Tree Shelters Improve Establishment on Dry Sites

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Improving plant establishment on arid and semi-arid sites can be very difficult. In addition to providing water and soil capable of supplying the nutrients required for growth (including necessary soil symbionts such as rhizobia and mycorrhizal fungi if appropriate), the planter must provide protection from grazing, abrasion from blowing sand, mechanical wind damage, and temperature extremes. This paper reviews the nature of these problems and examines the results from field tests and observations in the California desert on the effects of TUBEX Treeshelters™ with several species. Plants grown with Treeshelters generally showed markedly improved survival and growth. Tree Planters' Notes **45(1):13-16; 1994.**

Although soil moisture and nutrients are often considered the primary limitations for plant establishment, more recent studies suggest that herbivory may be equally important (McAuliff 1986, Bainbridge and Sorensen 1990, Bainbridge and Virginia 1990). Newly established or transplanted seedlings are often the most succulent plants available and can be subjected to heavy grazing pressure. Rodents, rabbits, reptiles, domestic and feral livestock, and insects easily devour and kill young plants unless adequate protection is provided. Rabbits *(Sylvilagus auduboni),* blacktail jack rabbits *(Lepus californicus),* and rodents (presumably *Citellus* and *Neotoma* spp.*)* have proven most detrimental to desert planting efforts. Rabbits have even heavily browsed transplants of the highly resinous creosote bush.

Observations from a series of field studies suggest that grazing pressure on perennial shrub species decreases from mesquite *(Prosopis glandulosa),* palo verde *(Cercidium floridum),* four-winged saltbush *(Atriplex canescens),* bur sage *(Ambrosia dumosa),* creosote bush *(Larrea divaricata),* bladderpod *(Cleome isomeris),* to smoke tree *(Psorothamnus spinosus).* Although rabbits seem to be the principal herbivore, tooth marks suggest that smaller rodents are also active. Although they are not a problem on the experimental sites, feral animals can also be very destructive in the desert. Burros have eliminated bur sage from thousands of hectares of range near Lake Mead by repeated heavy browsing. The seedlings of most species tested can survive repeated herbivory (to half centimeter stubs) if they are irrigated, but when plants are moisture-stressed the results are usually fatal.

Protection from the wind can also be essential for establishment in dry environments (Virginia and Bainbridge 1987). High winds and blowing sand can damage and kill plants (Mosjidis 1983). Observations of eroded buildings and utility poles in California's Coachella Valley demonstrate the abrasive effects of wind-carried sands. The potential for sand blast damage at a site can be evaluated by placing a vertical piece of railroad chalk (2.5 cm diameter, 15 cm tall) on a metal pin at the soil surface. This chalk clearly shows the intensity of sand abrasion and direction of maximum impact. In addition to sand blast effects, plants may be damaged or killed by the mechanical action of high winds. Young tree seedlings (with only cotyledons) have been blown out of the ground. Multiple branching is a common response to wind damage. Wind-borne sand also fills in plant collars and makes irrigation difficult. Drying winds increase the moisture stress of young seedlings. Protection can reduce evapotranspiration and water stress. This appears to be most critical in the first 6 to 12 weeks after outplanting.

Although freezing is not often considered important in the low desert, many native plants are very sensitive to below-freezing temperatures, and frost may play a major role in distribution patterns of desert plants (Bowers 1980). Freezing temperatures are not uncommon on winter nights with clear skies, and frost damage has frequently been observed on unsheltered seedlings in the Coachella Valley. Hard freezes, however, only occur only about once every 10 years. The freeze of 1978 was particularly severe and resulted in widespread damage and mortality for many desert species (Lenz and Dourley 1981). Tree shelters should provide some protection damage against freezing.

Many strategies can be used for plant protection, including tree shelters, rock mulch, plastic or metal screens, plant collars, repellent, straw stubble, dead branches, or shade screens (Bainbridge and Virginia 1990). Although all of these may prove worthwhile for specific site problems and species, tree shelters have proved to be effective in many studies in temperate environments (Potter 1991, Windell 1992) and may be the best option for most situations.

Materials and Methods

TUBEX Treesheiters ™ – 75-mm-diameter twin-wall plastic tubes available in various heights and two colors, tan (used here) and white - have been evaulated on a range of restoration and revegetation sites in the California desert, where precipitation is below 75 mm and potential evaporation as high as 3,627 mm/yr (Hughes 1963).

