Reducing Salinity Parameters with Cultivation Practices and Products on Golf Course Fairways

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Introduction

As drought conditions prevail in the Southwestern US, golf courses rely on irrigation water to maintain the playability and quality of their fairways. Groundwater from the Ogallala Aquifer is the main source of irrigation in our region, but the rapid depletion of water has diminished water quality by increasing salt concentration. The continual use of this water source with limited leaching rainfall events has allowed for salt accumulation in the soil. Cleaner water sources are not available for leaching, and many of the golf courses may not be able to apply the additional water needed to effectively leach salts with their irrigation alone. Therefore, additional methods to move salts below the effective rootzone need to be evaluated further. Current recommendations include the use of cultivation practices and product applications to improve leaching potential, but limited research is available on their effectiveness alone or in combination. Therefore, the purpose of this study is to provide golf course superintendents with best management practices for salinity remediation for all golf courses.

Objectives

- Determine if application of selected commercial products with and without cultivation practices can effectively reduce salt accumulation in the rootzone.
- Incorporate digital image analysis (DIA) and normalized difference vegetation index (NDVI) to examine enhanced fairway conditions.
- Apply the technology of portable x-ray fluorescence (PXRF) for rapid quantification and evaluation of salinity hazards in golf courses.

Materials and methods

- Study conducted at two golf courses in 2015
- The Rawls Golf Course uses 'TifSport' hybrid bermudagrass, while Meadowbrook Golf Club uses common bermudagrass
- Randomized complete block design with strip-split plot treatment arrangement
- Cultivation practices core aerification, Aerway, and uncultivated were main plot factors
- Nine products and an untreated control randomized with each cultivation treatment (Table)
- Visual turf quality, DIA, NDVI, and volumetric water content (VWC) were collected every two weeks
- Soil samples were obtained within sub-plots in Jun, Aug, and Oct, air-dried and ground to pass 2 mm sieve
- Element levels were obtained with PXRF
- Salinity parameters such as EC and pH were measured
- Statistical analysis in SAS 9.4 using Proc Mixed

Table. Products applied with rate and timing of application for each treatment

Treatments	Products	Rate	Application timing
1	Untreated control	None	None
2	Kelly's gypsum	488 kg/ha	Applied once a month
3	ACA 2994	25.5 l/ha	Applied once per two months
4	ACA 2786	14.3 l/ha	Every two weeks
5	ACA 1900 ACA 2786	25.5 l/ha 14.3 l/ha	Initial application and 6 weeks after Two aps two weeks apart between ACA 1900
6	Oars PS	15.9 l/ha	Applied once a month
7	Vertical-G	586 kg/ha	Applied once a month
8	Oars PS Vertical-G	15.9 l/ha 586 kg/ha	Applied once a month with liquid applied over the top of granular
9	DG Gypsum	586 kg/ha	Applied once a month
10	Cal-Pull	19.1 l/ha	Applied once a month

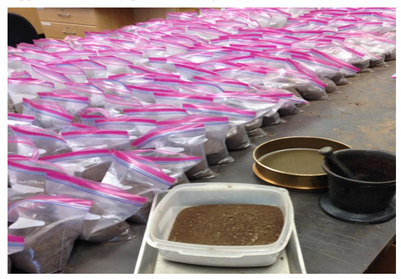
Core aerification practices at Meadowbrook Golf Club


Slicing with Aerway at Meadowbrook Golf Club


Initial product applications at Meadowbrook Golf Club


Application of dry product using shaker


Soil samples obtained with a soil profile sampler


Soil samples were air-dried and ground to pass 2 mm sieve

Results

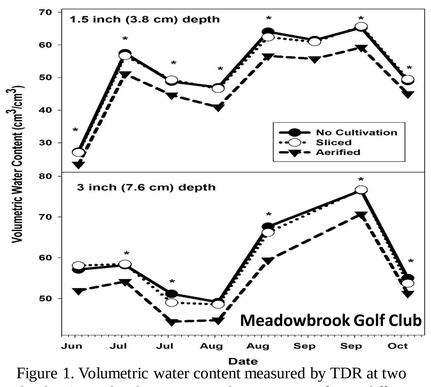


Figure 1. Volumetric water content measured by TDR at two depths. Asterisks above a rating date notes significant difference among cultivation practices at $\alpha = 0.05$.

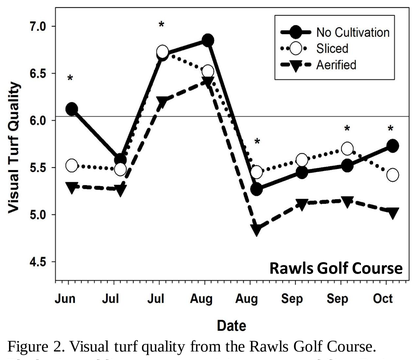


Figure 2. Visual turf quality from the Rawls Golf Course. The horizontal line represents minimum acceptability. Rating dates with asterisks are statistically difference at $\alpha = 0.05$.

