THE UNIVERSITY OF ARIZONA
Cooperative Extension

az2076 January 2024

Germination information for common Arizona restoration species

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Introduction

Seed-based ecological restoration is an approach used to revegetate damaged and disturbed habitats by spreading seed with the expectation that germination will occur and plants will become established and flourish. Although restoration can enhance the health and productivity of landscapes by reinvigorating ecosystem services both directly and indirectly, successful restoration is difficult to achieve – particularly in arid systems (Copeland et al. 2018). Germination is a well known bottleneck to plant growth that prohibits successful restoration (James at al. 2011).

General information about germination likelihood and requirements would provide critical information that managers need to make decisions about which species to prioritize for restoration. We assessed a series of commonly used restoration species and their germination using basic lab and greenhouse tests. Species we tested included the grasses *Aristida purpurea* (purple three awn), *Bouteloua gracilis* (blue grama), *Bouteloua rothrockii* (six-weeks grama), *Elymus elymoides* (squirreltail), *Pascopyrum smithii* (western wheatgrass), *Poa secunda* (Sandberg bluegrass), and *Vulpia octoflora* (six-weeks fescue); and the forbs/shrubs *Atriplex canescens* (four-wing saltbush), *Baileya multiradiata* (desert marigold), *Dalea candida* (white prairie clover), *Ericameria nauseosa* (rubber rabbitbrush), *Krascheninnikovia lanata* (winterfat), *Linum lewisii* (prairie flax), *Machaeranthera tanacetifolia* (Tahoka daisy), *Penstemon palmeri* (Palmer's penstemon), *Plantago ovata* (psyllium), *Senna covesii* (desert senna), and *Sphaeralcea ambigua* (desert globemallow). The seeds were purchased from Granite Seed in spring 2022, and were stored at room temperature for five months, then in cold storage until germination tests began in winter 2023. Seeds were sown in pots in a greenhouse in groups of 20 of the same species. They were provided sunlight and water daily in room temperature conditions. For species that had low germination in the greenhouse and/or documented (from our previous work) or suspected dormancy requirements (e.g. *Atriplex canescens, Baileya multiradiata, Bouteloua rothrockii, Penstemon palmeri, Senna covesii, and Sphaeralcea ambigua*) we also assessed effect of scarification (swiping each seed across sandpaper) and/or cold/moist stratification on germination (placing seeds in petri dishes with moist filter paper in a refrigerator for 40 days) (Dunn 2011). The experiment was conducted over a single month.

Results

All the shrubs we tested, *Atriplex canescens, Ericameria nauseosa,* and *Krascheninnikovia lanata*; as well as grass *Bouteloua rothrockii*, and forb *Senna covesii* demonstrated low germination (<25%). Grasses *Aristida purpurea, Bouteloua gracilis, Pascopyrum smithii, Poa secunda*, and *Vulpia octoflora;* and forbs *Baileya multiradiata, Linum lewisii, Penstemon palmeri*, and *Sphaeralcea ambigua* demonstrated moderate germination (25-70%). Finally, grass *Elymus elymoides,* and forbs *Dalea candida, Machaeranthera tanacetifolia,* and *Plantago ovata* demonstrated high germination (>70%; Table 1). Attempts to break dormancy through scarification and/or cold/moist stratification did not enhance germination for *Atriplex canescens, Bouteloua rothrockii,* or *Senna covesii,* but did improve germination for *Baileya multiradiata, Penstemon palmeri*, and *Sphaeralcea ambigua*.

Caveats

Although our study highlights species that might provide more utility for restoration based on their high germination, managers should be aware that many factors can drive differences in germination. These include variety, quality of seed, the presence of a seedcoat, storage conditions, temperature and moisture availability. For instance, the seeds in this study were stored at room temperature for five months,

Table 1. Common native restoration species and their percent germination. In the dormancy tested column, a “no” means the seeds were grown in the greenhouse, while “stratification” or “scarification + stratification” means the species were stratified in cool/moist conditions, and/or scarified with sandpaper, in order to break dormancy. Grasses are noted in green while forbs/shrubs are noted in black color.

Species	Dormancy tested?	Percent germination
Aristida purpurea (purple three awn)	No	40
Atriplex canescens (four-wing saltbush)	No	20
Atriplex canescens (four-wing saltbush)	Scarification + stratification	20
Baileya multiradiata (desert marigold)	No	5
Baileya multiradiata (desert marigold)	Stratification	25
Bouteloua gracilis (blue grama)	No	65
Bouteloua rothrockii (six-weeks grama)	No	0
Bouteloua rothrockii (six-weeks grama)	Stratification	0
Dalea candida (white prairie clover)	No	85
Elymus elymoides (squirreltail)	No	85
Ericameria nauseosa (rubber rabbitbrush)	No	0
Krascheninnikovia lanana (winterfat)	No	25
Linum lewisii (prairie flax)	No	60
Machaeranthera tanacetifolia (Tahoka daisy)	No	75
Pascopyrum smithii (western wheatgrass)	No	70
Penstemon palmeri (Palmer’s penstemon)	No	5
Penstemon palmeri (Palmer’s penstemon)	Stratification	30
Plantago ovata (psyllium)	No	75
Poa secunda (Sandberg bluegrass)	No	45
Senna covesii (desert senna)	No	10
Senna covesii (desert senna)	Scarification + stratification	0
Sphaeralcea ambigua (desert globemallow)	No	0
Sphaeralcea ambigua (desert globemallow)	Scarification + stratification	35
Vulpia octoflora (six-weeks fescue)	No	65

and may have had higher percent germination if they had been kept in cold storage. Our data can be used as a guide, but performing small batch germination tests for restoration species of interest is always recommended. Considering some of the significant differences in germination found between untreated and treated (e.g. approached to break dormancy) seeds, growers and practitioners should always explore the utility of pre treating seeds in some way to enhance germination. NRCS 'Plant Guides' often describe seed pre treatment requirements to break dormancy. For more information on restoration and to develop a plant list, visit Ecorestore.arizona.edu.

References

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Notes

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