Coir as a Substrate for Pot *Proteaceae* Production©

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INTRODUCTION

Arnelia farm and nursery specialise in propagating and growing *Proteaceae* cut flowers and potted plants. The production is focused on indigenous South African genera *Leucospermum*, *Leucadendron*, *Protea*, and *Serruria*, which grow naturally in the Western Cape and form a major part of the Cape Floristic Region (CFR). Soils in the CFR are typically sandstone derived and low in available nutrients. Therefore, *Proteaceae* generally have a low tolerance for nutrient levels, especially nitrates and phosphorous. We have to be particularly vigilant in monitoring our growing media, from delivery and throughout the growing process, to ensure that nutrient levels stay within preferred ranges.

In 2006 we started the nursery using 100% fine aged bark (0-9 mm) as potting medium. Four years later the mix was changed to 80% aged bark and 20% coir to increase the water holding capacity and re-wetting ability. However, uncertainty regarding the sustainable supply of bark increase as our source is often unable to supply due to aging equipment and rain delays. Additional problems are the inconsistency of the physical and chemical properties arising from varying particle size distribution, age of bark, hygiene, no testing of the bark and no minimum standards. There are also problems with reliable transport.

At Arnelia, the uncertainties around the sustainable supply of a consistent quality of bark as a potting medium are one of the key risk factors for the business. We identified coir as an alternative, sustainable potting medium. However, coir naturally contains high amounts of sodium and potassium. In South Africa, washed, but non-buffered and pre-buffered coir are available. Pre-buffered coir is approximately 30% more expensive compared to non-buffered coir. It was important to understand the importance of buffering or exchanging the ions on the exchange complex. The buffering process involves removing some of the sodium and potassium from the exchange cites and replacing it with calcium and magnesium. The aim of our experiments was to establish our own buffering procedure, whilst limiting water and time wastage.

MATERIALS AND METHODS

In 2009 we started with preliminary coir trials using 0, 20, 40, 60, 80, and 100% coir in blends with bark, perlite, vermiculite, and peat. A trial was conducted with 64 different treatments. The results were unclear and no conclusions could be reached. Two of the follow-up experiments will be discussed in this paper.

Experiment 1

Coir was expanded using two different recipes and left to stand for 8 or 24 h, after which the coir was rinsed with different amount of reverse osmosis water (Table 1). The first recipe used 2.5 g gypsum ($CaSO_4$) and 6.25 g magnesium sulphate ($MgSO_4$) per liter of expansion water. The second recipe used 1 g $CaSO_4$ and 0.3 g $MgSO_4$ per liter expansion water. The control was a sample of non-buffered coir. The samples were sent to a laboratory for analysis. The lab performed an ammonium acetate extract (Table 2).

Table 1. Lay out of expansion of non-buffered coir using two different recipes (Experiment 1).

Reference no.	Treatment	Duration (h)	Rinse
1	Control (expanded in RO H_2O)	8	None
2	Control (expanded in RO H_2O)	8	3 L RO water per 6l coir
3	Control (expanded in RO H_2O)	8	6 L RO water per 6l coir
4	Recipe 2	8	None
5	Recipe 2	8	3 L RO water per 6l coir
6	Recipe 2	8	6 L RO water per 6l coir
7	Recipe 2	24	None
8	Recipe 2	24	3 L RO water per 6l coir
9	Recipe 2	24	6 L RO water per 6l coir
10	Recipe 1	8	None
11	Recipe 1	8	3 L RO water per 6l coir
12	Recipe 1	8	6 L RO water per 6l coir
13	Recipe 1	24	None
14	Recipe 1	24	3 L RO water per 6l coir
15	Recipe 1	24	6 L RO water per 6l coir

Table 2. Analysis results from coir buffering experiment.

