Chapter 2

Nursery-Site Selection, Layout, and Development

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Abstract

Because no potential nursery site is perfect, site selection inevitably requires compromise. A three to seven-member selection team should be given responsibility for establishing and ranking site-selection criteria; climate, soil, water, topography, previous land use, production potential, land availability and cost, and proximity to services are key considerations. Potential sites should be visited and evaluated and the best site chosen. A development team should then lay out the nursery, formulate an action plan, and document current development and possible future expansion in a comprehensive master plan. Careful site selection and planning plus proper management are essential to the economical production of high-quality nursery stock.

2.1 Introduction

A nursery site must be located with the realization that a perfect site does not exist and that choice of site will require compromise. However, careful attention to the selection of a permanent nursery site will amply repay all the effort expended. An unsatisfactory site will sooner or later (generally, sooner) increase the cost of operations and could lead to unnecessary-ily high seedling losses and poor stock production [1]. Such a situation will leave customers dissatisfied and may cause the nursery to fail.

Fifteen of the 21 Northwest nurseries questioned in the OSU Nursery Survey (see chapter 1, this volume) ranked site-selection characteristics (Table 1). The six most important considerations were: (1) soil workability and drainage, (2) soil texture, (3) water supply, (4) land cost, (5) climate, and (6) soil depth. On the basis of these and related concerns, this chapter provides guidelines for selecting the optimum nursery site. (See chapter 29, this volume, for more information on solving site problems.)

Table 1. Nursery-site characteristics ranked by 15 Northwest bareroot nurseries (OSU Nursery Survey).

	Ranking[1]					
Characteristics	1	2	3	4	5	Total
Climate	2	1	3	…	1	7
Elevation	…	…	…	…	2	2
Aesthetics	…	…	…	…	…	…
Proximity to markets	2	…	1	…	2	5
Water supply	…	4	1	3	2	10
Soil depth	1	1	1	2	1	6
Soil workability and drainage	2	4	3	3	…	12
Land cost	2	1	…	4	…	7
Proximity to work force	…	1	…	…	3	4
Soil fertility (including pH and cation exchange capacity)	2	…	1	1	1	5
Local topography	…	1	2	…	1	4
Politics	1	…	…	…	1	2
Previous land use	…	…	...	…	…	…
Freedom from weeds	…	…	...	....	...	....
Soil texture	3	1	3	2	1	10
Other-adequate acreage	…	1	…	....	…	1

[1] 1 (most important) to 5 (least important).

2.2 Selection

2.2.1 The team approach

First, a list of possible sites should be screened by the person or group wishing to establish a nursery in a given market or use area. Because selecting and establishing a permanent nursery requires a large capital investment [9], a team approach for final selection is probably best.

The team should be composed of at least three of the following:

- Experienced nursery manager
- Reforestation specialist, silviculturist, or other potential customer

In Duryea. Mary L., and Thomas D. Landis (eds.). 1984. Forest Nursery Manual: Production of Bareroot Seedlings. Martinus Nijhoff/Dr W. Junk Publishers. The Hague/Boston/Lancaster, for Forest Research Laboratory, Oregon State University. Corvallis. 386 p.

- Soils specialist
- Forest pathologist
- Civil engineer
- Soil Conservation Service representative
- Entomologist

Team members must be capable of blending their varied backgrounds and individual areas of expertise together, and all should have a physical sense, or "feel," for the land. Because team input is so diversified, it is far less likely that the site selected will be difficult or impossible to manage.

The selection team should first review criteria for all potential sites using a site checklist (Fig. 1); this form may be modified to ensure that all selection criteria are listed and properly emphasized. Then each site should be visited (Fig. 2) and its merits and drawbacks discussed. Finally, the selection team should meet after all site visits have been completed to make the final selection. The entire selection process should be carefully documented in a written report.

2.2.2 Site-selection criteria

2.2.2.1 Climate

Growing-season requirements will vary with stock type. A long growing season (150 days or more) provides an adequate period to produce 1+0, 2+0, 3+0 [for slow-growing species such as Pacific silver fir (*Abies amabilis* Dougl. ex Forbes) and some sources of western white pine (*Pinus monticola* Doug]. ex D. Don)], and transplant stock. A growing season of less than 150 days would reduce the chances of consistently growing shippable 1 +0 seedlings but would be adequate for other age classes.

