Evaluating the Effects of Foliar Iron Formulations on Turf Quality

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Maintaining dark green leaves is a key aspect of turfgrass management. A rich green color is aesthetically important, as well as an indicator of turf health and quality. Color is affected by many factors, including nitrogen fertility, disease symptoms, and iron deficiency. Iron (Fe) is required in only small amounts, but is important because of its essential role in chlorophyll synthesis.

Inadequate Fe in leaves is frequently due to conditions that limit iron uptake, rather than low amounts of Fe in the soil. High soil pH, compaction, water-saturated soil and cool temperatures can induce Fe deficiencies. Foliar applications of Fe are frequently used to maintain and improve the appearance of turfgrass on golf course greens. Foliar Fe has been shown to promote a darker green leaf color, even when Fe is not limiting the growth of turfgrass. In some cases, the effect of Fe may be to stain and darken leaf surfaces rather than a physiological effect due to improved Fe nutrition. Application of foliar Fe is a recommended practice for improving green color of golf greens.

Research Objectives

This project evaluated the effectiveness of different spray formulations to increase foliar Fe uptake and improve turfgrass color on golf course greens.

Specific objectives were to:

1) Compare foliar Fe applications using a spray adjuvant to foliar Fe applications with no adjuvant

2) Compare Fe sulfate foliar sprays with foliar nitrogen applications and Fe + nitrogen foliar sprays

3) Evaluate treatment effects on turfgrass quality and the longevity of any observed improvement in leaf color through subjective visual observations

Experimental Procedures

This research was conducted at the Turfgrass Research, Outreach, and Education Center on the St. Paul campus of the University of Minnesota. Plots were established on a recently constructed golf course green. Standard cultural practices following University of Minnesota recommendations were used for all aspects of green maintenance other than the experimental treatments imposed by the study.

Six treatments were tested:

1. Control (no Fe applied)
2. Foliar Fe-sulfate (no adjuvant, no N)
3. Foliar Fe-sulfate + adjuvant (no N)
4. Foliar N + adjuvant (no Fe)
5. Foliar Fe + N (no adjuvant)
6. Foliar Fe + N + adjuvant

Each treatment was replicated three times in a randomized complete block design. Treatment plots within each block were 5 ft x 5 ft. Fe was applied at a rate of 0.4 oz/1000 sq ft in a total solution volume of 3 gal/1000 sq ft. For treatments containing the spray adjuvant, the rate was 2.5% by volume. The adjuvant being tested is an experimental product. A commercial product (Origin Six-Iron, Agriliance L.L.C.) was used for the treatments containing both Fe and N. This product is 6% Fe (from Fe-sulfate) and 15% N (from urea), so in these treatments N was applied at a rate of 1.0 oz/1000 sq ft. The foliar N (no Fe) treatment was applied at the same 1.0 oz N/1000 sq ft rate using urea as the N source.

Foliar Fe treatments were applied on June 11 and visual evaluations were made on June 13. A second set of treatment applications and evaluations was done on July 21-22, preceding the Turf Field Day. Visual evaluations of turf quality were made on a rating scale of 1 (light green color) to 5 (dark green color). Digital photos of each treatment were also taken.

Results

Figure 1 shows the results of visual evaluation of treatment effects on turf quality following the first application date. These ratings were made two days after foliar applications on June 11. Foliar Fe seemed to improve turf color and appearance. Applying N in combination with Fe provided no additional benefit compared to Fe alone. All Fe treatments had higher quality ratings than the unsprayed control or foliar N without Fe, although only the treatments with the spray adjuvant were significantly higher. Adjuvant + Fe treatments (with or without N) were also significantly higher than comparable Fe or Fe + N treatments with no adjuvant. Improved appearance was short-lived and no visible differences among treatments were observed five days after application.

The absence of an N effect on turf color indicates that the standard fertilizer program was supplying sufficient N for optimum appearance. The rapid and transient nature of Fe effects on turf quality suggests that the responses to Fe may have been due to changes on the leaf surface rather than Fe movement into the leaf, improved Fe nutrition, and increases in chlorophyll synthesis. This is supported by the observation that changes in appearance and differences among treatments seemed to occur immediately after spray application. Although ratings to document these rapid effects were not made, they were consistent with the trends observed two days later and appeared most pronounced for the adjuvant treatments. The adjuvant effect may have been due to more uniform spreading of the spray solution over the leaf surfaces. If improved color was due to darkening of the leaves by a surface coating of Fe, thorough coverage and better distribution of Fe could have created a more uniform staining effect.

