

# **Grain Processing Corporation 2006 Qualitative Evaluation – P15 Soil Amendment Study**

## ***Final Report***

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Table 1. Materials and methods outline for the Grain Processing Corporation 2006 Qualitative Evaluation – P15 Soil Amendment Study.

**Objectives:** To demonstrate the effect of P15 soil amendment on tall fescue irrigated at 85% reference evapotranspiration ( $ET_o$ ) during the summer and fall seasons.

**Cultivar:** Crossfire 2 tall fescue (*Festuca arundinacea*).

**Experimental site:** A plot established in March 2002 at the UCR Turfgrass Field Research Facility, Riverside, Calif. The root zone is a native soil which is classified as a Hanford fine sandy loam. Based on an irrigation catch-can test conducted 24 Feb. 2006, irrigation distribution uniformity = 79%. As of 14 Sept. 2005 the soil pH = 7.3; Olsen-P = 6.3 ppm (low); exchangeable K = 98 ppm (sufficient); cation exchange capacity (CEC) = 14.8 meq/100g (sufficient); and organic matter (OM) = 1.23% (low). Based on soil tests from 1996 to 2003, on average, sand = 52%; silt = 36%; and clay = 12% (see below for detailed information regarding analytical methods).

DANR Analytical Lab. soil analysis methods: pH = saturated paste, pH meter; Olsen-P = alkaline extraction by 0.5 Normal  $NaHCO_3$  for soils with pH > 6.5 by ascorbic acid reduction of phosphomolybdate complex and measured by spectrophotometry; exchangeable K = equilibrium extraction using 1 Normal ammonium acetate (pH 7.0), subsequent determination by atomic absorption/emission spectrophotometry; CEC = barium acetate saturation and calcium replacement; OM = potassium dichromate reduction of organic carbon and subsequent spectrophotometric measurement; particle size analysis of sand, silt and clay determined by soil suspension by hydrometer.

**Prior fertilization.** The plot has been fertilized at an annual N rate of approximately 4.5 lb/1000 ft<sup>2</sup> which would be considered well fertilized. This fertilization regime has involved applications of a N-only fertilizer in February, a complete fertilizer in early April, N-only fertilizer once every 6 to 7 weeks from May through October, and a complete fertilizer during the first part of November (listing of applications are in chronological order).

**Experimental design:** Randomized complete block design with four replications. Overall ANOVA was a repeated measures design with date as the repeated measures factor. Plots assigned to replications based on the amount of water collected from each plot as part of an irrigation catch-can test (resulting in high, medium-high, medium-low and low volume replications). Plot size was 7.0 x 10.0 ft. (Fig. 1).

**Mowing:** The plot was mowed once per week with a 21-inch walk-behind rotary mower. The mowing height was set at 2.0 inches. Clippings were collected.

**Irrigation:** Irrigation was based on the previous 7-day cumulative real-time  $ET_o$  as reported by the California Irrigation Management Information Service (CIMIS). The irrigation regimes used during the course of this study are listed below.

Phase	Dates	$ET_o$	Frequency
Study initiation	3 Mar. to 30 Apr. 2006	100%	Four times per week
Period I	2 May to 2 Aug. 2006	85%	Three times per week
Interim	3 Aug. to 28 Aug. 2006	130%	Four times per week
Period II	29 Aug. to 13 Dec. 2006	85%	Three times per week

**Fertilization:** Scotts Turf Builder Lawn fertilizer with 2% Iron (29-3-4) applied uniformly over the plot with a drop-type spreader at an N rate of 1.00 lb/1000 ft<sup>2</sup> on 17 Mar. 2006 and at an N rate of 0.75 lb/1000 ft<sup>2</sup> on 10 May, 10 July, 13 Sept., and 6 Nov. 2006 for an annual N rate of 4.0 lb/1000 ft<sup>2</sup>.

**Treatments:** P15 applied at 30 and 15 lb/1000 ft<sup>2</sup> and a no product check (control). P15 applied as topdressing and thoroughly watered in. Application dates were 8 Mar., 30 Mar., and 30 Aug. 2006.

