Incorporating Cultivation Practices and Products to Reduce Salinity Parameters from Poor Quality Irrigation Water on Golf Course Fairways

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Prior to the initiation of the study, Lubbock received very heavy, leaching rainfalls during the fall and spring seasons that likely facilitated the leaching of accumulated salts from the previous drought years. However, no measurable rainfall occurred from the first week of July through mid-September (10 weeks), which increased the application and reliance of irrigation water to maintain fairways. Cultivation treatments (Image 1) were the primary factor that resulted in significant differences in 2015. The core-aerified treatments at Meadowbrook GC initially had poorer turf quality and cover, but all treatments were similar following four weeks of recovery. The volumetric water content within core-aerified treatments remained significantly lower than sliced or non-cultivated treatments throughout the trial. In contrast, core-aerified treatments at the Rawls Course exhibited poorer turf quality, cover, and color through most of the summer (Fig. 1). The individual aerification holes filled in with grass relatively quickly, but each hole remained visible throughout the summer (Image 2). Soil from the Rawls had a higher clay content and potentially poorer soil structure that may have caused this problem. In addition to the different soil characteristics, the very dense 'TifSport' hybrid bermudagrass fairways at the Rawls course may have altered recovery from aerification compared to the common bermudagrass fairways at Meadowbrook GC.

The products applied did impact the electrical conductivity (EC) of the treatments. The application of the granular products (gypsum, Vertical-G, or DG Gypsum) significantly increased the measured EC level (Fig. 2). August soil samples were obtained just one week after application, which resulted in a much higher EC than liquid products or the untreated control. However, significantly higher EC values were also observed at Meadowbrook GC for those treatments in October, five weeks after granular products were applied. The high level of calcium in these products that would be deposited into the soil once disassociated from the granule likely increased the EC. Analysis from the X-ray fluorescence gun (PXRF) will be helpful to identify the elements that may be present within these soil samples demonstrating the significant increase in EC.

Ratio vegetation index (RVI) data were obtained weekly using the handheld RapidScan CS-45 meter (Holland Scientific, Lincoln, NE). The RVI is similar to NDVI, but RVI is recommended when measuring complete canopy cover in a turf situation. Cultivation treatments significantly affected RVI at both locations. The core-aerified treatments at the Rawls Course had significantly lower RVI on 10 dates compared to other cultivation treatments (Fig. 3). Core-aerified treatments were initially lower at Meadowbrook, but the non-cultivated treatments exhibited significantly lower RVI in August once reliance on supplemental irrigation was greatest (Fig. 3). We are currently maintaining the study areas at both locations and will be applying the same cultivation and product treatments in 2016 to determine the potential to manage salinity in the upper surface of golf course fairways.

Summary bullet points:

- Core-aerified treatments were slower to heal, especially at the Rawls Course, which resulted in poorer turf quality, cover, and color throughout the summer and early fall.

- The ratio vegetation index (RVI) was significantly improved with cultivation practices on the common bermudagrass fairways at Meadowbrook Golf Club in August when rainfall was scarce and the reliance on supplemental irrigation was increased.
- Granular product applications increased measured electrical conductivity levels at both locations.
- Further analysis of soil with the portable X-ray fluorescence gun should determine the specific elements that were providing the increased electrical conductivity levels in these treatments.
- Continuing this research in 2016 will help us determine the additive effects of implementing these cultivation treatments and product applications as a long-term management solution to reducing salinity in the upper soil layer of golf course fairways.

Tables, Figures, and Images

Trt #	Product trt	Rate/1,000 ft^2	Application timing
1	Untreated control	None	None
2	Kelly's gypsum	10 lbs	Applied once a month
3	ACA 2994	8 fl oz	Applied once per two months
4	ACA 2786	4.5 fl oz	Every two weeks
5	ACA 1900 ACA 2786	8 fl oz 4.5 fl oz	Initial application and 6 wks after Two aps two weeks apart between ACA 1900
6	Oars PS	5 fl oz	Applied once a month
7	Vertical G	12 lbs	Applied once a month
8	Oars PS Vertical G	5 fl oz 12 lbs	Applied once a month with liquid applied over the top of granular
9	DG Gypsum	12 lbs	Applied once a month
10	Cal-Pull	6 fl oz	Applied once a month

Table 1. Products and rates applied to three replicates of each cultivation treatment [non-cultivated, AerWay Slicer, and core-cultivated (3/4 inch diam. tine on 2 inch spacing)]. Initial applications were made on 16 June 2015 with subsequent applications made on manufacture recommendation.

