bermudagrasses.

Contrast and Cultivar	Turfgrass Coverage 1993 18 Oct	Turfgrass Coverage 1994 20 Apr	Spring Greenup‡ 1994 11 Mar	Spring Greenup‡ 1994 23 Mar
	——%——		——% Plot——	
AZ Common vs.	92	82	30	67
Primavera (FMC-1-90)	96	91	27	70
91-1	92	94*	37	73
91-2	96	93†	32	70
91-3	78*	79	38†	77
91-4	82†	85	40*	78
91-10	88	89	42*	73
91-12	72**	79	32	72
91-14	68**	87	40*	83
91-15	89	94*	63**	90*
Sign F test	**	†	**	.48
CV (%)	8	8	16	16

†,*,** Significant difference at .10, .05 and .01 probability levels.

†† No winter injury was observed; thus ratings reflect inherent greenup rates.

Table 4. Visual quality and shoot density ratings of seeded bermudagrasses (294 kg N ha^{-1} yr^{-1}) in 1993 and early 1994 before traffic and N levels were imposed.

Contrast and Cultivar	Visual Quality†† 1993 18 Oct	Visual Quality†† 1994 23 Mar	Visual Quality†† 1994 20 Apr	Shoot Density§ 1993 18 Oct	Shoot Density§ 1994 23 Mar	Shoot Density§ 1994 20 Apr
AZ Common vs.	6.3	5.0	5.1	7.4	5.2	5.3
Primavera	6.1	5.4	5.2	7.6	5.6	5.4
91-1	6.1	5.4	5.9*	7.6	5.8†	6.3*
91-2	6.5	5.6†	5.2	7.8†	6.3*	5.6
91-3	6.6	5.2	5.0	7.5	5.5	5.2
91-4	6.3	5.3	5.3	7.3	5.3	5.7
91-10	6.0	5.3	5.3	7.5	5.7†	5.8
91-12	5.9	4.9	5.0	6.9*	4.8	5.3
91-14	5.9	4.6	5.4	7.1	4.7	5.7
91-15	6.0	6.6**	6.8**	8.0*	7.7**	7.7**
Sign. F-test	.72	*	**	*	**	**
CV(%)	8	9	9	4	7	9

†,*,**Significant difference at .10, .05, and .01 probability levels.

††Quality: 9 = ideal density, color, uniformity; 1 = no live turf.

§Shoot density: 9 = ideal; 1 = no live turf.

Table 5. Analysis of variance (ANOVA) for visual quality data by cultivar, N-level, and traffic treatments.

	1994				1995						
ANOVA	1 Jul	9 Aug	15 Sep	8 Nov	10 May	9 Jun	3 Jul	21 Jul	1 Aug	5 Sep	26 Sep
Cultivar (C)	**	**	**	**	**	**	**	**	**	**	**
Rep	**	**	**	**	**	*	**	*	**	**	*
Rep X C	*	**	**	**	**	**	**	**	**	**	**
N-level (N)	**	**	**	**	**	**	**	**	**	**	NS
C X N	NS	**	**	*	†	NS	NS	NS	**	**	†
Rep X N X C	NS	**	**	NS	*	**	**	†	**	NS	**
Traffic (T)	**	**	**	**	**	**	**	**	**	**	**
C X T	NS	**	NS	NS	**	*	NS	**	*	**	*
N X T	**	**	*	NS	**	NS	†	NS	**	NS	NS
C X N X T	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	8	6	6	7	5	7	7	5	5	6	3

**, *, † Significant difference at 0.01, 0.05, and 0.10 probability levels, respectively. NS = not significant.

Table 6. N-Rate trend analyses for visual quality of bermudagrasses averaged across all traffic treatments.

		1994				1995						
	N-Rate	1	9	15	8	10	9	3	21	11	5	26
Cultivar	Response	Jul	Aug	Sep	Nov	May	Jun	Jul	Jul	Aug	Sep	Sep
Common	Linear	*	†	NS	NS	*	†	*	NS	**	NS	†
	Quadratic	NS	NS	NS	NS	NS	†	NS	NS	NS	NS	NS
Primavera	L	NS	†	NS	*	NS	†	NS	*	*	NS	NS
	Q	†	†	NS	NS	NS	*	NS	NS	NS	NS	NS
91-1	L	NS	†	NS	NS	NS	*	NS	NS	NS	NS	NS
	Q	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
91-2	L	*	**	†	**	NS	†	NS	**	NS	NS	NS
	Q	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	NS
91-3	L	†	NS	NS	NS	NS	NS	NS	NS	*	NS	NS
	Q	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
91-4	L	**	†	NS	NS	**	*	NS	†	*	†	NS
	Q	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
91-10	L	NS	NS	*	*	NS	NS	*	*	*	**	*
	Q	NS	NS	NS	†	NS	NS	NS	*	NS	**	NS
91-12	L	†	**	NS	NS	†	**	NS	NS	*	NS	NS
	Q	NS	**	NS	NS	†	NS	NS	NS	†	NS	†
91-14	L	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Q	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
91-15	L	NS	NS	NS	NS	NS	NS	NS	†	NS	NS	NS
	Q	NS	†	NS	NS	NS	NS	NS	NS	NS	NS	NS

**,*,†Significant response at the 0.01, 0.05, and 0.10 probability level, respectively.

Table 7. Visual quality at 98 kg N ha^{-1} yr^{-1} under traffic levels of none, compaction (C) and wear + compaction (WC).

Contrast		1994				1995						
Cultivar	Traffic	1 Jul	9 Aug	15 Sep	8 Nov	10 May	6 Jun	7 Jul	21 Jul	11 Aug	5 Sep	26 Sep
		9 = ideal shoot density, color,uniformity; 1 = no live turf										
AZ Com. vs.	None	5.4	5.7	6.1	5.6	5.5	5.6	5.8	6.3	5.6	5.8	6.1
Primavera	"	5.7	6.0	5.8	5.6	5.5	6.1	5.5	6.1	6.3	5.9	6.2
91-1	"	5.9	5.8	6.2	6.2*	5.9*	6.8**	6.2	6.4	6.3	6.3	6.4†
91-2	"	5.8	5.9	5.8	6.1	5.7	6.4*	6.4	6.5	6.1	6.0	6.6*
91-3	"	6.0†	6.4**	5.6†	6.6**	6.0**	7.0**	6.7*	7.0*	6.4†	6.1	6.5*
91-4	"	5.6	5.7	5.9	5.8	5.7	6.8**	6.1	6.4	6.5*	6.5*	6.7**
91-10	"	5.6	5.7	5.4**	5.8	5.8†	5.9	5.4	6.1	5.7	6.0	6.2
91-12	"	5.7	5.9	4.7**	5.2	4.8**	6.2†	5.5	6.6	5.8	6.0	6.4†
91-14	"	5.6	6.3*	5.3**	5.7	5.6	6.1	5.5	6.1	6.2	6.3	6.3
91-15	"	6.1*	6.8**	6.5†	6.4*	6.4**	6.9**	6.3	7.2**	5.9	5.1†	6.4
AZ Com. vs.	C	5.3	5.5	5.7	5.4	5.6	5.5	5.3	5.8	5.6	5.2	6.1
Primavera	"	5.5	5.9	5.9	5.4	5.5	6.0	5.7	6.0	6.0	5.4	6.2
91-1	"	5.7	5.8	6.0	5.9	6.0	6.7**	6.3*	6.3†	6.1	6.0*	6.3
91-2	"	5.6	5.7	5.7	5.4	5.9	6.4*	6.1†	6.1	6.2	5.3	6.4
91-3	"	6.0*	6.1*	5.2	5.4	5.7	6.8**	6.6**	6.5*	6.1	6.1**	6.6**
91-4	"	5.8	5.9	5.6	5.5	5.8	6.7**	5.9	6.3†	6.4	6.1**	6.5*
91-10	"	5.3	5.8	5.7	5.7	5.8	5.8	5.1	5.8	5.3	5.7†	6.3
91-12	"	5.8	5.7	4.7**	5.3	5.3	6.0	5.6	6.1	5.7	5.8*	6.4
91-14	"	5.7	5.8	4.9*	5.2	5.4	5.6	5.8	5.9	6.2	5.7†	6.4†
91-15	"	5.5	6.3**	6.2	6.5**	6.2	6.6**	6.7**	6.9**	6.2	3.8**	6.5*
AZ Com. vs.	WC	4.3	4.1	5.0	4.7	4.8	3.9	4.7	4.1	5.0	4.1	5.6
Primavera	"	4.2	4.2	4.5†	4.4	4.3*	2.8*	4.4	3.5†	4.6	4.1	5.6
91-1	"	4.6	4.7*	5.2	5.4*	6.0**	4.2	5.5	4.3	5.8†	4.9**	6.2**
91-2	"	4.4	4.3	4.7	5.1	5.6**	4.2	5.2	4.4	5.7†	4.6*	6.1*
91-3	"	4.5	4.5†	4.5†	4.7	5.3*	5.6**	5.6	4.7*	5.5	5.1**	6.4**
91-4	"	4.4	4.3	4.6	4.8	5.5**	4.4	5.8†	4.7*	5.9*	5.0**	6.5**
91-10	"	4.3	4.2	4.7	4.9	5.2	4.1	4.8	4.3	5.2	4.5†	5.8
91-12	"	4.7	4.2	4.1**	4.3	4.7	4.4	4.7	4.7*	4.7	4.4	6.3**
91-14	"	4.4	4.2	4.1**	4.4	4.8	4.4	4.7	4.5	5.4	4.6*	6.0†
91-15	"	4.2	4.2	5.6*	5.8**	5.5**	4.5	5.7	4.5	6.3**	3.4**	6.1*

