CONTAINERIZED SEEDLINGS AND CANADA'S FOREST RENEWAL

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Abstract.--The role of containerized seedlings in Canada's regeneration efforts is reviewed. The changing emphasis in forest management has given rise to demands for containerized planting stock. Because of these demands there is an increased need for critical analysis of present production techniques and for cooperation between stock producers and forest managers.

Résumé.--Cette communication passe en revue le rôle des plants en mottes emballées dans le reboisement au Canada. Les nouvelles priorités de l'aménagement forestier ont décuplé la demande de plants en mottes emballées et, par ainsi accentué la nécessité d'une analyse critique des méthodes actuelles de production ainsi que d'une collaboration entre les producteurs de plants et les aménagistes.

Seven years ago, Bingham (1974) in his keynote address to the North American Containerized Forest Tree Seedling Symposium suggested that, in forestry as in agriculture, North Americans had "graduated from being guardians of a nature-provided, unmanaged forest to becoming managers of a forest from seed to harvest". In Canada I think our role is more that of exploiter and sometimes protector, rather than guardian, of the natural forest.

There is nothing unnatural or reprehensible in our treatment of such a vast forest resource. It is human nature to exploit and convert our capital into forms deemed most appropriate to society at the time. Roads, schools, the infrastructure necessary for agricultural and urban development all have flowed from the converted capital of Canada's forests. Foresters and others in their professional and technical capacities have rendered the exploitation of our natural forests increasingly more efficient and extensive. In the settlement and development of this country late in the 19th century, agriculture was considered more important than forestry, yet it was also late in the 19th century that the first major concerns about the results of forest renewal and destruction were voiced -- by agriculturists. These people had experienced the loss of productivity in farmland associated with the absence of trees. Erosion and lack of shelter together with a growing scarcity of local fuel-wood were the main objects of such concern. By the turn of the century lumbermen were also expressing concern about the lack of regeneration, and about the destruction, particularly by fire, of the white pine *(Pinus strobus* L.) and red pine *(P. resinosa* Ait.) forests in eastern Canada.

Nevertheless, it seems that each time we have been about to embark on a program of forest management, either a new forest has been opened to exploitation, or a national crisis or economic catastrophe has intervened. As an example of exploitation, I would offer the establishment and development, in the early 1900s, of the pulp and paper industry in the boreal forest of eastern Canada as red pine and white pine lumbering diminished. It was during this same period that the west coast sawmill industry gathered steam, and the logging of Douglas-fir *(Pseudotsuga menziesii* [Mirb.] Franco) forests began in earnest.

In eastern Canada, particularly in Ontario, there were a few foresters who, as a result of their professional background,

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could see that the regeneration and management of forests was the key to a sustained forest economy. They, and a number of politicians and industrialists of the time, were able by the 1920s to embark on a limited program of forest renewal and management. The plantations of Grand'Mere and various parts of Ontario are living evidence of their efforts. The economic depression of the 1930s and World War II put an end to this work and little more was done until the 1950s.

Following World War II, renewed concern about the state of forest regeneration was expressed in several Canadian provinces and a number of Royal Commissions were appointed. There was much debate about the adequacy and standards of regeneration; in fact, the debates among foresters on this subject were almost interminable. In the meantime, the forest industry was mechanizing its logging to such an extent that it became the world leader in the 1960s. Paradoxically, it was the scale and extent of exploitation made possible by mechanized logging and the expansion of these hitherto seasonal operations to a year-round activity that provided the major opportunity for foresters to convince society, and governments in particular, that management of our forests is essential if a forest industry is to be maintained or increased in future decades. This is a major challenge and a continuing one. In meeting the challenge, I believe we have yet to establish the full credibility of our profession. We can do this only by demonstrating our unique ability to provide the professional and technical knowledge and expertise necessary to make efficient management of our forests a reality. Nowhere is our expertise more needed than in the field of forest regeneration.

The productive forest lands of Canada comprise some 3 million km^2; approximately 90% are Crown or public lands. As recently as last year some 12% of this land was considered inadequately stocked (Roberts 1980). The regeneration of even a significant portion of this presents an immense challenge to governments, industry, and the forestry profession.

