

Abstract

The annual seedling output in Quebec rose from nearly 33 millions in 1980 to more than 250 million in 1989. In terms of the type of seedling used, container represents over 75% of the production. About 99% of the production is softwood species, mainly black spruce, white spruce and jack pine. In Quebec, the provincial government is responsible for the production of seedlings for reforestation. The existing network comprises 8 government nurseries and 25 private ones. All the seedlings lots intended for reforestation must be inventoried by the staff of the Ministry's administrative regions. Over the next few years, major development efforts will be devoted to the production of large seedlings, production of bare-root started in minicells, cutting techniques and *in vitro* culture as well as the production of hardwoods.

Résumé

*La production de plants forestiers au Québec est passée de 33 millions en 1980 à plus de 250 millions en 1989. Les plants en récipients représentent plus de 75% de la production en termes de type de plants. Environ 99% des plants sont des résineux, dont principalement l'épinette noire, l'épinette blanche et le pin gris. Au Québec, le MER a la responsabilité de produire tous les plants forestiers. Pour ce faire, 33 pépinières, dont 8 gouvernementales, sont réparties sur tout le territoire habité du Québec. Tous les lots de plants destinés au reboisement font l'objet d'un contrôle de qualité par les équipes des régions administratives du MER. Au cours des prochaines années, les efforts de développement porteront sur la production de plus grands plants, l'amélioration des techniques de bouturage et de culture *in vitro*, ainsi que sur la production de feuillus à bois dur.*

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1. Introduction

During the past few years, seedling production for reforestation has undergone an exceptionally rapid expansion in Quebec. This activity represents an important element in the development of Quebec's forests, which play an important part in our social as well as economic development.

The theme selected by the conference organizers appears fitting given the changes in Quebec over the past decade in this specialized area of seedling

production. As in many countries, container seedlings in Quebec have displaced bare-root seedlings for reasons that we shall explain later. However, bare-root seedlings are still in demand mostly for sites where competing vegetation is severe. The discussions to be held during this conference will no doubt improve our knowledge of the culture of these two types of seedlings.

In this presentation, I aim to outline seedling output in Quebec. Following a brief historical summary, I shall speak of the producer network, production methods, the species produced and production objectives. Then I shall discuss the quality control of seedlings. Finally, I shall give a glimpse of the future by presenting, among other things, the new production center at Saint-Modeste — the *Bouturathèque*

