# BEDHOUSE SEEDLING PRODUCTION

David C. "Swede" Hansen
Wind River Nursery
USDA, Forest Service Carson, Washington

## ABSTRACT

Wind River Nursery has developed an option for its seedling customers to consider in meeting their reforestation goals: It can produce plantable Bareroot seedlings in one season by growing them in bedhouses. Some of the special features of bedhouses are:

1. Easily movable to allow crop rotation, hardening off, etc.

2. Conventional nursery equipment can be used to do most of the operations.

3. It can meet short-term, last minute needs for seedlings.

4. Operations are kept simple through use of intensive labor instead of sophisticated equipment.

## I. INTRODUCTION

Wind River Nursery is located near Carson, Washington, and is part of the Gifford Pinchot National Forest, U.S. Forest Service. The Nursery is presently capable of sustaining an annual production of 18MM bareroot seedlings. It is undergoing an expansion to raise the capacity to 27MM. For the last six years we have been averaging around 3UMM seedlings to meet increased reforestation needs. We have a permanent staff of 62 people and up to 290 temporary laborers to meet our goals. I hope to describe how we supplement our operation with bedhouses. Although there are many ways to use greenhouses, this is our way as we have developed it to the present.

Our bedhouse operation consists of 10 houses, approximately 43,200 square feet. We produce roughly 900M seedlings at a cost of $98/N for 1-U stock.

## II. BACKGROUND

As to why a bareroot nursery entered greenhouse production of bareroot seedlings, some background information may be helpful.

Our objective is to produce a bareroot seedling in one growing season which will survive in the field. There seems to be a place for a bareroot seedling which can be produced at the last minute. We are talking about a need which surfaces in the fall or winter, after normal sowing requests have been met. We were confident we could produce the seedlings, but were aware of the high costs which can be encountered.

The advantages of bedhouse seedlings are:

> Short-term needs of the national forests can be accommodated. It is one way to overcome unexpected occurrences such as fall fires, volcano eruptions, disease outbreaks, accelerated timber harvest, nursery falldown and plantation failures, to mention a few.

Comparative Seedling Prices[1]

| Type | $/M |
|---|---|
| Bareroot | |
| Field grown 1-0 | 64 |
| Field grown 2-0 | 84 |
| Bedhouse 1-0 | 98 |
| Containers | |
| RLP 1-0 | 264 |
| RLS 1-0 | 338 |
| DP 1-0 | 483 |

Can be planted under 2-0 site conditions in many cases.

[1]Region Six, 6580
12/8/81. USFS, Pacific Northwest Region Seedling Prices, FY 1982.

Some of the "inherent" problems of 2-0 seedlings can be avoided. For instance, 2-0 larch infected with Meria Laricis needle-cast, while 1-0 is not. Similarily, 1-0 sugar pine does not have the Fusarium problem so common to 2-0 seedlings.

Field survival of bedhouse seedlings is encouraging. Several forests have reported their seedlings are doing well.

Some disadvantages:

More expensive than field-grown seedlings.
Usually smaller in size than 2-0.
Requires a commitment of land, money, and personnel to enter into bedhouse production. Thus, there must be a longterm need for solutions to short-term problems.

## III. DEVELOPING THE SYSTEM

### A. WHAT WE WANTED --Criteria

After we decided we would use bedhouses, we then established criteria. Some of our basic needs were:

1. Easily movable between seasons to allow crop rotation and hardening-off.

2. Large enough to permit some equipment to operate inside.

3. We would use intensive labor for many of the operations instead of getting into sophisticated equipment.

4. Minimum disruption of soil. This would allow a return to conventional seedbeds if bedhouse operations were terminated.

5. Equipped with heat and ventilation.

6. Strong enough to withstand snow loads.

7. Some nurseries had tried bareroot bedhouse seedlings, but had always used regular bed widths, as far as we knew. We decided to use 14 foot beds with one aisle. This increased the productive area by 1/3. It also reduced the energy expense of heating the aisles.

