5%; from 400-500 lb. N 3%; and from 500-600 lb. 1%, or a typical Mitscherlich response. In 1978 on sand with 100% controlled release fertilizer, no significant differences in the PI were observed between 200 and 300 lb. N/acre, while tuber weights increased 15%, indicating heavier tubers within grades could be achieved with the 300 lb. rate. Thus, in light of the fact that fertilization practice indicated only 50% efficiency of soluble compared to controlled release fertilizer on sand, it appears that a 200-300 lb. N rate would provide adequate nutrition for excellent yields on sand. In the muck test, there was no indication that rates greater than the 200 lb. N rate would improve the PI, while a 13% increase in the PI was achieved from increasing rates from 100-200 lb. N/acre.

The carry-over effect of field fertilization practices on subsequent production of potted plants appears to be of little or no commercial significance, even though some effects were observed. In 1977, fresh weight of potted plants increased with increased field applications of fertilizer, indicating tubers may have been larger within the Jumbo grade used for potted plant production, but no measurements were taken to substantiate this. In 1978, individual tuber weights within the No. 1 grade were different with similar trends as the PI relative to field fertilization practices. The biggest differences and the trends for the plant parameter measured on potted plants indicated the response was as for the PI and weight of tubers. Thus, fertilization practices, which increase the PI, certainly do not have a negative effect on production of potted plants, but the positive effects are not great.

In summary, fertilization management in muck and sandy soils vary. With the full bed mulch system on sand, a rate of 300 lb. N/acre with a controlled release fertilizer, or similar rates with soluble fertilizer and absolute water control to prevent leaching during summer rains, should result in optimum yields. On muck, split applications of soluble fertilizer or a single application of a controlled release fertilizer at a 200 lb. N rate will be adequate. Tubers will be of high quality within grade with these practices.

This paper reported on the main effects of fertilization and we indicated these effects held true (trends or differences were similar), regardless of other treatments. However, one should not lose sight of the additive effects of the fertilization practices discussed in this paper and the fumigation and stock effects reported in our companion paper (5). Indeed, one objective of these tests was to develop the best production system integrating the knowledge of the effects of these 3 factors. For example, with the management system of no fumigation; grower stock; and the 100 lb. N/acre rate, the PI in the muck test was 6985, and 8480 in the sand test. The management system with fumigation, 3 GTC stock and 200 lb. N/acre (muck) or 300 lb. N/acre (sand) resulted in PI of 10,370 or 17,140, respectively. Thus, a 48% increase in PI on muck or 102% on sand was achieved by combining the main effect components of the system.

The differences in the PI with the "worst" and "best" management practices were much less on muck than with sand. The muck soil can apparently buffer many problems, while a mistake on the sand is very costly. Also, the PI on the sand in both 1977 and 1978 was very high and greater than PI's generally achieved on muck. Thus it appears the potential on sand is certainly as great as on muck, and/or the PI on muck can be improved by changing other practices. Consideration of the factors discussed in these companion papers show the importance of understanding fertilization practices, fumigation effects, and stock effects and the potential for high crop values on muck and sandy soils when these factors are integrated successfully.

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Literature Cited

1. Geraldson, C. M., A. J. Overman, and J. P. Jones. 1965. Combination of high analysis fertilizers, plastic mulch and fumigation for tomato production on old agricultural land. Proc. Soil and Crop Sci. Soc. Fla. 25:18-24.
2. Harbaugh, B. K. and G. J. Wilfret. 1982. Correct temperature is the key to successful use of Osmocote. Florists' Rev. 170:21, 23.
3. Hartman, R. D. 1974. Dasheen mosaic virus and other phytopathogens eliminated from caladium, taro, and cocoyam by culture of shoot tips. Phytopathology 64:237-240.
4. Marousky, F. J. and J. C. Raulston. 1973. Influence of temperature and duration of curing, storage, shipping and forcing periods on caladium growth. Proc. Fla. State Hort. Soc. 86:363-368.
5. Overman, A. J. and B. K. Harbaugh. 1982. Effect of tuber source and fumigation on caladium tuber production in two soil management systems. Proc. Fla. State Hort. Soc. 95:175-178.
6. Rhoades, H. L. 1964. Effect of hot water treatment of seed tubers and soil fumigation for control of root-knot on yield of caladiums. Plant Dis. Rptr. 48:568-571.
7. Sheehan, T. J. 1960. Caladium production in Florida. Inst. Food Agr., Sci., Univ. Florida Agr. Exten. Serv. Cir. 128A. 7p.

