1996-1997 Evaluation of Slow-Release and Fast-Release Nitrogen Fertilizer Treatments Applied on an Overseeded Common Bermudagrass During the Cool Season

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I. SUMMARY

This study was conducted to evaluate the performance of nitrogen fertilizer treatments (in terms of visual turfgrass color response) when applied on overseeded common bermudagrass maintained similar to fairway conditions during a five-month cool season.

Twenty-three nitrogen fertilizer treatments were evaluated during five months of the cool season, from November 11, 1996 to April 18, 1997, on a mature stand of Arizona common bermudagrass overseeded with Academy and Charger perennial ryegrass. Prior to overseeding, the plot was treated with Diquat on October 1, scalped with a flail mower on October 9, and fertilized with 2 lb P_2O_5/1000 ft^2 and 2 lb K_2O/1000 ft^2 on October 18. The plot was overseeded on October 18, 1996 with Academy perennial ryegrass at 16 lb seed/1000 ft^2, and again on November 13, 1996, with Charger perennial ryegrass at 18 lb seed/1000 ft^2, due to a slow establishment of the first overseed operation.

The study included twenty-three nitrogen fertilizer treatments and one no-fertilizer check treatment. These fertilizers were variable in terms of the percentage of N that was slow-release or fast-release. Twenty-one of the fertilizer treatments were granular-applied and received 4.0 lb N/1000 ft^2 over 5 months, with the exception of one treatment which received 2.5 lb N/1000 ft^2 over 5 months. Application rates ranged from 0.25 to 2.0 lb N/1000 ft^2 applied two to ten times during 5 months. Two treatments were spray-applied and received 0.75 lb N/1000 ft^2 per application (in two gallons of finished spray volume per 1000 ft^2). These applications were made once a month for four months, following a granular application of 6-20-20 at 1.0 lb N/1000 ft^2 in the first month of the study. During the course of the study, these treatments received a total 4.0 lb N/1000 ft^2.

Visual turfgrass color ratings were measured every two weeks beginning 3.5 weeks after initial fertilizer treatment applications. Initial fertilizer treatments were applied on November 11, 1996. These ratings were taken on a 1 to 9 scale, with 1=brown, 5=minimally acceptable, and 9=darkest green overseeded common bermudagrass. Weather measurements were collected from an on-site California Irrigation Management Information System (CIMIS) weather station.

Results from this study are listed below.

1. A rate of 4.0 lb N/1000 ft^2 produced good turfgrass color on overseeded common bermudagrass with an average visual color rating of 6.6 (on a 1 to 9 scale, with 1=brown, 5 = minimally acceptable, and 9 = darkest green overseeded common bermudagrass). This average includes all treatments that were applied at a N rate of 4.0 lb/1000 ft^2 during the 5-month cool season.

2. Nitrogen treatments, which included differences in seasonal nitrogen rates, nitrogen source, and number of applications during the five-month study, significantly affected visual turfgrass color ratings. Selected treatments, involving either a fast-release or slower-release nitrogen source, performed well in this study.

II. MATERIALS AND METHODS

Twenty-three nitrogen fertilizer treatments were evaluated for a five-month cool season, from November 11, 1996 to April 18, 1997 on a mature stand Arizona common bermudagrass overseeded with Academy and Charger perennial ryegrass and maintained similar to fairway conditions (Table 1, page 5; Table 2, page 6; Table 3, page 7). Prior to overseeding, the plot was treated with Diquat (October 1, 1996), scalped with a flail mower (October 9, 1996), and fertilized with 2.0 lb P_2O_5/1000 ft^2 and 2.0 lb K_2O/1000 ft^2 (October 18, 1996). On October 18, 1996, the plot was overseeded with Academy perennial ryegrass at 16 lb seed/1000 ft^2. Due to a slow establishment, the plot was reseeded on November 13, 1996 with Charger perennial ryegrass at 18 lb seed/1000 ft^2, followed by a topdressing operation.

The study included twenty-three nitrogen fertilizer treatments and one no-fertilizer check treatment (Table 2, page 6) which were variable in terms of the percentage of N that was slow-release or fast-release. Twenty-one of the fertilizer treatments were granular-applied and received 4.0 lb N/1000 ft^2 over 5 months, with the exception of one treatment which received 2.5 lb N/1000 ft^2 over 5 months. Individual application rates ranged from 0.25 to 2.0 lb N/1000 ft^2 applied two to ten times during 5 months. Two treatments were spray-applied and received 0.75 lb N/1000 ft^2 per application (in two gallons of finished spray volume per 1000 ft^2). These applications were made once a month for four months, following a granular application of 6-20-20 at 1.0 lb N/1000 ft^2 in the first month of the study. During the course of the study, these treatments received a total 4.0 lb N/1000 ft^2.

Visual turfgrass color ratings were measured every two weeks beginning 3.5 weeks after initial fertilizer treatment applications. Initial fertilizer treatments were applied on November 11, 1996. These ratings were taken on a 1 to 9 scale, with 1=brown, 5=minimally acceptable, and 9=darkest green overseeded common bermudagrass. Weather measurements were collected from an on-site California Irrigation Management Information System (CIMIS) weather station (Table 5, page 11).

