Evaluation of materials as components of a reduced-peat growing medium

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Introduction

There will be an increasing demand in the future for peat-free and reduced-peat growing media. There is therefore an urgent need to assess materials for their potential as partial peat replacements. This experiment studied the effect of three materials, composted green waste (CGW), composted bark and a ureaformaldehyde foam (Fytocell) on the physical properties of the growing medium and on the growth of nursery stock plants.

The CGW was supplied by Dublin Corporation from their composting site at St. Anne's Park, Clontarf. Coarse particles were screened out by passing the material through a 12 mm filter. The bark was composted at Kinsealy over a 12 week period with the addition of urea prior to composting to supply 500 g/m^3 of N. The Fytocell was supplied in granulated form by Resin Generated Foam (Ireland) Ltd.

Methods

Each of the three materials was mixed with 0-14 mm grade at three rates to form 12.5, 25 and 50 % by volume of the resulting mix. Dolomitic lime had been added to the peat at 3 g/L. Osmocote Exact Standard (12-14 month) controlled release fertiliser was added to each mix at 5 g/L. Samples of each mix were taken for physical analysis.

Each of the nine mixes was filled into 2-litre pots and 12 rooted cuttings of three species of nursery stock were potted into each mix at the end of March. The species were *Escallonia macrantha*, *Hebe* 'Mrs. Winder' and *Hypericum* 'Hidcote'. Two other treatments, 100% peat and 100% bark were also included. Each species constituted a separate experiment. The pots were placed in a glasshouse for a four week period and then laid out in randomised order on an outdoor gravel bed which was covered with Mypex. Irrigation was given through an overhead spray line which was controlled by a timer.

The plants were harvested in November, they were scored for appearance and root quality and the fresh weights were recorded.

Results

Physical analysis

The physical properties of the treatments are shown in Table 1. Addition of CGW or composted bark to the peat significantly increased the bulk density especially at the highest rate. Fytocell on the other hand reduced the dry bulk density.

Total pore space was reduced slightly by adding CGW and bark but was increased by the Fytocell. Bark and CGW increased the air content at 10 cm tension and reduced the water content at 10 cm tension and the easily available water content (EAW). Fytocell also increased the aeration at 10 cm and reduced the water content but the reduction in easily available water was less than with CGW or bark. The 100% bark treatment had a high aeration and a very low water holding capacity compared with peat.

Table 1. Physical analysis of peat mixes with CGW, Composted Bark and Fytocell.

Rate (%)	BD[1]	TPS[2]	Water content (%) at tension of			Air content (%) at tension of			EAW[3]	WBC[4]
	(g/L)	(%)	10 cm	50 cm	100 cm	10 cm	50 cm	100 cm	(%)	(%)
CGW										
12.5	168	89.8	66.1	46.5	43.7	23.7	43.2	46.1	19.5	2.9
25	194	89.0	61.1	43.8	41.6	27.9	45.3	47.4	17.3	2.1
50	251	86.5	56.2	41.7	40.3	30.2	44.8	46.2	14.5	1.4
Composted Bark										
12.5	172	89.5	64.8	48.0	45.4	24.7	41.5	44.1	16.8	2.6
25	185	88.6	64.2	47.8	45.3	24.4	40.8	43.3	16.4	2.5
50	210	87.6	60.8	47.0	45.0	26.7	40.5	42.5	13.8	2.0
Fytocell										
12.5	143	91.0	65.0	47.9	44.9	25.9	43.0	46.1	17.1	3.1
25	138	91.2	63.0	45.9	42.9	28.2	45.3	48.3	17.1	3.0
50	124	92.1	60.6	44.3	41.0	31.5	47.8	51.1	16.3	3.3
100 % Peat	153	90.1	66.4	47.1	44.3	23.8	43.0	45.8	19.2	2.8
100% Bark	263	85.5	54.0	46.7	45.7	31.5	38.8	39.8	7.2	1.1
s.e. (df=26)	3.7	0.22	0.90	0.59	0.90	0.90	0.62	0.90	0.77	0.46

[1] Dry Bulk Density
[2] Total Pore Space
[3] Easily Available Water : water content at 10 cm-water content at 50 cm
[4] Water Buffering Content : water content at 50 cm-water content at 100 cm

Plant performance

Shortly after placing the plants in the greenhouse, a marginal leaf scorch appeared on the plants in the growing media which contained Fytocell. This was very slight at the 12.5% rate but increased in severity as the proportion of Fytocel rose to 25 and 50%. The scorch was worst on *Escallonia,* less severe on *Hypericum* while only slight symptoms were seen on *Hebe*. The damage was temporary, as normal growth subsequently began to develop. However at the 50% rate of Fytocell incorporation, three plants of *Escallonia* and two of *Hypericum* did not survive. At the 25% rate one plant of each of these species was lost. No *Hebe* plants were killed.

(NOTE : at that moment in time the Fytocell flakes were not treated / neutralised before send out to customers (since that time, this buffering is a standard procedure) therefore this scorching is no loner an issue).

