Evaluation of Physical and Chemical Properties of Processed *Sphagnum palustre* Biomass as an Additive in Horticultural Substrates

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Relevance and Research Question

Relevance

- Provision of raw material is an important ecosystem service provided by restored/rewetted peatlands and their use helps to increase the interest of stake-holders to expedite further restoration measurements
- Cultivation of peat moss (i.e. *Sphagnum* farming) on rewetted peatlands offers a promising way of paludiculture[1]
- Hydrophysical properties (e.g. wettability, water holding capacity) and the stability to decomposition after fertilization (e.g. thermostability) are important parameters for horticultural substrates

Research Question

- The aim of this study was the evaluation of physical and chemical characteristics of harvested and processed *Sphagnum palustre* biomass to identify possible uses in horticultural substrates. Therefore, different substrates, including *Sphagnum*, peat and coir, were tested

Methods

Mixtures

- Living *Sphagnum palustre* biomass, coir and white peat were oven-dried (40 °C), cut and sieved (<2 mm) for homogenization and to remove unwanted impurities, *S. palustre* was exposed to microwave radiation (450 W, 4:30 minutes). Mixtures were prepared on a 50/50 vol.-% basis

Maximum Water Holding Capacity (MWC)

- Gravimetric water contents of mixtures were measured after water saturation, drainage in a sand bath (10 minutes) and oven-drying (105 °C)[2]

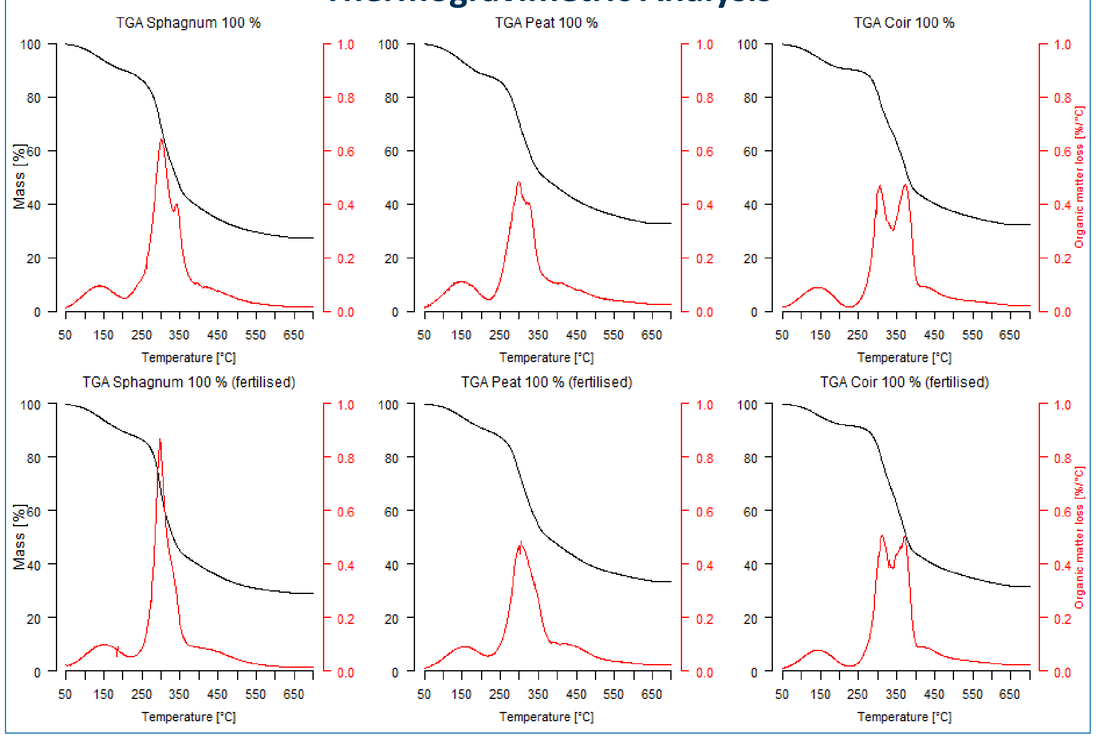
Wettability

- $4x10^{-3}$ m^3 substrate was hydrated 10 times using 4 kg deionised water and weighted after each hydration event[3]

