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TURFGRASS TRENDS

INTERSEEDING

Four Tips to Interseed Bentgrass into *Poa annua*

Generous, midsummer plantings can bolster germination

By Doug Brede, Ph.D.

Establishing creeping bentgrass into an existing stand of annual bluegrass (*Poa annua*) while the turf is in play has been an elusive goal of many golf course superintendents. Years ago I learned the hard way just how challenging it can be.

After graduating from Penn State University, I was working as an assistant superintendent for a country club near Pittsburgh. One early fall day, my boss suggested that we improve our bentgrass-with-annual bluegrass fairways by cutting in some Penncross seed to increase the bent population. At that time the fairways were about 30 percent to 40 percent annual bluegrass with the rest a mix of colonial and creeper.

The crew and I spent a week verticutting all 27 fairways and dropping Penncross seed into the open slits. Lo and behold after two weeks, we noticed slivers of grass emerging in beautiful corn rows. Another week brought even more seedlings until we had a stand, of which we were really proud after four weeks .

But perhaps a bit too proud. My boss rescheduled the next meeting of the local superintendents group at our course to show off my handiwork. By this time the individual seedlings were starting to tiller out. When the superintendents took out their hand lenses to get a closer look at our new seedlings, they found that (horrors!) almost every new seedling was *Poa annua*.

That vivid experience planted the question in my brain: What happened to the bentgrass? After earning my doctorate, I decided it was time to learn why my interseeding failed and see what could be done to make bentgrass interseeding a success.

What doesn't work

My years of golf course work and research have taught me something: To paraphrase Thomas Edison — I've discovered a thousand ways to unsuccessfully interseed a green. Many tools that you would swear would help, actually do no good.

Take plant growth regulators (PGRs) for example. Most PGRs inhibit gibberellin, the hormone in plants that causes blades to elongate. PRIMO has a side benefit that plant energy normally used to elongate leaves is channeled instead to grow lateral shoots. That's why superintendents like it: It thickens up the turf while reducing mowing.

Unfortunately, a denser turf makes a more formidable competitor against emerging seedlings. Thus the net effect of most PGRs on interseeding is, at best, a wash. (Trimmit is the exception to the rule, as it acts as a mild herbicide against *Poa annua*.)

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Four steps to success

1) The right time of year. Early autumn is generally regarded as the ideal time to establish cool-season grasses. But it is entirely the wrong time to interseed into *Poa*. Autumn is when *Poa annua* germinates. During that time it can outrun most any other grass, just as it did in my failed interseeding attempt.

Research I did for my doctoral thesis helped suggest *Poa annua*'s Achilles' heal: *Poa's* growth nearly stops when day lengths are at their max, during June and July. At this time, *Poa* is relegating its energies away from shoot growth and toward flowering, opening up a prime window for interseeding. Warm soil temperatures are another contributor.

James Beard (Beard, 1978) found good *Poa annua* germination at temperatures of 40, 50, 60 or 70 degrees Fahrenheit, but he found a substantial drop in germination at 80 and 90 F. Bentgrass has no trouble germinating in warm temperatures.

Jim Murphy and his colleagues (Henry, et al., 2002) put theory into practice in a series of monthly interseedings on a New Jersey *Poa* green. Spring and fall plantings were of limited success (less than 10 percent bentgrass), while midsummer sowing, coupled with a good variety, resulted in 40-percent coverage with bentgrass.

2) **The right seeding rate.** The standard bentgrass seeding rate for bare soil is 1 pound per 1,000 square feet. Most folks in the past have used one-half pound to interseed. A study at Virginia Tech using Southshore bentgrass interseeded into Penncross/*Poa annua* turf showed that "higher rates of seed, 2 pounds per 1,000 square feet or more, were desirable to increase numbers of plants in the turf" (Bigelow and Chalmers, 1995).

Higher seeding rates compensate for seedling mortality rates, which can reach 90 percent.

3) **Plant seed into soil.** The old axiom of "sowing seed into soil" holds true for interseeding. To be successful, you've got to get seed into intimate contact with the soil so it can germinate. Seed does no good if it is sitting in the leaf canopy, buried under an inch of sand in a core hole or collected in the mower buckets. Grooming, vertical mowing, aerification and topdressing all can be used to plant the seed successfully. Some manufacturers now have machines that slit, interseed and firm in one pass — with no disruption in play.

