Herbicide Use and Labor for Hand Applied Control of Mesquite

Use this simple method to determine costs of stem application.

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Mesquite encroachment is a widespread brush problem in Texas. As grasslands are overtaken by mesquite, grazing management is complicated because of reduced forage production and interference with livestock operations. Mesquite control is a perpetual process and ignoring brush encroachment until noxious plants reach unacceptable levels adversely affects stocking rate and range health (7,8).

Since the income derived from wildlife has been steadily increasing in Texas, the early practice of fenceline to fenceline broadcast herbicide application or clear-cut bulldozing have deviated toward selective clearing. With selective clearing and emphasis on "Brush Buster" tactics, hand applied herbicide treatments are becoming more acceptable to landowners (5).

Stem application of herbicide is a desirable method of mesquite control because this promotes quick removal of brush competition with minimum damage to sod and established native plants. It is also low volume, easy to apply, highly selective, and equipment needs are inexpensive. However, hand applications are labor intensive and a method of estimating herbicide needs and labor requirements for different brush densities and sizes are necessary to assess costs before application.

Typical of untreated mesquite in the treatment areas.

Research Objective

The relationship between individual tree dimensions and herbicide requirements are highly correlated and easily estimated. Our goal was to identify a dependable brush parameter for predicting herbicide usage that was user-friendly and based on low skill requirements. We measured the accuracy and time taken to assess the amount of herbicide that will treat an area, and labor needed to make single stem applications to mesquite.

This study was conducted south of Vernon on the rolling plains of northwest Texas in four pastures within seven miles of each other. Soils in the area were gently sloping clay loams. Vegetation consisted of mesquite trees less than fifteen feet in height varying greatly in stem size and number. Mesquite canopy in the treatment areas was fairly dense varying from 25 to 56% cover. Other significant brush present was prickly pear, lotebush, and catclaw. All sites had been disturbed by wildfire within 18 years prior to this study.

Cool and warm season grass mixes were the predominant forage. Texas wintergrass, silver bluestem, meadow dropseed, sideoats grama, and buffalograss were typical. Japanese brome, which is a cool season annual, has been significant forage when a wet winter followed a dry summer. Forbs most common were western ragweed, heath aster and silver-leaf nightshade. Occasionally annual broomweeds were abundant.

Which Tree Dimension Best Indicates Herbicide Use?

Tree dimensions measured in this study included density, height, radius, canopy cover, canopy volume, total stem number, and the number of stems with a diameter of 1 inch. Application time and ounces of chemical used were also recorded. Additional sampling was done to estimate costs for herbicide and labor inputs on 0.1 acre plots to determine the accuracy of a method of estimation.

Canopy cover was determined as area of a circle calculated using the average radius of the trees. Canopy volume was calculated as canopy cover multiplied by 80% of tree height. We assumed crown absence from the ground for the lower 20% of tree height. The Natural Resource Conservation Service (NRCS) step transect method was also used to estimate canopy cover of mesquite. The average of four step transects were used to estimate canopy cover for a site. Walking 200 steps in a straight line and marking overhead canopy presence on even numbered steps is the estimated percent canopy cover. This required less time than measuring tree radius and calculating canopy cover, or measuring canopy cover with the line-intercept method (3).

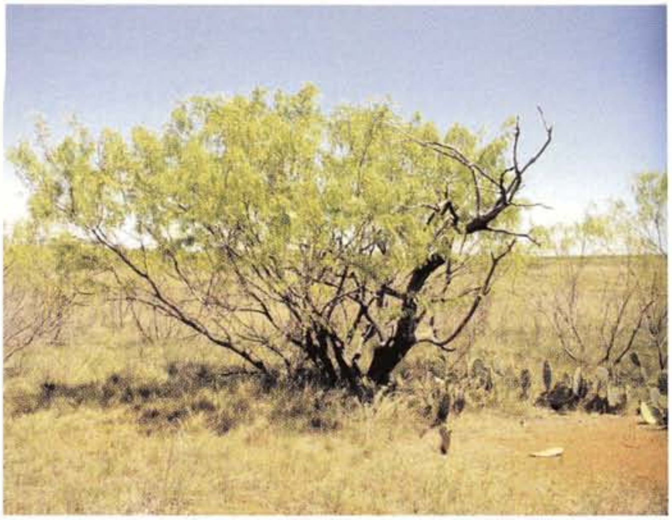
There is considerable variation in woody plant biomass for plants of the same height (4). Leaf area increases with leaf mass, but is a difficult parameter to measure (1,2). We chose to examine an estimate of biomass (dry leaf weight per tree expressed as 1-inch diameter stems) to better define tree size differences. A 1-inch mesquite stem has approximately 0.4 lb of dry leaf mass (S.L. Dowhower unpublished data). The estimated biomass of 1-inch stems is the canopy of tree including leaves and associated branches (crown cover).