**,*,† Indicates significant difference at 0.01, 0.05, and 0.10 probability levels, respectively.

Table 8. Visual quality at 196 kg N ha^{-1} yr^{-1} under traffic levels of none, compaction (C) and wear + compaction (WC).

Contrast		1994				1995						
Cultivar	Traffic	1 Jul	9 Aug	15 Sep	8 Nov	10 May	6 Jun	3 Jul	21 Jul	11 Aug	9 Sep	26 Sep
		9 = ideal shoot density, color,uniformity; 1 = no live turf										
AZ Com. vs.	None	5.7	5.5	5.9	5.9	5.6	6.0	6.1	6.5	6.0	6.0	6.1
Primavera	"	5.2*	5.9	5.6	5.7	5.4	6.1	5.6	6.3	6.1	5.7	6.4
91-1	"	6.0	5.9	6.2	6.1	5.9	6.9†	6.1	6.6	6.6†	6.4	6.4
91-2	"	5.9	6.1	6.3†	6.1	6.0	6.5	6.4	6.6	6.3	6.5	6.6*
91-3	"	6.0	6.6**	5.8	6.2	6.1†	7.3*	7.1**	7.1*	6.8*	6.5	6.8**
91-4	"	6.0	6.3*	5.9	6.3	5.8	7.4**	6.9*	6.8	6.9*	7.1**	6.8**
91-10	"	5.2†	5.7	5.6	5.7	5.8	6.3	5.8	6.3	6.3	6.4	6.3
91-12	"	5.7	5.8	4.7**	5.2†	5.7	6.8	5.7	6.2	6.1	6.1	6.6*
91-14	"	5.9	5.7	5.2*	5.4	5.4	6.5	6.0	6.7	6.9*	6.3	6.3
91-15	"	5.7	6.5*	6.7	6.3	6.8**	6.9†	6.7†	7.0†	6.4	5.4	6.4
AZ Com. vs.	C	5.0	6.0	5.5	5.7	5.5	5.5	5.6	6.0	6.2	5.3	6.2
Primavera	"	4.9	5.7	4.8*	5.2	5.3	5.5	5.3	5.9	6.1	5.1	6.1
91-1	"	5.5*	5.8	6.0	5.8	6.0†	6.1	6.4*	6.6†	6.5	5.7	6.4
91-2	"	5.7*	6.0	6.0	5.9	6.1*	6.8*	6.5*	6.6†	6.6†	6.1*	6.6†
91-3	"	5.9**	6.4	5.3	5.5	6.2*	7.2**	6.9**	6.8**	6.8*	5.9†	6.6†
91-4	"	5.4†	5.9	5.4	5.8	6.0†	7.0**	6.5*	6.5†	6.8*	6.6**	6.7*
91-10	"	5.1	5.8	5.3	5.7	6.0†	6.1	5.5	5.8	6.5	5.7	6.2
91-12	"	5.4†	5.6	4.7*	5.0*	5.5	6.5†	5.6	6.0	6.4	5.7	6.3
91-14	"	5.4†	5.4	4.8*	5.3	5.7	6.5†	5.9	6.4	7.1**	5.9†	6.3
91-15	"	5.4†	5.6	6.7**	6.1	6.8**	6.5†	6.9**	7.1**	6.4	4.1**	6.5
AZ Com. vs.	WC	4.2	4.4	4.9	4.7	4.7	4.1	4.7	4.2	5.2	4.5	5.8
Primavera	"	4.4	4.1	4.4	4.6	4.2	3.4*	4.4	3.5**	4.7	4.2	5.7
91-1	"	4.5†	4.7	5.8†	5.6*	5.6*	4.1	5.4†	4.3	6.5*	5.0	6.2**
91-2	"	4.6*	5.0*	5.5	5.4†	5.4†	4.3	5.5†	4.5	5.8	5.1	6.2**
91-3	"	4.5†	4.8†	5.0	4.9	5.5*	5.0**	5.9**	4.8**	6.4*	5.2†	6.4**
91-4	"	4.8**	5.0*	4.8	5.0	5.5*	4.4	5.7*	4.8**	6.3†	5.7**	6.5**
91-10	"	4.3	4.6	5.3	5.2	5.0	4.2	4.9	3.9	5.8	4.8	6.0†
91-12	"	4.5†	4.4	4.2	4.5	4.4	4.5	4.7	4.5	4.8	4.7	6.1*
91-14	"	4.5†	4.4	4.2	4.5	4.9	4.4	4.8	4.4	5.8	4.9	5.9
91-15	"	4.2	4.2	5.4	4.8	5.1	4.4	5.2	4.3	6.0	3.8*	6.2**

**,*,† Indicates significant difference at 0.01, 0.05, and 0.10 probability levels, respectively.

Table 9. Visual quality at 294 kg N ha^{-1} yr^{-1} under traffic levels of none, compaction (C) and wear + compaction (WC).

