Vegetation Response Following Spraying a Light Infestation of Honey Mesquite

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Highlight: *Vegetation change was evaluated for 4 years following aerial application of 2,4,5-T + picloram (1:1) at 0.56 kg/ha to semiarid rangeland with a light canopy cover of honey mesquite (12%) and sand sagebrush (2%). Stand reductions of woody plants exceeded 95% at 4 years after treatment whether in grazed or ungrazed pastures. Forage production increased on areas with brush control and protection from grazing only in years of average or above-average rainfall. However, sprayed, ungrazed areas produced during the study period an average of 3 kg/ha/year more grass for each centimeter of precipitation received than did untreated, ungrazed areas. At the end of the study, areas sprayed and protected from grazing supported more grasses of fair to good grazing value than did unsprayed areas.*

The Soil Conservation Service (Smith and Rechenthin, 1969) indicated over 16 million ha of Texas rangeland were infested with light to moderate stands (less than 25% of canopy cover) of honey mesquite (*Prosopis glandulosa* Torr. var. *glandulosa*). In the Rolling Plains, a part of the Great Plains region, many of the light to moderate stands are the result of massive disturbance of dense stands of large, single-stemmed honey mesquite. Honey mesquite growth form following initial control efforts is usually a multi-stemmed, bushy plant that is not susceptible to mechanical methods such as chaining and is only temporarily controlled by shredding (Fisher et al., 1969) (Fig. 1). The small, bushy, honey mesquite is not easily controlled by prescribed burning (Britton and Wright, 1971). Rootplowing is not practiced in much of the Rolling Plains because of shallow soils, rough terrain, investment costs and variability in the semiarid climate.

A 1965 study indicated that aerially spraying honey mesquite with 50% or greater canopy cover using 0.56 kg/ha of 2,4,5-T [(2,4,5-trichlorophenoxy) acetic acid] applied in about 40 to 50 liters/ha of a diesel oil: water emulsion (1:3 or 1:4) was profitable in the Rolling Plains (Workman et al., 1965). However, the value of spraying light to moderate stands of honey mesquite has been questioned on the basis that control results in little or no additional forage production and small, scattered plants present no significant management problem.

Success from aerial applications of 2,4,5-T is strongly influenced by site factors such as soil temperature (Dahl et al., 1971) and physiological

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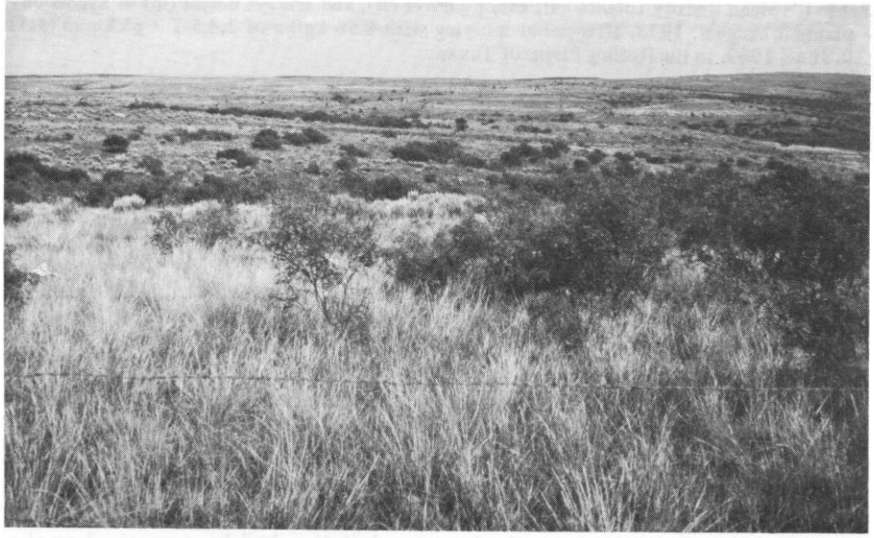

Fig. 1. *Much of the honey mesquite infestation on Texas rangeland, especially in the Rolling Plains, is composed of multi-stemmed, bushy plants that are difficult to control except by aerial spraying.*

conditions such as internal moisture stress (Meyer et al., 1972). Recently workers have combined 2,4,5-T with herbicides such as dicamba (3,6-dichloro-*o*-anisic acid) or picloram (4-amino-3,5,6-trichloropicolinic acid) in an effort to increase the level of honey mesquite control and to broaden the spectrum of phytotoxicity to associated undesirable species (Scifres and Hoffman, 1971). Control of honey mesquite by the 2,4,5-T + picloram combination is evidently governed by the same environmental factors which regulate 2,4,5-T effectiveness (Meyer et al., 1972; Sosebee et al., 1973). Sosebee et al. (1973) also reported that trees taller than about 2.5 m were more difficult to kill than smaller plants with aerial sprays of 2,4,5-T + picloram.