Image 1. Meadowbrook Golf Club (left) and Rawls Golf Course (right) following cultivation treatments [non-cultivated, AerWay Slicer, and core-cultivated (3/4 inch diam. tine on 2 inch spacing)] applied on 15 June 2015.

Image 2. Rawls Golf Course study area on 7 October 2015 at the conclusion of the research year. The lower left of the image illustrates the visible evidence remaining from core-aerification in June on the 'TifSport' hybrid bermudagrass fairways.

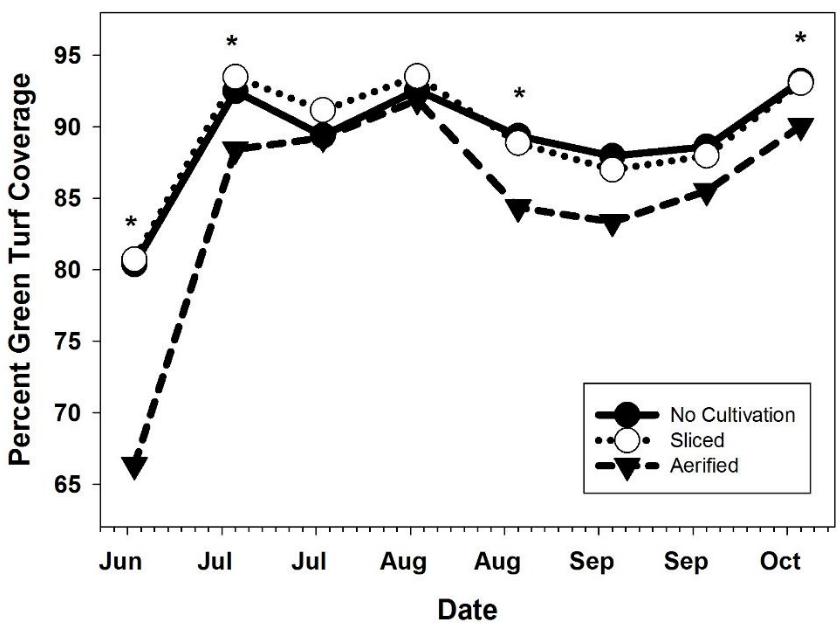

Figure 1. Percent green cover measured from digital image analysis at the Rawls Golf Course. Dates with asterisks are statistically different at $\alpha = 0.05$. Comparable to data for visual turf quality and color in the same area.

