

INFLUENCE OF GROWING MEDIA ON GROWTH AND  
SURVIVAL OF CONTAINER-GROWN SEEDLINGS 1/

Howard M. Phipps 2/

Abstract.--Peat moss and vermiculite mixes produced white spruce and red pine seedlings at least 30% larger than seedlings from any other mix tested. Outplanted seedlings from these mixes also survived best.

The growing medium or mix used in the production of containerized tree seedlings deserves more thorough study. Recent literature mentions the use of various natural and artificial media in producing containerized tree seedlings (Cayford, 1972; Miller and Schneider, 1971) but few studies have compared the effects of various media on seedling growth. (Edgren, 1973; White et al. 1970)

As a preliminary evaluation of some commonly used media, a greenhouse study (Phipps, 1974) was begun in late spring of 1971 to compare the growth and survival of red pine seedlings in various mixes of sphagnum peat moss, vermiculite, sand, arcillite,<sup>3/</sup> and a loam potting soil. Seed from an open-pollinated Michigan source was sown in the mixes contained in BC/CFS4/ styroblocks. Seedlings were watered at 3-4 day intervals, and fertilized about every 10 days with a water-soluble 30:10:10 fertilizer containing micronutrients. Natural light was supplemented to provide a 20 hour photoperiod.

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2/Research Forester, North Central Forest Experiment Station, USDA Forest Service, Rhineland, Wisconsin.

3/A calcined montmorillonite clay in granular form.

4/A rectangular block of foamed polystyrene with tapered, rounded cavities measuring 1.5 inches in diameter and 6 inches long. A small hole in the bottom of each cavity provides drainage.

Cation exchange capacities, as determined by flame photometry measurements of adsorbed sodium, showed values of 143 m.e./100 g. and 106 m.e./100 g. for the peat-vermiculite and peat-vermiculite-arcillite mixes, respectively. Values for the other media ranged from 80 m.e./100 g for the peat to 7 m.e./100 g. for the peat-sand mix. Mixes containing peat had a pH in the range of 5.0-5.6 except for peat moss-sand, and the potting soil which, with the other media, had values of 6.3-7.0. Electrical resistance measurements showed that a mix of peat moss with vermiculite or peat moss alone retained moisture near field capacity about twice as long as other media. Adding arcillite to the peat-vermiculite mix reduced moisture retention.

After 16 weeks there were significant differences in average stem length and diameter, and dry weight of stem and root of seedlings among several of the mixes (Table 1). The peat-vermiculite and peat-vermiculite-arcillite mixes, which had the highest cation exchange capacities and the lowest pH values (5.0 and 5.2), produced the largest seedlings. However, cation exchange and pH values of the other media did not correlate closely with seedling size. Differences in germination and survival among treatments were not statistically significant.

The peat moss-vermiculite, peat moss-sand, and potting soil plugs were easily removed with little adherence to the container walls. Plugs containing arcillite, however, were difficult to remove. Plugs composed of the peat-vermiculite mix and peat moss alone had a greater tendency to remain intact than the other mixes.

Table 1.--Average measurements of 16-week-old red pine seedlings (Preliminary Greenhouse Study)

Mix (by volume)	Stem length	Stem diam.	Stem wt.	Root wt.
	cm	mm	grams	grams
Peat-Vermiculite (1:1)	7.1	1.2	0.385	0.063
Peat-Vermiculite-arcillite (1:1:1)	5.2	0.8	.174	.023
Peat-Sand-Loam (1:1:1)	5.0	.7	.128	.025
Peat-arcillite (1:1)	4.9	.7	.152	.018
Peat	4.2	.6	.072	.017
Vermiculite-arcillite (1:1)	3.8	.6	.086	.014
Peat-Sand (1:1)	3.2	.5	.045	.012
Arcillite	3.0	.5	.047	.008
Vermiculite	2.8	.5	.039	.009

As a further step, a second study was begun to learn if the growing medium might also affect seedling performance after out-planting. Red pine and white spruce seed from National Forest seed-production areas in Michigan were sown in 6 different media in April 1972 and grown for about 20 weeks as previously described. The media consisted of peat moss-vermiculite (1:1 and 3:1); peat moss-vermiculite-arcillite (1:1:1); peat moss-sand (1:1); a potting soil mix of peat moss-sand-loam (1:1:1); and a mix not tested before - peat moss and perlite (1:1).

Survival during this period averaged 90-95% for both species in all media except the peat moss-sand mix where survival was only 25%. Desiccation due to high summer temperatures and low moisture retention probably caused the poor survival in this mix. Because of low survival this treatment was eliminated from further evaluation. Both species responded to the treatments in much the same way as red pine in the preliminary

study (Table 2). Peat moss and vermiculite produced the tallest seedlings of any mix. Increasing the amount of peat in this mix increased average stem length of both species slightly, but differences between the two mixes were statistically (.05 level) significant only for red pine. Peat and perlite was superior only to the potting soil.

In early September, 40 seedlings of each species and treatment were planted by hand in a randomized complete block design in a lower Michigan nursery. The seedlings were lightly irrigated during the first month after planting, but not thereafter. Plots were hand weeded when necessary.

After 20 months in the field, measurements showed that seedlings of both species had maintained essentially the same height rank as at the time of outplanting. However, only red pine had responded significantly in growth to the peat-vermiculite mixes; differences in white spruce stem growth due

Table 2.--Average stem length of white spruce and red pine seedlings at the time of outplanting (September 1972) and after 20 months in the field (April 1974)

Mix (by Volume)	White Spruce				Red Pine			
	9/72	4/74	Growth	Survival	9/72	4/74	Growth	Survival
	cm	cm	cm	%	cm	cm	cm	%
Peat-Vermiculite (3:1)	13.4 a	17.7	4.3 a	95	5.8 a	10.4	4.7 a	100
Peat-Vermiculite (1:1)	12.9 a	16.9	4.0 a	98	5.5 b	9.2	3.7 a	88
Peat-Vermiculite-Arcillite (1:1:1)	11.1 b	13.7	2.6 a	90	4.8 c	6.8	2.0 b	82
Peat-Perlite (1:1)	9.3 c	13.4	4.1 a	80	4.6 c	7.0	2.4 b	70
Peat-Sand-Loam (1:1:1)	7.7 d	10.7	3.0 a	85	4.0 d	5.4	1.4 b	82

Note: Means followed by the same letter are not significantly different at .05 level.

to treatment were not statistically significant. Survival after outplanting was generally good, ranging from 70 to 100% for red pine and 80 to 98% for white spruce. Seedlings produced in the peat-vermiculite mix survived best.

These short-term results indicate that different soil media can affect growth and possibly survival of container-grown seedlings. The reasons for the growth differences are complex and could not be definitely attributed to differences in cation exchange capacity or pH. Nevertheless, further study of these and other properties of growing media would help in defining the best media for production of a particular species. In our study, a mixture of sphagnum peat moss and vermiculite was superior to the other media tested.

#### LITERATURE CITED

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