4) **Use a variety that outcompetes *Poa*.** Penncross and many of the older-generation bent varieties were not competitive enough to keep up with *Poa*. I wanted to change all that, so I used a series of unique polka-dot spots of bent, sprigged on a grid system into a *Poa* green. Only bent strains that fought the *Poa* and won were selected in the development of two new bent varieties, T-1 and Alpha.

To test these new *Poa*-aggressive varieties, I established a trial on a 2-acre *Poa annua* test green (mowing height 0.156 inch) in Post Falls, Idaho. Seed was applied to plots in May 2005 during a routine topdressing operation. No vertical mowing or aerification was used to simulate a worst-case scenario for the seedlings to establish, so we used topdressing alone.

I expected positive results because I already knew Alpha and T-1 had incredible competitive power versus *Poa*. But I was surprised at how quickly they overran the *Poa*. Three months after the trial was seeded, more than one third of the *Poa annua* surface had turned to bentgrass. By summer 2006, many plots had greater than 80 percent bentgrass.

Like Bigelow and Chalmers, I found that higher seeding rates (2 to 4 pounds per 1,000 square feet) aided establishment. Bentgrass area essentially doubled with each doubling of the seeding rate. Many superintendents are reluctant to try higher rates, believing too much seed would lead to weak seedlings that unduly competed with each other. However, this thought was not supported by the data.

Our newest research is centered on identifying which cultural technique (coring, etc.) offers the fastest conversion to bent. Stay tuned for those results in a future edition of TurfGrass Trends.

Doug Brede is research director and an operating officer for Jacklin Seed. Before joining Jacklin Seed, he was associate professor of turfgrass management at Oklahoma State University in Stillwater. He earned his B.S., M.S., and Ph.D. degrees at Penn State University in turfgrass agronomy. Prior to graduate school, he managed a 27-hole golf course near Pittsburgh, Pa. He has written more than 100 articles on turfgrass science and the book "Turfgrass Maintenance Reduction Handbook," which details ways to optimize a maintenance budget.

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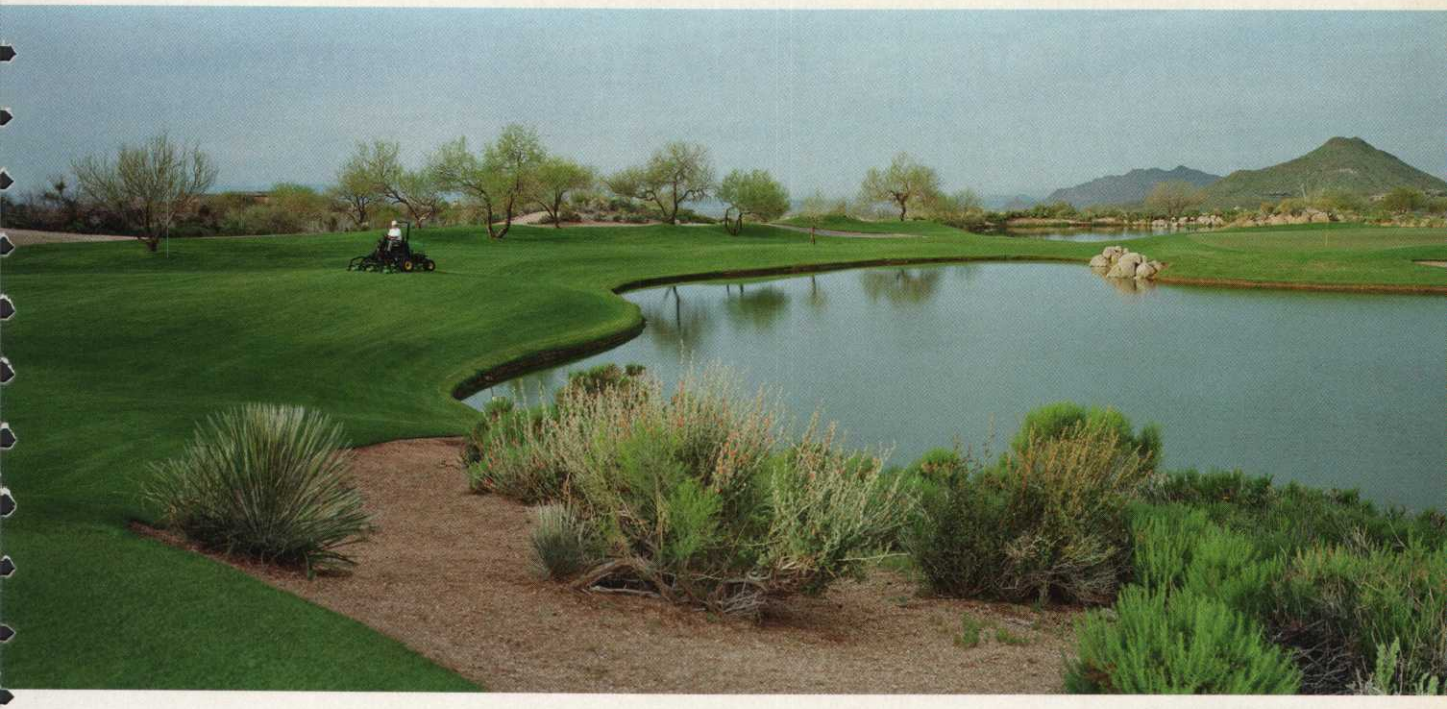

