Large Containers - Strategies For Growing Large Seedlings For Native Plant Restoration

Introduction

Back in the early 1970's, when forest and conservation plants were first grown in greenhouses, all the containers were in the 2.5 to 10 in^3 (0.04 to 0.64 l) range. The largest volume container listed in Volume Two: Containers and Growing Media of the Container Tree Nursery Manual was 30 in^3 or 0.49 l. Since then, the trend has been to grow plants in larger containers. This is particularly true for restoration projects where large plant materials are needed to survive and grow on harsh sites or those with competing vegetation (Figure 1). Large container stock is currently being used in forest road stabilization, restoration of recreation sites, and riparian restoration projects.

The interest in large containers is based on the generally accepted premise that larger stock survives and grows better after outplanting. Of course, the drawbacks to larger stock types are cost and handling. The challenge to the grower, therefore, is to produce large container plants at an affordable price. This paper will address some of the basic growing strategies growers need to consider in the production of plants in large containers.

Propagation Environments, Equipment, and Materials

Structures. The type of propagation structure needed to produce high quality seedlings in large containers is different than traditional forest nurseries. Most small container nurseries grow plants from seeds and greenhouses are used to culture the small plants and protect them from drying and other stresses. Irrigation and fertigation is particularly crucial as small volume containers dry out very rapidly - sometimes, in a hour or less.

Because large containers do not require greenhouses, nurseries can be established with less capital outlay. In many cases, the only investment in materials is the purchase of large containers, storage racks, irrigation system and the development of a simple outdoor growing space. For this reason, producing seedlings in large containers can be a viable opportunity for small nursery growers, volunteer organizations, and school groups. Small plugs can be purchased from another nursery and then transplanted into the large containers. Once established, the stock requires only water, fertilizer, and protection from extreme weather.

Figure 1 - Woody shrubs and trees are being grown in large containers for restoration projects (L to R: D-40 Deepot, Tall One Treepot, 2 gallon Treepot, 4 gallon Treepot).

Choosing the container. Selecting the best type of container for your particular crop can be a daunting task considering the myriad of sizes, shapes and styles on the market today (Table 1). Your choice should be based on the biological needs of plant and the target seedling specifications of the customer. Some considerations might include:

1. Objectives of the outplanting project
2. Type of plant material (seedling or rooted cutting)
3. Plant characteristics
4. Limiting factors on the outplanting site
5. The outplanting window
6. The type of outplanting tool

Container Size. The size of the container is determined by the size and species of the target seedling required by the outplanting project. Deciduous tree species, which include willows, cottonwood, maples, alders and ash tend to be very fast growing species and can fill out a range of container sizes in just one growing season. Evergreen tree species - firs, pines, cedars and hemlock **B** will fill smaller containers the first year

Table 1 - Common large containers used in restoration projects.

Container					
Brand	**Volume** **In^3** **liters**		**Shape**	**Material**	**Color**	**Anti-spiraling**
Hiko™	32 79	.52 1.29	round	rigid plastic	black	vertical ribs
Deepots ™	40	.65	round	rigid plastic	black	vertical ribs
Zipset™ Plant Bands	32 50 90 126	.52 .82 1.47 2.06	square	paper	tan	square sides
Long Tube	85 127 170 212	1.39 2.08 2.78 3.47	round	rigid plastic	white	Vexar™ netting
Styroblock™	32 43 61 195	.52 .70 1.0 3.19	round	styrofoam	white	vertical ribs
Copperblock™	32 43 61 195	.52 .70 1.0 3.19	round	styrofoam	white	copper, vertical ribs
Treepots™	101 173 380 467 588	1.65 2.83 6.23 7.65 9.63	square	rigid plastic	black	vertical ribs
Treepots™	650 1848	10.65 30.28	round	rigid plastic	black	vertical ribs
Poly-cel™	69 139 254 462 693 1062 1986	1.13 2.28 4.16 7.57 11.35 17.40 32.54	round	thin plastic	black	none

and then can be repotted into larger containers for another one or two growing seasons. Fast growing shrub species **B** ceanothus, bitterbrush, mountain mahogany **B** are often

grown in small containers in the spring and transplanted
into larger containers several months later. Slower growing shrub species must remain in smaller cells for a full growing season before transplanting to larger ones.

Container Dimensions. The shape and taper of a container will influence how easy the root plug is extracted from a container, and will also determine whether a support structure is required. A rule of thumb is a single container will need support if the length is over 1.5 times the diameter of the opening.

Bottom openings of large containers are either round or square and there are advantages and disadvantages to both. Square containers are less likely to have spiraling roots than round containers, however many round containers have been designed in recent years to prevent root spiraling (see discussion below). When consolidated, square containers have a higher seedling density and have little to no air space between each container. In colder climates this translates to less heat loss from the sides of each container and better protection from cold temperatures. Round containers have more air space surrounding them which reduces the humidity that can lead to foliar diseases.