We established three size categories of trees to facilitate a consideration of size effect on herbicide requirements, based on 1-inch stem counts. This was a way to group trees in a manner that would reflect crown cover and height, although not necessarily a measure of exact biomass. Trees were

Table 1. Average parameter values of mesquite trees by size class.

Tree parameter	Tree size class		
	Large	Medium	Small
Height (feet)	11.2	8.5	4.6
Width (feet)	14.4	9.8	4.6
Number of treated stems per tree	31	10	4
Number of 1-inch stems per tree	17	6	1
Leaf biomass[a] (lbs per acre)	397	302	43
Average % canopy	20	21	4
Number of trees per acre	53	114	97

[a]Leaf biomass as 0.4 lb dry leaf (per 1-inch stem)



An example of regrowth mesquite after wildfire common across the treatment areas.

grouped by their number of 1-inch stems; 0 to 2 for small, from more than 2 to10 for medium, and more than 10 for large trees. There was a uniform range of tree height, width, and treated stem numbers across tree size classes based on 1-inch stem counts.

The average height of these tree groups from stem numbers was very similar to the size groups used for mortality and tree re-growth assessments (0–3 feet, 3–6 feet, and >6 feet). Average estimated leaf weight increased 3 fold from medium trees to large trees, and increased 6 fold from small to medium trees (Table 1). Trees with less than two stems or under 3 feet in height contributed negligibly to the canopy cover of an area. Data in Table 1 showed that tree height and width alone under-estimated cover.

Tree numbers per acre were not accurate for predicting herbicide needs for a stand that lacks uniformity in height and diameter, which is characteristic of mesquite. A multiple regression of comparative herbicide use on large or medium trees per acre indicated that 2.2 times the herbicide used for medium trees was needed for a large tree, while large trees averaged 2.3 times the canopy cover of medium trees. We found that medium trees required 3 times the herbicide of the small trees and had 5 times the canopy average of small trees. Although small trees on average were numerous, they contributed little to canopy cover. For example, there was an average among sites of 97 small trees per acre, which was nearly twice the average among sites for large trees. These small trees contributed

Table 2. Tree parameters measured, amount of herbicide used, and application time per acre.

Site	Remedy mix used	Amt. Remedy used	1-inch Stems	Density	Tree canopy cover	Appl. Time	Oz. Remedy mix	Appl. Time min
		(oz/ac)	(no.)	(trees/ac)	(%)	(min)	(per 1% cover)	(per 1% cover)
1 hwpl	RTU[a]	310	943	222	24.8	78	12.5	3.1
2 srpl	RTU	828	1956	246	46.3	194	17.9	4.2
3 lcpl	RTU	621	1358	272	44.1	146	14.1	3.3
4 hwpe	R + D[b]	621	1573	223	52.6	165	11.8	3.1
5 poav	R + D	699	1320	283	38.6	121	18.1	3.1
6 srpe	R + D	871	2594	277	56.2	194	15.5	3.5
7 lcpe	R + D	579	1966	325	55.1	194	10.5	3.5
Avg.		647	1673	264	45.4	156	14.3	3.4

[a] 13.6% Remedy as RTU
[b] 15% Remedy in diesel

only 4% of the average canopy cover per site. The average number of medium and large trees per site was 114 and 53, respectively. This large difference in density between medium and large trees did not accurately reflect canopy cover. The average canopy cover for all sites due to medium trees was 21% and the average due to large trees was 20%.

How Herbicide was Applied

Two formulations of Triclopyr ester (Remedy™) were applied; RTU™ ("Ready To Use" 13.6% Remedy in vegetable oil), and Remedy mixed with diesel at 15% by volume. Three sites received Remedy RTU and four received Remedy mixed with diesel. Each site was .62 acre in size and treatments were applied between April 30 and May 7, 2002. Both forms of Remedy were applied as a twelve-inch band to smooth bark adjacent to rough bark (approximately 12 to 36 inches above the ground, except on seedlings where smooth bark went to the ground) on all stems of each tree. The Remedy mix was applied to thoroughly wet the bark without running off. The *Brush Busters Stem Spray Method*[1] recommends 15% Remedy in diesel on 1.5 in. diameter stems or smaller, and 25% Remedy in diesel on stems from 1.5 to 4 in. (6). We chose to use the lower 15% Remedy mix even though there were stems 2.5 inches in diameter. The herbicide was applied with a hand sprayer purchased at a local discount store and came with an adjustable polycone tip.

Remedy volume applied to the treated sites increased with stem number and tree density (Table 2). The inconsistency found in these data may be due to over-spray observed with increasing stem diameter and number, or applicator variability. Comparing trees per acre with percent canopy, the site with the greatest number of trees did not have the greatest canopy cover. The site with the greatest number of 1-inch stems had the greatest canopy cover. Also when comparing sites 1 and 4, tree density was nearly the same while the percent canopy cover of site 4 was twice that of site l.

