Will Mesquite Control with 2,4,5-T Enhance Grass Production?

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Highlight: Both honey mesquite density and percent of plants dead the year of aerial spraying with 2,4,5-T proved to be major factors influencing perennial grass production. Sites with sparse honey mesquite stands and very dense stands (over 50% canopy cover) yielded little extra grass after 2,4,5-T application. Heavy mesquite foliage probably prevented adequate leaf coverage with 2,4,5-T in dense stands, and in sparse stands mesquite competed little with the herbaceous plants. Increased perennial grass production of about 540 lb/acre/year would be necessary over a 5-year period to break even with a $4.60/acre aerial application of 2,4,5-T. With honey mesquite cover of 30%, a plant kill over 80% the year of application was required to provide a 540 lb/acre/year grass increase. However, a 90% kill would provide nearly 750 lb/acre/year extra perennial grass. Thus, paying particular attention to optimum environmental factors and proper timing for the 2,4,5-T application can pay big dividends.

In a series of publications entitled *Grassland Restoration*, Smith and Rechenthin (1964) pointed out that honey mesquite (*Prosopis glandulosa*) is the most common and widely spread "pest" plant in Texas. About 25% of the state's grasslands are infested with honey mesquite, with 16 million acres so densely covered as to seriously suppress grass production. The question is, "How much reduction constitutes seriously suppressed grass production?" Although Agricultural Extension Service demonstration plots and yield comparisons between sprayed and unsprayed pastures conducted by Soil Conservation Service personnel under Federal cost-share programs indicate increased forage production following honey mesquite control with herbicides, quantitative research accounts of forage increases are relatively scarce. Fisher et al. (1959) reported increased steer gains of 31 lb/head in pastures cleared of honey mesquite at Spur, Tex. Sale of animal products is ultimately the means whereby we measure direct monetary benefits of a range improvement practice; however, grazing studies to evaluate benefits of a brush control program are time consuming and costly. Consequently, it is necessary to utilize indirect means of measuring animal productivity increases by measuring forage increases. Prior to 1970, the major published research on increased forage production following herbicidal control of mesquite was conducted on the Santa Rita Experimental Range in Arizona. Forage production was inversely related to the number of velvet mesquite (*P. velutina*) trees (Martin 1966). Herbicidal control of velvet mesquite with 2,4,5-T [(2,4,5-trichlorophenoxy) acetic acid)] doubled grass production on sprayed native range and tripled Lehman lovegrass (*Eragrostis Lehmanniana*), as compared to that produced on unsprayed areas (Cable and Tschirley 1961).

Limited results led us to believe that honey mesquite control with herbicides in Texas would not provide yield increases of the magnitude reported from Arizona. First year results from near Matador, Tex., showed a 46% forage increase following honey mesquite spraying with 2,4,5-T (Robison et al. 1970). This extra forage increased beef production only 1.5 lb/acre, primarily because users maintained the same stocking rates on sprayed and unsprayed pastures. Following interviews with ranchers in the eastern part of the Texas Rolling Plains, Workman et al. (1965) reported that grazing capacity on upland sites was increased from 22 to 17 acres/AU/year, and from 20 to 16.5 acres/AU/year on bottomland sites.

In 1970, we began studying herbage yields from areas sprayed aerially with 2,4,5-T and from comparable unsprayed areas in the Texas Rolling Plains.

Study Area and Methods

This study was conducted in the Rolling Plains land resource area of West Texas. One location was near San Angelo in Tom Green County; one near Spur in Kent County; and one near Post in Lynn County.

At all locations, the basic herbicide mixture was 0.5 lb of 2,4,5-T (ester) in 1 gal diesel oil and enough water to bring the total spray solution to 4 gal/acre. The Tom Green County location was on a clay loam, and herbicide was applied on June 27, 1969. The pasture in Kent County was sprayed on May 26, 1970. For this location, we selected five variations in topography, in soils, and in honey mesquite density in each study pasture, pairing the sites as evenly as possible. Soils varied from clay loam to clay. Lynn County sites sprayed on July 6, 1971, constituted the third location. The soils of this location were clay loam to sandy clay loam.

