RICHARD ZIMMERMAN: So far they have been satisfactory. The first had an enormous amount of callus and we thought that this was what we did not want. As it turned out those were the only cuttings that rooted. Those were the tallest apple plants that I showed in the talk.

VOICE: Could you review how long it took you to get the 1800 strawberry plants mentioned in your talk?

RICHARD ZIMMERMAN: It takes 8 to 9 weeks from the initial meristem isolation to have material ready to go into the multiplication stage. At that point you have a culture that can be divided into 2 pieces; you would then subculture at 3 week intervals. Rooting requires 4 weeks and this is followed with a growing on period of 4 weeks. Starting in April with well established cultures, 1800 strawberry plants were produced by September.

Thursday Afternoon, November 30, 1978

The Thursday afternoon session convened at 2:00 p.m. with Burke McNeil serving as moderator.

PROPAGATION OF UMBRELLA PINE — CLONAL DIFFERENCES IN ROOT INITIATION[1]

SIDNEY WAXMAN

University of Connecticut
Storrs, Connecticut 06268

The Japanese umbrella pine, *Sciadopitys verticillata*, has long been considered extremely difficult to propagate by cuttings (4). Lowry (2), reported rooting less than 14 cuttings out of a total of 1100 taken. DeFrance (1) was more successful and obtained 50% rooting in 1938. Waxman (4) reported a relationship between the stage of plant development and the ease of root initiation. Cuttings taken after the chilling requirements were partially or completely satisfied had the highest rooting percentage. The recommended period for taking cuttings was from January through March.

Subsequent attempts to root Sciadopitys cuttings have given highly variable results even though the cuttings were taken during the recommended period. A considerable number

[1] Scientific Contribution No. 748, Storrs Agricultural Experiment Station, University of Connecticut, Storrs, Connecticut 06268.

of tests were carried out using a wide range of rooting hormones, concentrations and methods of applying them. The treatments found to be most effective were those in which the bases of the cuttings were submerged in dilute IBA aqueous solutions for periods ranging from 24 to 72 hours (Table 1). Treatments in which the base of the cuttings was given a brief concentrated dip (2000 ppm IBA) or dusted with 8000 ppm IBA in talc were not as effective. These results (Table 1), and others that followed, gave evidence that it was the method of application rather than the concentration of rooting hormones that was crucial to root initiation.

Table 1. Effect of IBA concentration and methods of application on the rooting of *Sciadopitys verticillata* cuttings.[1]

Treatment	Percent Rooted	Average No. Roots per Rooted Cutting
Control	20	1.0
8000 ppm IBA in talc	20	4.0
200 ppm IBA dilute submergence (24 hours)	80	17.1
2000 ppm IBA dip	10	4.0

[1] 10 cuttings/treatment, wounded and placed under mist.

In almost all instances, those cuttings in which the bases had been submerged in a dilute solution of IBA for 24 to 72 hours invariably had higher rooting percentages, and the greatest numbers of roots, compared to cuttings treated with concentrated dips or with talc preparations. Also, control cuttings, whose bases were submerged in water (without hormones) often had higher percentages than the various hormone-treated cuttings that were not submerged.

Immediately upon the severing of an umbrella pine cutting there is a discharge of white resin oozing out of the 13 resin ducts located in the phloem. A relatively large amount of resin emerges in hair-like strands when the cuttings are immersed in water. Under these conditions the resin falls away from the cut surface and drops to the bottom of the container. The exudation of resin can go on for several days, emerging rapidly during the first three minutes and slowly thereafter. If the freshly-made cuttings are not submerged, the emerging, sticky resin will gradually accumulate and adhere to the cut surface of the cutting.

It is conceivable that this substance may inhibit the rooting possibly by physically blocking movement of water, oxygen, and carbon dioxide.

The purpose of the present research, therefore, was to determine: if there are differences in rooting among clones; if

resin is associated with rooting; if there are seasonal differences in rooting and in resin production; and if there is a correlation between them.

MATERIALS AND METHODS

Root Initiation. Ten cuttings were taken at monthly intervals from each of ten 15-year-old umbrella pines. Five cuttings from each clone were wounded with the point of a knife, treated with 3000 ppm IBA (Hormodin No. 2) and Captan (10%) and placed directly into a peat moss and perlite (1:1) medium. The remaining five cuttings were wounded as above but were then suspended for 48 hours in a pan of water (under mist) in which only the lower two inches of the stems were submerged. Upon removal from the water, the cuttings were allowed to dry and were then treated with IBA and Captan as above. All cuttings were maintained under a mist system that was operated by a light-intensity-activated controller. A minimum temperature of 22°C (71.6°F) was maintained in the rooting medium throughout the study. Data on root initiation was taken approximately six months after insertion.

Resin Weight Determination. At monthly intervals five cuttings of uniform length (3 inches) were taken from each clone and immediately inserted into vials of water and then placed under a mist system. After 18 hours, the resin exudate that had fallen from the cuttings to the bottom of the vials was placed on previously weighed filter papers. The filter papers were then dried and the differences in weights between filter paper and filter paper plus resin were recorded.

