ROOTING MONTEREY PINE CUTTINGS

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The Monterey pine *(Pinus radiata)* seedling tree is used extensively in Southern California landscaping and is also the major species used for choose-and-cut Christmas tree farms in this area. These seedlings differ considerably in their growth habits, appearance, and resistance to air pollution. After a severe air pollution attack, the trees will vary from no apparent damage to slightly yellow tips on the needles to branches and entire trees which have turned yellow. Trees have occasionally turned completely brown and died. Apparently, seedling trees have different degrees of susceptibility to different types of air pollution. The search for trees with good vigorous growth habits and a beautiful appearance that are resistant to air pollution led to the interest in producing Monterey pine trees from cuttings.

Fred Dorman, whose Christmas tree farm is located in Highland, California, has been a leading grower in the search for better trees and the best methods to produce the cuttings. Mr. Dorman selected 17 of his best "Mama" trees to be used in a trial which began May 19, 1972 at Monrovia Nursery, Azusa, California. Results of that trial are shown in Table 1. Note the wide variation in percentage of rooted cuttings. We took plants of the nine trees that rooted the best, which included some that Mr. Dorman thought were his very best "Mama" trees, and transplanted them into gallon cans in January, 1973, for further evaluation.

Table 1. Rooting trial[1] of Monterey pine cuttings taken from selected source trees at Fred Dorman farm, Highland, California, Monrovia Nursery.

Selection No.	Rooted Cuttings	Total Cuttings	Percent Rooted
104-105	42	53	79.2
110-104	54	75	72.0
113-96	37	56	66.0
96-89	52	79	65.8
109-84	20	36	55.6
92-56	39	72	54.2
97-98	32	65	49.2
104-118	28	62	45.2
55-76	32	75	42.7
112-71	20	54	37.0
105-113	25	68	36.8
110-118	19	58	32.8
111-69	17	58	29.3

Table 1. (cont.)

Selection No.	Rooted Cuttings	Total Cuttings	Percent Rooted
107-124	20	84	23.8
12-28	14	79	17.7
101-113	3	75	4.0
101-75	1	59	1.7
TOTAL	455	1,108	41.1 (average)

[1]Cuttings made May 19, 1972, placed outdoors under mist — bottom heat 72°F. Cuttings moved August 24, 1972 for hardening-off under Saran with mist about every half hour from 9 to 3 p.m., depending on weather. Cuttings lifted September 13, 1972 and planted in four-inch pots.

Nine trees from selections above the center line transplanted into gallon cans in January, 1973, for observation at the Research Center, Monrovia Nursery.

We kept a record of height measurements, made notes regarding necessary pruning for Christmas trees, and kept a record of the trees' appearances and reactions to air pollution. The results are shown in Tables 2 and 3. It is interesting to note that we had

Table 2. Height growth (inches) of cuttings taken from the three best Monterey pine selections, Monrovia Nursery.

	Selection Number		
Date	55-76	109-84	96-89
Jan. 24, 1973	6.9[1]	5.6[2]	7.0[2]
April 10, 1973	10.9	9.6	10.0
Transplanted to three-gallon cans June 1973.			
June 19, 1973	14.8	13.1	12.5
Aug. 14, 1973	18.7	21.4	17.8
First pruning where necessary.			
Sept. 25, 1973	30.9	31.4	27.5
First leader pruning, cut at 14 inches if no whorl.			
	1 leader cut	2 leaders cut	no leaders cut
Nov. 28, 1973	35.4	32.8	29.5 — bef. prng.
Nov. 28, 1973	29.4	no pruning	28.0 — aft. prng.
	6 leaders cut		5 leaders cut
Transplanted to seven-gallon cans March 1974.			
March 12, 1974	33.9	36.0	31.1 — bef. prng.
March 12, 1974	31.3	no pruning	30.4 — aft. prng.
	3 leaders cut		2 leaders cut
July 2, 1974	42.4[3]	69.9	61.5 — bef. prng.

[1]Average of nine trees;
[2]Average of ten trees;
[3]Heavily pruned for cuttings.

