Use Of Coconut Husk Chips for Potting Medium

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Paphiopedilum Roots

To grow a good root system on a Paph you need to balance a number of things. Roots need adequate aeration, firm anchoring (wobbly plants' roots will have their sensitive growing tips damaged/destroyed), adequate supply of moisture without remaining too wet too long (which eliminates adequate aeration), adequate and properly balanced mineral nutrition without excess, reasonable temperatures, and a suitable pH in their surroundings. Because paphs do depend on root hairs for water and mineral uptake, it is important to grow new roots frequently as the effectiveness of root hair uptake does diminish with age. I had a discussion on the phone recently with a grower who made the comment " Well, Paphs just don't grow many roots anyway", and then added, "do they?". They can fill the pot with roots when their conditions are met and will do far better for you under these circumstances, as well as be able to weather the occasional problem that may develop. It's entirely possible to grow Paphs, and even flower them with few or even no roots, through foliar feeding and good humidity, but they are much more exacting when it comes to getting them to grow lots of roots. It is also important to maintain new root growth as the root hairs along the roots lose their ability to adsorb water and nutrient as they age, so you need to keep some level of new growth going to maximize uptake. This is why they are "easy to grow, but difficult to grow very well". You need to know what your water quality is and what it means , and then figure out how much and what to feed, and appropriate pH, and what special needs for substrate some may have.

Compressed Bales of Coconut Husk Chips

Like many Paphiopedilum and Phragmipedium growers, we have depended on bark based potting mixes for 20 years. We used small bark, extra coarse horticultural perlite (despite the name, it's pretty small), and chopped New Zealand Sphagnum moss for smaller pots and medium bark, #4 spongerock, and chopped New Zealand sphagnum for larger pots. In more recent years we'd added either #2 or #4 charcoal, depending on pot size. While results have generally been good, there have been a number of problems to deal with. Sequoia brand bark (the only brand we found suitable for Paphs) supply has had some interruptions, and a few years ago the quality was very low, basically being pre broken down before you received it. This spring (2000), after an Executive order setting aside the forest they timbered, Sequoia announced it was ending all orchid bark production mid summer. The #4 sponge rock is only occasionally produced by the manufacturer, so when it became available you would have to scramble to buy as many bags as possible, and the last delivery of 30 bags marked #4 turned out to be #3 and smaller, and extra brittle so that it crumbled into dust when worked with. While the quality of the New Zealand sphagnum moss has generally remained high, there have been periods when it brought along fast growing weed seeds, and the price has gotten quite high. It was also quite labor intensive to wet and cut it into the shorter pieces that were suitable for use in our mixes.

The other major problem associated with bark mixes is their rapid break down. The fine bark mixes are especially prone to this, with noticeable deterioration (with resultant loss of aeration and increase in drying time) in as little as 3 months, and significant deterioration within 6 months under our culture conditions. For a very small collection this is resolvable by very frequent repotting, but in a larger collection this is not feasible. And with the weather conditions found in the Northeastern US where we are located, especially in the winter, we need to maintain a freely draining mix that dries within

a few days, when there is less sunlight and somewhat cooler temperatures in the greenhouse.


Hydrated Small Coconut Husk Chips

Anticipating the eventual loss of bark supply, or at least another period of bark quality problems, along with the other problems associated with the bark mix components, we began experimenting with various other growing substrates the past few years. We have worked with rock wool, brick chips, vermiculite, pea gravel, coir, sponge rock, and perlite with varying successes. A couple of observations made are that Paph roots appear to be highly adapted to the conditions they are formed in, and a dramatic shift, even into conditions we might assume to be "better", can cause root loss. If the new medium is indeed better, than you should get rapid new root growth to take over for the ones being lost. Also, if moisture and nutrients are available in "excess" (i.e. in a dense mix), then the plants will grow far fewer roots, as they need less root mass to supply themselves. But, in these denser mixes, they are more prone to root loss, especially if warm conditions are not maintained at the root zone, and having fewer roots to start with, even minimal root loss can be critical. As a result, it is our goal to grow plants under conditions that encourage maximum root mass, as these plants will be far less affected by a problem resulting in the loss of some roots (i.e. being allowed to go too long before repotting with resultant mix breakdown or a period of overwatering), and in our opinion result in more robust plants and better flowering. In almost all of the components we worked with, there seemed to be a universal constant inverse relationship between the air capacity and the water capacity. In other words, a mix that drained freely and allowed enough air into the mix immediately after watering held insufficient water for Paphs and Phrags, those that held sufficient water allowed for insufficient air. Other aspects of the components that we felt were important were the ability to anchor the plant in the pot without and wobbling when watered or handled, to avoid damage to growing root tips, stability over time both with respect to aeration and water holding and pH.


