Evaluating Herbicidal Injury to St. Augustine Grass in Sod Production

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ABSTRACT

Studies were conducted at three locations (Burleson, Matagorda, and Wharton Counties) in south and central Texas to evaluate 25 commonly used herbicides for their effect on regrowth or re-establishment of St. Augustine grass [*Stenotaphrum secundatum* S. (Walt.) Kuntz] after sod had been harvested. Fenoxaprop-ethyl, metsulfuron-methyl, MSMA, and quinclorac caused significant injury (yellowing) at all three locations when rated 10 days after herbicide application. Benefin, imazapic, metolcachlor, triclopyr plus clopyralid, and 2,4-D plus MCPP plus dicamba caused injury to St. Augustinegrass at two of three locations while atrazine, bensulide, bentazon, bromoxynil, imazaquin, halosulfuron, oxadiazon, prodiamine, and simizine caused injury at one location. For St. Augustine grass regrowth, imazapic and metsulfuron-methyl resulted in reduced growth at all three locations while bensulide, fenoxaprop-ethyl, imazaquin, halosulfuron, and oryzalin caused considerable reduction in regrowth at two locations. Bromoxynil, dithiopyr, prodiamine, and quinclorac reduced St. Augustine regrowth at only one location.

KEY WORDS: turf injury, regrowth

INTRODUCTION

St. Augustine grass (*Stenotaphrum secundatum)* is a warm-season turfgrass commonly used in home lawns, athletic fields, and some golf courses throughout the southern United States (Carroll et al., 1996; Fagerness et al., 2002; Fry et al., 1986; Johnson, 1995). Due to the high demand for this grass, turf farms must produce a large amount of quality turfgrass and this requires the use of preemergence and postemergence herbicides to control troublesome weeds. Some of these herbicides may injure the turf (Bridges et al., 2001; McCarty et al., 1991; Murdoch et al., 1997) and the extent of this injury varies among species and cultivars within a species (Johnson, 1983, 1994; McCarty et al., 1991). For sod producers, the questions that must be asked are first, will the herbicide control the weeds in question and secondly, and perhaps more importantly, will it do so without adversely

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affecting the regrowth or re-establishment of grass in a recently harvested field. Herbicides used in sod production must control the weed(s) in question, but must do so very selectively so as not to cause long-term injury to the turf being produced. This study was conducted to evaluate 25 commonly used turfgrass herbicides for their effect on regrowth or re-establishment of St. Augustinegrass following sod harvest.

MATERIALS AND METHODS

Studies were conducted at three locations in central and south Texas to evaluate herbicides applied to 'Raleigh' St. Augustinegrass for turfgrass injury and subsequent regrowth. Studies were conducted in Burleson County, Matagorda County, and Wharton County, Texas. Herbicides were applied May 21, 30, 2002 and July 26, 2002 for Burleson, Matagorda, and Wharton Counties, respectively. Soils for the three locations were as follows: in Burleson County, the soil was a Ships clay (fine, mixed, thermic Vertic Haplustolls) with a pH of 7.5. In Matagorda County, the soil was a Laewest clay (fine, mixed, thermic Udertic Haplustolls) with a pH of 6.9. In Wharton County, the soil was a Silty clay loam (fine-silty, mixed, thermic Fluventic Haplustolls) with a pH of 7.8.

Treatment techniques were essentially the same regardless of the location. Table 1 includes herbicides applied, mode of action, trade name, common name, and rate of herbicide applied. All herbicides were applied using a hand-held CO_2 pressurized plot sprayer that was calibrated to apply the equivalent of 40 gallons per acre. Three replications of each treatment were arranged according to a randomized, complete block design with plot sizes of 6 ft by 8 ft. Treatments at each location were applied within two weeks following sod harvest where a 1 to 4 inch ribbon of grass was left between harvested strips. Each treatment plot was monitored and evaluated for herbicide phytotoxicity (0 to 5, 0 = no injury; 5 = severe injury) to the St. Augusine grass and percent regrowth from the ribbons and/or stolons. Phytotoxicity ratings were based on plant chlorosis, necrosis, and stunting. Initial ratings taken 10 days after herbicide application are presented since this rating was representative of the turf phytotoxicity. Percent vegetative cover was evaluated periodically throughout the growing season using a visual scale and this continued until the untreated check plots were 100 percent re-established and harvestable (data not presented).

