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Long-term chemical management of undesirable brush on southwestern U.S. rangelands

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Key words: rangeland restoration; woody plant control; aminocyclopyrachlor; *Prosopis glandulosa*; *Acacia schaffneri*

Abstract

Woody plant encroachment on rangeland used for beef cattle production and/or wildlife use in the southwestern United States has been a major problem of ranchers for many decades. Aminocyclopyrachlor premixed with triclopyr-amine was first marketed for use on grazing lands in Texas, Oklahoma, New Mexico, and Arizona in 2020. This herbicide was marketed for control of honey mesquite (*Prosopis glandulosa*) (NRCS 2025), huisache (*Vachellia farnesiana* a.k.a. *Acacia farnesiana*), and associated brush species and broadleaf forbs on grazing lands. Long-term (i.e. four to ten years post-application) honey mesquite canopy evaluations in aerial and ground broadcast-applied trials revealed more than twice the treatment life (i.e. the time from treatment until brush canopy returns to an economic threshold) with aminocyclopyrachlor+triclopyr-amine (ACP+T) treated plots versus plots treated with past industry standards (Medlin et al. 2019). Similar results were obtained for huisache treated plots evaluated four to six years post-application. Recent research has evaluated picloram and/or chlorsulfuron+metsulfuron-methyl combinations applied with ACP+T to widen the spectrum of activity and address additional undesirable species on rangelands while evaluating impacts on desirable plant species. When evaluated 40 months after application, ACP+T (140+280 g ae ha^{-1}) applied alone was highly efficacious (100% mortality) on honey mesquite, moderately efficacious (66% mortality) on guajillo (*Acacia berlandieri*), and slightly efficacious (less than 25% mortality) on all other woody plant species present. When ACP+T was applied in combination with picloram (560 g ae ha^{-1}) or picloram and chlorsulfuron+metsulfuron-methyl (10.5+33.5 g ai ha^{-1}) mortality of twisted acacia (*Vachellia schaffneri* a.k.a. *Acacia schaffneri*) increased to 25% and 50%, respectively. A tank mix of ACP+T (210+420 g ha^{-1}) with chlorsulfuron+metsulfuron-methyl resulted in 100% mortality of honey mesquite, twisted acacia, and whitebrush (*Aloysia gratissima*), less than 25% mortality of spiny hackberry (*Celtis ehrenbergiana*), and 0% mortality of ephedra (*Ephedra antisyphilitica*), guayacan (*Guaiacum angustifolium*), and lotebush (*Ziziphus obtusifolia*).

Introduction

Woody plant encroachment across southwestern United States' rangeland has reduced soil and surface water availability, forage production, diversity of desirable native forbs, livestock carrying capacity, livestock management efficiency, and wildlife habitat, while it has increased degradation of infrastructure (e.g. fences) and rangeland management costs (Allred 1949; Boggie et al. 2017; Dahl et al. 1978; Fisher 1950; Laxson et al. 1997; Smith and Rechenthin 1964; Teague et al. 1997, 2008; Thurow et al. 2000; Timmer et al. 2014). Although chemical and mechanical management options have been implemented for over five decades, woody plant encroachment on rangelands has continued to escalate. For example, the USDA Soil Conservation Service (USDA-SCS) estimated in 1963, 35.8 million hectares of Texas rangeland had been invaded by woody plants (USDA-SCS 1963). The infestation increased to 37.2 million hectares by 1973 (USDA-SCS 1973) and to 42.7 million hectares by 1985 (USDA-SCS 1985), while over 12 million hectares received treatment during that time span.

Some of the major species comprising this undesirable woody plant invasion include honey mesquite, huisache, whitebrush, tarbrush (*Flourensia cernua*), and catclaw acacia (*Senegalia greggii* a.k.a. *Acacia greggii*), however, not all woody plants on southwestern U.S. rangelands are undesirable. To complicate matters, the undesirable woody plants are typically found growing in association with desirable woody species such as hackberry (*Celtis laevigata var. reticulata*), lotebush, guayacan, etc. The close association of desirable and undesirable plants on rangeland make selective application to undesirable plants impossible with broadcast applications.

Medlin et al. (2019) reported broadcast-applied aminocyclopyrachlor+triclopyr-amine (ACP+T) more effectively killed honey mesquite and huisache, reduced the plant canopies of these species, and extended the treatment life compared to previous industry standard treatments. The research focused on long-term control of honey mesquite and huisache only, did not address other undesirable woody species, and did not include impacts on associated desirable species. Therefore, the objective of this research was to evaluate ACP+T applied alone or with chlorsulfuron+metsulfuron-methyl, and/or picloram for management of honey mesquite, whitebrush, twisted acacia, and other undesirable woody plants as well as the impacts of these treatments on desirable woody plant species.

