SILVICULTURE

Technical Note TN-228 September 1995

PLANTING LARGE SEEDLINGS: PRELIMINARY STUDIES IN QUEBEC

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Abstract

Large seedlings are being planted in Quebec as an alternative to the application of herbicides. To date, several million of these large seedlings have been planted and preliminary results on their survival and growth are promising. FERIC conducted time studies on planting operations during the 1993 and 1994 seasons. Seedling size, type of packaging and site preparation methods were the main factors that affected planter productivity.

Introduction

The forecast restrictions on the use of herbicides in Quebec have led government agencies and the forest industry to search for viable alternatives to herbicide spraying. Planting large seedlings (Figure 1) is one alternative currently being pursued by the Ministère des ressources naturelles du Québec (MRNQ). In theory, taller seedlings with a greater root mass should be better able to compete for light and other resources

Figure 1. A large seedling grown in a 340-cm^3 styroblock container.

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KEYWORDS: Planting, Manual method, Large seedlings, Containerized seedlings, Extracted container stock, Site preparation, Seedling transportation, Planting tools, time study, Productivity, Quebec.

and should thus quickly dominate the competing vegetation and become free to grow. Initial trials on sites prone to heavy competition have indicated that large seedlings could reduce and potentially even eliminate the use of herbicides or mechanical cleaning (Veilleux 1993).

Bareroot stock was used at the beginning of the trials, while the production of large container stock was being developed and tested. Container stock is less expensive to produce and offers certain operational advantages during the transportation and handling phases. The currently desired characteristics for these large seedlings are a 35- to 45-cm height (excluding the root plug), a height/diameter (cm/mm) ratio of 7 to 8 and a well-balanced root system.

In 1993 and 1994, respectively, approximately 1.5 and 4.5 million large container-grown seedlings were planted on a semi-operational basis. FERIC conducted timing studies on several contractor operations for REXFOR, Domtar Inc., and Kruger Inc. to determine the effect of the different sizes of seedlings, types of packaging, planting tools and site conditions on planter productivity.

Operations and Timing Studies

Details on seedling size, packaging, planting tools, and the method of site preparation in the three studies are provided in Table 1.

Table 1. Summary of operations

Operations studied	A					B		C	
Type of seedling (root-plug volume, cm^3)	110	200	340	340	340	340	340	340	340
Type of packaging	trays	trays	tubs	burlap	boxes	boxes	boxes	tubs	tubs
Type of planting tool	extractor	spade	spade	spade	spade	spade	extractor	spade	spade
Type of site preparation	rake	disc trencher	rake	disc trencher	rake	disc harrow	disc harrow	none	disc trencher
No of seedlings sampled	11 514	7 838	11 404	3 219	2 473	158	297	264	887
Average distance to cache (m)	26	13	17	8	48	30	25	27	60
Average no. of seedlings/cycle	99	61	54	29	59	26	30	88	68
Time elements (%)									
Planting	91	82	85	77	74	72	76	78	70
Walk to cache	4	3	4	4	9	11	6	10	17
Fill bags	5	15	11	19	17	17	18	12	13
Total	100	100	100	100	100	100	100	100	100
Productivity (seedlings/h)									
Planting only	410	281	230	225	215	213	249	253	353
Planting, walking and filling bags	373	230	196	176	159	153	189	197	247

Three different sizes of seedling were planted during the studies, with 110, 200 and 340 cm^3 of root-plug volume (referred to as 110, 200 and 340 stock hereafter). The respective height ranges for the stock were 25 to 35 cm, 30 to 40 cm and 35 to 50 cm. The 110 conventional stock was delivered to the field in multipot trays with 45 seedlings/tray. Planters carried two or sometimes three trays on a hip harness and prepared the planting hole with a soil extractor (i.e., a hollow, open-tipped dibble) (Figure 2a). The 200 stock was also delivered to the field in multipot trays with 25 seedlings/tray, whereas the 340 stock was extracted from the styroblock trays at the nursery and then packaged and delivered to the field in cardboard boxes, burlap bundles, or plastic tubs (Figure 3). The planters filled their bags with the 200 or 340 stock at a cache and usually made the planting holes with spades (Figure 2b). Some planters experimented with hollow, closed-tip dibbles (Figure 2c) for planting 200 stock and with extractors (Figure 2d) for the larger 340 stock.

In general, the level of planting difficulty was similar for all operations, but one small test area without any prior site preparation was more difficult. The time studies were conducted with experienced, conscientious planters. Non-productive time delays such as rest periods, lunch breaks, time spent waiting for trees or moving between sites were measured but were excluded in the analysis.

Results and Discussion

The results from the different studies should not be compared with each other because they are specific to their site conditions, level of planter experience, and work organization. As well, since the studies were conducted with experienced planters only, the productivities may be higher than those for the average planter.

Seedling Size

The effect of seedling size on planter productivity was examined in Study A. Planting rates of 410, 281, and 227 seedlings/hour (planting only) were obtained for the 110, 200 and 340 stock, respectively (Table 1). Productivity decreased as root-plug size increased, since more time was required to prepare a larger planting hole and because a spade was used rather than an extractor (see “Planting tools”).

