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# IMPROVING RUSSIAN OLIVE CONTROL BY USING BASAL BARK TREATMENTS COMBINED WITH MECHANICAL REMOVAL

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## ABSTRACT

Russian olive (*Elaeagnus angustifolia*) is an invasive tree impacting agricultural areas and disrupting riparian system functions. Basal bark herbicide application alone will seldom kill larger Russian olive trees, but it will kill the epicormic buds at the treatment site. This study evaluated combinations of three basal bark herbicide treatments (none, triclopyr in diesel, and triclopyr in methylated seed oil) with four mechanical removal techniques (none, saw-cut, grind, and uproot) for Russian olive control. The addition of herbicide pretreatment to cutting or grinding mechanical removal significantly improved control. Uprooting was the only mechanical removal treatment to have a significant increase in sprouting plants between the May and August evaluations.

## INTRODUCTION

Russian olive (*Elaeagnus angustifolia*), once touted as a great windbreak, erosion control and wildlife habitat plant, is now known for its overwhelming colonization abilities and negative environmental impacts throughout the western United States and Canada. Russian olive is now the fourth most common riparian tree in the West (Friedman et al., 2005). In 1950, Russian olive was introduced to the Milk River in north-central Montana and by 1999 it had become the dominant tree species (Pearce & Smith, 2001). Competition from Russian olive and its effect of altering flood disturbance regimes have been implicated in the decline of native cottonwood seedling recruitment along the Rio Grande in New Mexico (Knopf & Olsen, 1984; Howe & Knopf, 1991).

Because of its capacity to fix nitrogen, invasions can also alter stream nutrient cycling dynamics (Mineau et al., 2011). Russian olive fruits are consumed by wildlife, including invasive non-native species forming a mutualistic relationship which further disperses seeds (Edwards et al., 2014). Russian olive displaces native plant communities, forming monocultures and reducing wildlife biodiversity and ecosystem function (Brown, 1990; Stoleson & Finch, 2001; Wilson & Bernards, 2009). For example, the presence of Russian olive trees in traditional duck nesting sites reduces nesting success (Gazda et al., 2002).

Mechanical removal of Russian olive by cutting down or pulling up trees without an herbicide treatment usually results in a thick stand of root and crown sucker regrowth (USDA, 2014). There are two types of buds which produce Russian olive regrowth—epicormic and adventitious. Epicormic buds are already formed and remain quiescent until the growth suppression signal from auxin produced in the distal ends of the branches is disrupted. Russian olives have a large amount of epicormic buds along the trunk of the trees down to the root collar that may lay dormant for decades. Once the top of the tree is removed, the epicormic buds break dormancy and begin to grow rapidly, resulting in dense, bushy growth. During previous research in eastern Utah, regrowth more than six feet in height during the first growing season has been observed on trees removed before June (Patterson & Worwood, 2014).

At the same time, adventitious buds begin to form on the trunk and along roots that are near the soil surface. Adventitious buds take time to develop and seldom produce root suckers if roots are more than one inch below the soil surface. In an unpublished study, sixteen Russian olive trees that ranged from four to fifteen inches in diameter, were mechanically lifted with a bucket and the exposed roots of eight of them were then buried under 2 – 4 inches of soil, and eight were left exposed. The eight with exposed roots had sprouted when evaluated two years later. There was one root sucker from the buried root systems where a single root had been unintentionally left exposed (Patterson & Worwood, 2014).

The cut-stump application of glyphosate reduces regrowth and is effective year-round (Patterson et al., 2018). Observations during previous research on basal bark treatment indicated that basal bark herbicide application was quite effective on young, small, Russian olive trees, but not on older trees. However, the viability of the epicormic buds in the spray zone on the older trees appeared to be greatly reduced. The question was posed that if the epicormic buds are killed and the roots are deep enough, could mechanical removal reduce or eliminate the ability of the remaining stump or roots to produce epicormic and adventitious suckers?

The objective of this research was to evaluate the effectiveness of combining basal bark herbicide treatment and mechanical removal methods in reducing Russian olive regrowth.

## MATERIALS AND METHODS

The research location chosen for this study was in intermittently irrigated pastures, located south of Emery City in Emery County, Utah. The largest mature trees in this location were chosen for treatment with most being over 15 feet in height and between 5 to 15 inches in diameter at stump height. In April 2017, twelve combinations of treatments (three herbicide treatments × four mechanical treatments) were set up in randomized blocks with a ten tree subsample comprising each treatment plot. Three replicates were established within a two-mile radius, resulting in 360 trees in the entire study (*N* = 3). The herbicide treatments were untreated control and triclopyr (Garlon 4 Ultra) in either diesel or MSO (Southern Ag.) at a 25% (v/v) solution as the herbicide carrier. The carrier acts as a bark penetrant to increase triclopyr absorption into the underlying tissue. The mechanical treatments were control (left standing), cutting with a skid steer mounted tree saw, grinding with a skid steer mounted stump grinder, and uprooting with a thumbless backhoe bucket.

