Nursery Planning

- An important, often neglected first step – determine why a nursery is needed BEFORE beginning on-the ground activities
- Define objectives for nursery
  - Ecosystem restoration?
  - Urban Plantings?
  - Agroforestry?
  - Timber/biomass?
  - Watershed/coastal protection?
  - T&E species propagation?
  - Traditional or culturally significant plants?
  - Education/outreach?

Nursery Planning

Conduct a Needs Assessment

- What is needed and wanted by community or organization?
- Who are current and future clients?
- What are priorities for plant material?
- What species and stocktypes is the nursery capable of growing?
- How much material is needed?
- Use Target Seedling concept
  - What are the outplanting sites?
  - End user requirements for special properties, seed sources?
  - Age or size of stock required based on outplanting site limitations?
  - What is the planting season?

Nursery Site Selection

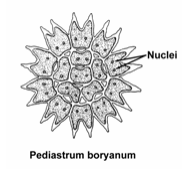
- Most Important Factors
  - Light
  - Water quality and quantity
  - Access to electricity
  - Freedom from ecological and political concerns
  - Adequate land area

Need the ability to manage light!

Consider nearby structures and vegetation…

Irrigation Water Quality is Determined By Two Factors

1. Type and Concentration of Dissolved Salts
2. Pests: Fungi, Weed Seeds, Algal Spores



Mist nozzle on Saipan

Treatments for Irrigation Water

1. Acidification - Yes
2. Reverse Osmosis - $$
3. Deionization - $$
4. Water Softeners – No!!
5. Chlorination - Maybe
6. Filtration – Yes
7. Change water source – from ground water to catchment?

Quantity of Irrigation Water

- Capacity of irrigation system in terms of
  - Pressure
  - Flow (gallons per minute)
- Capacity of water source will determine irrigation system design and ultimately nursery capacity

Access to Electricity? Palau did OK without until they decided to automate the irrigation system…

Eco-Political Concerns

- Air/Water pollution at site
- Pesticide drift from nearby agricultural operations
- Site water drainage (including runoff from nursery, poor soil drainage on nursery, runoff onto nursery)
- Unmanageable pest or weed problem
- Zoning or historic land use issues
- Adjacent schools, residential areas, etc. that may object to nursery operations such as pesticide applications.

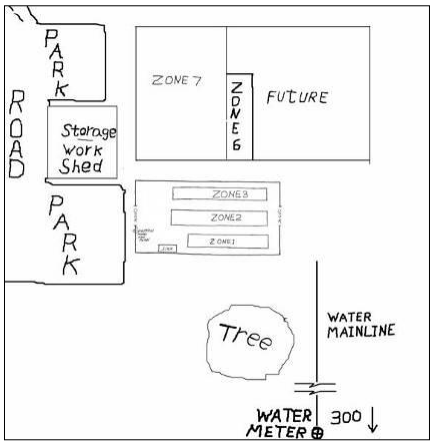
Nursery Site Selection

- Secondary Factors
  - Microclimate
    - Sheltered from wind, salt spray
    - Windbreaks, walls, curtains can be developed if needed
    - Avoid flood-prone areas!
  - Gentle topography
    - Slope complicates irrigation and movement of material
  - Road Access
    - All-weather road surface is important

Nursery Site Layout

- Plan nursery layout and operation around Target Plant Concept
  - Focus is on facility that produces plants matched with outplanting site and client needs and expectations
  - Outplanting windows will dictate scheduling of nursery operations and flow of plants through different areas of facility

Overall Site Plan



- Plan for easy access and material flow
- If moving material by hand or conveyer, minimize distance between facilities
- When material is moved with forklift, etc. distance is not as critical and will require more room to maneuver
- Headhouse should be accessible to growing areas – central location?

Nursery Design Criteria

- RELIABILITY
  - Nursery MUST use technology appropriate to local conditions
    - If local power grid is not reliable, do not use automated irrigation system without manual backup.
    - If commercial growing media is too expensive to import, develop compost-based media
    - Consider access to technical support or parts when procuring equipment

More Design Considerations

- Separate media mixing and pot filling area reduces dust
- Covered access corridors and loading dock improves operation during rain
- Consider site drainage during layout
  - Capturing and treating runoff reduces pollution and is good PR
  - Improving irrigation efficiency will reduce problem – and is also good PR….