Contrast		1994				1995						
Cultivar	Traffic	1 Jul	9 Aug	15 Sep	8 Nov	10 May	6 Jun	3 Jul	21 Jul	11 Aug	9 Sep	26 Sep
		9 = ideal shoot density, color,uniformity; 1 = no live turf										
AZ Com. vs.	None	6.3	6.6	6.6	6.4	5.9	6.5	6.6	6.9	6.9	6.1	6.3
Primavera	"	6.0	6.4	5.8**	6.2	5.6	6.2	5.9**	6.6†	6.9	6.0	6.5
91-1	"	6.4	6.4	6.5	6.5	6.0	7.0	6.6	7.2†	6.9	6.5	6.6
91-2	"	6.4	6.6	6.5	6.7	5.9	6.9	6.8	7.3**	7.5*	6.6†	6.7†
91-3	"	6.6	7.1†	5.9*	6.4	6.0	7.2*	7.3**	7.4**	7.1	6.6†	6.7†
91-4	"	6.5	6.8	6.1†	6.2	5.9	7.5**	6.9	7.3**	7.4†	7.1**	6.8*
91-10	"	6.3	6.3	6.2	6.5	5.9	6.6	6.1†	7.0	7.1	6.5	6.3
91-12		6.4	6.3	5.2**	5.6*	5.5†	7.1†	6.7	7.1	7.0	6.2	6.4
91-14	"	6.0	6.2	5.2**	5.9	5.7	6.9	6.4	7.2†	7.3	6.3	6.3
91-15	"	6.6	6.9	7.0	7.0*	7.1**	7.0	7.1†	7.3**	6.7	5.4**	6.5
AZ Com. vs.	C	5.7	6.2	6.3	5.9	6.3	6.5	6.4	6.9	6.8	5.8	6.2
Primavera	"	5.4	6.2	5.6*	5.9	5.9†	6.1	5.8†	6.6	6.7	5.1**	6.3
91-1	"	5.5	6.0	6.0	5.9	6.3	6.4	6.3	6.8	6.9	5.8	6.3
91-2	"	5.6	6.4	6.2	5.7	6.3	6.7	6.7	7.1	7.5*	6.1	6.6
91-3	"	5.9	6.5	5.5*	5.5	6.3	7.0	7.0†	7.3†	7.1	6.1	6.7†
91-4	"	6.1	6.4	6.0	5.7	6.4	7.4*	6.9	7.2	7.3	6.4**	6.7†
91-10	"	5.3	6.1	5.8	6.0	6.2	6.3	5.8†	6.7	7.0	5.7	6.1
91-12	"	5.9	5.8	4.9**	5.0**	5.7**	6.8	6.4	6.8	6.8	5.8	6.2
91-14	"	5.6	5.9	5.1**	5.3†	5.9†	6.8	6.3	7.0	7.2	5.8	6.2
91-15	"	5.1*	6.5	7.0*	6.8*	7.0**	6.6	6.9	7.2	6.6	4.0**	6.2
AZ Com. vs.	WC	4.7	4.7	5.7	5.4	5.3	4.5	5.4	4.5	6.5	4.6	5.9
Primavera	"	4.6	4.4	4.9†	5.1	4.7	3.9	4.6	4.5	6.4	4.2	5.7
91-1	"	4.7	4.6	5.4	5.5	6.0†	4.5	6.2†	5.1	6.6	4.3	5.9
91-2	"	4.6	4.8	5.8	5.0	5.9†	4.5	5.9	5.1	7.1†	4.9	6.3
91-3	"	4.7	5.1	5.2	5.1	5.6	5.4*	6.3†	5.3*	6.4	5.1	6.5*
91-4	"	4.7	5.1	5.5	5.3	5.5	5.0	6.3†	5.3*	7.0	5.8**	6.5*
91-10	"	4.3	4.5	5.2	5.3	5.5	4.6	5.4	4.6	6.6	4.3	5.8
91-12	"	4.6	4.2	4.4**	4.3**	4.7	4.7	5.7	5.6**	6.7	4.9	6.1
91-14	"	4.6	4.2	4.6*	4.6*	5.5	4.9	5.7	5.6**	7.1†	4.8	6.0
91-15	"	4.5	4.6	6.7*	6.0†	6.4**	4.6	6.7*	4.8	6.1	3.5**	5.9

**,*,† Indicates significant difference at 0.01, 0.05, and 0.10 probability levels, respectively.

Table 10. Summary of visual quality data. Percent of ratings statistically less than (<) or greater than (>) Arizona Common (AZC) by N-level and traffic treatment.

Contrast		98 kg N ha^{-1} ††		196 kg N ha^{-1}		294 kg N ha^{-1} ††		Across N	
Cultivar	Traffic§	<AZC	>AZC	<AZC	>AZC	<AZC	>AZC	<AZC	>AZC
		%							
Primavera	None	0	0	9	0	21	0	11	0
91-1	"	0	36	0	18	0	6	0	19
91-2	"	0	18	0	18	0	36	0	25
91-3	"	9	82	0	64	6	43	6	61
91-4	"	0	36	0	55	6	36	3	42
91-10	"	9	9	9	0	6	0	8	3
91-12	"	18	18	18	9	21	6	19	11
91-14	"	9	9	9	9	6	6	8	8
91-15	"	9	64	0	45	6	43	6	50
Primavera	C	0	0	9	0	36	0	15	0
91-1	"	0	36	0	36	0	0	0	24
91-2	"	0	27	0	73	0	9	0	36
91-3	"	0	64	0	73	9	27	3	55
91-4	"	0	36	0	73	0	27	0	45
91-10	"	0	9	0	9	9	0	3	6
91-12	"	9	9	9	18	27	0	15	12
91-14	"	9	18	9	36	27	0	15	18
91-15	"	9	55	9	55	18	27	12	45
Primavera	WC	36	0	18	0	9	0	21	0
91-1	"	0	55	0	64	0	18	0	45
91-2	"	0	36	0	55	0	18	0	36
91-3	"	9	55	0	82	0	36	3	58
91-4	"	0	55	0	73	0	36	0	55
91-10	"	0	9	0	9	0	0	0	6
91-12	"	9	18	0	18	18	0	9	12
91-14	"	9	18	0	9	18	18	9	15
91-15	"	9	45	9	9	9	36	9	30

**,*,† Indicates significant difference at 0.01, 0.05, and 0.10 probability levels, respectively.

†† Summary is based on 11 rating dates for all N levels and traffic treatments except for 294 kg N ha^{-1} and "none" traffic which is based on 14 rating dates.

§ Traffic. None, compaction (C), and wear + compaction (WC).

Table 11. Analysis of variance (ANOVA) for shoot density data by cultivar, N level, and traffic treatments.

	1994				1995						
ANOVA	1 Jul	9 Aug	15 Sep	8 Nov	10 May	9 Jun	3 Jul	21 Jul	11 Aug	5 Sep	26 Sep
Cultivar (C)	**	**	**	**	**	**	**	**	**	**	**
Rep	**	**	NS	**	**	**	**	**	*	**	**
Rep X C	**	**	**	**	**	**	**	**	**	**	**
N-level (N)	**	**	**	**	**	**	**	**	**	**	**
C X N	NS	**	**	*	NS	NS	NS	NS	**	*	**
Rep X N X C	NS	**	**	NS	NS	**	*	NS	**	**	**
Traffic (T)	**	**	**	**	**	**	**	**	**	**	**
C X T	NS	**	NS	NS	**	**	NS	**	**	**	*
N X T	**	*	**	NS	*	NS	NS	**	**	†	NS
C X N X T	NS	NS	NS	NS	NS	NS	NS	NS	*	NS	NS
CV (%)	8	7	6	7	6	7	8	5	5	6	2

**,*,† Significant difference at 0.01, 0.05, and 0.10 probability levels, respectively. NS = not significant.

Table 12. N-Rate trend analyses for shoot density of bermudagrasses averaged across all traffic treatments.