**Measurements:** During Periods I and II of deficit irrigation (85%  $ET_o$ ), visual ratings of turfgrass quality, turfgrass color, percent leaf rolling and/or wilting, and percent leaf firing (brown leaves) were taken once every 2 weeks; gravimetric soil water content and clipping yields were taken once every month.

## **Results**

### ***Visual turfgrass quality and color***

Visual turfgrass quality and color ratings are shown in Tables 2 and 3, respectively. There were no significant differences between the treatments on any individual rating date or in terms of overall visual turfgrass quality and color. All treatments, including the control, resulted in minimally acceptable to satisfactory visual turfgrass quality and color, with the exception of visual turfgrass quality ratings on 5 July 2006, which, on average, were below the minimally acceptable threshold of 5.0. During Period I, visual turfgrass quality and color ratings progressively became worse, especially during July and August.

### ***Visual ratings of percent leaf rolling and/or wilting and percent leaf firing***

Visual ratings of percent leaf rolling and/or wilting and percent leaf firing (brown leaves) are shown in Tables 4 and 5, respectively. There were no significant differences between the treatments on any individual rating date, with the exception of 10 May 2006. On that date, the control had significantly greater percent leaves rolled and/or wilted than the P15 treatments; the results were the same for percent leaf firing. There were no significant differences between the treatments in terms of overall percent rolling and/or wilting or percent firing. Generally, the values for percent rolling and/or wilting and percent leaf firing were greatest during the summer months in Period I, especially in July, and were low or not visible during the fall months of Period II.

### ***Gravimetric soil water content***

Gravimetric soil water content data are shown in Tables 6 and 7. In Period I, gravimetric soil water content was measured at the 0- to 3-inch and 3- to 6-inch depths, while in Period II, it was measured at the 0- to 1-inch and 1- to 2-inch depths. There were no significant differences between the treatments on any measurement date or for overall gravimetric soil water content throughout the course of the study. Overall gravimetric soil water content ranged from 16% to 17% at the 0- to 3-inch depth and from 13% to 18% at the 3- to 6-inch depth during Period I. During Period II, overall gravimetric soil water content ranged from 24% to 25% at the 0- to 1-inch depth and from 16% to 17% at the 1- to 2-inch depth.

### ***Clipping yield***

Average daily clipping yield data are shown in Table 8. There were no significant differences between the treatments on any measurement date or in terms of overall average daily clipping yield, with the exception of the clipping yield measurement from 28 June 2006, when P15 at 15 lb/1000 ft<sup>2</sup> had significantly more clipping yield than the untreated control. It should be noted that there was a biological trend that the P15 treatments had more clipping yield than the control on all measurement dates, except on 1 Nov.



Table 1. Calendar of major activities.

Date	Activity
24 Feb. 2006	Irrigation catch-can test (used to assign plots to each of four replications).
3 Mar. 2006	Irrigation regime set to 100% previous 7-day cumulative real-time ET <sub>o</sub> .
8 Mar. 2006	P15 soil amendment application.
16 Mar. 2006	Mowing regime set to once per week at 2-inch mowing height; clippings collected.
17 Mar. 2006	Fertilizer application (at N rate of 1.00 lb/1000 ft <sup>2</sup> ).
30 Mar. 2006	P15 soil amendment application.
<i>Period I</i>	
2 May 2006	Irrigation regime set to 85% previous 7-day cumulative real-time ET <sub>o</sub> .
10 May 2006	Fertilizer application (at N rate of 0.75 lb/1000 ft <sup>2</sup> ). Initial visual ratings for Period I (ratings subsequently taken every 2 weeks).
24 May 2006	Clipping yield.
31 May 2006	Gravimetric soil water content (0- to 3- and 3- to 6-inch depths).
26 June 2006	Gravimetric soil water content (0- to 3- and 3- to 6-inch depths).
28 June 2006	Clipping yield.
10 July 2006	Fertilizer application (at N rate of 0.75 lb/1000 ft <sup>2</sup> ).
26 July 2006	Clipping yield.
2 Aug. 2006	Gravimetric soil water content (0- to 3- and 3- to 6-inch depths). Final visual ratings for Period I.
3 Aug 2006	Irrigation regime set to 130% previous 7-day cumulative real-time ET <sub>o</sub> .
<i>Period II</i>	
29 Aug. 2006	Irrigation regime set to 85% previous 7-day cumulative real-time ET <sub>o</sub> .
30 Aug. 2006	P15 soil amendment application.
6 Sept. 2006	Initial visual ratings for Period II (ratings subsequently taken every 2 weeks).
13 Sept. 2006	Fertilizer application (at N rate of 0.75 lb/1000 ft <sup>2</sup> ).
2 Oct. 2006	Gravimetric soil water content (0- to 1- and 1- to 2-inch depths).
4 Oct. 2006	Clipping yield.
30 Oct. 2006	Gravimetric soil water content (0- to 1- and 1- to 2-inch depths).
1 Nov. 2006	Clipping yield.
6 Nov. 2006	Fertilizer application (at N rate of 0.75 lb/1000 ft <sup>2</sup> ).
13 Dec. 2006	Gravimetric soil water content (0- to 1- and 1- to 2-inch depths). Clipping yield. Final visual ratings for Period II.

