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BRUSH CONTROL AND FORAGE PRODUCTION ON SOUTHEASTERN ARIZONA RANGELANDS

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Abstract. We aerially applied tebuthiuron [N-(5-[1,1-dimethylethyl]-1,3,4-thiadiazol-2-yl)-N, N'-dimethylurea] at rates ranging from 0.27 to 1.65 kg ai/ha to reduce competition of creosotebush (Larrea tridentata [DC] Coville), whitethorn acacia (Acacia constricta Benth.), desert zinnia (Zinnia pumila Gray), tarbush (Florensia cernua DC) and associated half-shrubs at three sites. Plant mortality was greatest on shallow, coarse-textured soils and least on deep, fine-textured soils. Creosotebush mortalities ranged from 32 to 100%, whitethorn acacia from 31 to 100%, tarbush from 87 to 100% and desert zinnia from 88 to 100%. Shrub mortalities increased as herbicide rate increased. Perennial grass forage production across all herbicide rates increased from 50 to 478 kg/ha between one and three years at two sites; and varied from 376 to 914 kg/ha between two and seven years at the third site. Forage production increased as

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herbicide rate increased (shrub competition declined) and was from three to five times greater on treated than on untreated areas.

Introduction

Woody plants have invaded the semidesert grasslands in the western United States (1, 17). As woody plant densities increased, perennial grass densities and forage production declined (7). Often it is desirable to reduce woody plant competition and stimulate perennial grass growth in order to reduce runoff and erosion, increase infiltration and provide forage and cover for livestock and wildlife (2, 6, 11).

Mechanical tillage and seeding perennial grasses have been used to reduce shrub competition and restore grassland productivity for the past 90 years (3). The probability of establishing perennial grasses in semiarid areas of the southwest occurs in only one of ten years (4). Therefore, a less destructive approach which will reduce shrub competition without destroying existing native grasses is needed (10).

Tebuthiuron, a soil applied herbicide, effectively reduces woody plant competition and at low rates has a minimal effect on existing perennial grasses (8, 9, 10, 12, 13). In this study we aerially applied tebuthiuron to reduce shrub competition and determine forage production in subsequent years.

Materials and Methods

Site Descriptions. Three sites were selected in southeastern Arizona. Sites were located: 1) 80 km southeast of Tucson at Fairbanks, 2) 100 km southeast of Tucson at Hereford, and 3) 40 km south of Tucson at the Santa Rita Experimental Range (SRER). Elevation varied from 1000 m at SRER to 1300 m at Hereford. Creosotebush [Larrea tridentata (DC) Cov.], whitethorn acacia (Acacia constricta Gray), burroweed [Haplopoppus tenuisectus (Green) Blake], Mariola (Parthenium incanum H.B.K.), tarbush (Flourensia cernua DC.), broom snakeweed [Xanthocephalum sarothrae (Pursh) Shinners] and desert zinnia (Zinnia pumila Gray) were the dominant woody plants, while the predominant grasses were bushmuhly (Muhlenbergia poteri Scribn.), spike dropseed (Setaria macrostachya H.B.K.), fluffgrass [Tridens pulchellus (H.B.K.) Hitchc.] and threeawns (Aristida spp.).

At Fairbanks soils were loamy, mixed, thermic, shallow typic Palerothid and Pectrocalcic calciustoll (15). At Hereford they were fine, mixed, thermic Typic Paleargid and Ustolic Haplargid. At SRER they were coarse, loamy, mixed, calcareous, thermic Typic torrifluvents and loamy, mixed thermic shallow Typic Palerothids (14). Soils at the three sites were mixed and formed complex associations. All soils were well drained.

The Fairbanks site was fenced to exclude domestic livestock grazing in 1979. Livestock were removed and no grazing by livestock occurred at the Hereford site after treatments were applied in 1978. The SRER site was grazed by domestic livestock from the time of treatment in 1976 until 1981 when livestock was excluded. Livestock grazing on the treated plots was essentially nil (utilization of forage plants less than 5%) in 1976, 1977, and 1978. However, grazing in 1979 and 1980 was moderate but heavy enough to preclude accurate forage production estimates.

Chemical treatments. Tebuthiuron pellets containing 20% active ingredient (ai) were aerially applied at SRER on July 15, 1976 with a slotted metering plate and spreader at rates of 0.35, 0.46 and 1.20 kg

ai/ha. The herbicide was aerially applied at Fairbanks and Hereford on June 19, 1978 at rates of 0.27, 0.64, and 1.25 kg ai/ha at rates of 0.55, 1.10 and 1.65 kg ai/ha. At SRER and Hereford plots were 100 by 800 m and those at Fairbanks were 100 by 460 m. SRER and Hereford had 100 m wide check plots.

Plant mortality. Plots were evaluated 39 months after treatment by determining dead plants within each plot. Six to 10, 100-plant groups were counted on each plot.