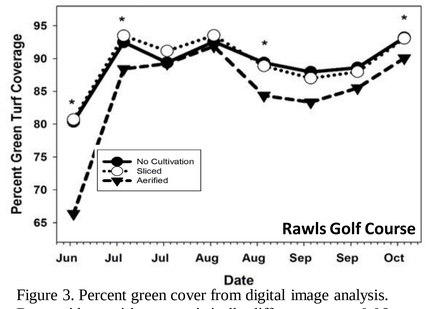


Figure 3. Percent green cover from digital image analysis. Dates with asterisks are statistically difference at $\alpha = 0.05$.

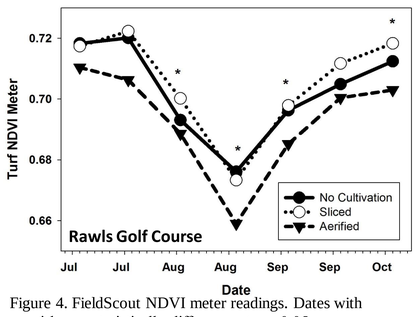


Figure 4. FieldScout NDVI meter readings. Dates with asterisks are statistically difference at $\alpha = 0.05$.

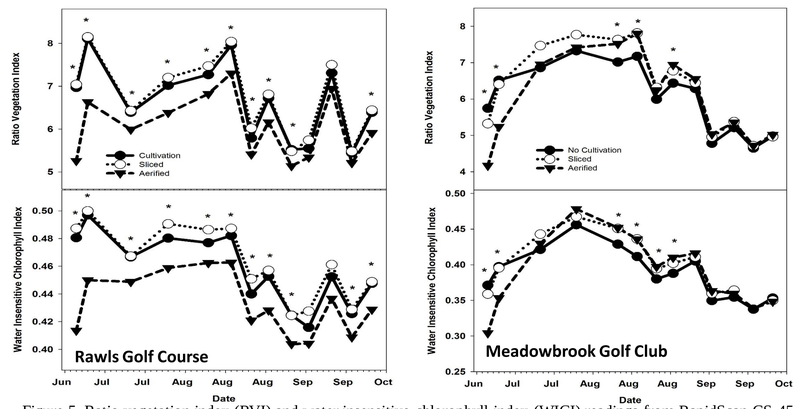


Figure 5. Ratio vegetation index (RVI) and water insensitive chlorophyll index (WICI) readings from RapidScan CS-45 meter. Dates with asterisks are significantly different at $\alpha = 0.05$.

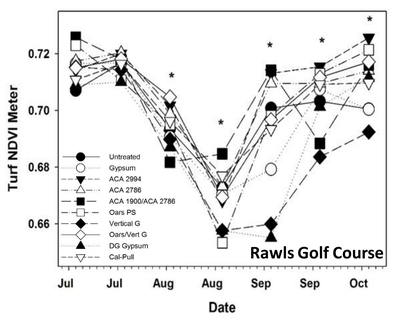


Figure 6. FieldScout NDVI meter readings. Dates with asterisks are statistically difference at $\alpha = 0.05$.

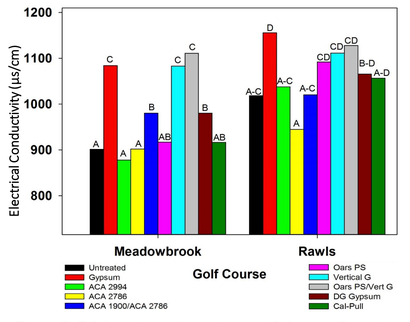


Figure 7. EC from the soil samples on 15 August. Bars sharing the same letter are statistically similar at $\alpha = 0.05$.

Preliminary conclusion

Meadowbrook Golf Club

- Core aerified treatments had lower VWC at both depths
- Both cultivated treatments significantly improved measurements on RVI and WICI in August and September
- Liquid products maintained lower soil EC
- Grass type and soil characteristics may have limited above ground quality, cover, and color differences

Rawls Golf Course

- Core aerification reduced turf quality, percent green cover, NDVI, RVI, and WICI throughout the summer (Figs 2-5)
  - Visible symptoms of aerification holes through October
  - Soil structure and texture difference to Meadowbrook GC
  - Elevation change and reduced water infiltration
- ACA 1900 caused phytotoxicity; ACA 2786 improved turf color following application (Fig 6)
- Dry products had poorer color than liquid products (Fig 6)
- Liquid products maintained EC levels in August while gypsum and Vertical-G increased EC levels (Fig 7)

Future work

PXRF data analysis and EC and pH measurements of soil samples collected in June and October will be completed soon. This trial will be conducted at same plots in 2016 to interpret the effects of cultivation practices and products in two consecutive years.

Acknowledgements

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