Table 2. The effect of P15 soil amendment on visual turfgrass quality ratings of tall fescue under deficit irrigation (85% ET<sub>o</sub>) from 2 May to 2 Aug. 2006 and from 29 Aug. to 13 Dec. 2006 (1 to 9 scale, with 1=worst, 5=minimally acceptable, and 9=best tall fescue).

Rate of P15 application <sup>y</sup>	Period I: 2 May to 2 Aug. 2006							Period II: 29 Aug. to 13 Dec. 2006							Overall	Grand overall
	Date (days after initiation of deficit irrigation <sup>z</sup> )							Date (days after initiation of deficit irrigation <sup>z</sup> )								
	10 May 2006 (8)	7 June 2006 (36)	19 June 2006 (48)	5 July 2006 (64)	19 July 2006 (78)	2 Aug. 2006 (92)	Overall	6 Sept. 2006 (9)	20 Sept. 2006 (23)	4 Oct. 2006 (37)	18 Oct. 2006 (51)	1 Nov. 2006 (65)	15 Nov. 2006 (79)	13 Dec. 2006 (107)		
30 lb/1000 ft <sup>2</sup>	5.9	5.9	5.6	5.1	5.1	5.1	5.5	5.4	5.4	5.7	5.8	5.6	5.6	5.3	5.5	5.5
15 lb/1000 ft <sup>2</sup>	5.8	6.3	5.9	4.8	5.0	5.2	5.5	5.6	5.4	5.6	5.6	5.4	5.6	5.3	5.5	5.5
Control	5.4	6.0	5.6	4.9	5.0	5.2	5.4	5.3	5.4	5.8	5.6	5.4	5.7	5.1	5.5	5.4
LSD, <i>P</i> =0.05 <sup>x</sup>	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Mean	5.7	6.0	5.7	4.9	5.0	5.1	5.4	5.4	5.4	5.7	5.7	5.5	5.6	5.5	5.2	5.5
C.V. (%)	6	5	5	6	2	2	4	3	7	3	4	6	9	3	3	5
Randomized complete block design effects <sup>w</sup> ( <i>P</i> )																
Treatment (T)	0.1986	0.3024	0.1012	0.4082	0.4941	0.4941	0.3713	0.1465	0.8301	0.7901	0.4444	0.8264	0.9149	0.1736	0.8915	0.2659
Date (D)							<0.0001								0.0055	<0.0001
T x D							0.0679								0.7298	0.5439

<sup>z</sup> Deficit irrigation (85% ET<sub>o</sub>) initiated on 2 May 2006 for Period I and 29 Aug. 2006 for Period II. Irrigation applied in three irrigation events/week based on the previous 7-day cumulative real-time California Irrigation Management Information System (CIMIS) reference evapotranspiration (ET<sub>o</sub>).