Nursery Operations and Facilities

- Besides Propagation Areas….
  - Material and equipment storage
  - Pesticide and chemical handling and storage
  - Seed cleaning, storage, and pre-sow treatment areas
  - Soil mixing and container filling operations
  - Work areas for sowing and transplanting
  - Electrical and mechanical areas
  - Office/staff accommodations
  - Vehicle access (roads, parking, loading docks
  - Windbreak layout, if needed
  - Site drainage/runoff management

Propagation Environments

- Design propagation environments to accommodate crop growth phases:
  - Establishment (germination or rooting, early growth)
  - Growing Out (optimum water, light, nutrients for exponential phase of growth
  - Hardening (Acclimating plants to withstand planting operations and outplanting site conditions)

Typical Nursery Operation for Native Plants

- Many Species
- Different Propagation Methods
- Plants at Different Growth Stages

Greenhouse

Rooting Cuttings	Germinating Seeds in Trays
Large Pots	Growing-Out Plants In Containers

Seed Germination
- Flats, trays, beds with germination media
- Some shelter and shade to reduce drying

Rooting Beds

- Flats, Beds, Trays of rooting media
- Mist, shade, shelter may be required to maintain humidity and reduce drying

Transplant Establishment

- Relatively short transition after pricking out or potting up germinants or cuttings
- May require more shade or shelter than main growing area until plants establish
- Roofed to prevent rain damage

Growing Out Area

- May require shade to reduce stress and protect from intense rain
- May be roofed, shaded, or open depending on species and environment

Main Growing Areas

Hardening Areas

- Gradually match light levels to conditions at outplanting site
- Reduce irrigation rate
- Reduce fertilization rate
- Root plug should be developed enough to withstand rain

Hardening Area - Rota

Other Considerations

- Adjustable and retractable shade allows plants to same area during establishment, rapid growth, and hardening
- Group species with similar growth rates and propagation requirements
- Different container types and sizes require different irrigation schedules and watering zones

Determine Size of Propagation Environment

- Goal – maximize production space efficiency
  - Production space = area covered with seedlings
  - Non-production space = Aisles, irrigation lines, fixtures
  - Production space efficiency =

$$\frac{\text{Production Space}}{(\text{Production Space} + \text{Non-Production Space})}$$

  - For initial planning purposes, generally use a 60% (0.6) production efficiency

Determining Zone Size

Zone size =

# of containers / containers per ft^2 / production efficiency

Example:

3000 Deepots @ 16.2 containers per ft^2 needs 3000/16.2 = 185.2 ft^2 of production space and 185.2 ft^2/0.6 =308 ft^2 of total space

- Actual number of plants would depend on survival rate

Bench Layout

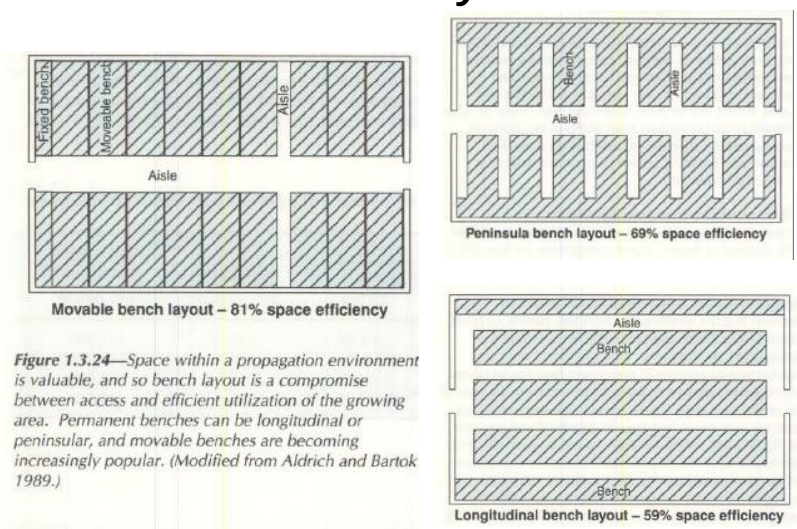


Figure 1.3.24—Space within a propagation environment is valuable, and so bench layout is a compromise between access and efficient utilization of the growing area. Permanent benches can be longitudinal or peninsular, and movable benches are becoming increasingly popular. (Modified from Aldrich and Bartok 1989.)

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Growing Environment Considerations

- Benches 4 – 5 feet wide allow hand access to center
- Comfortable height is 28-32 inches
- Side aisles should be 20-30 inches wide
- Main aisles should be 3-5 feet or as needed for conveyers, carts, forklifts, etc

Shadehouse – Semicontrolled

Figure 1.3.7—*Shadehouses are semicontrolled propagation structures that modify sunlight and can be used to either propagate* (**A**) *or harden crops* (**B**). *They are particularly useful in tropical or semitropical climates* (**C**). *(B, courtesy of Daniel Jordan, Iron Range Resources and Rehabilitation Board.)*