2. Historical summary

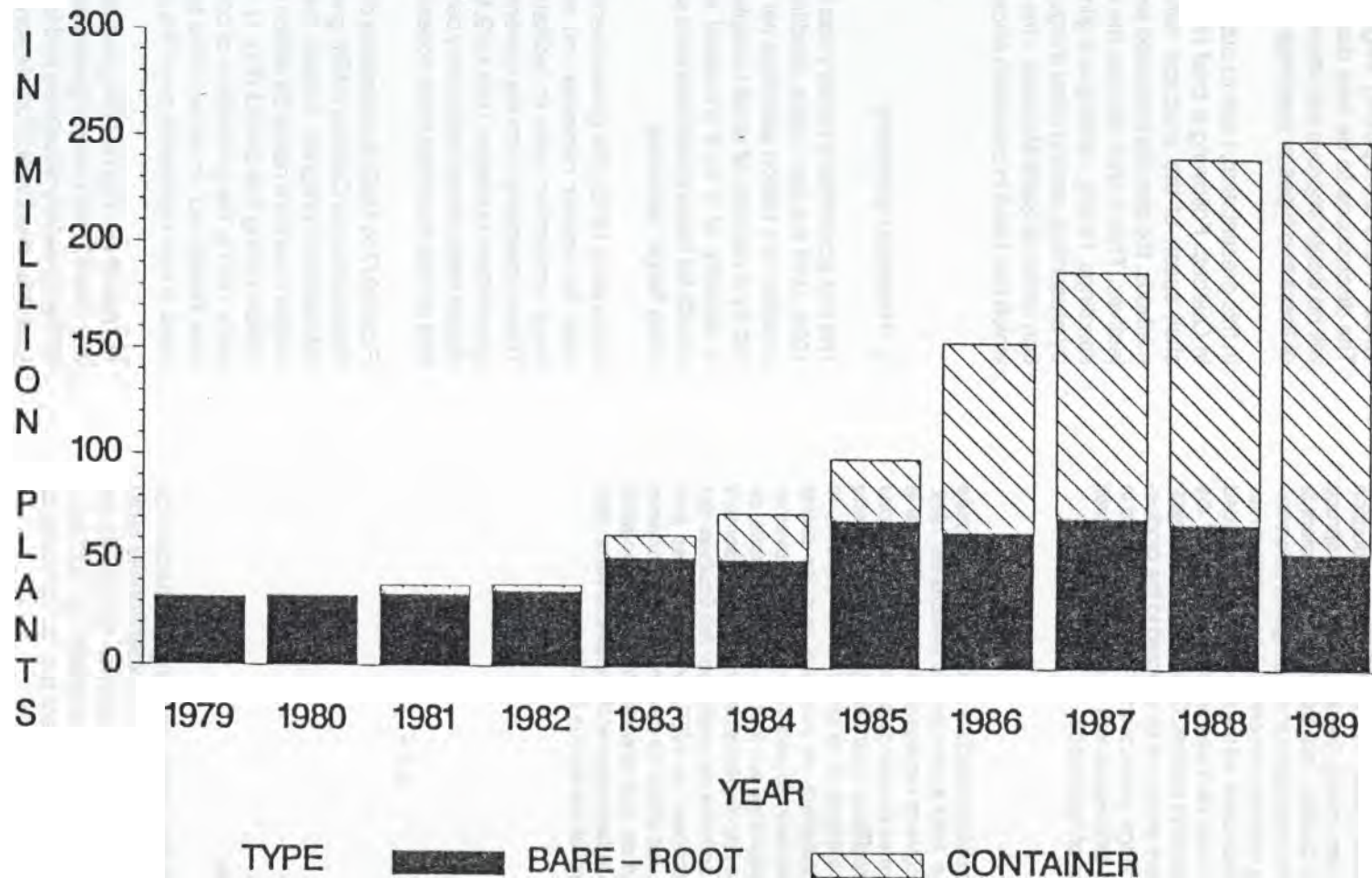
The first government nursery was built in Berthier in 1908. Until the late 1960s, seedling output — about 3 million to 4 million seedlings per year — was assured by a network of small transplant nurseries with a capacity of 3 to 4 thousand seedlings. Young shoots for these operations were supplied by two or three "large" nurseries.

In the early 1970s, the government decided to eliminate the smaller nurseries and replace them with large production units to facilitate mechanization. These operations form the current network of eight government nurseries. Until 1979, the seedlings produced were almost exclusively bare-root seedlings, and private nurseries were nonexistent.

From 1977 to 1989, the *ministère de l'Énergie et des Ressources du Québec (MER)* greatly intensified its reforestation program. Indeed, the annual seedling output rose from nearly 33 million to more than 250 million during this period (Fig. 1). Moreover, in the early 1980's, the production of container seedlings was introduced. In terms of the types of seedlings used, it now represents over 75% of the production.

To meet these high seedling requirements, the *MER* then decided to provide government nurseries with all the necessary structures and facilities to cultivate container seedlings. Furthermore, contracts granted private companies helped create new production centers.

Figure 1 SEEDLING DELIVERIES FROM 1979 TO 1989



3. Current output

3.1 Organization of seedling production in Quebec

The Quebec government has nearly always been responsible for the production of seedlings for reforestation. Occasionally, small quantities of seedlings were produced by nurseries that belonged to the forest industry. With the introduction of the new forest policy in 1986, the government has undertaken to supply free of charge the seedlings required by the forest industry to regenerate areas that are not regenerated or poorly regenerated. Moreover, the *MER* must produce seedlings for the backlog, for which it is responsible. Finally, the department continues to provide small woodlot owners with seedlings free of charge, as it has been doing for more than a quarter of a century.