		1994				1995						
Cultivar	N-Rate Response	1 Jul	9 Aug	15 Sep	8 Nov	10 May	9 Jun	3 Jul	21 Jul	11 Aug	5 Sep	26 Sep
Common	Linear	†	†	NS	†	*	NS	**	NS	**	NS	**
	Quadratic	NS	†	NS	NS	NS	NS	NS	NS	NS	NS	NS
Primavera	L	NS	†	NS	*	NS	NS	NS	NS	**	NS	NS
	Q	NS	*	NS	NS	NS	NS	NS	NS	NS	NS	NS
91-1	L	NS	*	NS	NS	NS	NS	NS	NS	**	NS	NS
	Q	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
91-2	L	NS	†	NS	**	*	NS	†	NS	**	NS	†
	Q	NS	NS	NS	NS	NS	NS	NS	NS	*	NS	NS
91-3	L	NS	NS	NS	NS	NS	NS	NS	NS	**	NS	NS
	Q	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
91-4	L	**	*	NS	†	NS	NS	**	†	**	NS	NS
	Q	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
91-10	L	NS	NS	*	*	NS	NS	*	NS	**	NS	NS
	Q	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	NS
91-12	L	†	**	NS	NS	NS	NS	**	†	**	NS	NS
	Q	†	NS	NS	NS	NS	NS	†	NS	NS	NS	NS
91-14	L	NS	NS	NS	NS	*	NS	**	*	**	NS	NS
	Q	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
91-15	L	NS	NS	NS	*	*	NS	*	NS	NS	NS	NS
	Q	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

**,*,†Significant response at the 0.01, 0.05, and 0.10 probability level, respectively.

Table 13. Shoot density at 98 kg N ha^{-1} yr^{-1} under traffic levels of none, compaction (C), and wear + compaction (WC).

Contrast		1994				1995						
Cultivar	Traffic	1 Jul	9 Aug	15 Sep	8 Nov	10 May	9 Jun	3 Jul	21 Jul	11 Aug	5 Sep	26 Sep
		9 = ideal shoot density, 1 = no live turf										
AZ Com. vs.	None	5.7	6.0	6.2	5.8	5.7	6.1	6.0	6.5	5.8	6.1	6.1
Primavera	"	5.9	6.5†	6.2	5.9	5.7	6.5	5.6	6.3	6.4	6.3	6.2
91-1	"	6.3*	6.3	6.3	6.6*	6.0	7.0**	6.6	6.7	6.5	6.5	6.5*
91-2	"	6.1†	6.5†	6.1	6.2	5.8	6.8*	6.5	6.8	6.3	6.2	6.7**
91-3	"	6.4*	6.9**	6.0	6.7**	6.2	7.2**	7.1*	7.2*	6.7*	6.6	6.8**
91-4	"	5.9	6.2	6.0	6.0	5.9	7.1**	6.2	6.7	6.7†	6.8†	6.8**
91-10	"	5.9	6.1	5.6*	6.0	5.8	6.2	5.7	6.4	6.0	6.0	6.3
91-12	"	6.1	6.1	4.7**	5.3	4.8**	6.5	5.7	6.7	6.1	6.2	6.5*
91-14	"	5.9	6.8**	5.5**	5.8	5.7	6.5	5.8	6.5	6.4	6.6	6.5*
91-15	"	6.8**	7.5**	7.3**	7.2**	6.7**	7.5**	6.7	7.3**	7.1**	5.7	6.5*
AZ Com. vs.	C	5.5	5.9	5.8	5.6	5.7	5.7	5.6	6.1	5.8	5.5	6.2
Primavera	"	5.9	6.3	6.1	5.8	5.6	6.2	5.8	6.2	6.3	5.5	6.3
91-1	"	6.1†	6.3	6.2	6.3	6.1	7.0**	6.5†	6.6†	6.3	6.1*	6.3
91-2	"	5.9	6.2	6.1	5.4	5.9	6.7**	6.3	6.5	6.2	5.6	6.5
91-3	"	6.4*	6.7*	5.5	5.4	5.8	7.0**	7.0**	6.9**	6.2	6.4**	6.9**
91-4	"	6.1†	6.2	5.8	5.7	5.9	7.0**	6.1	6.5	6.5	6.3**	6.5†
91-10	"	5.6	6.1	5.7	5.8	5.8	5.8	5.2	5.9	5.4	5.7	6.3
91-12	"	6.2*	6.1	4.9*	5.3	5.3	6.3	5.8	6.3	6.2	6.0†	6.4
91-14	"	6.0	6.1	5.0*	5.2	5.5	5.9	5.5	6.3	6.3	6.0†	6.5†
91-15	"	6.2*	7.2**	7.0**	7.4**	6.3	7.1**	6.8*	7.1**	7.2**	4.1**	6.7*
AZ Com. vs.	WC	4.3	4.2	5.1	4.8	5.0	3.9	4.8	4.0	5.2	4.1	5.8
Primavera	"	4.4	4.2	4.6	4.6	4.4*	2.9*	4.4	3.7	4.7	4.1	5.7
91-1	"	4.7*	4.8	5.3	5.5*	6.1**	4.2	5.9†	4.4	6.1†	5.0**	6.3*
91-2	"	4.6†	4.4	4.8	5.2	5.7†	4.3	5.4	4.5	5.8	4.6†	6.2*
91-3	"	4.7*	4.6	4.5*	4.8	5.3	5.7**	5.6	4.9**	5.7	5.1**	6.5**
91-4	"	4.5	4.4	4.7	4.8	5.5	4.4	5.9†	4.9**	6.1*	5.2**	6.6**
91-10	"	4.3	5.3*	4.7	4.9	5.3	4.1	4.8	4.3	5.3	4.5	6.0
91-12	"	4.9**	4.2	4.1**	4.3	4.7	4.4	4.9	4.8*	4.9	4.5†	6.4**
91-14	"	4.5	4.3	4.1**	4.3	4.9	4.4	4.8	4.6†	5.5	4.6†	6.1
91-15	"	4.4	4.3	6.5**	6.5**	5.5	4.5	6.2*	4.6†	7.0**	3.9	6.3*

**,*,† Indicates significant difference at 0.01, 0.05, and 0.10 probability levels, respectively.

Table 14. Shoot density at 196 kg N ha^{-1} yr^{-1} under traffic levels of none, compaction (C), and wear + compaction (WC).