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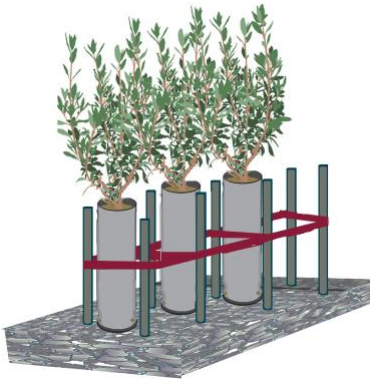
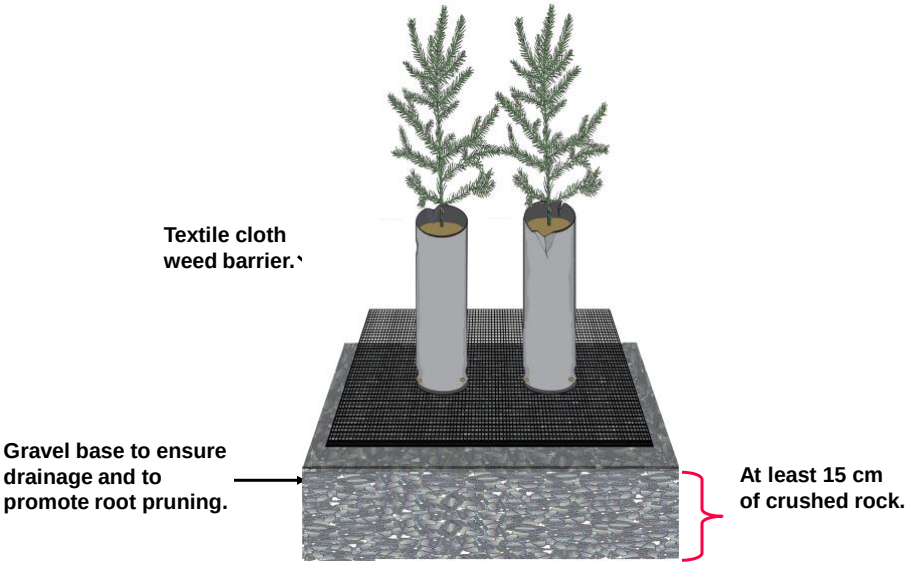
Using a soil less medium will reduce weight and conserve precious topsoil.

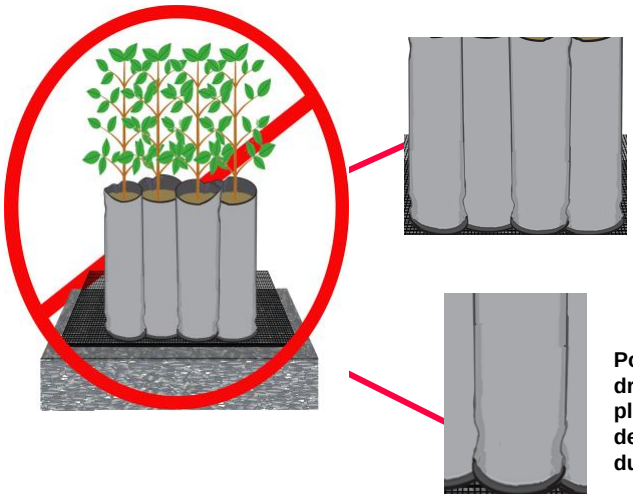


Newer polybags can be purchased impregnated with copper to reduce spiraling.

A typical polybag nursery bed showing a textile weed barrier and a 15 cm crushed rock base.



Crowding is a common mistake growers make with poly bags.



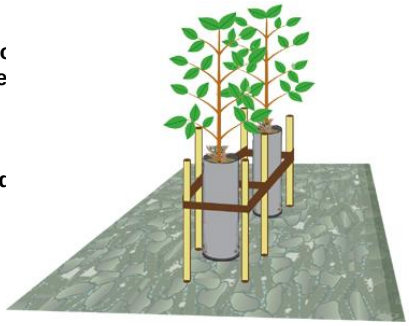
Crowding reduces cubic volume and decreases root growth.

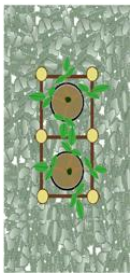
Poor alignment causes drain holes to be plugged up and decreases root growth due to poor aeration .

One method to prevent crowding is to use a physical constraint to separate the polybags.

These pc separate wooden rope.

Wooc

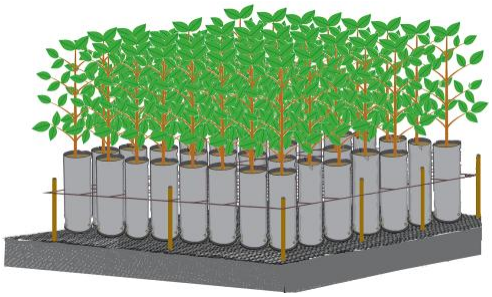




Viewed from above.

These polybags are not crowded and have room to grow and develop.

Constraint systems can be developed for large or small operations



Proper placement of poly bags increases growth.