Establishment of Sphagnum to sustainably produce biomass for Growing media

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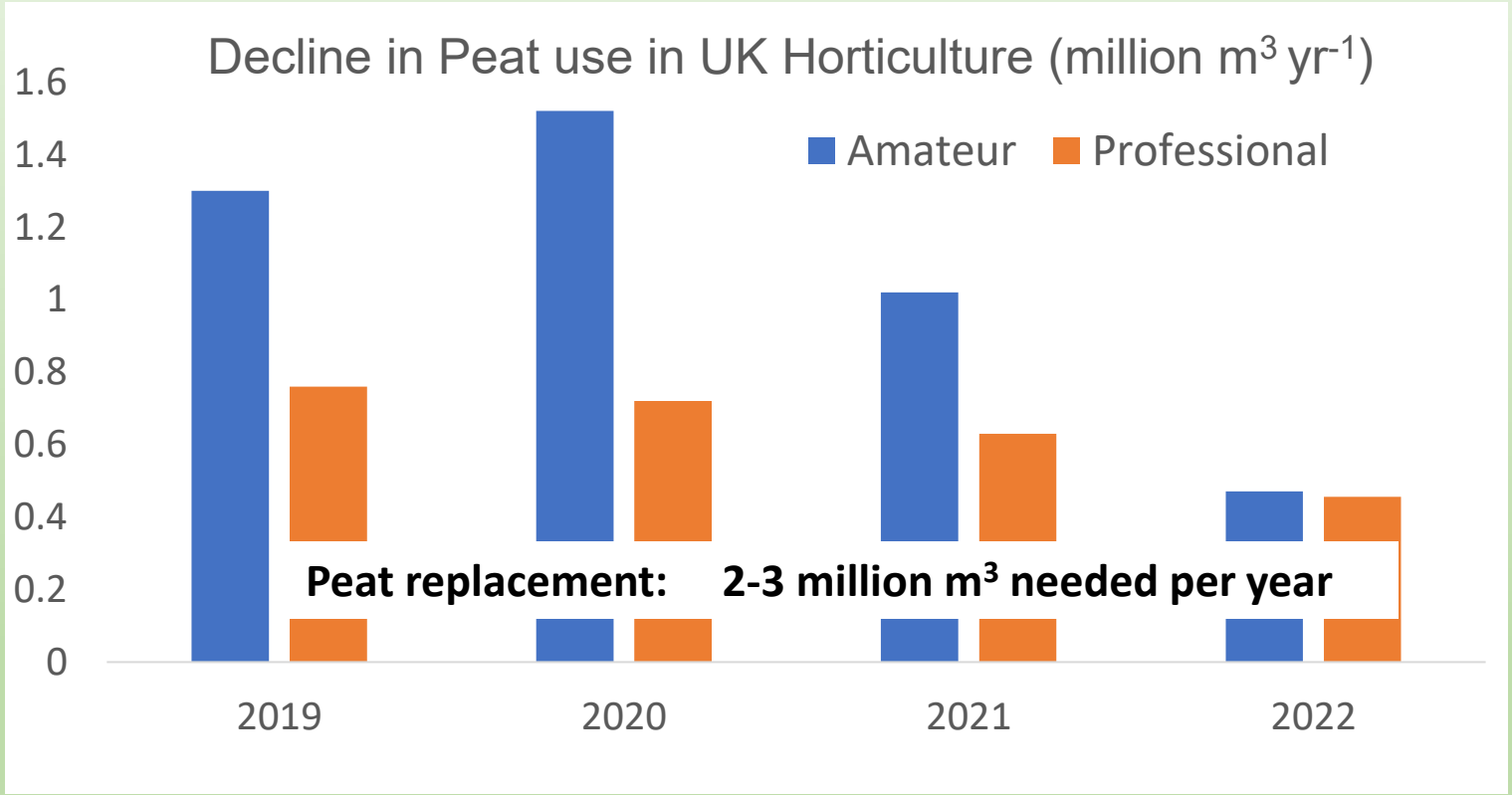
f UKRI Innovate UK

Rise in demand for peat-free Growing media in UK

UK Government agreed in March 2023:

- *Ban peat use in Amateur Horticulture 2024*
- *Ban all peat use by 2030*



Source: https://hta.org.uk/media/omiojakk/2021-growing-media-monitoring-report-vf.pdf

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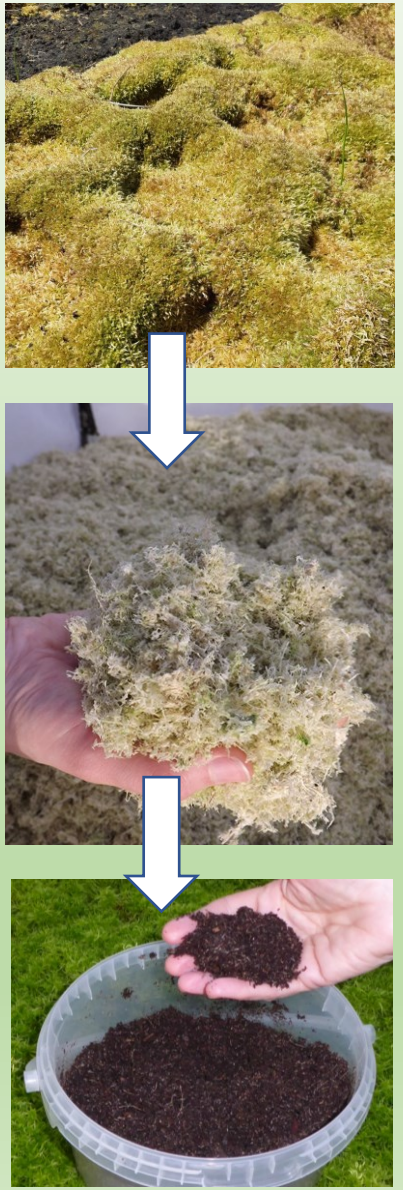
Farming Sphagnum as an alternative to Peat in Horticulture?

