ARE BARE ROOT NURSERIES OBSOLETE?

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To answer that question in brief, no, bare root nurseries are not obsolete. For those functions that they perform well, they will continue to be used. Where they fail, they will be replaced.

Objectives

Before we can decide whether any concept or operation is obsolete, we must state our objectives. In forestation, our objective is to obtain high survival, rapid growth, and greatest economy measured in cost per established tree. Those are the objectives, and everything said from hereon is a means to that end. In order to come to a decision, we must discuss the total system, which includes the genetic base and physiological condition of the trees, the handling logistics and economics in the nursery, transportation, planting, and maintenance care. With respect to each of these items, let us see how the greenhouse container system compares with the bare root nursery.

Genetic Base

Tree improvement is still in its infancy compared to agricultural crops, especially in northern climates. The sequence is something like provenance test, seed production areas, seed orchard, controlled pollination, grafting, rooted cuttings and the like. As tree improvement progresses, there are two characteristics of the genetically improved propagules. They are not plentiful, and they are expensive. Losses in the greenhouse container nursery are much smaller than in the bare root nursery. This is because of the increased degree of control over the total environment, especially disease, insects, spacing, and weeds. Loss after outplanting also tends to be smaller. The higher survival and faster initial growth rate is due to the intact rootball and better physiological conditioning of the greenhouse container grown tree.

Physiological Condition

When the seedling leaves the nursery, it must be ready to meet its new environment, that is, do what is necessary to survive. Its first job is to establish root contact with the soil. After that, it must grow in height and dominate competing vegetation.

The bare root seedling has lost all contact with the soil, and has lost a portion of its fine roots. There is no way to replant a bare root seedling as well as it was originally planted in the nursery.

Usually the roots are pressed into a two dimensional spray. Even dead roots can function for a while to absorb moisture, but the volume of soil to which they have access is very limited, especially at soil moisture levels below field capacity. Therefore, new roots must grow into the surrounding soil, and this puts a premium on the bare root seedling having a high root regenerating potential, which in turn limits the time during which the seedling can be lifted.

The container-grown seedling, on the other hand, should lose practically none of its roots during removal from the nursery, shipping, and planting. Furthermore, container seedlings are outplanted with little or no change in the intimate contact between soil and root. More then anything else, it is the intact and undisturbed root system that accounts for the superior initial survival and growth of container over bare root seedlings.

Height growth is not desirable until root growth is well under way. Yet, as we all know, bare root stock is frequently damaged by lifting late and by improper transportation and storage which allow the seedlings to become warm. With hardwoods the usual practice is to top prune to bring them into balance. This is okay, because hardwoods sprout readily, but it is a poor practice on conifers. Damage to the apical bud on conifers is serious, because loss of apical dominance can delay height growth for several years, which increases the chance that the tree will succumb to competition. Even if not top pruned, there are several ways in which damage may occur. If proper rearing procedure is not followed in the nursery, the buds may be small, immature, or not capable of breaking. Buds may be damaged by careless handling in the nursery, in shipment, and in planting. High moisture stress after planting may kill the bud, or at least prevent it from breaking. The latter may be just as serious as an outright kill, because buds that do not break on schedule may degenerate. Bare root seedlings are likely to be more highly stressed, and therefore, lose more of their buds than container stock. The intact root system of container stock, however, does more than simply permit the tree to continue water absorption. The root system produces hormones which are necessary for the health and growth of the top. Damage to the root system reduces or delays hormone delivery. Container seedlings not only leave the nursery with adequate internal mineral nutrient and food reserves, but they have access to an external supply of moisture and mineral nutrients several times larger than possessed internally. This is important. Since food reserves are required for root growth, and high temperatures and moisture stress may cause respiration to be greater than photosynthesis, the larger the initial food reserve, the longer a seedling can tolerate a net loss. Also, the less the stress, the *less* the loss.

Handling Logistics

A. Nursery. The bare root nursery is a farm. It requires level ground and lots of it. It requires the right soil and lots of water. Crop success is a function of weather. Crop growth rate is dependent on the length of season. Crops are most readily grown for spring planting especially in northern climates. At low elevations and further south, fall planting can be done, but few bare root nurseries can have stock ready to plant in midsummer.