Table 3. Evaluation of cutting performance of three Monterey pine selections. Research Center, Monrovia Nursery

Selection Number	Growth (Inches) 1/24-8/14/73	Color	Rating
55-76	11.8	Darkest green	Best tree.
109-84	15.8	Medium green	Very vigorous tree; open-type growth; good for landscape tree.
96-89	10.8	Med. to dark green	Third best tree.
Trees of the following six selections were discarded for the following reasons:			
104-118	19.0	Light green	Long, thin, open growth.
113-96	15.0	Medium green	Parent tree dev. air pollution damage at 5 yrs. of age.
110-104	12.8	Med. to dark green	Poorest tree for apical dominance. Parent tree showed ozone damage.
92-56	11.5	Dark green	Parent tree dev. air pollution damage.
97-98	10.5	Considerable chlorosis	Susceptible to air pollution, ozone-type damage.
104-105	10.1	Brown and chlorosis	Very susceptible to air pollution; both types of air pollution damage.

beautiful, three-foot-tall trees within two years after starting our cuttings. By July, 1974, after the spring flush of growth, many of the trees were over six feet tall.

For landscaping, selection 109-84 is a beautiful open tree with practically no pruning necessary; however, it might not be first choice for a Christmas tree farm even though it was the fastest grower. Selection 55-76 was rated best overall for Christmas tree farms. It had the darkest green color but did require considerable pruning. Selection 96-89 was not quite as good in color and also required a good deal of pruning for a Christmas tree. There are two other good selections: 113-96 and 92-56. However, although the cuttings showed no air pollution damage, the parent trees did show damage by the time they were five years old. They might warrant further study for Christmas trees, which are normally harvested when three years old, but would not be satisfactory as landscape trees. It should be noted that it takes about one year from the time the cutting is started until it is about one-foot tall in a gallon can. Normally, the cuttings would be made in January, ready to set out in the farm or to sell to retail nurseries one year later.

There were four other rooting trials at Monrovia Nursery of various selections taken from Mr. Dorman's farm. One was in October, 1972, but the results were not as good as the first trial. The

next three trials were all made late in the year: April, June and July, 1973; again, the results were poorer than the first trial. This was not the fault of the nursery. Cuttings in these small trials had to be placed under the same mist irrigation line as other plants. The needs of the other plants determined the frequency of the mist, which was an insufficient amount for the Monterey pine cuttings. Another reason for the poor results, especially in those trials taken late in the year, was the lack of maturity of the wood. The immature succulent wood did not root well.

In January, 1974, we started a trial with cuttings from the top three Monterey pine selections at the K & Y Nursery, Gardena, California. The flats of cuttings were placed in a greenhouse with some over heating cables (72°F) while other flats of cuttings had no bottom heat. To help with the rooting, the basal end of some cuttings were dipped in a 3 percent IBA solution, and all others were dipped in a 1.6 percent IBA solution. The results are shown in Table 4.

Table 4. Rooting trial of Monterey pine cuttings taken from three best selections at Fred Dorman farm, Highland, California. K & Y Nursery.

Rooting percentage[1]		
55-76	109-84	96-89
3% IBA — No Cable	3% IBA — No Cable	1.6% IBA — 72°F Cable
34.4	46.9	40.6
37.5	53.1	50.0
43.8	65.6	59.4
59.4	68.8	62.5
Av. 43.8	Av. 58.6	81.3
1.6% IBA — 72°F Cable	1.6% IBA — 72°F Cable	Av. 58.8
43.8	43.8	1.6% IBA — No Cable
43.8	1.6% IBA — No Cable	43.8
46.9	40.6	50.0
53.1	46.9	56.3
59.4	46.9	56.3
59.4	53.1	56.3
Av. 51.1	56.3	56.3
	56.3	62.5
1.6% IBA — No Cable	59.4	65.6
46.9	71.9	68.8
53.1	Av. 53.9	Av. 57.3
56.3	Total av. 54.6 — 1st lift	Total av. 57.8 — 1st lift
65.6	Plus 21.8 — 2nd lift	Plus 3.6 — 2nd lift
71.9	Overall av. 76.4	Overall av. 61.4
75.0		
75.0		
Av. 63.4		
Total av. 54.4 — 1st lift		
Plus 7.7 — 2nd lift		
Overall av. 62.1		

[1]Percent rooted cuttings out of 32 cuttings in one-half of a flat. Cuttings made January 21, 1974; first lifting 11 weeks later, April 9, 1974; second lifting 4 weeks later, May 7, 1974.