Reference	Lab.	Na	K	Ca	Mg
no.	no.	(Cmol(+)/kg)			
1	5315	7.10	16.35	9.29	10.04
2	5316	6.36	14.67	10.55	10.35
3	5317	5.46	14.02	10.55	10.30
4	5318	6.84	16.68	25.37	11.70
5	5319	5.14	13.46	14.19	11.64
6	5320	4.45	12.18	20.89	11.24
7	5321	6.29	16.80	14.53	11.93
8	5322	5.19	14.03	16.08	11.63
9	5323	5.19	12.31	22.89	11.46
10	5324	6.60	16.16	24.03	33.90
11	5325	3.58	10.09	31.78	27.56
12	5326	2.51	7.35	36.91	23.19
13	5327	7.05	16.80	28.05	34.06
14	5328	4.41	10.53	28.13	28.26
15	5329	1.99	6.29	17.46	24.99

Experiment 2

Non-buffered coir was used as a control and compared to different buffering recipes and pre-buffered coir. The treatments were (1) non-buffered coir, (2) coir buffered with 1 g $CaSO_4$ per litre of expansion water, (3) coir buffered with 1 g $CaSO_4$ and 0.5 g $MgSO_4$ per litre of expansion water, (4) coir buffered with 1 g $CaNO_3$ and 0.5 g $MgSO_4$ per liter of expansion water, and (5) pre-buffered coir. Pots similar to the 15-cm pots we use commercially were filled with the different mixes and put under overhead irrigation for four weeks. After this period samples were sent to a lab for analysis. The results of a 1: 1.5 volume extraction are summarised in Table 3.

Experiment 3

Rooted cuttings of eleven different cultivars were potted into our commercial bark-based medium and into a coir-based medium in 15-cm pots. The cultivars were selected from the *Leucospermum*, *Leucadendron*, *Protea*, *Brunia*, and *Serruria* genera. After 1 year's growth the medium was saturated with water. The plants were weighed to establish field water capacity (FWC) after all the free water drained. The plants were weighed daily until wilt point (WP) was reached. Water loss from FWC to WP was compared for the bark- and coir-based media (Fig. 1). The pattern of water loss is shown in Figure 2.

RESULTS AND DISCUSSION

Proteaceae are very sensitive to high amounts of nitrates and phosphorous in the growing medium and therefore it was critical to understand coir's properties and behaviour before possibly changing our production from a bark-based to coir-based medium.

There are several different buffering recipes and it is difficult to know which recommendation to follow. The procedure must also suit the production process. After treating coir with different amounts of $MgSO_4$ in Experiments 1 and 2, we decided that the addition of magnesium is not essential. After adding $CaNO_3$ to the expansion water and placing the pots under the overhead irrigation, the base saturation ratio of the medium was satisfactory.

Table 3. Analysis results of Experiment 2. Non-buffered coir (Trt 1) was compared to three buffering recipes and pre-buffered coir (Trt 5).

Reference no.	pH	EC	P	Na	K	Ca	Mg	Fe	Zn	Mn	Cu	B
		(mS/m)	(mg/L)									
TRT 1	6.6	64.8	0.79	97.66	61.66	2.05	0.84	1.414	0.009	0.011	0.008	0.174
TRT 2	6.4	56.1	0.80	83.56	46.34	3.27	1.37	0.873	0.005	0.013	0.000	0.148
TRT 3	6.4	62.4	0.45	100.14	44.26	4.33	2.16	0.561	0.017	0.015	0.009	0.155
TRT 4	6.6	41.9	0.83	69.16	23.90	2.72	1.00	0.536	0.009	0.010	0.007	0.176
TRT 5	6.8	44.6	0.59	89.50	8.83	4.77	1.31	3.103	0.006	0.015	0.006	0.179

In Experiment 3 we learned that coir has a structure that is ideal for holding water and releasing it again. Figures 1 and 2 show coir holding more water for a longer period of time, indicating a higher water holding capacity compared to bark. The bark we use in the nursery varies in terms of particle size as well as the inclusion of stones of various sizes which damage the blender, whereas the coir was more uniform and reliable. In the experiments the air filled porosity (AFP) of the coir varied from 17 to 19%, which is ideal. The AFP also differs depending on the grade you use as coir could have fines which will block the pores over time. It is advisable to therefore make sure of the source and grade of the coir. We also found coir has satisfactory re-wetting capability. Most importantly, the plants performed well in a coir-based medium after our buffering treatment.