The overall effects of the peat extender materials and the rate of incorporation are shown in Tables 2, 3 and 4.

Table 2 : Effect of peat extender on the fresh weight, marketability and root score of *Escallonia macrantha*.

	Fresh weight (g/plant)	**Marketability**	**Root score**
Material			
CGW.	141.4	7.1	8.7
	154.5	7.2	8.7
Composted bark.	155.4	6.7	8.9
Fytocell	148.3	5.9	9.1
F-test	NS	***	*
s.e.	5.11	0.14	0.09
Rate of incorporation (%)			
12.5	152.4	7.0	8.9
25	147.0	6.5	8.8
50	150.3	6.7	8.9
F-test	NS	*	NS
s.e.	4.48	0.13	0.08
Peat 100%	164.9	7.5	8.8
Bark 100%	148.6	7.1	8.5

With *Escallonia* the three peat extenders gave similar fresh weights (Table 2) and incorporation up to 50% similarly did not reduce plant size. The marketability score was lower with the addition of Fytocell and this was probably a consequence of the scorch damage described above which was still visible on the older leaves. The root score, which was a measure of the amount and condition of the root system was higher with Fytocell than

with CGW. This again illustrates the temporary nature of the phytotoxic effect of Fytocell. Marketability scores were slightly reduced when the rate of incorporation was 25% or more. The best results were obtained in 100% peat but all treatments produced saleable plants.

(NOTE : at that moment in time the Fytocell flakes were not treated / neutralised before send out to customers (since that time, this buffering is a standard procedure) therefore this scorching is no loner an issue).

Incorporation of either bark or Fytocell resulted in increased fresh weights compared with CGW in the case of *Hebe* (Table 3). These two materials also scores higher for marketability and root score than CGW. There was a slight reduction in fresh weight as the rate was increased from 12.5 to 25% but no further reduction at the 50% rate. Marketability score was not affected by rate of incorporation. There was a slight reduction in root score at the 25% rate. The 100% peat treatment produced anomalously small plants of *Hebe* with a similarly reduced marketability score although the root condition was good. Plants performed well in the 100% bark treatment.

Table 3. Effect of peat extenders on fresh weight, marketability and root score of *Hebe* "Mrs. Winder"

	Fresh weight (g/plant)	**Marketability**	**Root score**
Material			
CGW.	145.1	7.6	8.5
	150.7	8.0	8.4
Composted bark.	167.5	8.0	9.0
Fytocell	173.2	8.4	9.3
F-test	***	*	***
s.e.	4.29	0.16	0.12
Rate of incorporation (%)			
12.5	169.5	8.1	8.9
25	154.5	7.9	8.5
50	153.3	7.9	8.9
F-test	**	NS	*
s.e.	3.72	0.14	0.11
Peat 100%	136.0	6.7	8.9
Bark 100%	166.8	8.4	8.3

Both bark and Fytocell again gave a slight increase in plant size compared with CGW in the case of H*ypericum* (Table 4). Plant with Fytocell incorporated in the growing medium had a slightly reduced marketability score and as was the case with *Escallonia* this was probably related to the initial damage at the start of the trial. The rate of incorporation did not affect the fresh weight or the marketability score. Plant with bark and Fytocell incorporated performed at least as well as those in 100% peat as did those in 100% bark.

There was a strong interaction between the effects of material and rate of incorporation on root score which is shown in Table 5. With CGW and bark the root score was not affected by the rate of incorporation but in the case of Fytocell the root score improved with increasing rate. This effect of Fytocell in promoting development of the root system is illustrated in Figure 3 which shows the root systems of *Hypericum* 'Hidcote' in CGW, bark and Fytocell incorporated at the 50% rate. The more vigorous root system in the Fytocell treatment is quite clear.

(NOTE : at that moment in time the Fytocell flakes were not treated / neutralised before send out to customers (since that time, this buffering is a standard procedure) therefore this scorching is no loner an issue).

Table 4. Effect of peat extenders on fresh weight, marketability and root score of *Hypericum* 'Hidcote'

	Fresh weight (g/plant)	**Marketability**	**Root score**
Material			
CGW	91.5	7.2	3.7
	100.9	7.3	4.2
Composted bark.	111.0	7.1	6.6
Fytocell	115.2	6.6	7.5
F-test	***	*	***
s.e.	3.62	0.15	0.13
Rate of incorporation (%)			
12.5	101.9	7.2	5.4
25	104.9	7.0	5.0
50	107.1	7.0	6.1
F-test	NS	NS	***
s.e.	3.13	0.13	0.11
Peat 100%	105.7	7.0	6.7
Bark 100%	107.1	6.9	6.9

Table 5. Interaction between peat extender material and rate of incorporation on root score of *Hypericum* 'Hidcote'.