Depending on uniformity of understory vegetation, from 9 to 25 woven wire cages, 5 ft in diameter, excluded livestock grazing from vegetation to be sampled for yield. Since 80% of the yearly growth is achieved by July in these areas (Hiermann 1973), we measured standing crop each year in July or August. Cages were relocated for next year's growth at sampling. One 4.8-ft^2 plot was clipped from each cage.

Herbage yields in Tom Green County were obtained for the 6 years, 1970 through 1975, and in Lynn and Kent counties yields were obtained 1971 through 1974.

Percent canopy cover of honey mesquite was determined from transects 1 ft wide and 100 ft long (from 2 to 12 transects per site). Honey mesquite mortality was determined from 25 permanently

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Table 1. Perennial grass yields in oven-dry lb/acre following aerial 2,4,5-T application to honey mesquite on Texas Rolling Plains rangeland from 1970 to 1975.

		Year after spraying									
	Initial	2 mo. after		1st		2nd		3rd		4th	
Site	canopy cover (%)	Unsprayed	2,4,5-T sprayed	Unsprayed	2,4,5-T sprayed	Unsprayed	2,4,5-T sprayed	Unsprayed	2,4,5-T sprayed	Unsprayed	2,4,5-T sprayed
Shallow redland[1]	5			120	330	820	1000	1960	2080	1590	1210
Deep hardland[2]	12			1070	680	1060	1140	1760	2040	1060	1600
Deep hardland[3]	21	640	1850	2040	2530	1370	1640	560	840	—[4]	—[4]
Valley[1]	28			330	1290	2320	1990	2340	2670	1670	1710
Deep hardland[1]	34			390	1050	820	990	940	1420	—[4]	—[4]
Deep hardland[1]	36			480	2480	1490	2030	810	1220	1190	1580
Deep hardland[1]	54			540	770	1880	1270	580	990	—[4]	—[4]

[1] Kent County.
[2] Tom Green County.
[3] Lynn County.
[4] Plots lost due to mechanical disturbance.

marked trees/site. Initial mortality was measured during the October following spraying. If a tree had no sprouts anywhere, it was considered initially dead. A second check for sprouts was made during the fall following the second growing season after spraying.

Buffalograss (*Buchloe dactyloides*) and tobosagrass (*Hilaria mutica*) were dominant perennial grasses on the study sites. Other grasses commonly occurring were: vine mesquite (*Panicum obtusum*), Hall's panicum (*Panicum hallii*), blue grama (*Bouteloua gracilis*), three-awns (*Aristida* sp.), sand dropseed (*Sporobolus cryptandrus*), and Arizona cottontop (*Digitaria californica*). Texas wintergrass (*Stipa leucotricha*) was a minor component on some sites. Although Texas wintergrass and some winter annuals were occasionally present and sampled, the summer sampling sequence undoubtedly underemphasized their importance.

To ascertain if herbicidal control of honey mesquite can be justified, an example using yearling cattle is included. Assumptions in the example are: (1) cost of application will be repaid in 5 years using an interest rate of 10%; (2) steers weighing 400 lb can be purchased for $0.39/lb and resold 1 year later at $0.37/lb; (3) a yearly steer gain of 275 lb; (4) 1.5 lb/day of protein supplement costing $0.08/lb will be fed for 100 days; (5) $16.00/head for other variable costs including death loss, salt and mineral, veterinary and medicine, hauling and marketing, etc.; and (6) interest on operating costs of $18.00/head.

Correlation analysis was used to relate mesquite infestation to expected perennial grass yield increases.

Average Perennial Herbage Response

Aerially spraying honey mesquite with 2,4,5-T significantly ($P \leq 0.05$) increased perennial grass production in all three counties (Tables 1 and 2). It is apparent that while average grass yield increases for all counties due to 2,4,5-T spraying were significant, grass response on some sites was nonsignificant.

