Riparian Revegetation Using Native Seed: Feasibility Studies on the Lower Colorado River

### Introduction

Restoring native riparian plant communities is a major objective of management agencies in the West, with significant plans to revegetate areas currently occupied or dominated by invasive species with cottonwood and willow (e.g. USBR 2004). Vegetative propagation and subsequent planting of grafted seedlings or rooted cuttings is currently the standards practice for revegetation (Reardon 2003). If direct seeding can be achieved, restoration costs might be considerably reduced while increasing tree density, maximizing genetic diversity within restoration areas.

Passive revegetation from seed occurs in natural and managed riparian ecosystems where moist, bare soil is available during seed dispersal as a result of fluctuating hydrology. Local soils include relict riparian sediments of periodic flooding (e.g. Nagler et al. 2003) or managed drawdown of ponds during periods of seed dispersal (e.g. Rice et al. 2005). Direct seeding of cottonwood and willow has not yet been implemented in large-scale restoration due to permitted times of seed viability (Young and Clements 2003) and an unproven record of success (Reardon 2003).

The Bureau of Reclamation is conducting feasibility studies to assess revegetation of riparian trees along the lower Colorado River using native seed. Feasibility studies combined to date consist of small-scale studies for seed collection, germination, and greenhouse, and field study program focused on riparian cottonwood (Salix Gooddingii), Goodding’s willow (Salix exigua), and coyote willow (Salix Gooddingii). Goodding’s willow and coyote willow (Salix exigua) are introduced species, established at higher seeding rates and logistics for large-scale seed collection, storage, and application.

#### Objectives

1. Determine establishment rates from direct seeding of Fremont cottonwood, Goodding’s willow, and coyote willow.
2. Determine if seed collection increases establishment rates.
3. Determine the effects of soil, planting depth, and organic fertilizer on establishment and growth.
4. Determine the effects of seedling growth rates on species composition.

### Phase 1: Germination Study

**Objective:**

Determine potential for long-term seed storage.

**Methods:**

- Collection of native seed from various locations on the lower Colorado River (LCR)
- Experimental preservation methods: room temperature storage, freezing, and oxygen removal.
- Periodic viability analysis over time.
- Germination tests in incubators and on soil beds at different temperatures.

**Results POFR Stems/m**

- 0.05 A
- 0.06 A
- 0.07 A
- 0.08 A
- 0.09 A

**Discussion**

Higher seeding rates resulted in higher stem density, but favored POFR dominance (out-competition of willow species).

### Phase 2: Greenhouse Study

**Objective:**

- Determine establishment rates from direct seeding of Fremont cottonwood, Goodding’s willow, and coyote willow.
- Determine if seed collection increases establishment rates.
- Determine the effects of soil, planting depth, and organic fertilizer on establishment and growth.
- Determine the effects of seedling growth rates on species composition.

**Methods:**

- Determined establishment rates from direct seeding of Fremont cottonwood, Goodding’s willow, and coyote willow.
- Determined if seed collection increases establishment rates.
- Determined the effects of soil, planting depth, and organic fertilizer on establishment and growth.
- Determined the effects of seedling growth rates on species composition.

**Phase 2: Small-Scale Field Studies**

Cibola National Wildlife Refuge, Cibola, Arizona

**Results POFR Stems/m**

- 0.05 A
- 0.06 A
- 0.07 A
- 0.08 A
- 0.09 A

**Discussion**

- Fremont cottonwood seeded at 25 PLS/ft² resulted in greater plant establishment, although the rate of establishment can be extended to greater than two years by freezing.

### Phase 3: Large-Scale Field Study

**Objective:**

- Tree establishment rates of approximately 1% were observed in field plots for Goodding’s willow at 100 PLS/ft².

**Methods:**

- Tree establishment rates of approximately 1% were observed in field plots for Goodding’s willow at 100 PLS/ft².

**Results POFR Stems/m**

- 0.10 A
- 0.11 A
- 0.12 A
- 0.13 A
- 0.14 A

**Discussion**

- Long-term monitoring of small-scale field study plots to determine irrigation regime effects and long-term vegetation dynamics.
- Additional small-scale study plots seeded with Goodding’s willow alone to eliminate competition with cottonwood. More intensive weed control is also being implemented.

### References


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