Hydrated Medium Coconut Husk Chips

Two medium components did defy logic and have the capacity to hold large amounts of air and water simultaneously. The first is New Zealand sphagnum moss used alone. NZ sphagnum will simultaneously hold more water and more air than almost any other potting medium commonly available if kept loosely packed, but therein is one problem: overpack it or allow it to pack itself overtime and it holds way too much water and too little air. NZ moss does have some drawbacks: it is also hard to stabilize a plant in its pot with a loose pack of moss, it is hard to rewet if allowed to completely dry out, and does break down fairly rapidly if kept moist, so for some folks its a wonder medium, for most it's not very practical.

The second was coconut husk chips. While holding approximately the same level of air immediately after watering and as it dried out over a 5-day period in 2.5-inch rose pots as the equivalent size bark; it also held substantially more water. After six months under greenhouse conditions, fine fir bark had broken down and dramatically lost its air holding capacity and stayed quite soggy, while the small coconut husk performed essentially as it did when new. We'll discuss some quantitative aspects of coconut husk chips later in this article, but first lets discuss its preparation, use, and some of our qualitative observations.

Let's make completely clear what we are referring to, as there are several coconut products for potting on the market. What we are using are chunks of the husk, cut to surprisingly uniform size. The three sizes available correspond quite well with the sizes of Sequoia bark. Other coconut products include coir, which is ground up husk, coconut husk fibers which is a stringy material made by somehow "unraveling" the coconut husk, and coconut husk charcoal.

We use the compressed bales of coconut husk chips from Crystal Company of Saint Louis, MO (there are several suppliers of their product in the US). These have been prewashed and pressed by the company a couple of times to reduce the amount of leachable salts contained in the product, which can vary greatly and be quite high from some sources. When hydrated, each bale will swell to about 6 to 7 cubic feet of husk, so we divide each bale into two 32 gallon containers (plastic garbage cans) for hydration. The coconut husk from these bales has been extremely clean with relatively little dust, and quite uniform in size. There will be a small amount of fines after hydration, but the amount has been so small as to present no problems.

To prepare the husk we first hydrate the bale in two 32 gallon containers at least overnight, and then transfer the hydrated husk and excess water to a second container that has had a large number of holes drilled into the bottom, and about six inches up the sides. After the husk drains, a steady stream of water is washed through until it appears to run clear from the container. Then the husk is again transferred back to the solid container and again covered with water at least overnight. The draining and washing procedure is repeated for two cycles total for the medium size, and three cycles for the fine husk. At this point measurements have revealed virtually no significant leachable salts and a pH just slightly below neutral.


Washing Coconut Husk Chips

Coconut husk can be somewhat firmly packed in the pots, but not tremendously so, as it has a springy substance, and will change slightly in size as it loses water and then is rehydrated. It hydrates very rapidly, even from the completely dry state, and essentially instantly from the partially hydrated state it would be in your pot when you water it. It contains the water within itself like a sponge: if you squeeze a piece that is even partially hydrated, water will come out of the cut fiber end even when the outside of the husk appears dry. The exterior of the husk chips does dry very rapidly when exposed to air flow, so the tops of the pots appear to dry out very quickly, but just 1/2 inch further down their can still be a considerable amount of moisture. This takes a little getting used to in judging when to water, but has the benefits of discouraging fungus gnats (the larvae tend to live in the top 1/2 inch of the medium and prefer very moist conditions) and lessening the chance of rot starting in the lower leaf fans, especially if they are potted slightly lower than they should be.