<sup>y</sup> P15 applied as a topdressing and watered in on 8 Mar., 30 Mar. 2006, and 30 Aug. 2006. Nitrogen fertilizer applications of Scotts Turf Builder Lawn fertilizer with 2% Iron (29-3-4) were made on 17 Mar. 2006 (prior to initiation of deficit irrigation), 10 May and 10 July 2006 (Period I), and 13 Sept. and 6 Nov. 2006 (Period II). The rate of nitrogen applied was 1.0 lb/1000 ft<sup>2</sup> for 17 Mar. 2006 and 0.75 lb/1000 ft<sup>2</sup> for all subsequent applications.

<sup>x</sup> Mean separation within columns by Fisher's protected LSD test, *P*=0.05.

<sup>w</sup> Analysis of variance of individual dates by randomized complete block design and analysis of variance of overall effects based on repeated measures of the randomized complete block with date as the repeated measures factor.

Table 3. The effect of P15 soil amendment on visual turfgrass color ratings of tall fescue under deficit irrigation (85% ET<sub>o</sub>) from 2 May to 2 Aug. 2006 and from 29 Aug. to 13 Dec. 2006 (1 to 9 scale, with 1=brown, 5=minimally acceptable, and 9=darkest green tall fescue).

Rate of P15 application <sup>y</sup>	Period I: 2 May to 2 Aug. 2006							Period II: 29 Aug. to 13 Dec. 2006							Overall	Grand overall
	Date (days after initiation of deficit irrigation <sup>z</sup> )							Date (days after initiation of deficit irrigation <sup>z</sup> )								
	10 May 2006 (8)	7 June 2006 (36)	19 June 2006 (48)	5 July 2006 (64)	19 July 2006 (78)	2 Aug. 2006 (92)	Overall	6 Sept. 2006 (9)	20 Sept. 2006 (23)	4 Oct. 2006 (37)	18 Oct. 2006 (51)	1 Nov. 2006 (65)	15 Nov. 2006 (79)	13 Dec. 2006 (107)		
30 lb/1000 ft <sup>2</sup>	6.2	6.1	5.9	5.3	5.3	5.3	5.8	5.7	5.8	5.8	6.1	5.8	5.8	5.6	5.8	5.8
15 lb/1000 ft <sup>2</sup>	6.1	6.5	6.2	5.0	5.2	5.3	5.7	5.7	5.7	5.9	5.8	5.6	5.9	5.5	5.7	5.7
Control	5.6	6.3	5.7	5.1	5.2	5.3	5.5	5.5	5.7	6.0	5.8	5.7	5.9	5.3	5.7	5.6
LSD, <i>P</i> =0.05 <sup>x</sup>	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Mean	6.0	6.3	5.9	5.2	5.2	5.3	5.7	5.6	5.7	5.9	5.9	5.7	5.9	5.5	5.7	5.7
C.V. (%)	6	5	6	5	2	0	4	4	7	3	4	5	8	2	3	5
Randomized complete block design effects <sup>w</sup> ( <i>P</i> )																
Treatment (T)	0.1305	0.3024	0.1549	0.4082	0.1083	.	0.2645	0.5782	0.8858	0.5378	0.4444	0.9273	0.9149	0.1736	0.9705	0.2511
Date (D)							<0.0001								0.0021	<0.0001
T x D							0.0792								0.6908	0.5823

<sup>z</sup> Deficit irrigation (85% ET<sub>o</sub>) initiated on 2 May 2006 for Period I and 29 Aug. 2006 for Period II. Irrigation applied in three irrigation events/week based on the previous 7-day cumulative real-time California Irrigation Management Information System (CIMIS) reference evapotranspiration (ET<sub>o</sub>).

<sup>y</sup> P15 applied as a topdressing and watered in on 8 Mar., 30 Mar. 2006, and 30 Aug. 2006. Nitrogen fertilizer applications of Scotts Turf Builder Lawn fertilizer with 2% Iron (29-3-4) were made on 17 Mar. 2006 (prior to initiation of deficit irrigation), 10 May and 10 July 2006 (Period I), and 13 Sept. and 6 Nov. 2006 (Period II). The rate of nitrogen applied was 1.0 lb/1000 ft<sup>2</sup> for 17 Mar. 2006 and 0.75 lb/1000 ft<sup>2</sup> for all subsequent applications.

