Field Sandbur (*Cenchrus pauciflorus*) Control in Pastures Using Gramoxone, Roundup Ultra, or Touchdown

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ABSTRACT

Field studies were conducted during the 1997 and 1998 growing season to evaluate Gramoxone (paraquat), Roundup Ultra (glyphosate), or Touchdown (sulfosate) for field sandbur control, 'Coastal' bermudgrass tolerance, and effect on bermudagrass yield. All herbicides were applied within eight d of bermudagrass cut except in 1998 when herbicides were applied 17 d after cutting. Roundup Ultra at 0.5 and 1.0 pt/A controlled ≥ 90% field sandbur while Touchdown at 0.5 and 1.0 pt/A controlled ≥ 89%. Gramoxone control of field sandbur ranged from 61 to 94%. Bermudagrass injury (stunting) was greater with the 1.0 pt/A rate of RoundupUltra or Touchdown. Injury was less than 10% in most instances when herbicides were applied within 8 d of bermudagrass cut. When herbicides were applied 17 d after bermudagrass cut, bermudagrass injury varied from 11 to 93% and resulted in some bermudagrass death. Coastal bermudagrass yield was not affected by any herbicide treatments applied within 8 d of cutting when compared with the untreated check.

KEYWORDS: bermudagrass, efficacy, dry matter, grassbur, glyphosate, paraquat, sandbur, sulfosate

Forage production is an important facet of Texas agriculture as evidenced by the fact that over 40% of the land use in Texas is devoted to grazing lands and/or hay production (Census of Agriculture, 1992). Weeds are a problem on much of this production area. Field sandbur is rated the ninth most common and the second most troublesome pasture weed in Texas (Dowler, 1999).

Bermudagrass [*Cynodon dactylon* (L.) Pers.] is considered by many to be the most important grass of the livestock industry. Since the early times of fencing the ranching industry has depended on bermudagrass for grazing and hay. Weed species, such as field sandbur (*Cenchrus pauciflorus* Benth.), invade many of these bermudagrass production areas and need to be removed to prevent a reduction in yield and quality. (Ball et al., 1991). Field sandbur is adapted and grows best where mean daily temperatures are above 24°C (Burton and Hanna, 1995). *C. pauciflorus* can grow in many habitats. Often associated with low moisture and with sandy or light, well-drained soils of the tropics, the plant can spread rapidly in moderately moist regions. Under dry conditions the plant is short-lived, stays very small, and produces few burs, while under moist conditions it may be long-lived, can grow very large and produces many burs (Holm et al., 1991).

Field sandbur, commonly called grassbur, is a summer annual grassy weed that can be found in the southern part of the United States from California to North Carolina. This weed is especially adapted to dry, sandy soils but can be found growing in other types of soils as well (Holm et al., 1991).

The common name, sandbur, refers to the fact that these grasses are adapted to porous

sandy soils and to the spiny lure of the seed heads which easily detach from the racemes and become attached to clothing or animal hair. The spiny burs can cause painful or annoying injuries to human skin and can contaminate feeds and hay, thus reducing its palatability and acceptability for animals. It produces from five to 70 or more spiny burs on each raceme. When mature, these burs fall to the ground and produce new plants. Undoubtedly the primary method of dispersal is its spiny bur (Holm et al., 1991). The plants flower throughout most of the year in the moist tropics (Holm et al., 1991). Competition from this grass weed delays bermudagrass establishment and reduces both the forage yield and quality (Bingham and Shaner, 1981; Walker et al., 1998).

Since atrazine [6-chloro-N-ethyl-N=-(1-methylethyl)-1,3,5-triazine-2,4-diamine] is no longer available for use in pastures, no herbicide has been cleared which will effectively control sandbur in pasture. The bipyridinium herbicide, paraquat, is widely used for total vegetation control (Fuerst and Vaughn, 1990). In cropping systems, it is applied before planting annual crops, during the dormant stage of perennial crops, or as a spray directed away from growing crops. It is active only when applied to the foliage; it is not extensively translocated in plants and has no soil activity due to strong absorption to seed colloids (Anonymous, 1994). Paraquat is a highly water-soluble divalent cation that desicates plants in a few hours in full sunlight by a series of reactions which causes cell membranes to lose integrity, resulting in water loss and rapid desication (Dodge, 1982).

