CONTAINER PLANTING IN THE WEST

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I will try to answer three questions; Where it is, why it's there, and how they do it. The "West" I am considering is everything west from the eastern edge of the Plains and north of the Mexican border, including Canada.

Where the Action Is

Trees have been grown in containers for centuries, but only recently have foresters had more than an academic interest in them. In 1970 only British Columbia produced as many as a million container grown seedlings (fig. 1) (Waldron 1972). Most of them were grown in the Styroblock which was a brand new invention at the time. The other 200,000 were grown in Walter's bullets. Alberta grew 800,000 mostly in Ontario tubes. Several companies in Oregon grew a few hundred thousand each. The real boom in containers was just beginning.

Meanwhile, another type of containerized seedling was being produced in California, Colorado 2/, and South Dakotan. 2-0 bare root seedlings were root pruned and transplanted into 2 x 2 x 8" tarpaper pots in an amended soil mix. These were held for an additional year and then sold for 3 to 4 times the price of a 2-1 bare root transplant. The price was justified for special purposes and planting harsh sites, because the survival was much higher than bare root stock. This is undoubtedly the oldest form of container stock. The California program goes back 20 years.

Only 4 years later in 1974 the Pacific Northwest produced almost 48 million container trees and new nurseries were springing up all over (fig. 2) (Ter Bush 1974).

A 3 year projection in a field which is changing as fast as container tree technology is hazardous, but I estimate 1977 West Coast production will be around 82 million (fig. 3). (Notice that California will be a big producer by then.) Production of the Interior West will be 8 to 9 million, half of which will be in Alberta and Saskatchewan.

1/ Adams, R.S. 1974. Nurseries & Reforestation Forester, California Div. of Forestry, Sacremento, California. Personal Communication.
2/ Strachan, Marvin 1974. Nurseryman, Colorado State Forest Service, Ft. Collins, Colorado. Personal Communication.
3/ Suedkamp, James 1974. Asst. Nurseryman, Big Sioux Conifer Nursery, Watertown, South Dakota. Personal Communication.

Why it's Happening.

In the Northwest tree planting has been increasing exponentially for the last 20 years and the end of the trend is not in sight. The reasons are probably the same as for a similar increase in tree planting in the South. Direct seeding was an inexpensive way to cover large areas, but it is not reliable enough for present needs. Demand for forest products is up, therefore more area is cut. The reservoir of accessible virgin timber is depleted, and loggers must cover 2 to 3 times the area of young stands to cut the same volume. Idle forest land is no longer tolerable. A combination of economics, forest practice laws, and public outrage, all require that timber harvest be followed by prompt and certain regeneration.

These reasons explain the demand for trees, but not the container boom. Why containers? Suitable bare root nursery sites are scarce and expensive. Conventional nurseries require a long time to develop, and seedlings take several years to raise.

Containers are a standard package. All phases of growing, shipping, and planting are more adaptable to machine handling and automated control.

Container stock is more reliable. Nothing is quite so expensive as a replant job: Time is lost, site preparation deteriorates, there is more competition, and it is harder to get around on the site.

In the Interior West the reasons are the same, but the emphasis is different. Here the ability of container stock to survive where and when bare root stock will not, is paramount. Container stock is not used in such huge numbers, but is used where nothing else will do.

In addition, there are special cases where container stock has real potential. In New Mexico and Arizona, July should be a good time to plant, because that is when the rains come. But no nursery has been able to provide bare root stock that is ready to be planted at that time. In Hawaii the native trees never stop growing. The life expectancy of a bare root Koa lifted almost any time of the year is about 3 days. They would need a nursery on every island if it were not for container stock.

How They are Grown.

Since no two operations are alike, I will describe several to illustrate the range of types rather than try to create a picture of an "average" one.

1. Container Systems. The earliest container systems to be used in quantity were the Ontario tube and Walter's bullet. These have generally been superseded by the BC Styroblock, the Spencer-Lemaire book planter, the Crown Zellerbach supercow, and the Weyerhaeuser test tube. The Ontario tube and the bullet were designed to be planted with the tree and had no provision for controlling the root system configuration except for a root egress hole at the bottom. The supercow is an improvement only in that the root plug is removed from the container before planting. All the other new containers mentioned also have vertical ribs and lack sharp horizontal corners to prevent root spiralling. This is apparently not

important for Douglas fir and western hemlock on the west coast, but all pine species I know of do not recover from a balled up root system unless outplanted at a very early age.

In addition to its ability to grow an acceptable seedling, the container is part of a materials handling system which is mechanized and automated as much as possible not only in the nursery, but in shipping and planting as well. Each of the various containers has its own advantages and disadvantages in this regard. For example the styroblock is a light, cheap unit of 192 cavities. The plugs are pulled, graded, and packaged in plastic bags for shipment. The styroblock stays at the nursery and is reused. The test tube has these same features, but the tubes are individually removable from the rack. There is more labor involved in filling the racks, but blanks may be replaced so that greenhouse space utilization is maximized. The racks may also be filled in checkerboard fashion if additional spacing is required. The tube goes with the tree to the planting site and protects the root ball from damage, but it is a nuisance to remove at time of planting, and the tubes create a little problem if left, and a collection problem if reused.

2. Greenhouses. Coastal nurseries are blessed with a mild climate, and it requires much less energy and equipment to produce a suitable tree growing environment than in the Interior. As a result, environmental control may be very minimal. The Provincial Nursery at Surry, B. C. looks like an asphalt parking lot with shade cloth and a sprinkler system, Styro 2's sit on wooden pallets and are handled by fork lift.

At Cottage Grove, Oregon, Georgia-Pacific has a wood frame structure which is covered with polyethylene in the spring, shade cloth in the summer, and nothing in the winter.

