Vegetational Responses Following Control of Sand Shinnery Oak with Tebuthiuron

P.W. JACOBY, J.E. SLOSSER, AND C.H. MEADORS

Abstract

Tebuthiuron {N-[5-(1,1-dimethylethyl)-1,3,4-thia-diazol-2-yl]-N,N'-dimethylurea} pellets were applied aerially in April 1979 at rates of 0.5 and 1.0 kg ai./ha to rangelands supporting a uniform stand of sand shinnery oak (*Quercus havardii* Rydb.) near Andrews, Texas. Tebuthiuron pellets were applied at 1.1 kg ai/ha to a second location near Jayton, Texas, in March 1980. Sand shinnery oak was significantly reduced ($P \leq 0.05$) in treated plots at both locations. Yields of annual and perennial grasses were significantly greater ($P \leq 0.05$) and those of forbs significantly less ($P \leq 0.05$) on tebuthiuron-treated plots at Andrews. Untreated plots at Andrews had more bare soil than those treated with tebuthiuron after 18 and 30 months. Grass yields at the Jayton site were greater, although no significant ($P \leq 0.05$) differences occurred with forb yields.

Sand shinnery oak is a low growing deciduous shrub occupying sandy soils in western Texas, western Oklahoma, and eastern New Mexico (Pettit 1977, Scifres 1980). Rangelands dominated by sand shinnery oak usually produce very little forage of high quality for livestock. Aerial spraying of sand shinnery oak with either silvex [2-(2,4,5-trichlorophenoxy)propionic acid] or 2,4,5-T [(2,4,5-trichlorophenoxy) acetic acid] temporarily increases forage production, but fails to provide long-term control unless treatments are repeated annually for 2 or 3 consecutive years (Robinson and Fisher 1968).

In contrast to foliar active herbicides, single applications of pelleted herbicides such as fenuron (1,1-dimethyl-3-phenylurea), picloram (4-amino-3,5,6-trichloropicolinic acid) and tebuthiuron have shown promise for effectively controlling oaks (Darrow and McCully 1959, Pettit 1979, Scifres et al. 1981a). Picloram and tebuthiuron pellets (10% ai) applied at 2.2 and 1.1 kg ai/ha, respectively controlled most of the sand shinnery oak in a study on the southern High Plains of Texas, and increased grass yields 3 to 9 times that of untreated rangeland for 2 years following treatment (Pettit 1979). Tebuthiuron was highly effective at rates of 2.2 and 4.4 kg/ha for control of post oak (*Quercus stellata* Wangenh.) and blackjack oak (*Q. marilandica* Muenchh.) in east-central Texas, and significant increases in grass production were observed for 3 years after treatment (Scifres et al. 1981a, Scifres et al. 1981b).

The objective of this study was to compare differences in herbage yield and floristic composition in two sand shinnery oak sites in western Texas following treatment with tebuthiuron.

Materials and Methods

Andrews Study Site.

The study area, located 35 km west of Andrews, Texas, lies on deep, fine sands of the Jalmar (Arenic Ustalfic Haplargids) and the Penwell soil series (Ustic Torripsamments). Average annual rainfall is 35 cm and occurs mainly from April through October (Conner et al. 1974). Topography was gently rolling sandhills dominated by a nearly uniform stand of sand shinnery oak. Major grasses at the time of treatment were sand dropseed [*Sporobolus cryptandrus* (Torr.) Gray], giant dropseed (*Sporobolus giganteus* Nash), Wright threeawn (*Aristida wrightii* Nash) and common sandbur[1] (*Cenchrus incertus* M.A. Curtis). Although numerous warm-season annual grasses and forbs may appear during favorable rainfall years, they were not present at the time of treatment.

On March 9, 1979, tebuthiuron pellets (20% ai) were aerially applied to plots (5 ha each) at rates of 0, 0.5 and 1.0 kg/ha. Experimental design was a randomized complete block with 2 replications. Plots were evaluated on October 2, 1980, and on October 5, 1981, 18 and 30 months after treatment, respectively. Estimates of herbage yield were determined by clipping standing biomass in 9 quadrats (1 m^2 each) per plot. Grasses were clipped by species at ground level, oven dried at 60° C and weighed. Forbs were harvested as a composite sample.

Mortality of sand shinnery oak was estimated by examining approximately 100 plants per plot. Defoliated plants which had not resprouted were considered dead. Standing dead plants were clearly evident for the duration of the study, allowing for accurate comparisons among treatments.

Comparisons of the botanical composition of herbaceous stands were based on frequency data collected along three lines (30.5 m long) at 0.3-m intervals by recording the plant species rooted closest to a vertical rod. When no species was rooted within a 15-cm radius of the point, bare ground was recorded for that point (mulch was disregarded). Data were subjected to analysis of variance and means were separated by Duncan's multiple range test ($P \leq .05$).

