Forestry Technology #2

Essentials of Good Planting Stock

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The extent of the world land base that is being reforested or afforested is significant and is growing still. Unfortunately, several of these efforts are wasted in planting poor quality trees. While some problems are beyond the forester's control--poor weather, insect attacks, disease outbreaks, animal browse, and the like--others fall within the forester's influence. Two such areas are seed collection (which was dealt with in Forestry Technology #1 -- the previous issue of this Bulletin) and planting stock preparation and selection. Measures outlined in this bulletin provide basic guidelines that will help the forester ensure a cost-effective means of producing high quality seedlings.

A Measure of Quality

The basic goal of having quality seedlings is to achieve the best growth possible and have the highest amount of desired outputs. Outputs can be timber, food, fuel, fodder or other uses such as site improvement. Seedling quality is gauged by two factors: one, by the genetic make-up of the parent stock and secondly by the physical growth, which is influenced by the seedling's immediate environment (i.e., nursery conditions and practices).

Selection for desirable genetic traits takes place in the field at seed collection sites. When done properly, field selection will provide the best possible seeds, containing the desired inherent traits seen in the parent stock. Care in seed selection and collection will also reduce the amount of undesirable stock coming from physically poor or damaged seed. Aside from genetic traits, a seedling also displays physical traits including sturdiness, good form, health and vigor. Many of these traits, which are affected by nursery practices, are within the forester's control.

Benefits Outweigh Extra Cost, Effort

Nursery-grown stock requires investment in infrastructure, staff training and skilled management. The level of these costs relate to the type of nursery stock produced, species growth responses and the number of trees produced. But, the potential benefits of good nursery practices far outweigh their costs. For instance, properly developed seedlings stand a better chance of survival both in the nursery and when replanted in the field.

In the long term, quality stock will also produce a faster, higher return for the desired outputs. These outputs may include products such as fuelwood, building materials, industrial cellulose, animal fodder, erosion control, and soil and microclimate improvement. Given these benefits, seedling costs are a small portion of the end-product value of plantations. Conversely, slackened efforts at ensuring stock quality will result in lost opportunity throughout the life of the plantation. Low-quality seedlings will experience slow growth after transplanting and add to weeding and maintenance costs. In addition, the trees will be less able to resist disease and insects and will have smaller product yields.

Poor plant quality will result in uneven development throughout the nursery and increase costs through excessive culling needs. In addition, suboptimal quality will increase the risk of losing the seedlings, requiring a renewed effort or, at worse, cancel the project due to lack of adequate seedlings.

Common Principles

Regardless of the size of the tree planting effort, several common techniques can be applied to ensure the best planting stock quality possible. The techniques are applicable across a wide range of climate and soil variations.

The application of good practices must begin when the project, large or small, is planned and must continue through to outplanting in the field. In all cases, everything that can be done, should be done, within reasonable limits of time and capital constraints.

Seeking Optimum Growth

To ensure quality stock, a series of steps must be followed beginning with the planning stages and carrying through to outplanting in the field. Oftentimes foresters or nursery managers focus their efforts on only a few steps of the process. Under such circumstances, nursery stock may still grow. But the omission of any steps will slow the seedlings' progress and produce stock of suboptimum quality.

Such marginal results are unacceptable in light of the time and costs required to produce a forest crop. In fact, the best nursery managers take the trouble to visit field plantations and take pride in the way their plants have responded to the harshness of the real world. To ensure quality

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Identifying Weaknesses

Lack of knowledge may be the greatest hindrance to producing consistent quality in growing stock. Indeed, due to the rapidly expanding planting programs, many foresters have never seen a truly high-quality seedling population. Small-scale projects that have minimal resources are particularly vulnerable to lack of proper information for nursery planning, management, operations, and problem solving. Such information voids may be further compounded by inexperienced labor or lack of supervisory skills. Again, because of the lengthy time frame involved between field planting and harvesting, there is little room for error or omission in nurseries.

Producing the Best Possible Plants

The forester must keep the primary objective in mind: to grow the best possible uniform seedlings, for the highest plantation outputs, for the least possible cost. Of course, cost and seedling quality must be carefully balanced. The best plants are derived from consistent nursery practices that produce uniform growth throughout the seedling crop. Such practices include all the elements involved in nursery operations--watering, soil mixes, root pruning, weeding, and the like. The demands of planting schedules alone leave little room for inconsistencies. For example, if seedling growth is not carefully monitored, so that abnormalities can be detected and corrected, seedling development may vary widely.

As a result, some stock may be underdeveloped when planting season arrives and the opportunity for using the stock will be lost. Moreover, it is a fallacy to believe increased watering or fertilization schedules can correct the inadequacies of genetically poor stock that *appears* underdeveloped. A nursery manager can compound the problem if he keeps these underdeveloped seedlings for later use when "they are big enough." This is wrong. Never plant seedlings which have been held back for extra time.
What does good planting stock look like?

The prime targets are plant uniformity and health. Uniformity means there are few differences from plant to plant in height, stem thickness, the number and relative size of leaves. Health refers to both color and damage. Leaf and stem colors are often characteristic for a species and damage should be easily identified because parts may be eaten by insects or discolored by fungi.

Careful Planning is Crucial

To be successful, nursery establishment and operations must be well

coordinated efforts that flow smoothly from one step to the next. Each step relates to the plants' needs in order for them to produce the best possible growth when outplanted. Proper planning and plant monitoring are vital to that effort. Without a clear plan to guide him, the forester can quickly fall behind schedule if unforeseen factors demand his immediate attention.

The following sections detail a three-part planning guide to raising quality seedling stock. The sections review container types, planning the nursery, and organizing its operations.

