Late season control of honey mesquite with clopyralid

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Abstract

Herbicides were applied aerially to honey mesquite (*Prosopis glandulosa* Torr.) in the Rolling Plains and Edwards Plateau land resource areas of Texas to evaluate efficacy during late season applications. Although other herbicides gave higher levels of above ground mortality, clopyralid caused higher whole plant mortality throughout the growing season than 2,4,5-T or 2,4,5-T + picloram, both of which were ineffective when applied in September. Mixtures of clopyralid + picloram also were less effective when applied during later periods in the growing season, suggesting picloram added little or even reduced the efficacy of clopyralid for late season control of honey mesquite. Triclopyr alone or in combination with picloram was ineffective in controlling honey mesquite in the fall. Clopyralid in the fall was most effective when applied at rates of 0.56 kg ha⁻¹ or more. Dosage response of honey mesquite in late season applications (late August to October) was practically identical to that found for applications made in June and July, which indicates that clopyralid provides constant levels of mortality throughout the growing season. This research supports the practice of extending the season of applications with clopyralid into the fall. Application in the fall might allow more rangeland to be treated for honey mesquite reduction and also reduce risks associated with drift damage to crops during their most susceptible periods of growth in early to mid-summer.

Key Words: *Prosopis glandulosa*, brush control, picloram, triclopyr, 2,4,5-T

Herbicide control has been an efficient method of controlling honey mesquite (*Prosopis glandulosa* var. *glandulosa* Torr.) in Texas and neighboring states of Oklahoma and New Mexico for more than 40 years (Scifres 1980). Many of the practices and recommendations currently employed in the control of honey mesquite are based on the performance of the herbicide 2,4,5-T [(2,4,5-trichlorophenoxy) acetic acid] which is no longer registered for use in the USA. As new herbicides such as triclopyr [(3,5,6-trichloro-2-pyridinyl)oxy] acetic acid and clopyralid (3,6-dichloro-2-pyridinecarboxylic acid) have been registered for controlling honey mesquite, the recommendations for their use have followed those established for 2,4,5-T (Welch 1988). Recommendations for application include spraying within 40 to 90 days after budbreak (Fisher et al. 1959) or when soil temperature reaches 24° C or more (Dahl and Sosebee 1984). Maximum daily photosynthetic rate has been found to be highly correlated with herbicide control of honey mesquite, but until recently, the unavailability of special instrumentation for determination of this rate in the field has prevented the utilization of this parameter in timing applications of herbicides (Meyer et al. 1983).

These recommendations have limited aerial application of foliarly absorbed herbicides to a period from mid-May to early July.

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This short interval has reduced the amount of rangeland that can be treated in some regions, and resulted in application at a time that coincides with the most susceptible stages in the growth of cotton (*Gossypium hirsutum* L.) and many other crops sensitive to herbicides (Jacoby et al. 1990). This situation has caused restrictions to be placed on the use of herbicides where crops and rangeland exist in proximity to each other. Landowners in areas with susceptible crops often are forced to spray honey mesquite before the trees develop adequate foliage and during a physiological stage of growth less than ideal for herbicide absorption and translocation. Bovey et al. (1986) found that amounts of clopyralid detected in treated plants were similar throughout the growing season rather than being highest in early summer as with other herbicides.

Field observations of honey mesquite response to clopyralid during periods of stress or insect damage led us to formulate the hypothesis that efficacy of clopyralid could be more seasonally dynamic than 2,4,5-T, picloram or triclopyr. Our objective was to quantify honey mesquite response to clopyralid and other herbicides during the latter part of the growing season.

Materials and Methods

Herbicides were applied aerially on rangeland near Vernon, Texas, in the Rolling Plains land resource area in June, July, and September of 1981 and 1982 to evaluate the relative effects of seasonality on efficacy in controlling honey mesquite. Clopyralid, 2,4,5-T and 2,4,5-T + picloram were applied at 0.56 kg ha⁻¹ in a 1:6 mixture of diesel oil and water at a volume of 18.7 L ha⁻¹ from a fixed wing aircraft. Treatments replicated 2 or 3 times were applied in a randomized complete block design. Prior to application, the aircraft spraying system was calibrated for the desired swath width, and during the installation of treatments, residual spray solution was drained and measured following each application and the spraying system was purged prior to applying the next treatment.

Additional applications were installed near Vernon in October 1986 and in the Edwards Plateau land resource area near Ozona in October of 1986 and 1987 and in late August of 1988. Herbicide treatments included additional rates of clopyralid, clopyralid + picloram or triclopyr, and triclopyr + picloram in order to evaluate dosage response.

Soils near Vernon are deep clay loams (Pachic Argiustolls) and those near Ozona are shallow clays (Typic Chromusterts) and clay loams (Petrocalcic Calciustolls) overlying limestone parent material.

