Research Updates

Medium and Fertilization Affect Performance of Potted *Dendrobium* and *Phalaenopsis*

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Summary. *Dendrobium* Linnapa 'No. 3' plants were potted one per 1.75-liter pot with large or small fir bark with or without 30% peatmoss (by volume before mixing). Plants in each medium were fertilized at each or every third irrigation with 1 g·liter^{-1} of 20N–8.6P–16.6K fertilizer. Neither medium nor fertilization frequency affected flowering date of the first pseudobulb. Adding peatmoss to both types of bark resulted in taller first pseudobulbs. Peatmoss in the large bark promoted the production of more inflorescences and flowers (20) compared to the bark alone (11). Constant fertilization promoted the early emergence and development of the second pseudobulb and resulted in more inflorescences and flowers (21) than intermittent fertilization (12). Vegetatively propagated *Phalaenopsis* Taisuco Kochdian were planted in 0.5-liter pots with 1) equal volumes of no. 3 perlite, Metro Mix 700, and charcoal (PMC); 2) 100% large fir bark; or 3) 40% medium fir bark, 20% peatmoss, 10% each of no. 3 and no. 2 perlite, 10% vermiculite, and 10% ParGro rockwool (RM). Plants in PMC produced twice the number of new leaves and 1.5 -fold more leaf area than those in the large bark. PMC and RM resulted in similar shoot weights, but the latter enhanced flower count due to more lateral inflorescences. Most (80%) of the roots on plants in the bark were hanging out of the pots, whereas nearly all the roots remained in the pots with PMC. Although medium had no effect on flowering date, flowers on plants produced in PMC and RM were 10% larger than in those on plants produced in bark.

Dendrobium, particularly the Phalaenopsis type, and *Phalaenopsis* orchids have become increasingly popular due to their showy flowers, long blooming period, and ease of growing. Fir bark of various sizes has been used to grow these orchids for many years. However, fir bark is known for its quick decomposition, which alters the physical and chemical conditions of the rhizosphere and requires frequent repotting (Arp, 1980; Pierce, 1983). Bark initially does not retain much moisture after irrigation. Adding a small fraction of peatmoss to increase moisture and nutrient retention of the bark improves plant performance.

Perlite, rockwool, red lava rock, peat-lite media, and other materials have been suggested by hobbyists for growing orchids (Arp, 1980; McDowell, 1992; Pierce, 1983; Thomas, 1989; White, 1990). However, these media have drawbacks if used in large-scale commercial production due to the requirement for good plant anchoring, reasonable weight, and appropriate moisture retention. Plants in bark are recommended for yearly repotting (Griesbach, 1985).

Wang and Gregg (1994) reported that a medium consisting of perlite, Metro Mix 250, and horticultural-grade charcoal and several other porous media including composted pine-bark can be used to grow excellent *Phalaenopsis* plants. However, in that study, fir bark was not included for comparison. The objective of this study was to determine the effect of medium and fertilization frequency on vegetative growth and flowering of *Dendrobium* and *Phalaenopsis* orchids under commercial production conditions.

Materials and methods

Dendrobium. Three-year old bare-root *Dendrobium* Linnapa 'No.3' plants were potted on 13 May 1993 in 15-cm-tall, 1.75-liter plastic pots. Media used were 1) 100% large fir bark (2.5 to 6 cm long and 1.5 to 3 cm wide); 2) 7 large fir bark :3 peatmoss (by volume before mixing); 3) 100% small fir bark (seedling bark, 0.8 to 1.3 cm long and 0.5 to 0.8 cm wide); and 4) 7 small fir bark :3 peatmoss. Pots were placed on a greenhouse bench receiving about 400 μmol·m^{-2}·s^{-1} photosynthetic photon flux (PPF) to facilitate recovery and then moved after 2 weeks to another greenhouse with 670 to 800 μmol·m^{-2}·s^{-1} PPF.