In efforts to develop more effective herbicides and herbicide combinations, researchers have concentrated almost solely on response of the target species. Relatively few studies in the study area have emphasized reaction of the total plant community to herbicide application. The objective of this research was to evaluate the reaction of a rangeland community with a light infestation of honey mesquite and sand sagebrush (*Artemisia filifolia* Torr.) to aerial application of 2,4,5-T + picloram.

Materials and Methods

Two watersheds, 3.5 and 4 ha in area and less than 0.6 km apart, were chosen for study. The watersheds were typical Rolling Hill range sites (Scifres et al., 1974) with south to southeasterly exposure and about 5% slope. The surface 2.5 cm of the Carey sandy loam had pH 7.1 and contained 1.1% organic matter, 66% sand, and 14% clay.

On June 9, 1969, the triethylamine salts of 2,4,5-T + picloram were aerially applied in a 1:1 commercial formulation at 0.56 kg/ha total herbicide in 47 liters/ha of a diesel oil:water emulsion (1:4) to one watershed. The other watershed was not treated. In early July, 1969, an exclosure of about 0.32 ha in area was constructed in the center of each watershed.

Numbered stakes were placed along the upper fence and along one side of each exclosure such that their intersection formed a sampling point in a stratified scheme. Fifty-four points were randomly selected for sampling each year from 1969 through 1973. To compensate for slope effects, the watersheds were divided into three equal portions downslope and 18 points randomly drawn from each strata for sampling each year. During August of each year from 1969 to 1973, broadleaved species were counted, standing herbaceous vegetation was clipped at 2.5 cm stubble height, and mulch was hand collected at each sampling point from 0.25 m^2 quadrat. Standing vegetation, sorted into grasses and broadleaves, and mulch were oven-dried and weighed. Within 2 m either side of each quadrat harvested for yield, at least two samples were taken for botanical composition. Botanical composition was determined using basal intercepts from 10-point inclined sampling frames.

Canopy cover and density of honey mesquite and sand sagebrush were estimated using belt transects 1.5 m wide and 25 m long. At each sampling date, 12 transects were evaluated in the exclosures (four randomly located in each of the three sampling strata) and in an adjacent area beginning 9 m from the exclosure fences. Other undesirable species of minor importance in the area were observed for reaction to the spray.

Population attributes were compared between sprayed and untreated areas using a *t*-test. Influence of time on change of vegetation attributes was evaluated by regression analyses.

The range was stocked continuously during the study period with cows and calves at 1 AU/7 to 8 ha. The study area was within 0.15 km of a watering facility, which may have induced higher use than in other areas of the range.

Results and Discussion

Brush Control

Honey mesquite canopy was reduced by over 90% within 30 days after aerial spraying. The other primary woody component, sand sagebrush, did not defoliate but demonstrated typical, morphological responses to the growth-regulator herbicides (stem epinasty and dieback from the tips) at 1 month after treatment. At the time of treatment, canopy cover of honey mesquite was estimated to be about 12%, and sand sagebrush cover was about 2%. Canopy cover of these species increased slightly over the 4-year study period in the unsprayed plots (Table 1). Total canopy cover, reduced drastically by the spray, was less than 1% at 4 years after herbicide application. Density of honey mesquite and sand sagebrush did not change in the unsprayed areas over the study period but was reduced to about 32 live plants/ha on the sprayed watershed. The reduction in honey mesquite density, about 97%, was higher than normally expected from the spray. In the same area, Fisher et al. (1972) reported an average of about 50% reduction in number of live plants, regardless of growth form, with the same treatment from 1968 to 1970. Also, Sosebee et al. (1973) indicate that plants of the stature of those in our study are more difficult to control than larger plants.

