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Effect of the Growth Regulator Proxy on Creeping Bentgrass Fairway Turf¹

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Abstract

Proxy is a newly-labeled plant growth regulator (PGR) for use on golf course and commercial turfgrass areas. Four rates of Proxy (ethephon), 2.3, 3.6, 4.6, and 9.1 kg ai/ha (2.0, 3.2, 4.1, and 8.2 lb ai/A,) were compared to Primo (trinexapac-ethyl) at 1.0 kg ai/ha (0.9 lb ai/A) and an untreated control for clipping reduction and effects on aesthetics of creeping bentgrass maintained as fairway turf. Treatments were applied three times at 28-day intervals during 1998 at locations in Indiana and Wisconsin. Proxy was as effective at reducing clipping yields as Primo, although the magnitude of effects varied between the two locations. In general, Proxy was more likely to reduce turf quality and color than Primo. All rates of Proxy reduced clipping weights similarly, but low rates were less likely to reduce color or quality ratings. Turf density was not affected by Proxy or Primo. Effects of Proxy on creeping bentgrass occurred within two weeks after application and generally dissipated within four weeks, whereas Primo effects occurred within one week after application and generally dissipated within three weeks. Turf quality was occasionally reduced following application of Proxy.

Index words: clipping reduction, ethephon, mowing, plant growth regulator, Primo, trinexapac-ethyl.

Growth regulators used in this study: Primo (trinexapac-ethyl) [4-(cyclopropyl-a-hydroxy-methylene)-3,5-dioxo-cyclohexane-carboxylic acid ethyl ester], Proxy (ethephon) [2-(chloroethyl)phosphonic acid].

Significance to the Nursery Industry

Proxy is at least as effective as Primo for clipping yield reduction on creeping bentgrass maintained at fairway height. Proxy applied at 4.6 to 9.1 kg ai/ha (4.1 to 8.2 lb ai/A) were no more effective than 2.3 to 3.6 kg ai/ha (2.0 to 3.2 lb ai/A) in reducing clipping yields. Higher rates tended to reduce turf color and quality by turning the turf lighter green compared to untreated turf or turf treated with Primo. Proxy can be safely applied twice at 28-day intervals during the spring and early summer but a third application in mid-summer may reduce turf quality.

Introduction

Turfgrass growth regulators have been studied for almost 50 years for their potential to reduce mowing inputs. The effectiveness of growth regulators for reducing growth and mowing requirements in turf is well-documented (12) with new types of PGRs periodically being developed that have fewer detrimental effects on turf aesthetics. Negative effects of earlier growth regulators, which reduced growth by inhibiting cell division, included unacceptable leaf discoloration (8) and inconsistent growth effects across a mixed stand of different species and cultivars (13). The growth regulators labeled for turf over the last 10 to 15 years reduce yields by inhibiting gibberellic acid (GA) production, thereby limiting leaf elongation without stopping cell division, typically with little or no reduction in turf quality. With the improved growth regulators, researchers and practitioners are identifying possible uses of growth regulators beyond simply re-

ducing growth. The newer growth regulators are being used to reduce *Poa annua* populations and seedhead formation in creeping bentgrass (1, 5), increase putting green speed (14), and to improve turf color and quality (2, 4).

Prior to 1998 the most recently released growth regulator for turf was Primo (trinexapac-ethyl). Primo was developed by Novartis, labeled for use in the early 1990s and is now widely used in many sectors of the turfgrass industry. Primo reduces clipping yields by inhibiting GA biosynthesis (7) without reducing tillering (9). In 1998, Rhône Poulenc introduced the growth regulator Chipco Proxy (ethephon) for use on turfgrasses. Proxy has been commonly used as Florel or Ethrel in other horticultural industries and is labeled for use on golf course fairways and commercial lawns. Proxy acts by stimulating ethylene production which reduces growth by indirectly affecting growth hormones (10). On golf courses, multiple applications of growth regulators are used most commonly on fairways to minimize clippings throughout the year. Since creeping bentgrass is the most common species now used on golf course fairways in the northern half of the United States, it is important to evaluate Proxy for use on creeping bentgrass maintained as fairway turf. The objective of this study was to determine the effect of repeated applications of Proxy on growth, visual quality, color, and density of creeping bentgrass maintained at fairway height.