Methods

A trial was established on a privately-owned ranch in Duval County, Texas. Individual plot dimensions were 180 m by 1300 m. Treatments were applied June 18, 2021, with fixed-wing aerial application equipment to mixed woody plant stands of actively growing brush canopies with healthy vegetation. Treatments consisted of ACP+T (140+280 g ae ha^{-1}) applied alone, with picloram (560 g ae ha^{-1}), with picloram (560 g ha^{-1}) and chlorsulfuron+metsulfuron-methyl (10.5+33.5 g ai ha^{-1}), and ACP+T (210+420 g ha^{-1}) with chlorsulfuron+metsulfuron-methyl (10.5+33.5 g ha^{-1}). All treatments were applied in 45 l ha^{-1} water carrier with 365 ml ha^{-1} methylated seed oil / organosilicone adjuvant.

Mortality assessments by species were collected 16 and 40 months after treatment. Plants were considered dead if no green vegetation was present in the leaves or stems.

Results

All treatments killed honey mesquite 100% when evaluated 40 months after application (Table 1). ACP+T applied at 140+280 g ha^{-1} killed less than 25% of the twisted acacia population and 0% of the whitebrush plants present. When this treatment was tank mixed with picloram, twisted acacia mortality increased to 50% but there was no change in the whitebrush mortality. ACP+T at 210+420 g ha^{-1} and applied with

chlorsulfuron+metsulfuron-methyl resulted in 100% mortality of honey mesquite, twisted acacia and whitebrush.

ACP+T applied at 140+280 g ha^{-1} killed 66% of the guajillo population present and 93% when applied with 560 g ha^{-1} picloram. All other traditionally accepted wildlife beneficial woody plants present suffered less than 25% mortality when ACP+T was applied alone or in a tank mix with picloram or chlorsulfuron+metsulfuron-methyl. However, when ACP+T was applied with picloram and chlorsulfuron+metsulfuron-methyl guajillo and spiny hackberry resulted in 57% and 71% plant death. The other desirable woody plants present (i.e. ephedra, guayacan, and lotebush) did not suffer significant plant losses regardless of herbicide treatment or rate.

Table 1. Three years after treatment mortality ratings (%) of woody plant species resulting from ACP+T applied alone or with picloram and/or chlorsulfuron+metsulfuron-methyl tank mix partners sprayed June 18, 2021, on a ranch in Duval County Texas.

		Aminocyclopyrachlor + Triclopyr-amine (g ae + g ae ha^{-1})[1]			
		(140 + 280)			(210 + 420)
		Tank Mix Partner (g ae or g ai ha^{-1})[1]			
		None	Picloram (560)	Picloram + Chlorsulfuron + Metsulfuron (560 + 10.5 + 33.5)	Chlorsulfuron + Metsulfuron (10.5 + 33.5)
Common name	**Latin name**	Mortality (%)			
Traditionally Undesirable Plants					
Honey mesquite	*Prosopis glandulosa*	100	100	100	100
Twisted acacia	*Acacia schaffneri*	21	50	25	100
Whitebrush	*Aloysia gratissima*	0	0	--[2]	100
Traditionally Wildlife Desirable Plants					
Ephedra	*Ephedra sp.*	0	0	0	0
Guajillo	*Acacia berlandieri*	66	93	57	--[2]
Guayacan	*Guaiacum angustifolium*	0	0	0	0
Lotebush	*Ziziphus obtusifolia*	17	0	0	0
Spiny hackberry	*Celtis ehrenbergiana*	0	3	71	23

[1] For rate calculations, g ae (acid equivalent) was used for aminocyclopyrachlor, triclopyr-amine, and picloram and g ai (active ingredient) was used for chlorsulfuron and metsulfuron.

[2] Population was insufficient for assessment.

Discussion

Late spring through summer is the recommended application time for ACP+T when targeting mesquite species (*Prosopis* spp.) across Texas while fall applications of ACP+T are most suited for huisache. Species' efficacies with ACP+T are best when applications are made during the corresponding season. This trial was sprayed mid-summer of 2021 during the recommended mesquite application window. This may explain the resulting high mortality of ACP+T applied alone on honey mesquite and its limited impact on twisted acacia, a closely related species to huisache.

ACP+T is highly effective for control of several problematic leguminous species including, honey mesquite, huisache, honey locust (*Gleditsia triacanthos*), *Lespedeza* spp., etc., but has limited impact on other non-leguminous species such as hackberry, lotebush, oaks (*Quercus spp.*) and other desirable species. This is advantageous for land managers whose goals include more diverse plant communities, e.g. wildlife habitat management. For these land management models ACP+T applied alone has a good fit for its limited impact on many desirable wildlife browse and wildlife-positive habitat species such as lotebush, ephedra, spiny hackberry, and guayacan. However, when land managers' goals are more grazing land focused for domestic livestock, ACP+T alone may leave too many woody plant species to compete with desirable

grasses and forbs. In these instances, tank mixtures with other herbicides such as picloram, chlorsulfuron+metsulfuron-methyl, etc. can expand the spectrum of activity and help to transform the land to closer meet the landowner's goals.

Acknowledgements
Mr. David Killam, Duval County Ranch, Owner.

Mr. David Kitner, Duval County Ranch, Manager.

Mr. Daniel Mielke and Mr. Clay Wolter, The Orion Companies, Range and Pasture Specialists.

Dr. Wayne Hanselka, Texas A&M AgriLife Extension Service, Professor Emeritus

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