At those sites with 200 or fewer trees per acre, a high proportion were controlled with 2,4,5-T, but increased grass production was so low that it is unlikely that one could afford the treatment. Conversely, herbicide application to the most dense stand of honey mesquite (1,360 trees/acre) provided no perennial grass increase at all. However, this was because no trees were actually killed, and 56% of them had resprouted at the stem base by October of the year sprayed. Yield of honey mesquite basal sprouts the first year after spraying on this site was greater than the honey mesquite current year's top growth on a similar unsprayed site. We believe the heavy honey mesquite foliage resulted in poor leaf coverage with 2,4,5-T and subsequently in low root kill. Neither herbicidal treatment of sparse honey mesquite infestation of poor plant kill provide sufficient forage increases to warrant use of 2,4,5-T at today's cost of application. In this study we attempted to define those parameters that will delineate the point at which it is economical to use an herbicide for honey mesquite control.

Correlation analysis indicated that the two best predictors of increased forage production in this study were (1) the percentage of honey mesquite canopy cover before spraying and (2) the percentage of honey mesquite trees with no basal stem sprouts in the fall of the year sprayed. Table 3 may be used as a guide to the percentage kill necessary for a given degree of honey mesquite infestation to provide enough increased grass to justify the herbicide treatment. The amount of extra grass required will depend on current costs and returns. To illustrate, suppose the increased grass production necessary to justify spraying mesquite is 500 lb. The values in Table 3 indicate that one would need to get more than a 60% root kill during the first year in a pasture with 50% mesquite cover in order to provide the needed 500 lb of grass. However, a 90% kill at a site with 16 or 17% canopy cover should increase grass yields the same 500 lb/acre. These data also strongly indicate that mesquite infestations with less than 10% canopy

Table 2. Differences in perennial grass yields due to aerial application of 2,4,5-T to honey mesquite on Texas Raolling Plains rangeland from 1970 to 1975.

Site	Initial canopy cover (%)	Trees/ acre	Root kill 1st year (%)	Root kill 2nd year (%)	Grass yield differences (year after spraying): 2 mo. after spraying	1st	2nd	3rd	4th	Average
Shallow redland[1]	5	165	80	28		210	180	120	−380	30
Deep hardland[2]	12	206	85	40		−390	80	280	540	130*
Deep hardland[3]	21	630	80	40	1210	490	170	280	[4]	540*
Valley[1]	28	425	68	4		960	−330	330	40	250
Deep hardland[1]	34	625	65	8		660	170	480	[4]	440
Deep hardland[1]	36	665	92	12		2000	540	410	390	840*
Deep hardland[1]	54	1360	44	0		230	−610	410	[4]	10
Means	27	582	76	19		594	29	330	148	320

[1] Kent County.
[2] Tom Green County.
[3] Lynn County.
[4] Plots lost due to mechanical disturbance.
* Indicates that honey mesquite sprayed with 2,4,5-T resulted in significantly ($P \leq 0.05$) more perennial grass prodduction over the years sampled.

Table 3. Expected annual increases in perennial grass yield (lb/acre) in relation to degree of mesquite infestation and proportion of mesquite controlled in west Texas.[1]

Honey mesquite trees unsprouted (%) fall of year sprayed	Honey mesquite canopy cover (%)				
	10	20	30	40	50
40					
50				30	200
60			70	250	420
70		120	300	470	650
80	160	340	520	690	870
90	390	560	740	920	1090
100	610	780	960	1140	1310

[1] Yield increases (y) were determined by the formula Y = 17.6 (% canopy cover) + 22.2 (% root kill) − 1787. (R^2 = 0.78).

cover will seldom provide significant grass increases regardless of proportion of trees killed. An example, using 1977 prices, is given under the management implications section.

Longevity of Conrol

Mesquite control is expected to give maximum increased grazing capacity the first 2 or 3 years after spraying (Workman et al. 1965). Our results also showed the greatest grass response from 2,4,5-T spraying for 5 of the 7 locations studied occurred the first year after treatment.