1. Sphagnum rich peat forms excellent growing media; in the past it has been easily available, but no longer in the UK
2. *Can we use fresh-grown Sphagnum to replace peat?*
3. Sphagnum grows mainly in protected conservation areas
4. *Can we **cultivate enough** Sphagnum to supply the demand for peat alternatives in growing media ?*



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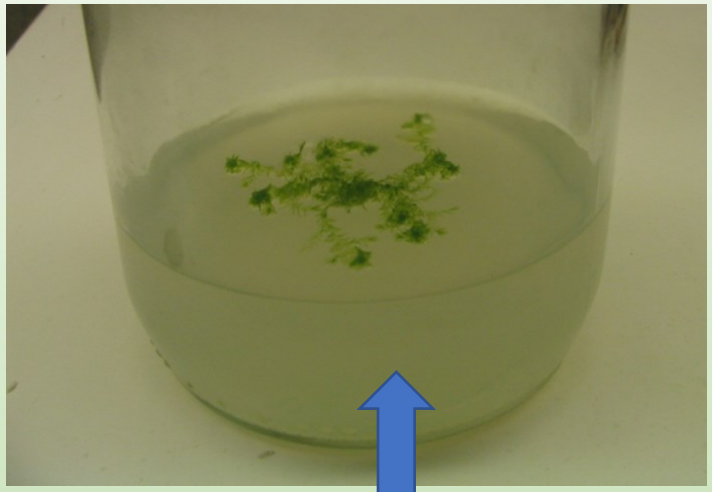
Sphagnum micropropagation to sustainably produce large quantities



BeadaGel®

BeadaHumok®

Clean material is sustainably grown in solar powered facilities

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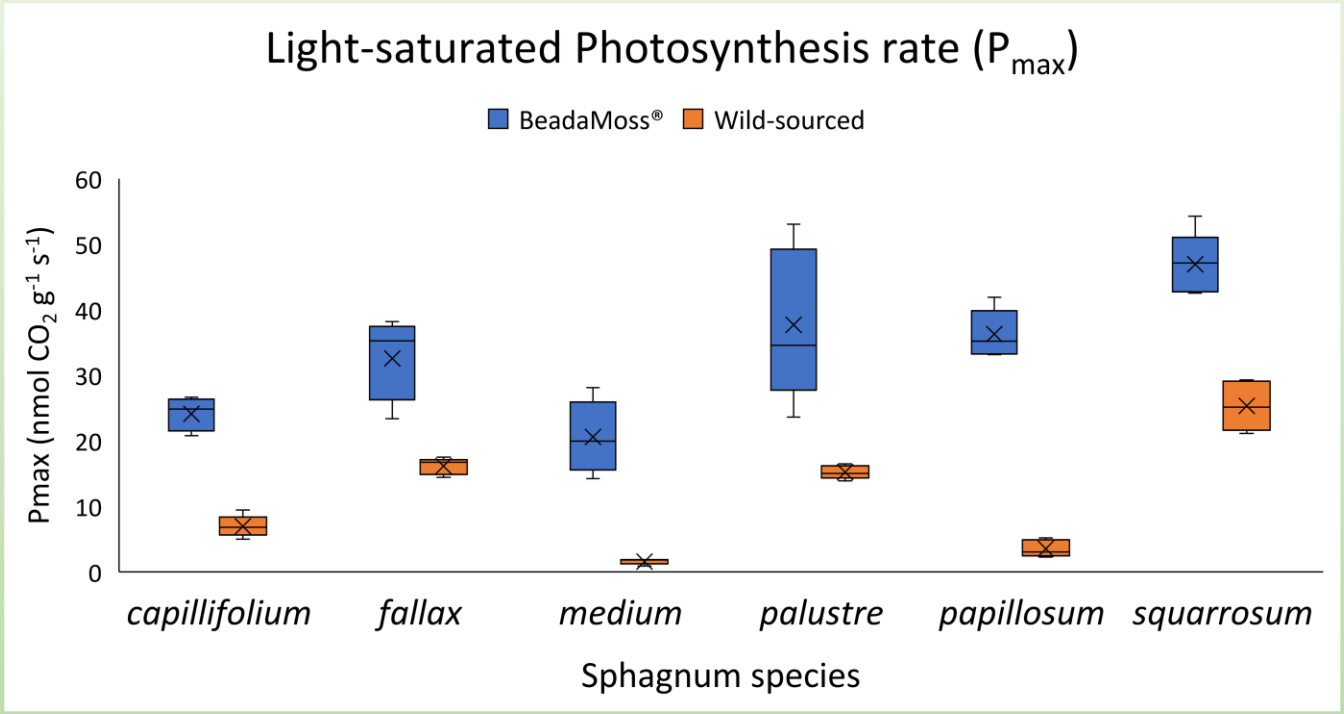
Photosynthesis:
Laboratory comparison of BeadaMoss® vs wild-sourced Sphagnum