<sup>x</sup> Mean separation within columns by Fisher's protected LSD test, *P*=0.05.

<sup>w</sup> Analysis of variance of individual dates by randomized complete block design and analysis of variance of overall effects based on repeated measures of the randomized complete block with date as the repeated measures factor.

Table 4. The effect of P15 soil amendment on percent leaves rolled and/or wilted of tall fescue under deficit irrigation (85% ET<sub>o</sub>) from 2 May to 2 Aug. 2006 and from 29 Aug. to 13 Dec. 2006.

Rate of P15 application <sup>y</sup>	Period I: 2 May to 2 Aug. 2006							Period II: 29 Aug. to 13 Dec. 2006							Overall	Grand overall
	Date (days after initiation of deficit irrigation <sup>z</sup> )							Date (days after initiation of deficit irrigation <sup>z</sup> )								
	10 May 2006 (8)	7 June 2006 (36)	19 June 2006 (48)	5 July 2006 (64)	19 July 2006 (78)	2 Aug. 2006 (92)	Overall	6 Sept. 2006 (9)	20 Sept. 2006 (23)	4 Oct. 2006 (37)	18 Oct. 2006 (51)	1 Nov. 2006 (65)	15 Nov. 2006 (79)	13 Dec. 2006 (107)		
30 lb/1000 ft <sup>2</sup>	3	2	18	32	13	5	11	3	2	0	0	0	0	0	1	6
15 lb/1000 ft <sup>2</sup>	1	0	12	32	23	12	13	6	8	1	0	0	0	0	2	6
Control	8	1	19	30	18	12	14	8	5	1	0	0	0	0	2	8
LSD, <i>P</i> =0.05 <sup>x</sup>	4	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Mean	4	1	17	31	18	9	13	5	6	1	0	0	0	2	7	
C.V. (%)	44	123	60	43	21	56	51	97	65	82	.	.	.	.	134	71
Randomized complete block design effects <sup>w</sup> ( <i>P</i> )																
Treatment (T)	0.0111	0.1768	0.6660	0.9846	0.1056	0.3124	0.5149	0.5495	0.4846	0.2500	.	.	.	.	0.5102	0.6533
Date (D)							<0.0001								<0.0001	<0.0001
T x D							0.4630								0.6889	0.6933

<sup>z</sup> Deficit irrigation (85% ET<sub>o</sub>) initiated on 2 May 2006 for Period I and 29 Aug. 2006 for Period II. Irrigation applied in three irrigation events/week based on the previous 7-day cumulative real-time California Irrigation Management Information System (CIMIS) reference evapotranspiration (ET<sub>o</sub>).

<sup>y</sup> P15 applied as a topdressing and watered in on 8 Mar., 30 Mar. 2006, and 30 Aug. 2006. Nitrogen fertilizer applications of Scotts Turf Builder Lawn fertilizer with 2% Iron (29-3-4) were made on 17 Mar. 2006 (prior to initiation of deficit irrigation), 10 May and 10 July 2006 (Period I), and 13 Sept. and 6 Nov. 2006 (Period II). The rate of nitrogen applied was 1.0 lb/1000 ft<sup>2</sup> for 17 Mar. 2006 and 0.75 lb/1000 ft<sup>2</sup> for all subsequent applications.

<sup>x</sup> Mean separation within columns by Fisher's protected LSD test, *P*=0.05.

<sup>w</sup> Analysis of variance of individual dates by randomized complete block design and analysis of variance of overall effects based on repeated measures of the randomized complete block with date as the repeated measures factor.



Table 5. The effect of P15 soil amendment on percent leaf firing (brown leaves) of tall fescue under deficit irrigation (85% ET<sub>o</sub>) from 2 May to 2 Aug. 2006 and from 29 Aug. to 13 Dec. 2006.

