Intraspecific Variation in Restoration Species

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Interspecific diversity does not capture the functional breadth of plant communities. Variation between individuals and/or populations of a given species (intraspecific variation) is responsible for a proportion of functionally relevant niche space occupation in biological communities (Albert et al. 2010, Fridley and Grime 2010, and Violle et al. 2011). Plants occupy space and time differently to avoid competitive interactions by means of variable morphology, phenology, and physiology. Like functional groups, same-species plants avoid competition with one another and diversify their biological strategies by trait variation.

Intraspecific variation is implicit in the language of restoration plant materials. When we talk about maintaining diversity in wild seed collections, locally adapted plants, ecotypes, biotypes, and/or cultivars, we acknowledge the importance of intraspecific diversity. Despite the implied importance of intraspecific variation, restoration practitioners usually consider only interspecific trait variation when formulating seed mixes.

We know little about how intraspecific trait variation influences restoration outcomes. The goal of this work is to examine how intraspecific variation contributes to interspecific interactions and plant community functioning in a restoration context. Can we improve restoration plantings by increasing intraspecific genotypic and phenotypic variation of site-adapted biotypes?

Experimental Design

We posit that phenotypic diversity between and within species increases niche occupation and resistance to invasion. To test this, we planted 169 experimental assemblages of four grassland species, two forbs (*Gaillardia aristata* and *Linum lewisii/perenne*) and two grasses (*Poa secunda* and *Festuca idahoensis*) at two levels of intraspecific diversity and two levels of interspecific diversity. These plots will be challenged with an invasive weed after they establish along with monoculture plots of each ecotype.

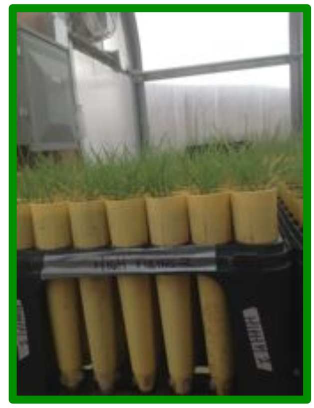
The plant materials listed below are adapted to climates similar to our area and are reasonable choices for restoration of Bitterroot Valley ecosystems (Table 1).

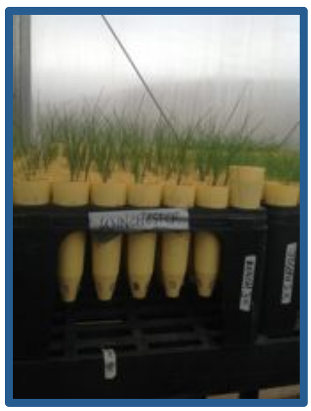
Table 1. Plant Materials Sources and Functional Groups

Species	Biotype	Functional Group	Seed Source
Poa secunda	MPG	grass	MPG collected
Poa secunda	MT-1	grass	Toole Co., MT
Poa secunda	High Plains	grass	Campbell Co., WY; Natrona Co., WY; Uinta Co., WY
Festuca idahoensis	MPG	grass	MPG collected
Festuca idahoensis	Winchester	grass	Winchester, ID
Festuca idahoensis	Joseph	grass	NW USA and Canada
Gaillardia aristata	MPG	forb	MPG collected
Gaillardia aristata	Thorn Creek	forb	Latah Co., ID
Gaillardia aristata	Meriweather	forb	14 MT collections and 1 WY collection
Linum lewisii	Maple Grove	forb	Maple Grove, Millard Co., UT
Linum lewisii	Smith Canyon	forb	Franklin Co., WA
Linum perenne	Appar	forb	Black Hills, SD (European release)

Plant Materials Preparation

In early February, we started *Poa secunda* and *Festuca idahoensis* seeds in the greenhouse with AMF inoculum.



Morphology differed between grass biotypes at the seedling stage.

Gaillardia aristata (Thorn Creek)

Gaillardia aristata (MPG)

Gaillardia aristata (Meriweather)

Linum lewisii (Maple Grove)

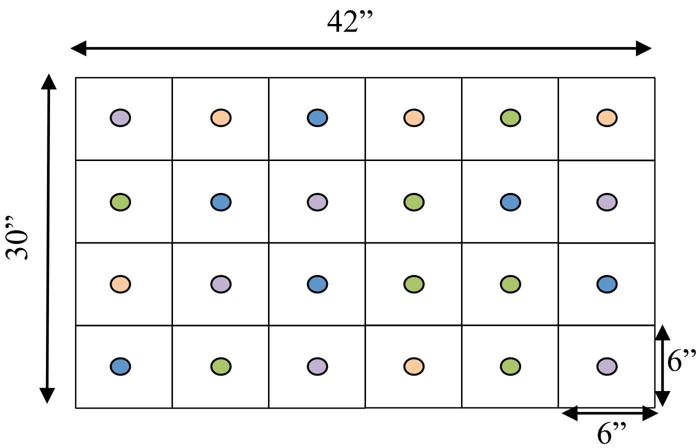
Linum lewisii (Smith Canyon)

