# THE INFLUENCE OF FORESTRY TRENDS ON NURSERY OPERATIONS

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## INTRODUCTION

No matter how good the seed, or how good its genetic potential, the success of a planting program is always greatly dependent on the quality of the trees produced in the nursery. Physiological conditioning of nursery stock has both short-range and long-range effects. For example, a heavy fertilization late in the season can produce "saleable" seedlings that may later be easily killed by drought or freezing weather after outplanting. The effects of nursery conditioning (physiological condition of the seedlings) was continually emphasized by specialists such as Phil Wakeley who also showed the effects can last for many years after planting. Similar results have been observed in our extensive field tests; for example, we have an absolute rule to never establish a test with seedlings produced in different nurseries.

This paper will briefly cover the effects of new forestry trends on nursery operations. The message of importance is that nursery practices play a critical role in successful plantation establishment and growth no matter what the trends in forest management. Additionally, new forestry methods will result in some changes in nursery operations.

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## WHAT'S NEW!

### In Tropical Areas

The relationship of field operations and nursery procedures is key in tropical and sub-tropical areas where changes take place rapidly. Sometimes changes in forest management strategy are massive and rapid.

1. In order to mechanize and to speed up operations and save cost, there is a strong move in the tropical areas to change as rapidly as possible from the conventional containerized seedlings now widely used to bare-root or semi-bare root stock. Semi-bare root refers to dipping roots in a mud slurry, a method that has proven to be very successful and is in widespread use. Some species, like P. caribaea and P. radiata, appear to respond well to bare-root planting, while others such as P. oocarpa, Cupressus lusitanica and most of the Eucalyptus are not so well suited to its use. Bare-root planting in the tropics is difficult for several reasons:
   a. Trees in nurseries in the topics often grow very rapidly in height resulting in a poor top-to-root ratio.
   b. The planting season is often during or near the dry season, with only seedlings in the best physiological condition able to survive and grow. Drought can be very severe and of long duration; this is especially serious in the deep sands and the very heavy clays which often shrink (and crack) to a frightening degree.
   c. Day temperatures usually are very warm, often with low relative humidity and strong drying winds. Some organizations have partially overcome these conditions by doing bare-root planting at night.

d. Growing conditions in the nursery are often so ideal that it is difficult to suitably harden-off seedlings prior to planting. The nurseryman's efforts to produce well balanced and physiologically suitable stock are often thwarted by nature. If there were ever a challenge to the nurseryman's skill, it is the developing of suitably hardened plants under these conditions.

2. Planting programs in the tropical areas have in many instances become very large and the old "backyard" concept of a small nursery for every planting location is rapidly changing. With the need for large numbers of seedlings has come the necessity for mechanization and specialization in nursery operations, currently nearly totally lacking in many operations.

3. The planting season may be year-round in some areas making the concept of a "one crop a year nursery" obsolete. An extreme example is in Esperito Santo, Brazil, where one company I work with plants containerized eucalypts all 12 months of the year. The need for removal of seedlings from the nursery is continuous and a new crop is sown approximately every two weeks.

4. Mycorrhizae are often lacking or are found in limited numbers. Some nurseries have special "mycorrhizae beds" (pine plantings) from which duff or soil is put on the trees in the nursery beds or on/and in the containers. Pure cultures of mycorrhizal fungi such as Pisolithus tinctorius are occasionally being used. Lack of mycorrhizae is a major problem in tropical plantations, and must be of major concern of the nurseryman. Too few nurseryman have a viable working concept of mycorrhizae and their management in the nursery.

In Northern Areas

Similar to the tropics, much of the stock recently produced in the northern regions has been containerized. It has taken so much time to grow bare-root stock such as spruce or fir (2-3 or 2-2 stock is not unusual) using the old methods that an inordinate amount of time, and thus nursery space and cost, was involved. The long period between sowing in the nursery and outplanting in the field is critical, making planning of regeneration programs difficult. Containerization, plus the use of plastic houses, have resulted in the production of good seedlings in a shorter time period. As planting programs continue to rapidly increase in size, (such as in New Brunswick, Canada), the logistics of producing sufficient containerized trees becomes very difficult. The current trend towards better site preparation, more planting mechanization and an increasing use of jack pine, larch and black spruce (as opposed to red and white spruce) has resulted in a greater emphasis on the production of bare-root seedlings in a reduced time period. Great success has been achieved; for example, fine 2-0 pine are now produced in Saskatchewan. The challenge to the nurseryman is to get physiologically suitable seedlings to a satisfactory size in the shortest possible time to enable the mass planting programs to function efficiently.

The better knowledge and techniques of nursery practices, and increasingly large regeneration programs, will dictate more emphasis on bare-root planting in the colder latitudes. This will not only require more skills by the nurseryman, but better choice of nursery sites combined with the use of better genetic stock and better seed. Mycorrhizal management, as well as fertilization, will be essential to produce seedlings with the survival and early growth so essential in the severe environments in the north. The kind of management methods now being increasingly employed, with their attendant high costs,

cannot tolerate poor or spotty stocking in plantationsestablished on the best lands.

In the Southeastern U. S.