A case for root trainers

For decades tree nursery managers and organizations worldwide have relied heavily on plastic pots or poly-bags because of their low cost, apparent simplicity and convenience. However, this simplicity can be deceiving because management of poly-bag plants requires intensive supervision and care. Such containers have inherent problems, which may not appear in out-planted trees until several years after a plantation has been established. Most notably, poly-bags hinder proper root development, including lateral roots, and tend to produce spiraled roots. The result is restricted growth, poor resistance to stress and windthrow and, in some cases, early demise due to ensnarled root masses or pathogens. Poor management practices, such as improper potting mediums, uneven watering and lack of root pruning, further stress the plants.

One corrective measure is the use of root trainer systems. These systems use rigid or semi-rigid containers with internal vertical ribs, which direct root growth straight down rather than permitting spiral growth. The containerized plants are set on frames above the ground resulting in air-pruning of roots as they emerge from the containers. Equally important, the latest containers are designed to encourage lateral root development. The lateral roots exit the container and are controlled either by air or chemical pruning.

Studies have shown that root trainer-grown seedlings have more vigorous and rapid root growth than seedlings grown in poly-bags. Outplanting survival is greatly increased and, more important, long-term survival is ensured. Root trainer systems produce further benefits in simplifying nursery operations such as disease and insect control, transportation and handling, and monitoring and sampling. Also, the reusability of root trainer containers offsets their initial higher costs when compared to poly-bags. But note, when considering the root trainer system, the nursery manager should recognize that all nursery practices may need to be redeveloped to meet the container's use requirements. Root trainers are not simply a different type of container, but an entire cultural system that must be adhered to for success.

Nursery site selection, preparation

Depending on the type and duration of the project, tree nurseries may be either temporary or permanent. Temporary sites are preferred for small, short-term projects, such as establishing erosion control in a limited area or planting windbreaks for a set of fields. In this case, nursery construction can be done on a small scale using such disposable materials as cut thorn bushes for protective fencing. However, the same level of attention is required for the plants' needs regardless of nursery size.

Permanent nurseries supply seedlings for ongoing programs like area reforestation, commercial plantations, village shade trees, fuelwood plantations, or agroforestry. In either case, the forester or nursery manager must consider where the nursery will be located in relation to the total planting area. Ideally, the nursery should be built in a central location with easy access to the desired project sites. Other factors include access to roads for transportation of seedlings, people and supplies. An ample, reliable and consistent water source must be located nearby. And, if possible, the site should be near a settled area to have a source of workers, materials and for security.

The area should be level, or have a slight slope for water drainage. Basins or other low areas should be avoided as these will collect water at the low points and inhibit proper growth. Low areas also tend to have more insect and disease problems.

Site selection varies by nursery type

Different types of nurseries require different site selection factors. Bare-root nurseries need to be carefully located in suitable soils to provide for optimum root development and growth. Loose, deep sandy clay loam soils are preferred. Also, a system for proper drainage is essential in preventing root growth stagnation due to standing water. When faced with growing bare-root stock in poor soil areas, some measures can be taken. Poor soils may be too hard for water to penetrate, too sandy to retain water, or are nutrient poor.

Soil improvement includes loosening the soil either manually or mechanically to allow for better water penetration and absorption. Additionally, compost materials made from decaying vegetation and animal manure will provide nutrients and help keep the soil loose and aerated.

In comparison, containerized nurseries are easier to locate because the potting medium can be brought in from a number of sources. It can be either mixed on or off-site with the required ingredients.

A simple test for hand texturing soils

To identify soils, a simple test can be done using just a small soil sample that is squeezed between the thumb and forefinger.

A sandy loam soil contains much sand, but has enough silt and clay to make it somewhat cohesive. Individual sand grains can be felt and seen. Squeezed when dry, the sample will form a cast that readily falls apart. Squeezed when moist, a cast can be formed that will bear careful handling without breaking.

A loam soil contains a relatively even mixture of different grades of sand, silt and clay. It is somewhat gritty yet fairly smooth to the feel. Squeezed when dry, it will form a cast that can be handled quite freely without breaking.

When moist, clay soils can be squeezed into ribbons that are long and flexible. Such soils must be avoided as they will inhibit proper root development and moisture absorption.

Good nursery design improves workflow, production

Essential parts of the nursery layout include a water storage source and location with siltation facilities if needed, shade for young seedlings (and nursery workers), adequate space for nursery beds and pathways, driveways and turnaround areas, storage areas for tools and equipment, soil mix stockpiles, fencing, gates, fire buffers and clear areas.

When planning any nursery it is important to have a "materials-flow-chart" or plan indicating how materials enter the nursery, how they move within the nursery and how they leave the nursery. Basic materials are: water, tools, seed, containers, potting mixture ingredients, etc. In addition, the site should also have additional areas set aside for expansion if demand increases and for cutting orchards if vegetatively propagated planting stock is to be raised. For containerized nurseries, pots are best arranged on raised beds with side supports for the plants. However, if ground-level beds are chosen they should be of gravel or some free-draining material. Pots can be placed in rows of 12 to 15 pots wide, depending on pot diameter, or an easy arm's reach to the center of the bed to facilitate weeding and other operations.

However, as discussed in the previous section, the use of plastic pots, or poly-bags, is highly discouraged as several serious problems may arise. Such problems could place any project in jeopardy at the nursery stage or even a much later date. For best results, root trainers are the preferred method. Root trainers are more than just a simple container, but include an entire system that promotes proper root development and growth. When root trainers are used the beds can be raised well above the ground to facilitate aerial root pruning and easier growth monitoring.

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Site comments and suggestions

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