Plant response was evaluated after at least one complete growing season following treatment to determine if trees had survived by retaining aerial tissue, resprouted, or succumbed. Plants without visible live tissue were classified as having whole plant mortality (WPM). Trees devoid of original live aerial tissue but having sprouts were classified as having above ground mortality (AGM). Any plant having visible live tissue was considered alive. Approximately 100 individual honey mesquite plants were examined in a 10-m belt transect oriented diagonally across each replicate plot, and percentages of AGM and WPM within the treated stand were used in analysis of variance.

Results and Discussion

Seasonal Trends

Honey mesquite treated with herbicides in June, July, and Sep-

Table 1. Comparisons of above ground mortality (AGM) and whole plant mortality (WPM) in stands of honey mesquite on rangeland aerially sprayed with herbicides on 3 dates during the growing season during 1981 and 1982 near Vernon, Texas.

Herbicide	Rate (kg ha ⁻¹)	Plant response					
		AGM	WPM	AGM	WPM	AGM	WPM

		(1981) ¹					
		19 June		7 July		18 Sept	
Clopyralid	0.56	84	68	68	54	92	78
2,4,5-T	0.56	86	23	93	22	1	0
2,4,5-T + Picloram (1:1)	0.56	100	58	94	35	58	42
		(1982) ²					
		25 June		14 July		7 Sept	
Clopyralid	0.28	60	52	39	29	50	41
	0.56	69	61	62	54	83	74
Clopyralid + Picloram (1:1)	0.56	64	51	72	63	65	42
	1.12	93	73	84	68	79	58
Clopyralid + Picloram (1:2)	0.42	65	50	57	44	41	22
	0.84	88	73	58	39	42	24
Clopyralid + Picloram (1:4)	0.70	84	51	58	39	45	19
2,4,5-T	0.56	85	17	35	10	1	0
2,4,5-T + Picloram (1:1)	0.56	95	49	93	20	8	1

¹For mean separation in 1981, L.S.D.₀₅ for AGM and WPM is 20 and 33, respectively.

²For mean separation in 1982, L.S.D.₀₅ for AGM and WPM is 22 and 19, respectively.

tember of 1981 near Vernon were controlled more effectively with clopyralid across all dates of application than with either 2,4,5-T or 2,4,5-T + picloram at rates of 0.56 kg ha⁻¹ (Table 1). Both 2,4,5-T and 2,4,5-T + picloram produced higher levels of above ground mortality (AGM) than clopyralid when applied in June and July 1981, but in mid September applications, clopyralid caused 92% AGM compared to 1 and 58% for 2,4,5-T and 2,4,5-T + picloram, respectively. Clopyralid also produced significantly higher whole plant mortality (WPM) than the other 2 herbicides in September 1981.

Clopyralid applied at 0.56 kg ha⁻¹ in 1982 produced a similar trend to that observed in 1981 by producing higher AGM and WPM in September than in June or July (Table 1). In contrast to this trend, both 2,4,5-T and 2,4,5-T + picloram diminished in

efficacy as the growing season advanced. Levels of AGM were generally lower for clopyralid than those for 2,4,5-T or 2,4,5-T + picloram in June and July, but WPM produced by clopyralid at either 0.28 or 0.56 kg ha⁻¹ was greater than the other 2 herbicides. When treated with 2,4,5-T or 2,4,5-T + picloram, aerial portions of most honey mesquite in a stand were destroyed but most of the plants survived by sprouting from dormant buds located near the basal stem. Conversely, honey mesquite treated with clopyralid usually failed to sprout when the above ground tissue was destroyed; however, many trees maintained a portion of the original foliage as opposed to those in stands treated with either 2,4,5-T or 2,4,5-T + picloram.

Clopyralid was significantly more effective when applied at 0.56 than at 0.28 kg ha⁻¹ except in June when the lower rate provided 52% WPM compared to 61% for the higher rate (Table 1). Efficacies of clopyralid and clopyralid + picloram at 0.56 kg ha⁻¹ were similar during June and July applications, but the mixture was significantly less effective in causing WPM in September. Clopyralid at 0.56 kg ha⁻¹ produced 74% WPM in September, which was much higher than that produced by the mixture of 0.56 kg ha⁻¹ of clopyralid and an equal amount of picloram. All mixtures of clopyralid + picloram showed a tendency toward loss of efficacy with later application dates. Higher rates of 1:1 and 1:2 mixtures of clopyralid + picloram produced higher AGM and WPM than lower rates of these mixtures during June applications but not in July or September. These results suggest that picloram added little or even diminished efficacy of clopyralid applied to honey mesquite in September.

Late Season Dosage Response

Clopyralid applied from 0.28 to 1.12 kg ha⁻¹ near Vernon demonstrated a positive dosage response in AGM and WPM (Table 2). A similar response was seen at Ozona except overall mortality rates were higher. Trees treated with clopyralid showed closely correlated levels of AGM and WPM, reaffirming the tendency for trees not to resprout to the extent seen in other herbicides such as 2,4,5-T, 2,4,5-T + picloram or triclopyr.

Clopyralid + picloram (1:1) showed no dosage response in WPM at the Vernon site; however, dosage response was evident in AGM at both Ozona and Vernon. At Ozona, levels of WPM increased

Table 2. Comparisons of above ground mortality (AGM) and whole plant mortality (WPM) in stands of honey mesquite on rangeland aerially sprayed with herbicides in 1986 near Vernon and Ozona, Texas.

