Tyfu Cymru: Technical Advice Sheet
Peat-free Horticulture: How and Why?

The Drive for Peat Free

The Government's 25 Year Environment Plan, published in 2018, spelt out the ambition to gradually eliminate peat use with a final voluntary phase-out target for professional growers of fruit, vegetables and ornamental plants of 2030. The underlying driver is environmental; peatlands are significant carbon stores, draining of peatlands for agricultural use and harvesting peat releases carbon, which is a significant contributor to atmospheric greenhouse gases.

To replace peat, alternative raw materials must be found which are comparable with peat performance in containerised plant raising systems. By 'raw materials' we mean materials as supplied by growing media manufacturers, which have therefore already been processed to make them suitable for use as a growing media, for example washing, composting and grading. In addition, we focus on four broadly grouped types of materials which are currently commercially available and can be reliably sourced: wood fibre, coir (fibre from the outer husk of a coconut), bark and green compost, which are all renewable and primarily plant cell wall based.

Methodology

Growers and growing media manufacturers have long been aware of the need to reduce the reliance on peat, and diluting peat with up to 30% of a substitute material is common practice for some e.g. nursery stock producers. In other sectors, such as soft and cane fruit, the industry has switched to coir. Focussing on a single material does however expose the industry to price and availability issues and in fact there is insufficient coir available to meet UK or global demand. The reality is that materials will have to be mixed to create peat-free growing alternatives.

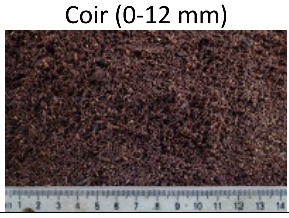
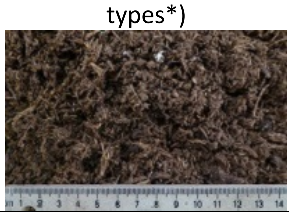
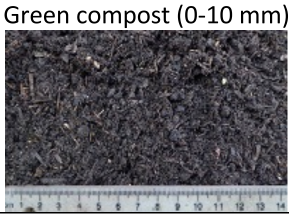
Attempting to blend different raw materials to create suitable growing substrates is not new. However, there is a core challenge: how to select the blend recipe? Often blends are the result of intuitive trial and error mixtures that are assessed via growing trials. But this is slow, expensive and can easily end in failure. At ADAS we have developed a strategy for a rational approach to growing media blending based on the physical properties of the materials. The objective is to reduce the number of trials needed, speed up the selection of viable new blends, and minimise new growing media product development costs. This strategy was based on the findings of a 5-year programme of work funded by Defra, AHDB Horticulture, growing media manufacturers and growers, in collaboration with Quadram Institute Bioscience and Stockbridge Technology Centre.

The physical properties of a material are relatively fixed, whereas the chemical properties can be largely modified via additives to create the correct plant growing conditions in the root-zone. Previous work has demonstrated that three parameters; **AFP** (air-filled porosity), $\mathbf{D_b}$ (dry bulk density) and **AW** (available water), adequately describe the physical properties of a growing media substrate. These three parameters can be determined by physical measurement in the laboratory, using the methods detailed in the growing media Technical Monograph[1].

AFP is the amount of water the substrate can hold. $\mathbf{D_b}$ is the weight of the substrate per unit volume devoid of water. **AW** is the amount of water available to the plant. Some examples of values for raw

[1]http://www.adas.uk/Portals/0/Documents/Technical%20Monograph%20Growing%20Media%20Laboratory%20Methods.pdf

material parameter values appear in the table below. Values for blends can also be measured, and in addition they can be predicted by combining raw material values.

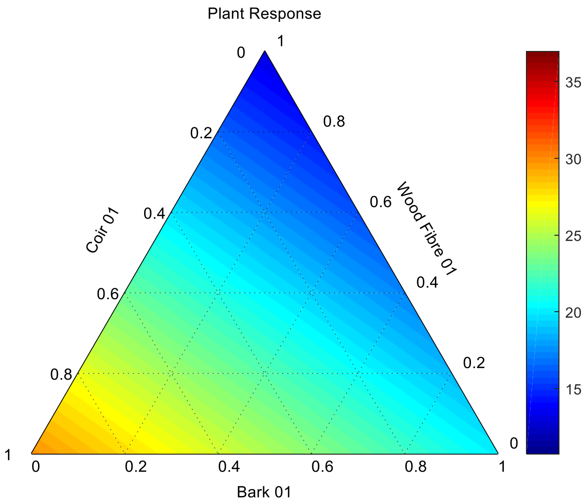
Raw material	Properties
Coarse peat (10-25 mm) 	AFP (%) = 13.3 - 38.4 AW (%) = 32.5 - 44.6 D_b (g cm^{-3}) = 0.12 - 0.19
Fine peat (0-5 mm) 	AFP (%) = 8.2 - 9.1 AW (%) = 35.0 - 43.0 D_b (g cm^{-3}) = 0.09 - 0.17
Bark (0-8 mm) 	AFP (%) = 16.3 - 26.3 AW (%) = 30.1 - 34.2 D_b (g cm^{-3}) = 0.16 - 0.23
Potting bark (5-16 mm) 	AFP (%) = 38.6 - 49.4 AW (%) = 35.0 - 43.0 D_b (g cm^{-3}) = 0.15 - 0.17
Coir (0-12 mm) 	AFP (%) = 17.3 - 20.3 AW (%) = 36.6 - 40.4 D_b (g cm^{-3}) = 0.06 - 0.11
Wood fibre (all tested types*) 	AFP (%) = 25.4 - 51.7 AW (%) = 13.2 - 24.7 D_b (g cm^{-3}) = 0.06 - 0.11
Green compost (0-10 mm) 	AFP (%) = 5.0 - 15.1 AW (%) = 35.8 - 46.7 D_b (g cm^{-3}) = 0.23 - 0.52

