Iron pumps up creeping bentgrass

With iron applications, annual bluegrass looks better, bentgrass grows better.

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Annual bluegrass (*Poa annua*) and creeping bentgrass (*Agrostis palustris*) are the two major cool-season species on golf course putting greens, although annual bluegrass is often considered a very troublesome weed (4). Frequent irrigation, a high level of nitrogen, possibly phosphate and a low level of sulfur encourage annual bluegrass growth (6).

Many types of annual bluegrass exist on greens. Some genotypes produce prolific seedheads, whereas others are primarily vegetative and seldom flower. Seedheads disturb the beauty of turf and greatly reduce putting quality. In addition, yellowing and susceptiblility to summer heat and drought limit annual bluegrass's usefulness in turf (6).

Although iron applications can boost *P. annua* growth and color, our research shows that the nutrient gives a greater growth boost to creeping bentgrass, which may lend an advantage to bentgrass on golf courses where annual bluegrass is considered a weed.

Iron is associated with plant chlorophyll synthesis. It greatly contributes to turf color and growth (5). However, annual bluegrass's iron requirements have not been previously determined.

Knowing how genotypes of annual bluegrass respond to varying levels of iron will help turf scientists and managers facilitate annual bluegrass development or minimize its infestation of putting greens.

Although iron is a relatively abundant element in most soils, it frequently limits turf growth, especially in alkaline and calcareous soils. Iron chlorosis may become a problem on sandy greens if iron leaches by irrigation or rainfall. Clipping removal makes recycling iron impossible. Heavy foot and vehicle traffic cause soil compaction, limiting plant uptake of iron, which may lead to iron deficiency.

Application of iron is usually effective for remedying iron chlorosis. However, indiscriminate use can lead to serious turf injury (1). Use of effluent irrigation water and sewage sludge can also exacerbate burning from excess iron.

A sufficiency range of iron at 35-100 milligrams per kilogram in shoot tissue has been reported for turfgrass (5). These values are average, however, and do not represent the levels at which deficiencies or toxicities can occur. Plant species, cultivars, genotypes and even the developmental stage may cause iron demand and tolerance to vary considerably (3). It will be difficult to make fertilizer recommendations until these levels are better defined.

The objectives of this research were to determine the color and growth response of three vegetative and three flowering genotypes of annual bluegrass and three parents of creeping bentgrass to varying levels of iron and to determine whether interspecific or intraspecific differences exist in iron requirements.

Materials and methods

Two experiments were conducted in greenhouse sand culture medium. Three vegetative and three flowering genotypes of annual bluegrass were used and compared with three parents of Penncross

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Key points

- Iron applications cause more growth in creeping bentgrass than in annual bluegrass.
- Annual bluegrass will attain better color than creeping bentgrass at higher rates of iron.
- Superintendents might be able to use iron to enhance the competitiveness of creeping bentgrass while improving the appearance of annual bluegrass.

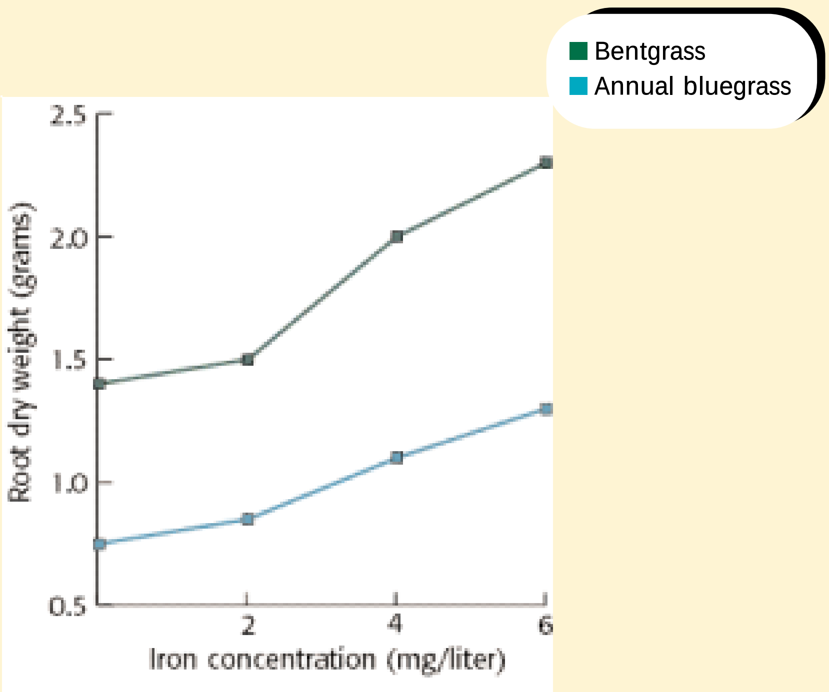
creeping bentgrass. David R. Huff, Ph.D., collected the annual bluegrass from the putting greens of Oakmont Country Club in Pennsylvania.

