FOREST NURSERY HISTORY IN WESTERN CANADA WITH SPECIAL EMPHASIS ON THE PROVINCE OF BRITISH COLUMBIA

EVERT (EV) VAN EERDEN

Evert Van Eerden is President and CEO of Pacific Regeneration Technologies, #4-1028 Fort Street, Victoria, British Columbia, V8V 3K4, Canada, (250) 381-1404.

Ev.vaneerden@prtgroup.com
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Key Words

Bareroot nursery, container nursery, nursery technology, reforestation, privatization

In Canada, forest land ownership and management is largely under provincial jurisdiction, and forestry operations are mainly conducted on public land and not on private land. This public ownership has exerted a profound impact on the development of reforestation policies and nursery technology in Canada.

Collectively, about 650 million seedlings are planted annually in Canada's forests. In excess of 90% of this production is grown as container seedlings, mostly by commercial nurseries.

As most of my experience relates to the province of British Columbia (BC) in Canada, my presentation will largely focus on the nursery history in that province, especially as it relates to the development of container seedling technology and the introduction of private sector nursery production during the 1980s. Developments in the other western Canadian provinces, Alberta, Saskatchewan and Manitoba, were similar to those in BC, but they were generally smaller in scope and their impact on operational practices occurred later.

To start with, let's define what is western Canada. The west to east mid-point of Canada is at Thunder Bay, Ontario, some 3,500 miles east of Vancouver, BC (Figure 1). Hence, the western half of Canada extends into the province of Ontario by some 400 miles. Given this geographic reality, and notwithstanding the fact that inhabitants of that part of our country don't usually see themselves as western Canadians, I will include a few comments about nursery developments in Ontario in my presentation.

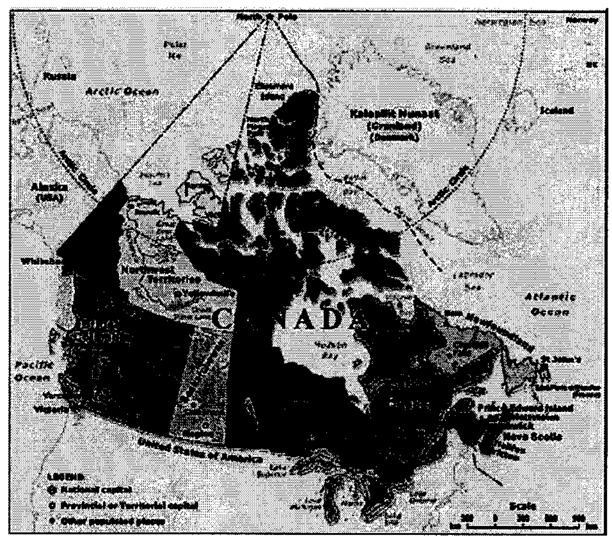

Figure 1. Map of Canada.

Thunder Bay is located on the northern shore of Lake Superior close to the border with Minnesota at Grand Portage. The city is in a major forestry area in northwestern Ontario, dominated by black spruce and jack pine. Forests in the general area support significant regional operations of several major forest companies, including Abitibi, Bowater, Buchanan Forest Products, Domtar, Kimberly Clark, and Weyerhaeuser.

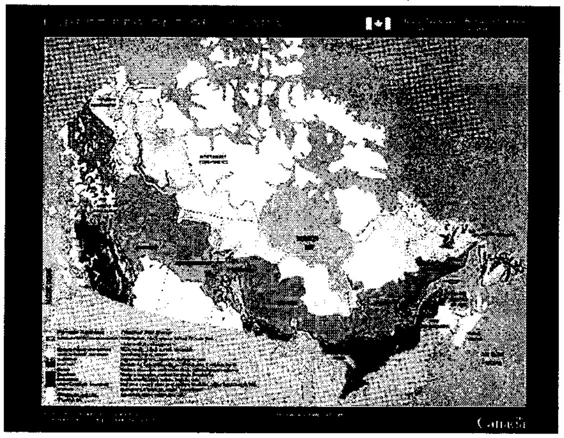

Figure 2. Forest regions of Canada.

To get an appreciation of Canada in a forestry context, one can look at the country from a major species or forest types point of view. The Forest Regions of Canada map (Figure 2) clearly shows the great species diversity of Canada's forests. Due to its variable geological, topographical and climatic characteristics, BC has the greatest number of commercial timber species that are of interest with respect to reforestation. This species expressed variation significantly impacts silviculture, reforestation and nursery practices.
Speaking about forestry practices, let's now move on to a closer look at western Canada's and, in particular, BC's nursery history.