To assure the production of the millions of seedlings required, the *MER* manages a network of 33 private and public nurseries. In 1989-1990, expenditures of \$39.5 million have been earmarked for the production of some 250 million seedlings.

3.2 Production objectives

The annual production objective is currently 230 million softwood trees, 180 million of which are intended for public forests and 50 million for private woodlots.

As regards hardwoods, the short-term objective is 3 million seedlings per year. In the medium term, this objective should be raised to 10 million.

3.3 The producer network

The existing network comprises eight government nurseries and 25 private ones, five of which belong wholly or in part to forest companies. According to the 1990 nurseries seeding, public sector nurseries should produce 84 million seedlings per year (36.6%) and together private sector nurserymen should provide 146 million (63.4%) (Fig. 2).

These nurseries are distributed throughout the administrative regions (Fig. 3). The network's annual output capacity, considering the type or size of containers currently used, is approximately 255 million seedlings.

3.4 Seedling Production Contracts

The first generation of contracts was granted by negotiations or public tenders. The contracts gene-

rally entail an annual delivery of 3 to 5 million seedlings over 5 years. The *MER* is responsible for gathering the seeds, and supplies producers with these seeds and the containers. The *MER* remains at all times the owner of the seedlings. Producers must deliver the seedlings, which comply with certain criteria regarding quality, as defined in the contracts. In each administrative region, the *MER* has at its disposal a team that is assigned to control the quality of the seedlings before they are delivered. The *MER* only pays for the seedlings that meet the standards.

Most of these contracts are now nearing the expiry date and will be renewed by direct negotiations with the present nurserymen.

3.5 Production methods

The three production methods currently used for softwoods are : bare-root seedlings, container seedlings in tunnels (45 cavities of 110 cm³ each), and those in containers in greenhouses (67 cavities of 50 cm³ each). The production breakdown between these three methods is, respectively, 20.6%, 47.3% and 32.1% (Fig. 4).

To meet the rapid increase in demand for seedlings, the *MER* has therefore opted for the container method of production rather than the bare-root method. This choice was influenced by the following advantages regarding both production and planting:

- shorter production delays;
- less space required in nurseries;
- lower production costs;
- more closely controlled growth conditions;
- increased mechanization;
- longer planting period;
- higher planter productivity;
- reduced planting shock, therefore higher survival rate.

The relative importance of container seedlings has thus risen from less than 1% in 1980 to nearly 80% in 1990. Nevertheless, bare-root seedlings are still very important since they are used mainly to regenerate sites where competing vegetation is strong.

BREAKDOWN OF SEEDLING PRODUCTION BY TYPE OF PRODUCER (1990 NURSERIES SEEDING)

