Reducing and Replacing peat in Irish Horticulture:
The Research Challenge

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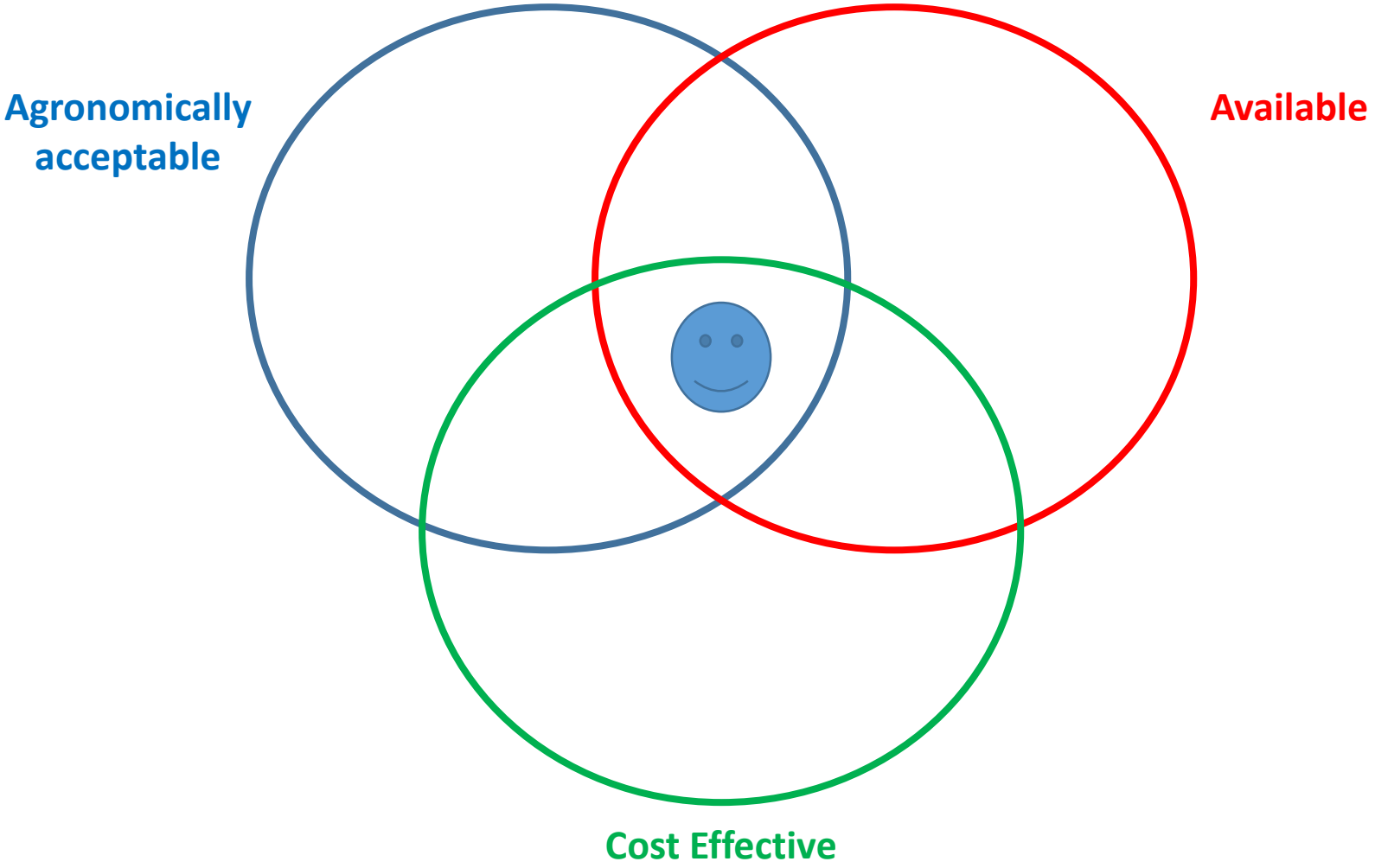
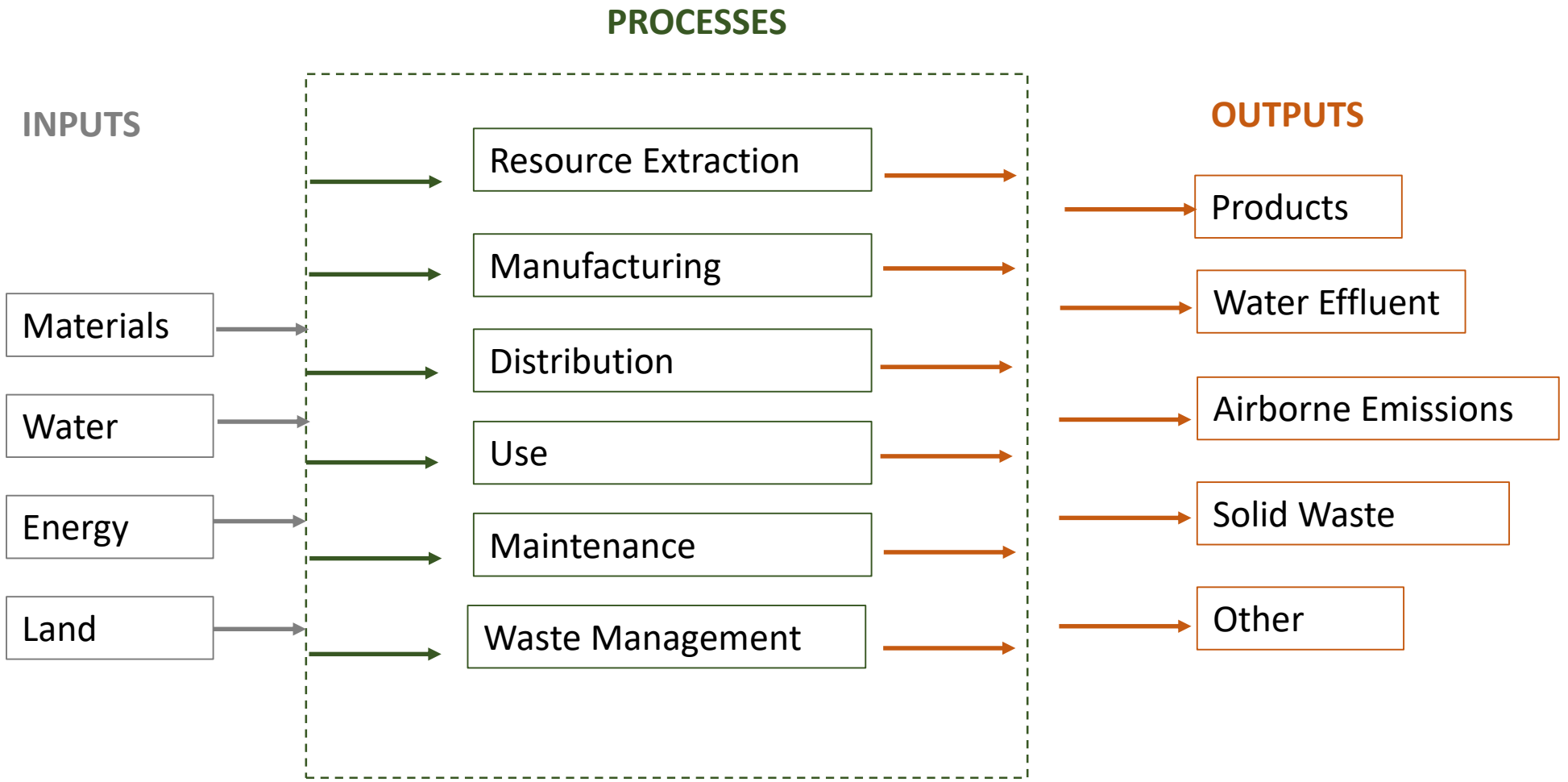
Peat in Horticultural Production