Initial tests were conducted on a highway revegetation site near the Salton Sea (Bainbridge 1991) using 3-cm-tall mesquite seedlings with 21-cm roots (from Ray Leach C-10 supercells). These trees were given less than 20 liters of water per plant over the 6-month establishment period (figure 1). This test compared growth and survival of seedlings in 3 treatments with 10 trees per treatment:

! 24-inch TUBEX Treeshelters™
! 3-inch-diameter white plastic pipe of similar height
! Rigid plastic-mesh seedling protectors from International Reforestation Suppliers

The second test was performed at Anza-Berrego Desert State Park (1991), comparing the survival and growth of bur sage, creosote bush, and saltbush seedlings with and without TUBEX Treeshelters™ (11 replications per treatment). Seedlings were spaced 2 m apart down the tire tracks of abandoned roads in a randomized treatment structure. Once again, only limited water could be provided, less than 8 liters of water total per plant.

The third test was planted in the same area in 1992 using 48 matched pairs planted with TUBEX Treeshelters™ or with no protection. Ocotillo seedlings 1 to 2 cm tall from Supercells were planted in three blocks with spacings of 1 to 2 m between seedlings and 3 to 10 m between pairs. These also received less than 8 liters of water.

Results

Survival for the various trials is presented in figure 2. At the Salton Sea site there was 100% mortality in the IRS rigid plastic-mesh seedling protector group, poor survival in the white pipe shelters, but excellent survival in Treeshelters. Mesquite trees in TUBEX Treeshelters™ reached 3 to 4 m height in 2 years. At

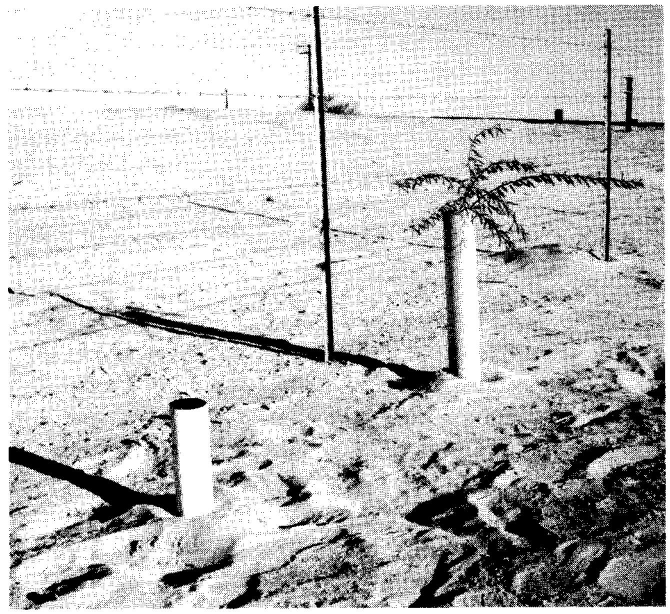

Figure 1—*One-year-old seedling of Mesquite* (Prosopis glandulasa) *growing in a Tubex Treeshelter along Highway 86 near the Salton Sea, CA.*

Anza-Borrego Desert State Park, survival of ocotillo and saltbush was dramatically better with Treeshelters. After the second summer in the field, no control saltbush plants were alive, compared to roughly 45% survival with shelters. Creosote bush with TUBEX performed better than without, but the difference was the smallest for any of the species studied.

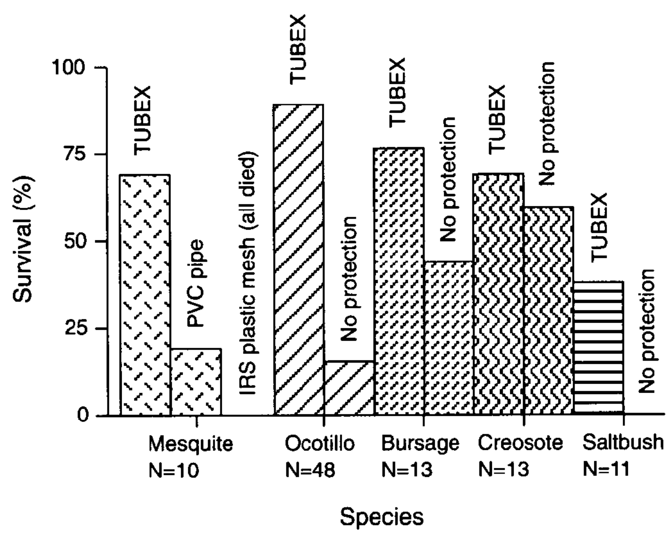

Figure 2—*Benefits of TUBEX Treeshelters in the low desert of southern California.*

Discussion

TUBEX Treeshelters™ have proved to be very beneficial for mesquite, four-winged saltbush, ocotillo, and many other species. Although Treeshelters do not provide complete protection against herbivory, they do reduce grazing. Wind scour exposes the bottoms of some Treeshelters (reducing wind protection) and blows others away (despite metal pins), but survival and growth generally increases. The benefits for creosote bush were limited to the first few months; after the establishment phase the Treeshelters reduced growth and vigor of this desert dominant, perhaps as a result of increased heat stress (Sorensen 1993).

