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Management of Annual Bluegrass Putting Greens in California

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Executive Summary

Most golf course superintendents in California are managing annual bluegrass as their putting green turfgrass. The major reason for this norm is the relatively mild climate of the region which usually results in newly established creeping bentgrass putting greens converting to annual bluegrass putting greens in 5 to 7 years. An exception to this rule is the more inland, hotter locations, such as Palm Springs, where bermudagrass and, less frequently, creeping bentgrass putting greens are maintained.

The major problems of managing annual bluegrass putting greens include: summer decline, which includes several issues, such as high temperature stress, disease activity, and salinity stress; seedhead production, especially in the spring; and puffiness during the growing season (October to December and February to June). We investigated fertility and water injection cultivation (WIC) treatments to improve plant performance and soil conditions during the warm season. However, it is possible that these treatments also may influence important plant characteristics during the cool season.

The objectives of this study were: 1) to determine the influence of the annual nitrogen and potassium fertility programs and foliar iron applications on plant performance [visual estimates of turfgrass quality and color, plant stress (e.g. mottling/patchiness and leaf wilting and rolling), disease activity, scalping, and seedhead coverage; root mass density, crown mass, and shoot density counts from plant cores; clipping yield; and concentrations of key nutrients in clipping tissue and soil]; 2) to determine the influence of WIC treatments during the warm season on plant performance; 3) to determine the influence of the fertility and WIC treatments on plant performance during the cool season; and 4) to determine fertility treatment effects on key nutrients in clipping tissue once every 6 weeks, utilizing both standard laboratory and near infrared reflectance spectroscopy (NIRS) methodologies. It should be noted that target ranges for elements in the clipping tissue of annual bluegrass basically have not been reported.

The location of this study was at Industry Hills Golf Courses, City of Industry, California, on an annual bluegrass practice putting green constructed to USGA specifications in 1978. The climate of this location, like much of southern California, is Mediterranean. Visual estimates indicated that the putting green was approximately 80% annual bluegrass and 20% creeping bentgrass. Results from a soil test taken on 3 June 1998, prior to the application of fertility treatments, showed: pH=6.7; EC_e=1.07 $dS \cdot m^{-1}$ (685 ppm total dissolved salts); SAR=2; ESP=2%; Fe=78.9 ppm; CEC=12.0 meq/100 g; OM=3.21%; Olsen-P=45.5 ppm; exchangeable K, Ca, Mg, Na=39, 1443, 170 and 115 ppm, respectively; and 88%, 10%, and 2% sand, silt, clay, respectively. The putting green was irrigated with effluent water with 1999 to 2000 average values as follows: pH=7.2; EC=1.01 $dS \cdot m^{-1}$ (646 ppm total dissolved salts); and SAR=3.2. The effluent irrigation annually supplied N at the approximate rate of 1.0 lb/1000 ft^2.

Eight liquid-applied fertility treatments and two summer-applied WIC treatments were arranged in a strip-plot design with four blocks (replications). Two nitrogen, two potassium, and two iron levels were factorially arranged into eight fertility treatments and were randomly assigned to 5.5- x 12.0-ft main plots that were within each 44.0- x 12.0-ft block. The fertility treatments are shown in a table below. The two WIC treatments were: a Toro HydroJect operated in the raised position once every

3 to 4 weeks from April through October and no WIC treatment. There were a total of 64, 5.5- x 6.0-ft subplots in this study.

Eight liquid-applied fertility treatments were tested in the annual bluegrass putting green management study. Fertility treatments were applied once every 3 weeks.

Treatment designation			lb/1000 ft^2 per year		
N	K_2O	Fe[z]	N	P_2O_5	K_2O
High	High	+	10.0	3.0	12.0
High	High	–	10.0	3.0	12.0
High	Low	+	10.0	3.0	4.0
High	Low	–	10.0	3.0	4.0
Low	High	+	5.0	3.0	12.0
Low	High	–	5.0	3.0	12.0
Low	Low	+	5.0	3.0	4.0
Low	Low	–	5.0	3.0	4.0

[z]Fe only applied to treatments indicated with "+" at 2.0 oz/1000 ft^2 $FeSO_4$ applied foliarly every 3 weeks.

Measurements that were collected during the study included: visual turfgrass quality and color ratings; Minolta spectrophotometer readings; elemental analyses of clippings; clipping yield; irrigation water analyses; soil elemental analyses; shoot density, crown mass, and root mass density from plant cores; and on-site air and soil temperatures. Visual estimates of turfgrass plant stress (e.g. coverage of mottling/patchiness and leaf wilting and rolling), disease activity coverage, seedhead coverage, and scalping coverage were taken on an as-needed basis. The purpose of these measurements was to help adequately describe plant and soil status and plant and soil responses to treatments and other effects, such as temperatures and turfgrass management practices. The practice putting green was managed in a similar manner as the greens on the golf course.