- Since the early 1960s peat has been a critical component in the development of containerised plant production
- Has many beneficial properties, including a low bulk density, low nutrient content and low cost
- As such many systems and processes were designed around the use of peat
- Timeline to 2030? – Increased demand
- Therefore there is a need to identify and evaluate materials to that can dilute and replace peat
- Research is essential, but the importance of knowledge transfer and peer to peer learning should also not be underestimated

Considerations for alternative growth media



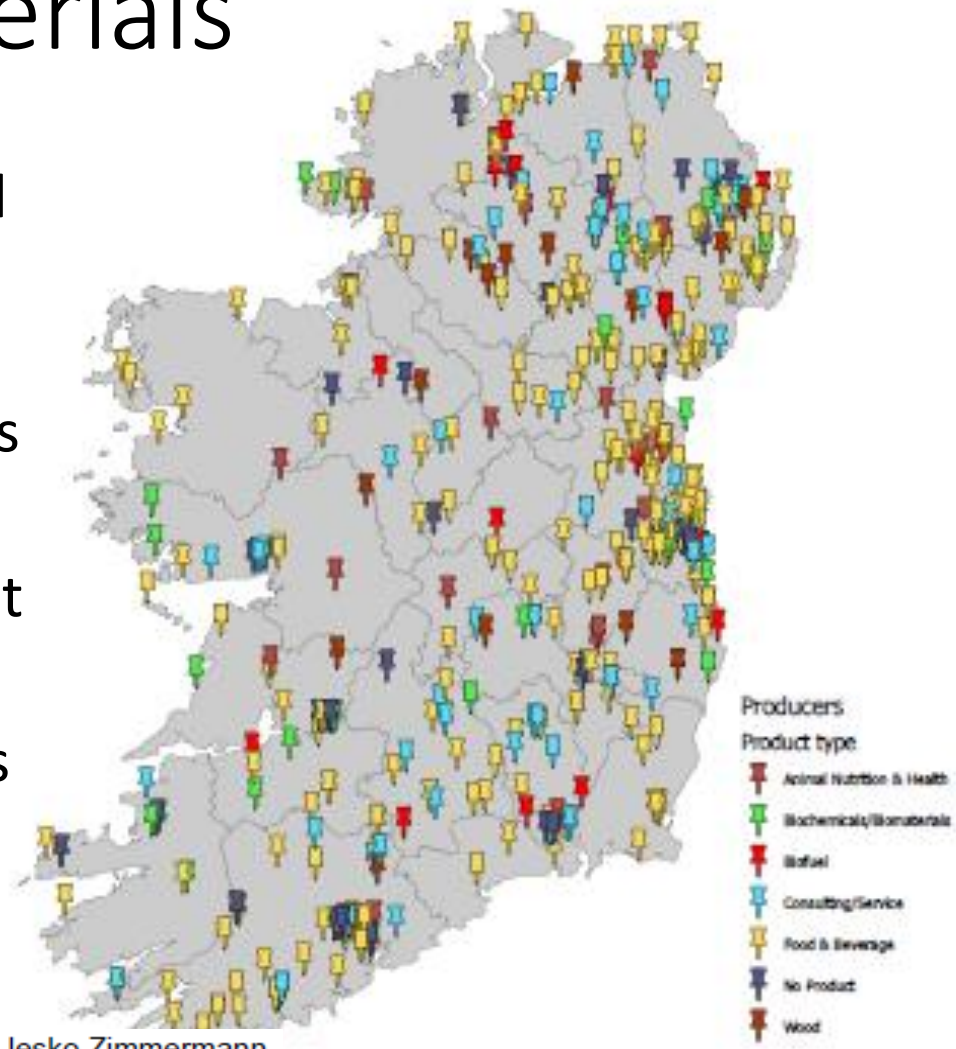
What is factored into the Life Cycle Assessment Process?



Acknowledgement: Dr Lael Walsh, Teagasc

Availability of alternative materials

- Current volume of peat required by the professional Horticulture sector is estimated to be between 180,000 and 250,000 m^3
- An initial challenge is identifying candidate materials where there is sufficient volume available
- Rapid assessment for their potential as a component of a growth media (Volume, Bulk Density, pH, E.C.)
- Consideration given to alternative uses for materials (i.e. Wood based materials for fuel)
- National reports from government agencies



Dr Jesko Zimmermann
Department of Agrifood Business and Spatial Analysis
Teagasc Ashtown Research Centre

Filippo Giancarlo Martinelli, Stephen Napier & Kevin Ryan
Irish Bioeconomy Foundation (IBF)
National Bioeconomy Campus (former Lisheen Mine)

Characteristics of target growth medium (1)

The material must have the correct physical, chemical and biological characteristics to allow healthy root development

(1) A physical structure that creates an appropriate balance of air and water

(2) Determined by the size, shape, texture and arrangement of the particles it is composed from

(3) How is this defined? (Bulk Density, particle size distribution, pore size)

(4) Hydraulic properties - how water is absorbed, held and released (Air Filled porosity, Water Holding Capacity)

These methods and approaches have been well defined for peat based growth media, but less well so for alternative materials and mixes of these materials

Barrett et al., 2016 Achieving environmentally sustainable growing media for soilless plant cultivation systems – A Review. *Scientia Horticulturae* 212 220-234

Characteristics of target growth medium (2)