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Herbicide Trials Show Mostly Short-term Injury to Bermudagrass Seedlings

By Michael D. Richardson, John W. Boyd, Douglas E. Karcher, John H. McCalla and Josh W. Landreth

Until recently, seeded bermudagrass (*Cynodon* spp. L.) cultivars were considered of low quality and did not perform as well as vegetative hybrids such as Tifway or Midlawn. Although lower-quality, seeded cultivars provided an adequate turf for home lawns and utility areas, they did not produce an acceptable turf for golf course, sports field or other high-maintenance applications.

In recent years, a renewed interest in seeded bermudagrass breeding yielded several new seeded cultivars that perform much better than older seeded types and can even perform as well as the established vegetative hybrids. Of the new seeded cultivars, Princess, Yukon and Riviera are widely accepted due to their very high shoot density, dark-green color and enhanced stress tolerance. These improvements in turf quality have stimulated considerable interest from the turfgrass industry because a high-quality bermudagrass turf is attainable using a seeded cultivar.

Ability to control weeds during the emergence and establishment period will be a key factor in the success of these new seeded bermudagrass cultivars. Competition during the seedling stage, especially from warm-season, annual grasses such as crabgrass (*Digitaria* spp (L.) Scop.) and goosegrass (*Eleusine indica* (L.) Gaertn.) could inhibit stand establishment and reduce overall stand density significantly. Although numerous studies have investigated the efficacy and safety of postemergence herbicides on established bermudagrass turf, there have been limited studies that address postemergence herbicide tolerance on seeded bermudagrass, especially during the critical establishment period. Currently, Drive (quinclorac) is the only postemergence herbicide that is labeled for use during seedling establishment of bermudagrass, and previous studies have confirmed its safety.

TABLE 1

Herbicides and rates used for Study 1

Herbicide	Rate*
MSMA	1.0
metsulfuron	.019
diclofop	1.0
clopyralid	0.5
dicamba	0.5
2, 4-D amine	0.5
quinclorac	0.75

*Pounds of active-ingredient product/acre

The objectives of our research were to examine the safety of a wide range of herbicides and tank-mixes on seedling bermudagrass.

Analysis of herbicide tolerance

Two field studies were each conducted during two growing seasons at the University of Arkansas Research and Extension Center in Fayetteville.

The soil at the site is captina silt loam with an average pH of 6.2. Prior to planting, the sites were fumigated with methyl bromide (67 percent) and chloropicrin (33 percent) at 350 pounds per acre. Fumigation of the soil provided a weed-free seed bed so injury effects of various herbicides and establishment rates of the bermudagrass could be measured more easily .