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MELALEUCA: AN ALTERNATIVE CONTAINER MEDIA COMPONENT FOR WOODY ORNAMENTALS[1]

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Abstract. Melaleuca quinquenervia **(cav.) Blake bark and whole tree milled to pass a 1/2 inch (1.2 cm) screen were adequate substitutes for pine bark in a 1 pine bark: 1 peat: 1 sand (v/v/v) medium for production of** Rhododendron simsii **Planch. 'Red wing',** Juniperus horizontalis **Moench. 'Andorra Compacta' and** Illicium anisatum **L. Processed melaleuca trees were not an adequate substitute for pine bark in a medium of 2 pine bark: 1 peat: 1 sand (v/v/v) for production of 'Andorra Compacta' juniper and illicium. Melaleuca was a poor substitute for peat in these common ratios of pine bark, peat and sand.**

Most woody ornamentals in Florida and other southern states are produced in containers using media composed of pine bark, peat, sand, cypress shavings or cypress sawdust.

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Inexpensive, uniform and readily available alternative components are needed because increasing cost and decreasing availability of common components limit their use.

Melaleuca is a shaggy-barked tree found throughout South Florida and could be an alternative to peat, pine bark and other wood products as a media component for woody ornamentals. Thick layers of bark constitute up to 50% of the volume of melaleuca trunks and branches, therefore, the volume of bark available during lumber harvesting is considerable. Consideration must be given to processing the entire tree for use in container media because of the reduced cost associated with this harvesting method.

Research by Poole and Conover (2) indicated melaleuca bark was an acceptable media component for foliage plant production. Initial research indicated melaleuca bark was an acceptable substitute for pine bark in a container media in terms of *Juniperus horizontalis* 'Andorra Compacta' and *Ilex vomitoria* 'Schellings' shoot growth (1). Juniper root growth was retarded when melaleuca bark comprised one-half the volume. Two-year old melaleuca bark generally resulted in more shoot growth than fresh bark when the proportion of bark was greater than one-third by volume.

Experiments were conducted to evaluate 2 particle sizes of aged melaleuca bark and a melaleuca product from processing a whole tree as substitutes for pine bark and Canadian peat in common container media for woody ornamental production.

Methods and Materials

Experiment I. Uniform *Rhododendron simsii* 'Redwing' and *J. horizontalis* 'Andorra Compact' liners in 2¼-inch containers were transplanted into 1-gal plastic nursery containers on May 6, 1981. Ten media, composed of various ratios of 2 fractions of melaleuca bark; pine bark; Canadian peat moss and builders sand, were included in this study. Melaleuca bark was shredded to pass through either a ½-inch or ¾-inch screen and aged for 1 to 2 yr. Media were formulated to allow direct evaluation of melaleuca bark as a substitute for pine bark or peat in common media used in the southern states. The 10 media were formulated on a volume basis as presented in Table 1.

Media were amended with dolomite, superphosphate and Perk (a micronutrient formulation manufactured by Estech General Chemical Co., Winter Haven, FL 33880) at 7, 3 and 2 lb./yd,^{3}, respectively. Osmocote 18-6-12 (manufactured by Serra Chemical Co. Milpitas, CA, 95035) was incorporated at 8 lb./yd^3 and surface applied 3 months later at 0.2 oz per container (1800 lb. N/acre/yr).

Azaleas were grown in a shade house with 47% light exclusion and junipers in full sun in Gainesville, Florida. The 10 media were replicated 5 times for each species. Plants were irrigated daily with ½-inch of water during the summer, provided there was not adequate rainfall.