Materials and Methods

The experiments were conducted at the O.J. Noer Turfgrass Facility in Verona, WI, and at the W.H. Daniel Turfgrass Research and Diagnostic Center in West Lafayette, IN, during the 1998 growing season. Experimental conditions in Wisconsin included a four-year old 'Pennncross' creeping bentgrass grown on a Miami silt loam soil with pH of 7.1, 94 kg P/ha (84 lbs/A), and 280 kg K/ha (250 lbs/A), and irrigation supplied at 70% of the evaporation rate three times per week, and a mowing height of 1.3 cm (0.5 in). Experimental conditions in Indiana included one-year-old 'Penneagle' creeping bentgrass grown on a Starks-Fincastle silt loam with pH of 7.3, 177 kg P/ha (158 lbs/A), and 488 kg K/ha (436

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lbs/A), irrigation as needed to prevent stress, and a mowing height of 1.6 cm (0.63 in). Both areas were mowed three times per week prior to application of treatments and then two times per week thereafter, immediately after clipping harvest. Fertilizer was applied to both sites at 48 kg N/ha (44 lbs/A) one week prior to application of treatments as part of the annual fertilization program using a slow-release nitrogen source (sulfur coated urea in Indiana and isobutylidurea in Wisconsin). Plot size in Wisconsin was 1.2×1.8 m (4×6 ft) while plot size in Indiana was plot was 1.5×3.0 m (5×10 ft). The experimental design at both locations was a randomized complete block with three replications. Treatments included three applications each of Chipco Proxy 2E and Primo 1E applied at approximately 28-day intervals. Rates were the same at both locations except for the lowest rate of Proxy. The low rate of Proxy used in Wisconsin was 2.3 kg ai/ha (2.0 lb ai/A) while the low rate used in Indiana was 3.6 kg ai/ha (3.2 lb ai/A). Medium and high rates of Proxy were 4.6 kg ai/ha (4.1 lb ai/A) and 9.1 kg ai/ha (8.2 lb ai/A). Primo was applied at the label rate of 1.0 kg ai/ha (0.9 lb ai/A). An untreated control was included for comparison. Applications were made using CO₂-powered backpack sprayers equipped with flat fan nozzles using 1635 gal water/ha (175 gal/A) on May 5, June 3, and July 6 in Wisconsin and May 21, June 18, and July 16 in Indiana.

Clippings were harvested twice per week with one pass of a 31 cm (12 in) (Indiana) or a 51 cm (20 in) (Wisconsin) wide reel-type greens mower. The clippings were oven-dried at 37C (100F) for at least 48 hours prior to weighing. Immediately after clipping harvest, the entire plot area was mowed with a triplex mower and the area was allowed to regrow for either 3 or 4 days prior to the next harvest.

Visual quality of plots was rated on a scale of 1 to 9 where 1 = dead turf, 5 = acceptable as a fairway, and 9 = excellent. Color was also rated visually on a scale of 1 to 9 where 1 = dead turf, 5 = acceptable green for fairways, and 9 = dark green. Density was estimated on a scale of 1 to 9 where 1 = dead turf, 5 = acceptable as a fairway, and 9 = excellent. All visual data were recorded twice per week until 6 weeks after the last application. Visual ratings and clipping weights were averaged within each week of the study and weekly means are presented. All data were analyzed with MSTAT (6) to detect differences among treatment effects. All data are presented as a percentage of the control.