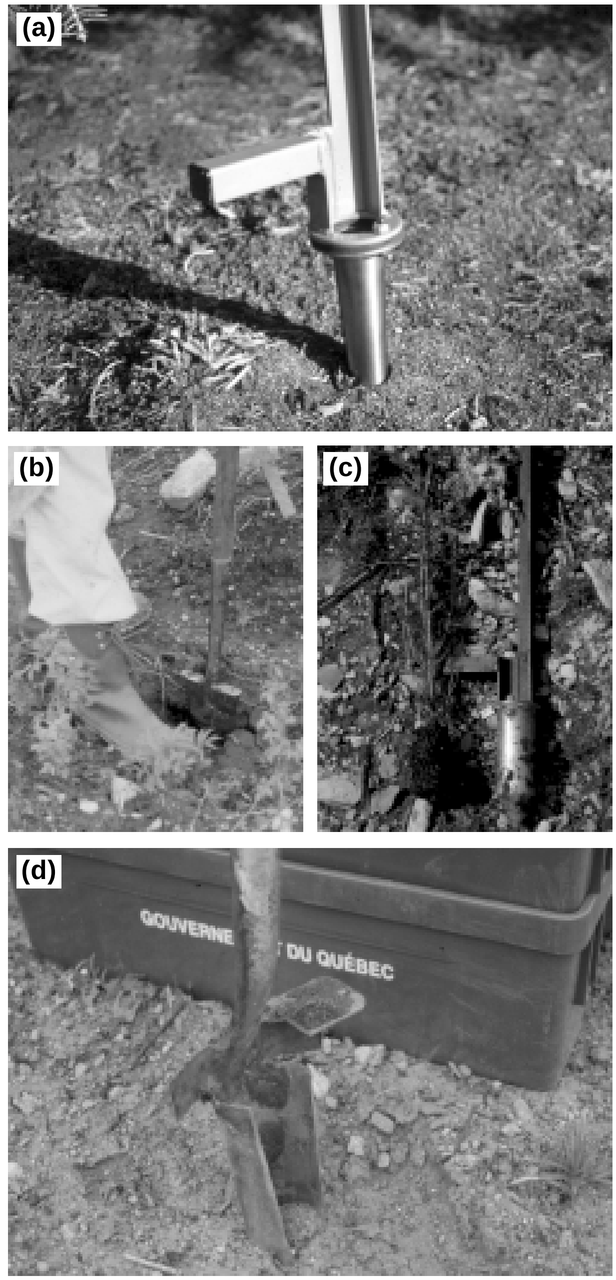

Figure 2. Planting tools: (a) soil extractor (hollow, open-tipped dibble) for 110 stock; (b) planting spade for 340 stock; (c) hollow, closed-tip dibble for 200 stock; (d) home-made soil extractor for 340 stock.

Figure 3. Large seedlings (340 stock) packed in cardboard boxes (top), burlap bundles (center) and plastic tubs (bottom).

In Study A, the planters also spent a higher proportion of their time provisioning with the larger seedlings, thus reducing the time available for planting. Provisioning time (walking and filling bags) accounted for only 9% of the total time with conventional 110 stock, versus 15 to 26% for the larger stock. Fewer large seedlings could be carried by the planters because of the extra weight and space required in the bags (Figure 4). Planters carried an average of 99, 61, and 52 seedlings per trip, respectively, for the 110, 200, and 340 stock.

Figure 4. Planters carrying 340 stock in bags.

Types of Packaging

The times taken to fill up with large seedlings stored in different types of packaging media were also measured in Study A (Figure 5).

Filling up with 340 stock in plastic tubs took half as long as with other packaging. Seedlings in the tubs were packed upright and were quicker to remove than from boxes or burlap bundles, in which the seedlings were laid on their sides. The tubs held 60 seedlings and were generally emptied at each fill-up, whereas the boxes and bundles held 100 seedlings and were rarely emptied at each fill-up. Partially empty boxes and burlap bundles required the planters to fold back the plastic liner and close the boxes or bundles to protect the root plugs of the remaining seedlings from exposure to air and light. Another disadvantage of the boxes or burlap bundles was the extra time required to pile them up when empty; the tubs stack easily inside each other and were easier to recover from the field. The plastic tubs could also be delivered to the planting operation using the existing stackable pallet system (Figure 6). This system enables mechanical unloading, whereas the boxes and bundles had to be unloaded manually.

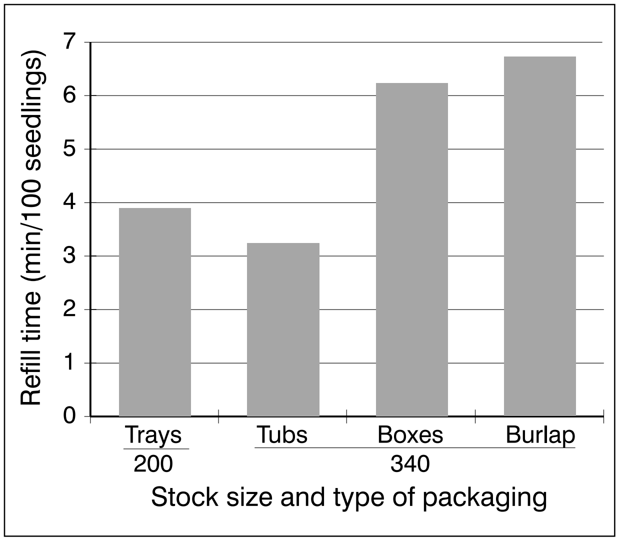

Figure 5. Refill time with large seedlings in different packaging.

