CONTAINER-GROWN SEEDLINGS MAKE EXCELLENT ROOTSTOCK

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For potted rootstock, plug +1 lodgepole pine seedlings were better than bareroot 2+1 seedlings.

Approximately 5,000 rootstock are required annually to meet the grafting needs of the British Columbia Forest Service's lodgepole pine breeding program located near Prince George in the central interior of British Columbia. Climatic and operational restrictions militate strongly against the use of extensive field grafting in this region. Heavy frosts may occur until mid-June and qualified grafters are usually in short supply — too short to permit extensive grafting in a brief period of time, as dictated by field grafting conditions. Consequently, the pine breeding program relies almost exclusively on potted rootstock and greenhouse grafting. By so doing, rootstock accessibility is easily controlled, ideal environmental conditions can be maintained and grafting load can be evenly distributed over a period of 3 to 4 months.

Experience has shown that a styro-plug 4 (65 cm^3 soil capacity, figure1), repotted for a second year (plug +1) consistently produces the best rootstock for our grafting requirements (*3, 4*). The next best stock, a bareroot 2+0 seedling potted up for a third growing season prior to grafting, lacks many of the attractive characteristics of the plug+1. However, the bareroot seedling has been, until recently, our primary source of rootstock. Data presented here demonstrate the

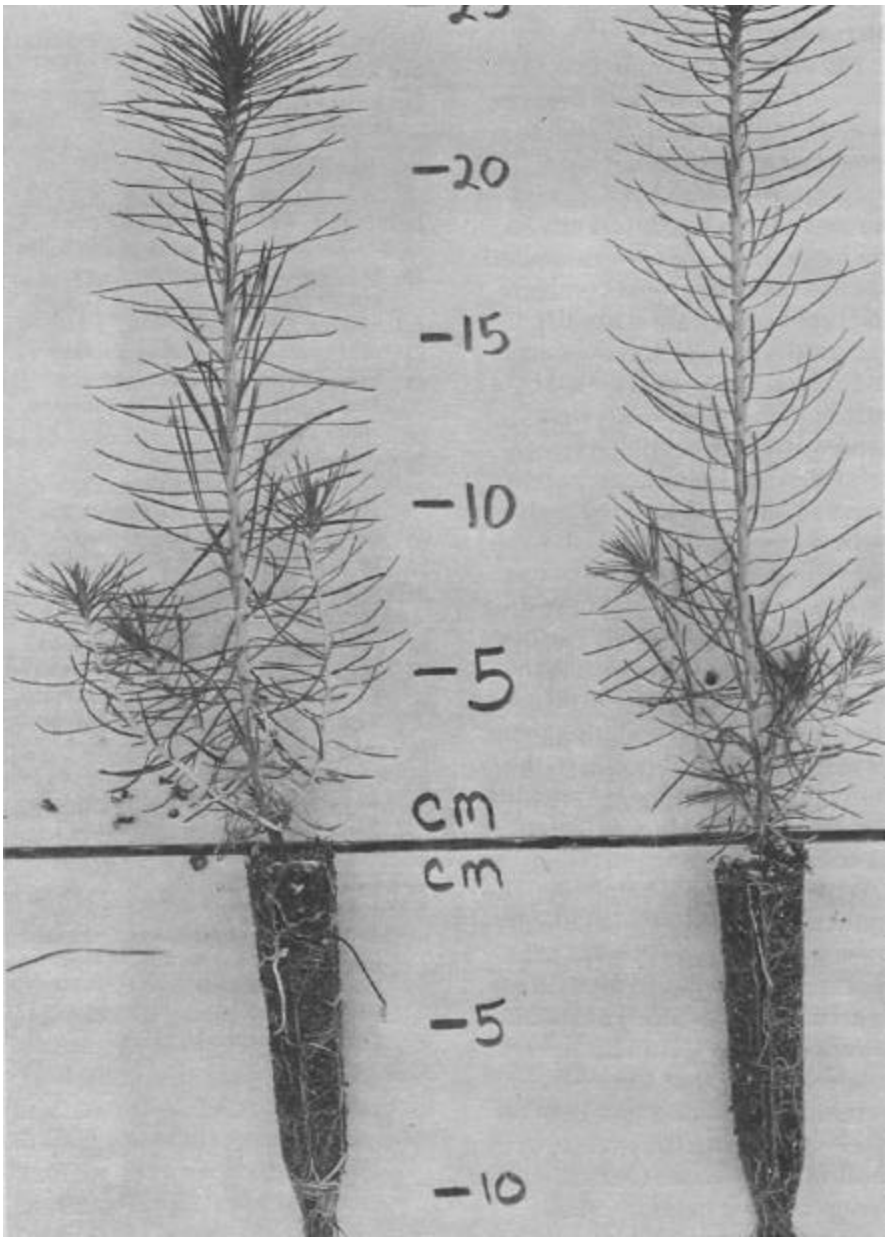

Figure 1.—*Lodgepole pine styro-plugs 4 months after sowing. Average height growth exceeding 20 cm and a lack of lateral branch development characterize the first year plug - traits essential for the development of excellent rootstock.*

principal differences between these major types of rootstock.