Plants in 100% bark were irrigated twice a week, whereas those in bark–peatmoss media were watered weekly due to their higher water retention capacity. Municipal water with an electrical conductivity of 1.2 to 1.5 dS·m^{-1} was used. Fertilizer treatment included applying 1.0 g·liter^{-1} 20N–8.6P–16.6K soluble fertilizer (Grace-Sierra, Milpitas, Calif.) at each or every third irrigation. Average maximum and minimum air temperatures were 32.8 and 25.4C for July and 24.4 and 17.1C for December, respectively.

The opening date of the first flower was recorded for each plant. Flower size and count, diameter of the pseudobulb at its widest point, leaf number, and height were recorded in

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Table 1. *Effects of bark size, addition ofpeatmoss, and fertility on growtb and flowering of* Dendrobium.[z]

Treatment	First pseudobulb Ht (cm)	First pseudobulb Diam (mm)	First pseudobulb Leaf no.	Second pseudobulb Ht (cm)	Second pseudobulb Diam (mm)	Second pseudobulb Leaf no.	New shoot no.	Spike no.	Total flower no.
Medium									
Large bark	28.7 c	13.3 a	5.0 ab	37.5 a	23.6 a	7.5 a	1.6 b	1.6 b	11.3 b
Large bark + peat	33.6 ab	14.2 a	5.5 a	42.9 a	24.4 a	7.9 a	1.9 a	2.3 a	20.0 a
Small bark	31.1 bc	13.3 a	4.9 b	43.8 a	23.8 a	7.5 a	1.9 a	2.3 a	16.5 ab
Small bark + peat	34.7 a	13.4 a	5.4 a	41.6 a	24.3 a	7.5 a	1.9 a	2.2 a	18.1 ab
Fertility									
Constant	31.3 a	13.3 a	5.2 a	41.7 a	24.5 a	7.7 a	1.9 a	2.4 a	20.8 a
Intermittent	33.0 a	13.8 a	5.2 a	42.0 a	23.1 b	7.7 a	1.7 a	1.7 b	12.0 b

[z]*Mean separation within* a *column and factor by Duncan's multiple range test using = 0.05,*

October. A second pseudobulb emerged soon after blooming. Treatments continued, and data similar to those described above were recorded for the second pseudobulbs on 23 Feb. 1994.

Phalaenopsis. Bare-root, vegetatively propagated Taisuco Kochdian plants with four leaves measuring 20 cm in leaf span were planted on 25 Feb. 1993 in 10-cm pots (0.6-liter) with one of three media including 1) equal volumes of no. 3 perlite, Metro Mix 700, and horticultural-grade charcoal (PMC) (Wang and Gregg, 1994); 2) 100% large bark as described above; and 3) 40% medium fir bark, 20% peatmoss, and 10% each of no. 3 and no. 2 perlite, 10% vermiculite, and 10% ParGro rockwool (RM). All ingredients were measured by volume.

The youngest leaf on each plant was marked to facilitate the determination of new leaf production. Plants in bark were irrigated twice a week with water containing 1 $g \cdot liter^{-1}$ 20N–8.6P–16.6K soluble fertilizer (Grace-Sierra); others were fertigated weekly. The PPF was 215 (March) to 250 (July) $\mu mol \cdot m^{-2} \cdot s^{-1}$ at noon. Average maximum and minimum air temperatures were 29.5 and 24 .0C for July and 22.6 and 17.5C for December, respectively. Data were collected when all flowers on an inflorescence had opened. Roots growing in and out of a pot were weighed separately. Spike diameter was measured at 5 cm above the base.

In both experiments, each plant was an experimental unit. Treatments were arranged in a randomized complete-block design and replicated 10 times. Data were subjected to analysis of variance, and Duncan's multiple range test was used for mean separation.