Results and Discussion

Yield effects. PGR responses varied depending on the location, but turf responses to Proxy within each site were similar regardless of rate (Fig. 1). In Indiana, Proxy reduced clipping yields within 2 weeks of initial application only to increase clipping yields 4 weeks after initial application. Although there were some differences in the magnitude of response due to application rate, all responses followed the same trend regardless of rate. Presumably, the increase in clipping yield was due to mower scalping where Proxy induced bentgrass internode elongation while reducing leaf length (3). During harvest, the mower removed much of the leaf and some of the relatively heavier stem material. Additionally, the Proxy-treated bentgrass appeared puffy and not as low-growing as the untreated and Primo-treated bentgrass, adding to the mower scalping. The second application of Proxy did not affect clipping yields in Indiana, whereas the second application of Primo did reduce clipping weights

within two weeks following application. Both growth regulators effectively reduced clipping yields after the third application with Proxy effects lasting up to 4 weeks and Primo effects lasting 3 weeks.

In Wisconsin, Proxy increased clipping yields only during the first week following treatment, perhaps due to internode elongation. Within three weeks of initial treatment, Proxy reduced yields approximately 40–50% for seven of the 14 weeks of the study, independent of the application rate. Growth reduction effects generally occurred within one to two weeks following application with Primo and two to three weeks with Proxy. PGR effects diminished within four to five weeks regardless of the location.

Differences in treatment effects between the two sites were not surprising based on previously published data which indicated variable effects of PGR treatments (12). Although the turf at the two sites differed in age, with the Indiana location being less than one year old and the Wisconsin location being four years old, turf stands in both locations were mature. The inconsistent effects of treatments in Indiana could be due to the age of the turf and its aggressive growth. This turf area was established in September 1998 and was fertilized to promote rapid establishment with a total of 144 kg N/ha (132 lbs/A) during fall of 1998. The growth regulating effects of the treatments became more consistent later in the summer when the residual N from the previous fall was apparently depleted. Additionally, inherent differences between the cultivars used in the study could have caused the discrepancy in results between the two sites. There are no reports of bentgrass cultivar differences in sensitivity to Primo or Proxy, though differences in Kentucky bluegrass cultivar sensitivity have been noted with other PGRs (11).

Turf quality. In Indiana, Proxy temporarily decreased turf quality following each application while Primo decreased turf quality only after the initial application (Fig. 2). Neither PGR significantly enhanced turf quality compared to the untreated control, but Primo improved turf quality regularly compared to Proxy. In Wisconsin, turf quality was not affected by PGR application until after the third application. Following the third application, Primo enhanced turf quality for the subsequent five-week period. Proxy occasionally reduced turf quality following the third application, particularly at the high rate of 9.1 kg ai/ha (8.2 lb ai/A).

Turf color. Proxy usually decreased turf color within seven days of application, particularly at 9.1 kg ai/ha (8.2 lb ai/A) (Fig. 3). These effects persisted longer than Proxy's effects on either turf yield or quality. In Indiana, Proxy consistently reduced color compared to the control and Primo. This was because of earlier mentioned mower scalping where the mower removed much of the leaf, leaving behind the lighter-green-to-yellow stem. In Wisconsin, the reduction in color due to Proxy was less consistent and dramatic than in Indiana, but the same trends occurred. Primo enhanced turf color throughout the study, beginning within three weeks after treatment in Indiana and four weeks after treatment in Wisconsin.

Turf density. Turf density was not significantly affected by PGR applications in either location (data not shown). It is unknown if multiple applications repeated over two or more years will affect turf density. The lack of effect on turf den-