Table 1. Materials and methods outline for the evaluation of nitrogen fertilizer treatments applied on an overseeded common bermudagrass during the cool season.

Objective:
To evaluate the performance of nitrogen fertilizer treatments (in terms of visual turfgrass color response) when applied on overseeded bermudagrass maintained similar to fairway conditions during a five-month cool season.

Cultivars: Arizona common bermudagrass overseeded with Academy and Charger perennial ryegrass.

Experimental Site:
A mature stand of Arizona common bermudagrass (established in 1989) located at the UCR Turfgrass Field Research Center in Riverside, CA. The plot was treated with Diquat on October 1, 1996, scalped with a flail mower on October 9, and fertilized on October 18 with 2.0 lb P_2O_5/1000 ft^2 and 2.0 lb K_2O/1000 ft^2. The plot was overseeded on October 18, 1996 with Academy perennial ryegrass at 16 lb seed/1000 ft^2. Due to a slow establishment, the plot was reseeded on November 13, 1996 with Charger perennial ryegrass at 18 lb seed/1000 ft^2, followed by a topdressing operation. The root zone was a native soil, classified as a Hanford fine sandy loam. As of October 1996 the soil pH=7.1; Olsen-P=25 ppm; exchangeable K=156 ppm; CEC=16.5 meq/100 g; EC=1.77 mmhos/cm; ESP= 2%; SAR=2; soluble Ca=14.3 meq/L; soluble Na=5.8 meq/L; soluble Mg=3.6 meq/L; soluble HCO3=3.5 meq/L; OM=2.14%; sand=42%; silt=43%; and clay=15%.

DANR Analytical Lab. soil analysis methods: pH = saturated paste (s.p.), pH meter; Olsen-P = alkaline extraction (ext.) by 0.5 Normal $NaHCO_3$ for soils with pH > 6.5 by ascorbic acid reduction of phosphomolybdate complex and meas. by spectrophotometry; exchangeable K = equilib. ext. using 1 Normal ammonium acetate (pH 7.0), subsequent determination by atomic absorption/emission spectrophotometry; CEC = barium acetate saturation and calcium replacement; SAR = est. calc. from Ca, Mg, and Na on s.p. ext.; soluble (sol.) Ca and Mg = s.p. ext., inductively coupled plasmic atomic emission spectrometry; sol. Na = s.p. ext., emission spectrometry; HCO_3 = s.p. ext., titration with 0.05 Normal H_2SO_4 acid; OM = potassium dichromate reduction of organic carbon and subsequent spectrophotometric measurement.

Experimental Design:
Randomized Complete Block design with three replications. Plot size 4.5 ft x 6 ft. Overall analysis was a repeated measures design with fertilizer treatments as the main plot factor and rating date as the repeated measures factor.

Mowing: Twice per week with a triplex riding greens mower, clippings returned. Bench setting = $^{11}/_{16}$ inches.

Irrigation: Plots irrigated as needed to prevent visual drought symptoms and over-watering.

Fertilizer Treatments (*see Table 2)*:
- N rates for most treatments: 4.0 lb/1000 ft^2 for duration of study.

- Initial fertilizer treatments applied on November 11, 1996, and the final fertilizer treatment applications were made March 21, 1997.

Measurements:
Visual turfgrass color ratings were taken every two weeks beginning 3.5 weeks after initial fertilizer treatment applications. These ratings were taken on a 1 to 9 scale, with 1=brown, 5=minimally acceptable, and 9=darkest green overseeded common bermudagrass.

Weather data was collected from an on-site California Irrigation Management Information System (CIMIS) weather station.

Table 2. Twenty-three nitrogen fertilizer treatments applied on an overseeded common bermudagrass during the cool season.

