Germination of High Elevation Manzanitas

Tests Show that Greenleaf Manzanita Seed can be Germinated easily in the Greenhouse with 40-50 Percent Success

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Extensive land development in California's Sierra Nevada country, particularly in the Lake Tahoe resort area, has created a need for propagation information on native shrubs for revegetating disturbed sites. Among the most important are two manzanitas, *Arctostaphylos patula* Greene, greenleaf manzanita and A. *nevadensis* Gray, pinemat manzanita. Although relatively easy to propagate from cuttings, propagation of the two species from seed has been inconsistent.

Published data on seed propagation of these species is sketchy. Mirov (2) reports a maximum 5 percent germination of pinemat manzanita seed using sulfuric acid scarification and prolonged 5°C cold stratification. There were 173 days between sowing and germination. Using similar treatments, the U.S. Forest Service (3) obtained 16 percent germination of greenleaf manzanita seed and suggested warns stratification may improve germination. Emery (1) reports variable response of the *Arctostaphylos* genera to burning, sulfuric acid, stratification, or mulching. Prolonged periods between sowing and germination were required with burning and mulching. Mirov (2) attributes low germination percentage to poor seed quality and suggests that different seed lots might give better results.

Despite scarcity of information, the literature indicates two basic requirements for germination: seedcoat scarification and breaking of internal dormancy with cold stratification. The purpose of this study was to test germination of greenleaf and pinemat manzanita seed using sulfuric acid scarification plus cold stratification, and cold stratification combined with warm stratification.

Materials and Methods

Seed source.-Greenleaf manzanita (accessions PI. 141-72 and LK189) was collected in August, 1972 and 1973, from two sites in the Tahoe Basin. One accession, PL 14172, received summer irrigation. In August, 1972, pinemat manzanita (PL 133-72) was collected in the John hluir Wilderness Area at 8,500 feet. In August, 1973, additional Feed was collected in the Tahoe Basin (LK-263) and received from the National Park Service, Crater Lake, Oregon (ıLK-212). All seed lots were cleaned and stored at 21°C for 3 months. Pinemat manzanita seed was highly variable in size and shape, whereas greenleaf seed was uniform.

Experiment 1.-Two acid scarification treatments were imposed on both species, PL 141-72 and PL 133-72, to ascertain proper seedcoat scarification.

Treatment 1 consisted of treating a 50_0 -lot of each species with 400 ml concentrated sulfuric acid (sp. gr. 1.81). Each lot was stirred every 5 minutes. The acid was drained off and replaced with fresh material after 30 and 60 minutes. Ten seeds of both species were removed from solution at 60 minutes and subsequent 15-minute intervals. Samples were washed with water and tested for seedcoat thickness, determined by the ease with which seed was cut by an ordinary kitchen knife. Each sample was deemed soft when 70 percent were easier to cut than untreated 10-seed sample.

Treatment 2 consisted of changing the acid after 45 minutes, washing the seed in water for 10 minutes, removing the carbon residue, drying it between paper towels for 20 minutes, and reimmersing it in acid. Seed samples were taken at 15minute intervals, beginning 60 minutes after initial immersion in acid.

Experiment 2.-Treatment 1 of the acid experiment was imposed on small samples of LK-189, LK-212, and LK-263. From this sample test, 50-gram seed lots of each accession were soaked in acid for 120 minutes. After draining off the acid, the seed was washed in water for 30 minutes, scrubbed to remove the carbon residue, and soaked in water, 21°C, for 36 hours.

The following treatments were imposed on water soaked scarified seed to investigate the internal dormancy requirement. Four 10 g lots of each accession were mixed with moist vermiculite, put into separate small plastic bags, and loosely sealed. Stratification treatments for each accession were: (1) 90 days at 5.5°C; (2) 15 days at 18-25°C, 75 days at 5.5°C: (3) 30 days at

18-25°C, 60 days at 5.5°C; (4) 45 days at 18-25°C, 45 days at 5.5°C; (,5) no stratification. In addition a 10 g unscarified seed lot was stratified for 90 days at 5.5°C, and another received no stratification. After treatment, 400 randomly selected seeds of each lot were planted in two 22cm X 41 cm X 9 cm flats split into 4 replications. The potting mix used was 1 part sand and 1 part peat moss, limed to pH 6.0. Nutlets cohering as a whole or partial stone were considered one seed.

After planting, pots and flats were watered lightly each day for 30 days and alternate days thereafter.

Germination counts were recorded at planting and at 10, 14, 21, 35, and 42 days thereafter.

Results

Experiment 1, Scarification Seeds in treatment 1 took longer to scarify than those in treatment 2. See Table 1. Pinemat manzanita scarification was difficult. Viable seed was destroyed before 70 percent of the seed was soft in both treatments. For a given duration of immersion in acid, only a small percentage of seed was soft and, at the same time, undamaged.

Acid penetrated the seedcoat of greenleaf manzanita and, to some extent, pinemat in the area around the micropyle more rapidly than in any other area. This occurred in whole and partial stones as well as individual nutlets.

*Experiment 2, Stratification.*Seed of both species began to swell and burst after 20 or more days of 5.5°C in all stratification treatments. A few of these seeds were excised and placed in a petri dish for observation. The cotyledons were damaged slightly at the tip next to the micropyle, indicating penetration by the acid. The excised embryos proceeded to extend their radicles. In the case of two lots of greenleaf, germination occurred during stratification.

Germination of all lots commenced within 16 days after planting, except those that did not germinate at all. Germination activity generally leveled off after 30 days. Germination of greenleaf was much greater than pinemat manzanita (See table 2). For greenleaf manzanita, highest germination was achieved with scarified seed and cold stratification. Pinemat germination did not exceed 2.3 percent. Response of pinemat to different stratification treatments was not clearly delineated.