Jayton Study Site

The study area was located about 10 km northwest of Jayton, Texas, which is about 225 km northeast of the Andrews study site. Rainfall averages 52 cm annually. The site was on gently undulating topography supporting a uniform stand of sand shinnery oak with occasional motts of hybrid oaks, about 3 m in height. Soils were fine sands of the Brownfield (Arenic Aridic Paleustalfs) and Nobscot (Arenic Haplustalfs) series (Richardson and Girdner 1973).

Tebuthiuron pellets (20% ai) were applied at 1.1 kg/ha to 3 plots (0.25 ha each) on March 14, 1980, with hand operated spreaders. Plots were evaluated on November 11, 1980, and on November 3, 1981, 8 and 20 months following treatment, respectively, and herbage yield and species frequency data were determined utilizing the same methods employed at Andrews. Species composition was similar to that at Andrews, except the oak density was greater at Jayton and more little bluestem [*Schizachyrium scoparium* (Michx.) Nash], soapweed yucca (*Yucca glauca* Nutt.) and sand sagebrush (*Artemisia filifolia* Torr.) were present. Means from the three treated and three untreated plots were compared with *t*- tests

Authors are associate professors, Texas Agricultural Experiment Station, Texas A&M University Agricultural Research and Extension Center, P.O. Box 1658, Vernon, Texas 76384, and research associate, Texas Agricultural Experiment Station, P.O. Box 599, Spur, Texas 79370.

Report is published with approval of the Director, Texas Agricultural Experiment Station as TA-17505.

The study was partially funded by a grant RA-79-440 from Cotton Incorporated. Additional funds were provided by the Brush Control and Range Improvement Association, Albany, Texas; the University of Texas Lands—Surface Leasing, Midland, Texas; and Lilly Research Laboratories, Greenfield, Indiana. We also wish to thank R.P. Smith, M.A. Foster, R.D. Pettit, and C.S. Brumley for their assistance.

Manuscript received May 19, 1982.

[1]This species is a weak perennial according to Gould (1975) and was included as a perennial grass in our data, despite its annual grass characteristics.

Table 1. Composition of vegetational components and bare soil (% frequency) at 18 and 30 months after application of tebuthiuron pellets near Andrews, Texas in March 1979[1].

Tebuthiuron rate (kg/ha)	Bare soil	Annual grasses	Perennial grasses	Forbs	Sand Shinnery oak
			—18 months—		
0	41 a	6 b	31 b	7 a	15 a
0.5	26 b	21 a	40 ab	9 a	4 b
1.0	25 b	22 a	45 a	8 a	0 b
			—30 months—		
0	28 a	19 c	35 b	2 a	16 a
0.5	15 b	32 b	45 a	2 a	6 b
1.0	15 b	45 a	38 ab	1 a	0 c

[1]Within each sampling period means within a column not followed by the same letter are significantly different at the 5% level (Duncan's multiple range test).

($P \leq .05$). Percentage data were transformed (inverse sine) prior to analysis.

Plant composition and standing crop data from the last evaluation were given precedence in the following discussion because grass increase and shinnery reduction were visually evident in treated plots on this date. Livestock grazing was excluded from both study areas and influence by wild herbivores was negligible.

Results and Discussion

Andrews Study Site

Mortality of sand shinnery oak based on plant counts was estimated to be 42 and 94% for the 0.5 and 1.0 kg/ha rates of tebuthiuron, respectively, at 18 months post-treatment. Based on composition data shown in Table 1, reductions of 73 and 100% were obtained by the 0.5 and 1.0 kg/ha rates, respectively. By the 30-month post-treatment evaluation, mortality based on plant counts was estimated to be 86 and 94% for the 0.5 and 1.0 kg/ha rates, respectively, while line transects indicated 62 and 100% for the two rates, respectively.

There was a significantly higher frequency of vegetation in tebuthiuron-treated plots than in untreated plots at 18 months after herbicide application (Table 1). Annual grasses, such as purple sandgrass [*Triplasis purpurea* (Walt.) Chapm.] and false buffalograss [*Munroa squarrosa* (Nutt.) Torr.], composed a larger part of the community on plots treated with tebuthiuron at 0.5 and 1.0 kg/ha than on the untreated plots. Significantly more perennial grasses were recorded where 1.0 kg/ha of tebuthiuron was applied than in the untreated plot, while their occurrence in the 0.5 kg/ha treatment was intermediate and not significantly different from the control. Treated plots contained more perennial grasses, including thin paspalum (*Paspalum setaceum* Michx.), sand dropseed, giant dropseed and more sandbur than untreated plots. Forbs were present in about the same amounts in all plots, but live sand shinnery oak was reduced 73 and 100% in plots treated with the 0.5 and 1.0 kg/ha rates of tebuthiuron respectively, compared to the untreated plots.