Results

Dendrobium. Adding peatmoss to both types of bark resulted in taller first pseudobulbs (Table 1). Plants in the small bark alone had slightly fewer leaves than plants in either bark amended with peatmoss. However, peatmoss had no effect on height, diameter, or leaf number of the second pseudobulb.

The second pseudobulb started to grow soon after flowers on the first pseudobulb started to open. It was observed that the development of the second pseudobulb on plants in the large bark was slower than the others. This contributed to the lower flower count of plants in 100% large bark at the time data were collected. Peatmoss in the large bark promoted the production of more inflorescences and flowers (20 vs. 11) compared to the bark alone. Plant growth in the small bark gained limited benefits from the addition of peatmoss.

Constant fertilization had little effect on height or leaf number of both pseudobulbs, but slightly increased the diameter of the second one. Accelerated emergence and development of the second pseudobulb was observed at the higher fertilizer level, which contributed to a higher flower count (21 vs. 12) than the intermittent fertilization.

Phalaenopsis. Plants in PMC and RM performed better than those in the large bark. Orchids in PMC produced twice as many new leaves and 2.5 times the leaf area of those in large bark (Table 2). PMC and RM resulted in similar spike and shoot weights (Table 3). These two media resulted in similar amount of roots in pots; however, plants grown in RM had more roots outside pots (Table 3, Fig. 1). Most (80%) of the roots on plants in the bark were hanging out of the pots, whereas nearly all the roots on plants in PMC were in the medium (Table 3).

Medium had no effect on flowering date (Table 4). Plants in PMC and RM had more flowers, heavier inflorescences (Table 3), and thicker spikes than those in bark (Table 4). The highest flower number on plants grown in RM was the result of additional flowers on lateral inflorescences (Fig. 1). Flowers were 10% larger when grown in PMC and RM than in the bark.

Discussion

Although subject to the debate of conservation, fir and redwood bark are still among the most widely used media for growing many genera of orchids. It is obvious that large fir bark, due to its hydrophobic nature and small surface area, does not absorb much water and nutrients initially, especially when allowed to dry before the next irrigation, which causes fertilizer runoff and slow plant growth. Although when used judiciously large bark can provide good plant growth, it certainly is not the best medium for growing stressed, bare-root plants that have been shipped internationally for several days. In this study, adding peatmoss increased the water and nutrient retention of the bark medium, resulting in improved growth over bark alone. Keithly et al. (1991) reported

Table 2. *Effect of medium on* Phalaenopsis *leaf growth.*[z]

Medium	New leaf no.	Leaf span (cm)	Leaf area (cm^2)
Large bark	4.4 b	24.3 b	220 b
PMC[y]	7.6 a	33.0 a	534 a
RM[x]	7.0 a	32.5 a	478 a

[z]*Mean separation within a column by Duncan's multiple range test using = 0.05,*
[y]*Equal volumes of no. 3 pedite, Metro Mix 700, and horticultural-grade charcoal.*
[x]*40% medium fir bark, 20% peatmoss, 10% each of no. 3 and no. 2 perlite, 10% vermiculite, and 10% ParGro rockwool.*

Table 3. *Effect of media on fresh weight of various parts of* Phalaenopsis.[z]

Medium	Spike wt (g)	Shoot wt (g)	Root Inside (g)	Root Outside Wt (g)	Root Outside % total	Total fresh wt (g)
Large bark	42 b	45 b	7.1 b	29.9 a	82 a	124 b
PMC[y]	87 a	124 a	50.4 a	2.4 b	7 c	263 a
RM[x]	108 a	117 a	41.5 a	28.1 a	40 b	295 a

[z]*Mean separation within a* column by Duncan's *multiple range test using = 0.05.*
[y]*Equal volumes of no. 3 perlite, Metro Mix 700, and horticultural-grade charcoal.*
[x]*40% medium fir bark, 20% peatmoss, 10% each of no. 3 and no. 2 perlite, 10% vermiculite, and 10% ParGro rockwool.*

that small *Dendrobium* seedlings planted in a medium consisting office fir bark, coarse perlite, and sphagnum moss had good growth and needed watering only every 10 days. Since plants in a medium with improved water retention do not need to be irrigated so frequently, one needs to use less water and fertilizer. This becomes particularly important for growers in more arid areas or during dry years. Using less fertilizer also helps reduce environmental contamination.