Temperature.—Possible nursery sites whose daily temperatures consistently exceed 105°F for extended periods (3 weeks or more) should be avoided: extremely hot periods reduce growth and may cause burning of foliage. Short periods of daytime temperatures of 110°F or more can tax irrigation systems, but properly designed irrigation systems can protect seedlings from burning during those periods (see chapters 11 and 12, this volume). Growth of most species is greatly impeded by ambient temperatures of 90°F and above.

Field-planting periods must be discussed with customers. Seedlings to be outplanted from December through early March cannot be lifted and processed when cold daytime tempera- tures keep soil frozen. Those seedlings to be outplanted from late March through June can endure frozen nursery soil from December to early March and be lifted while still dormant. However, from 120 to 150 cold nights (49°F or below) seem to be necessary before peak root-regeneration potential is reached [4]. Moderately low combined day and night tem-peratures during fall and early winter are necessary for bud cooling, preparing seedlings for optimum budbreak about 2 weeks after outplanting. About 300 bud-cooling hours are required in the temperature range 28 to 40°F ([7]: see also chapter 23, this volume).

Extremely low temperatures can be detrimental to seedlings not protected by snow or mulch. Extreme cold can drive frost deep into the soil, delaying lifting and seedling processing well into spring. , If low temperatures recur annually, the species and basic seed sources that the nursery can produce will be limited because stock cannot be lifted and processed. If this fact is ignored, seedlings may not be available when needed for outplanting.

Precipitation.—Proposed nursery sites that have a record of frequent heavy snows persisting into the normal seedling-processing season should be avoided. Snow melting in late spring can radically reduce the time frame for processing seedlings, which can place undue stresses on workers and managers, facilities, equipment, and seedlings, and create dissatisfied customers because specified outplanting dates cannot be met.

POTENTIAL NURSERY SITE

NAME OF AREA ____________ DATE ________

LOCATION ____________

SOIL SURVEY TYPE ____________

TOP SOIL
1. TEXTURE ASSESSMENT ________
2. DEPTH ____________
3. pH ____________

SUBSOIL
1. TEXTURE ASSESSMENT ________
2. DEPTH ____________
3. pH ____________

DEPTH OF WATER TABLE ____________

DRAINAGE ____________

WATER SUPPLY: 1. ADJACENT CREEK ________
2. WELL ____________
3. OTHER ____________
4. RISE OR FALL (FEET) TO SUPPLY _____
5. pH ____________

TOPOGRAPHY: 1. (a) LEVEL ____________
(b) ROLLING ____________
(c) IRREGULAR ____________
2. SLOPE:
________ TO ________ DEGREES
3. UNSUITABLE (i.e., more than 6° or very irregular) ____________

COVER: 1. MAIN TREE SPECIES ________
2. COMMON MEMBERS OF GROUND FLORA ________

CLIMATIC DATA (USE NEAREST STATION IN DEPARTMENT OF TRANSPORT TABLES):
1. TOTAL ANNUAL PRECIPITATION ___
2. SPRING PRECIPITATION:
MARCH _____ APRIL _____ MAY _____
3. NUMBER OF FROST-FREE MONTHS ___
4. HIGHEST TEMPERATURE (AND MONTH RECORDED) LAST YEAR________

APPROXIMATE ACREAGE_______

ACCESS ____________OWNERSHIP ________

Figure 1. A nursery-site checklist such as this one is recommended for use by the site-selection team (adapted from [8]).

Figure 2. Selection team evaluating a possible nursery site.

High rainfall areas are best avoided. However, the season in which the precipitation occurs is important. Heavy spring rains can delay spring operations such as adding soil amendments, starting a cover or green manure crop, or sowing tree seed. Summer rains tend to be a problem only when they occur as cloudbursts and result in flooding, erosion, or seedling wash-out. Frequent summer rains may be detrimental, however, because rains may disrupt stock hardening processes already induced by withholding irrigation. Areas with heavy winter rains should be avoided; heavy rain saturates nursery soil to the point of hindering lifting, damaging soil structure, and causing flooding and erosion.

Wind.—Areas with frequent, long-lasting, high-velocity winds-particularly where humidity is low and winds are drying and from the east—should be avoided. Winds will affect irrigation application and uniformity and may result in soil movement. High winds can desiccate seedlings, and soil carried by winds can blast stems and foliage. Wind can restrict spraying of pesticides, cause tree-seed cover to be blown away, and displace or scatter seedbed mulches.