Visual ratings of percent cover of St. Augustine grass in Burleson County were concluded in October 2002. In Matagorda County, visual ratings on the St. Augustine grass were completed in November 2002, while in Wharton County St. Augustine grass regrowth was slower due to later harvest and ratings continued until May 2003. Prior to termination of the study, harvestability ratings (0 to 5, 0 = zero percent coverage, 5 = 100 percent ready to harvest) were taken at each location for each herbicide treatment. Statitistical analysis for phytotoxicity and harvestibility ratings in the study was accomplished using Fisher's Protected LSD test at the five percent level of significance.

RESULTS AND DISCUSSION

Phytotoxicity. Phytotoxicity ratings from the herbicide treatments were made at the three locations 10 days after the herbicide treatments (DAT) were applied. Phytotoxicity consisted of leaf yellowing and chlorosis in most instances.

Phytotoxicity on St. Augustine grass was significantly higher from the untreated check with fenoxaprop-ethyl, metsulfuron-methyl, MSMA, and quinclorac at all three locations (Table 2). Johnson (1994) reported quinclorac injured established tall fescue, (*Festuca*

Table 1. Herbicide mode of action, treatments, and the treatment rates for each herbicide.

Mode of action	Trade name	Common name	Rate (product/A)
Growth regulators	Confront 3EC	Triclopyr + clopyralid	1.5 pt
	Drive 75DG	Quinclorac	1.0 lb
	Lontrel 3EC	Clopyralid	0.5 pt
	Trimec Southern	2, 4-D + MCPP + dicamba	1.5 pt
Photosynthesis inhibitors	Atrex 4L	Atrazine	3.0 pt
	Basagran 4EC	Bentazon	2.0 pt
	Buctril 4EC	Bromoxynil	0.6 pt
	Princep 90DF	Simazine	2.8 lb
Amino acid synthesis inhibitors	Image 70DG	Imazaquin	0.54 lb
	Manage 75DG	Halosulfuron	0.05 lb
	Manor 60DG	Metsulfuron-methyl	0.5 oz
	Plateau 70DG	Imazapic	1.44 oz
Lipid synthesis inhibitors	Acclaim Extra	Fenoxaprop-ethyl	20 fl oz
Organic arsenicals	MSMA 6EC	Monosodium acid methanearsonate	2.7 pt
Seedling growth inhibitors-	Asulam 3.3L	Asulam	5.0 pt
	Balan 2.5G	Benefin	1.2 lb
	Barricade 65 WDG	Prodiamine	1.2 lb
	Betasan 3.6G	Bensulide	8.0 lb
	Dimension 1 EC	Dithiopyr	3.0 pt
	Gallery 75DF	Isoxaben	1.0 lb
	Pendilum 60 DG	Pendimethalin	3.3 lb
	Pennant 8E	Metolachlor	2.0 pt
	Prograss 1.5 EC	Ethofumesate	4.0 qt
	Ronstar 50 WSP	Oxadiazon	5.0 lb
	Surflan 4AS	Oryzalin	2.0 qt

arundinacea Schreb.), when applied at the same rate used in our study. He attributed the injury to heat and drought stress in Georgia. Our studies were not exposed to the drought stress noted in Georgia, but summer temperatures were just as high.

Benefin, imazapic, metolachlor, triclopyr plus clopyralid, and 2,4-D plus MCPP plus rating was representative of the turf phytotoxicity. Percent vegetative cover was evaluated periodically throughout the growing season using a visual scale and this continued until the untreated check plots were 100 percent re-established and harvestable (data not presented).