Rate of P15 application <sup>y</sup>	Period I: 2 May to 2 Aug. 2006							Period II: 29 Aug. to 13 Dec. 2006							Overall	Grand overall
	Date (days after initiation of deficit irrigation <sup>z</sup> )							Date (days after initiation of deficit irrigation <sup>z</sup> )								
	10 May 2006 (8)	7 June 2006 (36)	19 June 2006 (48)	5 July 2006 (64)	19 July 2006 (78)	2 Aug. 2006 (92)	Overall	6 Sept. 2006 (9)	20 Sept. 2006 (23)	4 Oct. 2006 (37)	18 Oct. 2006 (51)	1 Nov. 2006 (65)	15 Nov. 2006 (79)	13 Dec. 2006 (107)		
30 lb/1000 ft <sup>2</sup>	1	5	12	30	10	3	9	1	1	0	0	0	0	0	0.3	5
15 lb/1000 ft <sup>2</sup>	0 <sup>w</sup>	0	9	50	15	3	13	3	3	2	0	0	0	0	1.1	6
Control	2	3	11	44	13	5	13	3	2	1	0	0	0	0	0.9	7
LSD, <i>P</i> =0.05 <sup>x</sup>	2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Mean	1	3	11	42	13	4	12	2	2	1	0	0	0	0	1	6
C.V. (%)	60	114	53	61	35	37	85	68	91	91	.	.	.	.	116	121
Randomized complete block design effects <sup>v</sup> ( <i>P</i> )																
Treatment (T)	0.0312	0.2599	0.8106	0.6333	0.4749	0.9305	0.6588	0.4878	0.7546	0.3906	.	.	.	.	0.5724	0.7464
Date (D)							<0.0001								<0.0001	<0.0001
T x D							0.7435								0.8772	0.9307

<sup>z</sup> Deficit irrigation (85% ET<sub>o</sub>) initiated on 2 May 2006 for Period I and 29 Aug. 2006 for Period II. Irrigation applied in three irrigation events/week based on the previous 7-day cumulative real-time California Irrigation Management Information System (CIMIS) reference evapotranspiration (ET<sub>o</sub>).

<sup>y</sup> P15 applied as a topdressing and watered in on 8 Mar., 30 Mar. 2006, and 30 Aug. 2006. Nitrogen fertilizer applications of Scotts Turf Builder Lawn fertilizer with 2% Iron (29-3-4) were made on 17 Mar. 2006 (prior to initiation of deficit irrigation), 10 May and 10 July 2006 (Period I), and 13 Sept. and 6 Nov. 2006 (Period II). The rate of nitrogen applied was 1.0 lb/1000 ft<sup>2</sup> for 17 Mar. 2006 and 0.75 lb/1000 ft<sup>2</sup> for all subsequent applications.

<sup>x</sup> Mean separation within columns by Fisher's protected LSD test, *P*=0.05.

<sup>w</sup> Actual value greater than 0 but less than 0.05.

<sup>v</sup> Analysis of variance of individual dates by randomized complete block design and analysis of variance of overall effects based on repeated measures of the randomized complete block with date as the repeated measures factor.

Table 6. The effect of P15 soil amendment on gravimetric soil water content at the 0 to 3 and 3 to 6 inch depths of tall fescue under deficit irrigation (85% ET<sub>o</sub>) from 2 May to 2 Aug. 2006 (Period I).

Rate of P15 application <sup>y</sup>	0-3 inch depth				3-6 inch depth			
	Date (days after initiation of deficit irrigation <sup>z</sup> )			Overall	Date (days after initiation of deficit irrigation <sup>z</sup> )			Overall
	31 May 2006 (29)	26 June 2006 (55)	2 Aug. 2006 (92)		31 May 2006 (29)	26 June 2006 (55)	2 Aug. 2006 (92)	
	-----%soil water content-----							
30 lb/1000 ft <sup>2</sup>	17	18	17	17	13	13	14	13
15 lb/1000 ft <sup>2</sup>	18	13	17	16	21	17	14	18
Control	18	16	17	17	13	11	14	13
LSD, <i>P</i> =0.05 <sup>x</sup>	NS	NS	NS	NS	NS	NS	NS	NS
Mean	17	16	17	17	15	14	14	14
C.V. (%)	6	18	2	9	45	34	5	42
Randomized complete block design effects <sup>w</sup> ( <i>P</i> )								
Treatment (T)	0.2259	0.2229	0.1123	0.3609	0.3681	0.4005	0.7315	0.0852
Date (D)				0.0774				0.4131
T x D				0.1012				0.8663