It was reported previously that pot-grown *Dendrobium* Jaquelyn Thomas either did not respond to Osmocote or produced fewer sprays when the amount of Osmocote was increased from 393 to 1179 $kg \cdot ha^{-1} \cdot year^{-1}$ (Imamura et al., 1986). The high release rate of Osmocote at high temperatures may have caused a build up of soluble salts in the medium, causing root injury and hindering maximum plant growth. In this study, the higher rate of water-soluble fertilizer promoted flower production, regardless of medium.

Medium had no effect on the vegetative condition of the second pseudobulb. This effect might have been due to the partial decomposition" of the bark, accumulation of roots in pots, or more frequent irrigation, resulting in increased water and nutrient retention, which contributed to improved growth (Imamura et al., 1986) in the 100% bark. A greenhouse malfunction in May 1994 injured some *Dendrobium* leaves, eliminating the chance for evaluating plants' long-term performance in various media.

The condition of the *Phalaenopsis* plants in bark was clearly different from the others. Plants in PMC and RM resumed rapid leaf growth soon after planting, whereas those in bark had soft, wilted leaves. This difference was further manifested in the final leaf number and area. Additionally, plants in bark put out many roots from nodes being exposed to the air, possibly because of the inability to get adequate moisture from the bark (Arp, 1980). It has been observed that, when *Phalaenopsis* roots grow out of the nodes above the medium, they often stay on the medium surface and eventually come out of the pots. Plants grown in 100% bark had almost all functional roots out of the pots (Table 3). Since only media were wetted during irrigation, aerial roots likely supplied little or no nutrients to the plant. PMC apparently maintained good moisture, nutrients, and drainage and adequate porosity. As a result, nearly all roots stay in the pot, which would greatly facilitate moving and packaging plants under commercial conditions. The promotion of lateral inflorescence growth by RM is of great commercial value. In addition, this result implies that the best characteristics of an orchid plant may not be fully manifested if the best possible culture is not provided.

A medium consisting of 40% medium bark, 40% charcoal and 20% Pro-Mix was used success fully in growing *Phalaenopsis* (White, 1992). However, the large proportion of bark in this and the RM used in the current study may still require frequent repotting (Arp, 1980). The only material in PMC that decomposes is peatmoss, which would result in a gradual decline in the total volume instead of creating a soggy rhizosphere when bark is present. A peat-lite medium was

Table 4. *Effect of media on flowering of* Phalaenopsis.[z]

Medium	Date of anthesis (March)	Flower No.	Flower Diam (cm)	Spike Length (cm)	Spike Diam (mm)
Large bark	24 a	8.1 c	10.1 b	58 b	4.5 b
PMC[y]	26 a	13.8 b	11.0 a	89 a	6.1 a
RM[x]	24 a	19.8 a	11.0 a	88 a	6.6 a

[z]*Mean separation within a column by Duncans multiple range test using = 0.05.*
[y]*Equal volumes of no. 3 perlite, Metro* Mix 700, *and horticultural-grade charcoal.*
[x]*40% medium fir bark, 20% peatmoss, 10% each of no. 3 and no. 2 perlite, 10% vermiculite, and 10% ParGro rockwool.*