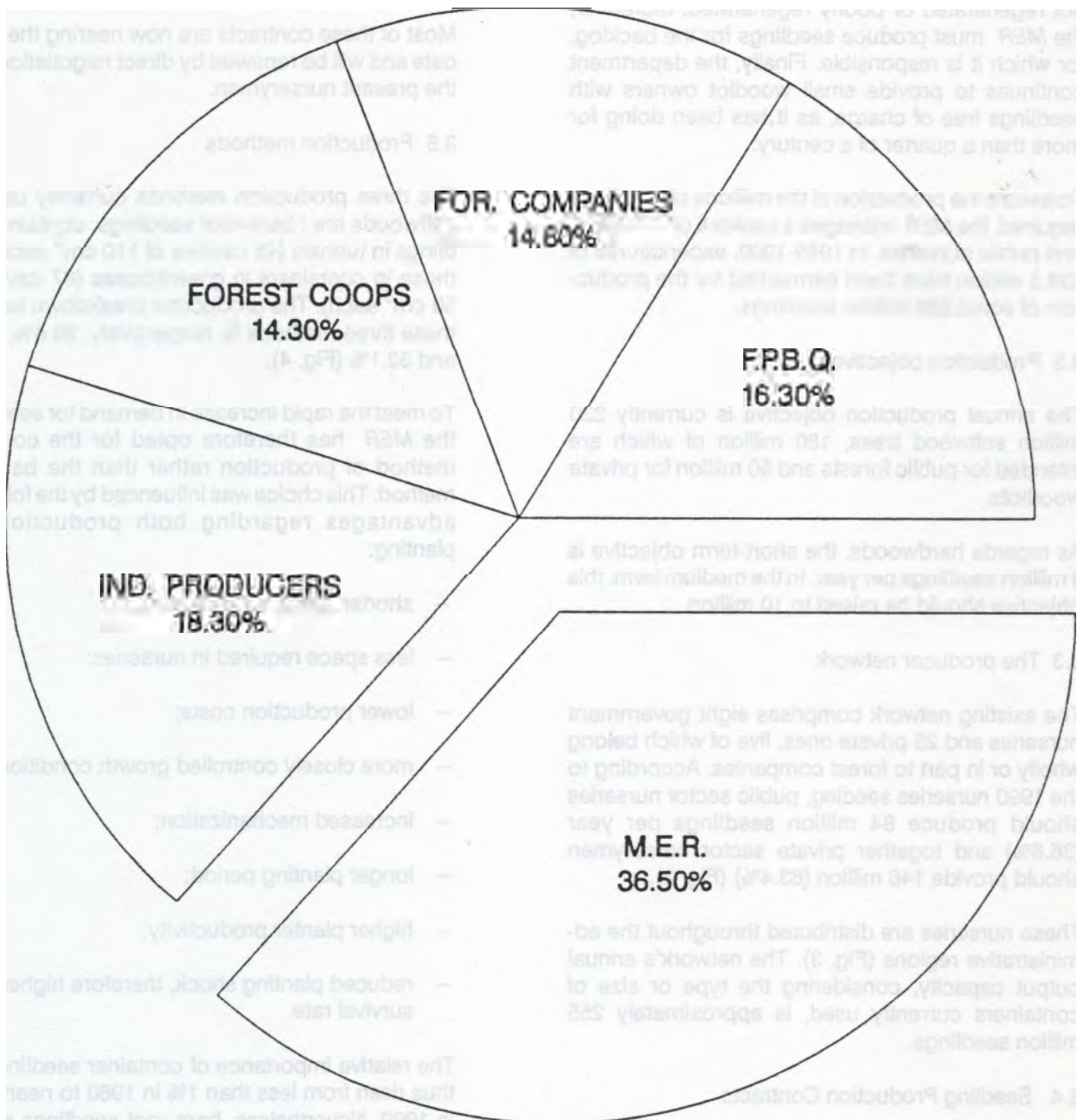


Figure 2

Localisation des centres de production de plants

LÉGENDE

- | | |
|-------------|-----------------|
| ▲ MER | T TUNNEL |
| ■ COMPAGNIE | S SERRE |
| ● PRIVÉ | RN RACINES NUES |



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Figure 3

**BREAKDOWN OF SEEDLING PRODUCTION
BY METHOD OF CULTURE
(1990 NURSERIES SEEDING)**

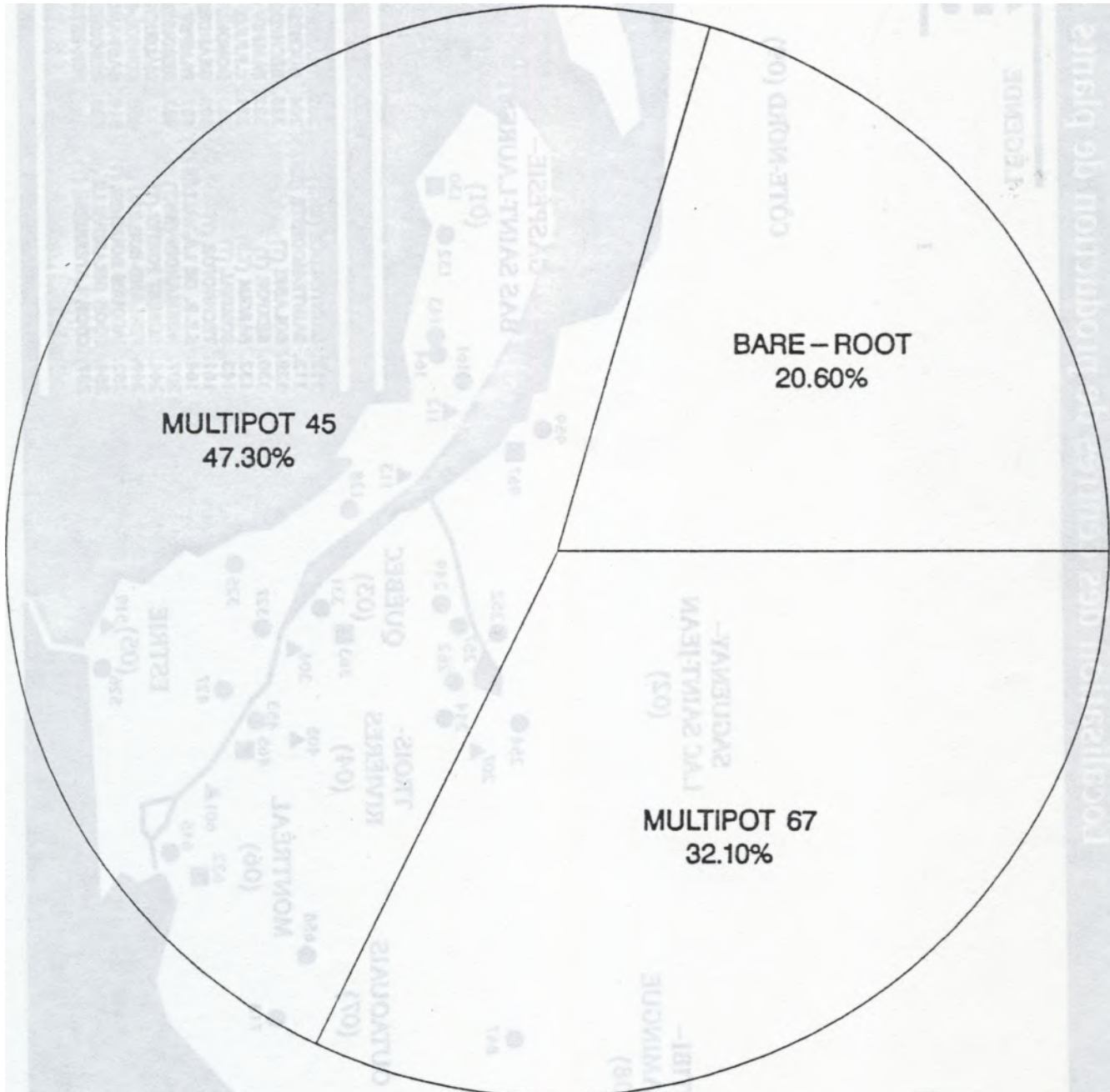


Figure 4

Seedlings in 45-cavity *Multipots* are produced inside tunnels during their first growth season. They are then placed outside where their cultivation is pursued until they are delivered in their third year. In some cases, delivery can occur at the end of the second year of growth.

Seedlings in 67-cavity *Multipots* are usually produced in greenhouses and used mostly in northern regions where competing vegetation is less severe. Production timetables are more flexible. As a rule, the first seeding is performed during the winter. Towards the end of May, the young shoots are placed outside the greenhouses for a second seeding. Seedlings from the first group can be delivered beginning in August of the first year, but normally they are not delivered until the following year. Seedlings from the second group are delivered in their second year.

Bare-root seedlings are generally produced over a four-year period, that is, two years as seedlings and two as transplants.

3.6 Species produced

The major softwood species produced are black spruce, white spruce and jack pine with, respectively, 51.8%, 23% and 18% of the nurseries seedlings in 1990 (Fig. 5). In descending order, the other species produced are: NorNay spruce, red spruce, red pine, white pine, tamarack, white cedar, European larch, Scotch pine, Japanese larch, and black pine. These species, however, only represent 7.2% of plantings in 1990.

