Evaluation of Herbicides for Saltcedar Control in Southwest Kansas

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Abstract. Saltcedar is an invasive species along some of the major rivers and tributaries in Kansas. The objective of this study is to determine control of saltcedar in southwestern Kansas using herbicides applied to individual trees as cut-stump, basal, and foliar treatments. Cut-stump treatments were applied in 2004-2010 during the months of April or May. Basal applications with 10% triclopyr in diesel were applied between 2007-2021 during the months of August through early October. Foliar treatments were applied during 2008-2021 using 467 L/ha spray volumes during August through early October. Chi square analysis at $P < 0.05$ was used to compare treatments. In initial studies, imazapyr (Arsenal) at 10% v/v in water, triclopyr (Remedy) at 10% v/v in diesel, and undiluted triclopyr (Pathfinder II) provided 80-100% control of saltcedar, and were more effective than triclopyr + 2,4-D (Crossbow) applied as a 4% v/v solution in diesel (60% control). During 2008-2010, 10% imazapyr, 50% glyphosate, glyphosate + imazapyr (0.5% + 0.5%), triclopyr at 10 or 25%, and a mixture of triclopyr + fluroxypyr (PastureGard) at 25% all provided greater than 91% control of saltcedar. Basal bark control using 10% v/v triclopyr in diesel averaged 72% control. Foliar applications with 0.5 or 1% imazapyr and 0.5% + 1% imazapyr + glyphosate all provided greater than 84% control of saltcedar treated in 2008-2011. Imazapic (Plateau) at 1% was first compared with 1% imazapyr during 2014-2016 with both treatments providing about 80% control. During 2017-2021, 1% imazapyr (82% control), 1% imazapic (79% control), and 0.5% + 0.5% imazapyr + glyphosate (92% control) were all more effective than a combination of aminopyralid (Milestone) + triclopyr applied at 239 g/L + 359 g/L (42% control). Herbicides can be applied as cut-stump, basal bark, or foliar treatments for the control of saltcedar.

Introduction

Saltcedar *(Tamarix ramosissima* Ledeb.**),** also known as tamarisk, is an invasive woody phreatophyte found throughout most of the western United States along rivers, streams, and wetlands. It is listed among the top 100 World's Worst Invasive Alien Species (Lowe 2000). The species, found in Europe, Asia, Africa, and North America infests over 25,000 ha in Kansas (Kansas Water Office 2005). Saltcedar was introduced into the United States by 1823 (Horton 1964) and was used primarily to stabilize eroding stream banks and as an ornamental. Saltcedar is known to resprout following fire (DiTomaso et al. 2006), cutting (Taylor and McDaniel 1998), or grazing. Biological control using *Diorhabda* spp. is ongoing in the U.S. (Deloach et al. 2008). Triclopyr was used as a bark penetrant in the 1980s (Neill 1988). Duncan and McDaniel (1998) reported on the use of glyphosate and imazapyr applied as foliar treatments for saltcedar control. The objective of this study is to determine the control of saltcedar in southwestern Kansas using herbicides applied to individual trees as cut-stump, basal, and foliar treatments.

Methods and Study Site

The study site is located in southwest Kansas on the Cimarron National Grasslands located in Morton County. Soils are classified as Happyditch loamy fine sand, occasionally flooded. Saltcedar is the major woody species on the site. Herbaceous vegetation includes alkali sacaton [*Sporobolus airoides* (Torr.) Torr.)], composite dropseed [*Sporobolus compositus* (Poir.) Merr.], inland saltgrass [*Distichlis spicata* (L.) Greene], and kochia [*Kochia scoparia* L.) Schrad]. Cut-stump treatments were applied in 2004-2010 with herbicides applied during April-May. Herbicides included 10% and 25% triclopyr v/v in diesel, 10% imazapyr v/v in water, undiluted imazapyr (Pathfinder II), 4% mixture of triclopyr + 2,4-D (Crossbow,

50% glyphosate v/v in water, 0.5% + 0.5% glyphosate + imazapyr, and a mixture of 25% triclopyr + fluroxypyr (PastureGard). Basal bark applications with 10% triclopyr v/v in diesel were made throughout the study with treatments made in August to early October. Foliar applications were made in 2008-2021 during August through early October. Foliar applications were made using a backback sprayer delivering 467 L/ha total spray solution. Herbicides included 0.5 and 1% imazapyr, 1 % imazapic, 0.5% imazapyr + 0.5 or 1% glyphosate, and aminopyralid + triclopyr at 239 g/L + 359 g/L. All herbicide treatments in the study were applied to 7-20 individual trees. Methylated seed oil or nonionic surfactant was added where recommended. Differences in control were determined using chi square analysis ($P<0.05$).