In Study 1, Princess was seeded at 1 pound per 1,000 square feet on May 31, 2000, and June 1, 2001. The site was irrigated with an automated irrigation system to provide optimum moisture conditions for germination and establishment of the seed and to maximize grow-in. Plots were amended with phosphorous and potassium prior to planting according to soil test recommendations.

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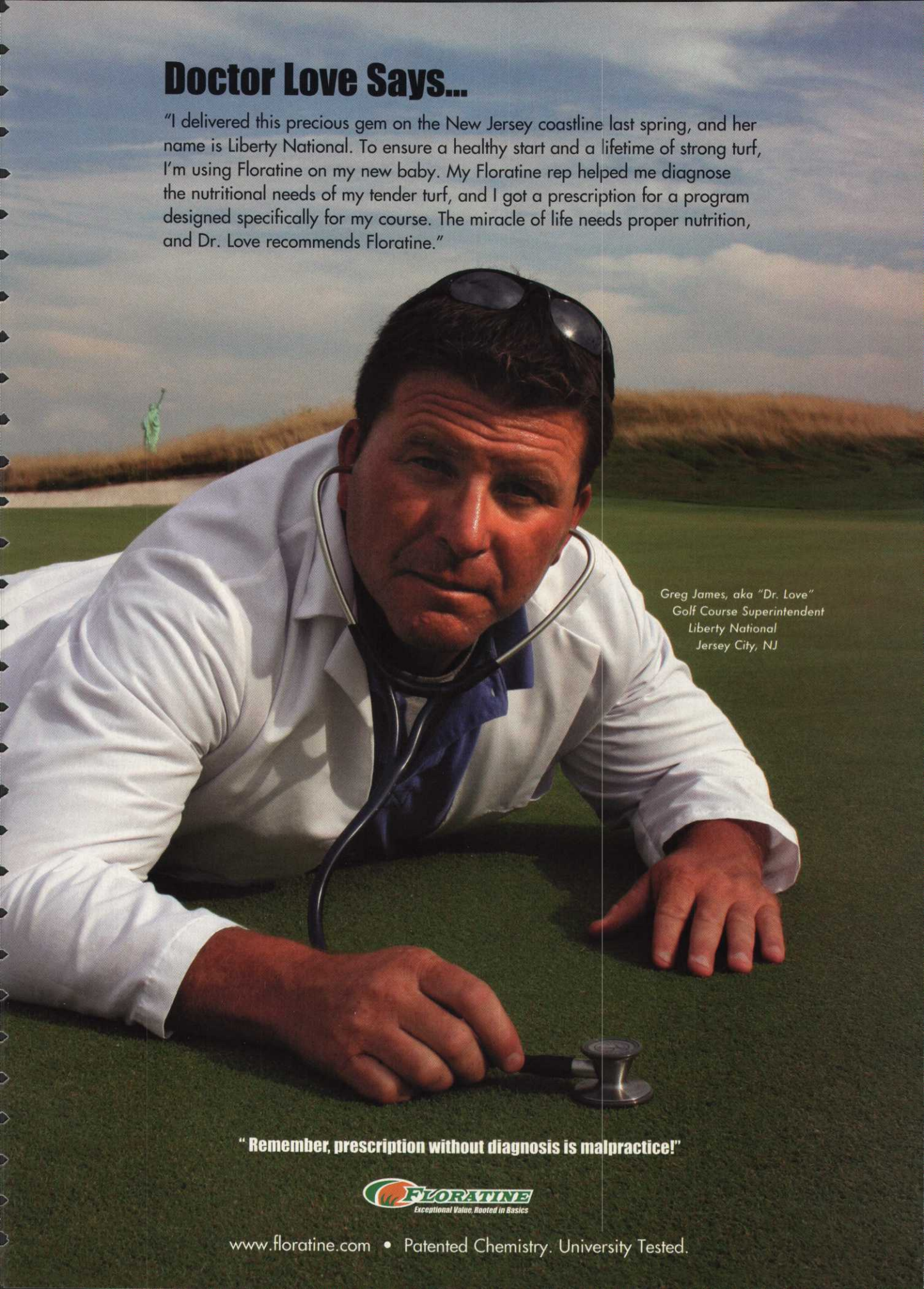