Yellow birch, sugar maple, red oak and white ash represent nearly 80% of the production of all hardwoods (Fig. 6). These are produced as bare-root seedlings or in large containers such as *Styroblocks # 20* with 45 or 28 cavities.

4. Seedling quality control

All the seedling lots intended for reforestation must be inventoried and consist of at least 85% of seedlings that meet height, diameter and height/diameter standards as well as various criteria – in particular relating to the form of the seedling (Fig. 7). These inventories are carried out by staff from the administrative regions. Furthermore, the department must issue a certificate attesting to the healthy phytosanitary state of the seedlings.

Quality standards for container productions have recently been revised. This revision was undertaken

to obtain more balanced seedlings with smaller height/diameter ratios. Thus, the average heights intended for 45-cavity container cultures are now shorter than before. With this approach, we can produce higher quality seedlings since they conform more closely to the optimal production capacity of these containers.

For container productions, the height and diameter standards required for each seedling varies according to the average height of the lot. These standards are aimed at obtaining lots whose average height generally stands between 16 and 20 cm for cultures in 67-cavity containers, and between 20 and 24 cm for cultures in 45-cavity containers. The average H/D ratio contemplated are smaller than 8 for black spruce, red spruce and Norway spruce and smaller than 7 for white spruce and jack pine.

After long having the minimal values of 15 cm and 3.5 mm respectively for height and diameter, bare-root standards are currently being revised so as to produce larger seedlings.

It is highly probable that in the future two seedling bare-root categories will be produced to meet specific needs : one category whose lots would have an average height of approximately 40 cm and another of about 30 cm.

