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Research Note

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Potting Media Affect Growth and Disease Development of Container-Grown Southern Pines[1]

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SUMMARY

Longleaf pine (*Pinus palustris* Mill.) and shortleaf pine (*P. echinata* Mill.) seedlings grew best in equal parts of peat and vermiculite with a low pH. Seedlings grew better in shredded pine cone media than pine bark media. Growth increased when soil or vermiculite was added to cone or bark chips. Commercial bark-vermiculite media with high pHs produced the smallest seedlings: Disease loss was related to drainage and pH. Seedling mortality was greatest in commercial media with pHs above 6.0. Losses, lowest in bark media, increased as the proportion of vermiculite increased.

Additional keywords: *Pinus, Pythium, Fusarium,* damping-off, seedlings, tubelings.

INTRODUCTION

Media, whether blended by growers or commercially produced, can affect containerized forest tree seedling growth. Typically a mixture of peat and vermiculite is used. In the South, pine bark mixes have gained prominence in recent years and are widely used for growing woody ornamentals but are not generally used for containerized tree seedling production.

Like peat, pine bark can be used alone or mixed with additives. Hammermilled cone chips, abundant at pine seed extractories, are another possibility. Though cone chips are usually burned or piled as a waste product, they are potential potting media. This study compared growth and development of containerized pine seedlings grown in peat, pine bark, and pine cone formulated media.

MATERIALS AND METHODS

Twelve potting media were evaluated for growing containerized longleaf and shortleaf pine seedlings (table 1). Three were commercial media, containing lime and fertilizer: Jiffy Mix@ (equal parts peat and vermiculite), Jiffy 70-30® and Jiffy 50-50® (Pine bark-vermiculite mixes). Nine media were formulated by mixing peat (P), pine bark (B), or pine cone chips (C) with vermiculite (V) or soil (S). Materials included horticultural grade peat, well rotted cone chips and uncomposted bark chips. Seventy-five percent of both cone and bark chip particles were less than 2.36 mm. Top soil was from the A horizon of a Ruston sandy loam (relatively infertile) and #2 vermiculite was obtained from South Carolina.

Recently germinated seeds with 1- to 2-inch radicles were transplanted from trays to 7-inch media filled bulb pots. Aqua-Gro®, a wetting agent, was applied in the initial watering to promote infiltration. Fertilizer was injected into the watering system 2 weeks after transplanting and applied thereafter

[1]Use of trade names is for information purposes only and is not an endorsement by the USDA Forest Service.

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Table 1 .-Seedling growth and fascicle bundle development of longleaf pine grown in peat, cone, and bark media

Medium[1]	Final pH	Dry Weight	Seedlings with fascicle bundles	Fasclcle bundles per seedling
		mg	percent	number
Peat				
PV-50	5.1 e[2]	798 a	89 a	4.45 a
Jiffy Mix	8.2 b	755 a	82 ab	3.83 ab
Pine Cone				
cv-50	6.1 bc	638 b	79 ab	2.73 cdef
cv-70	6.1 bc	819 bc	89 a	3.18 bc
c-100	5.9 c	562 cd	69 ab	2.75 cdef
cs-70	5.9 c	628 b	73 ab	2.92 bcde
Pine Bark				
BV-50	5.2 d	510 de	59b	2.07 def
BV-70	4.9 f	452 ef	61 b	1.94 ef
B-1 00	4.6 g	460 ef	61 b	1.85 f
BS-70	5.1 e	530 d	84 ab	3.03 bcd
Jiffy 50-50	6.4 a	420 f	64 b	2.83 bcdef
Jiffy 70-30	6.4 a	410f	81 ab	2.79 bcdef

[1]The number following the medium designation indicates the percentage of peat, bark, or cone chips present.
*Means followed by the same letter are not significantly different, Duncan's Multiple Range Test at the 0.05 level.

with each irrigation at 150 parts per million nitrogen. A Q-45-15 (N-P-K) fertilizer was used for the first 2 weeks, followed by 6 weeks of 20-20-20, and then 2 weeks of Q-45-1 5.

Five seedlings per pot were evaluated for growth. Each species was tested separately using a 12 X 12 Latin square design. To evaluate disease development, 10 recently germinated longleaf seeds per pot were established in media previously infested with *Pythium* or *Fusarium,* by mixing 5 ml of infested wheat grain with each liter of medium. This test was designed as a randomized complete block with five blocks.

Measurements included seedling dry weight, shortleaf height, and number of fascicle bundles on each longleaf seedling. The final pH of each medium was determined from averaging readings from five pots. Disease loss was determined by counting the surviving seedlings.

RESULTS

Longleaf Growth.— Seedlings grown in PV-50 and Jiffy Mix were significantly heavier than those in all other media (table 1). Except in C-100, cone media produced larger seedlings than bark media. Certain mixtures of vermiculite or soil with cone and bark chips also increased growth. Poorest growth and chlorotic seedlings occurred in commercial bark mixes, which also had the highest pH (table 1).

The percentage of seedlings that produced fascicle bundles ranged from 59 to 89 percent and was significantly greater in PV-50 and CV-70 media than in W-50, BV-70, B-100, and Jiffy 50-50. No other differences were significant.

The number of fascicle bundles per seedling was significantly greater in PV-50 than in all other media except Jiffy Mix. In general, media that promoted fascicle bundle development on individual seedlings were the ones with a high percentage of seedlings with fascicle bundles.