The short duration of the color change was probably due to the frequent mowing of greens and associated removal of treated leaves. This effect of frequent leaf removal would probably be the same whether Fe was darkening the surface of the leaf or taken up by the leaf and affecting color physiologically, because Fe is relatively immobile in plants and not

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Foliar Iron–

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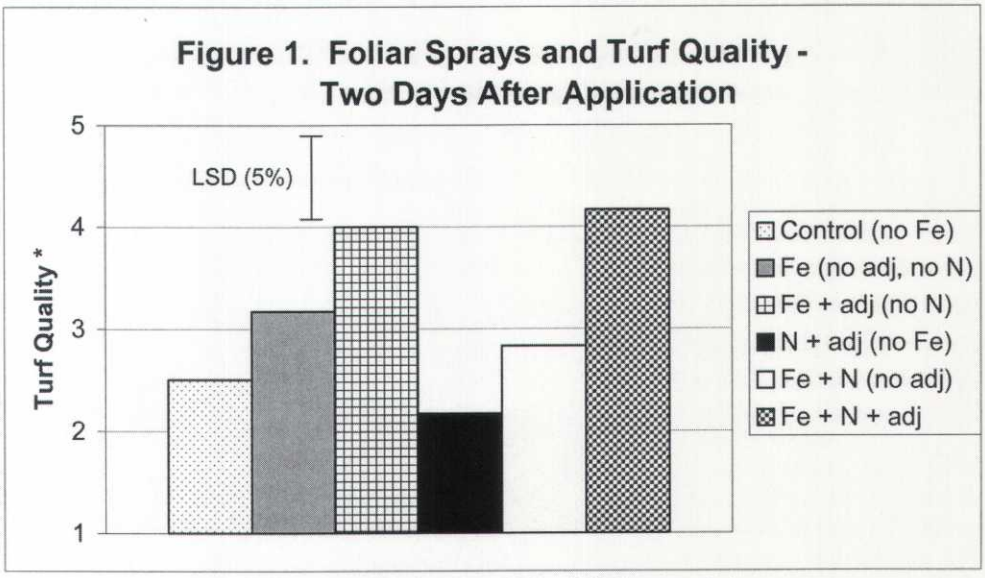
readily translocated from older to younger leaves.

Figure 2 shows the results of visual evaluation of treatment effects on turf quality for the second set of treatment applications. These ratings were made on July 22, one day after foliar applications. Results were similar to the first treatment date, but none of the observed differences was statistically significant. There was a trend for improved turf color and appearance with foliar Fe application and adjuvant + Fe treatments had numerically higher quality ratings than treatments with Fe alone. Plots were not revisited until ten days after initial evaluations, but no visible differences among treatments were observed at that time.

Conclusions

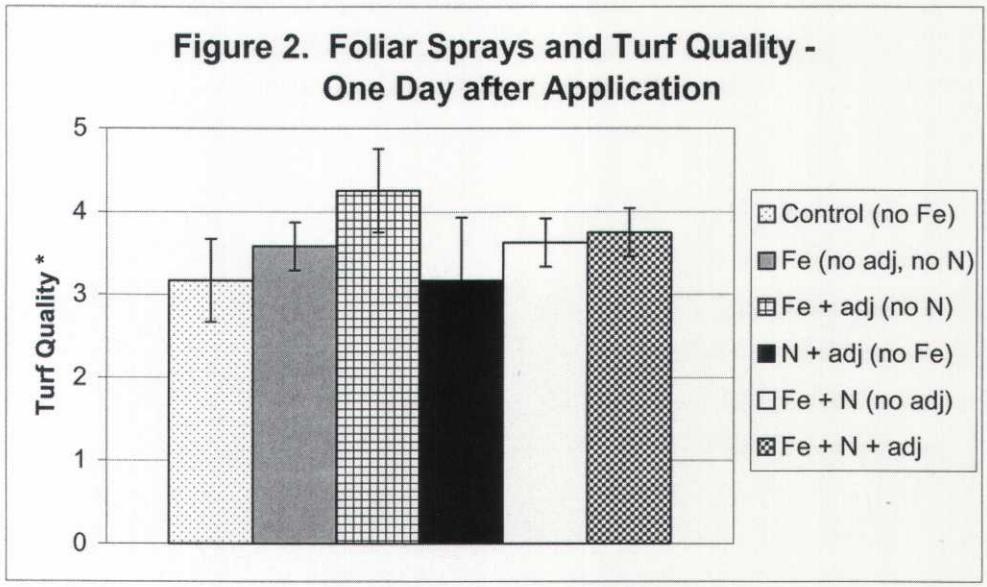
All Fe treatments had higher quality ratings than the unsprayed control or foliar N without Fe, although only the treatments with the spray adjuvant were significantly higher. Improved appearance was short-lived and no visible differences among treatments were observed five days after application. The rapid and transient nature of Fe effects on turf quality suggests that the responses to Fe may have been due to changes on the leaf surface rather than Fe movement into the leaf, improved Fe nutrition, and increases in chlorophyll synthesis. This is supported by the observation that changes in appearance and differences among treatments seemed to occur immediately after spray application.

For the 1st spray date on 6/11



* Turf Quality: visual rating on a scale of 1 (light green color) to 5 (dark green color).

For the 2nd spray date on 7/21



* Turf Quality: visual rating on a scale of 1 (light green color) to 5 (dark green color).
Vertical bars are standard errors of the mean.

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