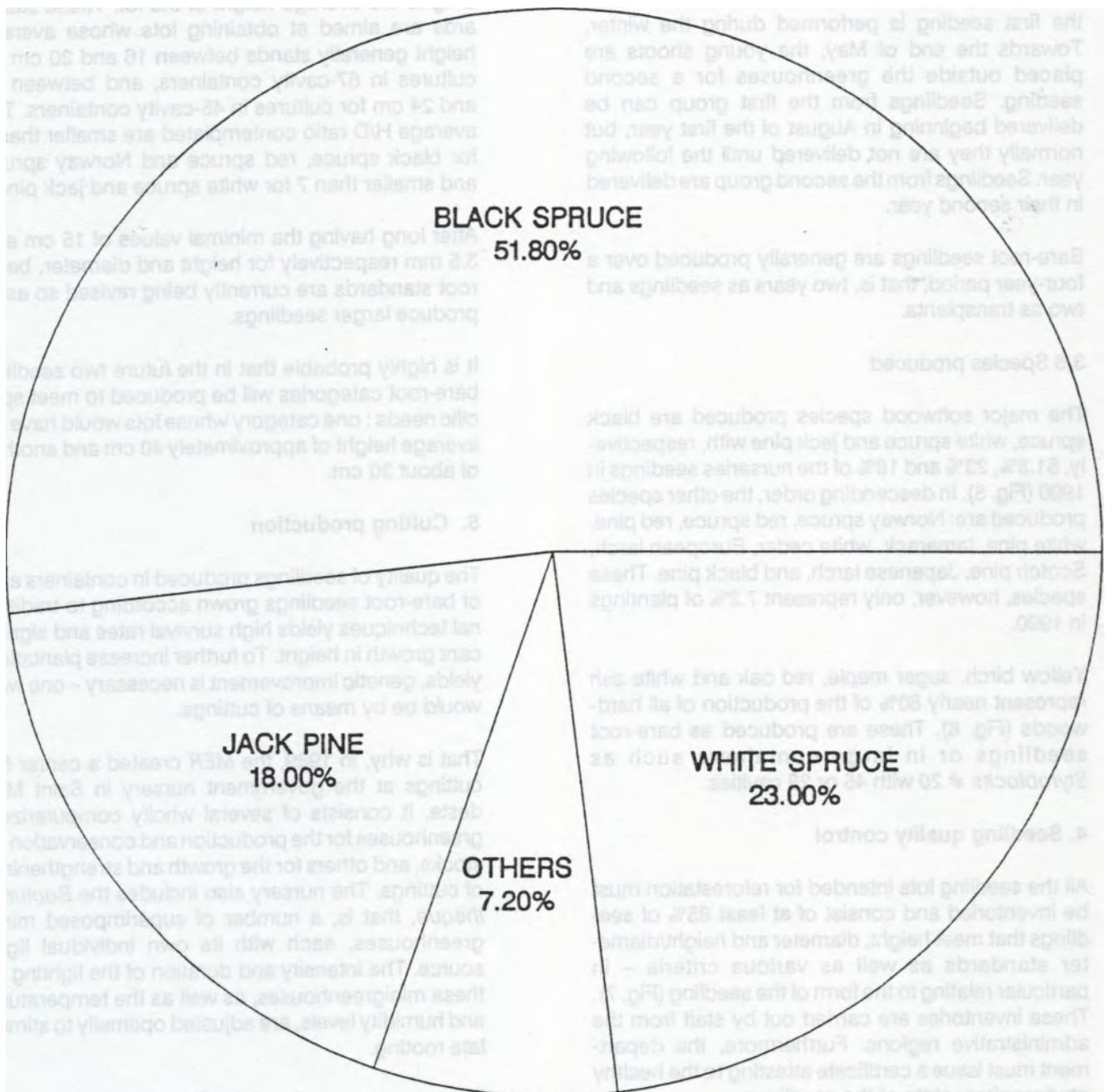
5. Cutting production

The quality of seedlings produced in containers and of bare-root seedlings grown according to traditional techniques yields high survival rates and significant growth in height. To further increase plantation yields, genetic improvement is necessary – one way would be by means of cuttings.