B. WHAT WE GOT -- Materials Received

A contract was designed to meet our criteria and awarded for 10 greenhouses. Nexus was awarded the contract for the houses, which are 30' x 144', propane heated, quonset style houses, ground-to-ground (not connected). They are covered with 2 layers of 4-6 mil poly with an air space between layers and corrugated plastic end walls. They had double doors at one end. The other end was without a door. The "portable" aspect consisted of unbolting 24 bows from stakes set in concrete 48" into the ground. So much for our criterion of minimum disruption of the soil. We found that each stake hole was a separate task of lining up, plumbing to vertical, etc. It was obvious that to move a house we would never match these up to a second set of 24 pair of stakes in the ground. The house was so low that equipment operation was out of the question. As designed, hand labor would be required all the way.

C. WHAT WE DID WITH WHAT WE GOT -- Implementation/Modification

We built one house according to plans and modified the rest. The immediate problem was to make the houses portable. We finally settled for connecting the bows to the stakes. Instead of burying the stakes, they were set on a 3 inch steel channel, or rail, and welded in place. This raised the house 48 inches and allowed for some equipment operations inside. Moving the houses was accomplished by two field tractors (Hydro 70) pulling or dragging them to the alternate location. Double doors were installed at both ends of each building. We buried all utility lines. Because we are using 10 houses on 19 sites, we needed utility lines to 19 sites. Utilities feed to a pedestal, which hooks into the bedhouse. It was cost effective to install 2 rows of pedestals along a service road *which* runs between the rows of houses. The utilities pedestal is at opposite ends of the houses on alternate years. Thus, plumbing and wiring inside the bedhouse is arranged so they can be connected to the utilities at either end.

Smaller service doors were installed within the double doors at each end. Once sowing is completed the double doors are bolted together and made air-tight. With the sides raised 48 inches off the ground, this provided the opportunity to install hinged doors, or shutters to allow access to the seedlings, and for ventilation on hot days.

IV. THE GROWING CYCLE

Our growing cycle follows this sequence:

A. Ground Preparation:

We prepare the ground. We prefer to do this work in the open, but can do it inside a bedhouse.

Soil Prescription:

A soil prescription is prepared after analyzing soil test information. Organics, amendments, and fertilizer are added.
Fumigate - either by machine or hand.
Move house into place if not already done.
Re-work ground.

B. Sowing

Beds marked off.

Raking.

Broadcast sowing. At first, we sowed for a density of 35-40 per square foot. However, this proved to be too dense so we now sow for 25-30 per square foot. With this density results are good. A hand roller is used to allow the soil to lightly embrace the seed. Seeds are then covered with peat and watered in.

C. Tending

After sowing is completed, one person can handle the growing job. They will occasionally get help, as for spraying, maintenance work or inventory.

1. Temperature

Houses are set for a minimum and maximum temperature. This year we strived for a night temperature of $60^0$ and a day temperature of at least 70.

When outside temperatures are lower, propane heaters raise the house temperatures to the desired setting.

Higher outside temperatures are handled through louvered exhaust fans. We also open up side shutters on hotter days when the exhaust fans capacity is exceeded. For higher temperatures, we can also use water to lower temperature (heat watering) which is normally 2-3 minutes. The last measure we can employ is to open up the double doors when temperatures reach 100°F.

2. Weeding

Because the seedbeds are 14 feet wide, we can use the wheeled plank in the case of a heavy job.

Usually weeds are scattered. We have devised a long-handled weeding tool which is quite effective and avoids damage to the seedlings. We can even use it for thinning by plucking out seedlings. This is only used in the thick clumps.

3. Inventory

The seedbeds are sampled around the end of July with a 6 inch by 48 inch rectangular frame.

4. Hardening-Off

The covers, poly sheets, or "tarps", are usually removed in late July to mid-August. We have kept the covers on one bedhouse until the trees were lifted in order to insure a December and January lift date. However, the seedlings did not totally harden-off.

After the covers are removed, to temper the seedlings from a protected greenhouse environment to field conditions, we cover with 45% shade cloth, or saran netting, for a month or so until the fall rains begin.

5. Lifting

At the very outset of our adventure, we recognized that with 14 foot beds, lifting would be a problem. Total mechanical lifting is out of the question. We use several methods. Our initial efforts were to dig a wheel path for the rearmounted Mann lifter. This works but is time consuming and the roots are heavily damaged when hand lifted from the wheel path. We devised a side lifter which worked with very limited success. We then devised our own side-lifter with a shaker cam. The machine is still in the experimental stage but is a definite improvement. In other words, we are still working out the bugs.

