TWO ACIDS EQUAL FOR GROWTH AND MINERAL CONTENT OF CONTAINER-GROWN SEEDLINGS

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Either hydrochloric or phosphoric acid can be used to maintain pH of peat moss-vermiculite potting mix low enough for good growth of western hemlock and Sitka spruce seedlings. Phosphoric acid which is nonvolatile and safer to use is recommended.

The pH of potting mixtures influences growth of container-grown conifer seedlings. Studies have shown that a pH between 4.5 and 5.5 is required for good growth (*2, 6*). When the irrigation water has a higher pH, there is a tendency for pH of the potting mixture to rise. Nutrients then become less available for uptake by seedlings (*3*). When pH of the potting mixture exceeds 6.5, chlorosis of conifer seedlings often becomes pronounced and their growth is reduced.[1]

Desired low pH levels can be maintained in potting mixtures by irrigating with acidified water (*4*). Of commonly available acids, which is best? Sulfuric acid produces substantial heat when combined with water, making it more dangerous to use than hydrochloric (HCl) or phosphoric acid (H_3PO_4). Of the latter two, are there differing effects because phosphorus is added with one and chlorine with the other? Each of the two acids was used to keep a peat moss-vermiculite potting mixture acidified, and resulting growth and mineral content of western hemlock (*Tsuga heterophylla* [Raf.] Sarg.) and Sitka spruce (*Picea sitchensis* [Bong.] Carr.) seedlings were compared.

[1]Peyton W. Owston, personal observations made between 1969 and 1975.

Materials and Methods

Seedlings were germinated and grown in styroblock 2 containers (*7*) filled with a 1:1 peat moss-vermiculite potting mixture. Eight styroblocks were used in each of three replications of the test. Four styroblocks were planted with western hemlock and four with Sitka spruce. Potting mixture in two styroblocks of each species was kept acidified with HCI, and the remaining two per species were treated with H_3PO_4. Two seed sources of each species were used, but differences in response between sources were not tested. Each styroblock was placed on one of three benches in one greenhouse, and all eight styroblocks of each replication were randomly arranged on the same bench.

Seedlings were sprinkled by hand two to three times a week with tapwater adjusted to a pH range of 5.3 to 5.7 by either HCl or H_3PO_4. This required 1.28 ml of 36 percent HCl or 0.88 ml of 85 percent H_3PO_4 per 10 gallons of irrigation water. They were fertilized periodically with a 20N-19P-18K mixture including trace elements added to the irrigation water following the regime used at the Forest Service greenhouse near Corvallis (*6*).

After 12 weeks of growth and treatment, 25 seedlings were randomly selected and harvested from each styroblock. Top heights (from 5 mm below cotyledon to base of terminal bud) and stem diameters (at 5 mm below cotyledons) were measured, and ovendry tops and roots were weighed. A spectrographic analysis was made for mineral content of needles from seedlings in each styroblock. Data were subjected to analysis of variance for randomized blocks.

Results and Discussion

The peat moss-vermiculite mixture had an initial pH of 5.6 to 5.8. At the end of the study, pH of the mixture averaged 5.5 in the HCI treatment and 5.4 in the H_3PO_4 treatment. Thus pH was maintained within the desired range.

Seedlings subjected to the two treatments did not differ significantly (5-percent probability level) in height, stem diameter, or ovendry weight (table 1). They had attained heights suitable for planting in 12 weeks, but several more months of growth would have been necessary for sufficient development of roots, stem diameter, and total dry weight.

Seedlings differed little in foliage nutrient content after growing in peat moss-vermiculite acidified with the two acids (table 2). Only two statistically significant differences (5-percent probability level) were found;

Table 1.—*Average growth per seedling when pH of peat moss-vermiculite was regulated by two acids*

Acid used	Seedling size: Height	Seedling size: Diameter	Seedling ovendry weight: Top	Seedling ovendry weight: Root
	— — — *mm* — — —		— — — *mg* — — —	
	Western hemlock			
Hydrochloric	124	1.4	236	82
Phosphoric	125	1.5	239	78
	Sitka spruce			
Hydrochloric	176	1.8	425	102
Phosphoric	171	1.8	409	103

Table 2.—*Average content of five macronutrients and five micronutrients in foliage of seedlings growing in peat moss-vermiculite with pH regulated by two acids*

Nutrient Element	Western hemlock: HCl	Western hemlock: H_3PO_4	Sitka spruce: HCl	Sitka spruce: H_3PO_4
	— — — — — *Percent* — — — — —			
Macronutrients:				
Nitrogen	1.66	1.77	1.87	1.91
Phosphorus	0.48	0.49	0.35	0.36
Potassium	1.36	1.38	1.62	1.72
Calcium	0.42	0.36[1]	0.49	0.48
Magnesium	0.26	0.24	0.23	0.24
	p/m			
Micronutrients:				
Manganese	415	344[1]	330	309
Iron	108	109	128	129
Copper	8	8	9	10
Boron	52	46	32	32
Zinc	43	45	61	58

[1] Differs significantly from HCl treatment at 5-percent probability level.

calcium and manganese levels were lower in western hemlock seedlings grown in the peat moss-vermiculite acidified with phosphoric acid. The differences were obviously not large enough to affect growth (table 1), and it is doubtful that they affected seedling physiology.

Judged on available information, all nutrients were present in the foliage in adequate amounts (*1, 5, 8*).

Phosphorus content of seedlings growing in mix acidified with phosphoric acid might be expected to be higher than in seedlings growing in HCl-treated mix. This did not occur. The probable reason is that phosphorus was more than adequate in the HCl treatment as well as in the H_3PO_4 treatment. This is shown by a higher level of phosphorus in the foliage of seedlings from both treatments than the 0.18-0.34 percent that the literature indicated was adequate.

In conclusion, either hydrochloric or phosphoric acid apparently can be used to acidify irrigation water for conifer seedlings growing in peat moss-vermiculite potting mixtures. However, response might differ with different water supplies, so growers should conduct tests for their own facilities.

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Cost is a minor factor in deciding between the two acids. H_3PO_4 is twice as expensive as HCI, but cost of even the former would amount to much less than 1 percent of the total production cost.

All acids are corrosive and must be handled carefully for personal safety and protection of irrigation equipment. From the safety standpoint, H_3PO_4 is the best to use. It is a relatively weak, nonvolatile acid, whereas HCI is a strong, very volatile reagent. Be sure to obtain reagent or food grade phosphoric acid. Other grades may contain phytotoxic quantities of heavy metals (*4*).

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