Results and Discussion

In initial studies, imazapyr at 10% v/v in water, triclopyr at 10% v/v in diesel, and undiluted triclopyr (Pathfinder II) provided greater than 80% control of saltcedar (Table 1) and were more effective than a mixture of triclopyr + 2,4-D (Crossbow).

Table 1. Control of saltcedar in southwest Kansas using cut-stump treatments, 2004-2006.

Herbicide	Trade Name	Rate	Percent Control
Imazapyr	Arsenal	10% v/v water	90 a*
Triclopyr	Remedy	10% v/v diesel	87 a
Triclopyr	Pathfinder II	ready to use	97 a
Tricloopyr + 2,4-D	Crossbow	4% v/v diesel	60 b

*Different letters within a column show significant differences ($P<0.05$)

An expanded study with cut-stump treatments showed no differences among herbicides with all providing greater than 90% control (Table 2).

Table 2. Control of saltcedar in southwest Kansas using cut-stump treatments, 2008-2010.

Herbicide	Trade name	Rate	Percent Control
Imazapyr	Arsenal	10% v/v water	94 a*
Glyphosate	Roundup	50% v/v water	97 a
Glyphosate + Imazapyr	Roundup + Arsenal	0.5% + 0.5%	97 a
Triclopyr	Remedy	10% v/v diesel	91 a
Triclopyr	Remedy	25% v/v diesel	98 a
Triclopyr + Fluroxypyr	PastureGard	25% v/v diesel	100 a

*Similar letters within a column indicate no significant difference ($P<0.05$).

Basal bark applications with 10% triclopyr v/v in diesel were applied during 10 years. Control varied across years from 0-100% (data not shown) and averaged 72% control. The applied rate of triclopyr was less than the labeled rate. Control with basal bark applications can vary considerably if all stems in a multi-stemmed clump are not sprayed correctly.

Foliar applications were conducted in 2008 to 2021. In 2008-2011 (Table 3), 2 rates of imazapyr were compared with a mixture of glyphosate and imazapyr. These treatments provided 84-91% control.

Table 3. Control of saltcedar in southwest Kansas using foliar-applied herbicides in 467 L/ha aqueous spray solutions, 2008-2011.

Herbicide	Trade Name	Rate	Percent Control
Imazapyr	Arsenal	0.5%	86 a*
Imazapyr	Arsenal	1.0%	84 a
Glyphosate + Imazapyr	Roundup + Arsenal	0.5% + 1.0%	91 a

*Similar letters within a column indicate no significant difference (P<0.05).

Imazapyr and glyphosate are known to cause non-target species damage. In 2014-2016 1% imazapic was compare to 1% imazapyr. Both treatments provided about 80% control of saltcedar (Table 4). Impacts on associated vegetation was not measured in this study, but Fick (2016) reported that alkali sacaton, composite dropseed, and western wheatgrass [*Pascopyrum smithii* (Rydb.)] were not present in plots treated with 1% imazapyr 1 year after treatment. Alkali sacaton was still present 1 year after treatment using 1% imazapic.

Table 4. Control of saltcedar in southwest Kansas using foliar-applied herbicides in 467 L/ha aqueous spray solutions, 2014-2016.

Herbicide	Trade Name	Rate	Percent Control
Imazapyr	Arsenal	1.0%	79 a*
Imazapic	Plateau	1.0%	81 a

*Similar letters within a column indicate no significant difference (P<0.05).

During 2017-2021 another herbicide combination, aminopyralid + triclopyr, was applied to compare with previously used foliar herbicides., but was less effective providing only 42% control (Table 5).

Table 5. Control of saltcedar in southwest Kansas using foliar-applied herbicides in 467 L/ha aqueous spray solutions, 2014-2016.

Herbicide	Trade Name	Rate	Percent Control
Imazapyr	Arsenal	1.0%	82 ab*
Imazapic	Plateau	1.0%	79 b
Glyphosate + Imazapyr	Roundup + Arsenal	0.5% + 0.5%	92 a
Aminopyralid + Triclopyr	Milestone + Remedy	239 g/L + 359 g/L	42 c

*Different letters within a column show significant differences ($P<0.05$)

Conclusions

Cut-stump treatments applied prior to resprouting using imazapyr, triclopyr and glyphosate applied alone or in combination can effectively control saltcedar. Basal bark applications using triclopyr in diesel can also be effective. Complete coverage of all cut surfaces and stems is critical for maximum control with the cut-stem and basal bark methods. Imazapic and aminopyralid + triclopyr are less damaging to associated vegetation than imazapyr or glyphosate, but can be less effective for saltcedar control.

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