Weyerhaeuser has 2 nurseries which are steel framed fibreglass covered greenhouses complete with space heaters and pad cooling.

In the Interior West a highly controlled environment is a necessity in order to achieve the desired growth. By holding the maximum day temperature below 80° and maintaining warm nights, Colorado State Nursery was able to produce blue spruce 20" tall in 6 months. These were equivalent to 4 year old seedlings, while the same seed grown outdoors during the same time produced seedlings less than 1" tall.

3. Cultural Practices. Cultural practices vary depending on the degree of environmental control.

The pot medium must have high water holding capacity, and yet be well aerated. A mixture of peat and vermiculite works well. So does ground Douglas fir bark when additional nitrogen is used. Sand and top soil are frequently added, but these have the disadvantage of being heavy.

Some nurseries mix nutrients into the pot mix before filling and seeding, (Matthews 1971) but most control pH and nutrition by injecting soluble concentrates into the watering system. This has the advantage that mineral nutrition is more highly controlled and can be changed to maintain a pH of 5.5-6.0 on the plants. The nutritional program generally begins with no added nutrients until the seedlings become autotrophic. They do not need them until then, and a sterile medium at this time greatly helps reduce damping off without resorting to heavy doses of fungicides. After the seed coats are shed a high N formulation is applied to maximize growth until the seedlings are as large as desired. The containers are then leached to remove nitrogen and allowed to dry until they are close the the wilting point. This combination of moisture and nutrient shock helps initiate bud set and dormancy. A low N high PK solution is then applied which helps maintain dormancy and develop coldhardiness.

All large operations have mechanized their filling, seeding, materials handling, and much of the greenhouse maintainence. Some systems are sophisticated, sleek and store bought, others are simple and homemade but do almost as good a job.

Probably the most important variable to control is temperature. In some cases cooling is achieved with just shade cloth. In others fans and pad cooling are used, frequently in conjunction with shade cloth. Fortunately, pad cooling is much more efficient in the arid west than in the humid south, and we can maintain a greater range of temperatures. The need for greenhouse heating varies tremendously depending on the local climate and the time of year the greenhouse must operate. In some cases solar heat may suffice. At the other extreme, at Bottineau, N. D. our greenhouses have the capacity to maintain a 100 F differential (Tinus 1971).

Greenhouses may be equipped with CO_2 generators, and it has been found well worth raising the atmospheric CO_2 whenever the vents are closed (Tinus 1972).

Most northern species and ecotypes require long days to prevent dormancy (Tinus 1971, Arnott 1974). Thus, it is highly beneficial, if not crucial, that they receive supplemental light at night. The amount of light needed is very small; 8 watts per square foot of incandescent light given 3% of the night will do, provided no dark period is longer than 30 minutes. How necessary supplemental light is depends on what is being grown, the time of year, and the size it must reach.

Mycorrhizal fungi are an immense asset to a seedling, yet comparatively little attention has been given to them. All seedlings from a well managed bare root nursery will be mycorrhizal because of resident fungi in the soil.

But container nurseries change soil every crop. Unless the pot mix is inoculated deliberately, there is no guarantee that each seedling will be mycorrhizal. In humid forested areas airborne spores may be an effective inoculant. In arid and non-forested areas they are not. In my experience differences between inoculated and uninoculated seedlings begin to show at age 3 to 4 months. If seedlings are outplanted before then into inoculated sites, perhaps there is no need for inoculation in the nursery. On the Plains and sterile soils such as spoil piles, nursery inoculation is essential.

4. Field Performance. Production technology has so far outdistanced field testing. The need for seedlings is so great that companies and governments are rishing large sums on a relatively untried system. What information is available indicates that on favorable sites in the Northwest, 1 year old plugs can replace 2-0 bare root seedlings with equal or better survival and growth (Arnott 1971). Small plugs are not suitable for harsh sites, but large plugs such as from the 25 cu. in. book planter are clearly superior to any bare root stock (Owston 1973, Tinus 1973).

REFERENCES

Arnott, J. T. 1971. Field performance of Douglas fir and western hemlock container seedlings on Vancouver Island, British Columbia. Can. For. Serv. Info. Rept. BC-X-63.

Arnott, J. T. 1974. Growth response of white - Engelmann spruce provenances to extended photoperiod using continuous and intermittent light. Can. J. For. Res. 4 69-75.

Matthews, R. G. 1971. Container seedling production: A provisional manual. Can. For. Serv. Info. Rept. BC-X-58, 48 p.

Owston, P. W. 1973. Field performance of containerized seedlings in the Western United States. Western Forestry and Conservation Association. Proceedings of Reforestation Committee. 1972, 109-112.

Ter Bush, F. A. 1974. The container situation in the American Northwest. USDA - Forest Service, Region 6. Division of State & Private Forestry, Box 3623, Portland, Oregon 97208. Unpublished manuscript. 10 p.

Tinus, R. W. 1971. A greenhouse system for rapid production of container planting stock. Presented at annual meeting Amer. Soc. Agr. Eng., Pullman, Wash. June 27-30, 1971. Paper No. 71-166, 17 p.

Tinus R. W. 1972. CO2 enriched atmosphere speeds growth of ponderosa pine blue spruce seedlings. Tree Planter's Notes 23, 12-15.

Tinus, R. W. 1973. Improvements in the greenhouse containers process for raising tree seedlings. Proceedings of the annual meeting of the Intermountain Nurserymens Association, Watertown, S. D. Aug. 8, 1973, 14 p.

Waldron, R. M. 1972. Proceedings of a workshop on container planting in Canada. Dept. of Environment, Can. For. Serv. Info, Rept. DPC-X-2, 168 p.