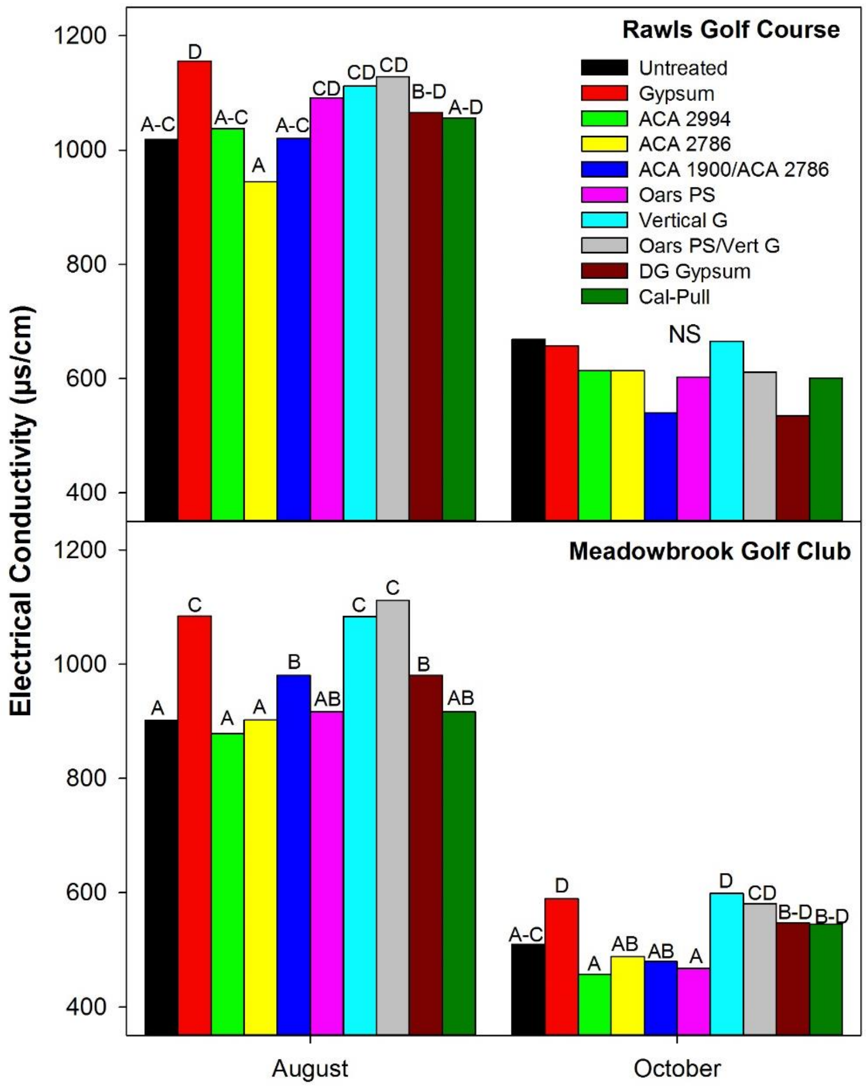

Figure 2. Soil electrical conductivity from samples obtained in August and October 2015. Three soil samples were obtained with a profile sampler (3 x 0.5 x 3.5 inch) from each experimental unit and combined for soil analysis. Mean values for the three replicates are provided. Bars sharing the same letter are statistically similar at $\alpha = 0.05$.

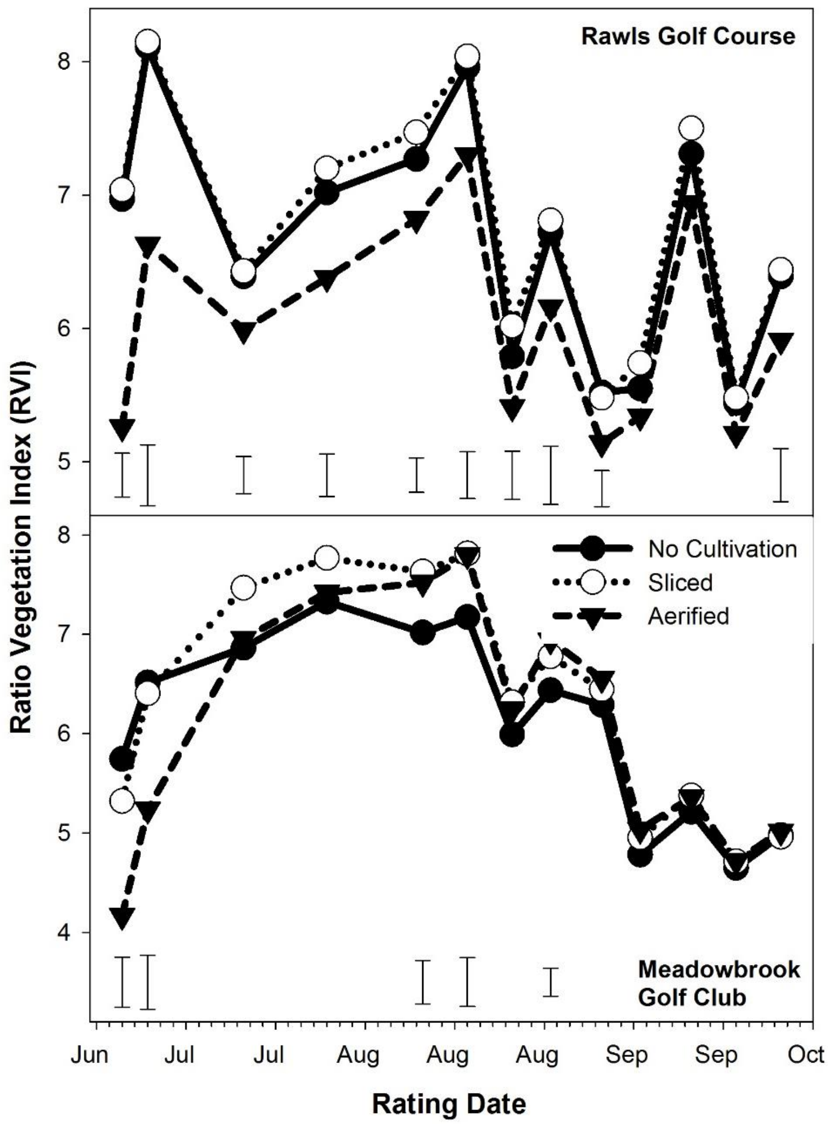

Figure 3. Ratio vegetation index (RVI) measured from the RapidScan CS-45 meter. A single measurement was taken from each plot and averaged over all product applications and the three replicate cultivation treatments. Error bars represent the least significance difference value for each significant rating date at $\alpha = 0.05$.