UCRTRAC Accumulative Research Summary
Section E: Production of Quality Putting Greens
Project 6

Title: Defining Optimal and Deficient Annual Nitrogen Fertility Rates for Poa annua-Creeping bentgrass Putting Greens in California.

Objective: To evaluate annual N fertility rates ranging from 5.5 to 1.5 lb/1000 ft^2 for 2 years on a *Poa annua*-creeping bentgrass putting green nursery. Irrigation with recycled water supplies an annual N fertility rate of approximately 0.5 lb/1000 ft^2. During the study, levels of P, K, and Fe are being maintained at commonly-practiced levels.

- In a relatively recent GCSAA/CGCSA Chapter Cooperative Research Program study, Green et al. (2001; see UCRTRAC Accumulative Research Summary, Section E, Project 4) tested annual N fertility rates of 6.0 and 11.0 lb/1000 ft^2 on an in-use *Poa annua* putting green in southern California and reported that the lower rate was close to optimal in terms of: visual turfgrass quality and color ratings; coverage of seedheads, mottling and patchiness, disease activity, leaf wilting and rolling, and scalping; root and crown mass; and concentration of total N in clipping tissue. The lower N rate ranged from 4.24% to 5.81% total N in clipping tissue which is basically within the published target range of 4.5% to 6.0% for creeping bentgrass.

- Since there is a trend for golf course superintendents to apply less N on *Poa annua*-creeping bentgrass putting greens, it would be useful to evaluate the lower range of annual N fertility rates. These data could be combined with other data concerning optimal annual N fertility rates, so that golf course superintendents in southern California could be offered a range of optimal, sufficient, and deficient rates. This information could serve as a general guide, keeping in mind that N rates may need to be adjusted depending on such factors as: amount of play; soil type; salinity and leaching requirements; amount of rainfall; irrigation with recycled water; N application schedule, rates, and N sources; Fe and plant growth regulator applications; and others.

- There are four annual N fertility rate treatments (Table 1 and Fig. 1) which are arranged in a randomized complete block design with three replications. Individual plot size is 6.0 x 11.0 ft with 1.0- or 3.0-ft borders between plots. The first N fertility rate treatment application was 13 Apr. 2005 and the last application will be 25 Apr. 2007. Table 1 also shows how P and K are being applied to maintain sufficient and representative nutrient levels. It also should be noted that Fe (2 oz ferrous sulfate/1000 ft^2) is being tanked mixed with Primo (0.125 oz Primo Maxx/1000 ft^2) and being applied once every 2 weeks.

Continued . .

- Starting June 2005, visual turfgrass quality and color ratings are being taken every 4 to 6 weeks. Visual ratings of shoot density, disease activity, drought stress symptoms, seedhead coverage, recovery from core cultivations, and others will be taken on an as-needed basis. Measurements of clipping yields; concentration of total N, P, and K in clipping tissue; and 2-day plant uptake of N, P, and K are being measured in July, October, January, and April. Soil analyses for total N, Olsen-P, exchangeable K, Ca, Mg, and Na and organic matter are being taken 1 and 2 years following N fertility rate treatment initiation. Other measurements include plant morphological analyses during the end of the second year.

- Starting in Apr. 2005, the nursery is being maintained in exactly the same way as other greens on the golf course. The details of the plot management are shown in Table 2.