Contrast		1994				1995						
Cultivar	Traffic	1 Jul	9 Aug	15 Sep	8 Nov	10 May	9 Jun	3 Jul	21 Jul	11 Aug	5 Sep	26 Sep
		9 = ideal shoot density, 1 = no live turf										
AZ Com. vs.	None	5.8	5.7	6.1	6.2	5.7	6.4	6.4	6.7	6.4	6.5	6.3
Primavera	"	5.5	6.3	5.8	6.0	5.5	6.5	6.0	6.5	6.4	6.4	6.5
91-1	"	6.2	6.3	6.5	6.6	6.1	7.1	6.5	6.8	6.9	6.8	6.5
91-2	"	6.1	6.5	6.7†	6.3	6.0	6.9	6.7	6.9	6.6	6.7	6.8*
91-3	"	6.3†	7.0**	6.0	6.6	6.3*	7.6*	7.3**	7.3*	7.2*	6.8	6.9*
91-4	"	6.3†	6.7*	6.1	6.4	5.8	7.6	7.1*	7.0	7.1*	7.2*	6.9*
91-10	"	5.5	6.2	5.6	5.9	5.9	6.6	6.1	6.5	6.5	6.5	6.5
91-12	"	5.9	6.3	4.8**	5.2*	5.7	7.1	5.8†	6.5	6.6	6.3	6.8*
91-14	"	6.2	6.0	5.2*	5.5	5.4	6.9	6.4	6.9	7.1*	6.7	6.4
91-15	"	6.0	7.4**	7.2**	7.4**	7.2**	7.5*	7.1*	7.3*	7.3*	6.5	6.6
AZ Com. vs.	C	5.2	6.3	5.9	5.8	5.7	5.7	5.9	6.1	6.5	5.6	6.3
Primavera	"	5.2	5.8	4.9*	5.4	5.3	5.7	5.5	6.1	6.3	5.5	6.3
91-1	"	5.8**	6.2	6.2	6.0	6.2†	6.4	6.6†	6.9**	6.7	5.8	6.6†
91-2	"	5.8**	6.3	6.1	6.1	6.2†	7.0*	6.8*	6.7†	6.9	6.2†	6.7*
91-3	"	6.1**	6.9	5.4	5.7	6.3*	7.4**	7.1**	7.0**	7.0†	6.2†	6.8*
91-4	"	5.8**	6.3	5.5	5.8	6.1	7.2**	6.8*	6.8*	7.0†	6.8**	6.9**
91-10	"	5.4	6.2	5.3	5.9	6.1	6.3	5.7	6.1	6.7	5.8	6.3
91-12	"	5.7*	6.0	4.7**	5.1*	5.5	6.8*	5.8	6.3	6.6	6.0	6.5
91-14	"	5.7*	5.6	4.8**	5.5	5.8	6.8*	6.2	6.7*	7.3**	6.2†	6.4
91-15	"	5.9**	6.2	7.1**	6.8*	7.1**	7.1**	7.2**	7.3**	7.3**	4.8*	6.6
Com. vs.	WC	4.3	4.5	5.0	4.9	4.8	4.1	5.0	4.2	5.4	4.7	5.9
Primavera	"	4.5	4.2	4.5	4.5	5.2	3.4†	4.7	3.6*	4.8	4.3	5.8
91-1	"	4.7*	4.8	6.0†	5.8*	5.7*	4.2	5.9	4.4	6.8*	5.2	6.3†
91-2	"	4.7*	5.2*	5.7	5.4	5.5†	4.4	5.6	4.5	5.9	5.2	6.3†
91-3	"	4.7*	5.0	4.9	5.0	5.5†	5.1**	6.1†	5.1**	6.7†	5.3†	6.6**
91-4	"	4.9**	5.2*	4.9	5.0	5.5†	4.5	5.9	4.9**	6.4	5.9**	6.6**
91-10	"	4.4	4.6	5.4	5.2	5.0	4.2	5.0	3.9	5.9	4.9	6.1
91-12	"	4.7*	4.3	4.3	4.5	4.4	4.5	4.8	4.6	4.8	4.9	6.2
91-14	"	4.6	4.4	4.2	4.5	4.9	4.5	5.9	4.5	5.8	4.9	5.9
91-15	"	4.3	4.2	5.8	5.2	5.1	4.4	5.6	4.4	6.3	3.9†	6.3†

**,*,† Indicates significant difference at 0.01, 0.05, and 0.10 probability levels, respectively.

Table 15. Shoot density at 294 kg N ha^{-1} yr^{-1} under traffic levels of none, compaction (C), and wear + compaction (WC).

Contrast		1994				1995						
Cultivar	Traffic	1 Jul	9 Aug	15 Sep	8 Nov	10 May	9 Jun	3 Jul	21 Jul	11 Aug	5 Sep	26 Sep
		9 = ideal shoot density, 1 = no live turf										
AZ Com. vs.	None	6.6	7.0	6.8	6.7	6.1	6.8	6.8	7.0	7.1	6.6	6.6
Primavera	"	6.3	6.9	6.0*	6.4	5.8	6.5	6.1**	6.8	7.0	6.5	6.5
91-1	"	6.9	6.7	6.6	6.8	6.2	7.2	6.9	7.3*	7.1	6.7	6.7
91-2	"	6.7	7.0	6.8	6.9	6.0	7.1*	7.0	7.4**	7.7*	6.8	6.7
91-3	"	6.9	7.4	6.1*	6.6	6.1	7.4**	7.4**	7.5**	7.4	6.9	6.8
91-4	"	6.8	7.2	6.3	6.5	6.0	7.7	7.1	7.4**	7.6†	7.3**	6.8
91-10	"	6.5	6.6	6.4	6.7	6.1	6.9	6.3*	7.2	7.3	6.6	6.4
91-12	"	6.8	6.6	5.3**	5.8*	5.6**	7.3†	6.9	7.3†	7.2	6.4	6.6
91-14	"	6.4	6.5	5.3**	6.0*	5.9	7.3†	6.7	7.4**	7.5	6.6	6.5
91-15	"	7.0	7.7*	7.5*	7.6*	7.5**	7.5*	7.4**	7.6**	7.5	6.4	6.7
AZ Com. vs.	C	6.1	6.4	6.4	6.2	6.6	6.8	6.7	7.0	7.0	6.2	6.4
Primavera	"	5.7	6.6	5.8†	6.2	6.1	6.6	6.2†	6.9	6.8	5.4†	6.3
91-1	"	5.9	6.4	6.3	6.2	6.4	7.0	6.6	7.1	7.2	6.0	6.5
91-2	"	6.7	7.0*	6.8	5.8	6.4	6.9	6.8	7.3	7.6*	6.3	6.7
91-3	"	6.5	6.8	5.7*	5.7	6.3	7.3†	7.3*	7.5*	7.4	6.3	6.9†
91-4	"	6.5	6.9†	6.2	5.9	6.4	7.5**	7.1	7.4†	7.3	6.7	6.8
91-10	"	5.7	6.4	6.0	6.2	6.2	6.7	6.0**	6.9	7.2	5.7	6.2
91-12	"	6.2	6.2	4.9**	5.1**	5.8*	7.1	6.6	7.0	7.0	6.1	6.4
91-14	"	6.0	6.3	5.1**	5.3*	6.0†	7.1	6.6	7.3	7.4	6.1	6.3
91-15	"	5.7	7.2*	7.3**	7.2**	7.4*	7.3†	7.3†	7.5*	7.5†	4.9**	6.6
Com. vs.	WC	4.7	4.8	5.9	5.6	5.4	4.5	5.7	4.6	6.7	4.6	6.1
Primavera	"	4.7	4.6	5.0*	5.2	4.8	3.9	4.7†	4.6	6.6	4.2	5.9
91-1	"	5.0	4.6	5.3	5.8	6.0	4.7	6.4	5.3†	7.0	4.3	6.0
91-2	"	4.7	4.9	5.9	5.1	6.0	4.6	6.1	5.3†	7.4*	5.0	6.4
91-3	"	4.9	5.4†	5.2	5.1	5.7	5.8**	6.6†	5.6*	6.6	5.2	6.7*
91-4	"	4.9	5.2	5.7	5.5	5.5	5.0	6.5	5.7**	7.0	6.0**	6.7*
91-10	"	4.4	4.6	5.3	5.3	5.5	4.7	5.5	4.7	6.8	4.2	5.8
91-12	"	4.9	4.3	4.4**	4.3**	4.7†	4.9	6.0	5.8**	6.9	4.9	6.2
91-14	"	4.7	4.3	4.6**	4.6**	5.5	4.9	6.1	5.9**	7.2†	4.8	6.1
91-15	"	4.7	4.8	7.4**	6.9**	6.4*	4.8	7.1**	5.2	7.2	3.7*	6.2

**,*,† Indicates significant difference at 0.01, 0.05, and 0.10 probability levels, respectively.

Table 16. Summary of shoot density data. Percent of ratings statistically less than (<) or greater than (>) Arizona Common (AZC) by N-level and traffic treatment.

