

OSMRE National Technology Transfer Team (NTTT), **Applied Science Final Report**\* U.S. Department of the Interior, OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT

# A Multi-Site Test of Herbicide Protection Seed Technologies for Sagebrush Ecosystem Restoration

Authors: Magdalena Eshleman<sup>1</sup>, Michaela Owens<sup>1</sup>, Hannah Demler<sup>1</sup>, Corinna Riginos<sup>1</sup>, Olga Kildisheva<sup>2</sup>, Cameron Duquette<sup>2</sup>, Chad Boyd<sup>3</sup>, Roxanne Rios<sup>3</sup>, Corinne Schroeder<sup>2</sup>, Owen Baughman<sup>2</sup> Affiliations: The Nature Conservancy, Lander, Wyoming<sup>1</sup>, The Nature Conservancy, Bend, Oregon<sup>2</sup>, USDA Agricultural Research Service, Burns, Oregon<sup>3</sup>

#### Project Background and Objectives:

Herbicide protection (HP) seed enhancement technologies (SETs) are one tool that could improve native plant restoration. They are being developed and tested with the goal of allowing the simultaneous application of pre-emergent herbicide to control invasive annual grasses and seeding perennial plants for improved dryland restoration outcomes. These seed technologies combine restoration seed with activated carbon, an ingredient which protects the seed from the deleterious effects of pre-emergent herbicide by adsorbing and locking up the herbicide in the immediate vicinity of the seed.

The objective of our study was to test how HP SETs impact seedling emergence, survival and size in the presence and absence of herbicide and if different seed bed preparations can be combined with these SETs to improve seedling outcomes.

# Applicability to Mining and Reclamation:

All reclamations must consider and manage for invasive species. The results of this study will inform whether HP SETs could be a tool for reseeding native vegetation when invasive annual grasses are present at a site and require treatment.

### Methodology:

We tested a suite of prototype HP SETs for bluebunch wheatgrass (*Pseudorogeneria spicata*), bottlebrush squirreltail (*Elymus elymoides*), and Wyoming big sagebrush (*Artemisia tridentata var wyomingensis*) at sites with invasive annual grasses across the western United States. In one experiment we paired these SETs with two different seed bed preparation treatments: shallow vs. deep furrows.

We monitored these experiments twice throughout the growing season and tracked emergence, survival and seedling size as well as the reduction in percent cover of invasive annual grasses following herbicide treatment.



Figure 1: Reduction in cheatgrass (Bromus tectorum) after herbicide application at the Wyoming site in spring of 2022.

#### Highlights:

The most significant results from this study are:

- 1. In the second field trial, HP SETs had greater numbers of seedlings when compared to bare seed for all three species, with HP coatings performing better than loosely applied carbon. This indicates that the coatings were not inhibiting seedling development and providing some herbicide protection.
- 2. The deep furrows (7 cm deep) improved seedling outcomes compared to shallow furrows (2-3 cm deep).
- 3. Winter and spring precipitation conditions can severely limit the success of a seedling establishment regardless of whether an SET is used.



Figure 2: Example of deep furrows at the Nevada site in 2023.

## Conclusions:

These studies demonstrated mixed results that seemed to hinge on winter and spring precipitation. Best results were obtained using a mix of herbicide protection and deep furrows to reduce the top layer of herbicide-impacted soil. Results indicate some potential promise for herbicide protection SETs for perennial grasses, with further research and development necessary to improve upon outcomes. The potential promise for sagebrush appears limited, given the challenges of small seeds and needing light to germinate.



Figure 3: Red toothpicks marking blueblunch wheatgrass seedlings at the Wyoming site in spring 2023.

#### Fact Sheet Contact Information

PRINCIPAL INVESTIGATOR (PI): Corinna Riginos, <u>corinna.riginos@tnc.org</u> 307-335-2131 The Nature Conservancy

PROJECT TECHNICAL REPRESENTATIVE (PTR): Jacob Mulinix, <u>jmulinix@osmre.gov</u> 303-236-4700 Office of Surface Mining Reclamation and Enforcement

#### **Applied Science Information**

NATIONAL TECHNOLOGY TRANSFER TEAM (NTTI) CONTACT: Daniel Sammarco, <u>dsammarco@osmre.gov</u> 412-937-2150 Office of Surface Mining Reclamation and Enforcement

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