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Using a Diverse Seed Mix to Establish Native Plants on a Sonoran Desert Burn

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INTRODUCTION

- ◆ Revegetating burned areas is a formidable challenge facing resource managers in southwestern United States arid lands.
- ◆ Natural revegetation of desert burns by native species may be slow, or dominated by exotic annual grasses that perpetuate a frequent-fire regime.
- ◆ Resource managers may have several reasons for actively revegetating burns with native species, such as for providing competition with exotic species, minimizing soil erosion and dust pollution, and improving aesthetics.
- ◆ The use of native species in revegetation has been limited by a lack of available seed and by findings that native desert species are difficult to establish (e.g., Bainbridge and Virginia 1990, Banerjee et al. 2006).
- ◆ Seeding may be one of only a few feasible options for reintroducing propagules to large desert burns covering thousands of hectares.
- ◆ Our objective was to assess the outcome of a 28-species (all native) operational seeding project for revegetating a 2005 burn in the Arizona Upland Subdivision of the Sonoran Desert.

Fig. 1. Monthly precipitation after seeding on 1 August 2005, through March 2008 after the last sampling, compared to the 1962-2007 average. Arrows indicate sampling dates. Precipitation recorded at the Carefree, Arizona, weather station, 8 km east of the study site (Western Regional Climate Center, Reno, Nevada).

METHODS

- ◆ Seeding was conducted two months after the June 2005 burn, located in Cave Creek Regional Park, 15 km north of the Phoenix suburbs.
- ◆ The seeding was a hydro-seeding including straw mulch and tackifier.
- ◆ We monitored seedling establishment on five dates during a 32-month sampling period on the seeded burn using 22, 10-m² circular plots (Fig. 1). We also monitored plant composition on adjacent burned/unseeded and unburned/unseeded units on the last sampling date (Abella et al. 2009).

SPECIES ESTABLISHMENT

- ◆ By 15 months after seeding, desert senna (*Senna covesii*) established best in terms of both relative cover and frequency (Table 1, Fig. 2).
- ◆ Only one grass, purple threeawn (*Aristida purpurea*), exhibited substantial establishment by the end of the study. Establishment of shrubs also was sparse, making forbs the most successful seeded group overall.
- ◆ Overall, seven (25%) of the 28 seeded species became established in 25% or more of plots by the end of the monitoring period.
- ◆ Seeding increased native species richness by > 50% relative to the unseeded burn by the last monitoring date (Fig. 3).
- ◆ Non-seeded volunteers on the burn included the exotic *Schismus* spp., which are important to continue monitoring in addition to the seeded native species.

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Fig. 2. Seeded burn on the same spot in (a) November 2005, three months after seeding,

(b) May 2006, nine months after seeding, and

(c) March 2008, 32 months after seeding. The major green plant in the seeded area of a-b is desert senna.

Photos d (unseeded burn) and e (adjacent unburned area) shown in November 2005 for comparison with photo a.

Photo f shows another view of the seeded burn in March 2008 with desert marigold and desert bluebells flowering, illustrating high plant cover and meeting park revegetation objectives for aesthetic appeal and soil cover.

Table 1. Establishment of representative seeded and unseeded species on four of the five monitoring dates.

Species	Burned/seeded				B/U ¹	U/U ¹
	11/2/05	5/1/06	5/2/07	3/27/08		
Seeded grasses						
<i>Aristida purpurea</i>	0	91	50	27	0	0
<i>Heteropogon contortus</i>	95	45	0	0	0	0
Seeded forbs						
<i>Baileya multiradiata</i>	14	23	18	14	0	0
<i>Eschscholzia californica</i>	82	77	0	73	20	0
<i>Lesquerella gordonii</i>	91	82	59	59	20	0
<i>Penstemon eatonii/parryi</i>	0	68	28	0	0	0
<i>Phacelia crenulata</i>	95	100	73	95	80	0
<i>Senna covesii</i>	59	68	82	91	40	0
<i>Sphaeralcea ambigua</i>	36	55	9	5	20	0
Major unseeded species						
<i>Ambrosia deltoidea</i>	5	0	0	14	60	100
<i>Erodium cicutarium</i> ³	100	95	91	91	100	100
<i>Plantago ovata</i>	73	82	18	73	80	60
<i>Schismus barbatus</i> ³	0	95	100	95	100	100

¹ B/U = burned, unseeded; U/U = unburned, unseeded.

² Based on 22, 10-m² plots for the burned/seeded area, and five plots each for the burned/unseeded and the unburned/unseeded areas.

³ Exotic species.

Fig. 3. Species richness of seeded and unseeded species during the last two sampling dates. Error bars are one standard deviation for average total richness.

CONCLUSION

- ◆ Although precipitation was only 67% of normal for 21 months following seeding and 71% of 28 seeded species established in < 10% of plots, we consider the seeding to have met short-term management objectives because of the subset of highly successful species.
- ◆ Our results also illustrate that caution should be used when evaluating seeding success: conclusions would have differed if the diversity of the seed mix had not included the successful species, and longer term monitoring was needed to detect some seeded species that did not establish until 32 months after seeding.
- ◆ Our data suggest that seeding native species has potential as a revegetation tool in these deserts. We need a better understanding of which species are amenable to seeding given current technology, which treatments promote success, and under which environmental site conditions particular combinations of seeding components can be effective.
- ◆ In our study, a highly successful subset of species (e.g., desert senna, purple threeawn) were key for meeting revegetation objectives, since most species in the 28-species seed mix did not become established. It is important to continue identifying and testing potentially successful species for improving seed mixes.

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