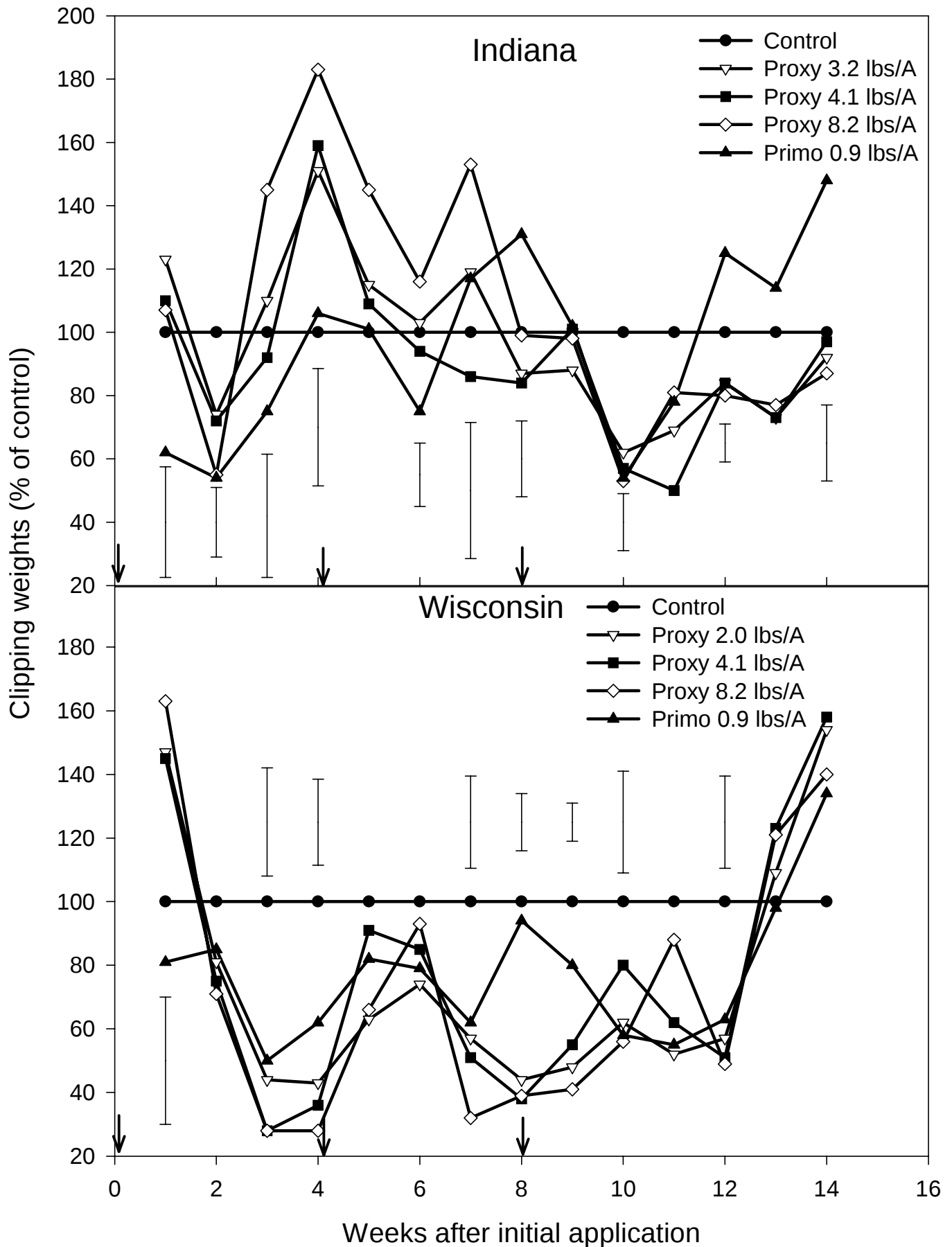


Fig. 1. Effect of Proxy and Primo on clipping weights of fairway height creeping bentgrass grown in Verona, WI, and West Lafayette, IN. Vertical bars represent LSD (0.05) and arrows represent treatment applications.