Materials and Methods

Lodgepole pine rootstock are generally potted in 2.5-l pots 8 to 12 months prior to grafting. These seedlings are normally healthy, vigorous and possess well-established root systems. Typically, potting is done in early May while stock is still dormant and environmental stress is low. Grafting is done the following spring. The pine breeding program relies almost exclusively on the side-veneer grafting method (*1*), (*2*).

To accommodate the grafting requirement for the 1978 season, rootstock were obtained from two distinct sources. In late April 1977, 500, 2+0 lodgepole pine from each of three different seedlots were lifted from production nursery beds and stored for 2 weeks at +1° C. Upon removal from cold storage, they were root-pruned and repotted in 2.5-l pots. The remaining understock, of which there were approximately 3,000, were obtained from plug seedlings sown in March 1976 in the greenhouse. These seedlings were placed outside in late June 1976 and overwintered under a shallow snow cover. Extracted plugs were root-pruned by removing the lower 1.5 to 2.0 cm of compacted root-mass. The remaining roots were carefully spread by hand when seedlings were repotted.

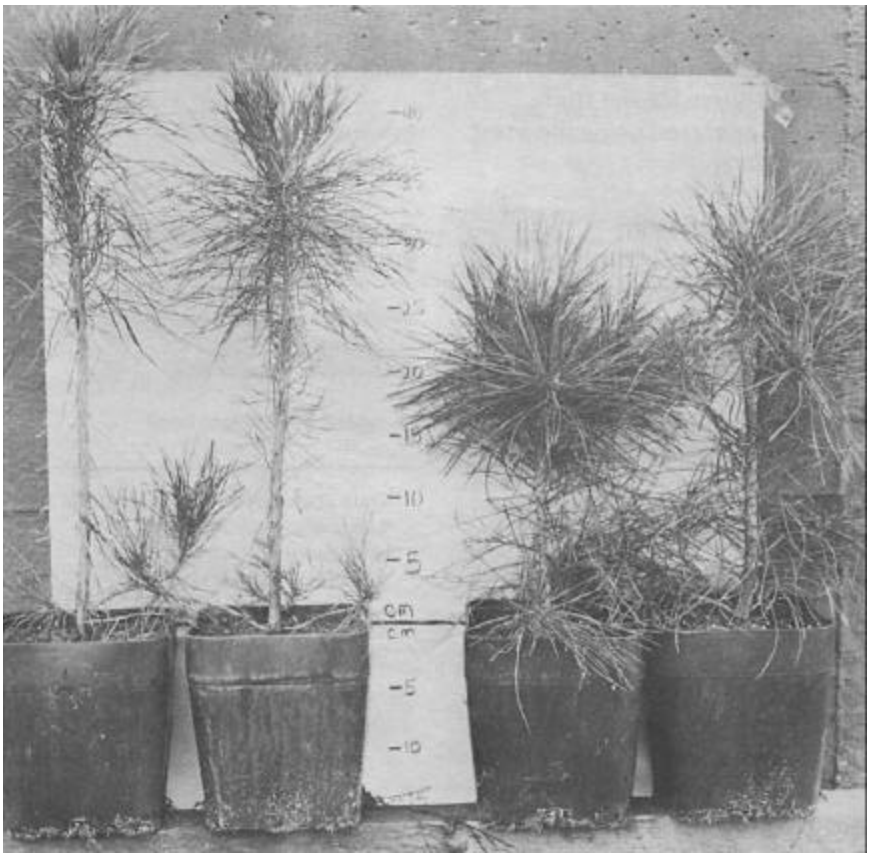

Figure 2.–*Potted plug + 1 (left) and 2 + 1 bareroot (right) lodgepole pine seedlings after one growing season in 2.5-1 pots. Note the long, unbranched stem of the plug +1.*

Fertilizing regimes prior to potting followed standard nursery requirements for both plug and bareroot sources. Prospective rootstocks were potted in a 60 percent peat, 40 percent sand mix containing 2.7 kg/m^3 of slow-release 14-14-14 "Osmocote" fertilizer. Potted seedlings received top-dressings of 21-0-0 (325 g/m^3 of potted soil) at 4-week intervals from June to August.

