

Determining optimal nitrogen fertility rates for reduced-input fine fescue putting greens

Dominic P. Petrella, Sam Bauer, Brian Horgan, and Eric Watkins

Department of Horticultural Science, University of Minnesota, St. Paul, MN

Introduction

- The use of nitrogen fertilizers on golf courses is scrutinized worldwide.
- Identifying alternatives to creeping bentgrass (*Agrostis stolonifera* L.) for putting greens may help decrease nitrogen use while maintaining turfgrass quality.
- Fine fescue turfgrasses are known for lower nitrogen requirements and reduced input management.
- Fine fescues are used for putting greens in northern Europe, Ireland, the UK, and other European countries, but have received limited attention in the U.S.
- Objective:** To determine the optimum annual nitrogen fertilizer rate for maintaining a reduced input fine fescue putting green in Minnesota.

Material and Methods

- 2-year study consisting of a split-plot design with 4 replications.
- Fertility treatment as the main plot (2.7 x 3 m), and turfgrass species as the sub-plot (0.9 x 1.4 m).
- Colonial bentgrass cv. 'Greentime' (CLB; *A. capillaris* L.), creeping bentgrass cv. 'Penncross' (CRB; *A. stolonifera* L.), Chewings fescue cv. 'SR 5130' (CHF; *Festuca rubra* ssp. *commutata*), hard fescue cv. 'MNHD' (HDF; *F. rubra* ssp. *brevipila*), slender creeping red fescue cv. 'Shoreline' (SLR; *F. rubra* ssp. *litoralis*), and strong creeping red fescue cv. 'Chantilly' (STR; *F. rubra* ssp. *rubra*) were established in St. Paul, MN (9/10/2014) on a native soil capped with 10 cm of sand.
- Nitrogen (N) treatments were 0, 1, 2, or 4 lb. N 1000 ft⁻² (0, 48.9, 97.7, or 195.3 kg N ha⁻¹) annually applied (75% methylene urea, 25% urea).
- Fertility treatments were split in 4 applications every 40 d beginning 5/25/2017 and 5/24/2018.
- Plots were mowed 3x per week at 5.1 mm. Irrigation was applied as needed by monitoring soil moisture content.
- Snow mold control products were the only pesticides used.
- Turfgrass quality and Normalized Difference Vegetation Index (NDVI) data were acquired every 14 d.
- Digital images were acquired every 14 d using a light box.
- Disease incidence was rated from 0-10, with 10 representing approximately 100% disease coverage.
- Images were analyzed using Turf Analyzer software.
- Data were analyzed within date as a split-plot (SAS v. 9.4, PROC MIXED). LSMEANS were compared using 95% confidence intervals.

Results

2017

- CLB plots exhibited the poorest turfgrass quality, and nitrogen treatment did not significantly improve quality, but 2 and 4 lb. N treatments did increase NDVI and % cover on 6/23/17 compared to the 0 lb. treatment (Figs. 2A-F).
- On 6/23/17, higher nitrogen rates resulted in increased NDVI and turfgrass cover for CRB, but turfgrass quality was not significantly increased compared to the 0 N treatment (Figs. 2A-C). However, on 9/27/17, CRB plots exhibited a significant decline in quality and NDVI (Fig. 2D-E), and can be attributed to dollar spot (*Sclerotinia homoeocarpa*) pressure (Data not shown).
- For CHF, 2 and 4 lb. N treatments increased quality, NDVI, and % cover compared to the 0 lb. treatment, but 4 lb. N did not significantly improve CHF compared to the 1 lb. or 2 lb. N treatments on both 6/23 and 9/27/17. (Figs. 2A-F). CHF 2 and 4 lb. treatments also performed significantly better than CRB when evaluating turfgrass quality and percent cover. Additionally, CHF 2 and 4 lb. N treatments had significantly greater turfgrass quality at the end of 2017 (Fig. 2D) compared to HDF and STR.
- Higher amounts of nitrogen significantly improved NDVI and turfgrass cover for HDF plots, but increased nitrogen did not improve turfgrass quality for both 2017 rating dates (Figs. 2A-F). This reduced quality, but maintained NDVI and cover can be attributed to midseason summer patch (*Magnaportheopsis* sp.) pressure that resulted in mottled, non-uniform, HDF plots (Fig. 1) contaminated with CRB (data not shown).
- SLR performed very similar to CHF for both 2017 dates (Figs. 2A-F), but on some occasions the 0 lb. N and lower N treatments were not significantly different to the higher rates used on SLR (Figs. 2A, 2C, and 2F).
- STR performed similar to HDF. However, while increasing amounts of N somewhat improved quality, NDVI, and cover compared to STR treated with 0 lb. N, STR plots exhibited significantly poorer turfgrass quality compared to CHF and SLR, especially later in 2017.