In contrast, the greenhouse container nursery is a factory. It can be located anywhere, and would generally be most useful either close to a supply of skilled labor, or close to the point of utilization of the product. It does not take up much space, because its per acre seedling densities are much higher than a bare root nursery, and will produce several crops on the same piece of ground in the time that it takes to produce one crop in the outdoor nursery. Because it is enclosed, it uses only about 10% of the water needed in a bare root nursery. Crop success is not dependent on the weather. You create your own weather conditions indoors. This means that you should have more assurance of being able to deliver a crop at a given time. The nurseryman has little control over the weather, but there is no excuse for mechanical breakdowns. The accelerated growth rate in the greenhouse nursery means not only more crops in the same length of time on the same piece of ground, such as shelterbelt size trees in 6 months, or walnut seedlings in 6 weeks, but makes it much easier to produce seedlings on demand. The crop can be ready to plant almost anytime, and with the container seedling,, we can successfully plant spring, summer, and fall, provided field conditions are satisfactory. Down South, we may plant all year around.

B. Transportation. The bare root seedling has the lowest bulk and weight possible. Nothing but tree is shipped. No special shipping facilities are needed, but refrigerated storage and refrigerated vans are highly desirable. On the other hand, bare root seedlings are susceptible to damage from drying and overheating at any stage between lifting and planting.

In contrast, the container grown seedling is relatively high in bulk and weight. It needs special boxing, racks, or repackaging for shipment, but it is quite resistant to damage, because first, the root system is in a container and protected mechanically; second, it carries an external supply of moisture which keeps the tree from drying out much longer than if it had to rely on its own internal moisture; and third, the packaging or racks make apical bud damage much less likely.

C. Planting. As in transportation, the bare root seedling is low in bulk and weight, which means that the planter can carry a lot. In the West, where hand planting is the rule and sites are often steep, rocky, or littered with debris, the ability to carry a large number of seedlings may be important. On the other hand, as in transportation, bare root seedlings are susceptible to damage, and in the planting process it is easy to J-root or wad up the roots.

Container trees, on the other hand, are higher in bulk and weight. This means that the planter cannot carry as many, and especially with hand planting on adverse terrain, it compounds the problem of getting the trees to the planter. On the other hand, in areas where trees are machine planted, the machine can ordinarily be made to carry as many trees as needed. Furthermore, container trees are much more resistant than bare root to extremes of temperature and susceptibility to drying. This is probably more important at the planting site than anywhere else, because here the bare root seedlings are removed from cold storage, unbundled, and the entire tree exposed to the elements for varying lengths of time depending on the diligence of the planting crew. But it is only with great care and determination that a container tree can be planted

wrong. It comes equipped with a standard size and shape of root system without any loose roots hanging out. The planting tool or machine makes a hole which is designed to fit the plug well. The main problem right now, is lack of familiarity with container stock on the part of the planting crew. Once they become accustomed to it, container stock is just as quick and easy to plant as bare root stock. In fact, on the west coast, they report planting rates two to three times what they are for bare root stock.

D. Maintenance. In the reforestation of logged-over areas, there is usually no maintenance beyond site preparation and planting, (and in that respect may not be very different from many plantings on the Plains). The bare root seedling is usually a slow starter. The weeds get ahead and overtop the seedling. Although this may not kill the seedling in the first season, it will reduce its vigor and reduce the size of flush that it is capable of making the following year. Repeat this for several years and survival will be affected as well as adding years to the rotation age.

In contrast, the spring planted container seedling will normally put up a good flush the first year, and thus has a better chance of staying ahead of the weeds. In situations where maintenance is desirable, such as almost any planting on the Plains, there is a psychological factor involved. A landowner is not motivated to care for a planting with poor survival and slow growth. He is likely to hit the trees, because he can't see them from the tractor. If the trees do not emerge from the weeds for several years, the whole planting is likely to be written off and plowed under. However, if he can see the trees growing, he will be enthused, and take better care of them. Although container grown seedlings should have the same maintenance as bare root, the container grown tree is more likely to get it.

Economics

Compared to the bare root system, the greenhouse container system gives the nursery better use of expensive seed, more assurance of success, and flexibility with respect to rotation and nursery location. In the field, it gives resistance to mishandling, extends the planting season, and gives better survival and initial growth. Compared to the bare root system, the greenhouse container system costs for an equivalent tree, 1 - 2 times that of the bare root seedling. It costs more to transport, but it should plant for the same price or less, once the crews know how. Beyond the initial establishment, an increase in survival rate reduces the original number of trees that must be planted, and may eliminate a replanting. The combination of high survival and rapid initial growth rate may subtract years from the production of a usable product, whether it is wood fiber, or a protective windbreak.

Are bare root nurseries obsolete? Put your own price tag on all of the foregoing benefits and costs, and answer that for yourself.