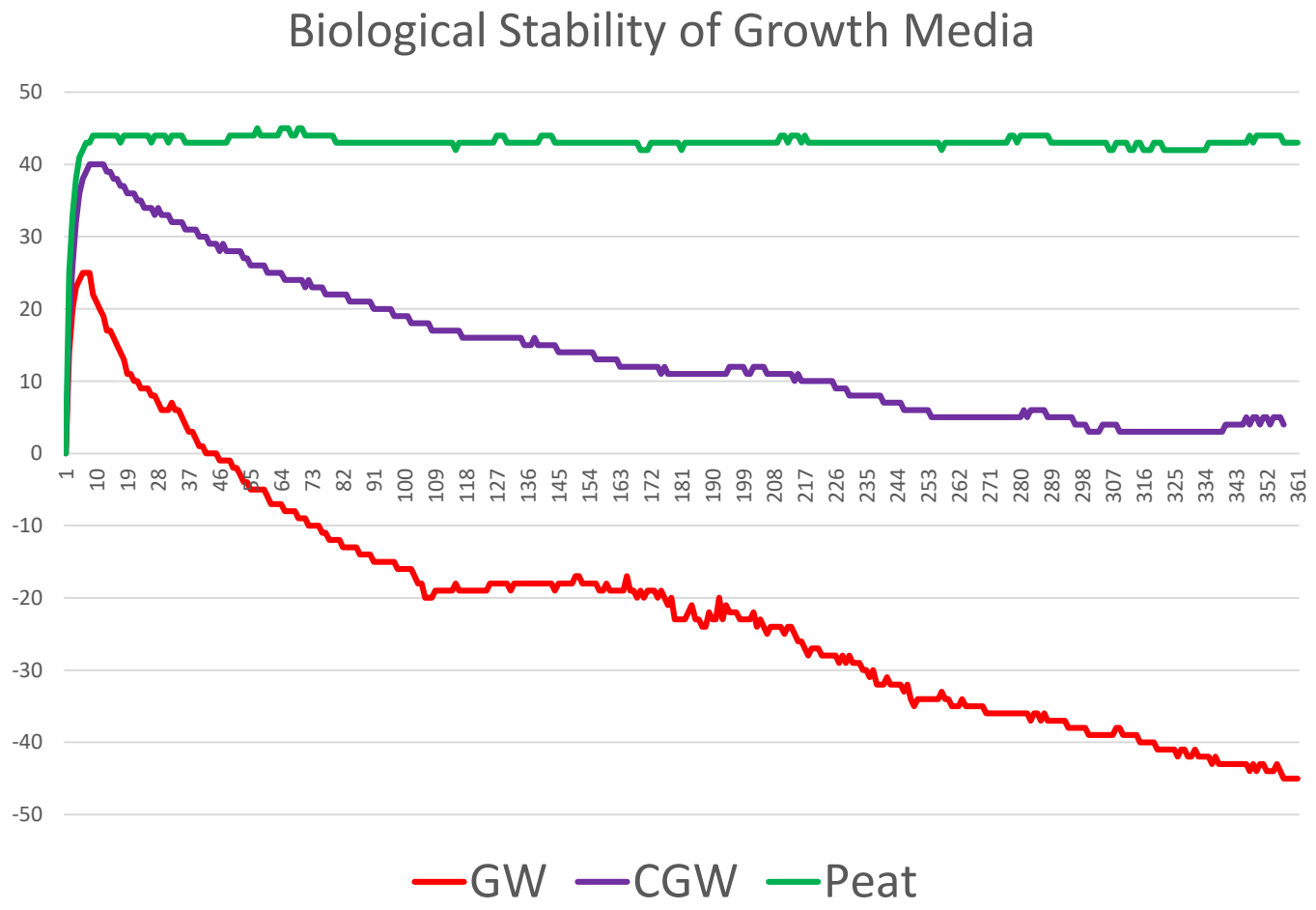
Chemical characteristics

Optimal pH between 5.5 and 6.5
Greenwaste 7.7 – 6.3
Biowastes 8.1 – 5.4

EC, CEC, nutrient availability etc – These can be somewhat manipulated by the grower

Biological Properties

Instability
Weeds/Pests
N fixation



Characteristics of target growth medium(3)

- Alternative material(s) needs to perform within the existing production system

(1) Peat was consistent across multiple different plant species

(2) Consistency in plant development

(3) Impact on irrigation system

(4) Suitability to use with growing media handling equipment

(5) Appearance / Consumer acceptance

Barrett et al., 2016 Achieving environmentally sustainable growing media for soilless plant cultivation systems – A Review. *Scientia Horticulturae* 212 220-234