NURSERY AND REFORESTATION HISTORY IN BRITISH COLUMBIA

1926

- Recognition of the need for some research into the growing and planting of coniferous species allowed the establishment of a small Government research nursery in Victoria, BC at the southern tip of Vancouver Island-closed in 1932.

1930

- Green Timbers-first production nursery, established near Vancouver, BC.
- An additional 10 production nurseries were developed by the BC Provincial Government through 1985.

1976-1978: Pearse Royal Commission

- Recommends the participation of private sector nurseries in the production of forest seedlings in BC.

1980-1981

- In addition to two existing commercial nurseries, Pelton (mudpacks), and Reid Collins (paper pots), a number of commercial and forest company nurseries start contract growing for the government of BC.

1987

- Most of the responsibility for acquiring seedlings is turned over to the BC forest industry (October 1, 1987).

1988"

- BC Government privatizes eight of its eleven nurseries. PRT, our company, buys six of those nurseries.

1998

- Government closes Green Timbers Nursery near Vancouver, BC.

NURSERY DEVELOPMENT IN ALBERTA, SASKATCHEWAN, MANITOBA AND ONTARIO

Alberta, 1997-1999

- Pine Ridge Nursery (1970s)-near Edmonton; bareroot and container; privatized by the government in 1997;
- First (early to mid 1960s) container nursery (industrial) in the province located at Hinton, Alberta, closed in 1999.

Saskatchewan, 1997

- The two government nurseries-mostly bareroot, but with a small volume of container seedling production at one of the two nurseries-are closed/privatized. One (bareroot) nursery is closed permanently. The other nursery (Prince Albert) is acquired and expanded into a complete container seedling operation by PRT. Two other small commercial container seedling operations continue to operate.

Manitoba

- One government-supported nursery (Pineland)-bareroot and container-remains and competes with the private sector in spite of capital funding by the government;
- A container nursery operated by a local Indian Band was closed some years earlier.

Ontario, 1998

- Government closes or privatizes last of its nurseries.

PRESENT PRODUCTION IN WESTERN CANADA

With these closures of government nurseries in Ontario, a total of only three nurseries (two in BC and one in Manitoba) remain under management by the government in all of the provinces of BC, Alberta, Saskatchewan, Manitoba, and Ontario. Of the approximately 450 million seedlings that are raised in these five Canadian provinces, about 400 million seedlings are presently grown by commercial nurseries. The remaining 50 million seedlings are produced by the three aforementioned government nurseries as well as three BC forest company nurseries.

Figure 3. Bareroot production at PRT Red Rock in north central British Columbia prior to the nursery's conversion to a container growing seedling operation.

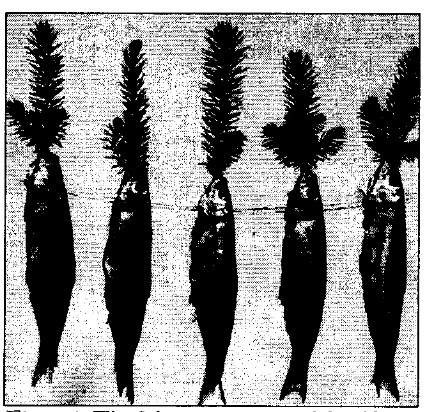

Figure 4. The fish container, one of the oldest plant containers (Source: J.M. Kinghorn, 1974)

Until the mid to late 1960s and early 1970s, bareroot (Figure 3) was the dominant stock type in Canada. Presently, most seedlings in Canada are grown in containers. In western Canada and eastern Ontario, in excess of 95% of the seedlings are, in fact, grown as container stock, predominantly in Styroblocks™

So what brought about this almost complete change from bareroot to container seedling production?

RATIONALE FOR CONTAINER-GROWN STOCK

- Effectiveness of planting versus natural regeneration
- Rapidly increasing planting programs:
  1. Visions of mechanized planting with container stock to facilitate increased planting productivity rates.
- Improved plantation performance:
  1. Difficult species that did not do well as bareroot performed much better and more consistently as container stock. Overall survival improved from the low 60% range to 85% or better.
  2. Improved delivery assurance.
- Conversion from government-controlled production to private sector production:
  1. After the government turned most of reforestation responsibility over to the forest industry, foresters had freedom of choice in ordering their stock types.
  2. Private sector nurseries were willing and able to invest in the required container growing facility infrastructure.