The depth of a container can be very important to seedling survival and growth, especially on drier sites, where surface soils dry out by early summer but soil moisture is still available at deeper soil depths. On these sites, the deeper soil moisture is accessed by the longer root system, and this could be the difference between establishment and failure. Outplanting equipment has been developed for long containers including power augers and the expandable stinger. (See FNN, Winter 2002)

Composition Material. Large containers are generally constructed from Styrofoam, flexible or rigid plastic or treated paper. Styrofoam containers are constructed as blocks that contain a set of cavities. Styroblocks do not require support, and can be reused for many years. Styrofoam is a good insulator so protects the roots against cold or hot temperatures. A drawback to styroblocks is that seedlings cannot be separated or consolidated.

Plastic containers come in a variety of thickness, from very thin sleeves, like the Poly-cel™, to very dense, rigid containers, like the Hiko™ and Deepot™ containers. Generally the denser the plastic the longer the lifespan. Very dense plastic containers can have life spans of greater than a decade, especially if they are treated well. Thinner plastics might last half that length of time, while plastic sleeves, like the Poly-cel™ are designed for one or two years and are not reusable.
Paper containers, like the Zipset™ containers, are biodegradable and have a life span of 9 to 18 months, depending on their thickness. Even though these containers are biodegradable, the container must still be removed before outplanting.

With the exception of the white styroblocks, most large containers are black and when they are exposed to sunlight, can reach lethal temperatures. White containers are more reflective and less likely to have heat buildup.

Root Controls. The problem of root spiraling in round containers is well documented. Spiraling is a serious problem in some large containers when the bottom is partially enclosed (Treepot and Poly-cel). Others are open-bottomed (like the Zipset and long tube) or have a large drainage hole at the end of the container (Deepot, Stroblock, Hiko) which prevents spiraling at the bottom. Open-bottomed containers must be supported above an air layer to promote air pruning. If this is not possible, they can be placed on copper-treated landscape fabric such as Tex-R™ brand, which inhibits root growth. Copper coating the container walls have proven to be an effective

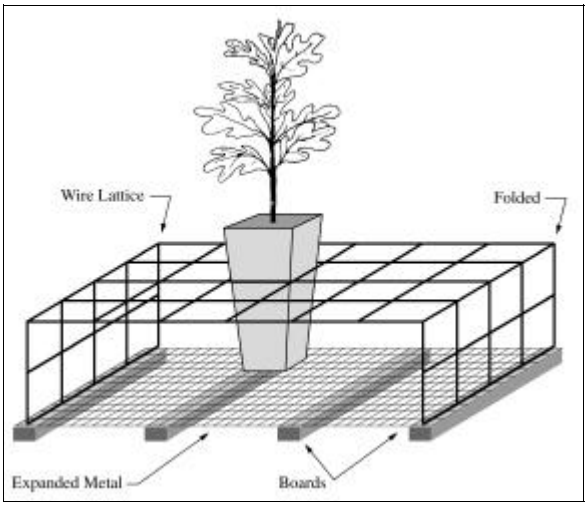

Figure 2 - Most large containers are individual free-standing cavities, and require some sort of rack system for support and handling.

way to "chemically prune" roots and prevent spiraling. Copperblocks™ are a type of styroblock with the cavities pre-treated with a copper coating. Other containers can be painted with a copper product such as Spinout™. In the long tube system, the PVC pipes are lined with Vexar netting to prevent spiraling.

Support and Handling. Large containers can be expensive and labor intensive to support and move. A good container handling system should support individual tall containers against toppling and also allow easy movement of many containers at once. Styroblocks and DeePots are the only large containers that do not need some type of rack or other support system. Most tall individual containers like the Treepots, or Long Tubes will need to have a support structure built to keep the containers from toppling during transportation or slight winds. Wooded pallets, pear bins, or storage racks can be modified to store large containers but they must be made strong enough so that they can be moved by a forklift or pallet jack (Figure 2).

Growing Schedules

Some species of plants can be direct sown in large containers whereas other are first grown in small containers and then transplanted into larger containers. The decision to direct sow or transplant is a function of species characteristics and the type of propagule. Cuttings from willows and cottonwood can be direct stuck in large containers. Transplanting is a better option for slower growing plants and for the larger stock types. Transplanting ensures that every large container has a live plant but reduces the need for costly propagation structures for the larger stock.

Growing schedules are the best way to illustrate the time that it will take to produce the desired target seedling and also show the various phases of nursery production. Figure 3 shows growing schedules for four species of native woody plants grown in different large containers. Note that the red alder and ponderosa pine are grown in 10 in^3 (164 cm^3) containers for the first year before they are transplanted. In general, the larger the final container, the longer it takes to produce a shippable plant (Figure 3). Fast growing species like willows can generally be grown in one season whereas slower growing species may take up to four years to produce.

Cultural Procedures and Production Costs

Types of growing medium and cultural procedures including filling the containers, irrigation, fertilization, and pest management are different for large containers. There is considerable variation in the costs of producing the

Figure 3 - Growing Schedules for several plants in large containers at J.H. Stone Nursery