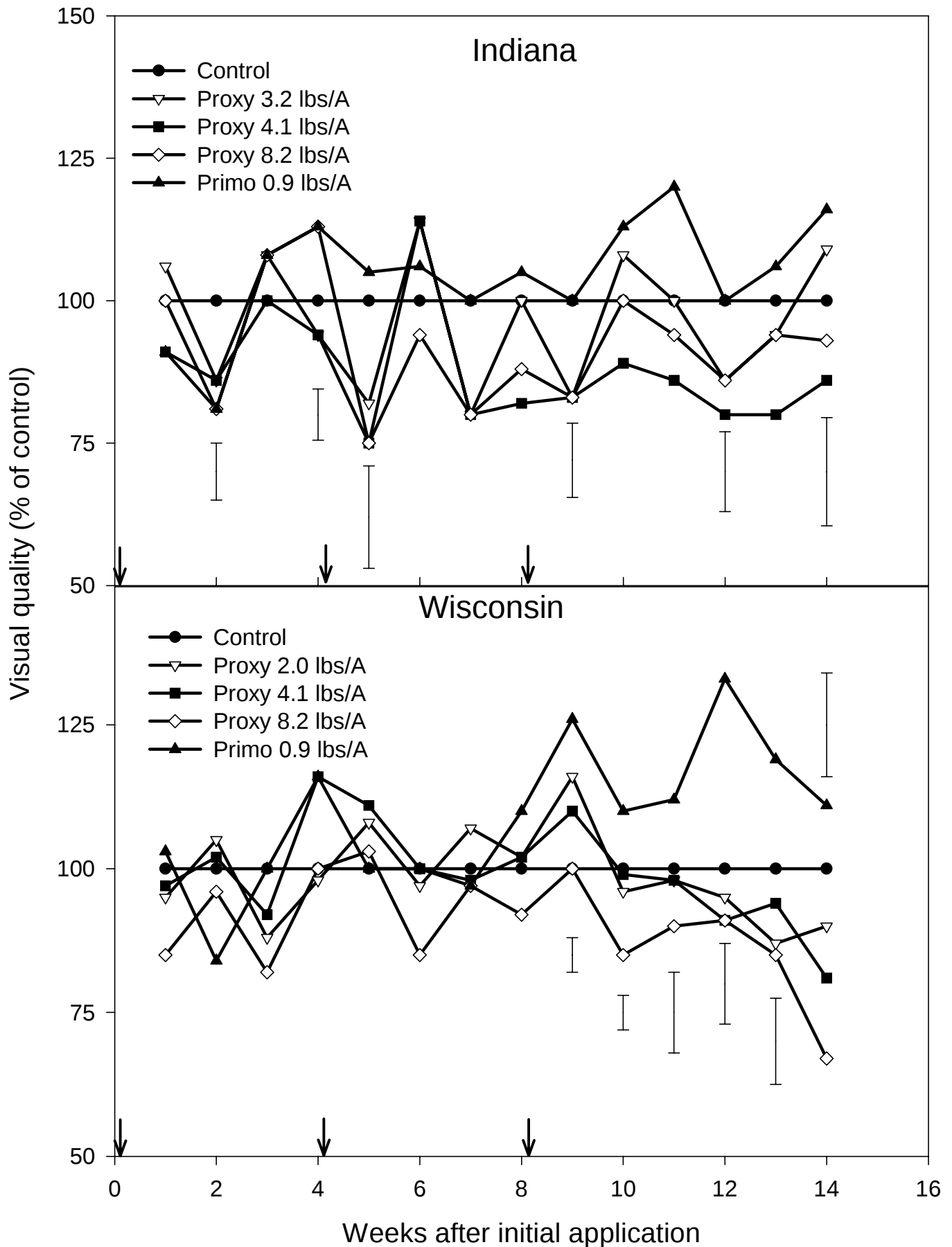


Fig. 2. Effect of Proxy and Primo on visual quality of fairway height creeping bentgrass grown in Verona, WI, and West Lafayette, IN. Vertical bars represent LSD (0.05) and arrows represent treatment applications.

