

Nursery Design

Fundamentals of Greenhouse and Shadehouse Conifer Seedling Production in Afghanistan

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26

- **Container conifer seedling production**
- **Greenhouse**
 - **construction**
 - **operation**
 - **maintenance**
- **Shadehouse**
 - **construction**
 - **operation**
 - **maintenance**



Why Polybag Conifer Seedling Production:

1. Increased survival from reduced transplanting shock
2. Root system is protected and remains intact from nursery to plantation.
3. Greater production in smaller area.
4. More efficient use of seed.
5. The planting season can be extended.
6. More balanced shoot-root ratio.



Container Conifer Seedling Production

1. Polybag size minimum 10 cm x 20 cm.
2. Use polybags that will remain intact for at least two years.
3. Make sure there are drain holes in the sides and bottom of the bag.
4. Soil mix to contain equal parts sand, mulch and soil (minimum pore space = 25%)
5. Mulch (sawdust, leaves, dung) completely decomposed (>1 yr old)
6. If sow seed in the fall, keep seed moist for natural stratification.
7. If sow seed in the spring, use stratified seed (refer to Seed Handbook)
8. Sowing depth 2 times diameter of seed.



Container Conifer Seedling Production (Cond.)

9. Have “cut test” or germination before sowing
10. If cut test/germination is $\geq 90\%$, sow two seeds per bag
11. If cut test/germination is 80-90%, sow three seeds per bag
12. If cut test/germination is 70-80%, sow four seeds per bag
13. And so on.
14. Once germination is complete, thin to only one seedling/bag; no empty bags.
15. Place bags into pre-dug trenches for root protection.
16. Keep seed moist during germination
17. Keep seedling well-watered during growth and development.
18. Provide shade during the heat of the summer.



Greenhouse Construction: Site Preparation

1. **Site slightly elevated, level (prevent flooding)**
2. **Soils should be well-drained (warmer, fewer disease problems)**
3. **Side walls to be perpendicular to prevailing winds (temperature control)**
4. **Erected far from shade trees**



Greenhouse Construction: Setting the Base

1. Lay out wooden footing (for attaching plastic)
2. Set hoops at distance for proper support



Greenhouse Construction: Setting the Hoops

1. **Secure hoops to base with bolts and screws**
2. **Install 30-60 cm footings for hoop installation**
3. **Begin to install hoops into pre-set footings**
4. **PVC hoops are easy work with**
5. **If use PVC, hoop distance is 90 cm with 3.8 cm diameter**
6. **Interior hoop height when erected minimum 190 cm**
7. **Note buried sleeves for hoop installation**



Greenhouse Construction: Horizontal Hip Board Support

1. Use wooden side boards for supports
2. Attach with bolts at height of 75 cm.
3. Make sure all surface areas are smooth (wood and bolt heads)