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TABLE 2

Herbicide combinations and rates used for Study 2

Treatment	Chemical 1 (active ingredient) (product / acre)	Rate	Chemical 2 (lb. a.i. / acre)	Rate
1	Confront (clopyralid + triclopyr)	1.0 pt.	MSMA	2.0
2	Drive (quinclorac)	1.0 lb.	MSMA	2.0
3	Drive (quinclorac)	1.0 lb.		
4	Katana (flazasulfuron)	3.0 oz.	MSMA	2.0
5	Lontrel (clopyralid)	1.0 pt.	MSMA	2.0
6	Monument (trifloxysulfuron)	0.75 oz.	MSMA	2.0
7	Revolver (foramsulfuron)	17.4 oz.	MSMA	2.0
8	Sencor (metribuzin)	0.5 lb.	MSMA	2.0
9	Trimec Classic (2,4D + mecoprop + dicamba)	3.5 pt.	MSMA	2.0

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Nitrogen (N) was applied as urea, beginning five days after first emergence, at a rate of one-half pound N per 1,000 square feet, and re-applied every two weeks during the test.

Seven herbicide treatments (Table 1, p. 44) were applied at one, two and four weeks after emergence (WAE). Full emergence was considered the point where seedlings had emerged on about 75 percent of the plot based on a visual analysis. Plot sizes were 4 feet by 6 feet. Visual injury ratings of each herbicide treatment were taken at three, five, seven, 15 and 30 days after treatment (DAT). For brevity, the data discussed are for treatment applications two weeks after emergence.

Methods for Study 2

Riviera bermudagrass was seeded at 1 pound per 1,000 square feet on June 15, 2003, and June 1, 2004. Plot size, irrigation, fertilization and mowing practices were similar to Study 1.

Nine postemergence herbicide treatment combinations were applied at two and four WAE at a rate in compliance with the manufacturer's label. Visual injury ratings were taken on all plots at three, five, seven, 10, 14, 21 and 28 DAT. Visual injury ratings were taken using a scale from 0 to 9 with 0 being no injury and 9 being death of all plants. A score of 3 or less was considered an acceptable level of injury. For brevity, the data discussed are for treatment applications two WAE.

Results

In 2000 and 2001, diclofop caused unacceptable injury to seedling turf, with herbicide injury ratings approaching 6 in both years. The maximum injury with diclofop was observed between the three and seven DAT timings for both seasons. Injury ratings remained above the acceptable level for at least seven days in both years of the trial.

Diclofop has been used effectively on established hybrid bermudagrass and Johnson reported that a single application of diclofop at 1 pound per 1,000 square feet was safe on established common bermudagrass. However, it is apparent from our studies that seedling bermudagrass is more sensitive to diclofop than mature bermudagrass.

Although the turf eventually recovered from the diclofop injury, the current recommendation would be to avoid applications of diclofop during establishment of bermudagrass unless goosegrass is present in high concentrations. In cases with heavy infestations of goosegrass, the injury caused by diclofop would not be as damaging as the reduced stand caused by heavy competition from an aggressive weed.

Metsulfuron also caused unacceptable levels of injury to the seedling bermudagrass in

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both seasons and the injury was generally most severe at three DAT. By 15 DAT, the seedlings began to recover, and the injury was completely absent by 30 DAT. Although injury observed with metsulfuron in this study is slightly more severe than what had been observed on mature Tifway and Tifdwarf bermudagrass, turf recovered quickly, and metsulfuron should not cause a serious problem if used during establishment.

Herbicide injury, on plots treated with 2,4-D, was highest between three and five DAT across both years of the study and unacceptable levels of injury were observed at various times after treatment. However, these levels of injury were only observed for short periods of time each year and were never considered a serious problem. Coats et al. found similar results on mature common bermudagrass, with injury from 2,4-D temporary and lasting only two weeks. Much of the recent research involving 2,4-D has focused on its use in three-way herbicide combinations with dicamba and mecoprop. In those studies it was found that three-way broadleaf herbicide combinations caused more severe injury than 2,4-D alone, but injury was also temporary.

