# Grower Summary

## Vegetable Propagation: Grower-led peat reduction and replacement demonstration trials 2021

## FV 464a

Final report 2022

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| **Project title:** | Vegetable Propagation: Grower-led peat reduction and replacement demonstration trials 2021 |
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| **Project leader:** | Dr Catherine Eyre, ADAS Horticulture |
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| **Date project commenced:** | 6 May 2021 |

# DISCLAIMER



*[The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.]*

# AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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# GROWER SUMMARY

## Headline

There are viable alternatives to peat for use in the vegetable propagation industry. Fine composted bark is a very promising new material, but availability may be an issue. Blocking is more challenging that modules. More work is required by growing media producers to develop and bring these peat alternatives to market.

## Background

Government targets along with retail, environmental and public pressures are all pushing towards the reduction and eventual elimination of peat from horticulture. In August this year the Government announced that the sale of peat to amateur gardeners in England is to be banned by the end of 2024. The Government is also encouraging the transition to peat-free alternatives in the professional horticulture sector, with a ban on peat to follow at some point in the near future.

A great deal of effort has been put in to developing peat-alternatives. There are some specialist areas, however, that turn up particular challenges. One of those is vegetable propagation. In vegetable propagation, very small containers are filled mechanically with substrate. A single seed is planted in each container where it then germinates. The seedlings are raised under glass before being mechanically planted out in open fields at high speed. There are multiple issues here, in addition to 'simply' identifying a basic peat-free or peat-reduced substrate. Firstly, the substrate must be able to flow into small containers, or be formed into small substrate 'blocks'. Secondly, the substrate must be suitable for seed germination. Finally, the small substrate bolus and seedling must be able to survive mechanical planting in a field.

If the transition to peat-free is to be respected then peat-alternatives for vegetable propagation must be found. If not, the sector is threatened. Since vegetable propagation is an important contributor to high-efficiency food production and food security this cannot happen. Workable solutions must be found.

In search of solutions towards this goal this project considered the transition to peat-reduced and peat-free substrates in three different vegetable propagation methods: blocking, modules and ellepots.

In 'blocking', moistened substrate is mechanically compressed into a slab then cut by a square grid of blades to create a set of individual 37.7 x 36 x 36 mm cubic blocks. Blocks are created a tray at a time, with 176 blocks per tray. A set of dibbers makes a small depression in the centre of each block ready to receive a seed. In the blocking method the substrate must be self-supporting and the block must be capable of sustaining mechanical handling without any container support, though once the seedling has developed there is root support for the substrate. Because blocks are self-supporting their creation conventionally relies on special sticky ‘blocking peat’.

‘Module trays’ are plastic trays with arrays of cells to receive substrate. Each cell has a 25 by 25 mm opening and a depth of 43 mm, giving a cell volume of 15.5 $cm^3$. There are 345 cells per tray. Modules are filled by flowing substrate into the cells row by row. Rotating brushes press the substrate into the cell and remove excess material. The substrate plus subsequent seedling is supported by the material of the tray. However at planting-out time the seedling plus substrate and root ball must retain its structural integrity without relying on the module tray for support.

The third and final technology is the ellepot system. Substrate is fed under suction to a continuous paper-wrapping stage. Every few centimeters the continuous emerging ‘sausage’ of paper-wrapped substrate is sliced into separate cylinders which are then stored vertically side by side in trays ready for sowing and planting out. Significantly, the cylinders are open top *and* bottom. Like modules, the ellepot system relies on a relatively free-flowing substrate. Each ellepot cylinder is typically 33 $cm^3$ (diameter 29 mm, depth 50 mm). At planting out, the substrate plus seedling is supported by the paper sleeve which relieves the need for so much structural integrity from the substrate. The paper sleeve is biodegradable.

At the growers request, this project considered both peat-free *and* peat-reduced options, the latter being a step towards the ultimate peat-free objective and potentially easier to achieve. Crops that featured in this work were lettuce, celery, tenderstem broccoli, kale, cauliflower and spring greens.

There are three disparate threads to this project.

1. Existing commercially available peat-reduced and peat-free blends were trialled in various combinations with the three propagation technologies.