TRT	Company	Fertilizer Program: Product / Analysis - N:P_2O_5:K_2O (Rate - lb N / 1000 ft^2)					lb N/1000ft^2/5 mo.
Application Dates --->		Nov 11 '96	Dec 10 '96	Jan 23 '97	Feb 21 '97	Mar '97	
1	J.R. Simplot	Endure 15-15-15 (1.0)	Polyon 43-0-0 (1.0)	Turf Gold 21-3-5 (1.0)	Turf Gold 21-3-5 (1.0)	--	4.0
2	J.R. Simplot	Pro Balance 15-15-15 (1.0)	Nitra King 22-3-9 (1.0)	Nitra King 22-3-9 (1.0)	Pro Balance 15-15-15 (1.0)	--	4.0
Application Dates --->		Nov 11 '96	Dec 10 '96	Jan 23 '97	Feb 14 '97	Mar 17 '97	
3	J.R. Simplot	Re-Gain 6-2-6 (0.5)	Re-Gain 6-2-6 (0.5)	Re-Gain 16-3-7 (1.0)	Re-Gain 16-3-7 (1.0)	Re-Gain 16-3-7 (1.0)	4.0
Application Dates --->		Nov 11 '96	Dec 10 '96	Jan '97	Feb 21 '97	Mar '97	
4	IMC Vigoro	ParEx 10-22-22 (1.0)	Par Ex 24-4-12 (1.5)	--	Par Ex 24-4-12 (1.5)	--	4.0
5	IMC Vigoro	ParEx 10-22-22 (1.0)	Par Ex 28-3-10 (1.5)	--	Par Ex 28-3-10 (1.5)	--	4.0
Application Dates --->		Nov 11 '96	Dec 10 '96	Jan 23 '97	Feb 14 '97	Mar 20 '97	
6	Sea Source	Turf Rally 6-10-10 (0.6)	Turf Rally 16-4-8 (0.4)	Turf Rally 16-4-8 (1.0)	Turf Rally 16-4-8 (1.0)	Turf Rally 16-4-8 (1.0)	4.0
Application Dates --->		Applied every two weeks: 11/11/96, 11/27, 12/13, 12/23, 01/09/97, 01/21, 02/10, 02/21, 03/07, 03/21					
7	Vicksburg Chemical	K-Power miniprill 13.75-0-44.5 (0.4)					4.0
8	Vicksburg Chemical	K-Power miniprill 13.75-0-44.5 (0.25)					2.5
Application Dates --->		Nov 11 '96	Dec '96	Jan 23 '97	Feb '97	Mar '97	
9	Vicksburg Chemical	Multicote 40-0-0 (2.0)	--	Multicote 40-0-0 (2.0)	--	--	4.0
10	Vicksburg Chemical	Multicote 12-0-43 (2.0)	--	Multicote 12-0-43 (2.0)	--	--	4.0
Application Dates --->		Nov 11 '96	Dec 13 '96	Jan 24 '97	Feb 26 '97	Mar 19 '97	
11	Tessenderlo Kerley	6-20-20 (1.0)	N-Sure Lite 30-0-0* (0.75)	N-Sure Lite 30-0-0* (0.75)	N-Sure Lite 30-0-0* (0.75)	N-Sure Lite 30-0-0* (0.75)	4.0
Application Dates --->		Nov 11 '96	Dec 9 '96	Jan 24 '97	Feb 26 '97	Mar 19 '97	
12	Tessenderlo Kerley	6-20-20 (1.0)	Trisert KS 15-0-12-8S* (0.75)	Trisert KS 15-0-12-8S* (0.75)	Trisert KS 15-0-12-8S* (0.75)	Trisert KS 15-0-12-8S* (0.75)	4.0
Application Dates --->		Nov 11 '96	Dec '96	Jan 23 '97	Feb 14 '97	Mar 17 '97	
13	Bandini	28-4-6 (1.0)	--	28-4-6 (1.0)	28-4-6 (1.0)	28-4-6 (1.0)	4.0
Application Dates --->		Nov 11 '96	Dec '96	Jan 23 '97	Feb 14 '97	Mar 20 '97	
14	Bandini	ProLong 21-4-6 (1.0)	--	ProLong 21-4-6 (1.0)	ProLong 21-4-6 (1.0)	ProLong 21-4-6 (1.0)	4.0
Application Dates --->		Nov 11 '96	Dec '96	Jan 23 '97	Feb 14 '97	Mar 17 '97	
15	Bandini	22-4-22 (1.0)	--	22-4-22 (1.0)	22-4-22 (1.0)	22-4-22 (1.0)	4.0
Application Dates --->		Nov 11 '96	Dec 10 '96	Jan 23 '97	Feb 14 '97	Mar 20 '97	
16	Hydro Agri	Turf Royale 21-7-14 (1.0)	Turf Royale 21-7-14 (1.0)	Turf Royale 21-7-14 (1.0)	Turf Royale 21-7-4 (0.5)	Turf Royale 21-7-14 (0.5)	4.0
Application Dates --->		Nov 11 '96	Dec 10 '96	Jan 23 '97	Feb 14 '97	Mar 17 '97	
17	Hydro Agri	Classic Royale 15-15-15 (1.0)	Classic Royale 15-15-15 (1.0)	Classic Royale 15-15-15 (1.0)	Classic Royale 15-15-15 (0.5)	Classic Royale 15-15-15 (0.5)	4.0
Application Dates --->		Nov 11 '96	Dec 10 '96	Jan 23 '97	Feb 14 '97	Mar 20 '97	
18	Hydro Agri	HydroPrill 16-15-15 (1.0)	HydroPrill 16-15-15 (1.0)	HydroPrill 16-15-15 (1.0)	HydroPrill 16-15-15 (0.5)	HydroPrill 16-15-15 (0.5)	4.0
Application Dates --->		Nov 11 '96	Dec 10 '96	Jan '97	Feb 21 '97	Mar 20 '97	
19	United Horticultural Supply	Turfgo 23-5-10 (1.25)	Turfgo 23-5-10 (0.75)	--	Turfgo 23-5-10 (1.0)	Turfgo 23-5-10 (1.0)	4.0
20	United Horticultural Supply	Turfgo 16-23-16 (1.25)	Turfgo 16-23-16 (0.75)	--	Turfgo 16-23-16 (1.0)	Turfgo 16-23-16 (1.0)	4.0
Application Dates --->		Nov 11 '96	Dec '96	Jan 23 '97	Feb 14 '97	Mar 17 '97	
21	Scotts	ProTurf 16-25-12 (0.96)	--	Scotts 30-3-9 (1.04)	Scotts 30-3-9 (1.0)	Scotts 30-3-9 (1.0)	4.0
Application Dates --->		Nov 11 '96	Dec 10 '96	Jan 23 '97	Feb 21 '97	Mar 20 '97	
22	UCR 1	Nitra King 22-3-9 (0.8)	Nitra King 22-3-9 (0.8)	Nitra King 22-3-9 (0.8)	Nitra King 22-3-9 (0.8)	Nitra King 22-3-9 (0.8)	4.0
Application Dates --->		Nov 11 '96	Dec 10 '96	Jan '97	Feb 14 '97	Mar '97	
23	UCR 2	6-20-20 (1.0)	Coarse IBDU 31-0-0 (1.5)	--	Coarse IBDU 31-0-0 (1.5)	--	4.0
24	Check	N/A					

* Formulation reflects weight per volume.