The average filling time with 200 stock in multipot trays was 3.9 min/100 seedlings. Despite their smaller size, the 200 stock seedlings were difficult to remove from the growing trays, thus requiring more time than the 340 stock in plastic tubs.

Planting Tools

One planter's productivity was compared using two planting tools (spade vs. extractor) to plant 340 stock on the same site (Study B). A rate of 213 seedlings/h (planting only) was obtained using a spade, versus 249 seedlings/h (17% more) with the extractor (Table 1). Planting holes could be made more quickly with the extractor; however, one must take into account the intensive site preparation (with a disc harrow) that enabled the planter to push the extractor into the soil without difficulty on this site.

The planting spade, more commonly used with 200 and 340 stock, is usually inserted in the ground and moved from side to side until a large enough hole is produced. This technique compacts the soil to the sides and increases the risk of leaving air pockets inside the planting hole. A soil extractor such as a hollow-tipped dibble is a more suitable tool for preparing planting holes, especially for seedlings with large cylindrical root plugs. A well-designed extractor can remove a soil plug from the ground equivalent in size and shape to the root plug without compacting the soil around the perimeter of the planting hole. However, in dry, stony, or unprepared soils, a planter could have some difficulty using an extractor and consequently a spade may be more appropriate.

Figure 6. Large seedlings delivered in plastic tubs using an existing stackable pallet system.

Site Preparation Versus No Site Preparation

In Study C, FERIC compared planter productivity while planting 340 stock using a spade on sites scarified with a powered disc trencher and without any site preparation. The results indicated that productivity was 40% higher on the site-prepared site (353 versus 253/h) (Table 1). Although the sample size was relatively small, it was obvious that the planters spent less time preparing the planting hole on the site-prepared area and that they moved more quickly with less debris in their way. They also spent less time ensuring proper spacing between the rows of trees and searching for the next planting spot.

The intensity of the site preparation could also have an effect on planter productivity; deep soil tilling with implements such as rototillers would facilitate the use of extractors, and would thus help increase planter productivity, as shown in Study B.

Seedling Distribution

A good distribution system should reduce the walking distance to the cache. Although more frequent fill-ups are required with large seedlings, this does not necessarily imply that more personnel and equipment are required for delivering large seedlings because of the lower daily productivity.

Figure 7 shows the effect of the distance to the supply of seedlings on productivity for 110, 200, and 340 stock in Study A. Productivity decreases less (in number of trees/h) with 340 stock than with smaller stock as the distance to the cache increases.

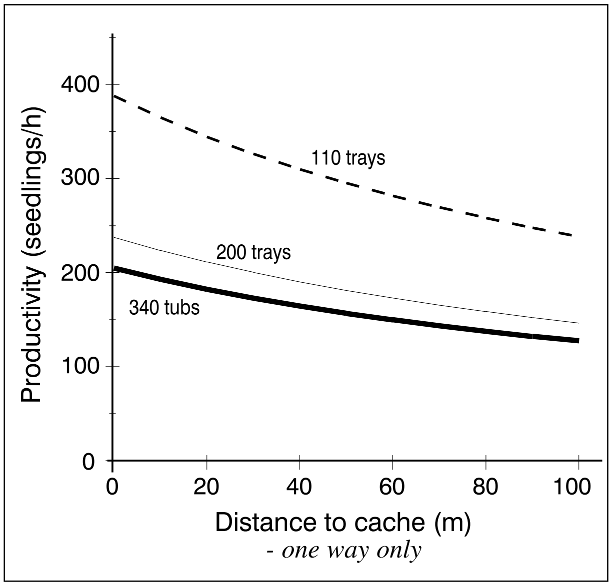

Figure 7. Planter productivity (including planting, refilling, and walking to and from the cache) in relation to distance to cache.

Conclusions

The study indicated that seedling size had a direct effect on planter productivity, primarily because of the increased time spent preparing the planting hole and the more frequent provisioning required by using large seedlings. Plastic tubs were the most efficient type of container for transporting and delivering the large stock, since refill times were shorter. The tubs were also easier to handle and to recover from the field, and they fit into the rack systems currently used for conventional stock.

During the past two years, contractors have modified and improved their work organization to make these operations as efficient as possible. However, there is still a need for an extractor that is both easy to use and that can produce better-quality planting holes. FERIC and the MRNQ are developing several extractor-type tools to be tested in 1995.

Reference

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Acknowledgments

The author expresses his appreciation for the cooperation of the planting contractors, tree planters, and member companies who participated in the studies. The technical support of FERIC employee J. Lirette is also acknowledged.