Fig. 2: 2017 turfgrass quality, NDVI, and % turfgrass cover of turfgrass species treated with 0, 1, 2, or 4 lb. N 1000 ft⁻². Data taken on 6/23/17 and 9/27/17 are presented. Bars represent 95% confidence intervals.

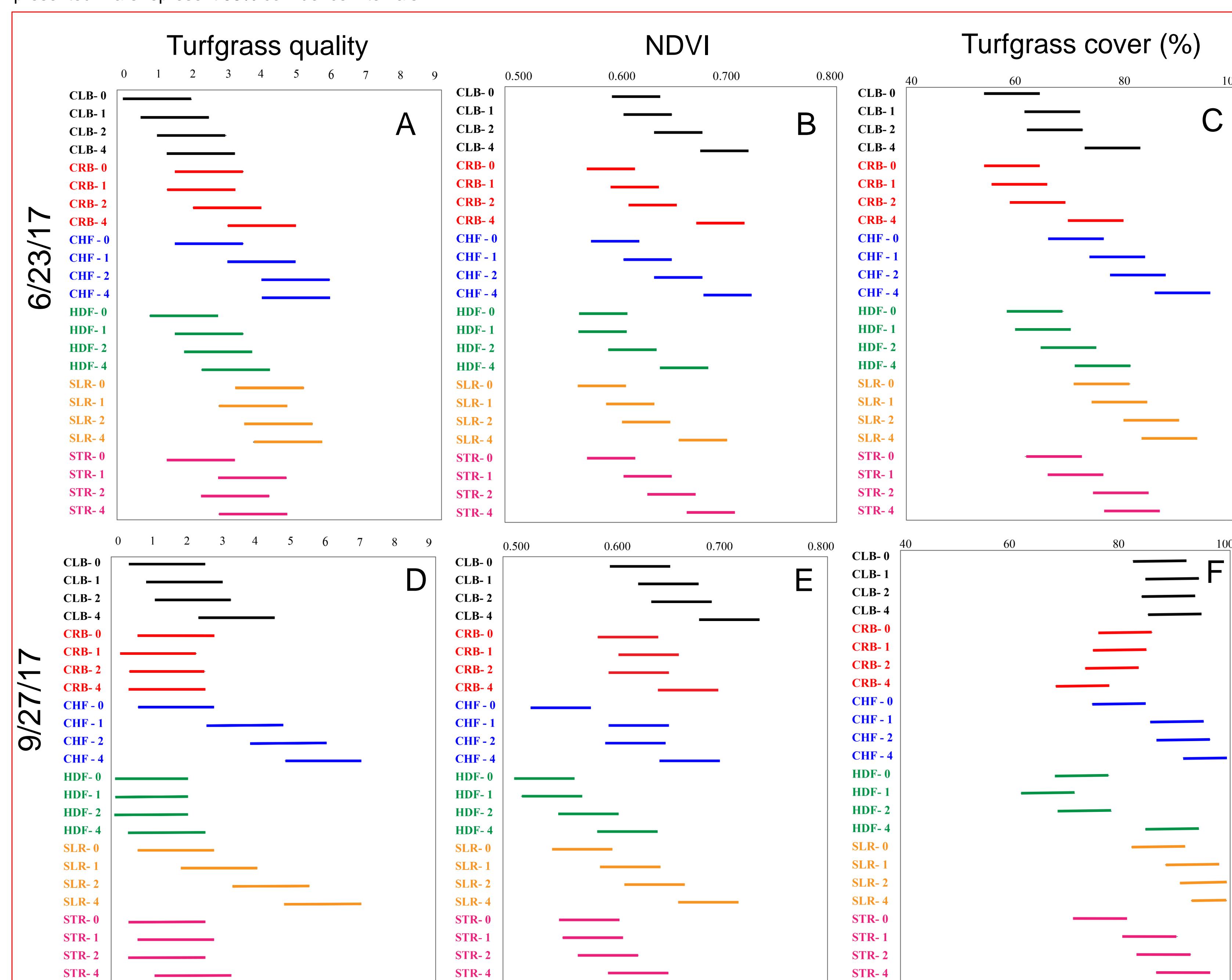
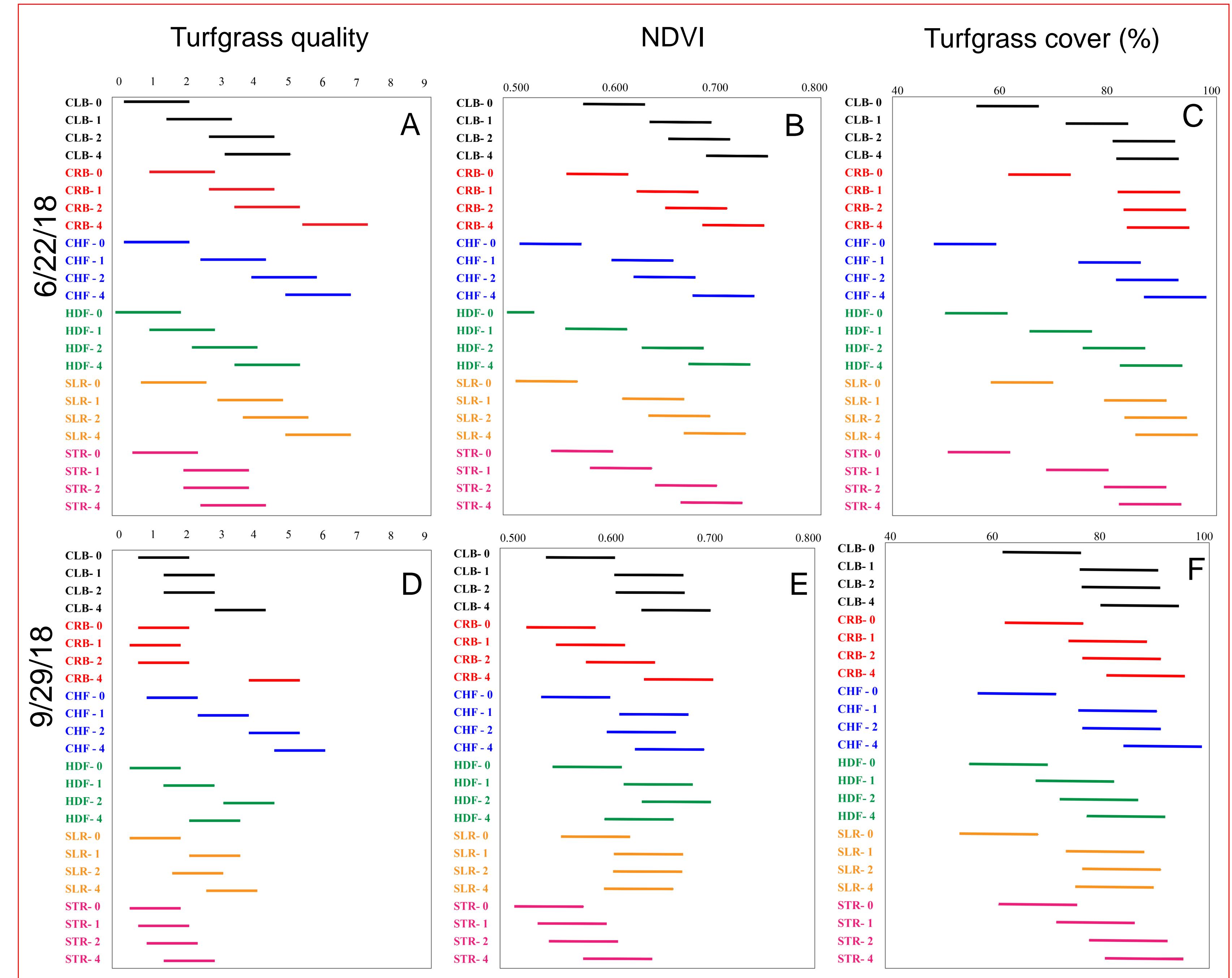


Fig. 3: 2018 turfgrass quality, NDVI, and % turfgrass cover of turfgrass species treated with 0, 1, 2, or 4 lb. N 1000 ft⁻². Data taken on 6/22/18 and 9/29/18 are presented. Bars represent 95% confidence intervals.