We have a Mustang loader which does the job. We originally used the loader bucket which worked, but we were stripping some roots because the soil was loose but could not fall away. We purchased a hayfork attachment which did quite well. We were amazed at the extent of the root structure of bedhouse seedlings we saved when we used this device. We knew we were stripping roots with the previous methods, so we kept looking around. The Mustang with the hayfork has done a good job, but we feel the sidelifter will do it better and faster. We plan to use it as the main lifting machine when it becomes operational and use the Mustang as a backup.

## V. REFINING THE OPERATION

Sidedoors and End Panel: Once our operations developed to this point we could start refining the system. We have adopted clear flat plastic panels on a wooden frame instead of corrugated panels. This eliminates the need for an inside air seal and promises to hold up the longest. We are also replacing the ends with flat plastic. We installed handles to open the side panels. To avoid damage to seedlings when moving the houses, we installed hinged partitions at each end. These are raised up during the moving operation.

Incorporating the Utility Systems into our Operations: A great many modifications and improvements were made to these to increase efficiency.

Moving the Houses by Winching with a Skidder: This has reduced physical damage to the structure in the moving operation. It is faster than using tractors, and uses less bracing. Most important of all, it can be done in wetter conditions, which gives us greater flexibility with less soil compaction. This method works quite well. Some welds have broken and some joints have pulled apart. However, they are easily repaired.

Hand Fumigation: We can cover and fumigate a house in less than 3 hours. The results are comparable to machine fumigation and the cost this year was $356.00 per house. A year ago we contracted the work for $800.00 per house.

Organics: The key to successfully produce seedlings in one year is good soils management. We amend our soils with chicken manure and worm castings.

## VI. COSTS

The hardware was acquired at a cost of $7000 per house. Because we were experimenting and modifying while we constructed the houses, it is difficult to estimate our actual costs of construction. The most realistic estimate is our last house which was built with no changes, modifications, or stoppages, at a cost of $8400 to construct.

The utilities were a considerable cost to install, but have operated well since installation, and have incurred minimal costs. They cost $2,000 per house. Thus, at $7,000 for materials, $8,400 for labor, and $2,000 for utilities, the total costs amount to about $17,400 per house. Keep in mind this is to be depreciated over 20 years, the estimated life of the house.

Our seedlings sell for $98.00 per M. A rough breakdown is $45.00 per M for stock production, $39.00 for lifting and packing, and approximately $14.00 for energy.

VII. NEEDS

Looking to the future, we realize that a bedhouse operation is similar to any other aspect of nursery work: Nothing stays the same, no two years alike and we still don't have all the answers. With this in mind, we are contemplating the following systems or procedures be put into use:

A. Refining our Growing Techniques

We can grow excellent ponderosa pine, douglas-fir, western larch, lodgepole pine, noble fir, shasta red fir, sugar pine and grant fir. Sitka spruce show promise of being excellent. Englemann spruce has mixed results - some good and some doubtful, depending on seed source. White pine, cedar, silver fir and hemlock do not seem to be suitable for bedhouse production.

B. Equipment

We are still looking for a rolling lightweight aluminum plant to span the beds.

We have applied fertilizer and pesticides during the growing season with a hose and nozzle from a tractor mounted spray tank. We are investigating into various injection systems to use with our sprinklers, but we have no burning desire to change over as we feel our present system is fairly efficient, cost effective, and in line with our policy of keeping the operation simple.

C. Energy Efficiency

The cost of electricity in our area increased 402 last year. It will double this year. Fuel prices are going up and up. We have experimented with gasification of wood products. In the meantime, we are trying to plug air leaks, turning off heat, etc., to save a few dollars. Believe me, it is easy to save a few dollars when you are using 3500 gallons of propane a week in April if the weather turns cold.

D. Seedbed preparation

We need to level each bedhouse site to maximize efficiency, improve drainage, minimize weed and disease problems, and reduce erosion.

E. Other Uses

We also use the bedhouses for air drying of cones during our extractions season in bumper years such as 1978 and this year.

## VIII. CONCLUSION

To summarize, we began our bedhouse project in hopes of producing a low cost, plantable 1-0 seedling which would provide some short term flexibility to the reforestation program of the national forests of Washington and Oregon. As we approach the end of our fifth growing season, we have proven we can do it. Bareroot bedhouse seedlings have a place. We hope they are here to stay.