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Phytotoxicity on St. Augustine grass was significantly higher from the untreated check with fenoxaprop-ethyl, metsulfuron-methyl, MSMA, and quinclorac at all three locations (Table 2). Johnson (1994) reported quinclorac injured established tall fescue (*Festuca arundinacea* Schreb.) when applied at the same rate used in our study. He attributed the injury to heat and drought stress in Georgia. Our studies were not exposed to the drought stress noted in Georgia, but summer temperatures were just as high.

Benefin, imazapic, metolachlor, triclopyr plus clopyralid, and 2,4-D plus MCPP plus dicamba resulted in significant toxicity at Matagorda and Wharton Counties but not Burleson County, while atrazine, bensulide, bentazon, bromoxynil, imazaquin, halosulfuron, oxadiazon, prodiamine, and simazine caused significant phytotoxicity only at the Matagorda County site. Clopyralid and ethofumesate caused significant injury at the Wharton County location only (Table 2). Asulam, dithiopyr, isoxaben, oryzalin, and pendimethalin did not cause any St. Augustine injury at any location, and this agrees with previous research on cool-season turfgrasses (Chism and Bingham, 1991; Enache and Ilnicki, 1991; Reicher et al., 1999). Of the herbicides causing damage, bentazon, clopyralid, dithiopyr, ethofumesate, halosulfuron, isoxaben, metsulfuron-methyl, metolachlor, pendimethalin, prodiamine simazine and imazaquin are the only products currently labeled for use on St. Augustine grass (Anonymous, 2006).

Re-establishment or Percent Cover/Harvestability. Herbicide treated plots at all locations were evaluated at various dates for regrowth from the ribbons and/or stolons. Grass growth ratings continued until the untreated check plots were completely established and harvestable (a rating of 5). Results are presented from the last rating.

Table 2. Herbicide phytotoxicity when rated 10 days after application to St. Augustine.[a]

	Location		
Herbicide	Burleson	Matagorda	Wharton
Asulam	0	0.3	0.3
Atrazine	0	1	0
Benefin	0.3	1.3	1
Bensulide	0	1	0.7
Bentazon	0	1	0.3
Bromoxynil	0	1.3	0
Clopyralid	0	0.3	1.3
Dithiopyr	0	0	0.3
Ethofumesate	0	0.7	1.3
Fenoxaprop-ethyl	2.3	2.3	2
Halosulfuron	0.7	1.7	0.7
Imazapic	0.3	3.3	2
Imazaquin	0.3	3	0.7
Isoxaben	0.3	0.3	0.3
Metolachlor	0	1	1
Metsulfuron-methyl	1	1.7	1.3
MSMA	3	4	3.7
Oryzalin	0.7	0.7	0.3
Oxadiazon	0	1	0.7
Pendimethalin	0	0.7	0.3
Prodiamine	0	1	0.3
Quinclorac	2	3	2.7
Simazine	0	3.3	0.3
Triclopyr + clopyralid	0	1	3.3
2,4-D + MCPP + dicamba	0	1.7	1.3
Untreated check	0	0	0
LSD (0.05)	0.9	1	0.9

[a]Phytotoxicity ratings: 0 = no injury, 5 = severe injury.

At the Burleson County location, bensulide, fenoxaprop-ethyl, imazapic, halosulfuron, metsulfuron-methyl, and oryzalin were herbicides that differed significantly from the untreated plot for harvestability by November (Table 3). During re-establishment, these herbicides differed in their effects on grass regrowth for the growing season. Metsulfuron-_methyl was the only herbicide that showed substantial injury throughout the growing period (data not shown), while bensulide, halosulfuron, and imazapic only affected the grass at the end of the growing season. In addition, imazaquin, fenoxaprop-ethyl, and quinclorac hindered recovery or establishment during the growing season (data not shown) but only fenoxaprop-ethyl affected harvestability in November.