Glyphosate, the active ingredient in Roundup Ultra, and Touchdown, is a nonselective, foliar-applied herbicide that is useful for perennial weed control because it translocates to the roots (Gottrup et al., 1976; Sandberg et al., 1980; Schultz and Burnside, 1980; Sprankle et al., 1975). Glyphosate accumulation in the roots of perennial weeds is required to kill root buds and other organs capable of vegetative reproduction (Claus and Behrens, 1976; Waldecker and Wyse, 1985). Factors that reduce glyphosate absorption and translocation to root tissue reduce control of vegetative reproductive parts (Chase and Appleby, 1979; Waldecker and Wyse, 1985).

Since field sandbur is such a problem in bermudagrass pastures, the objective of this research was to determine the feasibility of using a nonselective foliar-applied herbicide to control field sandbur in a bermudagrass pasture and the effects of these herbicides on bermudagrass yield.

MATERIALS AND METHODS

Field studies were conducted during the 1997 and 1998 growing season near Shiner, TX in Lavaca County. The soil at the test site was a Carbengle loam (fine-loamy, carbonatic, thermic Typic Calciustolls) with less than 1% organic matter with a pH of 7.1. The test location remained in the same vicinity of the field in each year due to the heavy population of field sandbur (2 to 3 plants/ft^2).

Herbicide treatments included Roundup Ultra and Touchdown applied at 0.5 and 1.0 pt/A and Gramoxone at 0.4 pt/A. These herbicides were applied after the first or second cutting or a combination herbicide application after both the first and second cutting. Touchdown and Gramoxone included a nonionic surfactant (X-77, a mixture of alkylaryl polyoxyethylene glycols, free fatty acids and isopropanol; Valent USA Corp., Box 8025, Walnut Creek, CA 94596) at 1% (v/v). Herbicides were applied within 8 d of bermudagrass cutting except in 1998 when herbicides were applied 17 d after the second bermudagrass cutting.

Herbicide treatments were applied broadcast with a CO_2 backpack sprayer equipped with Teejet 11002 flat fan nozzles (Spraying Systems Co., Wheaton, IL 60189-7900) cal-

ibrated to deliver a spray volume of 20 gal/A at 28 psi. Field sandbur control and 'coastal' bermudagrass injury were evaluated 30 and 50 d after treatment (DAT) in 1997 and 40 and 60 DAT in 1998. Visual estimates were based on a scale of 0% (no field sandbur control or bermudagrass injury to 100% complete control of field sandbur or death of bermudagrass) relative to the untreated check. Bermudagrass injury was characterized as stunting of the regrowth except for the 60 DAT which included bermudagrass necrosis and chlorosis.

Treatments were applied in a randomized complete block design with four replications. Plot size measured 6 ft wide by 25 ft long. Grass plots were harvested 3 to 4 d prior to the commercial harvest of remaining pasture. Two randomly selected 16 in^2 quadrants were hand-cut from each plot. Field sandbur and bermudagrass were hand-separated to determine forage composition, and dried for 72h at 150°F. After samples were dried, bermudagrass yields on a dry matter basis were determined.

Plot yields were not taken at the first cutting of each year since herbicides had not yet been applied. Plots were harvested on 30 June and 27 November, 1997 and 1 September 1998. Herbicides were applied on 6 May and 8 July, 1997 and 14 May and 18 September, 1998. Lack of rainfall during the spring and summer of 1998 resulted in poor bermudagrass growth and a late season (18 September) herbicide application. Therefore a second harvest was not obtained in 1998.

All data were evaluated with analysis of variance and LSD at the 0.05 level of significance were calculated to compare treatment means. Data were evaluated individually by years because of differences in application timing and rating intervals.