<sup>z</sup> Deficit irrigation (85% ET<sub>o</sub>) initiated on 2 May 2006 for Period I and 29 Aug. 2006 for Period II. Irrigation applied in three irrigation events/week based on the previous 7-day cumulative real-time California Irrigation Management Information System (CIMIS) reference evapotranspiration (ET<sub>o</sub>).

<sup>y</sup> P15 applied as a topdressing and watered in on 8 Mar., 30 Mar., and 30 Aug. 2006. Nitrogen fertilizer applications of Scotts Turf Builder Lawn fertilizer with 2% Iron (29-3-4) were made on 17 Mar. 2006 (prior to initiation of deficit irrigation), 10 May and 10 July 2006 (Period I), and 13 Sept. and 6 Nov. 2006 (Period II). The rate of nitrogen applied was 1.0 lb/1000 ft<sup>2</sup> for 17 Mar. 2006 and 0.75 lb/1000 ft<sup>2</sup> for all subsequent applications.

<sup>x</sup> Mean separation within columns by Fisher's protected LSD test, *P*=0.05.

<sup>w</sup> Analysis of variance of individual dates by randomized complete block design and analysis of variance of overall effects based on repeated measures of the randomized complete block with date as the repeated measures factor.

Table 7. The effect of P15 soil amendment on gravimetric soil water content at the 0 to 3 and 3 to 6 inch depths of tall fescue under deficit irrigation (85% ET<sub>o</sub>) from 29 Aug. to 13 Dec. (Period II).

Rate of P15 application <sup>y</sup>	0-1 inch depth				1-2 inch depth			
	Date (days after initiation of deficit irrigation <sup>z</sup> )			Overall	Date (days after initiation of deficit irrigation <sup>z</sup> )			Overall
	2 Oct. 2006 (34)	30 Oct. 2006 (62)	13 Dec. 2006 (107)		2 Oct. 2006 (34)	30 Oct. 2006 (62)	13 Dec. 2006 (107)	
	-----%soil water content-----							
30 lb/1000 ft <sup>2</sup>	25	24	24	24	16	16	16	16
15 lb/1000 ft <sup>2</sup>	26	24	26	25	16	16	18	17
Control	25	22	27	25	16	15	17	16
LSD, <i>P</i> =0.05 <sup>x</sup>	NS	NS	NS	NS	NS	NS	NS	NS
Mean	26	23	26	25	16	16	17	16
C.V. (%)	15	21	21	5	12	19	16	8
Randomized complete block design effects <sup>w</sup> ( <i>P</i> )								
Treatment (T)	0.5437	0.7469	0.7125	0.7514	0.8395	0.8888	0.4800	0.6705
Date (D)				0.0309				0.2602
T x D				0.0964				0.6474

<sup>z</sup> Deficit irrigation (85% ET<sub>o</sub>) initiated on 2 May 2006 for Period I and 29 Aug. 2006 for Period II. Irrigation applied in three irrigation events/week based on the previous 7-day cumulative real-time California Irrigation Management Information System (CIMIS) reference evapotranspiration (ET<sub>o</sub>).

<sup>y</sup> P15 applied as a topdressing and watered in on 8 Mar., 30 Mar., and 30 Aug. 2006. Nitrogen fertilizer applications of Scotts Turf Builder Lawn fertilizer with 2% Iron (29-3-4) were made on 17 Mar. 2006 (prior to initiation of deficit irrigation), 10 May and 10 July 2006 (Period I), and 13 Sept. and 6 Nov. 2006 (Period II). The rate of nitrogen applied was 1.0 lb/1000 ft<sup>2</sup> for 17 Mar. 2006 and 0.75 lb/1000 ft<sup>2</sup> for all subsequent applications.