In terms of the results of this study, it should be noted that the Mediterranean climate of this region is very conducive to the growth of annual bluegrass, resulting in it being more competitive than creeping bentgrass on putting greens. A second point that should be made is that the practice putting green was irrigated with effluent. This resulted in the constant spoon-feeding of numerous plant nutrients, including N, P, K, Ca, Mg, and others. The approximate annual 889 mm (35 inches) of irrigation supplied N at the annual rate of 1.0 lb/1000 ft^2. Thus, the high and low N treatment rates were actually 11.0 and 6.0 lb/1000 ft^2 per year, respectively.

Nitrogen

The high N treatment rate was excessive, resulting in plant stress compared to the low N treatment rate. The high N treatment rate had: a similar overall average visual turfgrass quality rating (6.1 on

a 1 to 9 scale) with lower ratings during late spring and summer; a higher overall average visual turfgrass color rating (6.8 on a 1 to 9 scale); an overall average of 106% more seedhead coverage; an overall average of 313% more mottling/patchiness coverage (an indicator of plant stress, characterized by areas of turfgrass with a lighter green visual leaf color, lower visual shoot density, and greater vertical leaf extension rate); an overall average of 273% more leaf wilting and rolling coverage; an overall average of 55% more clipping yield; an overall average of 37% less root mass density of the 0.5- to 3.5-inch root zone; and an overall average of 17% less crown and plant mass.

The low N treatment rate may be close to the optimal N fertilizer rate for annual bluegrass. This is based on visual turfgrass quality (an overall average rating of 6.2) and color (an overall average rating of 6.3) and total N content of clippings. Both N treatments were basically within or higher than the target range of 4.5% to 6.0% total N in clippings of creeping bentgrass. The N rate of 6.0 lb/1000 ft^2 per year may need to be adjusted for other golf courses, depending on numerous conditions, such as: soil type, quality of irrigation water, infiltration rates, salinity and leaching requirements, climate, amount of rainfall, rounds of golf, N application schedule and N source, and Fe applications. Lastly, there is a need to define the minimal annual N fertilizer rate for annual bluegrass.

Iron

The foliar application of Fe as $FeSO_4$ at the rate of 2.0 oz/1000 ft^2 per 3 weeks increased visual turfgrass color ratings (plots treated with Fe had an overall average visual turfgrass color rating of 6.7 while plots not treated had a rating of 6.4) and total Fe content of clippings (however, both Fe treatments were basically within the target range of 100 to 300 ppm total Fe in clippings of creeping bentgrass). An Fe application once every 2 weeks would provide additional color improvement because our observations indicated that the turfgrass color response to $FeSO_4$ lasts for about 2 weeks. It is not unreasonable to believe that, in terms of visual turfgrass color, the amount of N fertilization may be reduced when a successful Fe fertilization program is used. This assumes that necessary growth is maintained.

Potassium

Other than total K content in clippings, we observed no difference between the high and low K treatments for all plant measurements. The high K_2O rate was 12.0 lb/1000 ft^2 per year while the low K_2O rate was 4.0 lb/1000 ft^2 per year. Our plant data were in spite of the fact that the low K treatment resulted in relatively low exchangeable K levels in the soil (overall average exchangeable K levels in the soil during 1999 and 2000 were 106.4 and 66.2 ppm for high and low K treatments, respectively). It should be noted that the effluent irrigation annually applied K at the approximate rate of 2.8 lb/1000 ft^2. Both K treatments were basically within or higher than the target range of 2.2% to 2.6% total K in clippings of creeping bentgrass. These data most likely support the approximate ratio of 3N:2 to 3 K_2O for a fertilizer schedule of a sand-based annual bluegrass putting green. Additional amounts of K above this ratio probably do not enhance the stress resistance of annual bluegrass.

Water injection cultivation during the summer

The summer WIC treatment significantly reduced leaf wilting and rolling during two of four rating dates. However, WIC treatments basically did not affect root mass density. Stated in the positive, WIC summer treatments neither harmed nor enhanced root mass density. This is notable because in a previous study on the same practice putting green, WIC treatments during the summer significantly increased field infiltration rates and lowered soil EC_e compared to check plots; also, root mass density was neither harmed nor enhanced by WIC treatments.