Table 3. Calendar of events for the evaluation of 23 nitrogen fertilizer treatments applied on an overseeded common bermudagrass during the cool season.

Date	Activity
October 1, 1996	Plot treated with Diquat.
October 9, 1996	Plot scalped with a flail mower.
October 18, 1996	• Applied 2 lb P_2O_5/1000 ft^2 and 2 lb K_2O/1000 ft^2. • Plots overseeded with Academy perennial ryegrass at 16 lb seed/1000 ft^2.
November 11, 1996	Initial application of all fertility treatments.
November 13, 1996	Plots re-seeded with Charger perennial ryegrass at 18 lb seed/1000 ft^2.
November 25, 1996	Initial mowing.
November 27, 1996	Application #2: K-Power treatments (Treatments 7-8).
December 6, 1996	First visual color ratings. Ratings subsequently taken every two weeks until April 18, 1997.
December 9, 1996	Application #2: Trisert KS (Treatment 12).
December 10, 1996	Application #2: Treatments 1-6, 16-20, 22-23 (all scheduled monthly granular treatments).
December 13, 1996	• Application #2: N-Sure Lite (Treatment 11). • Application #3: K-Power treatments (Treatments 7-8).
December 23, 1996	Application #4: K-Power treatments (Treatments 7-8).
January 9, 1997	Application #5: K-Power treatments (Treatments 7-8).
January 21, 1997	Application #6: K-Power treatments (Treatments 7-8).
January 23, 1997	Application #3: Treatments 1-3, 6, 9-18, 21-22 (all scheduled monthly granular treatments).
January 24, 1997	Application #3: Trisert KS and N-Sure Lite (Treatments 11-12).
February 10, 1997	Application #7: K-Power treatments (Treatments 7-8).
February 14, 1997	Application #4: Treatments 3, 6, 13-18, 21, 23.
February 21, 1997	• Application #4: Treatments 1-2, 4-5, 19-20, 22. • Application #8: K-Power treatments (Treatments 7-8).
February 26, 1997	Application #4: Trisert KS and N-Sure Lite (Treatments 11-12).
March 7, 1997	Application #9: K-Power treatments (Treatments 7-8).
March 17, 1997	Application #5: Treatments 3, 13, 15, 17, 21.
March 19, 1997	Application #5: Trisert KS and N-Sure Lite (Treatments 11-12).
March 20, 1997	Application #5: Treatments 6, 14, 16, 18-20, 22.
March 21, 1997	Application #10: K-Power treatments (Treatments 7-8).
April 18, 1997	Study ends with final visual color rating.

Table 4. Percentage of nitrogen that is slow-release and fast-release for 23 nitrogen fertilizer treatments applied on an overseeded common bermudagrass during the cool season.

Product	Analysis (N-P_2O_5-K_2O)	Slow release		Quick release	
		% of total N (by row)	Source information (N analysis)	% of total N (by row)	Source information (N analysis)
Treatment 1: Endure/Polyon/Turf Gold (J.R. Simplot)					
Endure	15-15-15	68	coated slow release urea (10.2%)	32	ammoniacal (4.3%), water soluble organic (0.5%)
Polyon	43-0-0	100	coated slow release (43.0%)	0	--
Turf Gold	21-3-5	48	coated urea (10.0%)	52	ammoniacal (10%), water soluble organic (1.0%)
Of 4.0 lb N/1000 ft^2		**66**	17% Endure, 25% Polyon, 24% Turf Gold	**34**	8% Endure, 26% Turf Gold
Treatment 2: Pro Balance/Nitra King (J.R. Simplot)					
Triple Pro (ProBalance)	15-15-15	0	--	100	ammoniacal (13.5%), water soluble organic (1.5%)
Nitra King	22-3-9	0	--	100	ammoniacal (14.0%), nitrate (8.0%)
Of 4.0 lb N/1000 ft^2		**0**	--	**100**	50% Triple Pro, 50% Nitra King
Treatment 3: Re-Gain (J.R. Simplot)					
Re-Gain	6-2-6	45	water insoluble (2.7%)	55	ammoniacal (0.4%), water soluble organic (2.9%)
Re-Gain	16-3-7	73	coated slow release (10.7%), water insoluble (1.0%)	27	ammoniacal (3.2%), water soluble organic (1.1%)
Of 4.0 lb N/1000 ft^2		**66**	11% 6-2-6, 55% 16-3-7	**34**	14% 6-2-6, 20% 16-3-7
Treatment 4: ParEx 24 (IMC Vigoro)					
ParEx	10-22-22	40	water insoluble (unground) from IBDU (4.00%)	60	water soluble ammonaical (5.55%) water soluble urea (0.45%)
ParEx	24-4-12	45	water insoluble (unground) from IBDU (10.79%)	55	water soluble ammonaical (1.60%) water soluble urea (11.61%)
Of 4.0 lb N/1000 ft^2		**44**	10% 10-22-22, 34% 24-4-12	**56**	15% 10-22-22, 41% 24-4-12
Treatment 5: ParEx 28 (IMC Vigoro)					
ParEx	10-22-22	40	water insoluble (unground) from IBDU (4.00%)	60	water soluble ammonaical (5.55%) water soluble urea (0.45%)
ParEx	28-3-10	70	water insoluble (unground) from IBDU (1.98%) coated slow release urea (17.60%)	30	water soluble ammonaical (1.16%) water soluble urea (7.26%)
Of 4.0 lb N/1000 ft^2		**62.5**	10.0% 10-22-22, 52.5% 28-3-10	**37.5**	15.0% 10-22-22, 22.5% 28-3-10
Treatment 6: Turf Rally (Sea Source)					
Turf Rally	6-10-10	92	ureaform (3.0%) water insoluble (blood) (2.5%)	8	ammoniacal (blood) (0.5%)
Turf Rally	16-4-8	97.5	ureaform (10.6%) water insoluble (blood) (5.0%)	2.5	ammoniacal (blood) (0.4%)
Of 4.0 lb N/1000 ft^2		**97**	14% 6-10-10, 83% 16-4-8	**3**	1% 6-10-10, 2% 16-4-8