(PhD research of Anna Keightley, https://e-space.mmu.ac.uk/627236/)

BeadaHumok®

Wild-sourced



BeadaMoss® vs Wild

- Higher Photosynthesis
- Higher nutrient content
- More chloroplasts per cell
- Lower bulk density

Better performance of BeadaMoss® Sphagnum photosynthesis than the wild samples is consistent with observations of better establishment in field restoration trials (Pilkington et al 2021; https://doi.org/10.1002/2688-8319.12113)

Sphagnum BeadaMoss® applications:

Peatland Restoration:

Re-introduction of Sphagnum for habitat improvement on degraded bogs; >8 million plugs, >4,000 ha

Carbon Farming:

'Product' is carbon captured & retained in vegetation and soil

- No harvesting but 'selling' the carbon

Sphagnum Farming:

'Product' is Sphagnum biomass - harvested

– peat-free growing medium.

– reduces peat and carbon loss from the substrate

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Sphagnum Farming UK Trials

Lowland raised bog – former peat extraction site

Little Woolden Moss (Lancashire Wildlife Trust), near Manchester, Trial 2018-2021

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Cover materials – None, mesh, perforated plastic or straw

Continuous cover over 3 years, except for measurements

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Irrigation systems – using bog pool water applied from above

patent pending technology

No water table management or flooding needed

Irrigation – with solar powered pumping

Spray

Drip

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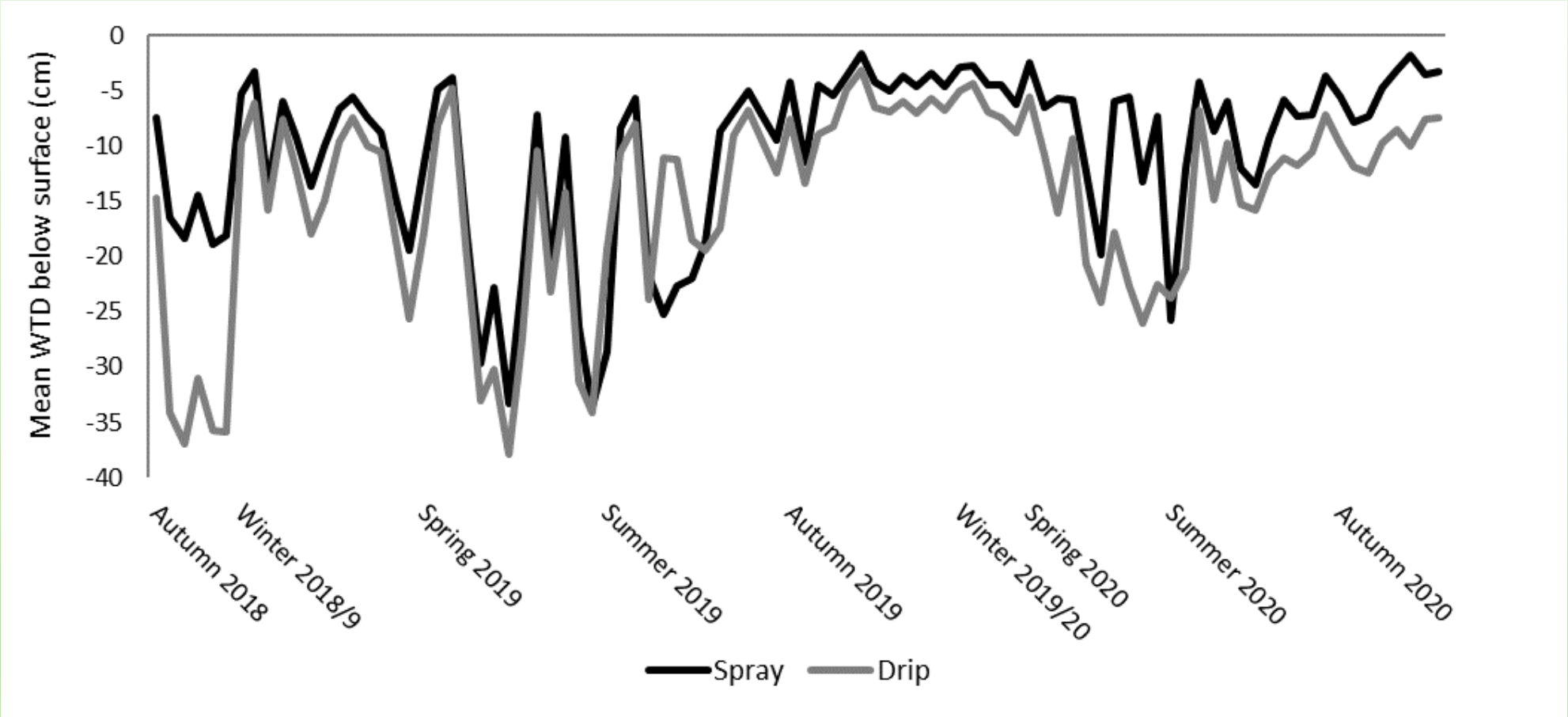
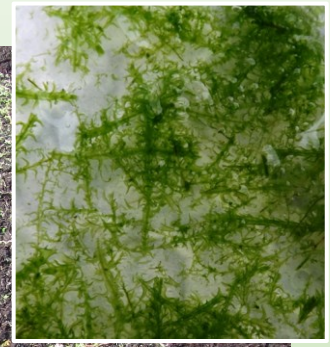
Water table in the experimental area stabilised during the trial