Shortleaf Growth. -Seedling weights of shortleaf pine were almost identical to longleaf pine patterns (table 2). The heaviest Seedling8 developed in peat media and the smallest in bark media. Growth was intermediate in cone media except that seedlings in C-100 were comparable to seedlings in the commercial bark media. As with longleaf, shortleaf seedlings grown in PV-50 were significantly heavier than in all other media.

Height growth paralleled seedling weight closely.

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PV-50 produced significantly taller seedlings than all other media. Peat media produced significantly better seedlings than all others and cone media were generally better than bark media.

Disease Development. -Seedlings survived well in the *Fusarium*-infested media and no mortality occurred in six treatments. Those treatments were PV-50, CV-50, C-l 00, BV-50, BV-70, and BS-70. Jiffy Mix and the Jiffy bark media produced a slight, but significantly higher mortality than other media (table 3). While survival was high, seedlings grown in Jiffy Mix were chlorotic.

Mortality from *Pythium* was much greater than from *Fusarium.* It ranged from 9.4 seedlings per pot in Jiffy Mix to 0.6 seedling in B-100. Addition of vermiculite to bark and cone chips appeared to increase seedling susceptibility but the differences were not significant. Mortality in the three commercial media was significantly higher than in all others.

DISCUSSION

Phipps (1974a) compared nine media and found that containerized red pine (*Pinus resinosa* Ait.) seedlings grew best in equal parts peat and vermiculite. He attributed this response to high cation exchange capacity, long moisture retention, and low pH of this medium. In the test, best growth of longleaf and shortleaf pine seedlings also occurred in equal parts of peat and vermiculite with a low pH.

Although longleaf seedlings grew well in Jiffy Mix, peat-vermiculite mixes with high pH should be avoided when growing pine seedlings. Despite satisfactory growth, susceptibility to disease organisms is increased. The high water-holding capacity of peat-vermiculite media creates conditions favorable for *Pythium,* especially when the pH is high. Loss to *Pythium* was 54 percentage points higher in Jiffy Mix (pH 6.2-6.4) than in PV-50 (pH 5.1–5.4) although both had the same 50-50 peat:vermiculite formulation. The high pH of the Jiffy bark media, opposed to lower pH formulations, probably contributed to the increased mortality.

The well-drained character of pine bark media is desirable for ornamental production grown outside in large containers. This media drains well during frequent rainfalls and disease losses are reduced. However, soil moisture in small containers must be monitored closely and frequent irrigation is often required.

Adding soil or vermiculite to cone or bark media improves growth, increases water-holding capacity and makes nutrients more available. Adding soil, however, increases media weight more than vermi-

Table *P.-Seedling growth of shortleaf pine grown in peat, cone, and bark media*

Medium[1]	Final pH	Weight	Height
		mg	*cm*
Peat			
PV-50	5.4 c[2]	523 a	10.87 a
Jiffy Mix	8.4 a	3 8 3 b	9.72 b
Pine Cone			
cv-50	5.9 b	301 c	7.85 c
cv-70	8.0 b	259 de	7.48 cd
C-100	5.8 b	125 ij	8.08 fg
cs-70	5.9 b	270 cd	7.79 c
Pine Bark			
BV-50	5.4 c	218 f	8.18 fg
BV-70	5.0 d	201 fg	8.15 fg
B-l 00	4.9 d	175 gh	5.83 g
BS-70	5.3 c	224 ef	8.98 de
Jiffy 50-50	8.4 a	90 j	5.54 g
Jiffy 70-30	8.5 a	154 hi	8.82 ef

[1]The number following the medium designation indicates the percentage of peat, bark, or cone chips present.
[2]Means followed by the same letter are not significantly different, Duncan's Multiple Range Test at the 0.05 level.

Table 3.—*Mortality of 10 longleaf seedlings in* peat, *cone, and bark media infested with* Fusarium or Pythium

Medium[1]	*Fusarium*	*Pythium*
	number	
Peat		
PV-50	0.0 a[2]	4.0 cd
Jiffy Mix	0.8 bc	9.4 f
Pine Cone		
cv-50	0.0 a	4.8 d
cv-70	0.8 abc	4.0 cd
c-100	0.0 a	3.8 bcd
cs-70	0.2 ab	2.8 abcd
Pine Bark		
BV-50	0.0 a	2.4 abc
BV-70	0.0 a	1.6 ab
B-100	0.2 ab	0.8 a
BS-70	0.0 a	1.8 ab
Jiffy 50-50	1.6 d	8.8 e
Jiffy 70-30	1.2 cd	8.8 f

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culite and therefore increases shipping costs. While vermiculite is sterile, unfumigated soil contains a wide variety of soil fungi. Beneficial fungi, such as mycorrhizal symbionts and some saprophytes, coexist with undersirable pathogens. Fumigation or heat sterilization removes soil-borne pathogens but also destroys beneficial fungi.

Cone media held water better and generally produced larger seedlings than bark media. Cone chips, unlike bark chips, were well rotted. Had well-rotted bark chips been used, improved water retention and cation exchange properties may have increased growth. Rotted pine bark chips are generally not available from commercial sources, however. Results of this study suggest that rotted cone media could be substituted where bark media are now used. The pH of cone media, while not ideal for pine seedlings, is compatible with many ornamental crops.

Equal parts of peat and vermiculite with a low pH provided the best medium tested for growing containerized southern pine seedlings. Other peat-vermiculite mixes may be as good. Mixes of 1 to 3 parts peat moss and 1 part vermiculite are commonly used to grow containerized seedlings in the Pacific Northwest (Cleary et al. 1978). Phipps (197413) also has reported some improvement in seedling development of red pine when the ratio of peat to vermiculite was increased from 1 :1 to 3:1.

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