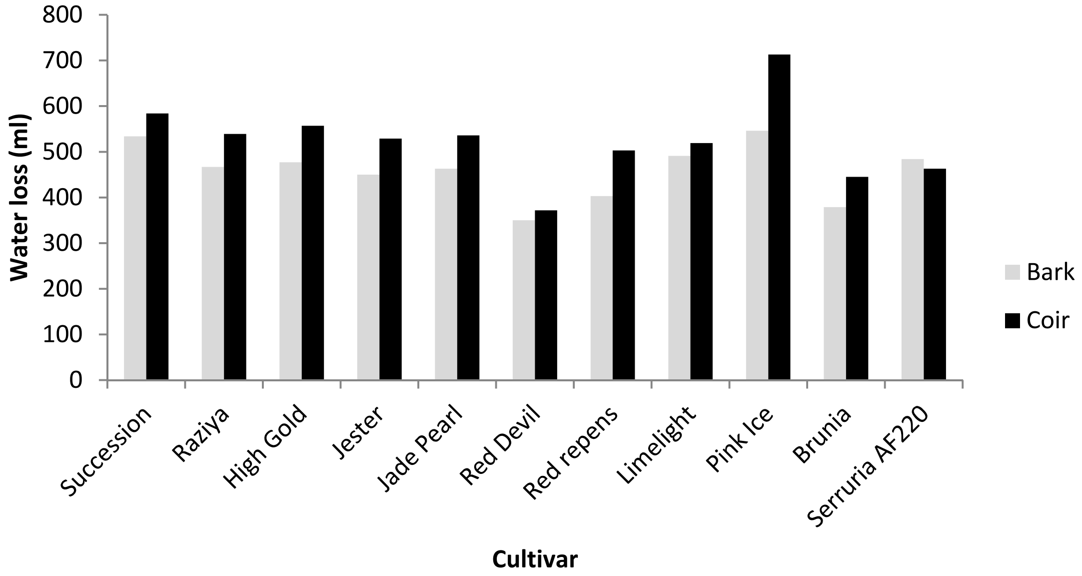

Fig. 1. Water lost via evapotranspiration of eleven different *Proteaceae* cultivars was compared between the bark- and coir-based medium.

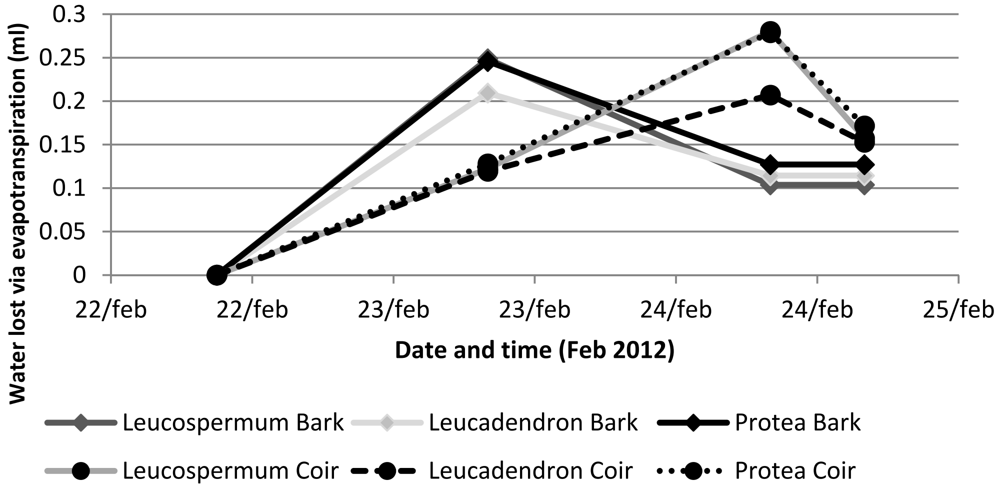

Fig. 2. The pattern of water loss from field water capacity to wilting point is shown for three different *Proteaceae* genera.