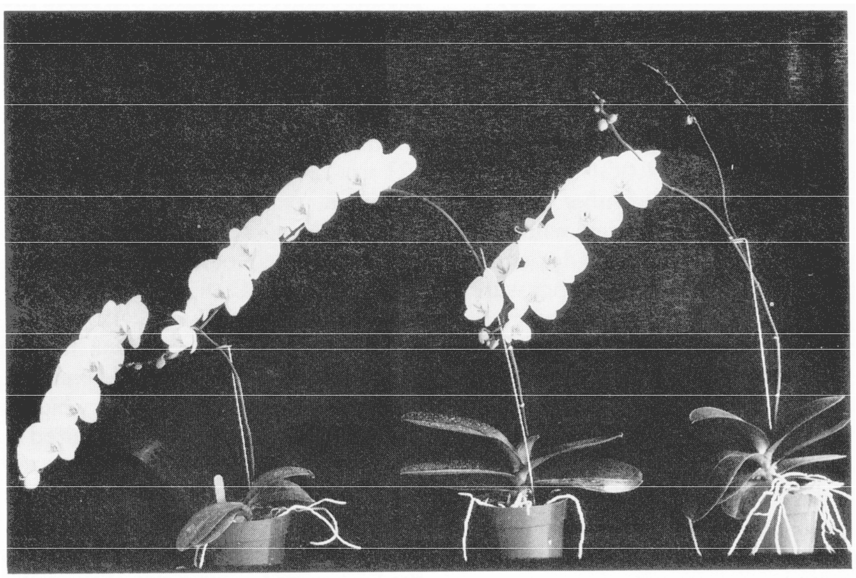

Fig. 1. *Plants grown in 100% large fir bark (left), PMC (middle), or RM (right). Note the lateral inflorescences on the plant grown in RM. PMC = equal volumes of no. 3 perlite, Metro Mix* 700, *and horticultural-grade charcoal. RM = 40% medium fir bark, 20% peatmoss, 10% each of no. 3 and no. 2 perlite, 10% vermiculite and 10% ParGro rockwool.*

suggested for potting *Phalaenopsis* (McDowell, 1992). However, inexperienced growers easily can over-water the medium, resulting in root rot.

An additional advantage of using PMC and RM over the large bark is that less time is required for potting since the smaller particles of these media disperse easily among the roots, whereas large bark has to be put into small pots piece by piece. The smaller particles in PMC and RM have good contact with roots, promoting fast recovery and rapid growth.

In summary, adding 30% peatmoss to the large fir bark improves the growth and flowering of *Dendrobium,* particularly when fertilized at each irrigation. Small bark can be used alone without peatmoss. Media that retain more moisture result in improved leaf growth and more, larger flowers in *Phalaenopsis* over that of large fir bark.

Literature Cited

Arp, *G.K. 1980.* Red lava rock—A reasonable substitute for fir bark. Amer. Orchid Soc. Bul. 49(12):1384-1386.

Griesbach, R.J. 1985. Phalaenopsis orchids as potential pot plants. HortScience 20:624.

Imamura, J. S., T. Higaki, and J. Kunisaki. 1986. Interactions of culture, medium, and fertilizer on *Dendrobium* Jaquelyn Thomas. HITARI, Univ. of Hawaii Res. Ser. 050.

Keithly, J.H., D.P. Jones, and H. Yokoyama. 1991. Survival and growth of transplanted orchid seedlings enhanced by DCPTA. HortScience 26:1284-1286.

McDowell, D. 1992. At home with *Phalaenopsis.* Amer. Orchid Soc. Bul. 61(2):150-153.

Pierce, J.W. 1983. Perlite culture of orchids. Amer. Orchid. Soc. Bul. 52(8):806–808.

Thomas, *W. 1989.* Growing orchids in rockwool. Amer. Orchid Soc. Bul. 58(12):1212-1218.

Wang, Y. T. and L.L. Gregg. 1994. Medium and fertilizer affect the performance of *Phalaenopsis* orchids during two flowering cycles. HortScience 29:269–271.

White, *J. 1990.* Beginner's series—Part II: Media mania revisited. Amer. Orchid Soc. Bul. 59(2):114-122.

White,J. 1992. The Caribbean orchid music. Amer. Orchid Soc. Bul. 61(10):988-993.