BeadaMoss® products used

BeadaHumok™ - hand planted

BeadaGel™ - sprayed



Planting: plot size 2 m x 1.7 m, 4 replicate plots per treatment

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BeadaHumok®

~6 months

BeadaGel®

~6 months

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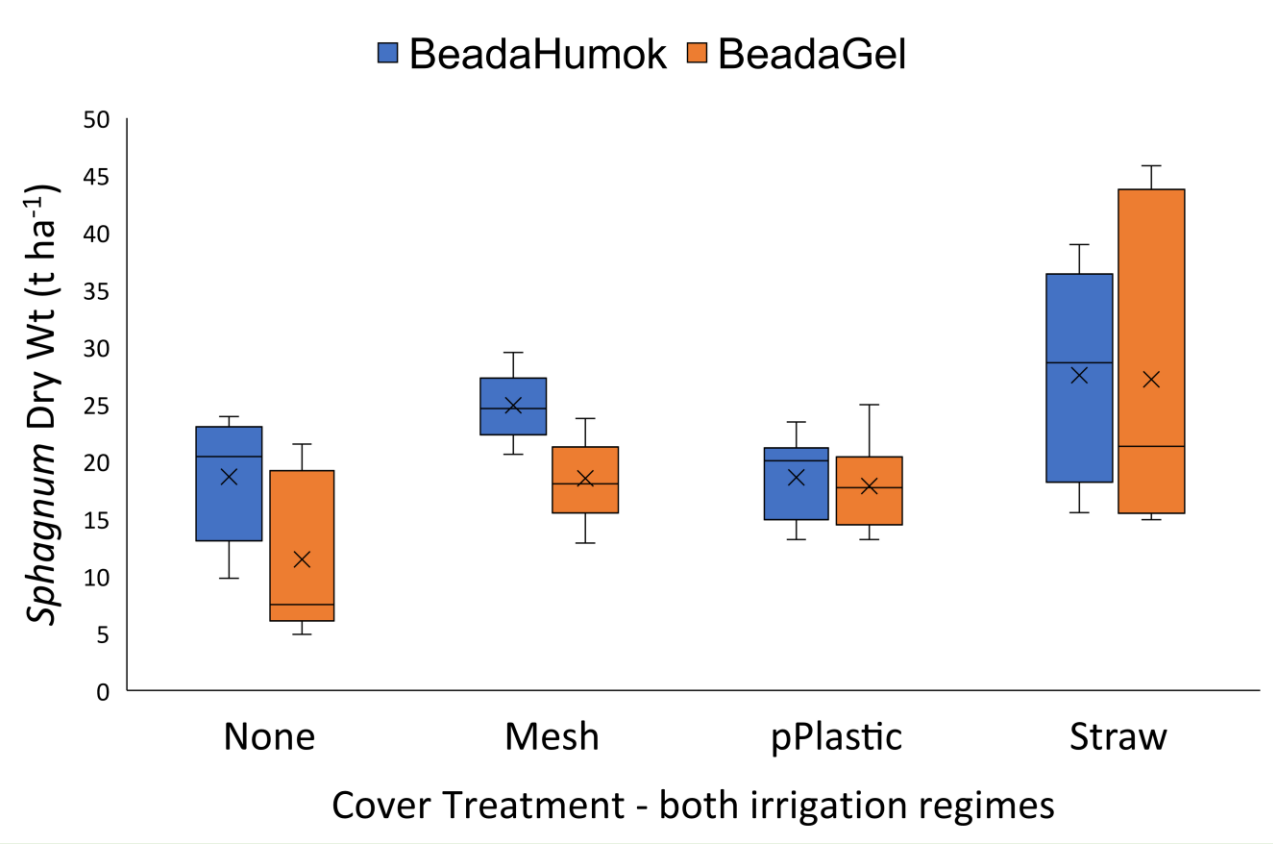
Production of Dry weight after 3 years