For any of us who harbor notions that container stock was something new or original related to other revolutionary events that took place during the 1960s or 70s, I have sobering news, however. The Aztecs or Incas thought of the idea long before we did (Figure 4).

DEVELOPMENT OF CONTAINER SEEDLING PRODUCTION IN WESTERN CANADA

In Canada, forays had already been made into container production in the 1950s and 60s. In 1959, for example, McLean in Ontario described that the province's production of small container grown seedlings, raised in "Ontario tubes" (Figure 5), which got up to as high a volume of 20 million

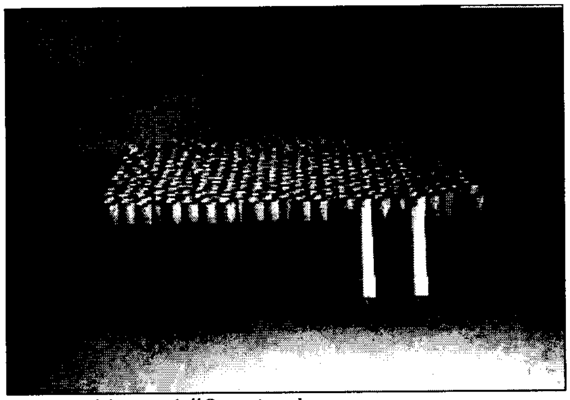

Figure 5. Tray with "Ontario tubes.

Figure 6. Ontario pine tubeling after planting. Note the "one" side slit for root egress.

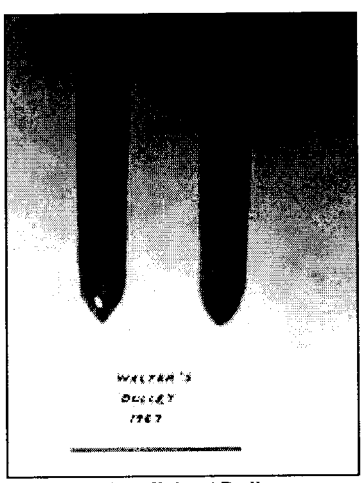

Figure 7. The Walters' Bullet.

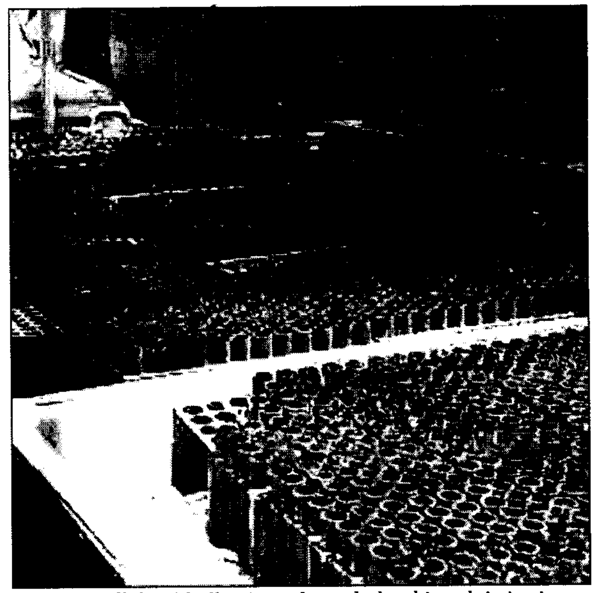

Figure 8. Walters' bullets in racks and placed in sub-irrigation tanks.

seedlings and then rapidly fell out of favour. This "tubeling" system (Figure 6) was not dropped because of the small size of the containers, but as a result of deficiencies in seedling size and quality and consequent poor plantation performance.

In BC it was the pioneering work of J. Walters, a professor at the University of British Columbia's School of Forestry, who invented the Walters' Planting Gun and Bullet (Figures 7 and 8) in 1961 that set the stage for the almost complete conversion from bareroot to container seedling production. Walters envisaged a system where the seedling, with its root system encapsulated in a bullet, together with the planting gun (Figure 9), provided two integral components of a planting tool that would increase planting productivity and ultimately lead to mechanized and precision planting.