Shoot and root dry weights, visual ratings, estimated shrinkage and growth index [(width + height) ÷ 2] were recorded on January 15, 1982. Shrinkage was estimated by measuring the distance from the lip of the container to the medium surface. Care was taken during potting to achieve uniform packing in filling each container to ½-inch of the lip.

Experiment II. Six media were formulated to evaluate processed melaleuca trees (bark, wood and leaves passed through a hammer mill with a ½-inch screen) as a substitute for pine bark or Canadian peat in common media ratios (2:1:1 and 1:1:1, by volume) of pine bark, peat and sand in 1-gal and 4-inch nursery containers (Table 2). Rooted cuttings of *I. anisatum* and *J. horizontalis* 'Andorra Compacta' were potted in factorial combinations of the 6 media and 2 container sizes on June 2, 1982. Media were amended with dolomite, Osmocote 18-6-12, Micromax (a micronutrient mix formulated by Seirra Chemical Co., Milpitas, CA) at 5, 8 and 2 lb./yd^3 respectively. Osmocote 18-6-12 was surface applied at 1 tsp per gal and ½ tsp per 4-inch container (2000 lb./acre/yr) on September 1, 1982. Each of the 12 medium and container size combinations were replicated 5 times for each plant species in a randomized complete block design. Illicum were grown in a shade house with 47% light exclusion and junipers were grown in full sun. All media and plants received ½-inch of irrigation daily unless there was adequate rainfall. The experiment was terminated on December 27, 1982 when shoot and root dry weights were recorded.

Results and Discussion

Experiment I. Azalea shoot and root dry weight and root rating were greatest under the described cultural conditions in 2 melaleuca bark (½-inch): 1 peat: 1 sand (medium No. 7) (Table 1). The 2 melaleuca (¾-inch): 1 peat: 1 sand medium (medium No. 8) resulted in azalea shoot and root dry weights and root rating equal to that of 2 pine: 1 peat: 1 sand (medium No. 6), although both were inferior to medium No. 7. Either particle size of melaleuca bark (No. 2 and 3) was an adequate substitute for pine bark in medium No. 1. Azalea shoot growth and root rating were reduced when either particle size of melaleuca bark (No. 4 and 5) was substituted for peat in medium No. 1. Substituting melaleuca for peat in medium No. 7 was not as detrimental to azalea growth compared to juniper growth.

Either particle size of melaleuca bark was an adequate

Table 1. Effects of container medium on *Juniperus horizontalis* 'Andorra Compacta' and *Rhododendron simsii* 'Redwing' growth and medium shrinkage.

Media[z]	Azalea: Shoot dry wt (oz)	Azalea: Root dry wt (oz)	Azalea: Root rating[x]	Juniper: Shoot dry wt (oz)	Juniper: Root dry wt (oz)	Medium shrinkage (% volume)
1. 1 pine bark: 1 peat: 1 sand	0.72 by	3.9 bc	2.2 bcd	0.94 abc	1.21 b	11 e
2. 1 melaleuca (½-inch): 1 peat: 1 sand	0.74 b	5.0 b	2.2 bcd	0.98 ab	1.61 a	25 bc
3. 1 melaleuca (¾-inch): 1 peat: 1 sand	0.70 b	4.0 bc	4.0 b	0.76 bcd	0.94 bcd	24 bc
4. 1 pine bark: 1 melaleuca (½-inch): 1 sand	0.53 cd	2.3 bc	1.4 def	0.76 bcd	0.82 cd	24 bc
5. 1 pine bark: 1 melaleuca (¾-inch): 1 sand	0.49 cd	2.3 bc	1.0 f	0.57 d	0.63 d	27 b
6. 2 pine bark: 1 peat: 1 sand	0.63 bc	2.9 bc	2.0 f	0.99 a	1.52 a	13 e
7. 2 melaleuca (½-inch): 1 peat: 1 sand	0.94 a	9.5 a	4.6 a	0.95 abc	1.08 bc	35 a
8. 2 melaleuca (¾-inch): 1 peat: 1 sand	0.65 bc	3.3 bc	2.6 bc	0.64 d	1.03 bc	26 bc
9. 2 pine bark: 1 melaleuca (½-inch): 1 sand	0.50 cd	1.7 c	1.2 ef	0.74 cd	0.77 cd	22 cd
10. 2 pine bark: 1 melaleuca (¾-inch): 1 sand	0.44 d	3.1 bc	1.0 f	0.66 d	0.79 cd	18 d

[z]Media were formulated on volume basis.
[y]Mean separation columns by Duncan's multiple range test, 5% level.
[x]Root visual ratings were 1 to 5 with 5 being the highest rating.