RESULTS AND DISCUSSION

Sandbur control

In 1997, Roundup Ultra and Touchdown controlled ≥ 89% field sandbur when rated 30 days after first cutting herbicide treatment (DA1T) while Gramoxone provided < 85% control (Table 1). When rated 50 days after second cutting herbicide treatment (DA2T), Roundup Ultra applied after first cutting provided ≤ 76% control, while Roundup Ultra applied after second cutting provided 78 to 95% control. Roundup Ultra applied both after first and second cutting provided 100% control regardless of rate. Touchdown applied after first cutting provided < 90% sandbur control while Touchdown applied after second cutting controlled 98 to 100% field sandbur. Touchdown applied after first and second cutting controlled 100% field sandbur. Gramoxone at 50 DA2T controlled < 70% field sandbur when applied at first or second cutting but controlled 88% field sandbur when applied after first and second cutting (Table 1).

In 1998, similar trends as seen with the early rating of 1997 were evident when evaluated 40 DA1T (Table 1). Gramoxone applied once controlled less field sandbur than Roundup or Touchdown. When rated 60 DA2T all herbicide treatments except Gramoxone applied after first cutting controlled ≥ 90 field sandbur. The excellent control with all herbicide treatments was due to lack of rainfall after second cutting which resulted in less field sandbur germination.

Bermudagrass injury

In 1997, Roundup Ultra at 1.0 pt/A resulted in ≤ 11% injury when applied after first or second cutting (Table 2). Touchdown at 1.0 pt/A caused ≤ 8% injury while the 0.5 pt/A rate of Touchdown applied after second cutting resulted in 15% bermudagrass injury. Injury from Gramoxone was 5%.

Table 1. Field sandbur control with Gramoxone, Roundup Ultra, or Touchdown.

Herbicide	Rate	Appl timing	Field sandbur control 1997 30 DA1T[a]	1997 50 DA2T[b]	1998 40 DA1T[c]	1998 40 DA2T[d]
	(pt/A)					
Check	-	-	0	0	0	0
Roundup Ultra	0.5	Cut 1	90	65	89	94
Roundup Ultra	1.0	Cut 1	99	76	96	93
Roundup Ultra	0.5	Cut 2	-	95	-	94
Roundup Ultra	1.0	Cut 2	-	78	-	95
Roundup Ultra	0.5	Cut 1 + 2	91	100	96	94
Roundup Ultra	1.0	Cut 1 + 2	99	100	98	93
Touchdown	0.5	Cut 1	89	73	100	93
Touchdown	1.0	Cut 1	96	89	89	93
Touchdown	0.5	Cut 2	-	98	-	95
Touchdown	1.0	Cut 2	-	100	-	95
Touchdown	0.5	Cut 1 + 2	93	100	100	93
Touchdown	1.0	Cut 1 + 2	95	100	85	95
Gramoxone	0.4	Cut 1	76	61	73	86
Gramoxone	0.4	Cut 2	-	64	-	90
Gramoxone	0.4	Cut 1 + 2	84	88	94	93
LSD (0.05)			8	33	17	5

[a] 30 DA1T = 30 d after first cutting herbicide treatments
[b] 50 DA2T = 50 d after second cutting herbicide treatments
[c] 40 DA1T = 40 d after first cutting herbicide treatments
[d] 60 DA2T = 60 d after second cutting herbicide treatments

In 1998, when rated 40 DAT, bermudagrass injury with Roundup Ultra at 1.0 pt/A ranged from 9 to 20% while injury with 0.5 pt of Roundup Ultra was ≤ 1%. Bermudagrass injury with Touchdown at 1.0 pt/A was ≤ 4%. Gramoxone resulted in ≤ 1% injury.

When rated 60 DAT all herbicides applied after the second cutting resulted in ≥ 36% injury to the bermudagrass (Table 2). Herbicides were applied 17 d after bermudagrass was cut and the bermudagrass had some leaf development (authors personal observation).

Paraquat resulted in 67 to 71% bermudgrass injury while Roundup Ultra injury ranged from 36 to 80% and Touchdown injury ranged from 75 to 80%. Although all the three herbicides are active when applied to foliage (Ambach and Ashford, 1982; Fuerst and Vaughn, 1990; McKinlay et al., 1974; Sprankle et al., 1975), Roundup Ultra and Touchdown are more useful for perennial weed control because they are translocated to the roots (Sprankle et al., 1975; Waldecker and Wyse, 1985; Wyrill and Burnside, 1976). Paraquat is not translocated in plants (Fuerst and Vaughn, 1990) and, therefore, will not effectively control perennial grasses.