Discussion

Effective seedcoat scarification occurred when the micropyle was enlarged enough to permit water imbihition without severely injuring the cotyledons during acid treatment. This phenomenon was much less prevalent with pinemat because of its irregular seedcoat shape.

Washing the seed with water during acid treatment improved the scarifying action of the acid. The heat buildup in the solution was noticeably increased and carbon residue formed more rapidly, producing a foam. This implies that seed with a high moisture content, such as freshly picked seed, takes a shorter time to scarify than older well-dried seed. This may account for the variable lengths of suitable acid treatment indicated in the literature and experienced by other propagators.

Since moisture and other factors may influence the speed with which the acid affects the seedcoat, close observation during acid treatment provides the best guide for length of seed exposure to the acid. Using seed stored in a dry place for at least 3 months after collection would probably result in more predictable scarification.

The Forest Service (3) points out that manzanita nutlets adhering as partial or whole stones exhibit poorer germination than individual nutlets. Although no factual data were compiled, partial or whole stones seemed to germinate as well as individual nutlets, particularly with greenleaf manzanita. This was not surprising because scarification

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TABLE 1.—Experiment 1. Effect of concentrated sulfuric acid on seedcoat hardness of Arctostaphylos patula *(ARPA) and* Arctostaphylos nevadensis *(ARNE)* [1]

Species	Minutes												
	60	75	90	105	120	135	150	165	180	195	210	225	240
Treatment 1—Acid drained and replaced with fresh material after 30 and 60 minutes													
ARPA PL 141–72	1	1	1	1	1	1	2	2	2	2	3	3	3
ARNE PL 133–72	1	1	1	1	1	1	1	1	1	1	1	3	3
Treatment 2—Acid drained after 45 minutes, seed washed, dried, and re-immersed													
ARPA PL 141–72	1	1	1	1	2	2	3	3	3	3	–	–	–
ARNE PL 133–72	1	1	1	1	1	1	1	1	3	3	–	–	–

[1] Hardness assessed against an arbitrary scale of 1 to 3: 1 = greater than 30 percent hard seed, 2 = greater than 70 percent soft seed, less than 30 percent seed destroyed, 3 = greater than 30 percent seed destroyed.

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The pruning levels had no significant effect upon final shoot/root ratio, no significant effect upon diameter growth on either site, and no significant effect upon average leaf size or leaves per seedling.

It is evident from these results that proper ratios of shoot and root pruning have not caused a loss in height growth under these conditions. Yet, removal of the excess shoot and root material prior to seedling planting can improve uniformity of planting and facilitate handling, especially by mechanical planters.

If shoot and root pruning is feasible at the nursery, a reduction in shipping costs would also be possible. Thus if a proper balance in the shoot/root ratio is maintained when pruning, both a cost saving and performance increase may be possible.

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(Continued from page 11) around the micropyle was just as evident with the stones as with individual nutlets.

The results demonstrate the importance of a high-quality seed source. Greenleaf manzanita seed was considerably superior to pinemat seed. One source of greenleaf seed came from irrigated shrubs, which may have contributed to higher viability. Finding a good pinemat manzanita seed source is probably the greatest obstacle to successful germination.

Based on the data, it is likely that greenleaf manzanita can be germinated easily in the greenhouse with 1-0-50 percent success. Key factors in optimum germination are a good seed source, closely monitored scarification, removal of the carbon residue from the seedcoat after scarification, and adequate moisture during stratification.

Pinemat manzanita seed germinated poorly. Further testing is needed to provide guidelines for obtaining uniform, viable seed in the field and optimum stratification requirements.

TABLE 2.—Experiment 2. Germination of Arctostaphylos patula *(ARPA) and* Arctostaphylos nevadensis *(ARNE)*

	Seedling counts							
Species	Planting	10 da	14 da	21 da	28 da	35 da	42 da	%
No treatment								
ARPA LK-189	0	0	0	0	0	0	0	0.0
ARNE LK-212	0	0	0	0	0	0	0	0.0
ARNE LK-263	0	0	0	0	0	0	0	0.0
90 days stratification at 5.5°C								
ARPA LP-189	0	7	13	26	26	26	27	6.8
ARNE LK-212	0	0	1	1	1	1	1	0.3
ARNE LK-263	0	0	0	0	0	0	0	0.0
H_2SO_4 scarification, 90 days stratification at 5.5°C								
ARPA LK-189	50	60	79	136	157	168	174	43.5
ARNE LK-212	0	0	0	1	1	1	1	0.3
ARNE LK-263	0	1	1	1	1	1	0	0.3
H_2SO_4 scarification, 15 days stratification at 18-25°C, 75 days at 5.5°C								
ARPA LK-189	29	45	53	100	108	110	113	28.3
ARNE LK-212	0	5	5	4	4	4	4	1.3
ARNE LK-263	0	0	0	0	0	0	0	0.0
H_2SO_4 scarification, 30 days stratification at 18-25°C, 60 days at 5.5°C								
ARPA LK-189	0	12	18	62	64	64	64	16.0
ARNE LK-212	0	1	3	9	9	9	9	2.3
ARNE LK-263	0	1	2	2	3	3	3	0.8
H_2SO_4 scarification, 45 days stratification at 18-25°C, 45 days at 5.5°C								
ARPA LK-189	0	1	14	39	42	44	41	11.0
ARNE LK-212	0	0	0	0	0	0	0	0.0
ARNE LK-263	0	0	0	1	1	1	1	0.3
H_2SO_4 scarification, no stratification								
ARPA LK-189	0	0	0	0	0	0	0	0.0
ARNE LK-212	0	0	0	0	0	0	0	0.0
ARNE LK-263	0	0	0	0	0	0	0	0.0