Small Aliflor

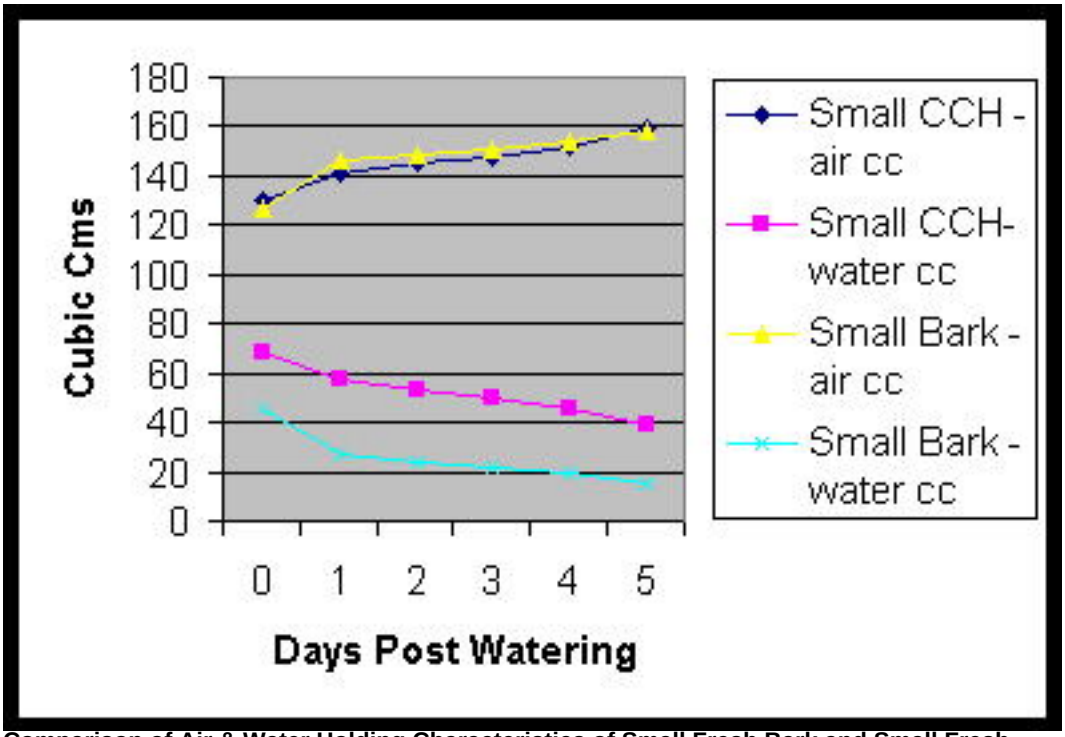
We add aliflor and charcoal to the husk, and for Phrags also a bit of heavy aggregate (#1 crushed sandstone). Our formulas, which will probably be tweaked a little over the next year, are listed later in the article. Aliflor is a kilned clay pellet that is roughly round in shape and available in three sizes. It is added to the mixes to open them up a little and to add weight to the mix, which helps to anchor the plants' stability in the pot. It is an additive in a class that is frequently referred to as lightweight aggregates. Other lightweight aggregates that are commonly used are expanded shale and lava rock. We have settled on the aliflor due to its uniformity in size and availability to us. For larger pot mixes, #2 charcoal is added to the mix, for smaller pots #4 charcoal is added to the mix (yes, charcoal size numbers are the reverse of spongerock and aggregate numbers). My scientific background makes me wish to be able to give a quantitative or at least sound theoretical reason for the addition of the charcoal, but I do not have one. Lynn's observations have convinced her it is a valuable addition, and I have learned that her observations are uncannily accurate, even when they might go against logic (more on this later).