Regrowth honey mesquite plants in treated areas were only about 0.3 m shorter than the average of the untreated population 4 years after spraying (Table 1). Kill of original topgrowth by the herbicide caused regrowth honey mesquite plants to develop over six stems per parent plant, whereas untreated plants averaged less than four stems per plant.

Less prevalent undesirable species, plains pricklypear (*Opuntia polyacantha*) Haw.), tasajillo (*O. leptocaulis* D.C. var. *leptocaulis*) and Jeff Davis cholla (*Opuntia davisii* Engelm. & Bigd.) were completely eliminated by the spray. No seedlings of woody or succulent plants were observed during the four growing seasons following spraying. The area has evidently reached a successional stage where disturbance of the ground cover would be necessary for invasion of honey mesquite seedlings (Scifres et al., 1971).

Table 1. Mean density (plants/ha), canopy cover (%), and average height (m) of live woody plants in August, 1973, after aerial spraying with 0.56 kg/ha of 2,4,5-T + picloram (1:1) in June, 1969, in the Rolling Plains of Texas.

Species	Treatment	Density	Canopy cover	Height
Mesquite	None	659	12.3	1.31
	Sprayed	17	0.2	1.01
	Difference[a]	*	*	N.S.
Sand sagebrush	None	259	3.8	0.52
	Sprayed	15	0.2	0.49
	Difference[a]	*	*	N.S.

[a]Asterisks indicate means of sprayed and unsprayed populations significantly different and "N.S." indicates no significance at the 95% level of probability.

Herbage Production

Long-term average annual rainfall for the area is 56 to 76 cm (Gould, 1969). During the year of treatment, the area received about 70 cm of precipitation.

Pretreatment evaluation showed no difference between watersheds in herbage production. Primary grasses at the time of spraying were buffalograss (*Buchloe dactyloides* (Nutt.) Engelm.), hooded windmillgrass (*Chloris cucullata* Bisch.), Hall's panicum (*Panicum halli* Vasey), Japanese brome (*Bromus japonicus* Thunb.), and Wright's threeawn (*Aristida wrightii* Nash). There was little change in production of herbage the first 90 days following herbicide application. Total standing yield was about 900 kg/ha of oven-dry herbage in the sprayed exclosure and about 975 kg/ha in the untreated area in August following spraying the previous June. However, grasses yielded only 120 kg/ha dry matter in the untreated area (12% of the total production) whereas 258 kg/ha (about 29% of the total) were harvested from the sprayed exclosure. The difference in total herbage production the year of spray application was accounted for in control of broadleaved species, primarily prairie pepperweed (*Lepidium densiflorum* Schrad.), Texas croton (*Croton texensis* (Klotzch) Muell. Arg.), prairie paintbrush (*Castilleja purpurea* (Nutt.) G. Don) and common broomweed (*Xanthocephalum dracunculoides* (D.C.) Shinners). Over 200 kg/ha less herbaceous, broadleaf dry matter were harvested on the sprayed watershed as compared to the untreated area after 90 days.

Annual precipitation during 1970 was less than 29 cm (about 40 to 50% of the annual average). Treatment effect evidently was completely masked by low rainfall and the high air temperatures which often exceeded 38°C during the summer months. Herbage yield averaged only 390 and 450 kg/ha total dry matter in the exclosures and less than 100 kg/ha was produced as grasses. Rainfall increased to over 56 cm during 1971, and herbaceous vegetation responded accordingly. However, there was little difference between sprayed and unsprayed areas in total herbage production. Grass yields averaged 380 and 485 kg/ha dry matter in untreated and sprayed areas, respectively, under complete protection. In 1972, about 60 cm precipitation was recorded. In the exclosures, about 750 kg/ha of oven-dry grasses were harvested from the sprayed area whereas the untreated exclosure produced about 680 kg/ha.

Highest herbage production for the study period was recorded in 1973, with the greatest differences recorded between sprayed and unsprayed exclosure (Table 2). Over 40 cm of precipitation had been received on the study area by time of the August harvests. Production of broadleaves was greater in grazed than in protected areas, but there was little influence due to spraying.