Dicamba, clopyralid and quinclorac, which could be alternative broadleaf herbicides to 2,4-D, generally caused minimal levels of injury to bermudagrass seedlings in both years of the trial, which is consistent with previous results on these herbicides. Johnson found that four established seeded cultivars were tolerant to dicamba at the 0.5 pounds per acre rate, and common bermudagrass was more susceptible than improved seeded cultivars at that application rate. Johnson reported that clopyralid caused moderate discoloration to established common bermudagrass, but full recovery occurred within one week. Numerous studies show that quinclorac can be used safely on both seedling bermudagrass and established hybrid bermudagrass.

MSMA caused minimal injury to seedling bermudagrass in both 2000 and 2001. These results are similar to those of Bell et al., where MSMA caused minimal injury on established Yukon bermudagrass. Injury caused by MSMA completely subsided by 30 DAT.

Collectively, these data suggest that MSMA can be used safely on seedling bermudagrass during establishment to control problematic weeds such as crabgrass.

Results of Study 2

When the effects of herbicide combinations were evaluated in 2003 and 2004, metribuzin + MSMA was the only herbicide combination that caused unacceptable levels of injury for an extended period in both years of the trial. All of the herbicides caused some injury soon after application, but the bermudagrass recovered quickly and most of the injury remained below acceptable levels throughout the evaluation period. Quinclorac generally caused the least amount of injury in both 2003 and 2004.

For those herbicides used to control grassy weeds, quinclorac had good safety on seedling bermudagrass, which is in agreement with earlier reports. When quinclorac was tank-mixed with MSMA, herbicide injury was increased, but the injury remained at or below acceptable levels. Metribuzin + MSMA caused significant damage to the seedling bermudagrass in both years of the trial, although the injury was greater in the 2003 trial compared to 2004 (Table 2, p. 46).

Although this is the first report of seedling bermudagrass tolerance to metribuzin + MSMA, McElroy and coworkers reported very high levels of injury on seedling bermudagrass with atrazine, a herbicide with a similar mode of action to metribuzin. This herbicide combination also causes a significant reduction in turfgrass quality when applied to mature common bermudagrass types.

Although metribuzin + MSMA is commonly used to control goosegrass in established bermudagrass, the extent of injury observed on seedling bermudagrass suggests this is an unacceptable combination to use during the first few weeks of establishment.

The broadleaf herbicides tested in these trials caused modest levels of injury to seedling Riviera, but turf only exceeded unacceptable levels of injury on a few evaluation dates.

The three-way herbicide (2,4-D, dicamba and mecoprop) + MSMA caused significant discoloration of the turf for up to 14 DAT, but the turf had recovered fully by 21 DAT. These findings are similar to those reported by McElroy, et al., on four seeded bermudagrass cultivars, including Riviera.

The clopyralid + triclopyr + MSMA treatment caused slightly higher injury ratings compared to the clopyralid + MSMA. Other researchers reported a 10-percent rate of injury with clopyralid + triclopyr on juvenile Riviera bermudagrass, which is similar to the injury observed in the present trial. Mature common bermudagrass has also shown tolerance of clopyralid and clopyralid + triclopyr combinations.