2.2.2.2 Soil

Perhaps the most important factor in establishing a nursery is the correct choice of soil (see chapter 6, this volume). Other site features, including fertility, moisture, and microclimate, can be manipulated by the nursery manager [2], but moving or significantly modifying large masses of soil is, at the very least, impractical and costly. An intensive soil survey, coupled with representative soil sampling, will help the selection team choose the site with the most suitable soil.

Texture.—Sandy loams or loamy sands with good drainage are excellent for nurseries. Light soils can be worked in weather conditions too wet for heavier soils—an important consideration in the Northwest. The content of clay and silt (particles < 0.05 mm in diameter) in the soil should be within 15 to 25%.

Depth.—The top 4 feet of soil should be free of claypan, hardpan, shale, iron concretions, calcareous substrata, or mottled gley layers [9]. Without artificial drainage, this depth seems a reasonable minimum; where artificial drainage has been installed, however, a minimum clear soil depth of 2 feet is probably acceptable [8]. The top 18 inches of soil should be free of stones, which are expensive to remove, make the soil difficult to work, and interfere with nursery cultural practices.

Soil pH.—The optimum soil reaction, or pH, for most tree species is between pH 5.0 and 6.0 (see chapter 7, this volume). Soils of lower pH may have fewer available nutrients, whereas soils of higher pH encourage the invasion of fungus diseases [9]. Soil pH can be altered with soil additives such as sulfur or by injecting phosphoric or sulfuric acid into irrigation water.

2.2.2.3 Water

Securing an adequate supply of domestic and irrigation water can be a major problem. Water rights must be obtained for any water source. Therefore, special consideration must be given to a site where the quantity and quality of water are adequate for current and possible future requirements (see chapter 11, this volume).

All water needs and the timing of those needs must be considered. For example, in most nurseries, irrigation is necessary during the growing season and for frost protection. Restrictions on flow and on periods of delivery must be closely scrutinized. Is the water source reliable during drought years? Can breaks in canals, pipelines, and other delivery systems be expected? What are the time frames for repair? Are backup sources available in emergency situations? Is domestic water available through a city, village, or other municipality? Are there restrictions on quantity? Are costs high? Is it feasible to develop an on-site water source? Is water quality high? Are there any potential delivery problems? If no water is available near the site, can a transmission line be constructed?

Irrigation-water sources.—Lakes are a good source of irrigation water. Storage capacity, draw-down, other uses, and contaminants must be examined before any commitment is made. Screening may be necessary to remove water-borne debris.

Streams are sometimes used for nursery irrigation and must be checked for water rights, other uses, and quality. In addition, attention must be paid to intakes, diversions for pumping stations, protection during runoff periods, and maintenance of the stream channel to ensure maximum carrying capacity. Stream water may need to be screened to alleviate contamination by vegetation, weed seeds, frogs, fish, algae, and other water-borne debris.

Irrigation water delivered through open ditches is usually controlled by irrigation districts and is subject to specific short delivery periods. Such a source is not reliable unless storage is made available on site and therefore is not recommended.

Water drawn from wells is probably one of the best irrigation sources for most locations. Draw-down and pumping capacity must be checked to ensure that water is available in reliable quantities when it is required.

Domestic or irrigation pipelines are reliable. In many instances, clean water will be supplied with adequate pressure and volume to eliminate the need for pumping. The two types of pipelines are similar, both generally well designed and constructed, although domestic water lines usually have more connections creating a high demand for water and more concern for failure of the system. Systems must be reviewed to ensure that maintenance is adequate and repairs are timely.

Water quality.—Chemical contaminants may be introduced into an irrigation source through the soil or from precipitation or surface runoff. Contamination by minerals such as calcium or boron, for example, will usually be found in well water. However, because streams, lakes, and ditches also may have mineral contaminants, any potential site must have its water sources evaluated for mineral content and concentration.

Water originating from any open source (lake, stream, or ditch) is subject to contamination by weed seeds. High concentrations of these can lead to unwanted vegetation in seedbeds and cover crops-a major problem. Special, well-designed screening devices can alleviate this problem.

