Use of Container Stock in Mine Revegetation

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Rodgers, Jane. 1994. Use of Container Stock in Mine Revegetation. In Landis, T.D.; Dumroese, R.K., technical coordinators. Proceedings, Forest and Conservation Nursery Associations. 1994, July 11-14; Williamsburg, VA. Gen. Tech. Rep. RM-GTR-257. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 234-238. Available at: http://www.fcnanet.org/proceedings/1994/rodgers.pdf

Abstract—Mining reclamation in the desert southwest has been hampered by the difficulties encountered with the climate and soils of the region. Natural recovery is slow, and direct seeding of mined areas has resulted in minimal success. The Silver Bell Mine at Joshua Tree National Monument offers an opportunity to explore the possibilities of revegetating a strip mine and its tailings using potted native plant material. Plants, rebar, wire fencing, and tools were flown into this roadless area by helicopter in February of 1994. A total of 383 plants of 24 species were outplanted using 3 types of containers which varied in depth and volume. Monitoring thus far reveals high survival of the large (97%) and mid-size (82%) pots, and fair survival of the smaller pots (69%). Continued monitoring over the coming years will examine the success of these various species and pot sizes in desert mine reclamation.

INTRODUCTION

In a cooperative venture with the US Bureau of Mines, Joshua Tree National Monument began examining alternate ways to reclaim abandoned mines in the desert southwest. In 1993, vegetation surveys were conducted on old mine sites in the monument to collect information concerning the return of native species to disturbed mine sites versus adjacent undisturbed vegetation communities. As one might guess, results showed significant differences between disturbed and undisturbed sites, as well as between types of disturbance. During these field surveys, an abandoned mine site within the monument was selected for use as a test for mine revegetation using native nursery stock. The Silver Bell Mine in Lower Wilson Canyon, unlike many underground mines in Joshua Tree, is a surface excavation with a large disturbed area and a waste rock overburden. The soil stratum is a mixture of cobble Pinto gneiss and hematite, low in fines with little to no organic matter. Drilling depth was often limited to 15" with a power auger and/or hand trowels.

METHODS

The project presented two challenges: transporting planting materials to a roadless site, and finding new container sizes to reduce weight and drilling depth while maximizing root mass.

Our standard container size (Tall Pot) is 30" tall and weighs 45 lbs. In 1987, the Joshua Tree Native Plants Nursery developed the Tall Pot for use in arid lands restoration (Miller et al. 1992). The pot depth allows for uninterrupted growth required by most desert plant taproots, thus maximizing root mass for outplanting in dry conditions. Our success

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with the Tall Pot has been excellent, averaging 88% survival where used in wilderness areas and for roadside mitigation. Such a cumbersome container, however, would have been too difficult to transport to Silver Bell. The solution was to try three types of pots significantly smaller than our Standard Tall Pot (Table 1), and sling-load them up to the site using a helicopter (Figure 1.) In looking for smaller containers, we found a one-gallon Citrus Pot ™ and four-gallon Tree Pot ™ from Stuewe & Son, and fashioned the third container by cutting our Tall Pot in half. Each of these had the advantage of being taller and slimmer than typical nursery gallon pots, yet easier to work with than our standard Tall Pot.

In the summer of 1993, the nursery collected seed of 29 different plant species; of these, 24 species were successfully propagated and outplanted at Silver Bell. By early February, nursery stock and planting equipment were sling-loaded up to Silver Bell along with 1500 gallons of water dropped into a port-a-tank. Throughout the month of February, the planting crew worked on benches, small bench slopes, road paths, and a wasterock slope. Digging holes proved challenging, and often our 2-person power auger went astray, jettisoning off large rocks encountered in the meager soil stratum. Most of the slope planting used hand trowels and the smallest container stock (Figure 2).

Table 1. Standard container vs. new containers.

Container Size	Height (in.)	Diameter (in.)	Volume (in^3)	Nursery Growing Period
Standard Tall Pot	30	6	855	1 yr
Tree Pot	18	7.5	601	7 mos.
Half-tall	15	6	416	6 mos.
Citrus Pot	14	4	231	4 mos.

During this time, there were only one or two light showers at the mine with frequent gusty winds prevailing, desiccating much of the stock awaiting outplanting. On February 25 planting was completed and the remaining water used to water the plants a second time (Figure 3). The cumulative precipitation from February through June measures 1.18 inches.