When we first started experimenting with coconut husk chip mix on

some plants, we would unpot a portion of them every week to inspect the roots. We were impressed at both the speed of initiation and the number and substance of new roots on the plants that had been switched. We continue to see this, and have been working to switch all plants, from seedlings to stud plants, over as quickly as possible to this new mix. We have repotted several plants that had lost all of their roots while in our standard bark mix and were "circling the drain" into coconut husk chip medium and have watched them revive and initiate new roots faster than we would have believed possible for a Paph to respond to such improved conditions. A few plants that we feel would have otherwise have certainly died due to their poor root health have been revived using this new mix. We have also seen a similar pattern in our Phrags. While it is much easier to maintain good root systems on Phrags than Paphs, our Phrags seem to have immediately picked up when put in coconut husk, perhaps due to the greatly increased reservoir of water contained within their pots while still maintaining a high degree of aeration. Our Phrag. besseaes, which have always suffered with the summer heat and have had to go under the bench for the summer in the past, have spent the entire summer on the bench top in very bright light and heat, and are not showing any of their usual summer stress signs. We have also switched some root distressed Phals (with some different proportions of medium components, including a greater percentage of aliflor) over with the same response as the Paphs and Phrags-- near immediate and vigorous root growth. It also appears to be working well with our agar-on compotting technique for both Paphs and Phrags.

Newly Emerging Roots Adhering to the Coconut Husk Chips Just a Few Weeks After Repotting

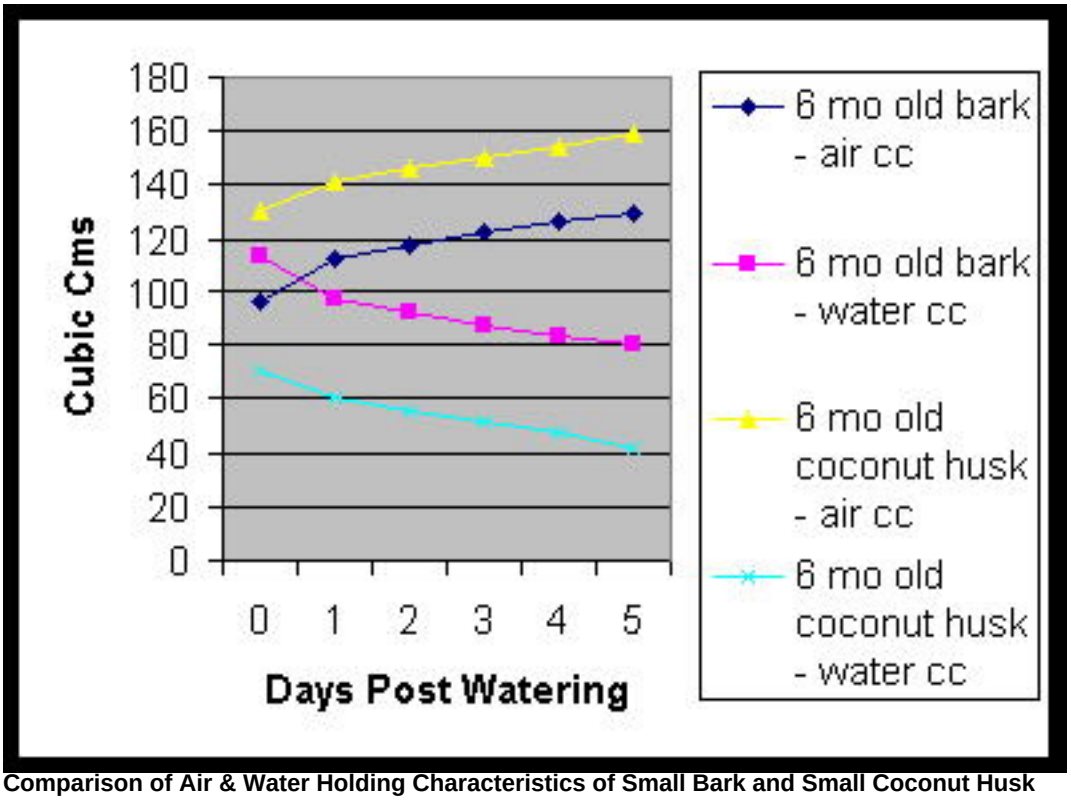
One of the most encouraging signs that the plants like the coconut husk chips is that when we unpot them, all of the new roots are attaching themselves firmly to the cut fiber end of the husk chunks, as if they are seeking out their personal water and nutrient reservoirs. While we would find roots attached to bark chunks also, it occurred at no where near the rate it does with the husk chunks.