Greenhouse Construction: Install Overhead Hoop Support

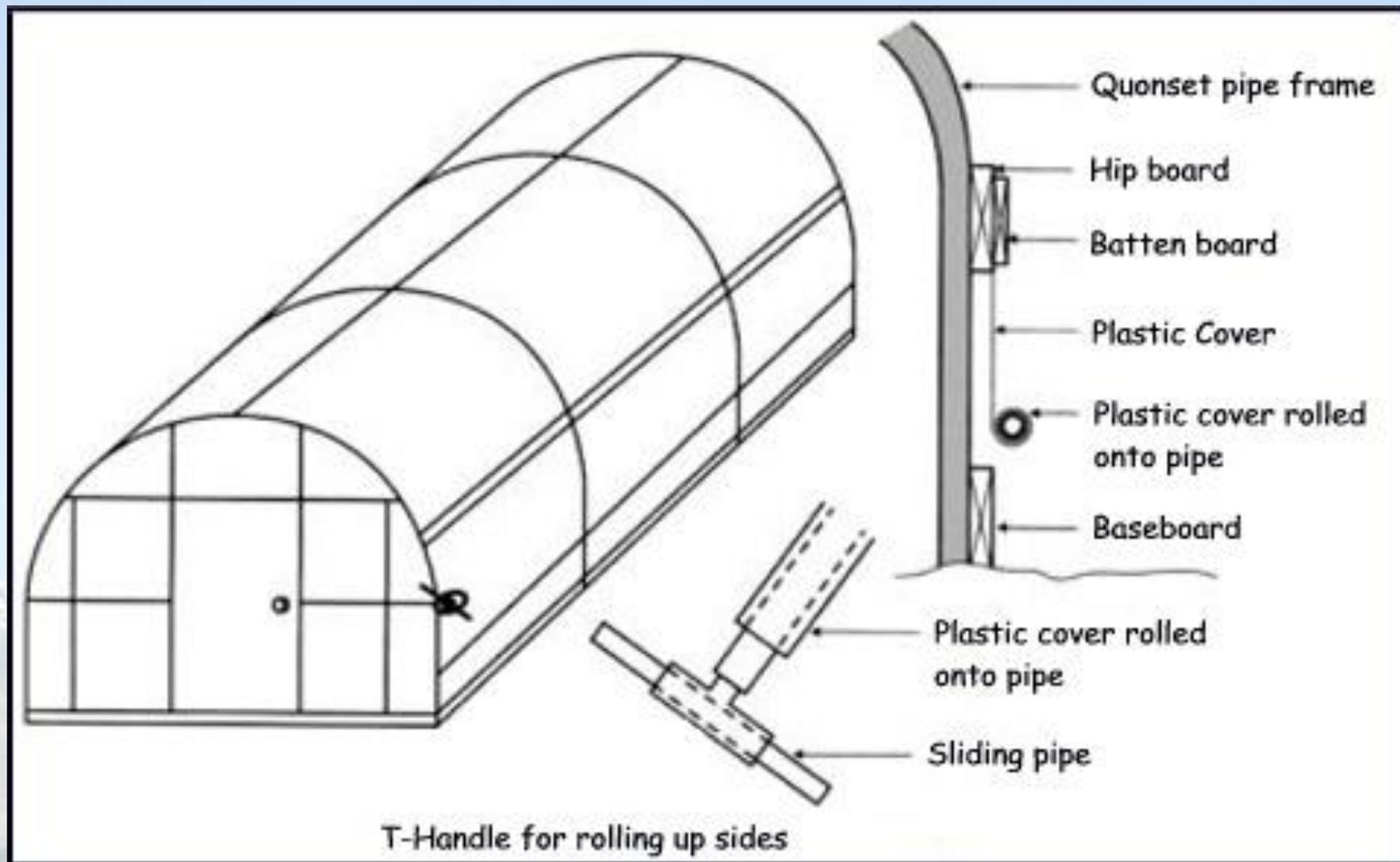
1. Attach support on inside of hoops
2. Make sure all hoops are parallel
3. Top surface of hoops to be smooth.
4. Tape can applied on top of hoops



Greenhouse Construction: Putting on the Cover

1. Minimum thickness 6 mil (1 mil = 1/1000 inch)
2. UV treated
3. Do on a calm day
4. Leave 60 cm excess on all edges
5. Make sure plastic is well-centered
6. Make sure all greenhouse edges that touch plastic are smooth
7. Prepare wooden frame at ends of greenhouse for attaching plastic and doors





Installation Design of Side Walls

Greenhouse Construction: Attaching plastic to frame

- 1. Place temporary weights on plastic to hold in place**
- 2. Attach exterior wooden horizontal strips to interior hip board**
- 3. Once one side is attached, pull plastic and attach on opposite side.**
- 4. Attach plastic to wooden frame in same manner.**
- 5. Tape is used to keep surfaces smooth.**



Greenhouse Construction: Roll-up Side Installation

1. Assemble top rail pieces to roll up sides (longer than sides)
2. Attach the pipe to the poly (tape or clips)
3. Note hand crank for easy operation of roll-ups
4. Make sure sides roll up evenly for uniform ventilation.
5. Rope loops can tie off crank hand for desired height of roll-ups



Greenhouse Construction: Stabilize Walls/Prevent Sidewalls from Billowing

1. Cut pieces of plastic tubing/drip tape to appropriate lengths.
2. Attach pieces vertically from hip board to floor board.
3. Install supports at each hoop.