2. Growing media producers supplied small quantities of promising prototype materials. These were assessed via laboratory measurements of their physical characteristics. The results were compared with a reference dataset of a range of raw materials, leading to the selection of the most promising of the prototypes on offer. Other factors such as material chemistry, availability and flow properties were also considered, leading to a final selection of peat-free and peat-reduced (50:50 blends of peat and prototype peat alternative) that were assessed for block, module and ellepot creation and seedling growth.

 

3. Mechanical assessment of substrates using laboratory compression testing. The objective was to assess the substrates' mechanical handling properties, an important aspect of their suitability for vegetable propagation, especially for blocking. The impact of binders, additives whose intended role is to provide additional cohesion to the substrate, was also investigated. Thread two, which investigated prototype materials for filling and growing, likewise considered substrate options containing binders.

## Summary


- The objective of this project was to explore peat-reduced and peat-free candidate substrates for vegetable propagation using blocking, modules and ellepots. We have confirmed that finding candidate substrates for blocking is the most difficult.
- Commercially available candidates, both peat-reduced and peat-free, are available for modules and ellepots.
- A 15% peat-reduced commercially available candidate for blocking exists
- Prototype materials were supplied by growing media manufacturers. These formed the basis of test substrates, though in some cases additional processing was required. Amongst these test substrates, viable peat-reduced and peat-free candidates were identified for modules and ellepots, but not for blocking.
- Among the new materials trialled, fine (0-2 mm) composted bark, a material not routinely available, was found to be of particular merit.
- Growing media producers struggle to supply substrates of adequate quality, or novel substrates in significant amounts. The supply of substrates is a pinch point on the path to peat-reduced and peat-free vegetable propagation.
- Mechanical testing of hand-formed substrate blocks showed that water content strongly influences their strength, and that some materials apparently gave rise to blocks sufficiently strong for mechanical blocking. This conflicts with subjective assessment of the materials as blocking candidates.
- Binders may have a role in substrate block strength, in the water content required to achieve that block strength, and in the growing success of the crop, but our data is not comprehensive enough for a definitive overview.

The objective of this project was to explore peat-reduced and peat-free candidate substrates for vegetable propagation using blocking, modules and ellepots. Vegetable propagation is a demanding system: substrates need to support germination, seedling growth and the creation of small growing units. In addition those small growing units – blocks, modules and ellepots – must be able to sustain mechanical handling.


 

For modules and ellepots there already exist peat-reduced (50% and 70%) and peat-free substrates that, according to this project, are viable solutions: modules and ellepots can be created, seeds germinate and develop, and planting out is successful. Further, two different peat-free blends were studied, one of which performed satisfactorily and one of which performed poorly. An additional organic peat-free substrate was trialled for modules, but its growing performance was disappointing and it was not sent for planting out.

For blocking, a single 15% peat-reduced substrate was available to the project (a second 30% peat-reduced material was defective and was abandoned). This was successful, though the blocks were inferior to those made with the peat standard, highlighting the challenge facing the creation of blocks with alternative materials.

Of the prototype materials contributed by the growing media manufacturers, many were confidential even from members of the project team. With regard to three key physical parameters, AFP (air filled porosity), $D_b$ (dry bulk density) and AW (available water), comparison with a reference library of raw material values saw five prototype materials excluded. Others materials were dropped on the basis that, even at a 50% blend with peat, some chemical properties might remain problematic. Other materials were simply unavailable. In summary, the project generated a list of eight materials (comprising six prototype materials) to carry forward. Two of these materials were peat-free. The remaining six were peat-reduced at the level of 50% peat and 50% non-peat. In all cases there were severe limitations on the availability of materials that impacted directly on project outputs – some materials were available in only a few litres in an industry where cubic metres are necessary to fully test the entire production process. Also, some materials required specific processing by the supplier, whilst others required in-house sieving to remove over-sized material.

The non-peat materials used were wood fibre, coir, composted bark (0-2mm) and two unidentified materials. Both the peat-free options were 100% composted bark (0-2mm). Where sufficient material was available, ‘with binder’ versions were also created. Counting the no-binder and with-binder versions as distinct, in total fourteen substrates were carried forward for limited assessment.