2018

- CLB plots again exhibited very poor turfgrass quality, but nitrogen treatment did significantly improve quality, in particular the 4 lb. N treatments (Fig. 3A-F). The poor turfgrass quality in conjunction with a higher NDVI and cover can be attributed to mottled, non-uniform growth (Fig. 4) throughout the season due to winterkill in CLB plots.
- CRB exhibited improved quality, NDVI, and cover in the beginning of the 2018 (Fig. 3A-D), but performance declined later in 2018 due to excessive dollar spot pressure (Fig. 2D-F, Fig. 4, and Fig. 6B). The 4 lb. N treatment significantly improved CRB performance, and is partially due to providing dollar spot control (Fig. 6B).
- CHF performed similar to 2017, and in some instances in 2018, all N treatments were statistically the same. Plots treated with 1-4 lb. N exhibited NDVI and % cover data that was not significantly different (Fig. 2B, C, E, and F). However, 2 and 4 lb. treatments produced very similar results for all 2018 data. Overall improved performance can be attributed decreased amounts of summer patch (Fig. 6A). CHF also performed similar to CRB, but CHF quality was significantly better than CRB during later dates in 2018 due to less dollar spot (Fig. 6B).
- Overall, HDF performed much better in 2018 compared to 2017, and in particular 2 and 4 lb. N treatments significantly improved performance early in 2018. Later in 2018, the 4 lb. N treatment had reduced HDF quality, which can be attributed to bentgrass contamination from 2017 due to summer patch.

Fig. 4: Digital images (9/27/17; rep. 1) of turfgrasses treated 0, 1, 2, or 4 lb. N 1000 ft⁻²