Untreated plots contained almost twice as much bare ground as did plots treated with tebuthiuron when evaluated 30 months after treatment. Annual grasses, especially purple sandgrass, were significantly more abundant on plots treated with tebuthiuron than on untreated plots. Perennial grasses comprised significantly more of the composition on the plots treated with tebuthiuron at the 0.5 kg/ha rate than on the untreated plots, but the amounts on the plots treated at 1.0 kg/ha were not significantly different from those on untreated plots. Sand witchgrass [*Leptoloma cognatum* var. *arenicola* (Swallen) Gould] and common sandbur were the most frequent grasses in all treatments. Composition of forbs was similar among treatments, but live sand shinnery oak was significantly lower in tebuthiuron-treated than in untreated plots.

Composition within classes of plants followed similar trends during both sampling periods. The area supported a higher frequency of vegetation at the 30 month post-treatment evaluation date than at the earlier evaluation date. Annual grasses comprised twice the amount that was recorded at 18 months although percentage of perennial grass, forbs and sand shinnery oak were about the same for both periods.

False buffalograss occurred much less frequently than did purple sandgrass, and was not enountered on untreated plots until the second evaluation. Major perennial grasses in 1980 (18 months after treatment) were common sandbur and sand witchgrass which comprised greater amounts of the vegetation on the treated than on the untreated plots. These grasses were the major dominants during 1981.

Andrews Site-Herbage Yields

Yields of annual and perennial grasses were significantly ($P \leq 0.05$) higher on plots treated with tebuthiuron than on untreated plots both sampling dates (Table 2). Forb yields were significantly ($P \leq 0.05$) higher on untreated than on the tebuthiuron-treated plots at both sampling dates. The greater abundance of forbs measured on the second sample date presumably reduced the growth of perennial grass the second year relative to the first year.

Table 2. Herbage yields after application of tebuthiuron pellets near Andrews, Texas in March 1979.[1]

Forage component	Tebuthiuron rate (kg/ha) 0	0.5	1.0
		—18 months—	
Annual grasses	10 c	187 a	325 a
Perennial grasses	418 c	1081 a	853 b
Forbs	128 a	43 b	31 b
Total forage	556 b	1311 a	1209 a
		—30 months—	
Annual grasses	18 c	278 b	510 a
Perennial grasses	294 c	428 b	536 a
Forbs	625 a	366 b	167 c
Total forage	937 a	1072 a	1213 a

[1]Means within a row followed by the same letter are significantly different at the 5% level (Duncan's multiple range test).

Yields of the annual grasses, purple sandgrass and false buffalograss, were much greater on treated than on untreated plots 30 months after treatment. Significantly ($P \leq 0.05$) more purple sandgrass was contained in the plots treated with 1.0 kg/ha of tebuthiuron than in plots treated with the 0.5 kg/ha rate or the untreated plots.

Perennial grasses having greatest yields were the same species which were measured in the composition transects, those being common sandbur and sand witchgrass. Sand paspalum and sand bluestem occurred only on the herbicide treated plots. Sedges contributed to the herbage yield on the treated plots but only a trace amount occurred on the untreated plots.

Jayton Study Site—Plant Composition

Mortality of sand shinnery oak based on plant counts was

Table 3. Composition (%) of vegetational components and bare soil at 8 and 20 months following application of tebuthiuron pellets near Jayton, Texas, in March 1980[1].

Tebuthiuron rate (kg/ha)	Bare soil	Grasses	Forbs	Sand shinnery oak
		—Nov 1980—		
0	59	18	4	19*
1.1	66	28*	2	3
		—Nov 1981—		
0	27	23	16	31*
1.1	30	57*	11	1

[1]Within a sampling period a mean followed by an asterisk differs significantly ($P \leq 0.05$) from the other in the same column.

Table 4. Grass and forb yields after application of tebuthiuron pellets near Jayton, Texas, in March[1,2].

Tebuthiuron rate (kg/ha)	Months after treatment (kg/ha)	
	8	20
	—Grasses—	
0	651 a	507 a
1.1	1710 b	3068 b
	—Forbs—	
0	T a	107 a
1.1	T a	136 a

[1]Within a forage component means in a column not followed by the same letter are significantly different at the 5% level.
[2]T = trace, less than 5 kg/ha

estimated to be 75 and 95%, respectively, at the 8 and 20 month post-treatment evaluation. Composition data from line transects (Table 3) indicated 84 and 97% mortality for the 2 periods.

