

GROWING CONTAINERIZED TREE SEEDLINGS IN A SHADEHOUSE

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ABSTRACT: Initial data indicate containerized ponderosa pine (*Pinus ponderosa*, Rocky Mountain form) tree seedlings germinated in a greenhouse in early May can be moved to a shadehouse in early June and successfully grown in Albuquerque, N.M. Data also indicate that ponderosa pine seedlings sown in early February can be removed from the greenhouse in early May rather than early June and may survive a July outplanting at the same location.

INTRODUCTION

On May 2, 1983, three baskets of seed, each containing 13 Spencer-LeMaire, Tinus (21.5 cubic inches) bookplanters, were sown at the Bureau of Indian Affairs (BIA) greenhouse in Albuquerque, N.M. A Zuni, N.M., seed source was used. Two seeds per cavity were sown. There was a crop of ponderosa pine (*Pinus ponderosa*, Rocky Mountain form) containerized tree seedlings present in the greenhouse that had been sown in early February 1983, therefore, germination conditions were not optimum. The production greenhouse currently maintains a triple crop schedule producing approximately 79,000 containerized tree seedlings per crop. The purpose of this study was to determine the potential for four crops annually. On May 3, 1983, two baskets each containing 52 containerized tree seedlings were removed from the greenhouse and placed in the shadehouse. These baskets were part of the crop that was sown in early February 1983, and were from a Zuni, N.M. seed source. It was felt that the weather was too cold to move the seedlings into the shadehouse earlier.

DISCUSSION AND RESULTS

The BIA facility in Albuquerque, N.M., is a 30' x 100' double poly nexus style greenhouse with a shadehouse approximately 100' x 100'. The fertilizer used is Peters 20-20-20 for the greenhouse, Peters 9-45-15 for after-stress and in the shadehouse, and Peters STEM for trace element addition in both the greenhouse and shadehouse.

In an attempt to determine if crop production could be increased, two baskets of seed, each containing 13 Spencer-Lemaire Tinus (21.5 cubic inches) bookplanters. were sown on May 2, 1983. These baskets of seeds were then placed with a crop of ponderosa pine containerized tree

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seedlings that were sown in early February 1983. All seedlings were from a Zuni, N.M., source.

The germinants were watered twice daily with the boom during scheduled waterings and supplemented with hand waterings for two weeks. No watering was done on the weekends.

Table 1 lists the daily temperature extremes in the greenhouse from May 2 to June 7, 1983.

Table 1.-- Greenhouse maximum, minimum, and current temperatures from 5/2/83 to 6/7/83

Date	Time	Max.	Min.	Current
5/2	0733	84	76	78
5/3	0720	80	68	71
5/4	0739	82	69	72
5/5	0727	80	70	72
5/6	0740	83	70	72
5/7	1159	78	69	76
5/8	1200	78	70	78
5/9	0729	84	70	72
5/10	0739	80	70	73
5/11	0735	82	70	73
5/12	0738	81	70	76
5/13	0740	80	70	71
5/14	0800	78	70	78
5/15	0800	79	71	78
5/16	0740	81	70	74
5/17	0735	79	70	72
5/18	0735	78	71	73
5/19	0730	78	71	74
5/20 ¹	0740	80	71	72
5/23 ²	0722	78	62	66
5/24	0735	82	63	66
5/25	0740	87	62	65
5/26	0725	84	65	66
5/27	0730	88	63	64
5/28	0800	80	63	68
5/29	0800	85	64	67
5/30	0814	80	64	68
5/31	0745	77	62	64
6/1	0735	78	60	62
6/2	0740	79	60	62
6/3	0734	80	58	60
6/4	0800	77	57	65
6/5	0800	81	58	64
6/6	0730	82	63	64
6/7	0715	78	62	63

¹Hygrothermograph clock stopped during evening of 5/20/83 and no recordings available until 5/23/83.

² May 23, 1983, the greenhouse crop was flushed then stressed: germinants were neither flushed nor stressed.

The temperatures that were maintained in the greenhouse were within the optimum range for seedlings in the "exponential" stage, but they were not optimum for "germination."

During stressing the germinants were watered Monday, Wednesday, and Friday morning, and were fertilized within one tablespoon/gallon 20-20-20.

The greenhouse crop and germinants were moved to the shadehouse on June 7, 1983.