In rationalizing the renewal of Canada's forests we have to take several factors into account. To most of you these are self-evident, but often we lose sight of them because we become too engrossed in our specific interests or projects. I suggest that we start by considering the basic components of the natural forest which we are putting under management for timber. These are:

1. forest lands which are converted to other uses after commercial logging. Their extent, as a proportion of the original productive forest land base, will vary with terrain, logging system, etc.

2. forest lands which, because of species, size of timber, or overall area, are deemed inoperable for commercial logging by current criteria. These criteria usually change with time and with the needs of the entrepreneur and marketplace. Nevertheless, at any time there is a quantifiable area in this category.

3. forest lands which are logged commercially but, because of their location, site class or extent, or for some other reason, are not considered suitable for forest renewal. This does not mean that they do not regenerate. In fact, the silvicultural prescriptions for harvesting these areas should be aimed at this objective, but only by virtue of the harvesting process itself.

4. forest lands which are logged commercially and require a deliberate cost-effective input to ensure regeneration of desired species to specified standards. These lands require the most attention silviculturally and economically because, if they are to be cost-effective, the input:output ratio has to be known or estimated. Essentially, these lands can be placed in one of two categories, although the boundary between them is not necessarily fixed or sharp, viz.:

   i) lands supporting species which can be regenerated naturally by specific harvesting techniques with or without relatively inexpensive site preparation or seeding. For example, sugar maple (*Ater saccharum* Marsh.), poplars (*Populus* spp.), jack pine (*Pines banksiana* Lamb.), lodgepole pine (*P. contorta* Dougl.), white pine and black spruce (*Picea mariana [Mill.]* B.S.P.) can be handled in this way. Site productivity and condition, seed availability, location and extent of the area, together with the objectives of management, including

rotation and anticipated tending requirements, all enter into the decision-making process.

ii) lands which, because of their productive nature, extent and location, must he artificially regenerated by planting. The key concerns are species control (including genetic control), density control (i.e., spacing), and a rotation age that will maximize productivity in keeping with the objectives of management. It is with these lands and associated species that we should be concerned in the application of containerized planting to forest renewal.

I stress the need for applying different techniques and treatments to different types of land because, in the past, not enough of this was done. Inappropriate use of containerized seedlings in relation to type of land or objectives of management was often a cause of failure or poor growth.

There are two aspects of container planting that are very important hut are not strictly part of forest renewal. These are the regeneration and amelioration of wastelands such as mine spoils, and the planting of stock for amenity, wildlife, or other nonconsumptive purposes. Container production for these two broad-use areas has not been well developed, but will, I believe, assume greater importance in the future.

My first direct involvement in containerized seedling production was in 1966 when Professor R.J. Day and I planted and assessed jack pine seedlings which were grown in the 1.4 x 7.5 cm plastic "Ontario tube". In the 15 years since then, I have had continuing contact with container production and have made observations and assessments of plantations developed from container seedlings in six Canadian provinces. The following remarks are based on this background.

The use of containerized seedlings has caught the attention of many foresters in recent years, and both government and industry now see this type of planting stock as potentially one of the most effective for artificial regeneration. The large tubed seedling program begun by Ontario in 1966 was in many ways in advance of its time. The expertise and knowledge required to grow seedlings and to provide adequate site preparation before outplanting were not well developed at that time and undoubtedly this was a factor in the slow expansion of container planting programs in Ontario. While there is much more knowledge to draw upon today, an important new factor in regeneration planning is the degree to which the forest industry is becoming involved in forest management, especially in planning and integrating harvesting and regeneration activities.

As I mentioned earlier, containerized stock plays a significant role in the regeneration of certain forest lands. If this stock is to be used effectively it must be planned for and integrated into the overall forest management process. Too frequently this has not been the case. The production of containerized seedlings requires seed of high quality and very high viability. It must be germinated uniformly and rapidly, and grown in containers of appropriate dimensions so that it will meet the requirements for outplanting. All this, as most of you know, is easier said than done. Yet it is necessary to make this our objective if we are to do the job properly and establish our professional credibility.