- **Location:** The location of this study is an 8,500 ft^2 mature *Poa annua*-creeping bentgrass nursery located at Industry Hills Golf Club at Pacific Palms Conference Resort, City of Industry, Calif. The majority of the nursery is covered with *Poa annua* during the cool season. The nursery was established in Nov. 1997 by planting cores of *Poa annua* and seeding creeping bentgrass onto a 11-inch deep sand rootzone which was constructed with a sand that met USGA specifications. The nursery does not have a drainage system. It is irrigated with recycled water which has the following most-recent, 2-year average N concentrations at the water treatment plant: 1.6 ppm ammonia N, 1.4 ppm organic N, 3.9 ppm nitrate N, and 0.08 ppm nitrite N (6.98 ppm total N). Based on previous work at this golf course, irrigation of putting greens supplies an annual N fertility rate of approximately 0.5 lb/1000 ft^2. Selected results of a soil test taken on 6 Apr. 2005, prior to application of annual N fertility rate treatments, showed: pH = 6.8; Sodium Absorption Ratio (SAR) = 2 (low); Exchangeable Sodium Percentage (ESP) = 2% (low); extractable Fe = 14.9 ppm (sufficient); Cation Exchange Capacity (CEC) = 2.3 meq/100 g (low); Organic Matter (OM) = 0.80% (low); Olsen-P = 7.2 ppm (low); exchangeable K= 64 ppm (low); exchangeable Ca = 602 ppm (sufficient); exchangeable Mg = 69 ppm (low); exchangeable Na = 52 ppm; and 93%, 5%, and 2% sand, silt, and clay, respectively.

Duration: 2 years.

Funding Source: United States Golf Association

Continued . .

Findings:

- *Visual turfgrass quality and color.* Preliminary observations indicate that all N fertility rate treatments are providing satisfactory visual turfgrass quality and color. In terms of annual N fertility rate (lb/1000 ft^2): 5.5 > 4.2 > 2.8 and 1.5. If the additional N supplied in irrigation (approximately 0.5 lb/1000 ft^2 per year) is included, then, in terms of annual N fertility rate (lb/1000 ft^2): 6.0 > 4.7 > 3.3 and 2.0. It is possible that the optimal and deficient annual N fertility rates may range from 6.0 to 3.0 lb/1000 ft^2. This range would be a general guide, keeping in mind that annual N fertility rates may need to be adjusted depending on several factors, such as: amount of play; soil type; salinity and leaching requirements; amount of rainfall; irrigation with recycled water; N application schedule, rates, and N sources; Fe and plant growth regulator applications; and others.

- *Clipping yield and growth.* Unfortunately, not enough data have been collected to provide consistent preliminary observations. Ideally, when this study is completed, data will have been collected that show clear differences among annual N fertility rates for clipping yield, shoot and leaf density, recovery from core cultivations, root mass and depth, crown mass, and seedhead coverage.

- *Concentration of total N, P, and K in clipping tissue.* There appears to be substantial variation among annual N fertility rate treatments for N and K concentrations. N and K concentrations have varied by date and on some dates have been below published target sufficiency ranges for creeping bentgrass. As the study continues, the latter observations will probably not occur, at least for the higher N fertility rate treatments. Ideally, when this study is completed, the effects of annual N fertility rates for selected data will be positively correlated with N concentrations. There does not appear to be substantial variation among annual N fertility rates for P concentrations, which have varied by date but have remained within published target sufficiency ranges for creeping bentgrass.

Status: This is an ongoing study and information associated with this study has been given in oral presentations and has been published in *News from the UCR Turfgrass Program* (Aug. 2005) and the *2006 Turfgrass and Environmental Research Summary.*

Table 1. N, P_2O_5, K_2O, and Fe application schedule for the N fertility study on a *Poa annua*-creeping bentgrass putting green.