Fisher et al. (1959) reported that with root kills of 30 to 50%, mesquite sprout growth is seldom great enough for retreatment within 4 years. Except for the Tom Green County location, our data do not extend beyond 4 years. However, for the Tom Green County site, mesquite canopy cover was 12% on unsprayed pastures compared to only 5% on sprayed plots in July, 1976, 7 years after spraying. Increased grass yields were 240 and 200 lb/acre for the 5th and 6th years, respectively. These are well above the 4-year average of 130 lb for the site (Table 2). Evidently, with root suppression of 75% or greater the year of spraying, significant grass yield increases can be obtained for more than 4 years after spraying.

Relationship of Mesquite Density to Mesquite Canopy Cover

Figure 1 shows the curvilinear relationship between canopy cover and honey mesquite density for this study. Canopy cover values, in combination with honey mesquite mortality in the year of 2,4,5-T spraying, was used in Table 3 rather than number of trees because it gave a slightly higher multiple correlation coefficient (R = 0.88 vs R = 0.80).

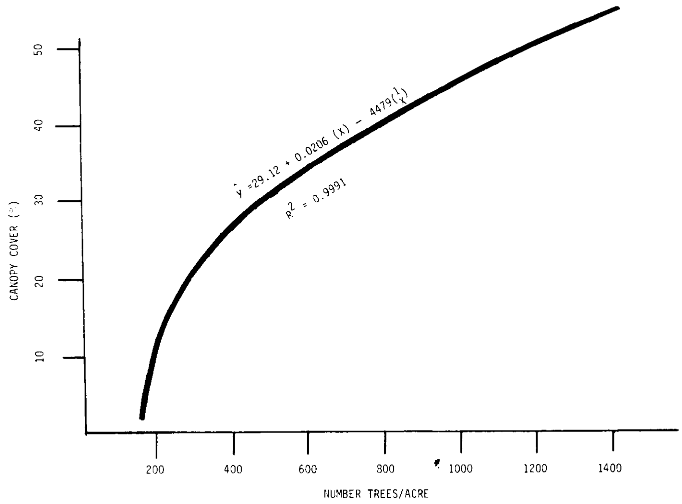

Fig. 1. *Relationship of honey mesquite canopy cover to density in the Rolling Plains of Texas.*

Management Implications

The question, "Do I have enough honey mesquite to justify the expenditure for chemical control?" is best answered by measuring increased livestock products to see if the increase can pay for an herbicide application strictly from increased forage. However, a major incentive for brush control is the accompanying labor savings in gathering and checking livestock, easier detection of crippled and diseased animals, etc. Some speculate that this aspect alone is worth $1.00/acre.

Aerial application of 2,4,5-T (0.5 lb/acre in 4 gal/acre total volume) currently costs about $4.60/acre. If this cost must be repaid in 5 years, at 10% interest, the annual payment would be $1.21/acre. To break even, this requires that the increased forage provide extra animal products worth $1.21. The question then becomes, how much forage increase does it take to provide this much extra beef?

Average grass standing crop in July on all untreated sites for the years of this study was 1,120 lb/acre. Sims et al. (1976) reported that forage disappearance per yearling steer per day varied from 20 to 30 lb/head/day under moderate and light stocking rates in eastern Colorado. Using a conservative value of 30 lb/day for a yearling steer and reserving 30 lb of forage to maintain plant vigor, then each yearling steer will require 1,800 lb of forage/month; or, the untreated range would require 19.3 acres/yearling steer annually. The locations sprayed with 2,4,5-T produced an average of 1,450 lb/acre of grass which would then require only 14.9 acres/yearling steer. Using the assumed production costs and returns given in the methods section, return per steer would be $47.75 or $2.47 return/acre before treatment and $3.20/acre after herbicide treatment. The $0.73/acre increase would not make the $1.21 payment. To allow enough increased stocking to make the $1.21 annual payment, 540 extra lb/acre are needed or a total grass yield of 1,660 lb/acre. Using Table 3 as a guide, a 30% canopy would require over 80% root kill to give this much extra grass. Consequently, it is important to get a high percent kill the year of herbicide application, so particular attention should be given to getting optimum conditions for applying the herbicide.

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