Comparison of Air & Water Holding Characteristics of Small Fresh Bark and Small Fresh Coconut Husk Chips

Perhaps the most valuable improvement coconut husk chunks offer over bark is its resistance to breakdown and ability to maintain its characteristics over a long period of time. Coconut husks durability stems from having a lignin content five times that of bark, and the other components we use, aliflor and charcoal, also have quite good resistance to breakdown. The data and charts presented here for fresh media components, and a comparison of fine bark and fine coconut husk chips as a fresh product and after 6 months of greenhouse conditions and a watering, offer a striking difference between the two. The bark and coconut start out essentially the same, both with excellent aeration characteristics and with the coconut husk at an advantage in water capacity, but within six months in a pot in the greenhouse with regular watering, the fine bark has rapidly broken down, holding way too much water and not drying out, all at the expense of its ability to hold air. The coconut husk is still performing essentially the same as it did

when fresh. As a result there will be far fewer complications when using coconut husk fiber if repotting is delayed, in fact we feel the only reason for annual repotting when using it will be to pot up because of the vigorous root growth we see with it.



Comparison of Air & Water Holding Characteristics of Small Bark and Small Coconut Husk Chips After 6 Months of Greenhouse Use

The chart following details some experimental findings with various mediums and medium components. All of the data was collected using 2.5 inch SVD "rose" pots (deeper than they are wide) in our greenhouse conditions. Relative humidity was in the 70% range during the test, with daytime temperatures in the low to mid 80's and night time temperatures in the mid 60's. The capacity of this pot is 246 cubic centimeters; the numbers listed in the first chart show the cubic centimeters of air and water retained in the pot with various mixes and mix components immediately after a thorough watering and then at the intervals listed.

Days Post Watering --->	immediately after watering	1 day	2 days	3 days	4 days	5 days
CHC Paph Seedling Mix - air cc	126	145	151	154	160	164
CHC Paph Seedling Mix - water cc	72	53	47	44	38	34
CHC Phrag Seedling Mix - air cc	133	144	154	158	165	171
CHC Phrag Seedling Mix - water cc	83	72	62	58	51	45
CHC Adult Large Paph Mix - air cc	135	152	158	162	169	174
CHC Adult Large Paph Mix - water cc	80	63	57	53	46	41
Med Aliflor - air cc	124	141	145	148	153	155
Med Aliflor - water cc	31	14	10	7	2	0
Small Aliflor - air cc	108	122	128	131	136	141
Small Aliflor - water cc	45	31	25	22	17	12
Small CHC - air cc	130	141	145	148	152	159
Small CHC- water cc	68	57	53	50	46	39
Med CHC - air cc	130	147	154	160	165	174
Med CHC - water cc	98	81	74	68	63	54
Med Bark - air cc	143	165	168	170	173	176
Med Bark - water cc	37	15	12	10	7	4
Small Bark - air cc	127	146	149	151	154	158
Small Bark - water cc	46	27	24	22	19	15
Large Char - air cc	122	132	137	140	143	148
Large Char - water cc	49	39	34	31	28	23
Small Charcoal - air cc	107	115	118	120	123	126
Small Charcoal - water cc	38	30	27	25	22	19
Small Stones - air cc	114	122	128	130	134	138

Small Stones - water cc	28	20	14	12	8	4
#3 Spongerock - air cc	137	164	171	177	183	189
#3 Spongerock - water cc	52	25	18	12	6	0
Hort Perlite - air cc	115	132	139	144	151	155
Hort Perlite - water cc	91	74	67	62	55	51
NZ Sphag - air cc	136	162	176	192	201	210
NZ Sphag - water cc	87	61	47	31	22	13
6 mo old small bark - air cc	96	113	118	123	127	130
6 mo old small bark - water cc	114	97	92	87	83	80
6 mo old small coconut husk - air cc	131	141	146	150	154	159
6 mo old small coconut husk - water cc	70	60	55	51	47	42

Notes on above chart:
Mixes - see formulas below
CHC = Coconut Husk Chips
Bark is Sequoia Brand
Large Charcoal = #2
Small Charcoal = #4
Small stones = #1A crushed sandstone
Horticultural Perlite = extra coarse
New Zealand Sphagnum = a loose pack of long fiber moss