	Application dates for first 12 months of the study																		
	2006					2005													
	11 Jan.	1 Feb.	22 Feb.	15 Mar.	12 Apr.	13 Apr.	4 May	25 May	15 June	6 July	27 July	17 Aug.	7 Sept.	28 Sept.	19 Oct.	9 Nov.	30 Nov.	21 Dec.	
	Application dates for second 12 months of the study																		
	2007						2006												
Fertilizer component	10 Jan.	31 Jan.	21 Feb.	14 Mar.	4 Apr.	25 Apr.	3 May	24 May	12 June	5 July	26 July	16 Aug.	6 Sept.	27 Sept.	18 Oct.	8 Nov.	29 Nov.	20 Dec.	Annual total[z]
	lb/1000 ft²																		
N5.5	0.20	0.30	0.30	0.40	0.40	0.40	0.40	0.30	0.20	0.20	0.20	0.20	0.20	0.40	0.40	0.40	0.40	0.20	5.5
N4.2	0.20	0.20	0.20	0.20	0.30	0.30	0.30	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.30	0.30	0.30	0.20	4.2
N2.8	0.10	0.10	0.20	0.20	0.30	0.20	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.20	0.20	0.20	0.20	0.10	2.8
N1.5	–	–	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	–	1.5
	Applied to all plots																		
P_2O_5	–	–	0.25	0.25	0.25	0.25	–	–	–	–	–	–	0.25	0.25	0.25	0.25	–	–	2.0
K_2O	–	–	0.20	0.20	0.20	0.20	0.40	0.40	0.30	0.30	0.30	0.30	0.20	0.20	0.20	0.20	0.40	–	4.0
Fe	Ferrous sulfate ($FeSO_4$) applied by golf course superintendent once every 2 weeks at a rate of 2.0 oz/1000 ft².																		
PGR	Primo Maxx applied by golf course superintendent once every 2 weeks at 0.125 oz/1000 ft².																		

[z]Plots are irrigated with recycled water. The water supplies an annual N rate of approximately 0.5 lb/1000 ft² (including ammonia, organic, nitrate, and nitrite forms of N).

Note: There are three replications of each of four N fertility rates. Individual plot size = 6.0 x 11.0 ft.

Note: N sources are ammonium nitrate (20-0-0; 10.55 lb/gal) for December, January, and February; ammonium sulfate (8-0-0-9S; 10.2 lb/gal) for March and April; and low biuret urea (20-0-0; 9.35 lb/gal) from May through November. P source is ammonium polyphosphate (10-34-0; 11.7 lb/gal). K source is potassium sulfate ESP-K (1-0-8-2.5S; 9.7 lb/gal). Finish spray volume for each N fertility rate treatment application is 2.0 gal/1000 ft². All N fertility rate treatments applied with a CO_2 sprayer mounted on a cart.

Table 2. Summary of cultural management for the N fertility study on a *Poa annua*-creeping bentgrass putting green.

Mowing: Putting green nursery is mowed 5 to 6 times per week at a 0.140-inch height of cut. A walk-behind 22.0-inch wide Jacobsen greens mower is used, except on weekends when a triplex mower is used. Groomers are attached to walk-behind mowers.

Rolling: Putting green nursery is rolled 1 or 2 times per week.

Irrigation: Putting green nursery is irrigated for optimal putting green conditions. Syringing and hand watering is applied as needed. Leaching with 1.5 to 3.0 inch of water occurs the last Sunday of each summer month, or as needed. Note that the green was not watered with the irrigation system from March to mid-May 2006 due to construction on the golf course. During this time, water was transported by a water truck and the green was watered by hand using a hose.

