Response of African Rue and Associated Vegetation to Herbicides

Laurie Abbott[1], Kevin Branum[2], Nina Klypina[2], and Tracy Sterling[2]
[1]Department of Animal and Range Sciences; [2]Department of Entomology, Plant Pathology and Weed Science
New Mexico State University, Las Cruces, NM 88003

INTRODUCTION

African rue (*Peganum harmala*) is an invasive perennial weed that is spreading in New Mexico (Figure 1). African rue typically occurs where soil has been transported or disturbed, such as roadsides, pipelines and railroads, adjacent to livestock travel routes and watering facilities, and abandoned cultivated fields. It is a Class B weed in New Mexico, and the recommended strategy for management is to control existing populations and prevent spread to new areas. Established populations are persistent and tend to dominate on invaded sites (Figure 2), and the plant is toxic to cattle and sheep. However, this plant is difficult to control. Herbicides provide the greatest control, although the efficacy of herbicides can be influenced by the kind of herbicide, season of application, and plant water stress.

Figure 1. Mature African rue plant in flower.

Figure 2. African rue tends to dominate in areas where it occurs.

OBJECTIVES

- Evaluate the long-term efficacy of hexazinone (Velpar), imazapyr (Arsenal), and metsulfuron (Escort) to control mature plants and seedlings of African rue.
- Evaluate the long-term response of associated grasses and forbs to these herbicides.
- Examine the effects of application date and moisture stress on herbicide efficacy.

METHODS

- Two sites with extant populations of African rue were studied:
  White Sands Missile Range (WSMR) east of Las Cruces
  Lazy E Ranch (Lazy E) west of Las Cruces

- Experiment was arranged as a randomized complete block design with 15 replications per herbicide/water/application date treatment. Each experimental unit included a mature (target) African rue plant centered in a 1m X 1m plot. Only the target plant was sprayed with herbicide.

- Two water treatments on target African rue plants were established in 2004:
  Plants received rainfall only
  Plants received rainfall and supplemental water delivered by a slow-release polymer (Dri-water®)

- Hexazinone, imazapyr, and metsulfuron were applied with a backpack sprayer at rates of 0.02 kg ai ha^{-1}, 0.13 kg ae ha^{-1}, and 0.09 kg ai ha^{-1}, respectively. Herbicides were applied on 3 application dates in 2004: May, June, and October. For all water/application date treatment combinations, we also had 15 non-sprayed control plants that did not receive herbicide.

- African rue control was evaluated in Fall 2004, Fall 2006, Spring 2007, and Fall 2007. Response variables for control were:
  Necrosis (percent of necrotic stems) and size of the target plant
  Number of African rue seedlings in a 1m x 1m plot centered on the target plant

- Effects on associated vegetation were evaluated in Fall 2006, Spring 2007, and Fall 2007. Response variables were:
  Density of grasses in 1m x 1m plot centered on target plant
  Density of forbs in 1m x 1m plot centered on target plant

- Data analysis was completed using Proc GLM (SAS v 9.1.3). LS means were separated using Fisher's LSD at a significance level of 0.05.

ACKNOWLEDGEMENTS

Authors would like to thank David Anderson, Greg Bettmann, Irene Calderon, Carol Lange, Dr. Johnny Maruthavanan, John Moeny, Matthew Pinch, Emily Pollak, and Amber Vallotton for assistance. This work was funded by USDA/ARS agreement 2003-34410-13096, the USDA/CSREES Special Grant on Rangeland Ecosystems, and the New Mexico Agricultural Experiment Station, New Mexico State University, Las Cruces, NM.

RESULTS

Herbicide Effects on African Rue

Necrosis and Size of the Target Plant

- Relative to non-sprayed controls, African rue plants treated with imazapyr and hexazinone were at least 30 to 40% more necrotic at both sites through Fall 2007 (Figure 3).
- Plants treated with metsulfuron were more necrotic than control plants through Fall 2004 at WSMR and through Fall 2006 at Lazy E (Figure 3).
- Significant interactions of herbicide and application date were detected at both site (data not shown):
  Hexazinone was most effective at both sites when applied in June, although the effects of application date for hexazinone were no longer detectable by Fall 2007 at WSMR.
  Imazapyr was consistently more effective when applied in October at Lazy E and June at WMSR.
  Metsulfuron treatments at Lazy E were most successful when applied in October, but effects of application date were not observed at WSMR.