Water-borne diseases can infect root systems and foliage. If pathogens such as *Phytophthora*, a fungus causing root disease, are present, chemical water treatment may be necessary (see chapter 19, this volume).

2.2.2.4 Topography

The area for nursery beds should be level, or nearly so. A slight slope (2% maximum) is beneficial for better surface drainage, but slopes greater than 2% can cause erosion, necessitating expensive control measures, and may cause undesirable translocation of soluble fertilizer salts [9]. Furthermore, all mechanical equipment used in forest nurseries operates best on level ground. Moderate slopes and small rough areas may be leveled by terracing and grading, but these operations can be expensive and usually expose infertile subsoil that can cause future seedling-growth problems. Fertile topsoil should be removed and stockpiled before any major soil-moving operation is attempted and evenly redistributed afterward over the leveled area (see chapters 5 and 13, this volume).

The importance of aspect will depend on nursery-site latitude and altitude. In most localities in the temperate zone, eastern and southeastern aspects should be avoided because of greater frost danger, and southern and southwestern aspects because of excessive dryness during periods of drought. Where irrigation is available, southern aspects in northern latitudes at high elevations are best because of their greater warmth. For most sites, though, a northwestern aspect is best because vegetative growth starts later in spring and is not subjected to injury by frost. Water loss through evaporation from the soil surface is not so rapid on northwestern aspects.

Topographic undulations can cause water to accumulate. Standing water, no matter how little, causes complete destruction of nursery stock because of oxygen depletion or buildup of toxic gases. Irregular topography complicates installation of irrigation systems, causes irrigation-line leakage, and makes it difficult to operate nursery equipment. Damage from early fall or late spring frosts can be catastrophic to growing seedlings. Frost hollows, which occur wherever cold air can accumulate—in valley bottoms and large topographic depressions, especially where trees bar cold-air drainage—must be avoided.

As mentioned earlier in this chapter, heavy snows and frozen soils should be avoided. Even though these conditions can occur throughout the elevational zones, they occur more frequently at the middle to higher elevations. Elevation requires special attention; it is mandatory to choose an elevation that will ensure stock dormancy as well as lifting dates that meet customer requests.

2.2.2.5 Previous land use

Past use of the land may influence its value as a potential nursery site (see chapter 5, this volume). For example, past practices that have altered soil acidity or caused toxic chemicals to accumulate will be detrimental to growing seedlings. Has the site been altered? If so, when, and what was done? If the land has been leveled, were any problems associated with the leveling? If so, has time ameliorated them? An intensive survey of topsoil depth will reveal previous land leveling. Will additional leveling be required and, if so, are any problems anticipated?

Are there any areas where water accumulates from surface or subsurface flows? Has the land been drained through a subsurface system? If so, when was the drainage system installed? Did it solve the drainage problems? Is it still functional? Are there any conflicts with neighbors caused by runoff onto adjacent land? How has runoff been handled in the past?

What irrigation system was employed? Was it functional? Have there been any problems with the water source? Are water rights secure and transferable? Will the available irrigation be adequate for seedling growth? Are water quality and quantity acceptable?

What was the previous cropping schedule? Were disease problems associated with any particular crop? If so, what steps were taken to alleviate the problem, or does it still exist? Current vegetation in the area should be carefully examined for root diseases and foliar disorders by the forest pathologist on the site-selection team and recommendations made on suitability.

What pesticides were used? Were any spilled? If spills occurred, identify where, what the chemical was, and what was done to prevent soil contamination. Is there a written pesticide-use record?

Are there any known insect problems? If so, are they soil borne or foliage associated? Do adjacent lands or associated crops have insect problems? If so, what control techniques are employed? Are there any insect associations that may be a concern for the tree-seedling crop? The entomologist on the site-selection team should make a thorough evaluation.

Ideally, the new site should be relatively free from annual and perennial weeds and weed seeds. Any previous crop species that is difficult to eradicate can become a weed problem. Costs of weed control can be very high; therefore, obtaining a weed-free site and managing to keep it weed free will be cost effective. Vegetation on the site should be identified by the selection team and control measures evaluated for all species (see chapter 18, this volume).

2.2.2.6 Site production potential

To help determine the acreage needed for the seedling growing area, the selection team must estimate potential requests for seedlings. A rule of thumb is 500,000 seedlings/0.4 ha (1 acre), but this figure may vary with species or seedbed density. For this calculation, subtract all nonproductive areas—roads, streams, reservoirs, administrative site, and anywhere else that seedlings will not be grown-from the total nursery-site area.