Canopy Cover Is an Accurate Indicator of Herbicide Use

An assessment of ounces of Remedy mix needed for stem treatment on mesquite can be made from Table 2. The average volume of mix required to treat each 1% of canopy cover was 14.3 ounces when applying a 12-inch band at the base of all stems with

Treated and untreated mesquite in srpl site (Table 2).

™RTU and Remedy are trademark products of DowElanco Co.

[1] www.texaserc.tamu.edu available for immediate downloading (PDF format)

Drift of Remedy plus diesel outside of treated area lcpe (Table 2).

smooth (juvenile) bark. If a 3-inch band of Remedy mix were applied there would be a reduction of 75% in volume of herbicide mix used. This has been an effective method in county extension demonstrations in the Rolling Plains (J.F. Cadenhead unpublished data). Regarding application times, an average of 3.4 minutes was used to treat each 1% of canopy cover (Table 2). Although Remedy RTU does not require mixing, at the current diesel price of $.98 per gallon, a mix of 15% Remedy in diesel would be 1/3 the cost of Remedy RTU.

The amount of Remedy used was closely correlated with counts of 1-inch stems ($R^2 = 0.969$), % canopy cover ($R^2 = 0.964$), and treated stems per acre ($R^2 = 0.954$). Remedy application volume was most correlated with canopy cover and 1-inch stems per acre, and least correlated with trees per acre. Trees per acre and canopy volume added little to estimating herbicide use.

Time Assessments for Herbicide Application and Plant Measurement

Tree dimensions were measured on 1-tenth acre sites to determine time requirements for tree height and radius, trees per acre, 1-inch stems per acre, and treated stems per acre. These measurements were repeated at four different sites to increase the accuracy of estimation and appear in Table 3. Canopy cover was estimated using the step transect and compared for accuracy with canopy cover using tree radius. The standard error of means of cover determined using the step transect was more precise being one third that of cover determined from tree radius measurements. Time requirements for each parameter except canopy cover contained an additional 2 minutes necessary to step off a 1-tenth acre site, and considered time to remove corner flags and move to a new site. The step transect method was used for canopy cover and no site boundary was required.

Canopy cover was a quick parameter to estimate (Table 3). Measurement of 1-inch stems, which was most closely correlated to Remedy use, required more time and considerable skill.

Time required applying treatments varied from 1.3 to 2.8 hrs. per acre (Table 2) with no difference observed between Remedy RTU and Remedy plus diesel, however time did increase with canopy cover. The mean application time for each 1% canopy cover was 3.4 minutes. The presence of prickly pear, lotebush, standing herbaceous vegetation around basal stems, and dead wood were significant obstructions and may increase treatment time when walking around trees to access stems.

Table 3. Average time required for tree dimension measurement on 1-tenth acre sites

Tree parameters	Time	Total of 4 sites
	------------(min)------------	
Canopy cover	4	16
Numbers of trees	4	16
Treated stems	5	20
1-inch stems	7	28
Height and radius	10	40

Treatment Effectiveness

Results of treatment success were preliminary, but virtually all mesquite leaf tissue was defoliated. Less than 1% of treated trees had re-growth following defoliation. Future monitoring will be required to determine actual control achieved.

Both formulations of Remedy appeared equally effective at controlling mesquite based on defoliation observations. Remedy mixed with diesel had a tendency to drift (damage trees outside the treatment area), while that was not observed with Remedy RTU. Remedy RTU treated trees were observed to have borer damage and bark splitting from the branches by late August. Similar damage was not observed in the Remedy mixed with diesel treatment by the end of September.

In conclusion, Remedy mix needed and application time was best assessed with canopy cover. The NRCS step transect method was the quickest way to estimate canopy cover. Tree parameters considered to affect stem applied herbicide amounts were all highly correlated, but time and skill requirements made canopy cover the logical preference. An average of 14.3 ounces of Remedy mix were used during an average of 3.4 minutes for each percent mesquite canopy cover. These figures precisely estimated herbicide use and application time. Herbicide use may be lowered when using a narrower band or when over-spray is reduced.

Because there was no specialty equipment involved for stem-applied herbicide, it is very time efficient and simple to use. However, *Brush Busters* demonstrations have proven a savings of herbicide by using the recommended 5500-X1 spray nozzle. Although Remedy in diesel was much cheaper than Remedy RTU, the use of Remedy RTU may be justified to avoid drift outside of the treated area or necessary where diesel is undesirable.

The findings of this study offer a way to assess cost. It is equally important to emphasize the need to be proactive. Land managers must adopt the idea that early treatment of brush is less expensive because costs may increase exponentially as the brush plants increase in size and as the area occupied increases. Postponing treatment until brush levels exceed 20-30% cover would result in increasingly prohibitive costs for restoring the productive capability of rangeland. In addition, ecological thresholds may be reached, from which it may be impossible to regain a rangeland plant community that is sustainable for livestock or wildlife.

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