Trends in mulch accumulation followed the same pattern as with herbage production in 1973. Based on protected areas only, regression analysis was used to isolate the influence of rainfall on herbage production. For every centimeter of precipitation received annually, the sprayed, ungrazed area produced 21.8 kg/ha of oven-dry grasses. The untreated, ungrazed area produced 18.3 kg/ha of grasses for each centimeter of precipitation received annually. Difference in slopes of the regression lines was significant at the 90% level of probability. Thus, in a year of "average" rainfall, treatment of the light honey mesquite infestation resulted in a 230 kg/ha increase in grass production.

Vegetation Composition

By 1973, the least amount of bare ground (17%) was contacted in the area sprayed and protected from

Table 2. Mean production (kg/ha, oven-dry) of herbage and mulch in August, 1973, after aerial application (0.56 kg/ha) of 2,4,5-T + picloram (1:1) in June, 1969, to semiarid rangeland and subsequent protection from grazing or continuous grazing in the Rolling Plains of Texas.

Treatment	Herbage		
	Grasses[a]	Broadleaves[a]	Mulch[a]
Sprayed, protected	1092 a	199 b	1284 a
Sprayed, grazed	492 c	255 a	875 b
Unsprayed, protected	839 b	134 b	1028 b
Unsprayed, grazed	834 b	248 a	591 c

[a]Means within a column followed by the same letter are not significantly different at the 95% level using t-test as a criterion.

Table 3. Basal contact (%) of grasses grouped by grazing value and total intercepts by broadleaves on aerially sprayed and unsprayed watersheds supporting light infestations of honey mesquite which were protected from grazing or grazed from June, 1969, to August, 1973, in the Rolling Plains of Texas.

		Watershed treatments			
		Unsprayed		Sprayed	
Species	Grazing value	Grazed	Protected	Grazed	Protected
Grasses					
Blue grama	Good	1.4	5.2	6.8	7.4
Buffalograss, Hall's panicum, hooded windmillgrass, tall dropseed, Texas wintergrass	Fair	5.6	7.2	10.0	13.6
Burrograss, Japanese brome, sand dropseed, Wright's threeawn	Poor	8.0	4.0	5.9	2.9
Total grasses		15.0	16.4	22.7	23.9
Total broadleaves		0.8	0.2	0.2	0.6

grazing. The greatest amount of bare ground (35%) occurred in the area not sprayed and grazed continuously. Percentage of ground covered by mulch varied from 48 to 59% among the experimental areas with greatest cover in the exclosures.

Four years after spraying, the desirable forage species, blue grama (*Bouteloua gracilis* (Willd ex. H.B.K.) Lag. ex Griffiths) was present in 1973 and not encountered in 1969 were tall dropseed (*Sporobolus asper* (Michx.) Kunth. var. *asper*) and Texas wintergrass (*Stipa leucotricha* Trin. & Rupr.). The latter, a cool season species, occurred only in sprayed areas which were protected from grazing. Two species of poor grazing value, burrograss (*Scleropogon brevifolius* Phil.) and sand dropseed (*Sporobolus cryptandrus* (Torr.) Gray), were also encountered in 1973 but were not present in other years. Wright's threeawn was present in all study areas but in greatest abundance (5.6% basal contacts) and highest vigor in areas unsprayed and grazed continuously for the 4-year study period. It constituted 1% or less of the basal contacts in other study sites.

Four years after spraying, the broadleaved species contacted were in similar proportions as mentioned for the year of spraying, with the addition of silverleaf nightshade (*Solanum elaeagnifolium* Cav.), scurfy side (*Sida lepidota* Gray), prairie spiderwort (*Tradescantia occidentalis* (Britton) Smyth), and Maximilian sunflower (*Helianthus maximiliani* Schrad.). Residues from 0.28 kg/ha of picloram can be expected to persist in soils of the study area for 60 to 90 days after application (Bovey and Scifres, 1972). These residues prevent establishment of many broadleaved species during the season of spraying. Accordingly, the broadleaf population in this study, based on density, was completely restored within the second season following spraying.

These data indicate that reduction in competition from light stands of honey mesquite in semiarid environments such as that of the Rolling Plains can result in increased grass production if rainfall is the long-term average or greater. Since the disturbed stands are usually not composed of plants of great stature and probably do not present a mechanical problem, increased efficiency in managing and handling livestock following spraying would be discounted as a benefit. However, honey mesquite control did result in vegetation more desirable for grazing. Controlling such stands is also necessary for maintenance of initial brush control levels.

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