Forage production. We estimated forage production (standing aboveground biomass) on each plot by the double-sampling technique of Wilm et al. (16). Weight of each plant species in a 0.89 m^2 quadrat was estimated, and plants in each tenth quadrat were clipped and weighed. After drying at 40° C for 48 h, regression equations for each species were calculated and corrections between estimated and clipped weights applied to the estimated dry weights. Ten quadrats made up a sample unit, and we used from 7 to 23 sampling units (70 to 230 quadrats) in each plot.

At Hereford and SRER, slope, aspect, botanic composition and soil differences affected responses of forage plants. At these two sites forage production means on treated plots and adjacent untreated check plots are presented. Forage production was evaluated after the 2nd, 3rd, 4th and 6th growing seasons after treatment at Fairbanks and Hereford and after the 3rd, 6th, and 8th growing season after treatment at SRER.

Results and Discussion

Brush mortality. All rates of tebuthiuron gave excellent control of all brush species at Fairbanks (Table 1). The shallow, course-textured soils at this site probably account for the high mortality rates. Mortalities were not as high at Hereford as at Fairbanks, but control of at least 54% was attained for all species except for honey mesquite (Table 2). Untreated desert zinnia and whitethorn acacia mortality rates of 4 and 5% were recorded at Hereford, Low temperatures in January 1979 caused extensive stem damage to nearly all plants of these two species but nearly all plants has resprouted in 1981.

Table 1. Mortality of shrubs treated with three rates of tebuthiuron at Fairbanks[a].

	Application rates (kg/ha)		
Plant Species	0.27	0.64	1.25
	----------(% dead)---------		
Creosotebush	78	81	100
Whitethorn acacia	91	93	100
Tarbush	87	90	100
Mariola	100	100	100
Desert zinnia	100	100	100

[a]Applied June 19, 1978 and evaluated September 1981.

Table 2. Mortality of shrubs treated with three rates of tebuthiuron at Hereford[a].

Plant Species	Application rates (kg/ha) 0.55	1.10	1.65
	----------(% dead)----------		
Whitethorn acacia	64	98	98
Desert zinnia	88	100	100
Broom snakeweed	69	65	95
Burroweed	54	71	90
Honey mesquite	38	71	69

[a]Applied June 19, 1978 and evaluated September 1981.

The two lowest rates of tebuthiuron killed about one-third of the creosotebush and whitethorn acacia plants, and the highest rate killed 90% or more of both species at SRER (Table 3). Desert zinnia was the most susceptible species to tebuthiuron and mesquite the least.

Forage production. Forage production on untreated areas at Fairbanks was essentially nil in 1979 (Table 4). Forage production increased each subsequent year and was highest in 1983. This reflects protection from livestock grazing as the plot area was fenced in 1979. Forage production on the 0.27 kg/ha rate peaked during the 1980 growing season and remained essentially unchanged during the next three years. Forage production on the 0.63 and 1.25 kg/ha rates were lower in 1979 than on the 0.27 kg/ha, suggesting that at these rates tebuthiuron was inhibitory to the forage plants. Some of the plants on these plots showed chlorosis and other symptoms of tebuthiuron toxicity in 1979. Forage production increased in 1980 and 1981 on plots treated at 0.63 and 1.25 kg/ha rates with highest production occurring at both rates in 1981.

Forage production increased between two and four fold on plots treated with tebuthiuron when compared with untreated check plots at the Hereford site (Table 5). Forage production at the SRER site was always higher in all years on the plots treated with tebuthiuron than on adjacent untreated plots (Table 6). Highest brush mortality and forage production occurred on the plot treated at 1.20 kg/ha rate. This study shows that forage production improves after brush competition is reduced or removed with tebuthiuron.

Table 3. Mortality of shrubs treated with three rates of tebuthiuron at SRER[a].

	Application rates (kg/ha)		
Plant Species	0.35	0.46	1.20
	----------(% dead)----------		
Creosotebush	36	32	90
Desert zinnia	32	76	100
Whitethorn acacia	31	35	94
Mesquite	17	27	92

[a]Applied July 15, 1976 and evaluated October 1979.

Table 4. Forage production in plots treated with tebuthiuron in 1978 at Fairbanks.

Tebuthiuron	Year of Evaluation			
rates	1979	1980	1981	1983
(kg ai/ha)	----------(kg DM/ha)---------			
0.00	2	32	45	103
0.27	201	379	311	269
0.63	113	457	490	316
1.25	45	530	605	504

Table 5. Forage production on plots treated with tebuthiuron in 1978 at Hereford.

Tebuthiuron rates	Year of Evaluation 1979	1980	1981	1983	Average
(kg ai/ha)	----------(kg DM/ha----------				
0.55	699	466	603	342	528
0.00	64	267	109	58	124
1.10	174	210	230	390	251
0.00	128	50	97	94	92
1.65	418	310	624	607	490
0.00	264	257	370	334	306

Table 6. Forage production on plots treated with tebuthiuron in 1976 and untreated plots at SRER.

Tebuthiuron rates	Year of Evaluation 1978	1981	1983	Rate Average
(kg ai/ha)	-------(kg DM/ha)-------			
0.35	403	337	734	491
0.00	81	121	193	132
0.46	376	482	822	560
0.00	104	151	223	159
1.20	528	653	914	698
0.00	146	158	230	178

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