RESULTS AND DISCUSSION

Since planting, we have monitored the site twice for plant survival and health. Each plant was mapped out, using aluminum tags for identification, and then recorded in our nursery database. On April 1, there was 84% survival and on June 16, with increased temperatures, that fell to77.5% (Table 2). Numbers are expected to continue decreasing during the hot summer, but we will have a better idea of survival after late summer and spring rains. Thirteen photo points have been established, and will be updated annually for

Table 2. Survival by container size.

Container Size	04-01-94	06-16-94
Tree Pot (n=77)	97%	97%
Half-tall (n=78)	86%	82%
Citrus Pot (n=223)	78%	69%
Overall Survival	84%	77.5%

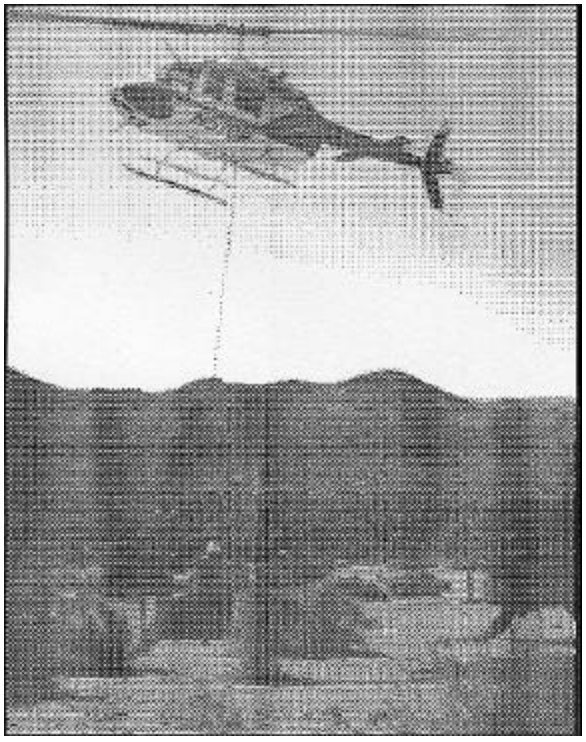

Figure 1.

the next five years, and every five years thereafter, providing us with visual images of the progress of the stock as well as any natural volunteers to the site. While incoming data provides only a glimpse at the long-term success of this project, mortality percentages already reveal trends among container sizes. Each monitoring of the site for plant survival showed a relationship between plant vigor and container size; on both occasions, highest mortality occurred in the smallest containers. Sloped areas versus flat benches seems to affect small stock survival; on the slopes, where soil is limited, June survival was 63% as compared to 78% survival on the flatter areas.

Current trends between species, based on a minimum of six representative outplanted stock, show significant differences in establishment success. Species with less than 70% survival are as follows: *Adenophyllum porophyloides, Cucurbita palmata, Hyptis emoryi, Marina parryi, Pleuraphis rigida,* and *Senna armat*a. Those with greater than 90% survival include: *Ambrosia dumosa, Encelia virginensis, Hymenoclea salsola, Isomeris arborea, Sphaeralcea ambigua,* and *Xylorhiza tortifoli*a. (See Appendix for complete species list).

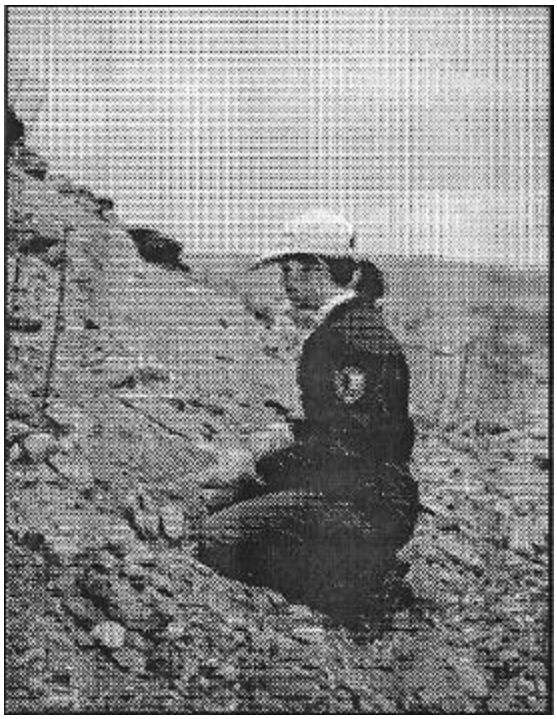

Figure 2.