Greenhouse Construction: End Walls

1. Frame for door
2. Optional frame for overhead ventilation (above door)
3. Attach plastic to wooden frame.
4. Plastic can be removed during heat of summer for ventilation



Greenhouse Construction: End Wall Ventilation (Optional)

1. Install small ventilation vents above doors on wall ends
2. Used to regulate interior temperature/humidity



Greenhouse Operation: Seedling Growth

1. Install thermometers at plant height to monitor temperature
2. Monitor outside and inside temperatures
3. Repair any tears to plastic.
4. Maintain interior surface temperature of 20-25C during germination phase.
5. Maintain interior surface temperature of 20-35 C during the rapid growth phase.
6. Maintain interior surface temperature of <25 C during hardening phase.
7. When outside temperature is above 20 C, slowly open sidewalls/overhead vents to increase wind exposure to help cool the plants.
8. When interior surface temperature >35 C and greenhouse fully open, cover greenhouse with shade cloth or washable white paint



Greenhouse Operation: Regulate Interior Temperature

1. Open vent above door.
2. Open side walls
3. Drape shadecloth over structure (50% shade < 6 C surface)
4. Irrigate seedlings (watering cans or irrigation systems)
5. White shade is more effective than other colors
6. Paint plastic with “whitewash” (1 part latex paint + 20 parts water)
7. Remove plastic on end walls.
8. Make changes incrementally



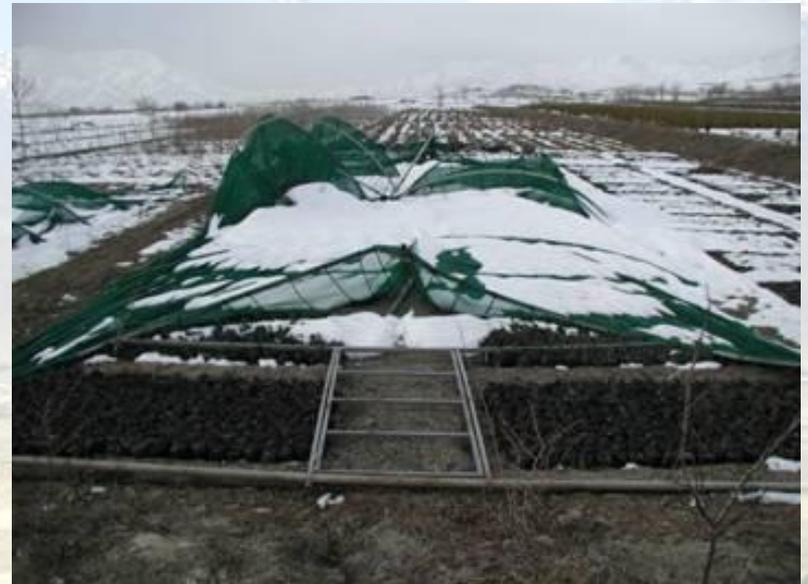
Greenhouse Operation: Watering

1. Keep seed zone moist
2. Thoroughly soak soil in polybags
3. Keep soil moist
4. Irrigate with watering cans or sprinkler systems.
5. Make sure entire greenhouse is watered equally
6. Measure irrigation volumes with simple cans
7. Irrigate lightly/frequently to cool surface temperatures



Greenhouse Winter Maintenance:

1. Heavy snow loads can damage structure.
2. Structure can support 3-6 cm of snow cover
3. Remove shadecloth by mid-October.
4. Can remove plastic
5. Manually remove snow with broom.
6. Orient structure for prevailing winds to blow off snow
7. Install interior heat source



Shadehouse Construction:

1. Set poles in ground at 3-4 m spacing
2. Secure with ground wires
3. Above ground pole end height 3 m
4. Extend cables to poles at opposite side
5. Attach one end shadecloth to one side of structure.
6. Attach loose clips on shade material and cable for ease of opening and closing.



Shadehouse Construction:

1. Make sure shadecloth will extend to opposite poles
2. Attach shadecloth to cables/poles at both ends
3. Make sure height in middle of shadehouse is high enough to walk under
4. Light-weight poles can be used to support shadecloth inside structure.



Shadehouse Operation

1. Shade will reduce water use in plants
2. Plants can be watered with watering cans or irrigation systems.
3. Make sure entire shadehouse is watered equally.
4. Measure irrigation volumes with simple cans



Shadehouse Operation:

1. **50% shade will reduce surface temperatures 6 C.**
2. **White shade is more effective than black for reducing surface heat.**
3. **Use shade when surface temperatures regularly >35 C**
4. **Shade could increase plant shoot growth**
5. **Pull back shade mid-October**



Shadehouse Maintenance

1. Pull back shade cloth and secure at one end.
2. Bundle shade cloth for protection from heavy snow loads.
3. Shade can be re-used until no longer effective (> 5 years)
4. Remove heavy snow loads from shade cloth.
5. Ensure cable are tight and secure
6. Ensure poles are secure.
7. Ensure ground wires secure.



References:

www.hightunnels.org

Information on Hoophouses

www.rngr.net Information on reforestation and nurseries