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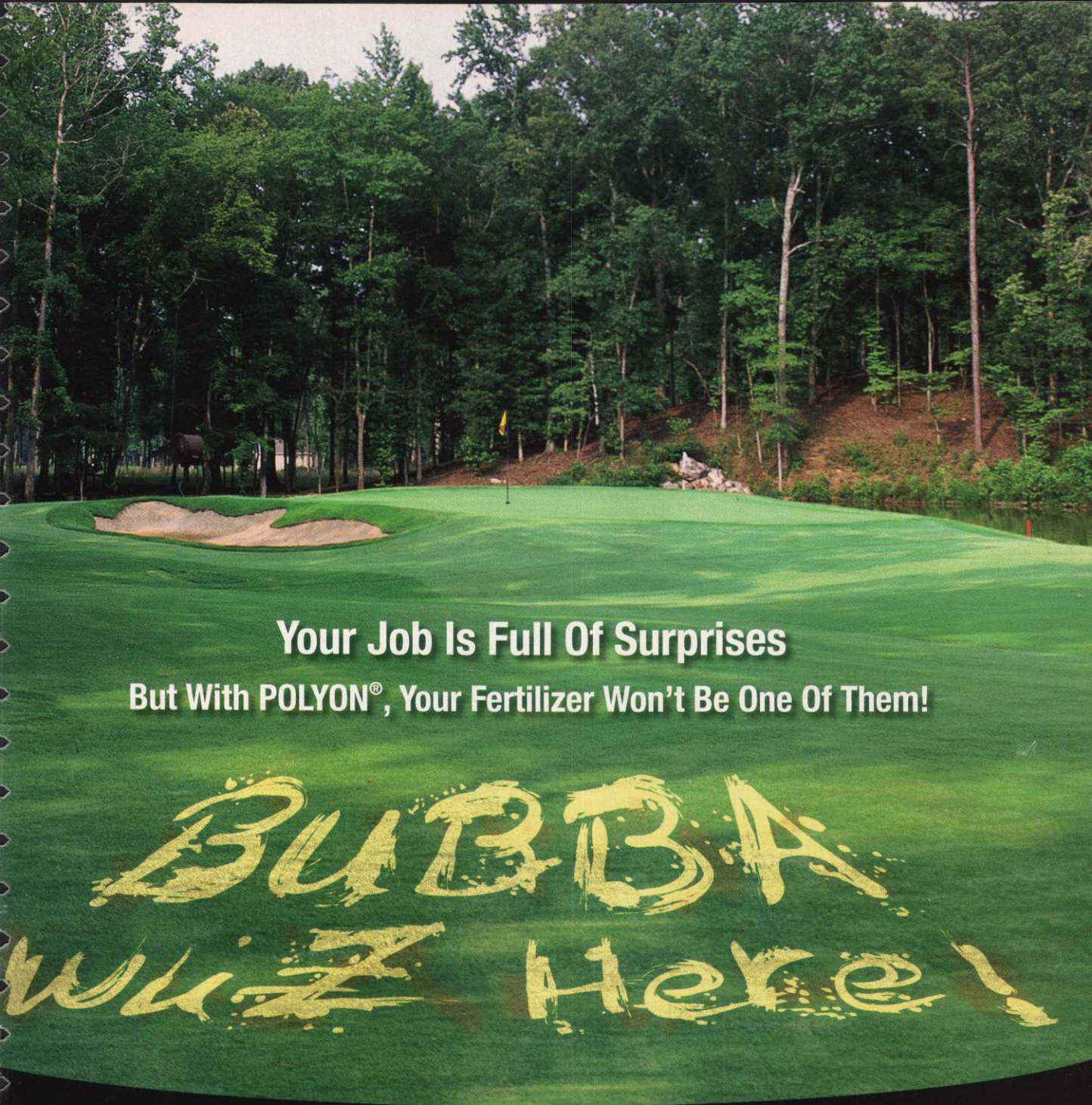

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Most of the broadleaf herbicides tested in this trial and by other researchers appear to have relatively good safety on seeded bermudagrass during establishment. Therefore, a number of herbicide combinations are available to control both annual and perennial broadleaf weeds during the establishment of seeded bermudagrass.

Three herbicides tested in this trial fall under the sulfonylurea class of herbicide, including foramsufuron, trifloxysulfuron and flazasulfuron. These herbicides, in combination with MSMA, caused relatively low levels of injury to Riviera bermudagrass.

Most of the injury was observed within the first 14 DAT and was not present at 21 DAT. The level of herbicide injury was similar for all three herbicides tested from this group. The present trial indicates that these herbicides can be safely used on seedling bermudagrass as early as two weeks after emergence.

Conclusions

The herbicide combinations tested in these trials caused varying levels of turfgrass injury to seedling bermudagrass, but most of the injury was generally short-lived and did not significantly reduce the rate of turfgrass coverage in most treatments. The treatments tested here and in previous studies offer broad-spectrum control for many of the problematic weeds that can reduce bermudagrass establishment.

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