In the shadehouse the germinants received the following:

- A. June 8 - water and fertilize with shadehouse 2 lb. 9-45-15+STEM/6 qt. water.
- B. June 10 - water from greenhouse lines.
- C. June 13 - water and fertilize with shadehouse 2 lb. 9-45-15+STEM/6 qt. water.
- D. June 15 - water from greenhouse lines.
- E. June 16 - water and fertilize with shadehouse 2 lb. 9-45-15-STEM/6 qt. water.
- F. June 17 - water from greenhouse lines, fertilize 1 tablespoon/gal. 20-20-20.
- G. June 20 - water and fertilize with shadehouse 2 lb. 9-45-15+STEM/6 qt. water.
- H. June 22 - water from greenhouse lines, fertilize 1 tablespoon/gal. 20-20-20.
- I. June 27 - water and fertilize from greenhouse lines, 1/2 lb. 20-20-20+STEM/4 qt. water.
- J. June 29 - water and fertilize from greenhouse lines, 1/2 lb. 20-20-20+STEM/4 qt. water.
- K. July 1 - water from greenhouse lines.
- L. July 4 - water and fertilize from greenhouse lines, 1 lb. 20-20-20+STEM/4 qt. water.
- M. July 6 - water and fertilize from greenhouse lines 1 lb. 20-20-20+STEM/4 qt. water.
- N. July 7 - water and fertilize from shadehouse lines, 2 lb. 9-45-15+STEM/6 qt. water.
- O. July 11 - water from greenhouse lines, fertilize 3 tps./gal. 20-20-20.
- P. July 13 - water and fertilize from greenhouse lines, 1/2 lb. 20-20-20+STEM 4 qt/ water.
- Q. July 15 - water from greenhouse lines.
- R. July 18 - begin water and fertilize from greenhouse lines, 2 lb. 20-20-20+STEM.
- S. Continue watering schedule of 7/18 on Mondays and Wednesdays, and water only from greenhouse lines on Fridays

Table 2 records the measurements of the germinants as of August 1, 1983.

Table 2.--Measurements of germinants, August 1983

Basket No.	Caliper (Inches)				
	Max.	Min.	Mean	Mode	Median
1	3/32	1/16	0.067	1/16	1/16
2	3/32	1/32	0.067	1/16	1/16
3	3/32	1/16	0.066	1/16	1/16

Basket No.	Height (Inches)				
	Max.	Min.	Mean	Mode	Median
1	4 7/8	1 1/2	3.983	4	4
2	4 7/8	1 3/4	3.635	3 1/2	3 5/8
3	5 3/8	2 1/2	3.756	3 1/4	3 1/2

Basket number 1 contained 52 seedlings, basket number 2, 51, and basket number 3 contained 50. The maximum possible number of seedlings was 52 per basket.

Containerized tree seedlings are grown for spring and summer outplanting. Seedlings sown in the summer are scheduled for outplanting the following spring. The goal of the summer sowing is to produce a seedling that would successfully overwinter in the shadehouse. Currently the seedlings are actively growing and have good secondary needle development. Chronologically, these seedlings are one month older than those in the greenhouse. They are further developed in all phases of growth than those that have been in a fully controlled greenhouse for two months.

On May 3, 1983, two baskets, each containing 52 ponderosa pine containerized tree seedlings were moved to the shadehouse. These seedlings were sown in early February 1983 from a Zuni, N.M., seed source. The seedlings were not moved to the shadehouse until low temperatures could be assured to be above 32°F.

Table 3 details daily Fahrenheit temperature ranges in the shadehouse.

Table 3.--Daily maximum, minimum, and current shadehouse temperatures from 4/29 to 6/7/83

Date	Time	Max.	Min.	Current
4/29	1553	85	39	85
5/2	1615	87	35	66
5/3	1630	88	33	74
5/4	1558	92	33	87
5/5	1615	90	36	88
5/6	1556	87	40	80
5/9	1617	88	40	80
5/10	1610	83	45	83
5/11	1602	91	40	87
5/13	1605	90	36	80
5/16	1613	88	34	82
5/17	1610	82	32	62
5/18	1618	86	34	84
5/19	1630	82	38	64
5/20	1618	83	46	64
5/23	1610	92	38	87
5/24	1610	92	46	92
5/25	1612	98	47	83
5/26	1609	97	53	86
5/27	1612	100	52	88
6/1	1610	90	45	88
6/2	1620	90	64	88
6/3	1622	93	46	90
6/6	1604	98	42	88
6/7	1616	92	50	90

Temperatures were recorded from a maximum/ minimum thermometer located on the north end of the shadehouse. The thermometer was not set up according to Weather Service specifications. The 50% shade provided by the shadehouse did not prevent the thermometer from being exposed to direct sunlight, therefore, the day time highs are "sun" temperatures. The low temperatures may be considered representative.