Target African rue plants treated with hexazinone and imazapyr were significantly smaller than control plants at both sites through Fall 2007.
Metsulfuron reduced the size of target plants at Lazy E only (data not shown)
Moisture status of the soil at the time of herbicide application had no effect on plant response to herbicides (data not shown).

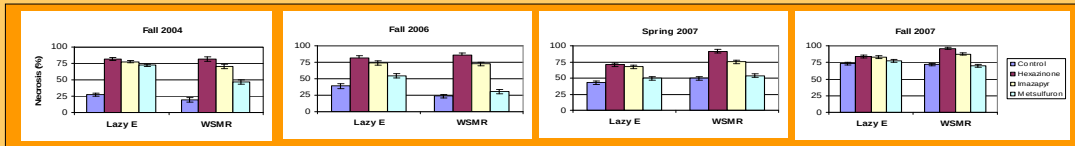

Figure 3. Effects of three herbicides on necrosis of target African rue plant. Target plants were treated with herbicides in 2004.

Density of African Rue Seedlings

- Hexazinone reduced the density of African rue seedlings through Fall 2007 at WSMR compared to all other treatments (Figure 4).
- Imazapyr and metsulfuron reduced the density of African rue seedlings at WSMR only in Fall 2004.
- Few African rue seedlings and no herbicide effects were observed at Lazy E.

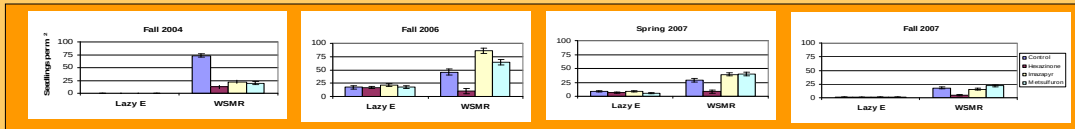

Figure 4. Effects of three herbicides on density of African rue seedlings in 1m x 1m plot centered on mature target African rue plant.

Herbicide Effects on Associated Vegetation

Density of Grasses

- Grasses were more prevalent at WSMR than at Lazy E throughout the project (Figure 5).
- Hexazinone reduced grass density at WSMR by 64% to 74% compared to non-treated controls, and imazapyr reduced grass density by 33 to 36% at that site (Figure 5).
- Metsulfuron did not reduce grass density compared to non-sprayed controls.
- Grass response varied with herbicide, but was not affected by application date at either site (data not shown).

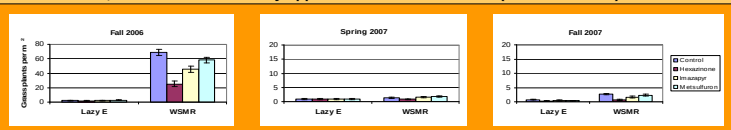

Figure 5. Effect of three herbicides on grass density in 1m x 1m plot centered on target African rue plant.

Density of Forbs

- Forbs were more prevalent at Lazy E than at WSMR throughout the project (Figure 6).
- Hexazinone reduced forb density at both sites through Spring 2007 (Figure 6).
- Forb density was not affected by imazapyr or metsulfuron at either site.

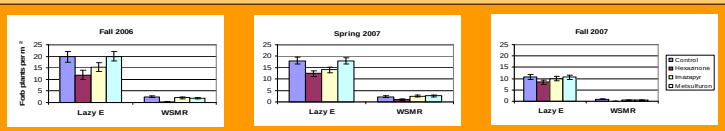

Figure 6. Effect of three herbicides on forb density in 1m x 1m plots centered on target African rue plant.

SUMMARY

African rue control was affected by herbicide and application date, but was not affected by soil moisture status. Hexazinone was most effective at controlling African rue, but was also most damaging to grasses and forbs. Imazapyr also effectively controlled African rue, but was damaging to grasses. Metsulfuron had the least impact on grasses and forbs, but was not effective at controlling African rue. Decisions on how to control African rue are site-specific, and must consider the trade-off between effective control and recovery of the associated vegetation. Vigilance and early detection of new infestations enable land managers to use effective control methods while minimizing potential negative impacts on associated vegetation.