Following the lead of J. Walters, J. M. Kinghorn of the Canadian Forestry Service in Victoria, BC undertook the further development of the Walters Bullet System in 1966 and 1967 as a demonstration vehicle for bringing researchers and forest practioners closer together. To this end, he secured the cooperation of the provincial Ministry of Forests and some forest companies to work with his group in the federal Canadian

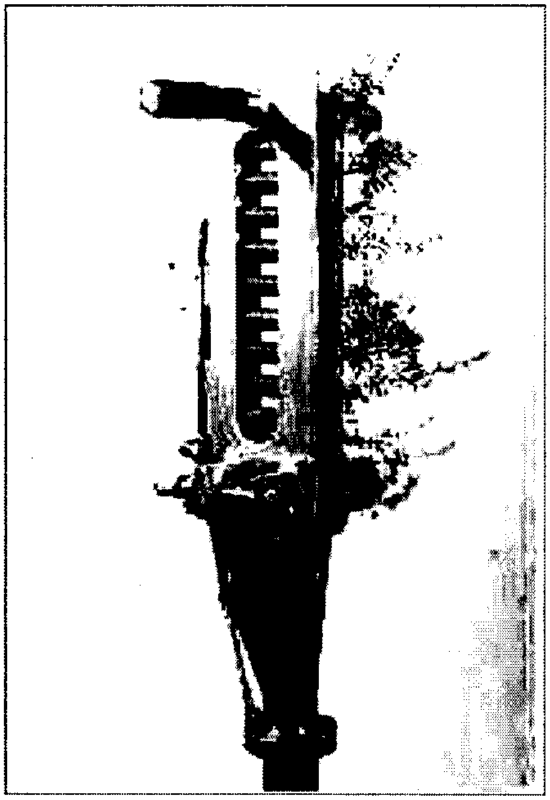

Figure 9. One version of a Walters' planting gun.

Forestry Service. Notwithstanding the significantly smaller size of the seedlings in Walters' bullets compared to bareroot stock, initial trial results showed promise for this type of containerized seedling system. However, notwithstanding the fact that the planting gun was designed to sever the bullets into two vertical halves, much like a clam shell, the bullet seedling system was not widely accepted due to concerns over the encasement of root systems by the rigid styrene bullet (Figure 10). As a result of this experience, further trials were therefore conducted to compare the performance of bullet-grown seedlings that were planted with or extracted from ("plugs") the bullet. The results with these "bulletless" plugs were favorable enough to stimulate the concept and design for a new container system that would permit ready extraction from the container after the seedlings had completed their growth cycle in the nursery. The first of this new, multi-cavity seedling growing container, the "StyroblockTM" (Figure 11), were manufactured early in 1970 and field tested in July, 1970 in the northern BC Interior.

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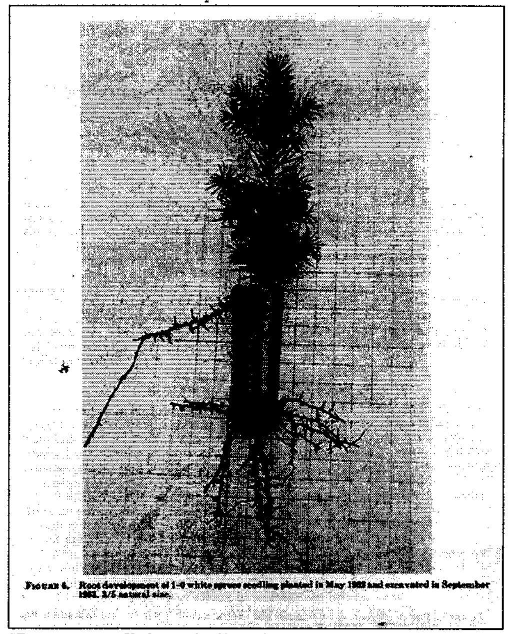
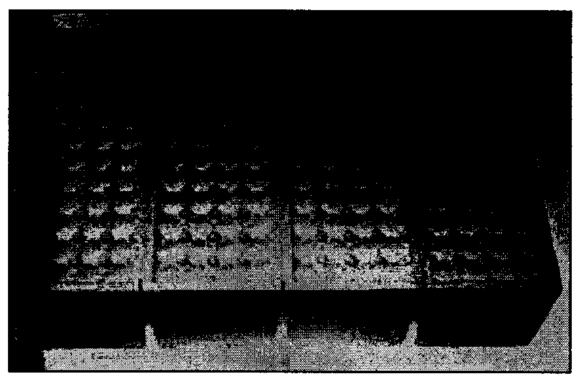
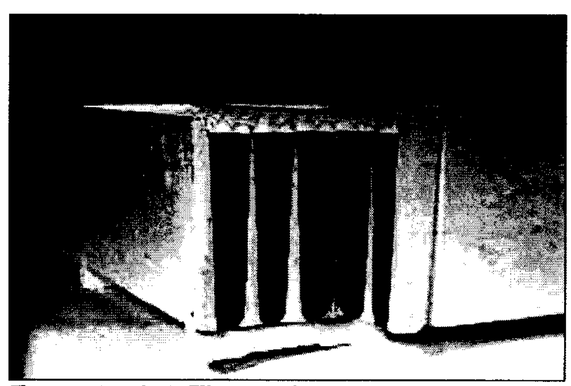


Figure 10. Walters' bullet, showing root egress of white spruce from the bottom drainage holes and through adventitious rooting over the top of the container, several years after planting.