The trees were treated in early May, 2017 with a basal bark treatment, spraying from the ground up to 12 – 15 inches on all sides of the trunk. In the case of multiple-stemmed trees, all stems were treated. All mechanical removals were done on the same day two weeks later. The tree saw removed the trees to within four inches of the soil surface. The stump grinder mulched the top down even with or just below the soil surface. The backhoe operator used the bucket to break the roots before lifting the top from the hole, leaving the roots predominantly buried, rather than pulling the roots to the soil surface as a thumbed backhoe might do.

Because Russian olives only partially killed will recover and continue to grow, control in this trial was evaluated as either dead or alive. Any sucker growth from the remaining stem or roots indicated the tree was still alive, and thus not controlled. Tree regrowth was evaluated in May 10 and August 30, 2018. On the August evaluation date, some cattle grazing had begun by this point and included some browsing on Russian olive regrowth. As a metric of estimated regrowth vigor for trees mechanically treated (i.e. cut, ground, and uprooted), maximum regrowth height and width were collected from the stems, many of which had branched secondary growth by this time. This shoot volume metric, in cubic feet ($ft^3$) was calculated as the area of a cylinder, even though there were variations in growth patterns. Percentages of alive trees were analyzed as a repeated measures ANOVA using the PROC GLM procedure, once data were transformed for normality. Posthoc mean separations were made using LSD for significant treatment interaction means (SAS Studio).

# RESULTS AND DISCUSSION

Mechanical and chemical main effects were significant as was the interaction of the physical and chemical treatments. Evaluation date was not a significant factor, except in the case of all uprooting treatments, where there was a significant mechanical removal by evaluation date interaction (Figure 2). In some cases, mechanical removal alone, chemical treatment alone, or combinations with basal bark herbicide application and mechanical removal significantly affected Russian olive survival. Within each mechanical treatment, the application of triclopyr in either MSO or diesel gave similar Russian olive control.

For trees with no herbicide treatment, grinding or uprooting trees had significantly less regrowth compared to those cut with the saw. There were just as many living trees with the non-herbicide saw-cut treatment as there were in the non-treated (non-mechanical/non-herbicide) plots (Figure 1).

For trees left standing, triclopyr applied with MSO or diesel significantly reduced standing tree survival to 31 and 17%, respectively, compared to untreated trees which had 98% survival. In August, we also observed that out of those trees treated with triclopyr that had regrowth, and therefore were considered “living” because healthy tissue can regrow, there was still canopy dieback. From brief visual ratings, the average canopy dieback was 76% with triclopyr applied in diesel and 73% with triclopyr applied in MSO compared to the 7% dieback noted in control trees.

After tree saw removal, 87% of untreated stumps survived and sprouted vigorously from epicormic buds. Triclopyr, applied in MSO or diesel, significantly reduced survival to 3 and 5%, respectively. August measurements of regrowth vigor indicated the average shoot volume for saw cut only stumps was 1149 $ft^3$ (SE ± 520) while those treated with triclopyr in MSO or diesel averaged 53.4 $ft^3$ (SE ± 46.2) and none, respectively.

Untreated trees removed with the stump grinder exhibited 38% average survival. This was less regrowth than expected. It is believed that since the trees were ground below the soil surface and soil and wood chips sufficiently covered the roots, sucker regrowth was inhibited. Likewise, because stumps were ground to such a low level, most of the epicormic buds commonly located at the root collar were removed. Triclopyr in either MSO or diesel limited regrowth to 7 and 2%, respectively, which was significantly less than grinding alone. Regrowth vigor measurements indicated stumps that were ground without chemical treatment averaged 687 $ft^3$ (SE ± 474) of regrowth. Treatment with triclopyr in MSO had 0.93 $ft^3$ (SE ± 0.81) while triclopyr with diesel produced 23.9 $ft^3$ (SE ± 12.0) of regrowth.

Uprooted trees showed surprisingly little regrowth overall. Uprooted trees which were not treated with herbicide had only a 30% regrowth rate from the remaining roots, which was similar to the grinder treatment and better than the saw-cut trees. This was a surprise as uprooted trees typically regrow from adventitious buds on the roots when they are close to the soil surface. The higher than expected level of control may be due to the removal method where the trees were moved from side to side before being pulled up which broke the majority of roots off underground where they did not produce suckers.

The uprooted trees that were pre-treated with triclopyr in MSO or diesel had 12 and 15% live plants, respectively, which was not significantly better than the uprooting treatment alone. In addition, the uprooting treatment was the only removal method that had a significant increase in the number of trees producing shoots from the May to August evaluation (Figure 2). Averaged over herbicide in both carriers, sprouting trees increased from 8% in May to 30% in August. This corresponds well with prior observations that Russian olive is able to regrow from adventitious buds developed on root fragments. The delay in observing those shoots until August is likely due to it taking longer for shoots to form from adventitious buds as compared to epicormic buds. The regrowth vigor measurements indicated an average of 32.9 $ft^3$ (SE ± 6.36) of regrowth for uprooted-only trees while those treated with triclopyr in MSO or diesel averaged 17.5 (SE ± 9.65) and 45.6 $ft^3$ (SE ± 32.8) in sucker regrowth, respectively.