Herbicide	Rate	Vernon		Ozona	
		AGM	WPM	AGM	WPM
		(kg ha ⁻¹) ----- (%) -----			
		18 October		4 October	
Clopyralid	0.28	28	21	55	54
	0.56	52	46	79	79
	0.84	74	65	90	89
	1.12	88	82	97	96
Clopyralid + Picloram (1:1)	0.56	46	37	43	42
	1.12	63	50	75	71
	1.68	70	55	90	86
	2.24	74	45	93	88
		27 September		4 October	
Triclopyr	0.56	3	0	10	6
	0.84	5	0	33	24
	1.12	23	0	16	6
Triclopyr + Picloram (1:1)	0.56	24	1	14	11
	1.12	12	0	23	19
Triclopyr + Picloram (3:2)	1.38	33	3	40	26
Triclopyr + Picloram (2:1)	1.68	36	3	58	35
L.S.D. .05		37	27	31	23

Table 3. Comparisons of above ground mortality (AGM) and whole plant mortality (WPM) in stands of honey mesquite on rangeland aerially sprayed with herbicides in 1987 and 1988 near Ozona, Texas.

Herbicide	Rate	1 Oct. 1987		25 Aug. 1988	
		AGM	WPM	AGM	WPM
	(kg ha ⁻¹)	----- (%) -----			
Clopyralid	0.28	45	40	43	34
	0.56	80	70	67	58
	0.84	76	71	83	78
	1.12	79	72	94	91
Clopyralid + Picloram (1:1)	0.56	66	48	13	10
	1.12	63	48	55	43
	1.68	71	65	86	74
	2.24	76	69	91	83
Clopyralid + Picloram (1:2)	0.84	56	42	23	16
Clopyralid + Picloram (2:1)	0.84	61	55	46	38
Clopyralid + Triclopyr (1:2)	0.84	50	37	68	63
Clopyralid + Triclopyr (2:1)	0.84	54	44	84	80
Clopyralid + Triclopyr (1:1)	0.56	59	37	55	45
	1.12	50	34	89	84
Triclopyr + Picloram (1:1)	0.56	42	14	39	24
	1.12	53	23	—	—
Triclopyr	0.56	25	8	55	10
	0.84	26	3	49	23
	1.12	45	20	62	25
L.S.D. .05		21	22	35	36

significantly when the mixture contained 0.56 kg ha⁻¹ of clopyralid.

Triclopyr alone or in combinations caused less than 40% AGM in honey mesquite and gave practically no WPM at Vernon (Table 2). These treatments also gave low efficacies at Ozona, with most treatments providing lower levels of mortality than produced with a 0.28 kg ha⁻¹ rate of clopyralid.

Applications applied in October 1987 and late August 1988 near Ozona produced high levels of efficacy when 0.56 kg ha⁻¹ or more of clopyralid was applied (Table 3). In 1987, combinations of clopyralid + picloram were less effective than produced by clopyralid alone. Triclopyr was less effective when applied alone or in combination with picloram. Triclopyr + clopyralid mixtures gave increased WPM over those produced by either triclopyr or triclopyr + picloram mixtures; however, levels of AGM were similar among these treatments. In 1988, triclopyr applied in late August produced higher efficacy than triclopyr applied in October 1987. Combinations of clopyralid + triclopyr that contained at least 0.56 kg ha⁻¹ of clopyralid produced more than 80% WPM when applied in August. This efficacy was equivalent to that produced by 0.84 kg

ha⁻¹ of clopyralid alone or combined with an equal amount of picloram. Clopyralid at 0.28 kg ha⁻¹ alone or mixed with an equivalent amount of picloram gave relatively low efficacy compared to either higher rates of clopyralid alone or mixtures containing clopyralid.

Mortality data from experiments including rates of clopyralid applied from 0.28 to 1.12 kg ha⁻¹ were utilized to develop the regression equation:

$$Y = 25.9 + 55.8 X$$

where Y is WPM as a percentage and X is the rate of clopyralid in kg ha⁻¹. This equation had a standard error of $\pm 6.5\%$ and a correlation coefficient of 0.86. Whole plant mortality from clopyralid applied at rates of 0.28, 0.56, 0.84, and 1.12 kg ha⁻¹ was predicted to be 41, 57, 73, and 88%, respectively. This equation is practically identical to one derived from dosage response data in experiments conducted in western Texas from 1979 to 1982 for clopyralid applied in June and July which gave the equation $Y = 25.1 + 56.1 X$.

These data, derived from large scale field experiments at several locations in western Texas over several years of tests and evaluations, indicate that a given rate of clopyralid has the potential to produce similar levels of efficacy from June to October.

Management Implications

The ability of clopyralid to control honey mesquite during late season applications could result in more rangeland being treated for brush management than is presently treated during the traditional early to mid summer period. Late season applications of clopyralid could permit honey mesquite to be treated in areas presently restricted because of proximity to susceptible crops.

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