I see little radically new in our area, but certainly some major refinements of current techniques will be essential. The current methods must be modified as follows:

1. To obtain the highest plant to seed ratio possible. With the almost universal use of genetically improved seed, loss of large numbers of seedsin nursery operations can no longer be tolerated. Nursery bed densities will need to be reduced with great care being taken to enable seedlings to become plantable. Even though it may sound "far out" to some of you, sowing seed in the nursery bed by clone or family will probably become more general because it enables a much more efficient biological handling of the nursery operation. Seeds of the same size, germinate at the same rate and respond to stratification in the same way. We find, for example, that seed of some loblolly pine mother trees react adversely to stratification. Only by handling as discrete seed lots can this information be used. Such special planting is now being done by one large organization in the South and appears to be very successful.
2. To ensure optimal survival when field planted. Although this meeting is not the proper place to discuss desired plantation spacings, all spacings used in an extensive plantation program require complete stocking; this requires the seedlings to be physiologically and genetically the very best for the planting chance. The role of the nurseryman is key here--no matter how good is the seed potential, sloppy nursery practices

resulting in a seedling in poor physiological condition can result in poor survival and poor initial growth. I recently visited several nurseries in which the seedlings had not developed well, so the nurseryman gave them "a shot of nitrogen late in the season" to make them plantable. Such practices result in succulent seedlings that usually have a poor field performance and are inexcusable for a good nurseryman. Additionally, survival and early growth on many sites relates to the condition of the mycorrhizae of the seedlings roots.

3. More care must be taken than in the past to prevent lifting the seedlings when they are in a physiologically unsuitable condition. As planting programs become increasingly large, strong pressures are present to expand the planting season, both earlier and later than normal. This has resulted in some rather horrifying fiascos, such as lifting before the seedlings are physiologically ready or after the plants have started active growth in the spring. I submit that these can be lessened when the nurseryman learns that the whole nursery need not be planted at one time as a single unit. One of the greatest challenges to the nurseryman today is to learn to seed in the nursery at differing times and to manage the seedlings in different ways so they will become suitable for outplanting at different times enabling more efficient forest management. Even the suggestion to use differential planting times and to adjust nursery management techniques to harvest crops at different times causes consternation with many nurserymen, but I know of no one challenge (opportunity) greater than to really manage the nursery so seedling production is fully compatible with field planting needs. Today, the general pattern is to produce seedlings at the convenience of the

nurseryman who then tells the forest manager "here they are--do what you can with them". The expanded regeneration programs will make this narrow approach by the nurseryman no longer tolerable. Developing suitable plants when needed will take real skill and trial and error testing, but it appears to me to be one of the greatest current needs of nursery activities caused by increasingly large regeneration programs. Production of physiologically suitable seedlings several times a year from a given nursery is a major challenge to southern nurserymen and one they have generally ignored or said couldn't be done. If the trends toward expanded forest management and increased planting programs are to be successful, this must be done, through timing in nursery activities and changes in management methods.

4. I do not foresee containerized seedlings playing a major role in southern pine or hardwood forest nursery operations. They will be used for special conditions, but always on a limited scale. A seedling in good physiological condition, handled correctly with the roots protected by methods such as clay slurries, has most of the supposed advantages of a containerized seedling plus being easier and cheaper to produce. I do see an expansion of containerization for very slow starting species such as Fraser fir and possibly white pine for which vigorous, well developed seedlings can be produced in a much shorter time with containers compared to using current standard nursery methods. I would not be surprised to see the use of numerous, small and inexpensive plastic houses (as used in Finland) near the planting site when containerization is more suitable rather than the larger more expensive greenhouses now often in use.

## SUMMARY: THE FUTURE! THE PREDICTIONS! THE OPPORTUNITIES!

If one wants to live dangerously, he will predict what will happen in the future in forestry--or in nursery methods. However, a non-specialist in nurseries such as myself has the advantage of not knowing what the traditional nurseryman says can or cannot be done--therefore, I don't even blush to walk where "fools fear to tread" and make predictions about the future. For your consideration, therefore, some ideas from a non-nurseryman of what can or should happen to nursery operations resulting from changing and predicted forestry trends are presented:

1. In the tropical and sub-tropical areas, pines such as P. caribaea and P. radiata will be planted largely bare-root to enhance mechanization and reduce costs; other species will be handled using a modified bare-root system. In addition:
   a. Nurseries will become larger, more centralized, more mechanized and more efficient. In many instances, single crops of seedlings will not be grown, but several will be produced during the year to coincide with planting opportunities. In some special situations nursery sowing may be as frequent as every two weeks.
   b. A great deal more and better mycorrhizal management will be done to enhance better nursery growth and field survival.
2. In the northern latitudes (Canada, Northern U. S.), there will be a trend towards planting black spruce, pines and larch, and a trend away from the white and red spruces. This makes feasible the production of more bare-root seedlings and less containerized seedlings. Better care in nursery location and management operations and timing will result in production of bare-root seedlings as 2-0, 1-1, or even 1-0 stock, currently not considered to be possible.

3. In the South, there will not be a movement towards large scale containerization in either pines or hardwoods; containerization will probably become more widespread for special problem sites or for initially slow growing species such as Fraser fir.

   a. A major effort will be made to improve the plant to seed ratio. This will require nursery beds with lower densities or radical changes such as nursery sowing by clone (or family) for better plant to seed ratios and more uniform nursery seedlings.

   b. Better handling and better seed will be necessary to ensure optimum survival and good initial growth, an absolute necessity with intensive forest management.

   c. Methods will be developed to extend the planting season by producing physiologically suitable seedlings plantable as needed rather than produce a single crop all of which is available at one time.

4. In the future, forest management intensification and specialization will continue requiring regeneration in times and places not now considered feasible. Nurserymen must rise to the challenge so physiologically suitable seedlings will be available when needed at a reasonable cost.