Unlike Andrews, the amount of bare soil area was similar between tebuthiuron treated and untreated plots 8 and 20 months after treatment. Plant response was evaluated sooner after treatment at Jayton than at Andrews. Grass was a significantly ($P \leq 0.05$) higher component on plots treated with the 1.0 kg/ha rate of tebuthiuron than on untreated plots at both sampling dates. Although forbs were slightly greater on untreated plots, no significant differences occurred in relative frequencies of forbs, sand sagebrush, or yucca between treated and untreated plots at either sampling date. Live sand shinnery oak was a significantly lower component on plots treated with tebuthiuron than on untreated plots at 8 and 20 months after treatment.

The major grass species in 1980 (8 months post-treatment) were sand dropseed, sand witchgrass, and Wright threeawn. All were more abundant on tebuthiuron-treated than on untreated plots.

Purple sandgrass was a higher component on treated than untreated plots in 1981 (20 months post-treatment). Common sandbur, sand dropseed, thin paspalum, hooded windmillgrass (*Chloris cucullata* Bisch.), and Wright threeawn contributed significantly more amounts to the vegetative composition on treated than untreated plots. No significant differences occurred between treated and non-treated plots for sand witchgrass and sedges.

Jayton Site—Herbage Yield

Grass yields at Jayton increased after tebuthiuron treatment, and forb yields were similar on both treated and untreated plots (Table 4). Grass yield almost doubled on the tebuthiuron treated areas between the first and second dates of sampling (1980 and 1981). Treated plots produced approximately 3 times as much grass as untreated plots 8 months after treatment and 6 times as much grass 20 months after treatment. Yields at Jayton were much greater than at Andrews, mainly as a result of greater amounts of rainfall received. Andrews received early summer rains but very little in mid- to late summer and fall, whereas rainfall at Jayton was near normal for the period.

Important grasses in 1980 were sand dropseed, little bluestem, and Wright threeawn on the treated plots, whereas sand witchgrass was the major grass on the untreated plots. All 3 major grasses produced significantly more standing crop on the treated plots than on the untreated plots. Significantly more sand witchgrass was produced on the untreated plots than on the treated plots.

Major grasses comprising the 1981 forage production were sand dropseed, sand witchgrass, common sandbur, purple sandgrass, and hooded windmillgrass. All of these, except sand witchgrass, yielded more herbage on the treated plots than the untreated plots. Sand dropseed produced almost 10 times as much herbage as any other grass in the treated plots.

Forbs were not significantly different between treated and untreated plots when sampled in 1981. Forb yields in November were about one-third of the summer standing crops (not shown).

Conclusions

Tebuthiuron pellets effectively controlled sand shinnery oak and resulted in a concomitant increase in grass yields at two western Texas locations.

These findings suggest that control of sand shinnery oak by tebuthiuron can result in significant increases in herbage, primiarily grasses. Annual species are likely to increase significantly during the first 2 years after treatment. Preferred perennial plants also respond favorably to sand shinnery oak control but increase at a slower rate than annuals, depending on the amount and timing of precipitation.

Literature Cited

Conner, N.R., H.W. Hyde, and G.R. Stoner. 1974. Soil survey of Andrews County, Texas USDA, Soil Conserv. Serv., Andrews, Texas.

Darrow, R.A., and W.G. McCully. 1959. Brush control and range improvement in the post oak-blackjack oak area of Texas. Texas Agr. Exp. Sta. Bull, 942.

Gould, F.W. 1975. Texas Plants. Texas Agr. Exp. Sta. Misc. Pub. 585.

Pettit, R.D. 1977. Sand shinnery oak. p. 8-9. *In:* Texas Tech Univ., Res. Highlights—Noxious Brush and Weed Control, Lubbock, Texas.

Pettit, R.D. 1979. Effects of picloram on sand shinnery oak communities. J. Range Manage. 32:196-200.

Richardson, W.E., and C.L. Girdner. 1973. Soil survey of Kent County, TX. USDA, Soil Conserv. Serv., Jayton, Texas.

Robinson, E.D., and C.E. Fisher. 1968. Chemical control of sand shinnery oak and related forage production. Texas Agr. Exp. Sta., Prog. Rep. 2583. p. 5-9.

Scifres, C.J. 1980. Brush Management-Principles and Practices for Texas and the Southwest. Texas A&M Univ. Press, College Station.

Scifres, C.J., J.W. Stuth, and R.W. Bovey. 1981a. Control of oaks (*Quercus* spp.) and associated woody species on rangeland with tebuthiuron. Weed Sci. 29:270-275.

Scifres, C.J., J.W. Stuth, D.R. Kirby, and R.F. Angell. 1981b. Forage and livestock production following oak (*Quercus* app.) control with tebuthiuron. Weed Sci. 29:535-539.