For modules, two substrates (plus the binder version of one of these) gave a superior performance in terms of both filling and seedling growth. One of these substrates was peat free, composed of composted bark (0-2 mm). Several other substrates gave useful outputs. Some were compromised by the presence of woody fragments, which interfere with module filling. These fragments should not be there, and suggest that one improvement for module filling lies with improved quality control of substrates to ensure disruptive fragments are absent. Of this second tier of substrates, one was peat-free, composed of composted bark (0-2 mm), and another was a 50:50 blend of this bark with peat. A third tier of substrates, a single candidate plus its binder partner, failed to grow.

All the experimental substrates bar this final one gave modules that could be extracted from the module tray, an essential prerequisite for field planting. In conclusion there are several viable candidates amongst the prototype substrates for use in modules. The choice is governed to some extent by the compromise between mechanical handling and seedling growth. Both peat-reduced and peat-free candidates exist.

For ellepots, two peat-reduced blends and their with-binder partners gave overall superior performance. Two other substrates and their with-binder partners gave a weaker performance. One of these tier-two materials was a peat-free composted bark (0-2 mm) material that caused filling problems due to the presence of woody fragments but which gave good seedling growth. The same material that failed for modules also failed for ellepots. For the other materials, though planting out was not explicitly trialled no problems were anticipated as the finished ellepots were satisfactory. Fewer substrates were available for ellepot trials due to the shortage of materials. Overall, the conclusion for ellepots mirrors that for modules –there exist viable peat-reduced and peat-free candidates, even better with improved quality control.

There was no clear pattern of the impact of binders on the creation of modules and ellepots. However, there is a hint of some impact on growth. For two substrates in ellepots, the binder version gave superior top growth. In a third substrate the binder version displayed better germination. The evidence is not robust but the impact of binder on top growth is likely worth further investigation.

In the case of blocking, according to subjective assessment none of the substrates carried forward in this project were likely to produce adequate blocks. This, together with only one commercial 15% peat-reduced blend suitable for blocking, confirms that finding candidate substrates for blocking is the most difficult of the three.

Compression testing of hand-made blocks of substrate gave readings for the load required to induce their fracture. These values we have termed the ‘strength’ of the substrate block. Water content of the material was found to be important – too much and too little both gave weaker blocks. The impact of the binder on the overall strength of the substrate blocks was unclear.

Mechanical testing allows comparisons between blocks made of different materials with a block made of black Baltic peat, a material which can itself be used as a blocking substrate. Therefore, even if the absolute values of ‘block strength’ do not have a directly accessible meaning, the hypothesis is that a *comparison* between a block made of a material of interest and with one made from black Baltic will be relevant. On this basis, all of the blocks tested are broadly comparable in strength with the black Baltic peat. Two (plus a binder partner of one of these) appear stronger and might be considered candidates for blocking substrates. However, this does not agree with the subjective assessment of the suitability of these substrates for blocking. Proper testing of candidate materials – with sufficient quantities (in the cubic metre range) to run through real blocking equipment – would resolve the issue. It is also possible that the mechanical testing regime is not measuring the block mechanical properties in a way that is wholly relevant to blocking. It is clear this is an area requiring more investigation.

A theme throughout this project is the availability or otherwise of substrate materials. The basic limitations are well-known: the key sustainable raw materials are coir, wood fibre, bark and green compost. Green compost is distrusted by the professional horticulture sector: the growers in this project would not even consider its inclusion, and some growing media producers will not supply it. Coir is a fine substrate but is in limited supply and must be imported from the tropics. With wood fibre and bark it is worth emphasising that a given substrate is in fact a result of *both* the fundamental raw material *and* the processing it is subject to. There are other candidate materials but currently all have serious limitations. The vegetable propagation sector would benefit from a fresh look at processing of known materials, at improved quality control of existing materials, and the introduction of wholly new materials.

## Financial Benefits

This project attempts to preserve a key industry sector through the transition to a peat-free operation.

## Action Points

- For modules and ellepots peat-reduced and peat-free candidates clearly exist. Propagators need to conduct trials sufficient to identify substrates that work on their sites and with their crops to give the confidence to make the transition from a peat-based operation.
- Blocking needs additional effort focussed entirely on the search for new blocking substrates in tandem with laboratory-based substrate assessment methods, especially mechanical assessment. It is the mechanical issue with blocks that is the real problem.

- Substrate providers need to improve quality control, particularly with regard to removing fragments from wood-based products.
- Substrate producers need to explore further the development and supply of fine (0-2mm) composted bark, since this project shows that this material performs well in the vegetable propagation environment.