Table 4 *(continued)*. Percentage of nitrogen that is slow release and fast release for 23 nitrogen fertilizer treatments applied on an overseeded common bermudagrass during the cool season.

Product	Analysis (N-P_2O_5-K_2O)	Slow release		Quick release	
		% of total N (by row)	Source information (N analysis)	% of total N (by row)	Source information (N analysis)
Treatment 7: K-Power (0.4) (Vicksburg)					
K-Power miniprill	13.75-0-44.5	**0**	--	**100**	Nitrate (13.75%)
Treatment 8: K-Power (0.25) (Vicksburg) *NOTE:* Treatment only received 2.5 lb N/1000 ft^2 during the course of the study					
K-Power miniprill	13.75-0-44.5	**0**	--	**100**	Nitrate (13.75%)
Treatment 9: Multicote 40 (Vicksburg)					
Multicote	40-0-0	**100**	coated slow release (40.0%)	**0**	--
Treatment 10: Multicote 12 (Vicksburg)					
Multicote	12-0-43	**100**	coated slow release (12.0%)	**0**	--
Treatment 11: N-Sure Lite (Tessenderlo Kerley)					
6-20-20	6-20-20	0	--	100	ammoniacal (6.0%)
N-Sure Lite	30-0-0 (w/v)	50	Triazone compunds (13.8%), other N sources (1.2%)	50	urea (15.0%)
Of 4.0 lb N/1000 ft^2		**37.5**	37.5% N-Sure Lite	**62.5**	25% 6-20-20, 62.5% N-Sure Lite
Treatment 12: Trisert KS (Tessenderlo Kerley)					
6-20-20	6-20-20	0	--	100	ammoniacal (6.0%)
Trisert KS	15-0-12 (w/v)	60	Triazone compunds (8.4%), other N sources (0.6%)	40	urea (6.0%)
Of 4.0 lb N/1000 ft^2		**45**	45% Trisert KS	**55**	25% 6-20-20, 30% Trisert KS
Treatment 13: Bandini 28-4-6 (Bandini)					
28-4-6	28-4-6	**53**	TriKote Poly Sulfur Coated Urea (14.84%)	**47**	ammoniacal (7.31%), nitrate (5.85%)
Treatment 14: ProLong (Bandini)					
ProLong	21-4-6	**39**	slowly available soluble (4.8%), water insoluble (3.4%)	**61**	ammoniacal (11.6%), water soluble (1.2%)
Treatment 15: Bandini 22-4-22 (Bandini)					
22-4-22	22-4-22	**36**	slowly available soluble (2.45%), water insoluble (1.73%), TriKote Poly Sulfur Coated Urea (3.70%)	**64**	ammoniacal (1.54%), water soluble (12.58%)
Treatment 16: Turf Royale (Hydro Agri)					
Turf Royale	21-7-14	**0**	--	**100**	ammoniacal (11.1%), Nitrate (9.9%)
Treatment 17: Classic Royale (Hydro Agri)					
Classic Royale	15-15-15	**0**	--	**100**	ammoniacal (8.7%), Nitrate (6.3%)

Table 4 *(continued)*. Percentage of nitrogen that is slow release and fast release for 23 nitrogen fertilizer treatments applied on an overseeded common bermudagrass during the cool season.