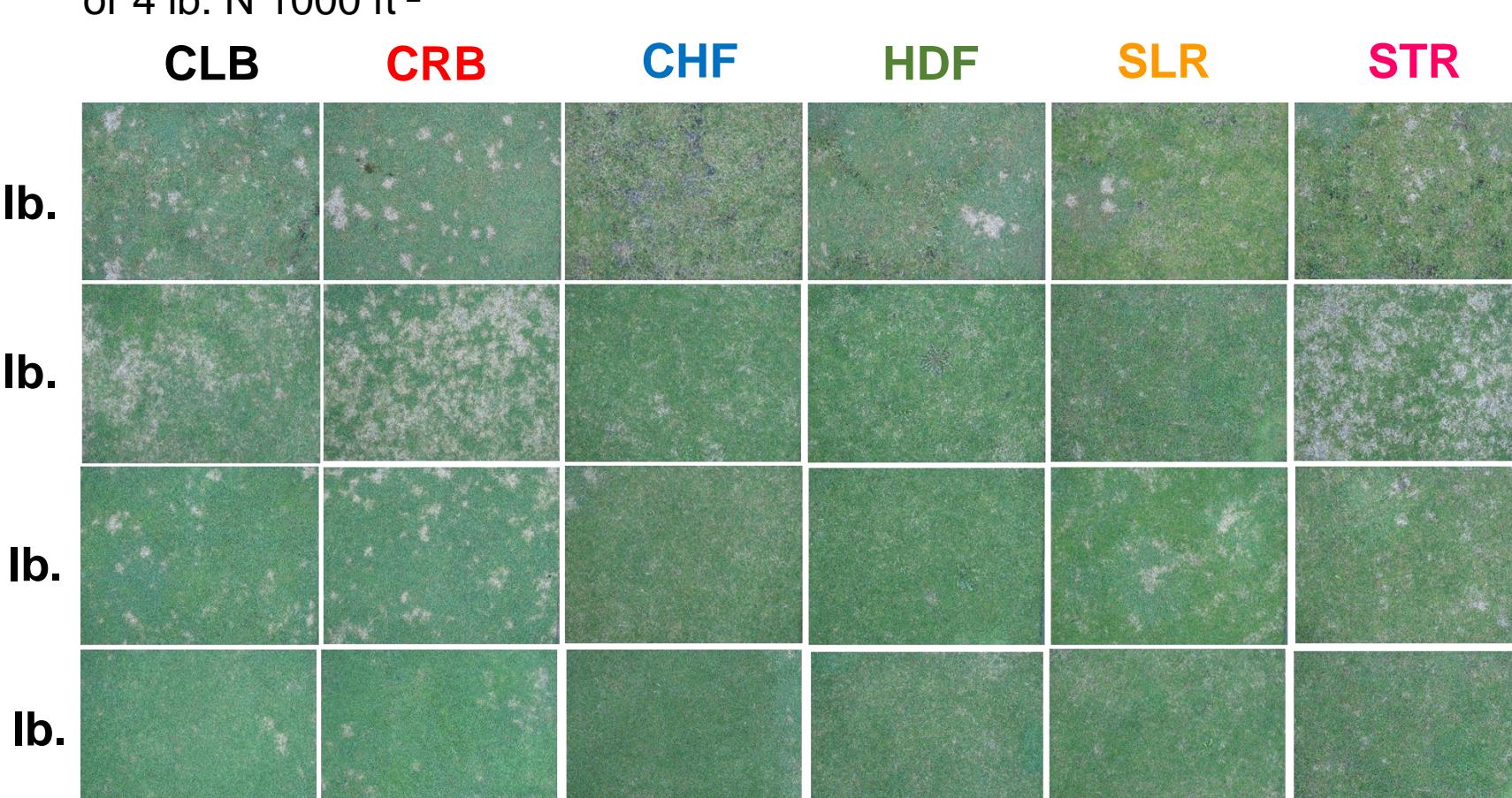


Fig. 5: Summer patch on HDF (A) and SLR (B) treated with 4 lb. N 