Contrast		98 kg N ha^{-1} ††		196 kg N ha^{-1}		294 kg N ha^{-1}		Across N	
Cultivar	Traffic§	<AZC	>AZC	<AZC	>AZC	<AZC	>AZC	<AZC	>AZC
		%							
Primavera	None	9	0	0	0	14	0	8	0
91-1	"	0	36	0	0	7	14	3	17
91-2	"	0	36	0	18	0	36	0	31
91-3	"	0	73	0	73	7	21	3	53
91-4	"	0	36	0	55	0	21	0	36
91-10	"	9	0	0	0	7	7	6	3
91-12	"	18	9	27	9	29	14	25	11
91-14	"	9	18	9	9	14	14	11	14
91-15	"	0	82	0	73	0	71	0	75
Primavera	C	0	0	9	0	27	0	12	0
91-1	"	0	45	0	45	0	0	0	30
91-2	"	0	9	0	64	0	18	0	30
91-3	"	0	64	0	73	9	36	3	58
91-4	"	0	36	0	64	0	27	0	42
91-10	"	0	0	0	0	9	0	3	0
91-12	"	9	18	18	18	27	0	18	12
91-14	"	9	18	9	45	27	0	15	21
91-15	"	9	82	9	73	9	73	9	76
Primavera	WC	18	0	18	0	18	0	18	0
	"	0	64	0	55	0	9	0	43
91-2	"	0	36	0	36	0	18	0	30
91-3	"	0	55	0	73	0	45	0	58
91-4	"	0	45	0	55	0	27	0	42
91-10	"	0	9	0	0	0	0	0	3
91-12	"	9	36	0	9	27	9	12	18
91-14	"	9	18	0	0	18	18	9	12
91-15	"	0	55	9	9	9	36	6	23

**,*,† Indicates significant difference at 0.01, 0.05, and 0.10 probability levels, respectively.

†† Summary is based on 11 rating dates for all N levels and traffic treatments except for 294 kg N ha^{-1} and "none" traffic which is based on 14 rating dates.

§ Traffic. None, compaction (C), and wear + compaction (WC).

Table 17. Analysis of variance (ANOVA) for turfgrass color and leaf firing data by cultivar, N-level, and traffic treatments.

	Turf Color				Leaf Firing
	1994		1995		15 Sep
ANOVA	9 Aug	8 Nov	10 May	5 Sep	1994
Cultivar (C)	**	**	**	**	**
Rep	NS	**	**	**	**
Rep X C	**	**	**	**	**
N-level (N)	**	**	**	**	**
C X N	NS	†	NS	NS	**
Rep X N X C	**	**	NS	†	**
Traffic (T)	**	**	**	**	†
C X T	NS	**	*	**	NS
N X T	NS	NS	**	NS	NS
C X N X T	NS	NS	NS	NS	NS
CV (%)	2	2	4	6	39

**,*,†Significant difference at 0.01, 0.05, and 0.10 probability levels, respectively. NS = not significant.

Table 18. N-Rate trend analyses for turfgrass color and leaf firing of bermudagrasses averaged across all traffic treatments.

Cultivar	N-Rate Response	Color 1994 9 Aug	Color 1994 8 Nov	Color 1995 10 May	Color 1995 5 Sep	Leaf Firing 15 Sep 1994
Common	Linear	†	NS	**	**	**
	Quadratic	NS	NS	*	NS	NS
Primavera	L	*	NS	NS	NS	NS
	Q	NS	NS	NS	NS	NS
91-1	L	NS	NS	†	NS	NS
	Q	NS	NS	NS	NS	NS
91-2	L	NS	NS	NS	NS	NS
	Q	NS	NS	NS	NS	NS
91-3	L	*	NS	NS	NS	NS
	Q	NS	NS	NS	NS	NS
91-4	L	*	†	**	†	NS
	Q	NS	NS	NS	NS	NS
91-10	L	*	**	†	NS	*
	Q	NS	**	NS	NS	NS
91-12	L	*	NS	NS	NS	NS
	Q	†	NS	NS	NS	†
91-14	L	NS	NS	**	NS	NS
	Q	NS	NS	NS	NS	NS
91-15	L	NS	NS	*	NS	NS
	Q	NS	NS	†	NS	NS

**,*,† Significant response at the 0.01, 0.05, and 0.10 probability level, respectively.

Table 19. Turfgrass color at 98 kg N ha^{-1} yr^{-1} under traffic levels of none, compaction (C), and wear + compaction (WC).

Contrast		1994	1995		
Cultivar	Traffic	9 Aug	8 Nov	10 May	5 Sep
		9 = dark green; 1 = no green			
AZ Com. vs.	None	6.9	6.1	6.2	5.9
Primavera	"	7.1	6.0	6.0	6.1
91-1	"	7.0	6.1	6.2	6.4
91-2	"	7.2†	6.2	6.3	6.4
91-3	"	7.3*	6.6*	6.4†	6.2
91-4	"	7.3*	6.3	6.2	6.6*
91-10	"	7.0	5.9	6.1	6.2
91-12	"	7.4**	6.0	6.5**	6.2
91-14	"	7.2†	6.1	6.4†	6.4
91-15	"	7.0	6.0	6.3	5.3†
AZ Com. vs.	C	7.0	6.2	6.3	5.4
Primavera	"	7.1	6.1	6.2	5.9
91-1	"	7.1	6.1	6.2	6.1*
91-2	"	7.0	6.2	6.4	5.7
91-3	"	7.3	6.4	6.4	6.1†
91-4	"	7.3	6.3	6.3	6.5**
91-10	"	7.0	5.9	6.2	5.8
91-12	"	7.2	6.1	6.5	6.0†
91-14	"	7.2	6.1	6.4	6.1†
91-15	"	6.8	6.1	6.4	3.9**
AZ Com. vs.	WC	7.1	6.3	6.5	5.3
Primavera	"	7.3	6.3	6.4	5.5
91-1	"	7.2	6.2	6.3	6.2*
91-2	"	7.3	6.3	6.4	5.9
91-3	"	7.5†	6.4	6.5	5.7
91-4	"	7.2	6.4	6.3	6.2*
91-10	"	7.1	5.9†	6.1*	5.7
91-12	"	7.4	6.3	6.7†	5.2
91-14	"	7.4	6.4	6.4	5.7
91-15	"	7.2	6.0	6.4	3.9**

**,*,† Indicates significant difference at 0.01, 0.05, and 0.10 probability levels, respectively.

Table 20. Turfgrass color at 196 kg N ha^{-1} yr^{-1} under traffic levels of none, compaction (C), and wear + compaction (WC).