Product	Analysis (N-P_2O_5-K_2O)	Slow release		Quick release	
		% of total N (by row)	Source information (N analysis)	% of total N (by row)	Source information (N analysis)
Treatment 18: HydroPrill (Hydro Agri)					
HydroPrill	16-15-15	**0**	--	**100**	ammoniacal (9.9%), Nitrate (6.1%)
Treatment 19: Turfgo 23 (United Horticultural Supply)					
Turfgo	23-5-10	**68**	polymer coated urea (15.58%)	**32**	ammoniacal (7.42%)
Treatment 20: Turfgo 16 (United Horticultural Supply)					
Turfgo	16-23-16	**44**	polymer coated urea (7.0%)	**56**	ammoniacal (9.0%)
Treatment 21: Scotts (Scotts)					
Pro Turf	16-25-12	47	coated urea (7.5% of 11.0% total urea)	53	ammoniacal (5%), coated urea (3.5% of 11.0% total Urea)
Scotts	30-3-9	30	Polymer-encapsulated sulfur-coated urea (9.0% of 29.4% total urea)	70	ammoniacal (0.6%), Polymer-encapsulated sulfur-coated urea (20.4% of 29.4% total urea)
Of 4.0 lb N/1000 ft^2		**34**	11% Pro Turf, 23% 30-3-9	**66**	13% Pro Turf, 53% 30-3-9
Treatment 22: UCR 1 (UCR)					
Nitra King	22-3-9	**0**	--	**100**	ammoniacal (14.0%), nitrate (8.0%)
Treatment 23 UCR 2(UCR)					
6-20-20	6-20-20	0	--	100	ammoniacal (6.0%)
Coarse IBDU	31-0-0	90	water insoluble (unground)	10	water soluble
Of 4.0 lb N/1000 ft^2		**67.5**	67.5% IBDU	**32.5**	25.0% 6-20-20, 7.5% IBDU
Treatment 24: Check					
Check	0-0-0	**0**	--	**0**	--

Table 5. Weather measurements collected[z] from October 20, 1996 to April 19, 1997 in Riverside, CA.

Date	Accumulative Weekly ET_o[y] (mm/week)	Accumulative Weekly Precipitation (mm/week)	Average Solar Radiation (W/m^2/day)	Average Daily Temperature (°C)	(°F)	Average Daily Relative Humidity (%)	Average Daily Soil Temperature at 10.2 cm Depth (°C)	(°F)
10/20/96 - 10/26	20.86	1.00	172	15	59	63	17	63
10/27 - 11/02	12.55	2.00	99	12	54	68	14	57
11/03 - 11/09	23.31	0.00	157	16	61	40	15	59
11/10 - 11/16	16.18	0.00	132	17	63	49	16	61
11/17 - 11/23	11.44	41.00	114	14	57	61	16	61
11/24 - 11/30	21.39	0.00	142	15	59	41	14	57
12/01 - 12/07	12.36	6.00	124	12	54	55	12	54
12/08 - 12/14	9.86	14.00	82	14	57	65	14	57
12/15 - 12/21	16.21	0.00	121	12	54	41	12	54
12/22 - 12/28	8.59	7.00	79	12	54	61	12	54
12/29 - 01/04/97	5.71	12.00	65	14	57	70	14	57
01/05 - 01/11	15.20	5.00	108	11	52	49	12	54
01/12 - 01/18	9.54	57.00	92	10	50	59	11	52
01/19 - 01/25	7.14	19.00	82	11	52	68	12	54
01/26 - 02/01	17.22	19.00	147	15	59	55	14	57
02/02 - 02/08	15.87	0.00	155	11	52	58	13	55
02/09 - 02/15	17.44	5.00	142	13	55	56	12	54
02/16 - 02/22	23.83	0.00	195	16	61	50	13	55
02/23 - 03/01	24.12	2.00	177	12	54	49	12	54
03/02 - 03/08	25.36	0.00	224	14	57	50	13	55
03/09 - 03/15	28.19	0.00	227	19	66	50	15	59
03/16 - 03/22	27.90	0.00	227	19	66	57	17	63
03/23 - 03/29	24.68	0.00	205	16	61	63	18	64
03/30 - 04/05	23.12	2.00	193	13	55	61	16	61
04/06 - 04/12	29.89	0.00	258	14	57	61	16	61
04/13 - 04/19	31.98	0.00	244	18	64	59	18	64

[z] Weather data collected from an on-site CIMIS weather station.
[y] ET_o = Reference evapotranspiration.

III. RESULTS AND DISCUSSION

Nitrogen fertilizer treatments significantly affected visual turfgrass color on all rating dates (Table 6, page 13). All nitrogen fertilizer treatments produced acceptable overseeded common bermudagrass visual color (≥ 5.0 rating) for each rating taken during the 5 months. There also were noteworthy differences among the nitrogen fertilizer treatments for number of rating dates the treatments rated ≤ 5.3, number of rating dates the treatments rated 5.4 to 6.7, inclusive, and number of rating dates the treatments rated ≥ 6.8 (Figure 1, page 14). These ratings were quantified and are summarized in Table 7 (page 15) and listed along with overall visual turfgrass color ratings, and other basic information about the treatments, including the percent of nitrogen originating from either slow- or quick-release sources.

The information in Table 7 (page 15) suggests that at an equal annual nitrogen rate, type of nitrogen source and number of applications influenced the performance of the nitrogen fertilizer treatments. Selected treatments, involving either a fast-release or a slower-release nitrogen source performed well in the study. Detailed information regarding each treatment's nitrogen sources can be found in Table 4, pages 8-10.