1000 ft⁻² (7/24/18).

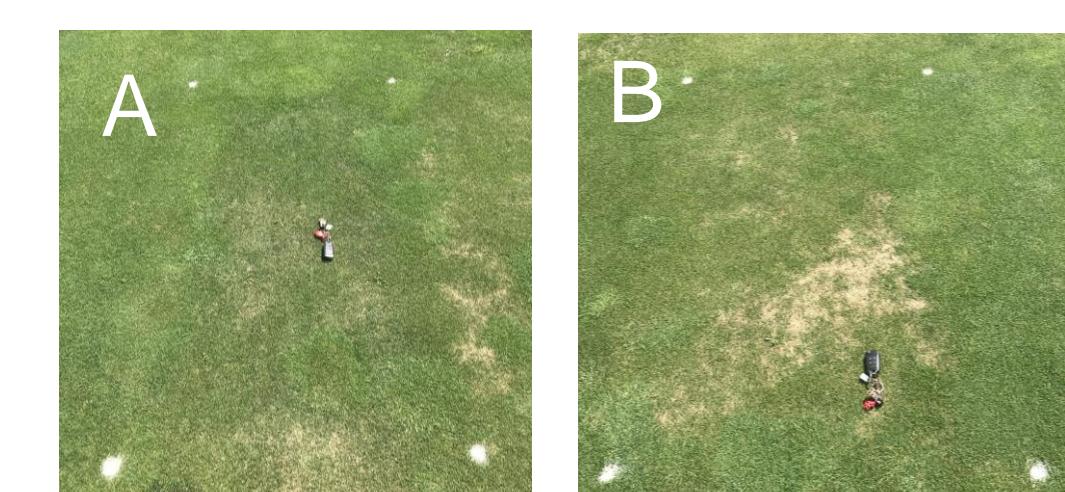
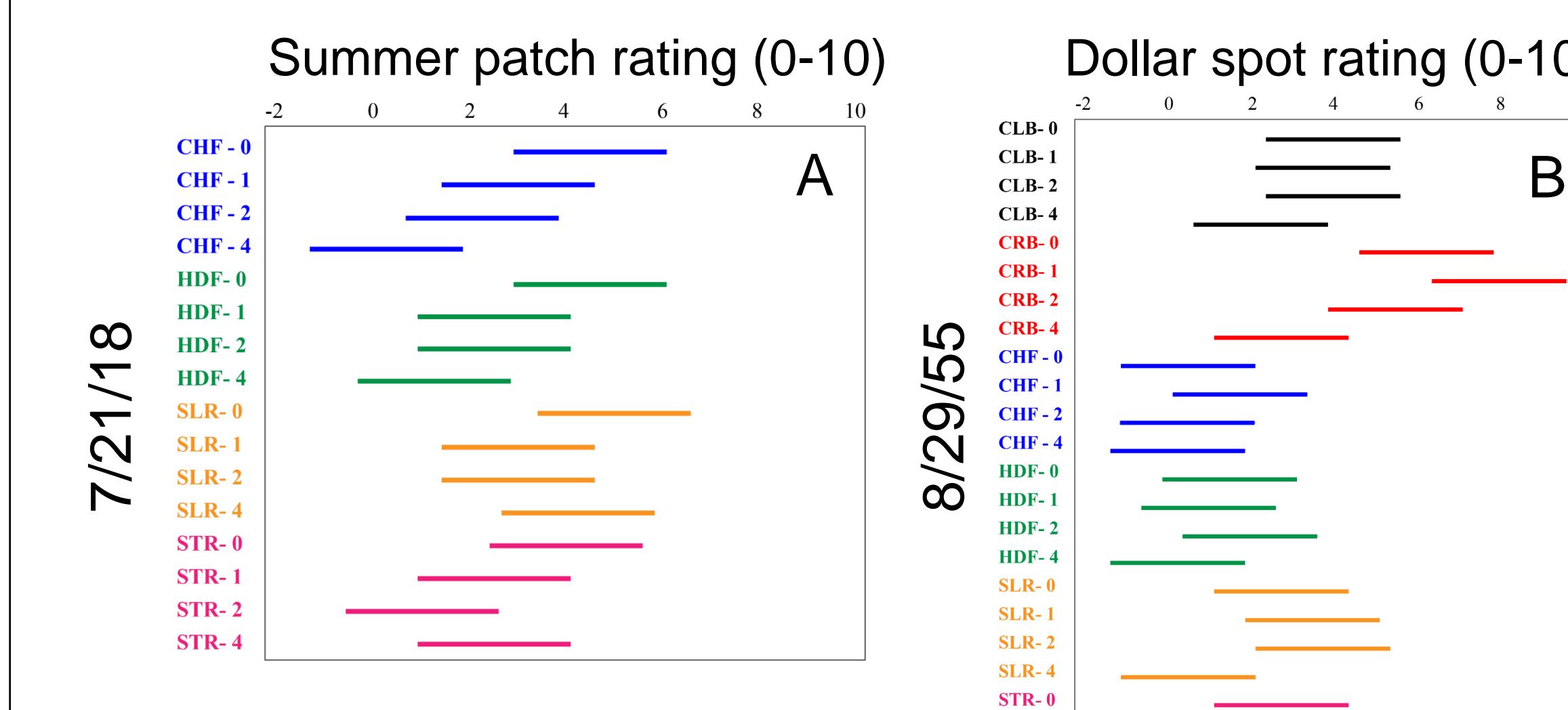