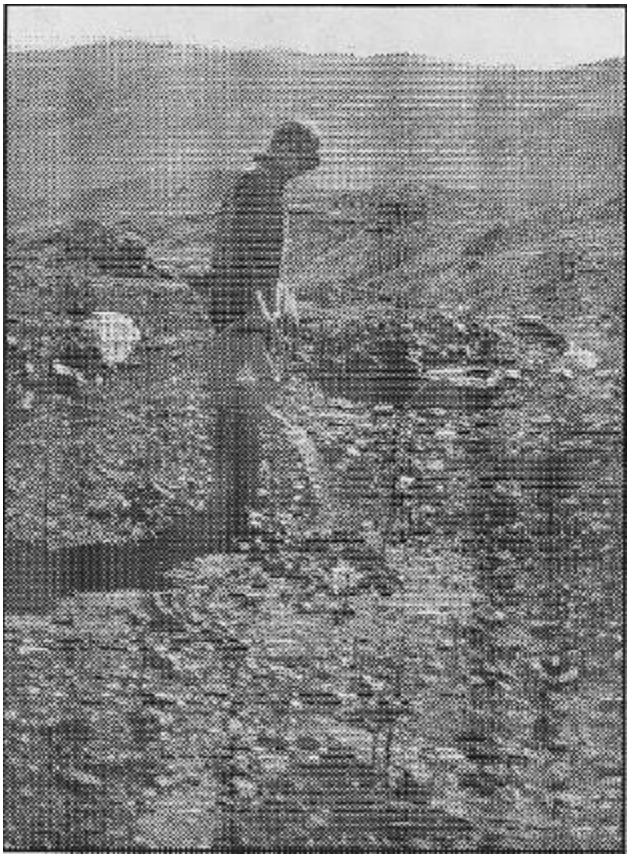

Figure 3.

In summary, high mortality amongst the smaller containers versus the two larger containers may be due to a variety of factors:

- reduced root growth potential, based on container volume
- quantity of fertilizer-enriched nursery soil mixture included with each transplant, based on container volume
- premature outplanting *(Pleuraphis rigida)*
- shorter growing time in the nursery
- due to their small size, the citrus pots were easier to outplant in rockier and thus harsher sites
- differences between species

As monitoring continues, we will have a better idea of optimum container size and species selection for revegetating landscapes such as the Silver Bell Mine. Use of containers smaller than our Tall Pot in arid lands restoration could significantly reduce costs, increase nursery production, and still meet the need for large root mass and deep taproots. These containers, over 14 inches deep for tap root development and of sufficient volume to allow for maximum fibrous root growth, greatly increase prospects for desert nursery stock survival. With larger and/or more remote areas in need of revegetation, success at the Silver Bell Mine could lead the way in changing rehabilitation methodologies for abandoned mines and other severely disturbed desert sites.

LITERATURE CITED

Miller, C., and M. Holden. 1992. *Propagating Desert Plants*. In Proceedings Western Forest Nursery Association Meeting, Stanford Sierra Camp, Fallen Leaf Lake, CA., Sept. 14-18, 1992.

ACKNOWLEDGEMENTS

I would like to recognize the staff at the Joshua Tree Native Plants Nursery for their dedication and enthusiasm for desert protection and restoration. Without their belief in this humble ecosystem, projects of such tremendous challenge and benefit would not exist.

Appendix: Species List

Scientific Name	Common Name
Adenophyllum porophyloides	Dyssodia
Ambrosia dumosa	Burrobush
Bebbia juncea	Sweetbush
Cucurbita palmata	Coyote Melon
Encelia virginensis	Brittlebush
Eriogonum fasciculatum	Red-top Buckwheat
Erioneuron pulchellum	Fluff Grass
Hibiscus denudatus	Desert Hibiscus
Hymenoclea salsola	Cheesebush
Hyptis emoryi	Desert Lavender
Isomeris arborea	Bladderpod
Larrea tridentata	Creosote
Marina parryi	Marina
Mirabilis bigelovii	Four o'clock
Physalis hederifolia	Ground Cherry
Pleuraphis rigida	Galleta Grass
Psorothamnus schottii	Purplebush
Salazaria mexicana	Paperbag Bush
Senna armata	Desert Senna
Sphaeralcea ambigua	Desert Mallow
Stephanomeria pauciflora	Desert Straw
Trixis californica	Trixis
Vigueria parishii	Parish Vigueria
Xylorhiza tortifolia	Mojave Aster