The following chart presents the same data as the percent of total volume of the pot:

Days Post Watering --->	immediately	1 day	2 days	3 days	4 days	5 days
	after watering					
CHC Paph Seedling Mix - air %	51	59	61	63	65	67
CHC Paph Seedling Mix - water %	29	22	19	18	15	14
CHC Phrag Seedling Mix - air %	54	59	63	64	67	70
CHC Phrag Seedling Mix - water %	34	29	25	24	21	18
CHC Adult Large Paph Mix - air %	55	62	64	66	69	71
CHC Adult Large Paph Mix - water %	33	26	23	22	19	17
Med Aliflor - air %	50	57	59	60	62	63
Med Aliflor - water %	13	6	4	3	1	0
Small Aliflor - air %	44	50	52	53	55	57
Small Aliflor - water %	18	13	10	9	7	5
Small CHC - air %	53	57	59	60	62	65
Small CHC- water %	28	23	22	20	19	16
Med CHC - air %	53	60	63	65	67	71
Med CHC - water %	40	33	30	28	26	22
Med Bark - air %	58	67	68	69	70	72
Med Bark - water %	15	6	5	4	3	2
Small Bark - air %	52	59	61	61	63	64
Small Bark - water %	19	11	10	9	8	6
Med Char - air %	50	54	56	57	58	60
Med Char - water %	20	16	14	13	11	9
Small Charcoal - air %	43	47	48	49	50	51
Small Charcoal - water %	15	12	11	10	9	8
Small Stones - air %	46	50	52	53	54	56
Small Stones - water %	11	8	6	5	3	2
#3 Spongerock - air %	56	67	70	72	74	77
#3 Spongerock - water %	21	10	7	5	2	0

Hort Perlite - air %	47	54	57	59	61	63
Hort Perlite - water %	37	30	27	25	22	21
NZ Sphag - air %	55	66	72	78	82	85
NZ Sphag - water %	35	25	19	13	9	5
6 mo old small bark - air %	39	46	48	50	52	53
6 mo old small bark - water %	46	39	37	35	34	33
6 mo old small coconut husk - air %	53	57	59	61	63	65
6 mo old small coconut husk - water %	28	24	22	21	19	17

There is a lot of data presented here, and a lot of information can be gained from its careful analysis, but that goes beyond the scope of this article. One important point I would like to emphasize is that the data on a mix component gathered from testing it alone will not always be predictive of its behavior as a minor component of a mixture of components. A case in point was experimentation with the # 1A sandstone. Lynn had made the observation that when it was added to the CCH mixes, even in fairly small amounts, that it caused the mixes to dry out more slowly. I didn't feel this made any sense, as it held very little water itself, and suggested that this was just an illusion due to the increased weight of the pots. However, when the mixes were tested, it turned out to be true that the mix with stones dried out more slowly than that without. As a result it is now used only with the Phrags.

Mixes Currently in Use

Note on the Paph mixes: if they are to be used for calcicolous or ultrabasic growing Paphs, approximately 1/2 cup of pulverized dolomitic limestone is added to each 2 cubic feet of mix. The pulverized dolomite adheres quite nicely to the surface of the CHC, whereas it did not adhere well to bark.

Paph Seedling Mix 2.5 inch pots and under:
8 parts small CHC
2 parts medium CHC
3 parts small aliflor
1 part #4 (small) charcoal

Adult Paph Mix 3.5 inch pots and under:
3 parts small CHC
1 part medium CHC
2 parts small aliflor
1 part #2 (large) charcoal

Adult Paph Mix 4 inch pots and up:
4 parts medium CHC
1 part small aliflor
2 parts medium aliflor
1 part #2 charcoal

Phrag Mix 3 inch pots and smaller:
6 parts small CHC
4 parts medium CHC
1 part small aliflor
1 part #1A crushed sandstone
1 part #4 charcoal

Phrag Mix 3.5 inch pots and up:
4 parts medium CHC
1 part medium aliflor
1 part #1 crushed sandstone
1 part #2 charcoal

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