Treeshelters have worked well with both minimal and intensive irrigation. They have improved irrigation efficiency by minimizing water loss and reducing waste when water is poured directly into the shelter sealed at the soil surface. This may prove very helpful for establishing plants on sloping sites.

One minor problem resulting from Treeshelter use has been changes in plant shape caused by the relatively narrow tubes. Spreading plants may develop a mushroom shape, which may be both aesthetically unpleasant and detrimental to long-term survival. Protection comparable to Treeshelters can be provided in larger diameters by wrapping a wire cage with bubblepack plastic. Treeshelters can also trap lizards and birds. Birds nested in the top of several Treeshelters in a planting project in Arizona and delayed plant growth. Nets or cross-threaded fishing line at the top of the shelter can minimize bird problems. Leaving a vertical stick in the shelter will enable lizards to climb out.

The increased cost of tree shelters (TUBEX 24-inch cost $2.15 compared to IRS Mesh protector 24-inch at $0.18) is easily offset by modest increases in survival on remote sites, where total planting costs may exceed $10 per tree. TUBEX Treeshelters™ have worked well in the desert, but it is clear that they are not well suited for long-term use on all species. Plants with upright growth forms and rapid growth in the summer seem to be most responsive to TUBEX Treeshelters™. However, the tree shelters can be more generally recommended for reducing transplant shock during the first 1 to 3 months after outplanting.

TUBEX Treeshelters™ have been very effective in the desert, but the wide range of available shelters should also be evaluated. It is likely that the plant response to other shelters with different colors (changed wavelengths, light intensity, radiation balance) and construction, (single versus twin wall) construction will be significantly different.

The value of tree shelters will also be related to irrigation method and watering schedule, fertilizer, amendments, weed control, and the interaction of these factors with the microclimate created by the shelter (Sorensen 1993). In addition, there are costs associated with the reduced light—as much as 50% of available light is eliminated with the tan TUBEX Treeshelters™. Plant response to these conditions will depend on the ability of the plant to acclimate, or at least tolerate, low light and high temperatures.

Sources of Tree Shelters

Many companies have followed the lead of TUBEX and introduced tree shelters in the last 2 years. These are commonly translucent tubes of various configurations and materials. The benefits and costs of using these under a wide range of conditions and with different species are still uncertain (Windell 1993). The following models are commercially available in the United States at this time:

TUBEX Treeshelters™ (now marketed as Supertubes)
Treessentials Company
75 Bidwell Street, Suite 105
St. Paul, MN 55107
(800)248-8239

TUBEX Supertubes come in a wide range of heights. They nest in groups of four and are strong and easy to install. They can be reused for several years.

TreePee™
Baileys
44650 Hwy 101, Box 550
Laytonville, CA 95454
(707)984-6133

The TreePee shelters are made of recycled polyethylene with UV stabilizer. The shelter is a 24-inch tall cone (8'-inch base with 4-inch top) with 3 built-in mounting pins.

Tree Pro™
Tree Pro Tree Protectors
445 Lourdes Lane
Lafayette, IN 47905
(317) 463-1011

The Tree Pro shelters are made of single-faced polyethylene and are assembled on-site. The top is flared to reduce damage.

Tree Sentry™
Tree Sentry
PO Box 607
Perrysburg, OH 43552
(419) 872-6950

The Tree Sentry is an open rolled tube made of recycled polyethylene. This allows for the shelter to be opened to look at the seedling.

BLUE-X™
All Season Wholesale Nursery
10656 Sheldon Woods Way
Elk Grove, CA 95624
(916) 689-0902

The Blue-X shelters are made of rolled recycled X-ray film. They can be cut to desired size. The rolled tubes are relatively stiff.

Conclusion

Plant establishment on dry sites requires careful attention to many factors, and plant protection has not always received sufficient attention. Transplanting projects in the desert have showed that TUBEX Treeshelters™ improve seedling survival and growth with minimal water use and maintenance. They can be generally recommended for the first few months after outplanting and are likely to dramatically improve survival and growth with plants with upright growth forms. The ultimate goal may be the development of an integrated container/shelter system that minimizes root disturbance and planting cost as the plant is moved from the nursery to the field.

Acknowledgments

Special thanks to John Rieger, NaDene Sorensen, Laurie Lippitt, Ross Virginia, and Bill Steen. Thanks to Matt Fidelibus, Debbie Waldecker, and NaDene Sorensen for review. Support provided by the California Department of Transportation, California State Parks, and The Canelo Project.

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