Contrast		1994		1995	
Cultivar	Traffic	9 Aug	8 Nov	10 May	5 Sep
		9 = dark green; 1 = no green			
AZ Com. vs.	None	7.1	6.1	6.1	6.0
Primavera	"	7.1	5.9	6.1	6.2
91-1	"	7.0	6.0	6.1	6.5*
91-2	"	7.4*	6.3	6.2	6.5*
91-3	"	7.4*	6.5*	6.4†	6.5*
91-4	"	7.4*	6.6**	6.2	7.1**
91-10	"	7.1	5.9	6.0	6.7**
91-12	"	7.4*	5.9	6.6*	6.5*
91-14	"	7.4*	6.2	6.3	6.3
91-15	"	6.9	6.0	6.2	5.7
AZ Com. vs.	C	7.0	6.1	6.2	5.5
Primavera	"	7.1	5.9	6.3	5.6
91-1	"	7.1	5.9	6.3	6.2†
91-2	"	7.3†	6.2	6.5	6.1
91-3	"	7.4*	6.3	6.8**	6.3*
91-4	"	7.4*	6.4	6.5	6.7**
91-10	"	7.2	5.9	6.3	6.0
91-12	"	7.5*	5.9	6.6*	5.9
91-14	"	7.3	6.1	6.5	6.2†
91-15	"	6.9	6.2	6.4	4.2**
AZ Com. vs.	WC	7.1	6.2	6.4	5.4
Primavera	"	7.2	6.0	6.8	5.3
91-1	"	7.3	6.3	6.5	6.3*
91-2	"	7.3	6.2	6.4	5.9
91-3	"	7.3	6.4	6.3	5.8
91-4	"	7.4†	6.4	6.3	6.4*
91-10	"	7.3	6.1	6.2	5.8
91-12	"	7.4†	6.1	6.6	5.5
91-14	"	7.4†	6.3	6.3	5.7
91-15	"	7.1	6.2	6.3	3.9**

**,*,† Indicates significant difference at 0.01, 0.05, and 0.10 probability levels, respectively.

Table 21. Turfgrass color at 294 kg N ha^{-1} yr^{-1} under traffic levels of none, compaction (C), and wear + compaction (WC).

Contrast		1993		1994		1995	
Cultivar	Traffic	18 Oct	22 Nov	9 Aug	8 Nov	10 May	5 Sep
		9 = dark green; 1 = no green					
AZ Com. vs.	None	5.5	4.0	7.1	6.2	6.4	6.1
Primavera	"	5.2	3.1*	7.3	6.1	6.0*	6.3
91-1	"	5.3	2.7**	7.3	6.2	6.3	6.4
91-2	"	5.6	3.0*	7.4*	6.4	6.2	6.6†
91-3	"	6.1*	4.1	7.6**	6.5	6.5	6.4
91-4	"	5.9†	4.0	7.6**	6.5	6.3	7.2**
91-10	"	5.7	3.6	7.4*	6.2	6.2	6.5
91-12	"	5.8	4.1	7.6**	5.9*	6.6	6.4
91-14	"	5.9†	4.2	7.5*	6.3	6.4	6.6†
91-15	"	5.1	3.1*	7.0	6.2	6.6	5.5*
AZ Com. vs.	C			7.2	6.4	6.9	6.0
Primavera	"			7.3	6.2	6.6	5.7
91-1	"			7.4	6.2	6.7	6.2
91-2	"			7.3	6.2	6.6	6.2
91-3	"			7.6**	6.4	6.8	6.3
91-4	"			7.6**	6.5	6.9	6.7*
91-10	"			7.3	6.2	6.6†	6.0
91-12	"			7.5*	6.3	6.8	6.1
91-14	"			7.5*	6.3	6.8	6.3
91-15	"			7.0	6.3	6.6	4.6**
AZ Com. vs.	WC			7.4	6.3	6.7	5.7
Primavera	"			7.5	6.2	6.5	5.3
91-1	"			7.5	6.3	6.5	5.8
91-2	"			7.5	6.3	6.6	5.8
91-3	"			7.6	6.4	6.4	5.9
91-4	"			7.5	6.7*	6.6	6.4*
91-10	"			7.3	6.1	6.3*	5.5
91-12	"			7.6	6.5	6.6	5.7
91-14	"			7.4	6.6†	6.5	5.9
91-15	"			7.4	6.2	6.5	4.2**

**,*,† Indicates significant difference at 0.01, 0.05, and 0.10 probability levels, respectively.

Table 22. Rhizome volume and weight of 10 seeded bermudagrasses sampled 8 August 1994 and 11 August 1995.

Contrast and Cultivar	Volume †† 8 Aug 1994	Weight 8 Aug 1994
	— cm^3 —	— $mg \cdot 100\ cm^{-3}$ —
AZ Common vs.	.05	19
Primavera	.07	4
91-1	.18	70
91-2	.33	73
91-3	.11	34
91-4	.02	8
91-10	.23	50
91-12	.23	57
91-14	.17	52
91-15	.11	30
Sign. F-test	.77	.74
CV (%)	158	155

**,*,†Significant difference at .01, .05, and .10 probability levels, respectively.

††Per 100 cm^3 soil volume. Sample depth to 6.0 cm.

Table 23. Evapotranspiration in 1994, 1995; averaged over the 39 measurement days (ET_{all}), and averaged over 14 well-irrigated days (ET_{wi}).

Cultivar and Contrast[††]	1994 23 Aug-1 Sep (9d)	1995 23 May-26 May (3d)	1995 7 Jun-26 Jun (19d)	1995 27 Jul-4 Aug (8d)	ET_{all} (Avg.)	ET_{wi}[§] (Avg.)
	cm d^{-1}					
AZ Common vs.	.19	.37	.20	.16	.20	.26
Primavera	.24†	.55*	.21	.15	.23†	.33†
91-1	.23	.43	.23	.22	.24†	.31
91-2	.17	.27	.22	.17	.20	.25
91-3	.18	.36	.21	.15	.20	.24
91-4	.18	.29	.20	.13	.19	.23
91-10	.20	.40	.19	.14	.20	.26
91-12	.19	.31	.20	.18	.20	.25
91-14	.22	.31	.21	.15	.21	.28
91-15	.22	.46	.22	.21	.23†	.33†
ANOVA (overall)						
Cultivar (C)	†	**	.96	†	.33	.32
Traffic (T)	.50	.32	.47	.29	.97	.95
CXT	.53	**	.96	.30	.97	.98
CV (%)	29	43	25	99	32	33
ANOVA (traffic treatments combined)						
C	†	*	.82	.25	†	†
CV (%)	19	49	19	30	27	30

**,*,†Significant difference at the 0.01, 0.05, and 0.10 probability levels, respectively.

††Paired comparisons are across traffic levels.

§ET_{wi} = ET during well-irrigated conditions within 3 to 6 days of irrigation application. Based on the periods of 23 to 29 August 1994, 23 to 26 May 1995, and 7 to 12 June 1995.

Table 24. Water extraction by rooting depth in 1994 and 1995 for dry-down periods of 8 to 19 days.

Cultivar and Contrast††	Water Extraction by Rooting Depth								
	23 Aug-1 Sep (94)			7-26 Jun (95)			27 Jul-4 Aug (95)		
	0-10 cm	11-20 cm	21-60 cm	0-10 cm	11-20 cm	21-60 cm	0-10 cm	11-20 cm	21-60 cm
	cm								
AZ Common vs.	.59	.36	.72	1.02	.90	1.95	.36	.26	.69
Primavera	.60	.48	1.10	1.06	.95	1.97	.43	.28	.52
91-1	.71	.60*	.77	1.03	.98	2.16	.35	.29	1.12†
91-2	.54	.39	.61	1.00	.91	2.23	.37	.26	.71
91-3	.56	.38	.64	1.03	.89	1.99	.33	.25	.59
91-4	.64	.45	.50	.91	.76	2.20	.28	.15*	.62
91-10	.67	.52	.62	1.01	.90	1.66	.27	.27	.59
91-12	.65	.35	.69	1.08	.83	1.86	.53*	.28	.59
91-14	.62	.45	.91	1.00	.81	2.20	.36	.30	.54
91-15	.62	.43	.91	.84	.86	2.39†	.32	.26	1.12†
ANOVA (overall)									
Cultivar (C)	.50	*	†	.95	.91	.40	*	.68	†
Traffic (T)	†	.40	.23	.25	.89	.11	.78	.91	.29
CXT	.40	.84	.81	.99	.99	.82	.81	.99	.33
CV (%)	26	35	53	33	33	30	43	56	35
ANOVA (traffic treatments combined)									
C	.32	*	.25	.85	.73	.21	*	.48	†
CV (%)	21	27	42	28	26	26	40	49	50

**,*,†Significant difference at the 0.01, 0.05, and 0.10 probability levels, respectively.

††Paired comparisons are across traffic levels.