We checked air temperatures in the greenhouse during the daytime and found they were averaging about the same as the heating cable — 72°F. Of course, at night air temperature was lower than the cable temperature. The results show that cuttings from selection 55-76 had a higher rooting percentage with no bottom heat than with the heating cable. Selection 96-89 was about the same. There was no good comparison for selection 109-84 since only one flat had a cable. As far as the IBA treatment was concerned, the higher dosage substantially lowered the rooting percentage for selection 55-76 and raised it slightly for selection 109-84. There was no comparison for selection 96-89. Results from other trials have shown that high concentrations of IBA either had no effect or reduced the amount of rooting. This trial was lifted too early — after just 11 weeks. We had good results, but many of the cuttings were just ready to root when we lifted them. We replaced those cuttings and lifted them again four weeks later, thereby getting more roots, which brought the overall averages up to very good percentages.

We started a second trial with the same top three selections at K & Y Nursery during March, 1974. The results are shown in Table 5. These results are included to show what can happen when a drainage problem occurs.

Table 5. *Rooting trial of Monterey pine cuttings taken from three best selections at Fred Dorman farm, Highland, California. K & Y Nursery.*

Rooting Percentage[1]					
55-76		109-84		96-89	
53.1		29.7		3.1	
53.1		50.0		18.8	
56.3		53.0		28.1	
64.1		56.7		31.3	
71.9		59.4		34.4	
73.4	Av.	49.8	Av.	23.1	
78.1					
79.7					
81.3					
Av. 67.9					

[1]Percent rooted cuttings out of 64 cuttings in a flat. Cuttings made March 26, 1974 and lifted 14 weeks later on July 2, 1974.

During this second trial, a drainage problem developed and most of the first set of roots were killed. The results shown in Table 5 are primarily from the second set of roots. Selection 55-76 was not hurt as much as the other two. It was affected, but many of the flats had excellent rooting. Selection 96-89 had many succulent cuttings, and they were most affected. The lower rooting percentages in 109-84 were due to succulent cuttings.

These trials emphasize that Monterey pine cuttings need frequent mist and excellent drainage. Bottom heat produces roots much faster than without added heat. While succulent cuttings did root, we had best rooting with wood that was more mature and pencil-sized. Cuttings larger in diameter showed more decay and had lower rooting percentages. We feel we have selected three excellent trees as sources for cuttings that will root with high percentages under good conditions.

We are proposing a large-scale, one-half acre plot or more at the University of California South Coast Field Station to compare cuttings from selections 55-76 and 109-84 with Monterey pine and *Pinus brutia* seedlings.

In our study of Monterey pine cuttings and work with Monterey pine seedlings (presently used primarily for Christmas tree farms and landscape in southern California), we discovered a disease which can be devastating to Monterey pines. Because these trees are very susceptible to it, *Phytophthora* fungus can be a serious problem for young cuttings, seedlings, and mature trees. The problem develops when too much water is used at one time or when there is poor drainage. In trials at the University of California, Riverside with Monterey pine seedlings, when this fungus was introduced in water culture and compared with clean cultures, there was a marked decrease in growth of the tree tops before any symptoms appeared. Many of the small roots were already destroyed at this point. As fungus development progresses, the trees become chlorotic and wilt. If the condition is noticed soon enough and water is used sparingly, the trees will recover. By the time the condition is noticed in small trees in containers, it is usually too late — these trees will die. We have not found any trees that show any resistance to *Phytophthora*. This is another good reason why water must be applied carefully to these cuttings and trees and why good drainage must be provided.

We have also noticed that good seedlings placed in poor soil are more vigorous than young trees grown from cuttings and placed in poor soil. This might lead to the conclusion that cuttings are not as good as seedlings. However, if special care is given to fertilization on light soils and careful watering on both light and heavy soils, cuttings will do as well as seedlings.

MODERATOR MAIRE: Thanks for a good presentation, Dick. We will now hear from Doug Christie, manager of Corbett's Nursery, Aldergrove, British Columbia, reporting on the nursery industry in Finland and Sweden based on his recent visit to these countries. Doug.