Bermudagrass yield

No significant differences in bermudagrass yield were noted at any harvest date (Table 3). A second harvest was not taken in 1998 due to late herbicide application. Although some bermudagrass injury was noted after first and second cutting in 1997 and the first cutting in 1998 the bermudagrass recovered by harvest. However, yield differences would have been noted if a harvest could have been taken after the second harvest in 1998 (authors personal opinion).

Although field sandbur did not have an effect on bermudagrass yield, the presence of these spiny burs reduces feeding palatability and presents problems in handling forage or hay by hand. Roundup Ultra and Touchdown were effective for field sandbur control, however, since these herbicides do not possess any residual activity, repeat applications

Table 2. Coastal bermudagrass injury following applications of Gramoxone, Roundup Ultra, and Touchdown.

Herbicide	Rate	Appl timing	Bermudagrass injury 1997 30 DA1T[a]	1997 50 DA2T[b]	1998 40 DA1T[c]	1998 40 DA2T[d]
	(pt/A)					
Check	-	-	0	0	0	0
Roundup Ultra	0.5	Cut 1	0	0	0	0
Roundup Ultra	1.0	Cut 1	11	0	9	0
Roundup Ultra	0.5	Cut 2	-	0	-	72
Roundup Ultra	1.0	Cut 2	-	10	-	80
Roundup Ultra	0.5	Cut 1 + 2	0	0	1	36
Roundup Ultra	1.0	Cut 1 + 2	1	10	20	77
Touchdown	0.5	Cut 1	0	0	0	0
Touchdown	1.0	Cut 1	0	0	3	5
Touchdown	0.5	Cut 2	-	15	-	75
Touchdown	1.0	Cut 2	-	0	-	80
Touchdown	0.5	Cut 1 + 2	0	3	0	75
Touchdown	1.0	Cut 1 + 2	0	8	4	76
Gramoxone	0.4	Cut 1	0	0	1	0
Gramoxone	0.4	Cut 2	-	0	-	71
Gramoxone	0.4	Cut 1 + 2	0	5	1	67
LSD (0.05)			7	9	4	25

[a] 30 DA1T = 30 d after first cutting herbicide treatments
[b] 50 DA2T = 50 d after second cutting herbicide treatments
[c] 40 DA1T = 40 d after first cutting herbicide treatments
[d] 60 DA2T = 60 d after second cutting herbicide treatments

Table 3. Coastal bermudagrass dry weight yield following applications of Gramoxone, Roundup Ultra, or Touchdown.

Herbicide	Rate	Appl timing[a]	Bermudagrass yield 6/30/97	11/27/97	9/1/98
	(pt/A)		----------Lbs/A----------		
Check	-	-	3849	1525	2326
Roundup Ultra	0.5	Cut 1	4227	1603	2178
Roundup Ultra	1.0	Cut 1	3780	1353	2468
Roundup Ultra	0.5	Cut 2	-	1494	-
Roundup Ultra	1.0	Cut 2	-	1260	-
Roundup Ultra	0.5	Cut 1 + 2	4607	1945	2662
Roundup Ultra	1.0	Cut 1 + 2	4004	2038	2807
Touchdown	0.5	Cut 1	4460	2022	3243
Touchdown	1.0	Cut 1	3970	1540	2372
Touchdown	0.5	Cut 2	-	1618	-
Touchdown	1.0	Cut 2	-	1509	-
Touchdown	0.5	Cut 1 + 2	4235	1431	2178
Touchdown	1.0	Cut 1 + 2	3803	1742	2420
Gramoxone	0.4	Cut 1	4123	1587	1936
Gramoxone	0.4	Cut 2	-	1773	-
Gramoxone	0.4	Cut 1 + 2	3964	1509	2614
LSD (0.05)			NS	NS	NS

[a]Herbicide application to bermudagrass no later than 5 day after designated cutting.

after each cutting will be necessary for effective control. Also these herbicides may cause bermudagrass injury if herbicide application is delayed more than 7 to 10 d after cutting when the bermudagrass develops new lead growth. At the present time, only Roundup Ultra is cleared for use on bermudagrass pastures.

