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.

Continued on page 46

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

Continued from page 44

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

Continued on page 48

Continued from page 46

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 co-workers 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.

Continued on page 50

To see additional figures and charts for this issue, visit:

www.turfgrasstrends.com.

Continued from page 48

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.

Acknowledgements

The authors would like to thank the United States Golf Association, the Golf Course Superintendents Association of America and the Golf Course Superintendents Association of Arkansas for their financial support of this research.

Michael D. Richardson (mricha@uark.edu) is associate professor in the Department of Horticulture at the University of Arkansas, Fayetteville. John W. Boyd is extension weed scientist with the Cooperative Extension Service at the University of Arkansas, Little Rock. Douglas E. Karcher is associate professor; John H. McCalla is a research specialist; and Josh W. Landreth is a research specialist. All are in the Department of Horticulture at the University of Arkansas, Fayetteville.

REFERENCES

Beard, J.B. 1973. Turfgrass : Science and Culture. Prentice-Hall Publishing: Englewood Cliffs, NJ.

Bell, G.E., D.L. Martin, R.M. Kuzmic, M.L. Stone, and J.B. Solie. 2000. Herbicide tolerance of two cold resistant bermudagrass (Cynodon spp.) cultivars determined by visual assessment and vehicle-mounted optical sensing. Weed Tech. 14:635-641.

Busey, P. 2004. Goosegrass (Eleusine indica) control with foramsulfuron in bermudagrass (Cynodon dactylon) turf. Weed Tech. 17:550-553.

Coats, G.E., J.H. Jordah Jr., and J.T. McGregor, Jr. 1985. Field evaluation of postemergence herbicides for Virginia buttonweed control in turf. Bull. Miss. Agric. For. Exp. Stn.: The Station. Apr . (937) 6 p.

Johnson, B.J. 1995. Tolerance of four seeded common bermudagrass (Cynodon dactylon) types to herbicides. Weed Tech. 9:794-800.

Johnson, B.J. 1996. Tank-mixed herbicides for large crabgrass (Digitaria sanguinalis) and goosegrass (Eleusine indica) control in bermudagrass (Cynodon dactylon) turf. Weed Tech. 10:716-721.

Johnson, B.J. 1997. Tank-mixed postemergence herbicides for postemergence goosegrass control in bermudagrass turf. J. Env. Hort. 15:33-36.

Johnson, B.J. 2001. Effects of herbicide treatments on suppression of seashore paspalum (Paspalum vaginatum) in bermudagrass (Cynodon spp.). Weed Tech. 15:63-169.

Lowe, D.B., T. Whitwell, S.B. Martin, and L.B. McCarty. 2000. Yellow nutsedge (Cyperus esculentus) management and tuber reduction in bermudagrass (Cynodon dactylon x C. transvaalensis) turf with selected herbicide programs. Weed Tech. 14:72-76.

McCalla, J.H., Richardson, M.D., Boyd, J.W., and Karcher, D.E. 2004. Tolerance of seedling bermudagrass to postemergence herbicides. Crop Sci. 44:1330-1336.

McCarty, L.B., Miller, L.C., and Colvin, D.L. 1991. Bermudagrass (Cynodon spp.) cultivar response to diclofop, MSMA, and metribuzin. Weed Tech. 5:27-32.

McCarty, L.B. 1991. Goosegrass (Eleusine indica) control in bermudagrass (Cynodon spp.) turf with diclofop. Weed Sci. 21:537-541.

McCarty, L.B. 1991. Metsulfuron for prostrate spurge control in bermudagrass. Proc. South Weed Soc. 44:180.

McCarty, L.B. 1992. Quinclorac evaluations in warm-season turfgrasses. Proc. South Weed Soc. 45:136.

McElroy, J.S., Breeden, G.K., Yelverton, F.H., Gannon, T.W., Askew, S.D. and Derr., J.F. 2005. Seeded bermudagrass response to herbicides during establishment. Golf Course Mgmt. 73(1):154-158.

Morris, K.N. 2002. National Turfgrass Evaluation Program. 1997 National Bermudagrass Test. NTEP No. 02-7. United States Department of Agriculture. Beltsville, MD.

Murdoch, C.L., and R.K. Nishimoto. 1982. Diclofop for goosegrass control in bermudagrass putting greens. HortScience 17:914-915.

Nishimoto, R.K., and C.L. Murdoch. 1994. Smutgrass (Sporobolus indicus) control in bermudagrass (Cynodon dactylon) turf with triazine-MSMA applications. Weed Tech. 8: 836-839.

Patton, A.J., G.A. Hardebeck, D.W. Williams, and Z.J. Reicher. 2004. Establishment of bermudagrass and zoysiagrass by seed. Crop Sci. 44: 2160-2167.

Reicher, Z., and G. Hardebeck. 2000. Safety of Drive and Dimension on newly seeded bermudagrass and zoysiagrass. 2001 Annual Report - Purdue University Turfgrass Science Program: 59-65.

Tucker, B.J., Higingbottom, J.K., and McCarty, L.B. 2002. Tolerance to fluroxypyr and clopyralid in bermudagrass (Cynodon dactylon) and St. Augustinegrass (Stenotaphrum secundatum). South. Weed Sci. Soc. Proc. 55:67-68.

Yelverton, F. 2003. A new herbicide for weeds in bermudagrass and zoysiagrass. Golf Course Mgmt. 71(5):119-122.