Summary proposed of alternatives (1)

Coir

- Waste product of coconut production.
- Provides favourable balance of air and water
- high rewetting capacity
- Buffering required
- Shipped from production areas

Pine Bark

- Utilised in many countries, and is a waste stream
- High air holding capacity but need other materials to improve water retention.
- Variable and usually requires secondary processing, aging or composting.
- Woody biomass to replace fossil fuels

Barrett et al., 2016 Achieveing environmentally sustainable growing media for soilless plant cultivation systems – A Review. *Scientia Horticulturae* 212 220-234

Summary proposed of alternatives (2)

Wood Fibre

- Woody material passed through an aperture under pressure and heat
- Process helps stabilise and sterilise
- N is added to reduce immobilisation and subsequently slump
- Generally has high total porosity and air holding capacity
- Reduces the BD and increase the air space when part of a compost mix
- Competing uses and manufacturing costs

Composted Organic wastes

- High in Nutrients and Organic matter
- Multiple examples of pathogen suppression
- Variability in feedstocks
- stability
- contamination

Barrett et al., 2016 Achieveing environmentally sustainable growing media for soilless plant cultivation systems – A Review. *Scientia Horticulturae* 212 220-234

Review of recent Irish Studies

Rapid review of recent published studies from Irish Institutions on materials assessed as peat replacements and diluents

- **Green waste composts**
- Greenwaste compost and spent brewery grain
- Composted Foodwaste
- Seafood waste
- **Composted bark**
- Spent Mushroom Substrate
- Horse Manure (Vermicompost)
- **Coir**
- **Wood Fibre**
- Hydrochar

Previous Irish Studies

Prasad and Maher (2006) reported that mixes of CGW , CGW+N and Bark could be successively incorporated into peat at 50% and produce high quality plants (Escallonia & Hypericum)

Paper reported that the a treatment of 100% Bark (12 week compost + 0.5Kg Urea / m3) performed as well as standard peat control

The addition of an N source during composting improved the performance of composted green wastes

Additional positive results also reported in other studies on the incorporation of wood fibre in peat based composts

However there is a need to replicate and build on these studies

M Prasad and M J Maher 2006.
Evaluation of composted botanic materials as a component s of a reduced peat growing media for nursery stock, Proc,of the International Conference Orbit 2006

Recent AHDB study (CP138)

Identified 9 compost mixes which produced plants of a quality statistically similar to the industry standard peat based composts

6 of the 9 materials have coir as a principal component of the compost mix

The authors do report variability across the plant species tested
(Lavender, Vinca, Cistus, Griselinia, Viburnum)

As the trials were conducted on grower nurseries, approaches to irrigation differed across the experiments

Sector	**Peat Free Components producing marketable quality plants**			
Hardy Nursery Stock	**Percentage of the Compost Mix (%)**			
Mix	**Coir**	**Bark**	**Green Compost**	**Wood Fibre**
1	66	17	17	
2	66	17		17
3	66		17	17
4	50			50
5	50	50		
6	50		50	
7		100		
8		33		66
9		66		33