At the Matagorda location, bromoxynil, imazapic, imazaquin, metsulfuron-methyl, oryzalin, and quinclorac all affected harvestability ratings as compared to the untreated plot (Table 3). Blum et al. (2000) reported that imazaquin injured common Bermuda grass [*Cynodon dactylon* (L.) Pers] slightly but injury was transient, lasting not more than 14 d. In other studies, imazaquin and imazapic have suppressed vegetative and reproductive growth on common Bermuda grass (Goatley et al., 1993; Peacock and Flanagan, 1987).

Table 3. St. Augustine harvestability rating as influenced by herbicide.[a]

	Location		
Herbicide	Burleson	Matagorda	Wharton
Asulam	5	4.7	5
Atrazine	4.3	4.3	4.7
Benefin	4.7	4.3	4.7
Bensulide	3.7	4.3	3
Bentazon	4.3	4.3	5
Bromoxynil	5	3.7	5
Clopyralid	5	4	5
Dithiopyr	4.3	4.7	3
Ethofumesate	4.3	4.3	4.3
Fenoxaprop-ethyl	4	4.3	3.7
Halosulfuron	3.7	4.3	3.7
Imazapic	3.7	3	2
Imazaquin	4.7	3.3	3.7
Isoxaben	4.7	4.3	4.3
Metolachlor	5	4.3	5
Metsulfuron-methyl	3	3.7	3.7
MSMA	4.7	4.7	4.3
Oryzalin	4	3.3	4.3
Oxadiazon	5	4.3	5
Pendimethalin	4.7	4.7	4.3
Prodiamine	4.7	4	4
Quinclorac	4.3	3.3	4.3
Simazine	4.7	4	4.7
Triclopyr + clopyralid	4.7	4	4.7
2,4-D + MCPP + dicamba	5	4	4.7
Untreated check	5	5	5
LSD (0.05)	1	1.3	1

[a] Harvestability ratings: 0 = no coverage, 5 = 100% coverage, ready to harvest. Ratings taken in October, 2002 in Burleson County; November 5, 2002 in Matagorda County; and May, 2003 in Wharton County.

The Wharton County site showed similar results as compared to the other locations with the exception of several herbicides (Table 3). The applications were made during the summer (July 26) and dithiopyr significantly affected the harvestability ratings when compared with the untreated check. No negative response with dithiopyr was seen at the other two locations. Other herbicides that hindered harvestability were bensulide, fenoxaprop-ethyl, imazapic, imazaquin, halosulfuron, metsulfuron-methyl, and prodiamine. Each of these herbicides also produced considerable injury to regrowth during the growing season. In addition, oryzalin, isoxaben, MSMA, triclopyr + clopyralid, and pendimethalin caused damage at times during the growing period (data not shown), but recovered with no effect on harvestability. Bromoxynil and quinclorac caused a reduction in harvestibility rating at the Matagorda location, but no negative response was seen at the Burleson or Wharton locations.

CONCLUSIONS

Sod growers need to be aware of potential injury that can occur through use of herbicides for weed control after sod harvest. The results of this study certainly illustrates that certain herbicides can have an effect on St. Augustine grass growth and re-establishment after harvest. Fenoxaprop-ethyl, MSMA, and quinclorac caused the greatest injury at all three locations; however, by sod harvest only MSMA had recovered sufficiently to be considered ready for harvest. Asulam, atrazine, benefin, bentazon, clopyralid, ethofumesate, isoxaben, metolachlor, oxadiazon, pendimethalin, simazine, triclopyr plus clopyralid, and the 3-way combination of 2,4-D plus MCPP plus dicamba resulted in grass growth that was considered ready-for-harvest with the untreated check. Many of the herbicides evaluated in this study are labeled only for use in established turf, and this should be considered when choosing their use on newly harvested sod areas.

Other important factors to consider when using herbicides are application rates, climatic conditions, soil and water pH, soil temperature, soil moisture levels, drought, and overall turfgrass health. Another very important factor is ribbon width. During the study, we discovered that substantial damage and hindered growth occurred on sites with limited ribbon width left after the initial harvest (1-2 inches). Leaving ribbons of at least 4 inches in width appeared to expedite regrowth and harvestability of the sod (authors personal observations). This is another variable that might warrant evaluation in a future research project.

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