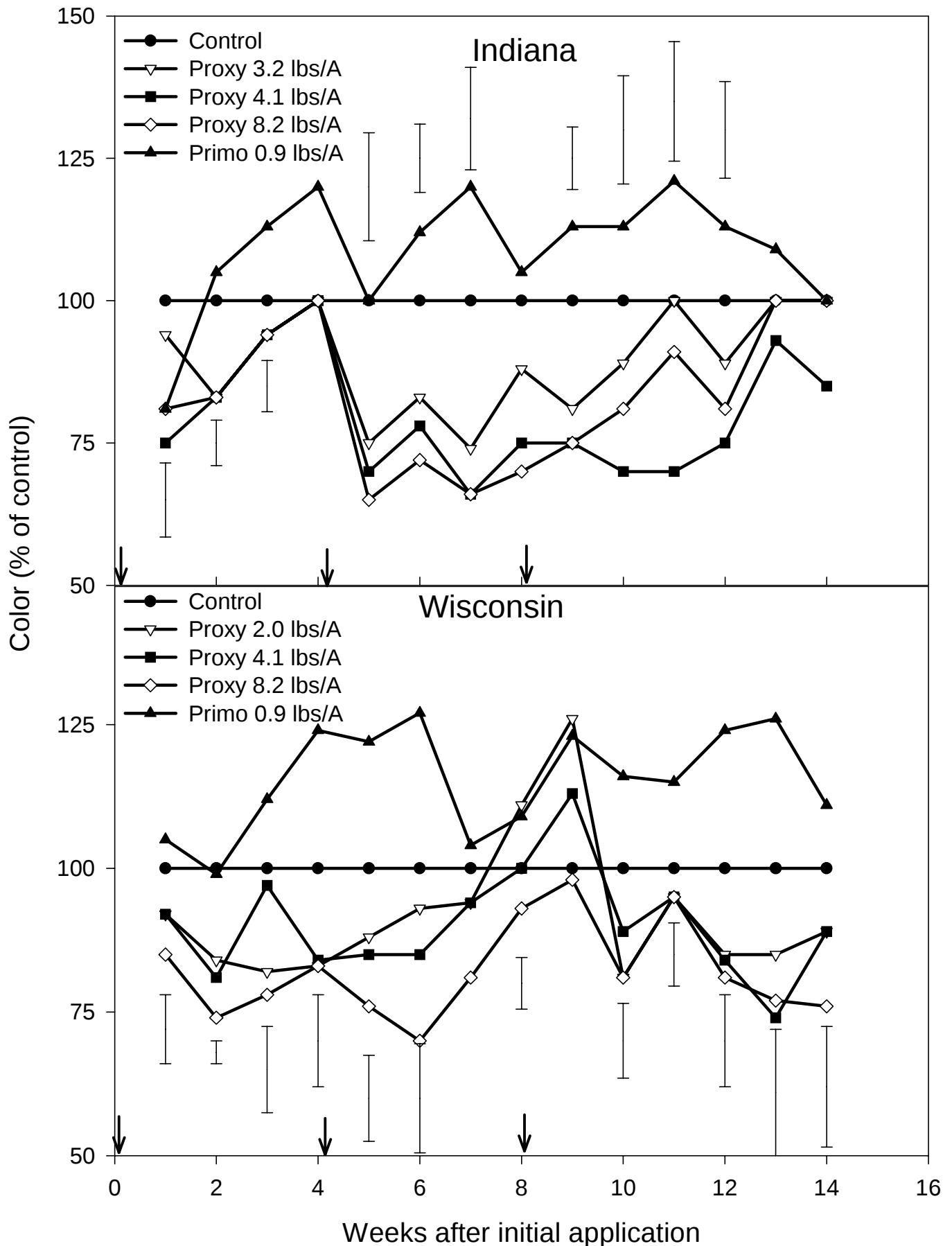


Fig. 3. Effect of Proxy and Primo on color of fairway height creeping bentgrass grown in Verona, WI, and West Lafayette, IN. Vertical bars represent LSD (0.05) and arrows represent treatment applications.

sity indicates Proxy is not dramatically toxic to creeping bentgrass maintained at fairway height. Instead, the occasional reduction in turf quality was limited to cosmetic, and not physical damage.

Proxy appears to be viable for clipping reduction on creeping bentgrass fairways maintained at fairway height when applied at four-week intervals at rates of 2.3 to 3.6 kg ai/ha (2.0 to 3.2 lb ai/A). However, results may vary depending on age of stand or cultivar, and higher rates and more than two applications per year should be avoided because of the potential for reducing visual quality and color of creeping bentgrass.

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