RESULTS AND DISCUSSION

Clonal Variation in Rooting. There was a wide range in rooting response among the ten clones (Table 2). Differences in rooting percentages ranged from 0 to 100% among the control group. Clones 6 and 9 were difficult to root, not only in this test but in all the others taken throughout the year.

Differences in numbers of roots per cutting ranged from 0.2 for clone No. 9 to 12.0 for clone No. 8. Clones 1 and 8 consistently produced the greatest numbers of roots in this experiment as well as in all the others. Mean root lengths ranged from 0.3 to 6.4 cm, with clones 1, 2, and 8 among the highest.

Resin Removal and Rooting. The removal of resin, by submerging the bases of the cuttings in water, significantly improved all three aspects of rooting. Rooting percentages, root numbers and root lengths were all increased as a consequence of the removal of the resin.

Seasonal Aspects of Rooting in Relation to Resin Exudation.

Table 2. Clonal variation and effect of resin removal on rooting cuttings of *Sciadopitys verticillata*[1].

	Percent Rooted									
Clone:	1	2	3	4	5	6	7	8	9	10
48 hr. Submergence -	100	100	80	100	100	100	100	100	40	80
Control -	60	100	40	40	40	0	60	80	20	60

	Average Number Roots/Cutting									
Clone:	1	2	3	4	5	6	7	8	9	10
48 hr. Submergence -	24.6	16.0	10.0	20.2	21.0	14.6	23.0	20.6	1.8	9.4
Control -	7.8	7.2	2.4	3.2	0.8	0.0	6.8	12.0	0.2	3.0

	Average Root Length (cm)									
Clone:	1	2	3	4	5	6	7	8	9	10
48 hr. Submergence -	7.9	7.9	4.4	7.0	9.4	8.2	10.9	8.4	2.0	5.2
Control -	4.2	5.9	2.2	2.3	0.3	0.0	4.7	6.4	1.4	3.0

[1] 2/4/76 - 8/11/76 5 cuttings/treatment.

The highest levels in rooting occurred in February and March and again in July and August (Table 3). Associated with high rooting levels were low resin levels. Also, on those dates during which rooting was poorest, resin levels were highest. There is a significant negative correlation between resin exudate and rooting percentages at the 5% level.

Table 3. Seasonal aspects of rooting cuttings of *Sciadopitys verticilliata* in relation to resin exudation.

Date	Percent Rooted[1]	Resin[2]	
		Date	Weight/Cutting (gr)
2/11/76	50		
2/24/76	90	2/24/78	.0981
3/16/76	86	—	—
3/31/76	80	3/31/78	.1363
4/13/76	42	5/ 5/78	.4064
6/ 2/76	55	6/13/78	.3316
7/12/76	88	7/21/78	.1054
8/28/76	80	8/25/78	.1266
9/15/76	64	—	—
10/13/76	50	10/19/78	.1054
11/ 9/76	68	11/19/78	.2394
12/14/76	34		
1/21/77	68		

[1] Average of 10 clones, 50 cuttings/date
Treatment: Hormodin No. 2 and Captan (not submerged) mist.

[2] Average weight in resin exudate/cutting from the above clones.

LITERATURE CITED

1. DeFrance, J. A., 1939. Propagation of *Sciadopitys verticillata* with root inducing substances. *Proc. Amer. Soc. Hort. Sci.* 36:807.
2. Lowry, W. J., 1932. Propagation of *Sciadopitys verticillata*. Sieb and Zucc. Massachusetts State College, M.S. Thesis.

3. Waxman, Sidney, 1957. Effects of daylength on the germination of *Sciadopitys verticillata*. *Proc. Inter. Plant Prop. Soc.* 7:71-72.
4. Waxman, Sidney, 1960. Propagation of *Sciadopitys verticillata*. *Proc. Inter. Plant Prop. Soc.* 10:178-181.

PETER ORUM: Are the cuttings completely submerged or are only the cutting bases?

SYDNEY WAXMAN: Only 2 inches of the stem are submerged.

BILL FLEMER: Do the rooted cuttings reproduce the original plant form?

SYDNEY WAXMAN: They reproduce the parent form. There is no need to stake them.

CARMINE RAGONESE: Is there any special position on the plant that you take cuttings from?

SYDNEY WAXMAN: We take them from all areas with no problems.

VOICE: Do you have any problem breaking dormancy in the spring?

SYDNEY WAXMAN: None. We pot the cuttings up after they are rooted and put them in a cold frame after a short stay in the greenhouse.

JOERG LEISS: Does the cutting location have any influence on resin production?

SYDNEY WAXMAN: No, it is the cultivar.

RICHARD FENICCHIA: Are the cuttings from current season's growth?

SYDNEY WAXMAN: Yes. Two-year cutting wood will also root.

VOICE: What type of auxin treatment do you give the cuttings?

SYDNEY WAXMAN: We treat the cuttings with Hormodin 2.

PROPAGATION OF RHODODENDRONS FOR SOUTHERN ONTARIO

A. W. SMITH

Horticultural Research Institute of Ontario
Vineland Station, Ontario, Canada

The program for the development of hardy rhododendrons for southern Ontario had its beginning in 1958 at the Horticultural Research Institute of Ontario, Vineland Station, Ontario.