Table 2. Effects of medium and container size on shoot and root dry weight of *Juniperus horizontalis* 'Andorra Compacta' and *Illicium anisatum*.

Treatment	Juniper		Juniper	
	Shoot dry wt (oz)	Root dry wt (oz)	Shoot dry wt (oz)	Root dry wt (oz)
Media[z]				
1. 1 pine bark: 1 peat: 1 sand	0.37 b[y]	0.21 abc	0.90 ab	0.64 a
2. 1 melaleuca: 1 peat: 1 sand	0.51 a	0.25 ab	0.76 bc	0.43 d
3. 1 pine bark: 1 melaleuca: 1 sand	0.43 ab	0.18 c	0.68 c	0.51 bcd
4. 2 pine bark: 1 peat: 1 sand	0.50 a	0.26 a	1.05 a	0.58 abc
5. 2 melaleuca: 1 peat: 1 sand	0.38 b	0.15 c	0.77 bc	0.50 ab
6. 2 pine bark: 1 melaleuca: 1 sand	0.39 b	0.19 bc	0.77 bc	0.47 cd
Container size				
One-gallon	0.60 a[y]	0.27 a	1.20 a	0.79 a
4-inch square	0.25 b	0.14 b	0.45 b	0.29 b

[z]Media were formulated on volume basis.
[y]Mean separation within columns for media and container size by Duncan's multiple range test, 5% level.

substitute for pine bark in medium No. 1 in terms of juniper shoot and root dry weight, and medium No. 2, with the smaller particle size of melaleuca, resulted in more root dry weight than medium No. 1 (Table 1). All juniper growth parameters measured were reduced when the larger particle size of melaleuca bark was substituted for peat in media No. 1 and 6. Juniper root dry weight was reduced by substituting the smaller particle size of melaleuca bark for peat, but shoot dry weight was not affected. Juniper root dry weight was reduced when either particle size of melaleuca (No. 7 and 8) was substituted for pine bark in medium No. 6 and shoot dry weight was reduced when the larger particle size of melaleuca (No. 8) was substituted for pine bark in this medium.

Medium No. 7 shrank more than other media during the experiment but this did not seem to be deterimental to azalea growth. Generally, the media containing one-half or one-third pine bark shrank less than media with melaleuca bark at these ratios.

Experiment II. There were no interactive effects of media composition and container size on shoot or root dry weight of either species. Juniper and illicium root and shoot growth in 1-gal containers was more than twice that in 4-inch square containers (Table 2). Whole melaleuca trees milled to pass through a ½-inch screen was an adequate substitute for pine bark (No. 1) in a medium of 1 pine bark: 1 peat: 1 sand for juniper production. Although melaleuca was an adequate substitute for pine bark in medium No. 1 for illicium shoot growth, root growth was suppressed. Melaleuca was not an adequate substitute for peat in medium No. 1 with regards to illicium shoot and root growth or juniper root growth (No. 3). Melaleuca was not a suitable substitute for pine bark or peat in media No. 4 with one-half volume of pine bark in terms of shoot growth of junipers and illicium.

Generally, melaleuca bark and whole trees milled to pass through a ½-inch screen would be an adequate substitute for pine bark in media with one-third volume of pine bark in relation to peat and sand. Milled trees would probably be a less expensive media component than milled bark.

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Literature Cited

1. Ingram, D. L. and C. R. Johnson. 1981. Melaleuca bark as a container medium component. Southern Nurseryman's Assoc. Res. J. 7(2):7-14.
2. Poole, R. T. and C. A. Conover. 1979. Melaleuca bark and solite as potential potting ingredients for foliage plants. Proc. Fla. State Hort. Soc. 92:327-329.