Material	**Rate of incorporation (%)**		
	12.5	**25**	**50**
CGW	3.8	3.4	4.0
	5.0	3.4	4.3
Composted bark.	6.6	6.6	6.6
Fytocell	6.3	6.8	9.5
		F-test	**s.e.**
material x rate		***	0.22

A correlation matrix between the measurement of plant performance and the physical properties of the treatments was calculated and is shown in Table 6. There were no significant relationships between the physical parameters and plant fresh weight and marketability score. This might have been expected because although there were differences in plant performance between the treatments these were relatively small and all treatments produced normal saleable plants. Moreover the differences in physical properties although significant were not extreme. The strongest relationships were with the root score where treatments that increased bulk density and reduced total pore space tended to have lower root scores in the case of *Escallonia* and *Hebe*. The relationships for pore space are shown in Figures 1 and 2.

Table 6. Correlation matrix between plant performance indicators and physical properties of the growing media (significant values at $p<0.05$ are in bold).

	BD[1]	**TPS**	**Water content at tension (cm)**			**Air content at tension (cm)**			**EAW**	**WBC**
			10	**50**	**100**	**10**	**50**	**100**		
Escallonia										
Fresh wt	-0.06	-0.01	0.17	0.39	0.40	-0.23	-0.31	-0.26	-0.04	0.04
Marketability	0.49	-0.52	-0.04	0.01	0.18	-0.31	-0.41	-0.46	-0.05	-0.45
Root score	**-0.66**	**0.66**	0.33	0.10	-0.14	0.01	0.44	0.53	0.33	**0.65**
Hebe										
Fresh wt	-0.16	0.14	0.04	0.49	0.45	0.04	-0.27	-0.19	-0.24	0.19
Marketability	-0.02	0.01	-0.14	0.34	0.33	0.20	-0.25	-0.20	-0.37	0.06
Root score	**-0.77**	**0.76**	0.38	0.19	-0.08	0.01	0.45	0.56	0.34	**0.76**
Hypericum										
Fresh wt	-0.27	0.22	0.11	0.42	0.34	0.00	-0.15	-0.06	-0.12	0.27
Marketability	0.29	-0.28	-0.03	-0.14	-0.07	-0.15	-0.11	-0.14	0.05	-0.21
Root score	-0.41	0.37	0.00	0.35	0.23	0.25	0.02	0.10	-0.21	0.36

[1] Abbreviations as for Table 1.

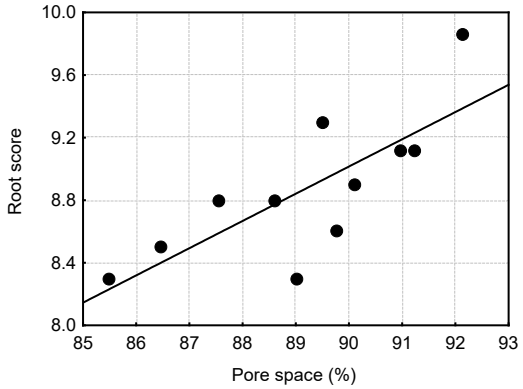

Figure 1. Relationship (r=0.76) between pore space of the growing medium and root score of *Hebe* 'Mrs. Winder'.

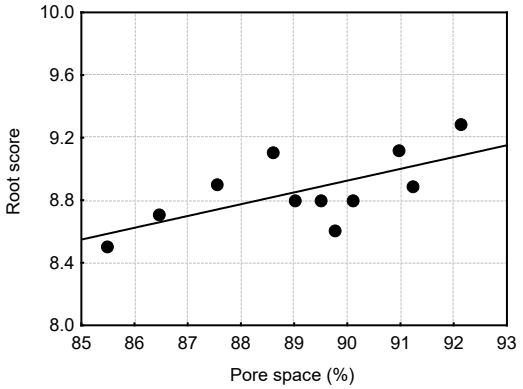

Figure 2. Relationship (r=0.66) between pore space of the growing medium and root score of *Hypericum* 'Hidcote'.

Conclusions

All three materials incorporated at rates of up to 50% by volume produced saleable plants of all three species.
For two of the species results were better with bark or Fytocell compared with CGW.
The high salt content of CGW and its N drawdown effect may limit the rate of its use in nursery stock growing media.

Both bark and CGW were easy to handle and mix with the peat.
Fytocell, in the form supplied, was dry and very light with a mixture of coarse and very fine particle sizes. This necessitated wearing a mask during handling. ***(Note : Fytocell flakes are no longer that fine)*** There was also a noticeable smell from the product. The initial damage to plants in the Fytocell treatments may have been due to the fact that no pre-treatment of the material to raise the pH was carried out.
(NOTE : at that moment in time the Fytocell flakes were not treated / neutralised before send out to customers (since that time, this buffering is a standard procedure) therefore this scorching is no loner an issue).

One of the most consistent effects in the trials was the vigorous root system which developed in the Fytocell treatments.

CGW and bark increased the bulk density of the growing medium and reduced pore space and easily available water. Fytocell reduced bulk density and increased pore space.

Figure 3. Root systems of *Hypericum* 'Hidcote' grown in peat mixed with 50% CGW, 50% Bark and 50% Fytocell.