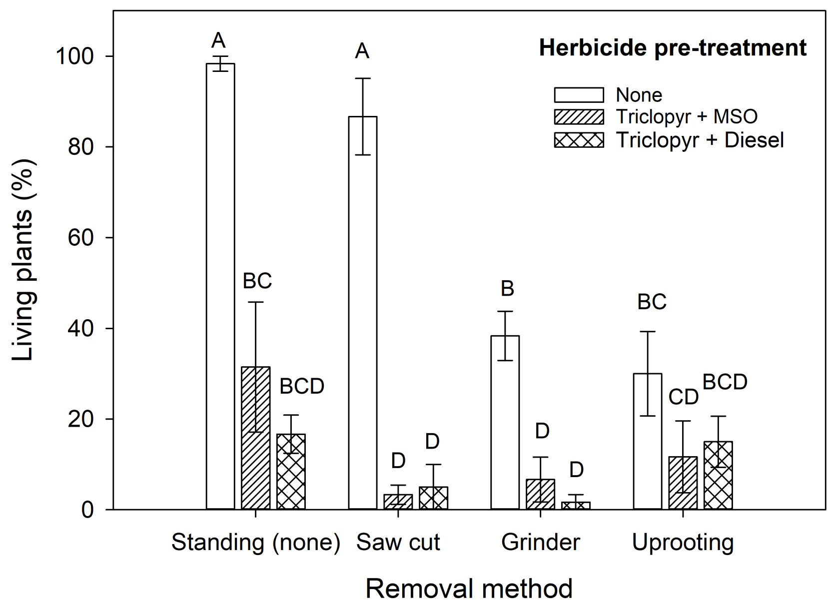


**Figure 1.** Russian olive tree response to basal bark herbicide treatments followed by physical removal. Bars labelled with different letters are significantly different according to LSD at ($P < 0.05$). Values are means ±1 SE and are averaged over two evaluation dates (N=6).

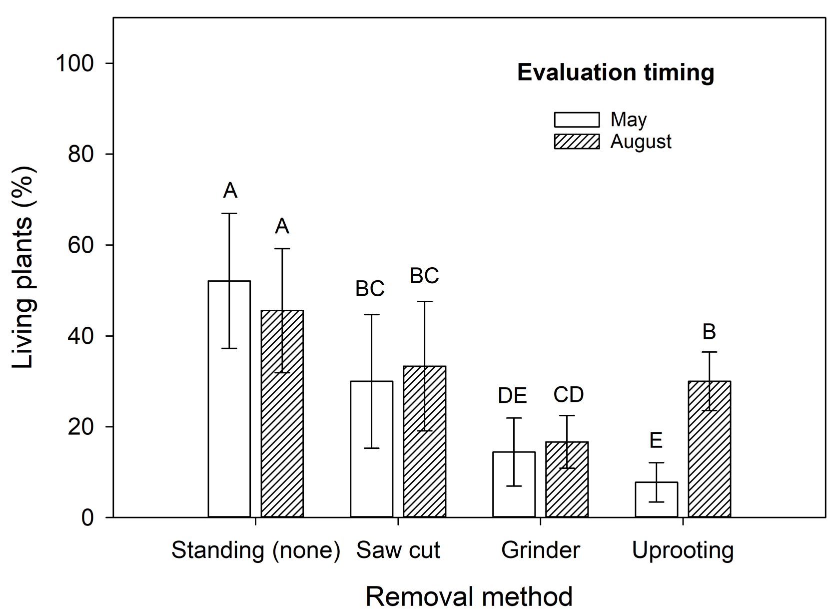


**Figure 2.** Percentage of surviving Russian olive trees as influenced by removal method and evaluation date. Bars labelled with different letters are significantly different according to LSD at ($P < 0.05$). Values are means ±1 SE and are averaged over herbicide treatments (N=9).

## CONCLUSIONS

Russian olive removal is typically done with a piece of machinery for ease. However, numerous sites exist in eastern Utah that clearly show mechanical removal without an herbicide treatment is ineffective in the long-term and generally increases growth density. While the cut-stump treatment method (treating the stump with an herbicide after tree removal; Patterson et al., 2018) is an effective year-round control option for Russian olive, it is difficult to find all the stumps after a tree saw or stump grinder is used. Herbicide pretreatment significantly decreased regrowth with both saw-cut and grinder tree removal techniques. Pretreatment of trees that were plucked from the ground did not affect mortality overall compared to untreated trees. However, the method of plucking may have had a bearing on the unexpected success of that mechanical removal technique and bears further study. If plucking is the chosen removal technique, it would likely be a better use of time to bury exposed root ends rather than undertake pretreatment with an herbicide. Because of the dense growth habit and thorniness of mature Russian olive, getting close enough to the trunk to thoroughly apply the basal bark herbicide is a challenge. In such cases, a long sprayer wand (up to 6 feet) would be helpful. Basal bark herbicide treatment prior to mechanical removal with a tree saw or stump grinder significantly improves overall treatment results. There were no significant differences between the herbicide carriers used in this research.

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