Site growing potential can be derived with the following formula:

$$P = \frac{A \times [1 - (C+F)] \times U \times D \times (m^2/\text{ha or ft}^2/\text{acre})}{R}$$

where

- P = Annual production capacity, in 1000s of seedlings
- A = Production area (acres or hectares)
- C = Estimated cull factor
- F = Estimated overrun factor
- U = Actual seedbed area, %
- D = Density objective (number of seedlings to be grown per square foot); density desired at seedling harvest age
- R = Crop rotation

Many nursery sites have been selected and developed with little or no allowance made for future expansion. Regardless of how remote it may seem, expansion should be considered. To do so, the site-selection team must examine areas adjacent or close to the property.

2.2.2.7 Proximity to customers, labor, and services

Proximity of the nursery to seedling customers, work force, transportation, utilities, and facilities for people all should be evaluated by the site-selection team. Locating the site geographically close to seedling customers seems to be most judicious, although, with the advent of transportation systems and refrigerated trucks, this is not as paramount as it once was. often, other criteria prevail.

Labor force.—The nursery should be within easy commuting distance—about 35 miles—of an adequate, dependable labor supply. The number of workers needed varies widely, depending on size of the nursery, extent of mechanization, amount of work contracted out, degree of chemical weed control, and type of stock grown. The peak period of employment occurs during the short 2 to 9-week processing season, when about 1 person is required for every 65,000 seedlings processed. About 10% of this work is supervisory and administrative. Over an entire year, about 1.6 fulltime equivalents (FTEs; 1 FTE is 2,080 person-hours) are required per million seedlings produced. Both male and female workers are needed; typically, 50 to 60% of the work force is women. Certain specialized positions such as tractor operator and irrigation specialist require some previous agricultural experience. Wages are usually higher than in other agricultural work, making it easier to recruit a reliable work force.

Transportation.—A good transportation network is essential. Rail, truck, bus, or plane can be used to transport seedlings, but refrigerated transportation equipment is mandatory. County or state roads that are well traveled, maintained, and connected to freeways will aid the transport of both seedlings and people; easy connections for seedling customers and nursery administrators expedite travel and reduce transportation and per diem costs. Motels, hotels, restaurants, and other facilities convenient for people in transit are a must, as are limousine, taxi, bus, and air transport to neighboring cities and states.

Refrigerated seedling storage.—Access to commercial tree-seedling storage is mandatory to ensure that stock can be stored without loss of vigor for up to 3 months. Potential storage may be found in the fruit or produce industry.

Utilities and fossil fuels.—Telephone, electric power, and other utilities required for nursery operation must be already available or easily secured. The history of these utilities as well as their current cost, supply, and reliability must be evaluated.

What is the commercial rate for electric power? Are the needed power types (single and 3 phase) and voltages (110, 208, 220, and 440 V) available? If an increased need develops, will power be available? Is there a potential for power failures? Are failures frequent and long term? Will backup on-site power be required? Is propane or natural gas available? What are the costs? Are fuel distributors available close-by? Will they provide service on short notice? What are the on-site storage requirements?

Other services.—Is a sewer and garbage disposal system available? What are the costs? What are the restrictions on materials that can be dumped in the system? Is there a discharge point for release of waste water from seedling processing and surface runoff? Are there restrictions on point discharge, and are permits obtainable?

What commercial repair, maintenance, and labor services are available? Are they able to respond with little or no advance warning? Are service contractors close—within 35 miles—or must they travel in excess of 50 miles?

Are electrical contractors equipped to handle main power, power panels, switches, automatic controls, warning systems for fire and burglar, refrigeration, and flow control for pumping stations? Are plumbing contractors and those that service refrigeration and heating systems available, reliable, and capable? Do all these services carry adequate parts inventories? If not, where must parts come from, and what are the turnaround times? For example, can parts be obtained and repairs made to refrigeration systems in from 48 to 72 hours?

Are contracting organizations available for seedling lifting and weeding? How flexible are these contractors? Will those available for tree planting, timber-stand management, and agricultural work also weed seedbeds and lift seedlings? Are janitorial contractors available? At what cost? Would in-house or contracted labor be more cost effective?