Comparison of Cover treatments and Sphagnum propagule type



Sphagnum annual dry matter production

Average annual production range:
3.8 - 9.2 t ha^{-1} yr^{-1}

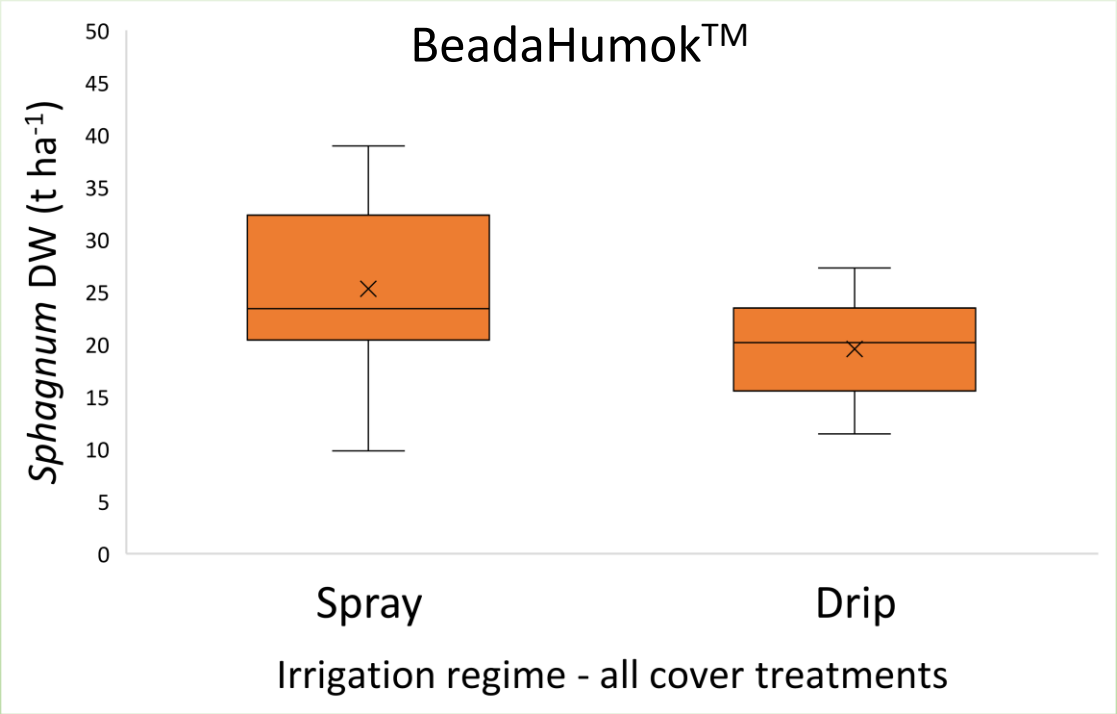
Compares favourably with:

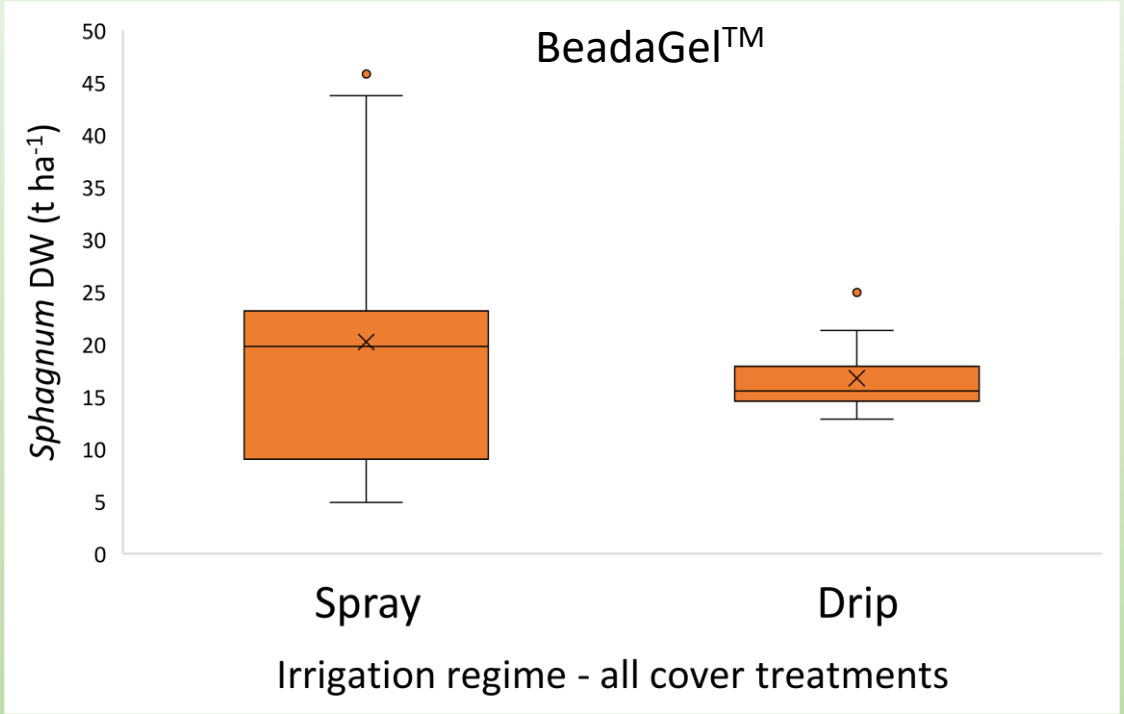
- Sphagnum Farming (Gaudig et al 2017)
- Georgia (Krebs et al 2016)
- Northern Hemisphere (Bengtsson et al 2021)

In box plots, crosses indicate the mean value, lines indicate the median, and interquartile median range is inclusive
Shared letters indicate statistically significant differences in post-hoc Tukey HSD tests where $p < 0.05$