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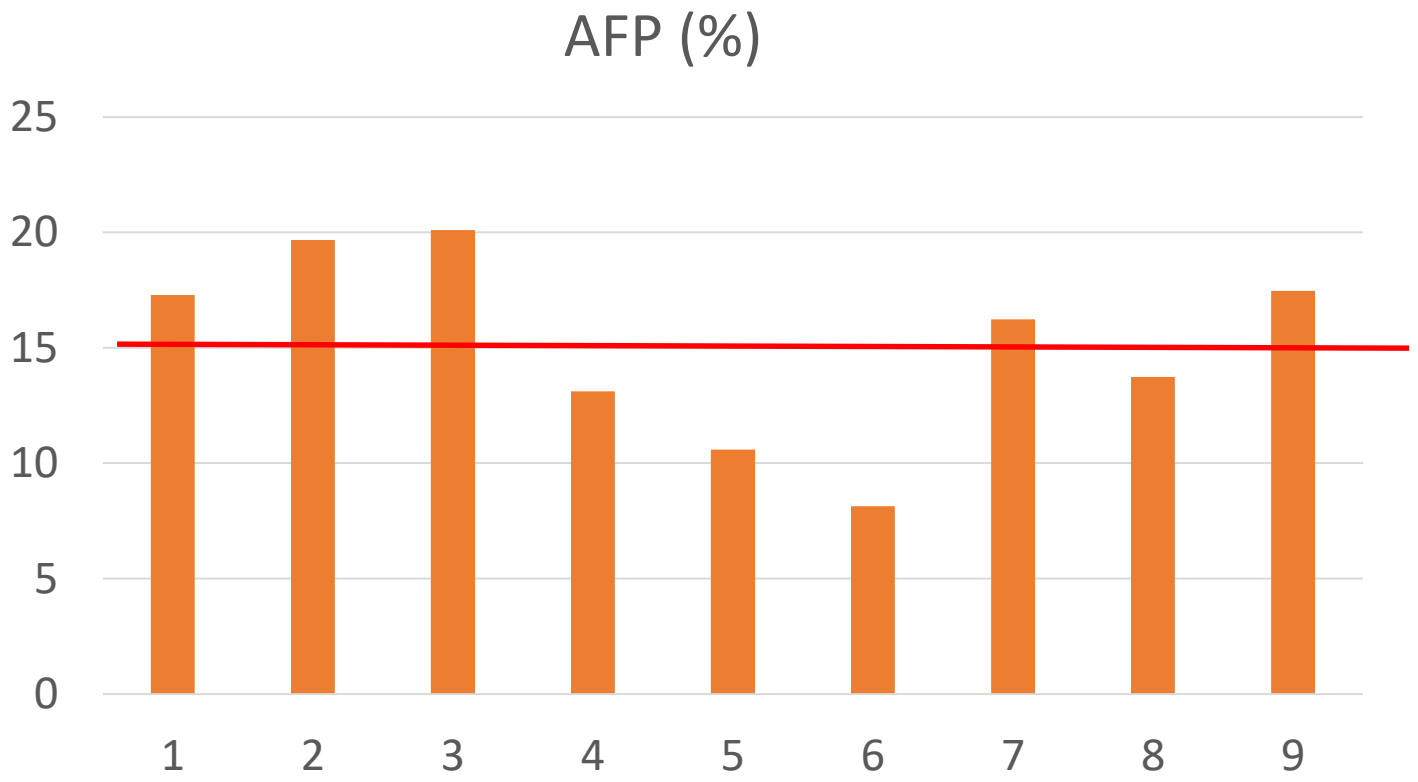
Recent AHDB study (CP138)



Maher & Kirkland, 1998
EOPR 4077

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Utilising transformed waste material as growth media

- Biochar – The pyrolysis of biomass in the absence of oxygen
  - Some biochar material is reported to have the same Bulk density as peat
  - Material has favourable characteristics in terms of nutrient retention
  - May assist in lowering the EC when added to composts
  - Can produce phytotoxic phenols and organic acids, so optimisation of the manufacturing process required

- Hydrochar – A process of hydrothermal carbonisation where biomass is heated between 200-300C in the presence of water to form a char
  - Can be applied to a more diverse set of wastes than pyrolysis
  - Physical properties of the char similar to peat

Kalderis et al, 2019 Waste and Biomass Valorization, 10 (5)

Manufactured growth media from bio-resources

- Materials created from biopolymers derived from natural materials such as plant based fibres, biopolymers, recycled biopolymers etc
- Some preliminary work has been conducted
- Materials with porous structures were created from PLA and TPS
- A need to improve water holding capacity
- Medium term research objective, with a focus on areas where peat replacement will be most challenging

Acknowledgement: Dr Yuanyuan Chen, TUS

Teagasc Research Approach

1. 5 key areas for peat replacement in professional Horticulture
2. Provide independent assessment of peat diluents and peat replacement materials
3. Build upon both progress achieved in previous national and international work, incl. composts commercially available
4. Build active collaboration internationally
5. Integrate key stakeholders into the start of the projects and consult consistently
6. Dual approach of assessing near to market materials / developing advanced materials
7. A need to develop a range of materials to provide options for the sector

Teagasc activities to date

- Peat replacement will be an increasingly important topic for research in Northern Europe over the next few years
- Teagasc have applied for funding from multiple funding calls
- An internally Teagasc funded project on peat alternatives commenced
- We are in discussions with research organisations in Europe to progress a formal grouping to share research information
- Permanent Research Officer in growth media

Conclusion

- The key will be identifying mixes of materials which work agronomically, are available in sufficient quantities, at a low cost with a favourable environmental footprint
- Research will build on previous work and has commenced
- International collaboration is key
- What is evident is that while materials may be identified it will be the skill and collaboration of the professional growers and growth media manufacturers will be needed for successful adoption

Acknowledgements

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References

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