Figures 11 and 12. The original styroblock. Note quarter block composite design.

The following chronology details the development and operational implementation of the "BC/CFS Styroblock Reforestation System."

THE HISTORY OF THE BC/CFS STYROBLOCK™ SYSTEM IN BRITISH COLUMBIA

1961

- Walters Planting Gun and Bullet

1966-1967

- J.M. Kinghorn at the CFS undertakes the further development of the Walters bullet system. Secures cooperation of MOF and some forest companies.

1967-1973

- Growing, testing and planting of Walters' bullets.

During this time, Walters continued with the development and testing of various other container prototypes, including sectional and wood (biodegradable?) bullets as well as planting guns.

1968

- Started extracting some seedlings from the bullets just prior to planting "bullet plugs."

1968

- Contract planting introduced on trial basis.

1969-1970

- Design of BC/CFS Styroblock - Styroblock 2 (2+ cubic inches in volume).

1970

- First planting of 100,000 "Styro-Plugs" in North Central BC in July, 1971 (Figures 13 and 14).
- Styroblock 8 (8 cubic inches in cavity volume) developed.

1973

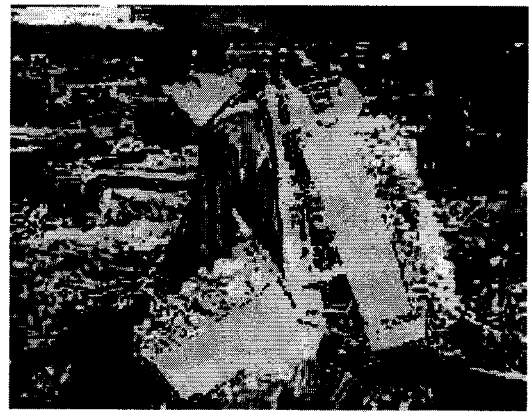
- Introduced ribbed cavities (Figure 15).
- Extract and package plugs at the nursery and ship packaged plugs to the field (Figure 16).

1985-86

- Introduction of 2+0 container-grown stock.

To Present

- Many more cavity sizes and other features introduced, but basic concepts maintained.



Figures 13 and 14. First operational planting of styro-plugs. Note planting from quarter blocks and backpack carrier and quarter block dispenser.

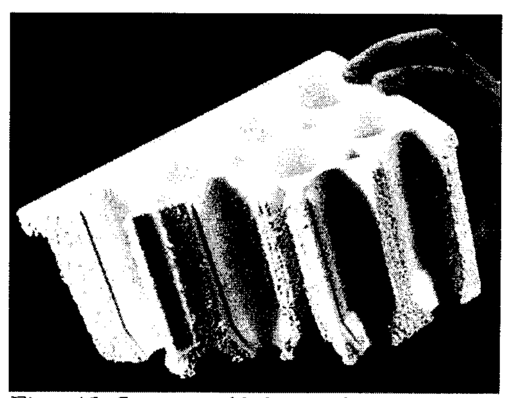


Figure 15. Current styroblock cavity design showing vertical ribs to control root morphology.

Figure 16. Extracted and packaged plugs.

Concurrent with developments in Canada, the Scandinavians, particularly the Swedes, started developing their own hard plastic multi-cavity containers. Although the Swedes and Canadians worked relatively independently, the principal design features of their seedling containers turned out fairly similar. I

Numerous other containers have been designed, developed, tried, and adopted, including Ontario tubes, Spencer Lemaire Rootrainers, paperpots, multipots, K-pots, Hiko's, Leach Cells, Supercows, Winstrips, Airblocks, and jiffy pots, to name just a few. The search for the ideal containers or a need to claim a place in nursery history by developing a new container goes on. There are some good designs, and there are also poorly conceived and designed containers. Unfortunately, this plethora of container types and undue emphasis on just the container rather than on the development of appropriate nursery practices has occasionally hindered the development of effective and efficient container seedling systems and practices in a timely manner.