All strains were vegetatively propagated in pots filled with 80 percent sand and 20 percent peat under greenhouse conditions to ensure the genetic purity of individual genotypes. Then tillers were washed and transferred to cones filled with white sand. Soil analysis indicated 46.7 milligrams per kilogram of iron in the original sand and 16.8 milligrams per kilogram of iron after the sand was washed for the second experiment.

Treatments began when plants were irrigated with half-strength Hoagland's nutrient solution (pH 5.5-6.0) every other day by hand (2). Application rates were 0, 2, 4 and 6 milligrams of iron per liter from citrate-iron in the initial experiment lasting three weeks, and 0, 2, 4, 6 and 8 milligrams of iron per liter in the repeat experiment.

The temperature of the greenhouse was up to 78 F during the day and as low as 60 F at night. Daytime light intensity fluctuated, depending on weather conditions.

Root growth



Bentgrass roots get a greater boost from iron than annual bluegrass roots do.

Turf color

Annual bluegrass, which started with low leaf color, gave an average 137.8 percent color improvement in response to iron up to 6 milligrams per liter. Color increase was 69.7 percent for creeping bentgrass.

Untreated controls exhibited light to yellow green color on younger leaves in both annual bluegrass and creeping bentgrass. Plants treated with iron became darker green in both species with increasing concentrations of iron up to 6 millgrams per liter. At 2 milligrams per liter, iron was still deficient because the treatment did not produce acceptable color in either species. No toxicity was detected in either species, even when we increased iron concentration in nutrient solution up to 8 milligrams per liter in the repeat experiment.

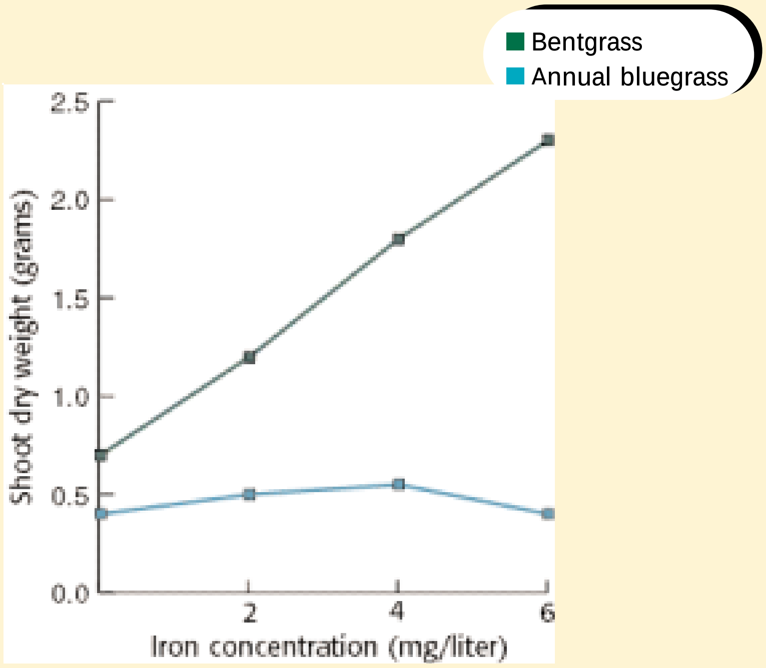
Annual bluegrass readily exhibited leaf discoloration without added iron, but had a notable color response at high levels of iron applied, and became greener than bentgrass at the higher iron rates. Color response among bentgrass genotypes was about the same, although differences were observed among annual bluegrass genotypes.

Turf shoot growth

Compared with the controls, all levels of iron significantly increased both species' shoot growth as indicated by shoot fresh weight. An increase in creeping bentgrass fresh shoot weight occurred with increasing iron application rates up to 8 milligrams per liter. However, the greatest shoot growth did not always correspond to the highest iron concentration in annual bluegrass. Although no visual phytotocity symptoms appeared, plant fresh weight declined in annual bluegrass as iron concentration in the nutrient solution increased beyond 4 milligrams per liter.

The three creeping bentgrasses that had greater fresh weight also produced greater shoot dry weight than annual

Shoot growth



Bentgrass shoots grow more vigorously with applications of iron, while annual bluegrass shoot growth slows.

bluegrass at each level of iron tested. Again, there was no difference between genotypes within species.

Root production

Plants receiving iron applications had a significantly higher root dry weight production than untreated controls at all levels. Generally, the low levels of iron (less than 6 milligrams per liter) increased plant root growth considerably, whereas higher levels (8 milligrams per liter) did not increase growth proportionally. Depressed root growth was evident in annual bluegrass when the iron concentration in nutrient solution increased to 8 milligrams per liter.

Conclusion

Iron applications improve turf leaf color, but high application rates can result in growth depression, especially in annual bluegrass. Iron fertilization might be an efficient management strategy in promoting creeping bentgrass growth but is less effective in enhancing its leaf color. ■

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