REFERENCES

Ambach, R. M. and R. Ashford. 1982. Effects of variation in drop makeup on the phytotoxicity of glyphosate. Weed Sci. 30:221-224.

Anonymous. 1994. Paraquat. p. 226-228 *In:* William H. Ahrens, ed. Herbicide Handbook. Weed Sci. Soc. America. Champaign.

Ball, D. M., C. S. Houseland, G. D. Lacefield. 1991. Southern Forages Potash and Phosphate Inst. and Found. for Agr. Res. Atlanta, GA.

Bingham, S. W. and R. L. Shaner. 1981. Goosegrass (*Eleusine indica*) control during bermudagrass (*Cynodon dactylon*) establishment. Weed Sci. 29:11-16.

Burton, G. W. and W. W. Hanna. 1995. Bermudagrass. *In:* R. F. Barnes, D. A. Miller, and C. J. Nelson, eds. Forages. An Introduction to Grassland Agriculture. Volume 1. Ames: Iowa State University Press. Pp. 421-428.

Census of Agriculture. 1992. Texas: State and County data. Part 43A. Vol. 1, Geographic Area Series.

Chase, R. L. and A. P. Appleby. 1979. Effects of humidity and moisture stress on glyphosate control of *Cyperus rotundus*. Weed Res. 19:241-246.

Claus, J. S. and R. Behrens. 1976. Glyphosate translocation and quackgrass rhizome bud kill. Weed Sci. 24:149-152.

Dodge, A. D. 1982. The role of light and oxygen in the action of photosynthetic inhibitor herbicides. P. 57-77 *In:* D. E. Moreland, J. B. St. John, and F. D. Hess, eds. Biochemical Responses Induced by Herbicides. Am. Chem. Soc. Symp. Ser. No. 181.

Dowler, C. C. 1999. Weed survey-southern states. Research Report, Southern Weed Science Society. Proc. South. Weed Sci. Soc. 52:299-302.

Fuerst, E. P. and K. C. Vaughn. 1990. Mechanisms of paraquat resistance. Weed Technol. 4:150-156.

Gottrup, D., P. A. O'Sullivan, R. J. Schraa, and W. H. Vanden Born. 1976. Uptake, translocation, metabolism, and selectivity of glyphosate in Canada thistle and leafy spurge. Weed Res. 16:197-201.

Holm, L. G., D. L. Plunknett, J. W. Pancho, and J. P. Herberger. 1991. The World=s Worst Weeds. Distribution and Biology, Krieger Publ., Malabar, FL.

McKinlay, K. S., R. Ashford, and R. J. Ford. 1974. Effects of drop size, spray volume, and dosage on paraquat toxicity. Weed Sci. 22:31-34.

Sandberg, C. L., W. F. Meggitt, and D. Penner. 1980. Absorption, translocation and metabolism of ^{14}C-glysophate in several weed species. Weed Res. 20:195-200.

Schultz, M. E. and O. C. Burnside. 1980. Absorption, translocation, and metabolism of 2,4-D and glyphosate in hemp dogbane (*Apocynum cannabinum*). Weed Sci. 28:13-20.

Sprankle, P., W. F. Meggitt, and D. Penner. 1975. Absorption, action, and translocation of glyphosate. Weed Sci. 23:235-240.

Waldecker, M. A. and D. L. Wyse. 1985. Soil moisture effects on glyphosate absorption and translocation in common milkweed (*Asclepias syriaca*). Weed Sci. 33:299-305.

Walker, R. H., G. Wehtje, and J. S. Richburg, III. 1998. Interference and control of large crabgrass (*Digitaria sanguinalis*) and southern sandbur (*Cenchrus echinatus*) in for-

age bermudagrass (*Cynodon dactylon*). Weed Technol. 12:707-711.
Wyrill, J. B. and O. C. Burnside. 1976. Absorption, translocation, and metabolism of 2,4-D and glyphosate in common milkweed and hemp dogbane. Weed Sci. 24:557-566.