Production of Dry weight after 3 years

Comparison of Irrigation method





In box plots, crosses indicate the mean value, lines indicate the median, and interquartile median range is inclusive
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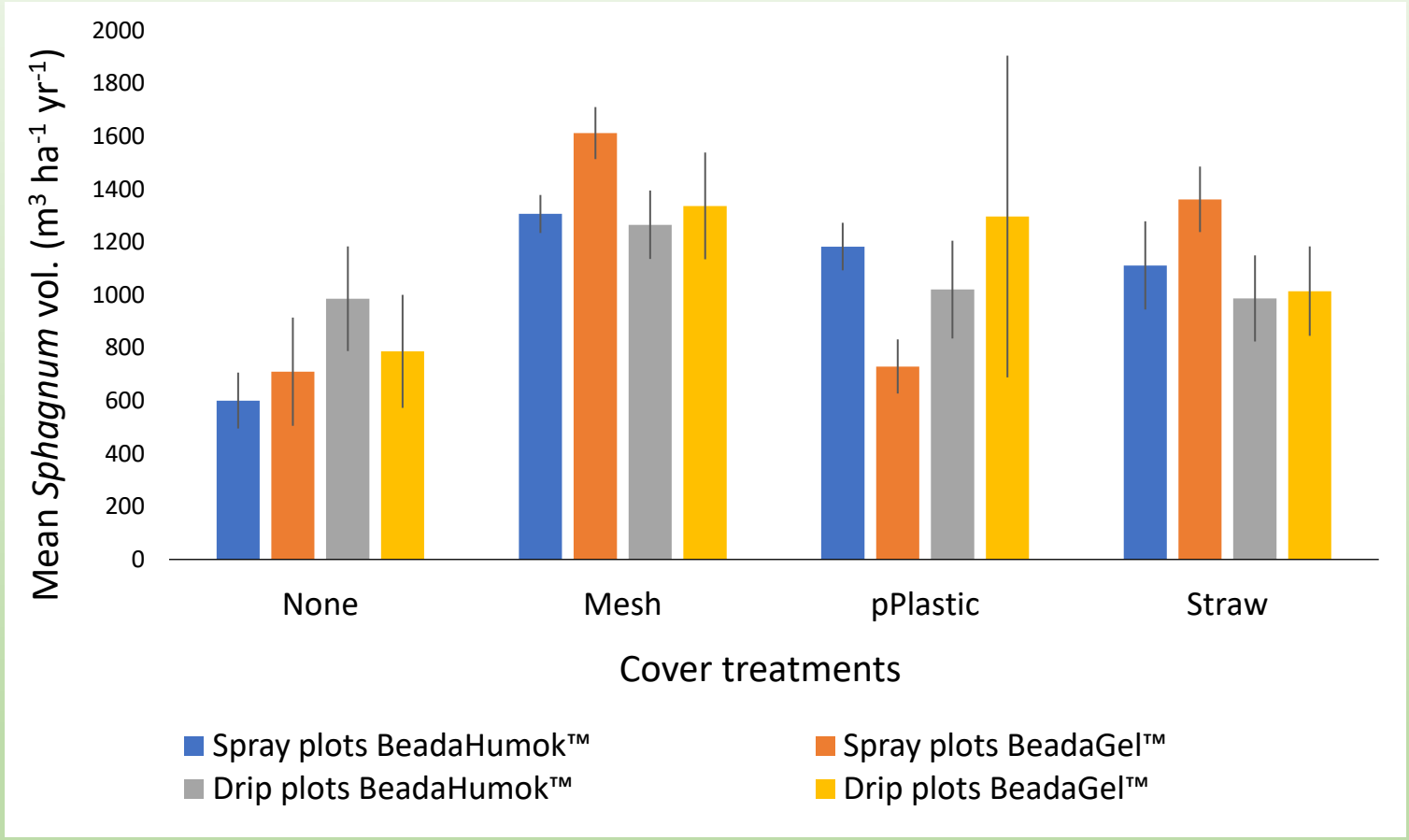
Production of Sphagnum Volume per area over 3 years

Comparison of Cover treatments and Sphagnum propagule type



Volume measured using standard method for growing media; Means +/- standard deviations

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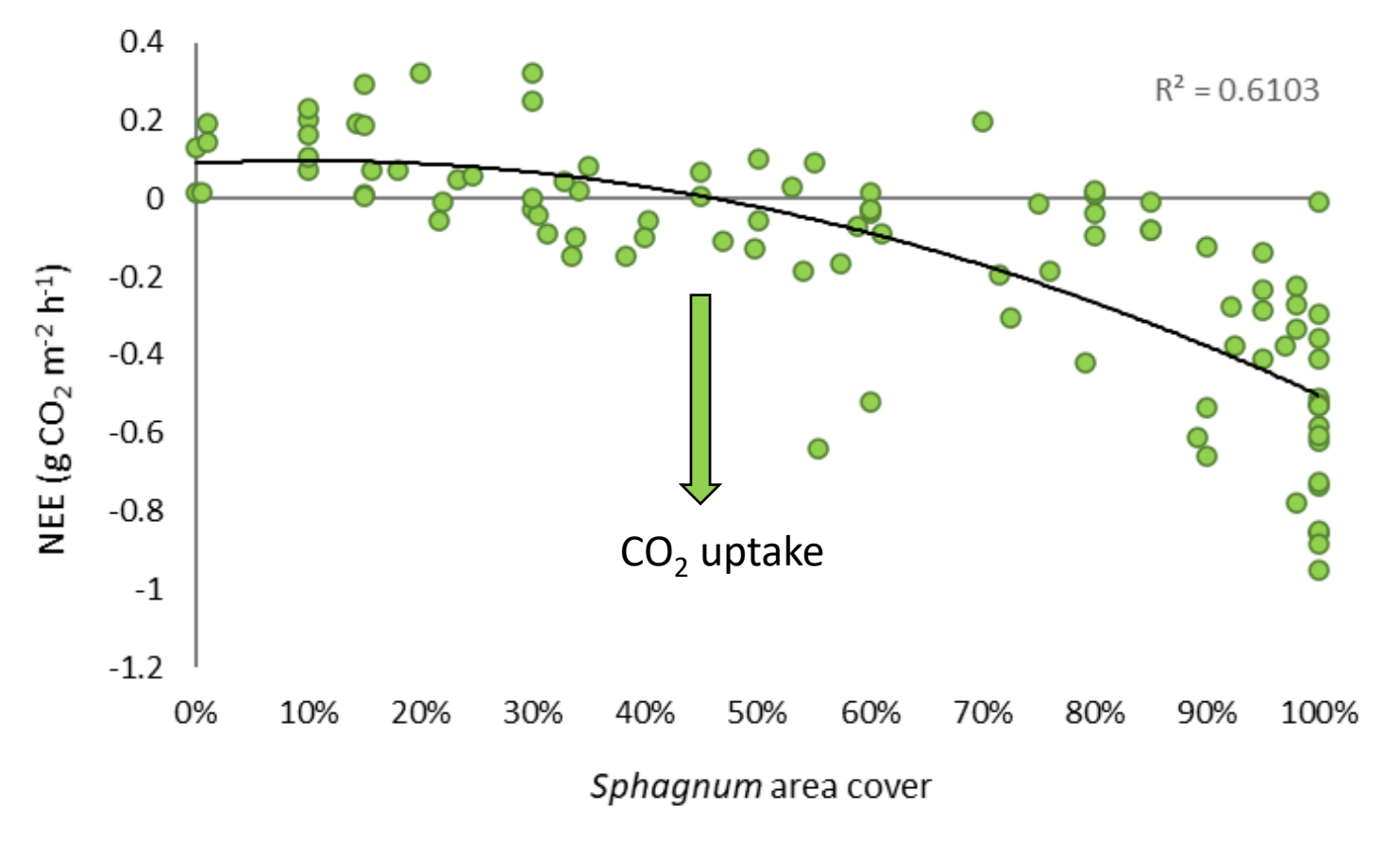
Net CO_2 uptake (NEE) increased with Sphagnum cover