Containers offer the most effective use of limited amounts of quality seed, especially if that seed is from genetically improved sources. Uniformity in germination and growth are key items in the production of such material as has already been mentioned. In Ontario we have begun production of vegetative cuttings on a large scale and for this type of rooted stock, container production is virtually mandatory. For certain genera such as *Picea* and *Larix* I believe that vegetative propagation in containers of genetically improved stock will become the main method of production.

It is not my intention to dwell at length on a comparison between bare-root and container stock, although there are certain basic advantages to containers. These advantages may be cancelled out, however, if the planting stock, rooting medium, type of container, cultural practices and related management practices are not matched to time of outplanting, outplanting conditions, and purpose for which the stock is being produced. inevitably, man and nature in their perversity will force compromises. Changes in plans and even catastrophes will occur, but the fact that they do should only serve to emphasize the necessity for clearheaded professional planning to ensure built-in safeguards to prevent or minimize the effects of such adversity. Keep in mind that, operationally, one of the most important advantages of containerized seedlings is that their performance is, or should be, superior to that of bare-root stock.

The prime biological advantage of container stock over bare-root stock is that the root system of the former is packaged and protected. The type and size of container, therefore, have to be chosen with regard for this fact. There is no point in growing seedlings in a plug-type container and then shipping them out to the field before the root systems have developed to the point at which the plug can be handled by the planter without disintegration. Conversely, holding over containerized stock so that the roots grow from one container into another not only leads to root damage but can also mean unnecessary expense and time spent in separating them before they are shipped or planted.

The nature of the rooting medium itself has received considerable attention from the standpoint of seedling growth but very little, to my knowledge, in terms of the physics of soil water movement between the container, its contents, and the soil in which it is placed. For a majority of forested soils this is probably not a critical feature, but I suspect that, in the reforestation of certain types of mineral materials such as mine spoils or tailings, the cause of failure can be traced in several instances to a mismatching of pores between those of the container and those of the surrounding soil, with a consequent loss of hydraulic conductivity.

One topic which continually arises with respect to container stock and its outplanting success is that of root development in relation to the type of container. I would like to bury once and for all the myth of "root strangling". Roots do not have suicidal or murderous tendencies. They grow in a simple biological manner. The anthropomorphic view of roots which has developed is totally without foundation. Vigor of root development and root symmetry are important, but let us judge them in light of the full development of trees and stands, not in terms of whether straight, uniform lines in a container appeal to us. The soil in which the tree has to grow is usually heterogeneous and anyone who has observed the roots of trees in natural stands will soon be disabused of the notion that they grow uniformly or in straight lines.

The cultural practices associated with container planting are, I believe, the most important area in which we have not advanced significantly. There is no substitute for the proper application of knowledge and expertise or the keen observation and judgment of properly trained and motivated people. Too often we assume that sophisticated controls will compensate for inexperienced, untrained people who obey a fixed set of instructions. This just isn't so. I am not opposed to the intelligent use of equipment, which in certain instances may be quite sophisticated, but let us use it wisely and sparingly.

This leads me to a final observation. Historically, in Canada, we have looked to the various provincial forest services for the provision of seed and planting stock. This is still the case, but I believe that, with all due respect to those government employees who have been involved in provincial nurseries, motivation, incentive and exchange of information have too often been lacking. These are more likely to be fostered if more than one organization is in the business of growing stock. In provinces with several nurseries, exchange of information and the stimuli to innovate are possible, but where there is only one nursery they are less Likely.

In recent years, production of containerized seedlings by the private sector -- both individual growers and forest companies -- has increased. In many instances these private growers are producing seedlings under contract for a provincial forest service. I view this development as a healthy one. It means that the production base is growing and also is being diversified. The challenge for forest renewal is here. If the owners of the land and those responsible for maintaining its productivity are to meet that challenge, you who produce and use containerized stock -- whether at the scientific, professional, technical or operational level -- have a formidable task ahead.

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