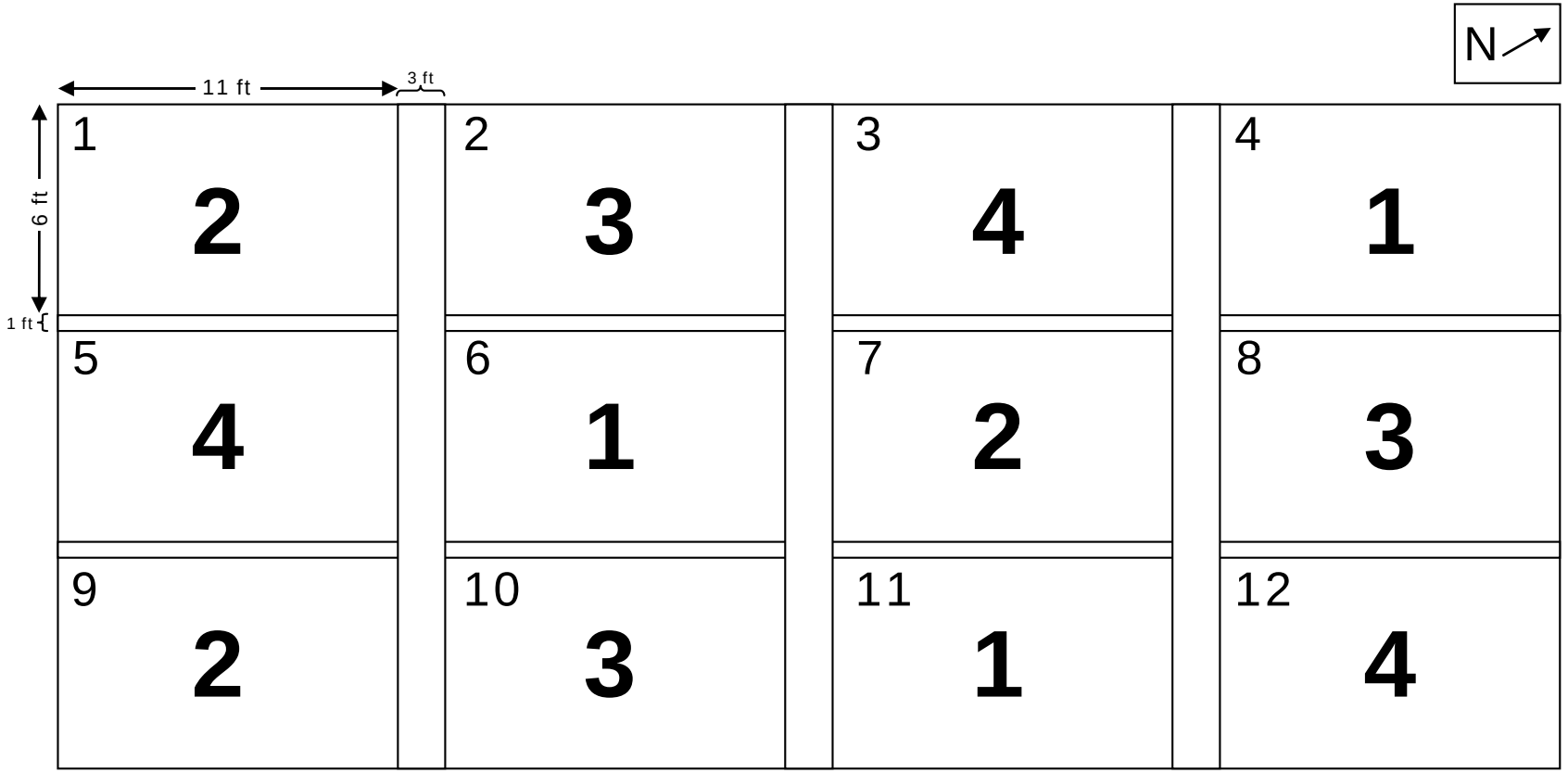
Core Cultivation: To date, cultivation occurred on 22 Feb., 16 May 2006 and 20 Mar. 2007 with 0.50-inch diameter hollow tines and cores were removed. Cultivations were followed with sufficient topdressing.

Verticutting: Verticutting is conducted as needed followed by light topdressing.

Light Topdressing: Light topdressing occurs 8 to 9 times per year.

Pesticide Applications: Insecticides and herbicides are applied as needed. Fungicides are applied to prevent moderate to severe disease activity.

Figure 1. Plot map for the N fertility study on a *Poa annua*-creeping bentgrass putting green at Industry Hills Golf Club at Pacific Palms Conference Resort, Industry, California.



Annual N fertility rate:
1 = 5.5 lb/1000 ft^2
2 = 4.2 lb/1000 ft^2
3 = 2.8 lb/1000 ft^2
4 = 1.5 lb/1000 ft^2