Fig. 6: Turfgrass disease ratings. Summer patch (A) and Dollar spot (B) disease during 2018. Ratings of 10 represent approximately 100% disease coverage



Conclusions

- CHF could be maintained with approximately 2 lb. N 1000 ft⁻² annually using a reduced input management program due to this species exhibiting decreased pressure from both summer patch and dollar spot. While SLR performed very similar to CHF, and could be maintained adequately with 2 lb. N 1000 ft⁻² during most of the study, severe levels of summer patch made it apparent that SLR would need increased levels of pesticide input compared to CHF.
- CRB plots exhibited relatively high turfgrass performance under moderate to low N treatment during 2017 and 2018; however, dollar spot infection resulted in unacceptable decline in turfgrass quality and cover.
- CLB did not perform well in 2017 and 2018, and while higher amounts of N did improve turfgrass quality and cover, CLB plots were mottled and were not uniform throughout the entire study.
- STR and HDF were the worst performing fine fescue species in this study. Both species exhibited turfgrass quality and overall performance that was reduced compared to CHF and SLR. This is primary due to summer patch on HDF and combined summer patch and dollar spot on STR.
- Based on our data, CHF and SLR can provide a quality reduced-input putting green in Minnesota.

Acknowledgements: We would like to thank the Minnesota Golf Course Superintendents Association (MGCSA) for their support

• SLR, exhibited acceptable turfgrass quality with 2 and 4 lb. N treatments early in 2018, but performance dropped later in 2018 due to summer patch (Fig. 5 and 6A). Interestingly, N had no effect on decreasing SLR summer patch, compared to both CHF and HDF (Fig. 6A).

• Early in 2018, STR performed similar to 2017, but in the later half of 2018, large amounts of summer patch and dollar spot drastically reduced performance of STR (Fig. 3A-F). Nitrogen had little effects on STR summer patch infection, and increasing amounts of N led to greater amounts of dollar spot (Fig. 6A-B).