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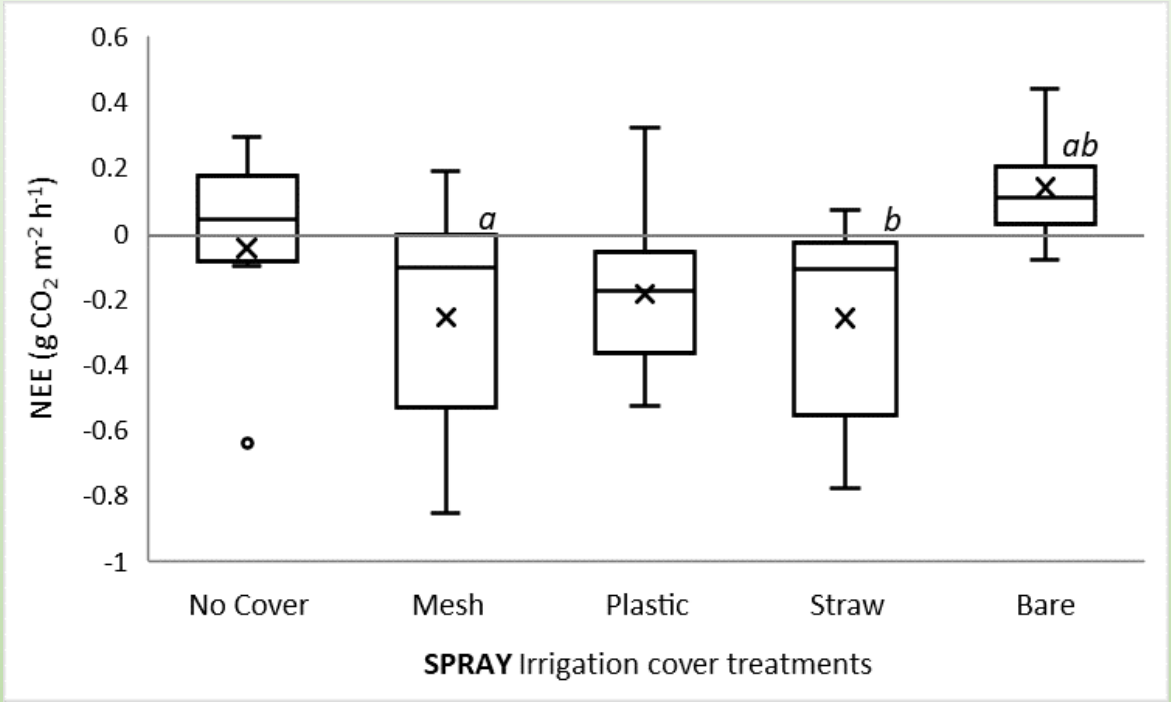
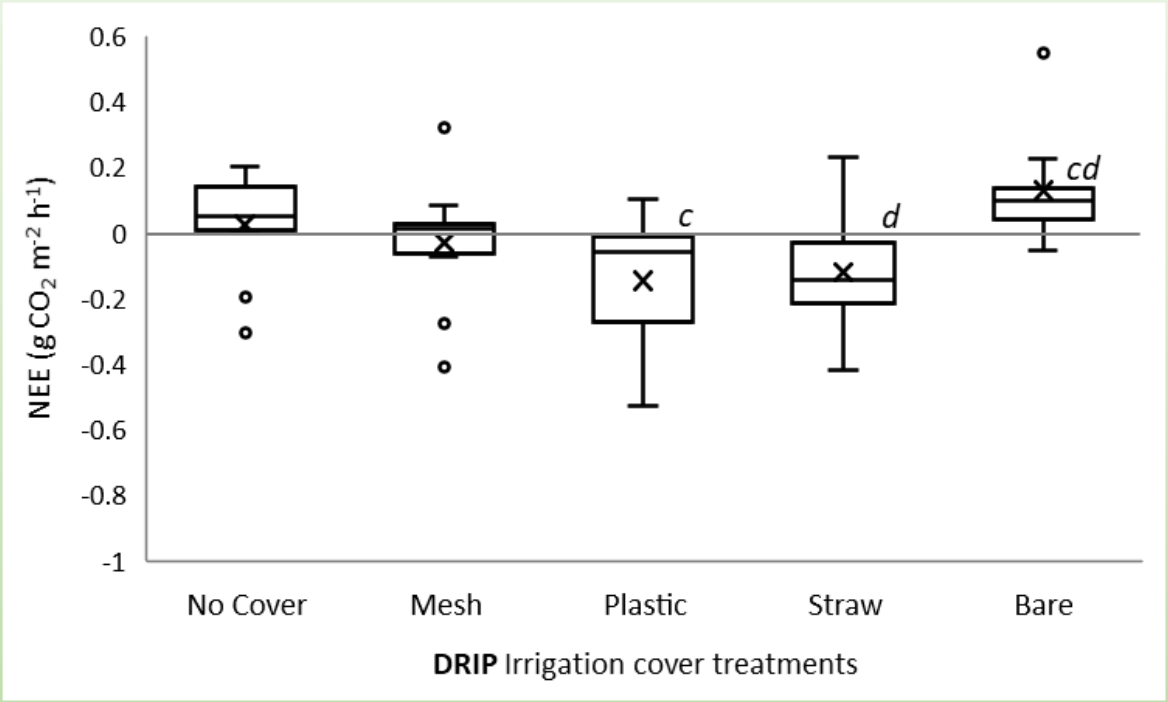
NEE across cover treatments and irrigation regimes