By October, essentially all vegetative growth of rootstock had ceased. Measurements were made to determine total plant height, height to first branch node, basal diameter, and diameter at grafting height (that portion of the stem between the root collar and the first branch node that is optimally suited for side-veneer grafting).

One hundred seedlings were randomly selected from each rootstock source for the study. Data were analyzed using the t-test for two means.

Results and Discussion

Rootstock types contrasted sharply in growth and form. After the first growing season plug seedlings averaged around 20 cm in height and had not developed lateral branches, probably as a result of intense competition of container-grown seedlings for light. Consequently, as plugs +1 these seedlings exhibited long, clean stems, free of encumbering branches (fig. 2). Bareroot stock, however, produced one and occasionally two whorls of branches each of the first 2 years of growth. As 2+1 seedlings, they were short and stocky with a considerably shorter length of stem available for grafting relative to the plug +1. Growth data are summarized in table 1.

Statistically significant differences between rootstock types existed for all parameters measured. Plug+1 seedlings exhibited a clean stem averaging more than twice the length of the 2+1, while the latter held an edge in diameter at grafting height of .6 mm. Although statistically significant, the diameter difference was not too relevant in that nearly all trees from both sources met grafting requirements. Differences in

Table 1.—*Height, height to first branch node, root collar diameter and diameter at grafting height of plug+1 and 2+1 potted rootstock* [1]

Parameter		Rootstock		
		Plug + 1	2 + 1 Bareroot	Significant Difference
Total height (cm)	x[3]	32.9	27.4	.01[2]
	SD[4]	5.4	4.2	
Height to node (cm)	x	31.8	14.3	.01
	SD	5.5	2.3	
Diameter, root-collar (mm)	x	7.8	8.3	.01
	SD	.9	1.0	
Diameter, graft height (mm)	x	7.3	7.9	.01
	SD	.9	1.0	

[1] Data are expressed as averages of 100 randomly selected seedlings.
[2] Level of probability.
[3] x = mean
[4] SD = standard deviation

Table 2.–*Percent of rootstock, by source, meeting acceptable standards for graftable stem length and diameter* [1]

Classification[1]	Length		Diameter	
	Plug + 1	2 + 1 Bareroot	Plug + 1	2 + 1 Bareroot
Optimal Ln ≥ 20 cm, dia ≥ 7 mm	95	2	82	92
Acceptable Ln = 12.5 -19.5 cm, dia = 6 mm	5	82	15	8
Not Acceptable Ln ≥ 12.0 cm, dia ≤ 5 mm	0	16	3	0

[1] Data based on 100 tree samples
[2] Ln = length; dia = diameter

length of graftable stem were of practical significance, however. Considering a stem-length of 12.5 cm to be a minimal standard for grafting purposes, 16 percent of the potted 2+1 rootstock was culled. Using a partially subjective classification system devised by our propagation staff, the desirability of the measured rootstock was summarized (table 2). The plug+1 proved to be clearly superior.

In addition to meeting desirable dimensional requirements for grafting, the plug+1 has a number of other favorable attributes. They are easily grown, maintained and transplanted, requiring minimal mechanization and labour. They are readily prepared for grafting by merely stripping the stem of needles. Because the rootstock possesses far fewer branches, graft, maintenance is significantly reduced in the initial phase of establishment by eliminating one and possibly two prunings. And finally, the vigorous growth of plug +1 rootstock appears to affect the early establishment and growth of scion material.

Conclusion

Plug+1 lodgepole pine seedlings were found to be superior to bareroot 2+1 seedlings for potted rootstock needs. They require less labour and time to grow, handle, and maintain in the quantities needed for our research grafting program. They were superior in growth and form, providing long, unbranched stems of good caliper.

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