Table 6. Visual turfgrass color ratings[z] during the evaluation of 23 nitrogen fertilizer treatments applied on an overseeded common bermudagrass during the cool season.

Fertilizer treatments[y]	12/06/96	12/20/96	01/10/97	01/24/97	02/07/97	02/21/97	03/07/97	03/21/97	04/04/97	04/18/97	Overall
Multicote 12-0-43	5.9	5.9	6.5	6.7	7.2	7.6	7.4	7.4	7.3	7.8	7.0
Bandini 28-4-6	6.2	6.1	6.8	5.9	7.0	7.8	7.5	7.3	7.1	7.3	6.9
ProLong	6.1	6.3	6.4	6.1	7.2	7.9	7.5	7.1	7.1	7.2	6.9
Bandini 22-4-22	6.1	6.2	6.5	6.0	7.0	7.8	7.6	7.3	7.2	7.2	6.9
Turf Royale	6.2	6.3	6.3	6.0	7.3	7.9	7.5	6.9	6.9	7.1	6.9
K-Power (0.4)	6.4	6.4	6.5	6.8	6.8	7.3	7.5	7.0	6.7	6.9	6.8
ProBalance/NKing	6.1	6.6	6.5	6.1	7.1	6.8	7.7	6.8	6.5	6.7	6.7
Turfgo 23-5-10	6.0	6.1	6.6	6.3	6.3	6.5	7.5	7.1	7.1	7.3	6.7
Multicote 40-0-0	5.5	5.5	6.3	6.2	6.9	7.3	7.3	7.0	6.9	7.6	6.6
UCR 1	5.9	6.0	6.3	5.8	7.2	6.7	7.5	6.8	6.9	6.8	6.6
Scotts	6.5	5.3	5.3	5.1	6.8	7.9	7.5	7.4	7.0	7.2	6.6
Turf Rally	5.3	6.2	6.0	5.6	7.2	7.8	7.5	6.4	7.0	6.9	6.6
Classic Royale	5.7	5.9	6.3	5.8	7.0	7.7	7.3	6.8	6.6	6.6	6.6
Turfgo 16-23-16	6.0	5.9	6.5	6.0	5.9	5.9	7.3	7.0	7.3	7.0	6.5
Trisert KS	5.8	6.4	6.6	6.3	6.5	6.4	6.6	6.7	6.6	6.8	6.5
HyrdoPrill	5.7	6.0	6.3	6.0	7.2	7.6	6.9	6.3	6.3	6.3	6.5
Re-Gain	5.7	5.5	5.8	5.4	6.0	7.1	7.0	7.3	7.0	7.3	6.4
ParEx 24-4-12	5.6	6.1	6.6	6.2	5.9	5.9	7.1	6.9	6.6	6.8	6.4
N-Sure Lite	5.6	6.3	6.4	6.1	6.5	6.3	6.4	6.8	6.4	6.7	6.3
Endure/Polyon/TGold	6.1	6.2	6.1	6.0	7.3	7.3	6.5	6.1	5.8	6.0	6.3
ParEx 28-3-10	5.5	5.8	6.2	5.8	6.0	5.7	7.3	6.8	6.3	6.1	6.1
K-Power (0.25)	5.8	6.1	6.3	6.3	6.1	6.5	5.9	6.2	6.1	6.1	6.1
UCR 2	6.0	6.3	6.6	6.1	5.5	5.7	5.4	5.9	6.0	6.3	6.0
Check	5.0	4.8	4.6	4.8	4.7	5.0	3.8	5.0	4.7	4.3	4.7
LSD *P*=0.05	0.5	0.6	0.5	0.4	0.4	0.6	0.5	0.5	0.5	0.7	0.1

[z] Visual turfgrass color ratings taken on a scale of 1-9: 1=brown; 5=min. accept.; 9=darkest green overseeded common bermudagrass.
[y] See Table 2 for a complete description of N fertilizer treatments.

Figure 1. Evaluation of 23 nitrogen fertilizer treatments, 1996-1997. Treatments applied on an overseeded common bermudagrass during the cool season. Number of rating dates within three ranges of visual turfgrass color.