Well-designed containers are modular, regardless of the cavity size and the number of cavities per block. These multi-cavity containers must be of a size and dimension and filled weight that can be comfortably and efficiently handled by nursery workers without injury, while at the same time allowing for mechanized processing. Cavities must be of a design and have features that prevent root spiraling. Overall, containers must allow for sound cultural and hygienic nursery practices, which are conducive to the production of high quality seedlings with high survival and growth potential. The containers must lend themselves to economical modification in cavity size and density, be reusable and have a reasonable long life of four to five years. Containers that require various parts to be assembled and/or must be replaced every year are costly to handle and purchase, and do not meet essential criteria for efficiency.

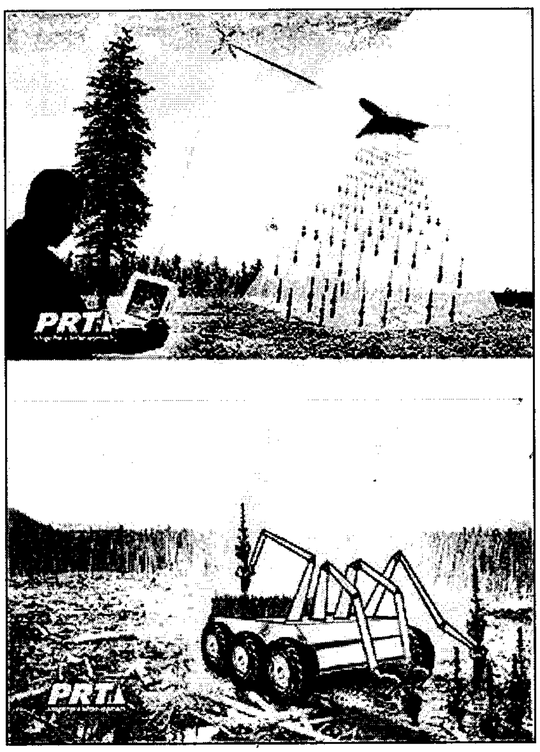
In BC, we have done extremely well with the Styroblock™ and that container is used as the system of choice in Alberta, Saskatchewan, and areas of Ontario, the Pacific Northwest US, Mexico, as well as many other places.

REASONS FOR WIDE-SPREAD ADOPTION OF CONTAINER-GROWN STOCK IN BC AND CANADA

- Early realization that size (Figure 17) and quality are equally important for the field performance of container-grown stock as they are for bareroot; fitness for purpose applies to container-grown stock just as it does to bareroot stock.
- Innovation, and early emphasis on biology rather than engineering, followed by gradual transition to production that is dominated by commercial operators.

Figure 17. The change from micro-seedlings in mini-containers to robust seedlings has contributed very significantly to the success of container seedling production and planting, especially the Styroblock™ system, in western Canada.

- Adoption of one container type by the entire industry for a long period of time, which provided a common basis for effective information exchange and extension work.
- Species, several of which were very difficult to grow as bareroot.
- Early awareness that container-grown seedlings that are planted "container-less" need strong and cohesive root systems that maintain plug integrity during harvesting, handling and planting.
- Predictable and consistent field performance.
- Improved delivery assurance.
- Short lead times to production and shipping.
- Improved planting productivity.



Figures 18 and 19. The future of planting.

THE FUTURE

No one is certain what the future will hold, but many believe that it will change, perhaps drastically (Figures 18 and 19). Current container systems will probably be replaced, but this is not likely to happen any time soon. And in time, nurserymen might be able to grow still better stock. The question is asked: Will container seedling plantations in western Canada "all fall down" because of their heavy root systems, as some have direly predicted? It's been thirty years since we started planting container-grown seedlings and... I am still waiting.

Although seedling physiology remains a popular subject of study at universities and research institutions, apart from a few basic qualitative tests, the assessment of seedling quality still relies significantly on measurement of size and morphology. I am confident, however, that our improving knowledge of seedling physiology as well as our advances through applied genetics and genetic transformation will enable us to enhance growth potential both significantly and physiologically, and it will morphologically tailor seedlings to very specific conditions of site, environment, and time of planting. Science and biotechnology will also allow us to address the issue of pests more effectively and impart resistance or immunity against many plant diseases and insects, and permit more efficient extraction of in situ nutrients both in the nursery and in the field.

Notwithstanding the progress that has been made to date and that will be made in the future, as foresters and nurserymen we must always understand that: "A poor tree well planted is better than a good tree poorly planted, but a good tree well planted is best." (Source: Jack Long, distinguished and long-retired nurseryman with BC Ministry of Forests.)