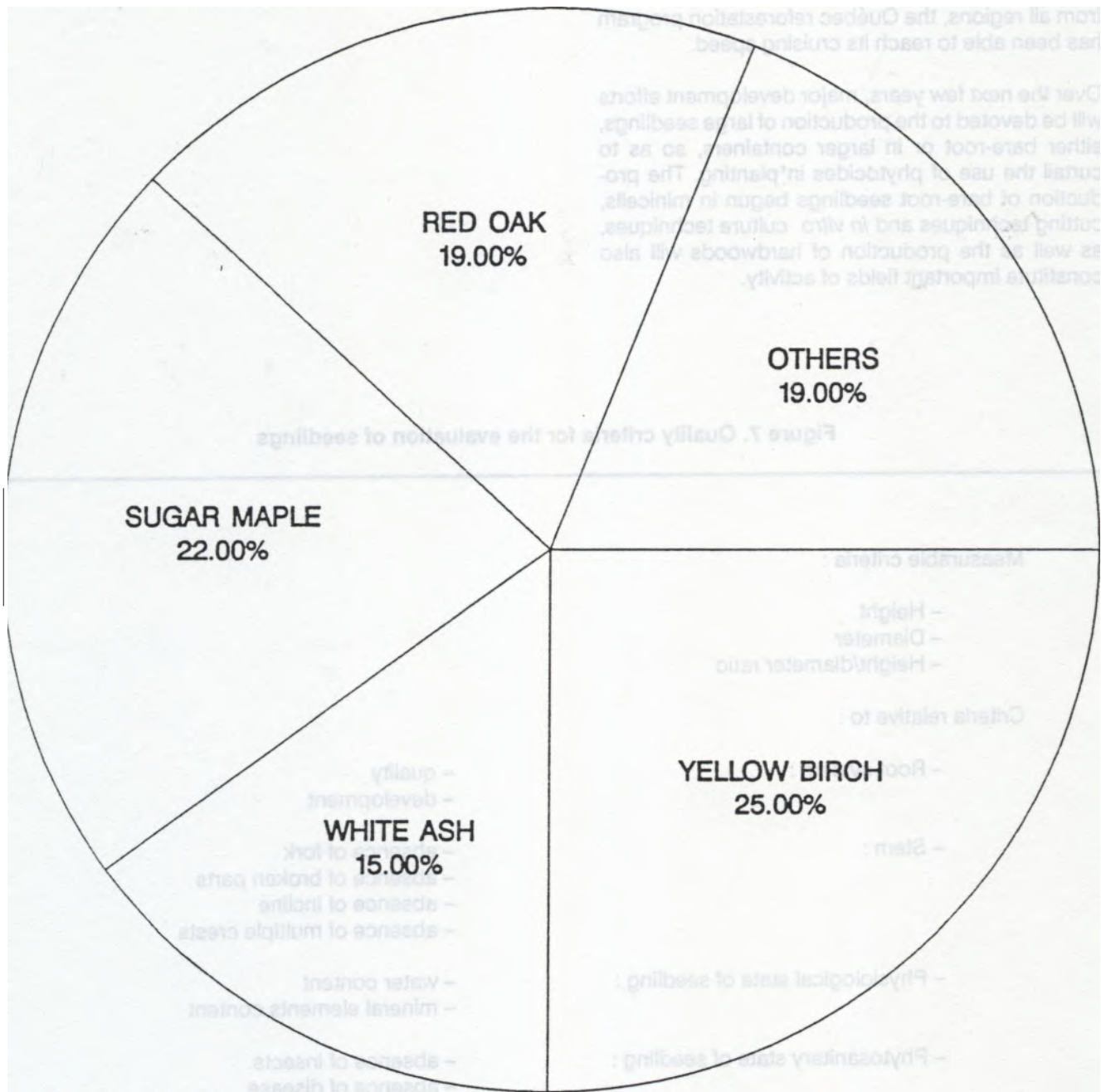
That is why, in 1989, the *MER* created a center for cuttings at the government nursery in Saint Modeste. It consists of several wholly computerized greenhouses for the production and conservation of stocks, and others for the growth and strengthening of cuttings. The nursery also includes the *Bouturathèque*, that is, a number of superimposed minigreenhouses, each with its own individual light source. The intensity and duration of the lighting in these minigreenhouses, as well as the temperature and humidity levels, are adjusted optimally to stimulate rooting.

The current capacity of the *Bouturathèque* stands at about 250 000 seedlings per eight-week rooting period, or nearly a million cuttings per year.

BREAKDOWN OF SOFTWOOD SEEDLING PRODUCTION BY SPECIES (1990 NURSERIES SEEDING)



BREAKDOWN OF HARDWOOD SEEDLING
PRODUCTION BY SPECIES
(1990 NURSERIES SEEDING)



It is therefore possible to reproduce on a very large scale seedlings of superior quality cultivated with seeds from artificial crosses or gathered in tree-seed orchards.

Conclusion

In the past few years, Quebec has developed and improved seedling production techniques and created highly specialized companies. Moreover, thanks to the efforts and competence of these nurserymen from all regions, the Quebec reforestation program has been able to reach its cruising speed.

Over the next few years, major development efforts will be devoted to the production of large seedlings, either bare-root or in larger containers, so as to curtail the use of phytocides in planting. The production of bare-root seedlings begun in minicells, cutting techniques and in vitro culture techniques, as well as the production of hardwoods will also constitute important fields of activity.

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Figure 7. Quality criteria for the evaluation of seedlings

Measurable criteria :	
<ul style="list-style-type: none"> - Height - Diameter - Height/diameter ratio 	
Criteria relative to :	
- Root system :	<ul style="list-style-type: none"> - quality - development
- Stem :	<ul style="list-style-type: none"> - absence of fork - absence of broken parts - absence of incline - absence of multiple crests
- Physiological state of seedling :	<ul style="list-style-type: none"> - water content - mineral elements content
- Phytosanitary state of seedling :	<ul style="list-style-type: none"> - absence of insects - absence of disease