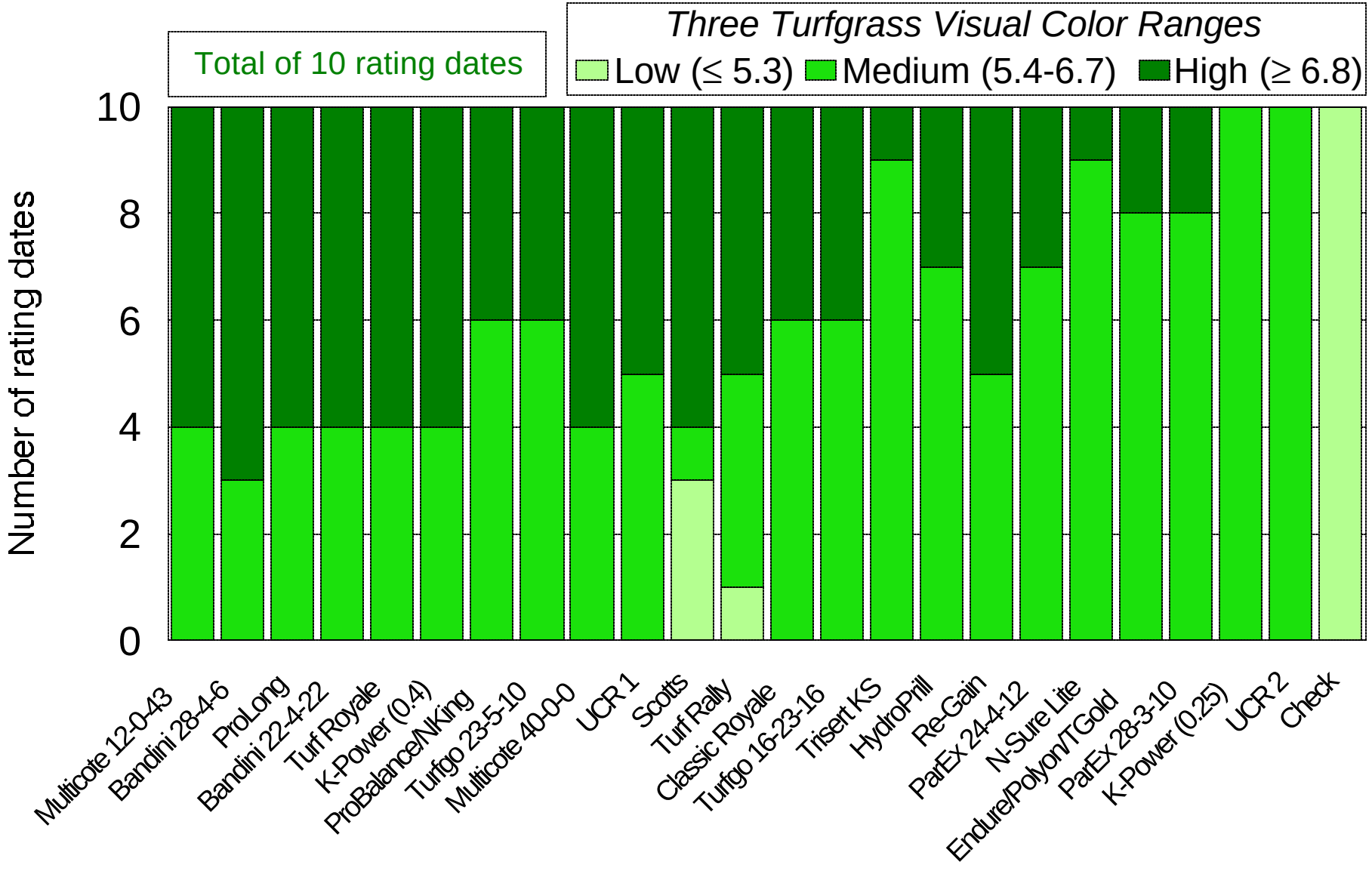

Table 7. Summary of the performance of 23 nitrogen fertilizer treatments applied on an overseeded common bermudagrass during the cool season.

Fertilizer treatment[z]	Visual color consistency score[y]	Overall visual color rating[x]	lb N / 1000 ft^2 per 5months	Number of Applications	% N Slow-Release[w]	%N Quick-Release[w]
Bandini 28-4-6	27	6.9	4.0	4	53	47
Multicote 12-0-43	26	7.0	4.0	2	100	0
ProLong	26	6.9	4.0	4	39	61
Bandini 22-4-22	26	6.9	4.0	4	36	64
Turf Royale	26	6.9	4.0	5	0	100
K-Power (0.4)	26	6.8	4.0	10	0	100
Multicote 40-0-0	26	6.6	4.0	2	100	0
UCR 1	25	6.6	4.0	5	0	100
Re-Gain	25	6.4	4.0	5	66	34
ProBalance/NKing	24	6.7	4.0	4	0	100
Turfgo 23-5-10	24	6.7	4.0	4	68	32
Turf Rally	24	6.6	4.0	5	97	3
Classic Royale	24	6.6	4.0	5	0	100
Turfgo 16-23-16	24	6.5	4.0	4	44	56
Scotts	23	6.6	4.0	4	34	66
HyrdoPrill	23	6.5	4.0	5	0	100
ParEx 24-4-12	23	6.4	4.0	3	44	56
Endure/Polyon/TGold	22	6.3	4.0	4	66	34
ParEx 28-3-10	22	6.1	4.0	3	62.5	37.5
Trisert KS	21	6.5	4.0	5	45	55
N-Sure Lite	21	6.3	4.0	5	37	63
K-Power (0.25)	20	6.1	2.5	10	0	100
UCR 2	20	6.0	4.0	3	67.5	32.5
Check	10	4.7	0.0	0	0	0

Note: LSD P=0.05 for overall quality ratings: 0.1.

[z] See Table 2 for complete description of fertilizer products and application rates for each treatment.

[y] Visual color consistency scores were based on the number of rating dates (10 total) the visual color ratings were in one of three categories: 3 points for high (≥ 6.8), 2 points for medium (5.4-6.7) and 1 point for low (≤ 5.3) ratings.

[x] Overall visual color ratings were averaged over the 10 rating dates during the course of the study. Ratings were taken on a 1-9 scale: 1=brown, 5=minimally acceptable, and 9=darkest green overseeded common bermudagrass.

[w] See Table 4 for a complete description.