One value of the temperature recordings is to demonstrate the temperature extremes the seedlings in the shadehouse experienced. Recordings were stopped on June 7 because a freeze was no longer considered a possibility and the purpose of recording temperatures was to document any freeze that occurred.

Table 4 records the maximum, minimum, mean, mode, and median for height and caliper in inches from two baskets of seedlings from the crop sown in February 1983 and moved to the shadehouse May 3, 1983. The measurements were taken on August 1, 1983.

Table 4.--Measurements of seedlings removed from the greenhouse 5/3/83 as of 8/1/83.

Basket No.	Caliper (inches)				
	Max.	Min.	Mean	Mode	Median
1	3/8	1/16	0.157	1/8	5/32
2	7/32	3/32	0.144	1/8	1/8

Basket No.	Height (inches)				
	Max.	Min.	Mean	Mode	Median
1	7	2 1/2	4.865	5.25	4.75
2	6 7/8	2	4.03	4	4

Basket number 1 contained 52 seedlings and basket number 2 contained 50. The maximum possible mother of seedlings per basket was 52.

The seedlings removed in May are shorter and have much woodier stems than those removed from the greenhouse in June.

The seedlings in the shadehouse were watered Monday and Thursday mornings and fertilized with 2 lbs. 9-45-15+STEM/6 qts. water through the shadehouse lines along with the rest of the shadehouse seedlings. These seedlings were moved back into the greenhouse on May 23, 1983, for flushing and stressed in the shadehouse. The Monday and Thursday watering 9-45-15 fertilizer was reinstated after stressing.

Table 5 records the maximum, minimum, mean, mode, and median of baskets from the crop sown in early February 1983, and moved to the shadehouse on June 7, 1983.

Table 5.--Measurements of seedlings removed from the greenhouse 6/7/83 as of 8/1/83

Basket No.	Caliper (inches)				
	Max.	Min.	Mean	Mode	Median
1	3/32	1/16	0.119	1/8	1/8
2	5/32	3/32	0.124	1/8	1/8

Basket No.	Height (inches)				
	Max.	Min.	Mean	Mode	Median
1	7	3	4.954	4	5 1/4
2	7	2	5.02	4 1/2	5

Basket number 1 contained 52 seedlings and basket number 2 contained 52. The maximum possible was 52 seedlings.

CONCLUSION

Initial results indicate the potential for four crops of containerized ponderosa pine tree seedlings annually at the BIA greenhouse facility in Albuquerque, N.M. The smaller seedlings should survive the harsh planting sites in New Mexico, but only a survival study can determine this field survival and growth is the bottom line. One month, early May to early June, growth in a greenhouse with subsequent shadehouse growth appears to be enough to produce a seedling that will overwinter in a shadehouse in Albuquerque, N.M. During an on-site inspection by Dr. Richard W. Tinus on July 20, 1983, he stated that these conclusions at that time seemed to be valid.

The purpose of this paper is to indicate the possibility of increasing crop production from three to four crops annually at the BIA greenhouse in Albuquerque, N.M. The problems of an administrative study in a production greenhouse are obvious. While all selections made were random, 2 baskets out of 1,523 may not be a large enough sample, therefore, a statistical analysis was not performed. The potential may exist, however, and therefore further research is needed.

ACKNOWLEDGEMENTS

Special thanks to Dr. Richard W. Tinus for an on-site inspection to the BIA Greenhouse facility and providing deeply appreciated comments.

In: Murphy, Patrick M., compiler. The challenge of producing native plants for the Intermountain area: proceedings: Intermountain Nurseryman's Association 1983 conference; 1983 August 8-11; Las Vegas, NV. General Technical Report INT-168. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1984. 96 p.