2.2.2.8 Land availability and cost

Are the sites under consideration actually for sale and within the price range given to the selection team? What are the owners' sale stipulations? Look at **total** developed cost. Unimproved land may initially cost less but require such large capital outlays for development that ultimate total cost may be more. Land that may initially cost more, on the other hand, may be developed to the point that few subsequent improvements are needed, and total cost may be less.

2.2.3 Evaluating criteria and selecting a site

All selection criteria are discussed by the team and the major ones listed and evaluated [5]:

Objective score = score x weighted value

where **score** reflects how well the site satisfies individual criteria (1, lowest, to 10, highest), and **weighted value** reflects the relative significance of each criterion (1, lowest, to 10, highest). The rationale behind the weighting of criteria and site assessment should be discussed for each site. Once sites have been rated and discussion is complete, the choice can be identified. For example, in Table 2, criteria have been ranked and weighted for three potential nursery sites. Site #3, with a composite score of 3 59, would be the preferred site.

Table 2. Evaluating criteria for three potential nursery sites with the Kepner-Tregoe [5] method.

Ranked criteria	Corresponding weighted value[1]	Weighted value (and corresponding objective score) for three sites #1	#2	#3
1. Soils	10	8 (80)	6 (60)	10 (100)
2. Water	9	10 (90)	10 (90)	5 (45)
3. Climate	9	6 (54)	8 (72)	8 (72)
4. Topography	7	5 (35)	5 (35)	10 (70)
5. Land availability and cost	8	10 (80)	8 (64)	9 (72)
Total objective score		(339)	(321)	(359)

[1] 1 (lowest) to 10 (highest).

2.3 Layout and Development

2.3.1 The team approach

Like site selection, layout and development benefit from the team approach. The development team should consist of the nursery manager; civil, electrical, and mechanical engineers; landscape and structural architects; and consultants for soils, irrigation, subsurface drainage, or other areas where on-site team expertise is weak or lacking.

Every effort must be made to visit similar facilities for comparison. Development of a new nursery requires a large initial monetary investment, and any new technology either already developed or under consideration must be evaluated for potential incorporation into development plans. New ideas always surface when other nurseries are visited and when both positive and negative sides of a particular site or procedure are discussed.

2.3.2 Access and traffic flow

The nursery should be as compact as possible—nearly square or regular in shape—to minimize the length of the boundary

Table 3. Comparative analysis on effects of access for four potential nursery-entry points.[1]

Entry	Cost, $	Security	Traffic	Site lines	School	Residential areas	Wildlife	Seedling growing area	Composite score
1	104,350	9	10	8	9	10	4	8	58
2	112,800	2	9	9	8	6	6	7	47
3	44,850	4	4	8	3	0	8	9	36
4	57,200	3	5	7	5	6	9	10	45

[1] 0 (high impact) to 10 (low impact).

fence and reduce the time lost moving from one part of the nursery to another [1].

Roads provide access to the site (see 2.2.2.7) and to growing fields. When the site is developed, all access roads should be paved; they must be capable of taking heavy "semi" truck and tractor traffic in all kinds of weather. Parking areas must be evaluated and particular attention given to pedestrian and vehicle traffic flows. Possible conflicts with people, vehicles, buildings, and landscaping must be taken into consideration. The potential maximum number of future employees must be anticipated and allowances made for future parking if the need is identified.

When considering connecting points (entries and exits) to existing road systems, the development team should solicit input from the local community. A decision matrix such as that shown in Table 3 is extremely helpful. In that case, four entry points were rated from 0 (high impact) to 10 (low impact) in eight categories and their composite scores determined. Because of anticipated conflicts, entry #1 was chosen—though it was far from the least costly.

2.3.3 Administrative site

The administrative site includes administrative offices; storage areas for equipment, trees, seed, pesticides, other chemicals, and fuels; shops; a fuel-dispensing station; an employee center; and seedling-processing facilities. The type, number, and location of required buildings can be determined with the team approach. Other administrative development could include employee-enrichment areas (in the form of parklike surroundings), holding areas for irrigation water or soil amendments, a culled-seedling disposal area, and anarea for holding scrap material and used equipment until sale is possible (potential aesthetic conflicts with neighbors may arise in this last case).

Although possible future expansion must always be kept in mind, the administrative complex must optimize the use of space to avoid being spread out. The results of poor or inadequate planning will cause the manager and staff considerable anxiety in future years.