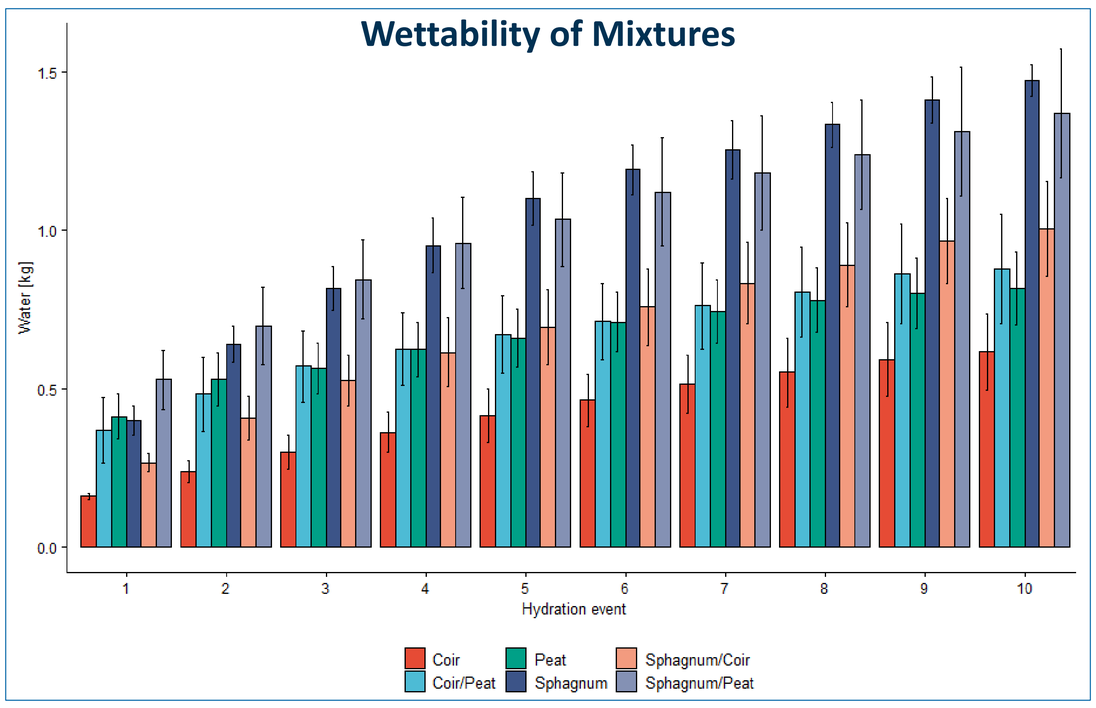
Thermogravimetric Analysis (TGA) and Bomb Calorimetry (BC)

- Subsamples of mixtures were fertilized weekly and incubated for 4 weeks at 40 °C. TGA analysis were conducted on SGA TGH 1200, using 50 mg of milled sample, a heat ramp of 10 K/min using N_2 as reaction gas. BC was conducted on Parr 6200 Isoperibol Calorimeter, using 1 g of milled sample, benzoic acid as standard[4]

Thermogravimetric Analysis



Wettability of Mixtures



Substrate	C (%)	N (%)	S (%)	H (%)	O (%)*	Gross heat value MJ/kg ± SD
Sphagnum	44.3	1.0	0.6	6.2	46.0	17.09 ± 0.01
Sphagnum fertilized	42.6	1.4	0.4	5.7	45.8	16.44 ± 0,09
Peat	46.4	0.8	0.2	4.9	42.9	16.77 ± 0.33
Peat fertilized	46.2	1.2	0.2	4.9	42.6	17.29 ± 0.05
Coir	45.3	0.4	0.2	4.1	42.1	16.87 ± 0.22
Coir fertilized	46.9	0.6	0.5	3.8	42.1	17.63 ± 0.19

Mixture	Coir	Coir/Peat	Peat	*Sphagnum* /Coir	*Sphagnum* /Peat	*Sphagnum*
Mean MWC ± SD (kg water/kg dry weight)	3.3 ± 1.3	6.3 ± 1.1	6.4 ± 0.3	9.9 ± 0.3	15.1 ± 0.8	28.4 ± 2.2

Conclusion

- ✓ Hydrophysical properties show advantages of mixtures that include processed *Sphagnum* biomass
- ✓ Significant higher maximum water holding capacities of *Sphagnum* mixtures
- ✓ Faster re-wettability of *Sphagnum* mixtures
- × *Sphagnum* mixtures show higher susceptibility to decomposition after fertilization and incubation indicated by results of TGA (peak at lower temperature), BC (decreasing gross heat value) and decreasing C content

Acknowledgement and Funding

Special thanks to Fred Worrall for giving the possibility of using the laboratory at Durham University, Department of Earth Sciences (UK). This project was financed by "bellaflora Gartencenter GmbH" (Austria)

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[2]**Marshall T.J., Holmes J.W., Rose C.W. (eds.) (1996)** Soil physics, Cambridge University Press, Cambridge. pp. 453.

[3]**Fonteno W.C., Fields J.S., Jackson B.E. (2013)** A Pragmatic Approach to Wettability and Hydration of Horticultural Substrates. Acta Horticulturae, 1013: 139–146.

[4]**Worrall F., Moody C.S., Clay G.D., Burt T.P., Kettridge N., Rose R. (2018)** Thermodynamic control of the carbon budget of a peatland. Journal of Geophysical Research: Biogeosciences, 123: 1863–1878.

*Based on separate measurements