The production of greenhouse transplants in mini-cells at the Thunder Bay Forest Nursery

Robert A. KLAPPRAT
Nursery Superintendent
Thunder Bay Forest Nursery

Paper read at the Northeastern State, Federal and Provincial Nurserymen's Conference, Montreal, Quebec, July 24 to July 27, 1990.

Abstract

This paper describes the development of the Technical Transplant System that became operational in 1988 at the Thunder Bay Forest Nursery. This system was first used for lettuce production in California by the *Castle and Cooke* organization.

Résumé

Cette communication decrit /a *methodologie de production de plants en usage depuis 1988* a /a *Pepiniere forestiere de Thunder Bay. Appelee* Techniculture Transplant System *(systeme de repiquage), elle fut d'abord miss au point en California pour* /a *production de laitue par la compagnie* Castle and Cooke,

At the Thunder Bay Forest Nursery we have developed a greenhouse transplant system for producing planting stock. The procedure involves starting and growing the crop in a greenhouse and then transplanting it on to the Nursery where its growth continues until harvesting.

The system was developed to replace the traditional 11/2 + 11/2 stock type. The seedling stage of this stock type was fraught with difficulties as the geographic location and precipitation patterns created some very unfavourable conditions for seedling production. Frost heaving and frost killing compounded the effects of other elements such as birds, rodents, insects, diseases, weeds and mechanical damage, which take a toll on seedlings.

Thus, the original intent in transferring the seedbeds to the greenhouse was to *improve reliability in achieving targets.* This was effectively accomplished as very predictable loss/survival information permitted accurate inventory control.

This original intent is now somewhat overshadowed by spin-off advantages of the system. Foremost among these advantages is an *increase in production efficiency.* It now costs less to produce trees. The mechanization of many of the procedures involved and a reduction in tending requirements contribute to this efficiency. We can now *optimize the use of valuable seed.* Whereas it used to take about a dozen seeds to produce a single shippable tree, it now takes about one and a third. This is particularly advantageous as we increasingly use the more expensive improved seed. *Increased production capacity* of the Nursery has been realized by using this system. By eliminating outdoor seedbeds and by growing the crop in two years instead of three, nursery compartment space is freed. The *stock produced is of superior quality.* Trees are taller, their diameter is larger, and their mop-like root system makes this product highly desirable for forest regeneration.

The system we are using is the Techniculture Transplant System that was developed for lettuce production in California by the *Castle and Cooke* organization. Central to the Techniculture System is the stabilized growing medium. It is a dimensionally stable mix of peat moss and a non-toxic binder. This medium is formed in tapered cavities which are 1.27 cm x 4.45 cm. Each resultant plug has a formed indentation which is 3.2 cm in diameter and 8 mm in depth. There are 400 plugs in each tray which has dimensions of 32.1 x 32.1 x 3.8 cm.

The *Castle and Cooke* system possesses many of the features that we were looking for in a transplant system.

The medium is ready to use. There is no necessity to purchase several components such as peat, vermiculite, perlite, wetting agents, etc., which must be accurately blended and mixed in special mixing vats. Also avoided are the filling lines and warehousing requirements of alternate soil medium and tray choices.

Greenhouse space optimized. Each tray has 400 cavities. A typical 9.2 x 42.7 meter greenhouse will hold approximately 1.2 MM trees in a single crop. With three crops per year, one house will produce 3.6 MM trees.

The design and configuration are culturally correct. The plug shape can accommodate the tap root of coniferous seedlings. The indentation/cavity within the plug permits ideal seed placement for even germination and growth.

The system lends itself to mechanization. Since plugs retain their conformity they can be handled mechanically. The square dimensions of the trays permit easier alignment at all stages of production and handling.

The concept is **a "system".** All components are readily available to assemble a system: trays, seeder, benching, handling, transplanting.

Trays are filled with the rubber soil (which is a patented product) at the plant in California and are shipped to us via commercial carrier. They are contained in a plastic wrapped pallet which can be handled by forklift for storage or for immediate seeding. Since the medium is moist, the plastic wrap is essential to prevent drying and shrinking of the plugs. In most cases trays are seeded within a short time of receipt, we have on occasion stored them for several months without any detrimental effects.

We do our seeding with a BCC seeder which was purchased from Sweden. With this high capacity, high precision seeder, we can sow up to 360 trays per hour with 98.5% of the trays receiving one seed per cavity. We have mounted the machine on caster wheels which allows us the mobility to set up the seeding operation at the entrance to each greenhouse. Seeded trays are transferred to the greenhouse with a conveyor and manually set on to the Y-bar benching system. The Y-bar permits sliding the trays into or out of position during loading or unloading. It also allows cavity drainage and air pruning of protruding roots.

Immediately after loading the greenhouse, conditions suitable for germination are established. Temperature is maintained at 25-27 ° C and irrigation is applied at levels and intervals to enhance germination but prevent damping-off and other detrimental effects. Energy curtains are drawn as appropriate in order to maintain a more constant environment: during the day to prevent high temperatures and at night to conserve energy and prevent very low temperatures.

After germination, greenhouse temperatures are maintained at 20-25 ° C and fertilization begins about five days after the seed caps have dropped off the seedlings. By this time lateral roots have begun to emerge. Fertilizer is applied at every irrigation during the active growing period. "Starter' fertilizer is applied at 50 ppm for the first two weeks. "Grower fertilizer is applied at 100 ppm for the remainder of the active growing period and "finisher fertilizer is applied at 40 ppm during the conditioning period.

Three crops are grown in the greenhouses each year. The first which is grown from mid-March until the end of May is moved into a cold frame at that time for a brief acclimatization period prior to transplanting. The second crop is grown from early June until mid-August when it is moved into the cold frame for maintenance and natural conditioning. The third and final crop is actively grown in the greenhouse from mid-August until late October after which light and temperatures are gradually reduced to induce dormancy and frost hardiness.

For the March crop no supplemental light is required, however an eighteen hour photoperiod is provided for the late summer crops in order to prevent premature bud set. The spring crop, after a period of acclimatization, is immediately transplanted onto the Nursery. The two summer crops, after achieving the desired index of injury (from frost) levels, are placed in boxes in late November and held in refrigerated storage at -2 to -4 ° C until the following May when they are thawed and transplanted.

The concept for the transplanter which we are using was also developed by the Castle and Cooke organization. Their machine was developed for lettuce crops which have a much different bed and spacing configuration. Hence an entirely new machine had to be designed. The result is a diesel powered, self propelled four wheel hydrostatically driven short turning carrier unit which supports eight high speed planting heads that can extract and transplant trees from trays that are inserted into the mechanism. An operator drives the machine while two feeders remove trays from large cartridges and place them into sliders leading to the extractor heads. Their next task is to return empty trays to the cartridge.

Cartridges are filled with current or overwintered trays at the cold frame and transferred to the field by truck. They are placed onto and removed from the platform of the transplanter with a fork lift.

The transplanter has the capacity to plant about 160,000 trees per hour. However, with loading time, the shift output ranges from 500,000 to 600,000 trees. Thus to transplant our target of about 16.0 MM black spruce it takes about 20 days.

The development of this production methodology began at the Thunder Bay Forest Nursery in 1984. Small trials were conducted during the first few years to test the biological feasibility of the system. Levels of production were then expanded to test the logistics of the system. In 1988 the method became operational at the Nursery and this year (1990) we have no outdoor black spruce seedbeds at all at our Nursery. To date we have transplanted about 40.0 million trees in the manner described in this presentation.