2.3.4 The master plan

Once agreement has been reached on placement of all structures and development begins, a master plan—a dynamic tool—must be made to document the team decision (Fig. 3). Once the development team has disbanded, this plan will stand as an illustrated document of site layout, indicating growing areas, roads, buildings, outdoor storage areas, reservoirs, streams, fences, neighbors, possible expansion areas for buildings, and other site development. The master plan is not cast in concrete, however, and can and must be updated as management needs change.

2.3.5 Development program

To properly develop a site, an action plan must be prepared. One approach is to construct a critical-path chart that shows events and operations on a timeline (Fig. 4). Tree-production scheduling must be coordinated with site development. Structures that are needed first must be built first. For example,

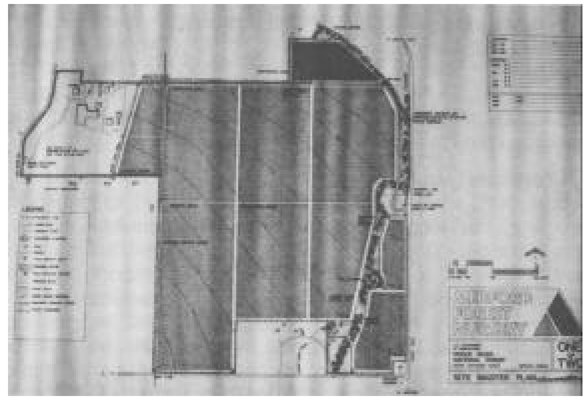

Figure 3. Master plan for a Northwest bareroot nursery.

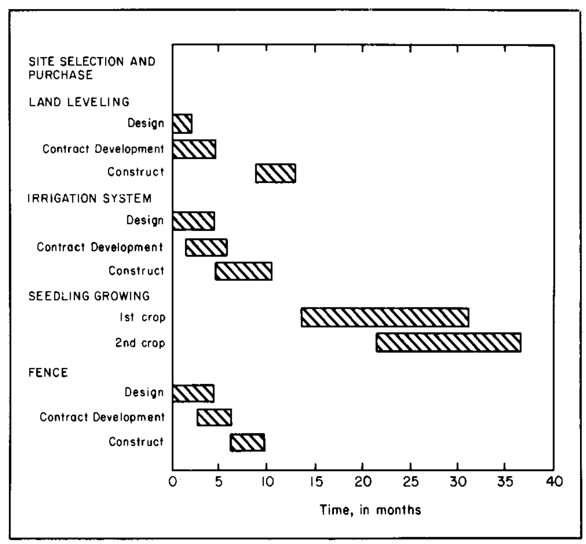

Figure 4. Partial nursery action plan, developed as a timeline.

because seedlings need to be processed and stored in refrigeration rooms at the end of the second year, that complex must be ready for the first crop.

Throughout nursery development, the action plan is continuously reviewed—by an individual, a team, or a concerned outsider-and revised, as needed. Critical factors that may have been overlooked initially are identified and incorporated. It is important for everything to be viewed objectively and in proper perspective.

2.3.6 Budgeting and accountability

Budgeting is critical and must have highest priority in the development process. Budgets should be planned 2 to 3 years in advance to ensure that funding, people, and facilities will be available when needed. The budget and the action plan must be developed together. If shortages of funds or people are anticipated, construction may have to be delayed or other alternatives sought.

The process of "fixing accountability" identifies objectives and action steps [6] and the individuals responsible for their accomplishment in the outlined time frames. Responsibilities must be reasonable, however, and should be adjusted if necessary to ensure that the work can realistically be completed.

2.4 Conclusions and Recommendations

- A three- to seven-member team should be designated to select a nursery site. The team should develop site-selection criteria and establish priorities, then visit and evaluate possible sites on the basis of the chosen criteria, and finally select the best site.
- A development team should lay out the nursery, formulate an action plan, and then document nursery-site development in a flexible but clearly defined master plan.
- Possible future expansion of facilities and staff must always be considered.
- A perfect nursery site does not exist; tradeoffs are inevitable—but nursery soil should not be compromised.
- Wise planning and thoughtful decision making—plus proper management—are essential for the economical production of high-quality nursery stock for reforestation [3].p

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For Further Reading

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