**Wood fibre includes medium and coarse, steam extruded and mechanically extruded samples.*

This means that the substrate now has a reproducible, lab-based description as opposed to one involving only its performance in a growing trial. Instead of describing a blend as a traditional '30% wood fibre + 70% coir' for example, we can instead describe substrates using three numbers (AFP, D_b and AW). According to this view, if a blend of wood fibre plus coir has the same physical parameter values as a blend of bark plus green compost then we can think of these two blends as 'the same'. When using recipe-type descriptions there is no defined way of describing blends as being different or the same. This is especially relevant for materials such as bark and wood fibre, where the properties are extremely variable to the point that descriptions such as '30% wood fibre + 70% coir' have little meaning outside of a given crop or trial. In addition, using parameters shows how to change a blend to improve it, for example by altering the balance of components or switching to different components to give a better set of parameter values.

Modelling

Over the last five years we have developed a model of growing media performance by testing the growth response of a wide range of plant types as a function of the three parameters AFP, D_b and AW. This means that when given some raw materials and their AFP, D_b and AW measurements, we are able to predict the outcome for all possible mixtures for a given plant type. This is presented using a highly visual format, illustrated below for a mixture potentially comprising three raw materials: bark01, wood fibre01 and coir01.



The colour depicts plant response ranging from blue (poor) to red (good). The left-hand lower corner is 100% coir, which unsurprisingly gives the best plant response. Moving along the bottom line of the triangle corresponds to blends of coir with bark (zero wood fibre), reaching 100% bark in the bottom right corner. Bark with wood fibre blends are shown along the right hand edge, culminating in 100% wood fibre (and poor performance) at the top corner. Three-way mixes inhabit the interior of the triangle.

The model can also produce additional matching colour coded triangles for material cost and for other factors such as sustainability, to allow direct comparison with plant performance data.

Grower Outcomes

From 2016 – 2019, a range of peat-free prototype blends were trialled on different nurseries across the UK, covering all sectors of horticulture with a range of growing systems. For containerised production, peat-free prototypes were highly successful, demonstrating that a range of blends can be used to produce marketable plants. Examples of plants from the trials are shown below.

	
Cherry trees – F P Matthews - 2017	*Choisya ternata* – Lowaters - 2017
	
Pansy ‘Inspire’ – Newey Roundstone - 2018	*Viburnum tinus* – James Coles & Sons – 2019

	
Raspberry 'Maravilla' – New Farm Produce - 2019	Pot Chrysanthemum – Double H - 2019

Practicalities

When switching to a peat-free blend, there are some crop management considerations to address.

Irrigation

Peat-free materials can behave very differently to peat, and may require a 'little and often' approach to irrigation. The surface tends to dry out quite quickly, which can be misleading, as containers may appear to be dry when in fact there is adequate moisture below the surface. Take time to learn how the material behaves both in summer and winter, and consider weighing containers to begin with, to get a good understanding of when a container is sufficiently watered, and when it is too dry.

Nutrition

It is important to have a nutritional analysis completed on new batches of growing media, to ensure that your feeding regime corresponds to the needs of the crop. It is also important to monitor pH (acidity) and EC (electrical conductivity) throughout the growth cycle, to ensure these remain within range. If the EC is too high, this can result in plant injury or loss. If the pH is too low, macronutrients such as nitrogen become less readily available, which may result in older leaves exhibiting deficiency and yellowing. If pH is too high, selected micronutrients such as iron can become unavailable to plants, resulting in young leaves turning white.

Mechanisation

It is important to ensure your machinery (pot-filler, tray-filler etc.) is set-up correctly to suit the material that will be flowing through it. Blends that are more fibrous may require slight adjustments to the machinery, to ensure that material flow remains consistent and blockages do not occur.

Pests, diseases and weeds

The interaction of growing media selection with pests, diseases and weeds is potentially complex, but generally, if a growing media blend is well managed, there should not be any major issues. Materials with high available water can cause root-zone problems (root rots such as *Pythium* and *Phytophthora* or through Sciarid and Shore fly larvae feeding on roots), but this can be resolved through the inclusion of other materials with lower available water contents and careful irrigation management.

Getting Help

Analysis of growing media properties, trial set-up and data evaluation is available from the ADAS Growing Media Service. Visit https: //www.adas.uk/services/growing-media or contact us directly.

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