Table 25. Water extraction by rooting depth averaged over all dry-down periods in 1994 and 1995. The total of dry-down periods was 39 days (see footnote §).

Cultivar and Contrast††	Water Extraction by Depth§			
	0-10 cm	11-20 cm	21-60 cm	0-60 cm
	cm			
AZ Common vs.	2.26	1.72	3.98	7.96
Primavera	2.47	1.91	4.66†	9.04†
91-1	2.37	2.05	4.87†	9.29†
91-2	2.22	1.67	3.93	7.82
91-3	2.28	1.68	3.78	7.74
91-4	2.07	1.50	3.81	7.38
91-10	2.33	1.91	3.47	7.71
91-12	2.62	1.61	3.57	2.80
91-14	2.26	1.71	4.16	8.13
91-15	2.13	1.77	5.23*	9.13†
ANOVA (overall)				
Cultivar (C)	.97	.75	.18	.33
Traffic (T)	.27	.75	.48	.97
CXT	.99	.99	.97	.97
CV (%)	31	36	36	32
ANOVA (traffic treatments combined)				
C	.93	.50	*	†
CV (%)	26	29	29	27

**,*,†Significant difference at the 0.01, 0.05, and 0.10 probability levels, respectively.

††Paired comparisons are across traffic levels.

§Dry-down periods were 23 August to 1 September 1994 (9d), 23 to 26 May 1995 (3d), 7 to 26 June 1995 (19d), and 27 July to 4 August 1995 (8d).

Table 26: Water extraction by rooting depth in 1994 and 1995 for dry-down periods of 3 to 6 days.

Cultivar and Contrast††	Water Extraction by Rooting Depth								
	23-29 Aug (94)			23-26 May (95)			7-12 June (95)		
	0-10 cm	11-20 cm	21-60 cm	0-10 cm	11-20 cm	21-60 cm	0-10 cm	11-20 cm	21-60 cm
	cm								
AZ Common vs.	.41	.23	.64	.29	.20	.62	.42	.28	.59
Primavera	.42	.29	.98	.38	.20	1.07*	.45	.27	.51
91-1	.58	.46*	.69	.28	.18	.82	.38	.27	.70
91-2	.39	.23	.53	.31	.11**	.38	.40	.33	.82
91-3	.42	.22	.54	.36	.16	.56	.41	.29	.40
91-4	.48	.31	.38	.24	.14†	.49	.43	.27	.50
91-10	.50	.31	.48	.38	.21	.60	.43	.32	.40
91-12	.49	.22	.57	.36	.15	.43	.55	.29	.40
91-14	.46	.28	.76	.28	.15	.52	.52	.31	.59
91-15	.48	.28	.76	.35	.22	.81	.46	.35	.86†
ANOVA (overall)									
Cultivar (C)	.25	*	.13	.45	*	*	.21	.89	.20
Traffic (T)	.34	.53	.21	.42	.57	.22	.66	.25	*
CXT	.46	.82	.93	.32	†	*	.92	.88	.90
CV (%)	32	51	63	46	43	68	30	39	73
ANOVA (traffic treatments combined)									
C	.21	*	†	.43	*	†	.85	.73	.21
CV (%)	29	45	55	45	44	76	27	26	27

**,*,†Significant difference at the 0.01, 0.05, and 0.10 probability levels, respectively.

††Paired comparisons are across traffic levels.

Table 27. Turfgrass leaf firing data at three N-levels and three traffic treatments of none, compaction (C), and wear + compaction (WC) 15 September 1994.

Contrast		Leaf Firing (15 Sep)		
Cultivar	Traffic	98	196	294
		% Plot		
AZ Com. vs.	None	16	11	5
Primavera	"	12	9	12
91-1	"	7	4	6
91-2	"	15	15	12
91-3	"	17	9	12
91-4	"	11	8	14
91-10	"	12	9	5
91-12	"	13	15	10
91-14	"	17	15	15†
91-15	"	0*	0*	0
AZ Com. vs.	C	16	13	6
Primavera	"	11	10	12
91-1	"	11	8	10
91-2	"	19	11	13
91-3	"	16	15	9
91-4	"	13	17	13
91-10	"	14	14	6
91-12	"	11	20	13
91-14	"	18	14	13
91-15	"	0	0	0
AZ Com. vs.	WC	10	11	1
Primavera	"	13	12	11
91-1	"	9	8	13
91-2	"	14	13	15
91-3	"	14	15	20
91-4	"	16	17	10
91-10	"	17	10	10
91-12	"	14	14	8
91-14	"	14	16	14
91-15	"	0	0	0

**, *, † Indicates significant difference at 0.01, 0.05, and 0.10 probability levels, respectively.

Table 28. Root length density (RLD) by soil depth at two sample dates and change in RLD over the summer of 1994 at the 196 kg N ha^{-1} rate and "none" traffic treatment.

Cultivar and Contrast‡	RLD 15 Jul 3-30 cm	RLD 15 Jul 30-60 cm	RLD 13 Sep 3-30 cm	RLD 13 Sep 30-60 cm	Change in RLD (13 Sep - 15 Jul) 3-30 cm	Change in RLD (13 Sep - 15 Jul) 30-60 cm
	cm cm^{-3}		cm cm^{-3}		cm cm^{-3}	
AZ Common vs.	1.61	1.11	3.56	1.26	1.95	.15
Primavera (FMC-1-90)	4.54	.38	5.84	1.51	1.30	1.13
91-1	5.18	.57	4.55	.43†	(-) .63	(-) .14
91-2	3.80	.35	5.40	1.22	1.60	.87
91-3	1.90	.76	3.90	1.61	2.00	.85
91-4	2.86	.50	7.39†	1.62	4.53	1.12
91-10	2.34	.61	6.32	1.03	3.98	.42
91-12	7.86*	1.79	4.21	1.03	(-) 3.65	(-) .76
91-14	4.60	.38	4.86	.76	.26	.38
91-15	3.30	.77	9.42*	2.21*	8.12	1.44
Sign. F-test	.53	.55	.32	.16	-	-
CV (%)	88	111	50	53	-	-

**,*,†Significant difference at the 0.01, 0.05, and 0.10 probability levels, respectively.

‡Orthogonal paired comparison versus Common.

Table 29. Total root length (TRL) and change in TRL over the summer in 1994 at the 196 kg N ha^{-1} rate and "none" traffic treatment.

Cultivar and Contrast††	TRL		Change in TRL
	15 Jul	13 Sep	13 Sep - 15 Jul
	cm cm^{-2}		cm cm^{-2}
AZ Common vs.	77.5	135.6	58.1
Primavera (FMC-1-90)	136.1	205.7	69.6
91-1	159.3	137.8	(-) 21.5
91-2	114.8	184.9	70.1
91-3	75.0	155.4	80.4
91-4	93.5	251.5*	158.0
91-10	82.6	204.4	121.8
91-12	269.5*	146.5	(-) 123.0
91-14	137.7	156.3	18.6
91-15	113.7	325.0*	211.3
Sign. F-test	.60	.18	-
CV (%)	88	42	-

**,*,†Significant difference at the 0.01, 0.05, and 0.10 probability levels, respectively.

††Orthogonal paired comparison versus Common.