Spray



Mean WTD -15.9 ± 10.8 cm

Drip



Mean WTD -18.3 ± 9.8 cm

Combined BeadaHumok™ and BeadaGel™ data, May to September 2019, *n* = 10 throughout

In box plots, crosses indicate the mean value, lines indicate the median, and interquartile median range is inclusive

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Issues to resolve

bird disturbance

weeds

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Field Trials - Summary

- Beadamoss products grown on cut-over peatlands with surface irrigation supported high growth rates in dry matter and volume
- Spray and drip irrigation were both effective
- Covers provided a protective environment, improving growth
- BeadaHumok™ and BeadaGel™ gave similar results
- Net CO_2 uptake response was consistent with growth results

Post-harvest processing

Sphagnum can be handled with adapted ‘normal’ Nursery equipment

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Sphagnum – in growing media as a renewable peat alternative

All the properties of peat

- **Good Water & Air holding**
- **Ion exchange properties**

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Post-harvest processing

Fine grade

For use in mixes for small plug plant production

Coarse grade

For use in mixes for pot and container plant production

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Trials show strong potential of Sphagnum in growing media

Three examples from over 30 different genera which universally demonstrated the potential of Sphagnum.

Left: nursery control;
Right: Sphagnum /woodfibre test mix

<u>Ceanothus</u> in Sphagnum mix showing excellent root system

Left: Peat-based control;
Right: Sphagnum /woodfibre mix

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BeadaGro® Nursery Trials – Bedding plants

Peat-based

Sphagnum-based

In Sphagnum-based media after 7 weeks

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Seedling trials
at Crop Health & Protection, Stockbridge Technology Centre, UK

5 weeks after sowing

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Commercial viability

- If Sphagnum production is used to replace peat in growing media in the UK, the demand is about 2-3 million m^3 per year

- Sphagnum farming UK trials produced at least 1,000 m^3 per ha per year, or 3000 m^3 per ha per 3 years. Around 2,000 ha of land would be required for each 3 year crop cycle

- If Sphagnum value is around €40 per m^3 then crop value every 3 years is ~ €120,000 per ha

- But - Set up costs are high and uncertain at present
  - Irrigation
  - Intensive Sphagnum planting
  - Soil sterilisation for weed control

England grows:
Onions ~10,000 ha per year
Potatoes ~100,000 ha per year

Trials: Scaling up Sphagnum Farming in the UK

- In addition to the original 2 trial sites…
  - East Midlands site:
    - 2,500 m^2 planted over past 2 years
    - 10,000 m^2 planned for 2023
- Demonstration Farms:
  - Lancashire site:
    - 4 Ha planning starting in 2023
  - East Anglian Fens sites:
    - Great Fen – unsuccessful due to 2022 drought
    - BeadaMoss New Farm site preparing for planting 4 Ha in 2024
    - Additional Farm site for planting 10 Ha in late 2024

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Current Innovate project

- a continuation of Sphagnum Farming UK

- Plant Husbandry
- Productivity optimisation - Increase
- Larger scale field trials:
  - Arable site
  - Fenland sites
- Mechanisation for Planting and Processing at Scale
- Commercial further grower trials ‘on nursery’ of BeadaGro®

Next project to take up to Commercial production >20 ha

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King Charles is interested!


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Thank you!
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