Linum perenne (Appar)

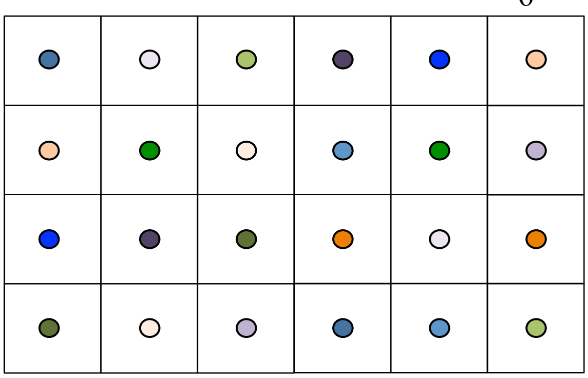
We prepared forb seeds for direct sowing into experimental assemblages in tubes with AMF inoculum (*Gallardia aristata* and *Linum lewisii/perenne*).

Experimental Assemblage Plot Design

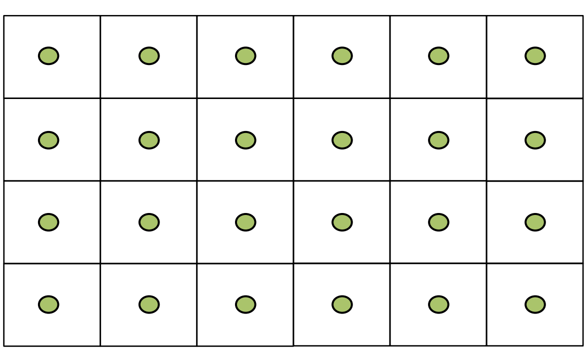
We installed 169 experimental assemblages in the experimental exclosure. We planted 12 total biotypes of *Poa secunda*, *Festuca idahoensis*, *Gaillardia aristata*, and *Linum lewisii/perenne* at varying levels of diversity (described below). A 2 ft. weed mat surrounds each plot.

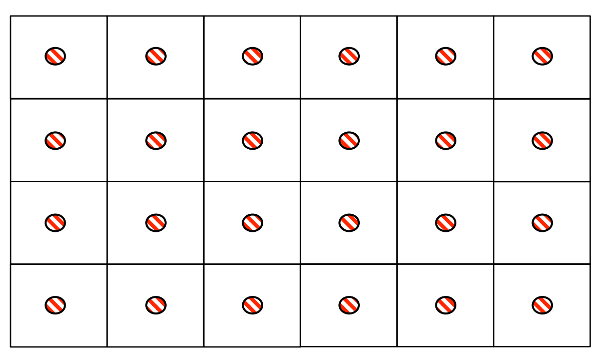


Low diversity plots (n = 81) include a single biotype of each of the four species. All ecotype combinations are represented. Plots are randomized in six blocks (each with a single representative of each species) to maximize inter- and intraspecific interactions.



High diversity plots (n= 20) include all biotypes of all four species.





Monoculture plots (n=48) include 24 individuals of the same biotype and species to control for interspecific interactions between plants in mixed plots.

Weed plots (n=20) represent control measure for weed treatments. These plots are left fallow until weed treatment application.

Plot Preparation and Planting

We delineated the plots with chalk using the weed mat. Morgan Luce sampled soils for baseline soils data before planting.

Reference planting maps and gridded frames insured proper plant placement.

We planted one biotype at a time with the help of the field crew. Extra plants were kept in reserve to replace mortalities.

We planted forb seeds prepared in tubes with AMF inoculum directly into the assemblage plots.

Does the phenotypic and genotypic diversity between and within species increase resistance to invasion?

Experimental assemblages will establish for one year before weed challenge. We will evaluate plant metrics the first growing season to evaluate trait space occupation in the assemblages during establishment. We will use second season plant and soil metrics in weed and challenged native communities to evaluate trait space occupation and resource use in all assemblages. We will evaluate the role of intraspecific diversity level on assemblage trait structure and resilience to artificial weed invasion.

Works Cited

Albert, CE, W Thuiller, NG, Yoccoz, R Douzet, S Aubert, and S Lavorel. 2010. A multi-trait approach reveals the structure and the relative importance of intra- vs. interspecific variability in plant traits. Functional Ecology 24(6):1192-1201.

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