<sup>x</sup> Mean separation within columns by Fisher's protected LSD test, *P*=0.05.

<sup>w</sup> Analysis of variance of individual dates by randomized complete block design and analysis of variance of overall effects based on repeated measures of the randomized complete block with date as the repeated measures factor.

Table 8. The effect of P15 soil amendment on clipping yield of tall fescue under deficit irrigation (85% ET<sub>o</sub>) from 2 May to 2 Aug. 2006 and from 29 Aug. to 13 Dec. 2006.

Rate of P15 application <sup>y</sup>	Period I: 2 May to 2 Aug. 2006				Period II: 29 Aug. to 13 Dec. 2006				Grand average	
	Date (days after initiation of deficit irrigation <sup>z</sup> )				Date (days after initiation of deficit irrigation <sup>z</sup> )					
	24 May 2006 (22)	28 June 2006 (57)	26 July 2006 (85)	Average <sup>x</sup>	4 Oct. 2006 (36)	1 Nov. 2006 (64)	13 Dec. 2006 (107)	Average		
	-----g·m <sup>-2</sup> per d-----									
30 lb/1000 ft <sup>2</sup>	1.67	1.27	2.04	1.75	1.15	0.52	0.20	0.62	1.19	
15 lb/1000 ft <sup>2</sup>	1.78	1.54	2.27	1.86	1.10	0.43	0.17	0.57	1.22	
Control	1.20	1.04	1.96	1.47	0.93	0.48	0.13	0.51	1.05	
LSD, P=0.05 <sup>w</sup>	NS	0.30	NS	NS	NS	NS	NS	NS	NS	
Mean	1.53	1.26	2.09	1.69	1.06	0.47	0.17	0.57	1.16	
C.V. (%)	28	11	8	7	25	11	30	19	9	
Randomized complete block design effects (P)										
Treatment	0.3453	0.0409	0.2886	0.1353	0.5652	0.1976	0.3741	0.5465	0.2792	

<sup>z</sup> Deficit irrigation (85% ET<sub>o</sub>) initiated on 2 May 2006 for Period I and 29 Aug. 2006 for Period II. Irrigation applied in three irrigation events/week based on the previous 7-day cumulative real-time California Irrigation Management Information System (CIMIS) reference evapotranspiration (ET<sub>o</sub>).

<sup>y</sup> P15 applied as a topdressing and watered in on 8 Mar., 30 Mar. 2006, and 30 Aug. 2006. Nitrogen fertilizer applications of Scotts Turf Builder Lawn fertilizer with 2% Iron (29-3-4) were made on 17 Mar. 2006 (prior to initiation of deficit irrigation), 10 May and 10 July 2006 (Period I), and 13 Sept. and 6 Nov. 2006 (Period II). The rate of nitrogen applied was 1.0 lb/1000 ft<sup>2</sup> for 17 Mar. 2006 and 0.75 lb/1000 ft<sup>2</sup> for all subsequent applications.

<sup>x</sup> Due to missing data, average yield for each period may not equal the average of monthly yields. Any plot which has missing data in any month has been eliminated from the average yield calculations for that period.

<sup>w</sup> Mean separation within columns by Fisher's protected LSD test, P=0.05.

Table 9. Monthly 2006 ET<sub>o</sub> and precipitation and normal precipitation in Riverside, Calif.

Month	ET <sub>o</sub> <sup>a</sup> (inches) in 2006	Precipitation <sup>z</sup> in 2006 (inches)	Normal precipitation (inches)
January	2.92	0.26	2.47
February	3.35	1.64	2.39
March	3.42	1.65	2.19
April	4.26	1.47	0.60
May	6.02	0.35	0.25
June	7.16	0.00	0.10
July	7.74	0.04	0.03
August	7.20	0.00	0.17
September	5.70	0.00	0.26
October	3.95	0.01	0.26
November	3.14	0.03	0.78
December	2.94	0.46	1.17
Total	57.80	5.91	10.67

<sup>z</sup> Data collected by an on-site California Irrigation Management Information Service (CIMIS) station.