Eliminating peat from propagation using growing media blocks

Guidance and information note 4 – Testing growing media

Peat will be banned from horticultural production systems in the near future and most growers are thinking of making the move towards peat-free and reduced-peat growing media. Some are already using peat-free media, although most of the larger conventional growers continue to use mainly peat-based media.

The growers at the three field lab sites have conducted four GrowBlocks trials, and the results of the germination and growth tests are currently being assessed. Different growing media can differ widely in terms of their ability to support the healthy growth of plants, whether they have been bought in bags from manufacturers or been made by the grower themselves. But why do some peat-free and reduced-peat growing media perform so well, yet others perform so badly?

This short guidance note outlines the tests you might commission to determine the quality of growing media and explains what to look for in test results.

The growers:

- Wester Lawrenceton Farm, Forres, Moray (Pam Rodway)
- East Neuk Market Garden, St Monans, Fife (Connie Hunter and Tom Booth)
- Tombreck Farm, Lawers, Aberfeldy, PH15 2PB (Rachel Wake and Ian Machacek)

Quality of growing media is highly variable

The quality of proprietary peat-free and reduced-peat growing media can be variable, even between bags of a single brand and type bought in the same year, but particularly within a brand/type from year to year. Whilst some brands are consistently good, others remain extremely variable and, in some cases, extremely poor, particularly when used for production of sensitive

seedlings. Professional media, rather than those sold into the amateur market, tend to be better, but there can be problems there too. The annual Gardening Which feature on growing media shows all too clearly how great the differences can be between performance of good and poor retail growing media.

Work conducted in the GrowBlocks project has demonstrated that, in some cases, nursery-produced media can be as good as proprietary brands. However, it is challenging to produce media that is reliably and consistently good enough for sowing a wide range of vegetable seed species for commercial production. There are now some excellent proprietary peat-free seed/seedling growing media available, and most growers will continue to prefer to purchase commercial media. However, even then, it is worth doing basic germination and growth trials, using a few sensitive seed species, before committing to buying enough media to last the whole growing season. That is true even when you have used the same brand and type successfully in the past. You should always compare your chosen medium with at least one other that you trust and have had success with in the past.

If you have made your own media, it is worth sending it to a laboratory for basic testing to ensure that it is likely to be fit for purpose. You should do this in addition to running simple germination and growth trials.

Types of tests

Tests that you might conduct on growing media fall into three types: physical, chemical and biological.

Physical tests: The main physical test is for "air-filled porosity" (AFP), which is the percentage of a growing medium that is filled with air after it has been saturated with water and allowed to drain. AFP is an important parameter, since it determines the amount of air which will be able to readily penetrate the medium to supply both plant roots and microorganisms to breathe.

Laboratories use a standard method to determine the value for this parameter. It is important to bear in mind that the amount of air in a medium also depends on the way in which pots, trays or GrowBlocks are filled. If considerable pressure is used to fill GrowBlocks for example, then less air will be able to penetrate the medium and it will tend to hold more water.

On discussion of the results from this project with growing media specialists, some feel that the AFP test is less suitable for non-peat media such as those made in this project and that a better test would be for the percentage of particles which are < 1 mm in size.

Chemical tests: Values for several key parameters together help to determine whether a growing medium will perform well. These include pH, electrical conductivity, carbon:nitrogen ratio, ammonium-nitrogen concentration, total major nutrient content and nitrogen drawdown.

These tests are not exhaustive, but used together they can eliminate many of the worst performing media. Note that it is difficult, impossible or expensive to test for everything that might be the cause of poor growing medium performance, such as the presence of organic acids caused by incomplete breakdown of composted materials or the presence of a residual herbicide.

Biological tests: We are at the very early stages of being able to interpret the results of biological tests (other than microbial respiration or CO2 evolution) and relate them to the ability of growing media to perform as a substrate for seedling germination or growth. Whilst most commercial labs conducting routine chemical and physical tests use standard methods which are documented and widely used throughout the UK, there are no such standards for biological testing. The value of biological testing is therefore questionable at present, particularly given its high cost.

However, there is increasing acknowledgement amongst scientists that reduced-peat and peat-free media are not sterile in the way that peat-based media were in a practical sense. There is worrying evidence that some constituents of peat-free and reduced-peat media can contain plant pathogens, but also evidence that they routinely contain microorganisms that are beneficial to plants.

Several commercial companies are now working on the creation of growing media containing specific types of microorganisms or specific microbial profiles. It therefore makes sense to start looking in more detail at the microorganism communities that are living in the media that we are producing. The biological testing that was conducted in the GrowBlocks project was done with the intention of gathering basic information on microorganisms present in both the constituents and finished media produced or purchased from manufacturers.

Interpretation of the test results

Table 1. Summary of tests to determine growing media quality and target values:

Test	Unit	Target range	Comments
Physical tests			
Air-filled porosity	%	~ 10 - 20	Ideal range depends on the size of container/module/block in which medium is to be used and the duration it is to be used for. Larger containers and longer durations mean higher target values. Test results more relevant in pots than in blocks where media is pushed into blocks.
% of particles < 1 mm in size	%	< 20% for potting media, less for seedling media	Standard AFP less useful for non-peat media and this test is more often used. Target value of <20% can be reduced for smaller container sizes. As above, test results more relevant in pots than in blocks where media is pushed into blocks.

Chemical tests			
pH	pH unit	5.5 – 7.5	pH affects nutrient availability and very low pH can harm roots. pH is less critical in growing media than in soil, but it is still very important.
Conductivity (CEN method)	µS/cm	Varies depending on type of media. Ideally < 300 for seed media	High conductivity (salt concentrations) are a major reason for poor growing media performance. Common in immature composts and in media that contain too much plant nutrient and other salts.
C:N ratio	-	< 20:1	Very important for composts, less so for growing media. In the absence of results from N drawdown tests, C:N ratio can give an indication of whether N might be locked up due to an excess of C, leading to poor seedling growth.
Ammonium-N	mg/kg dry matter	< 50	High ammonium concentrations are a major reason for poor growing media performance. Common in immature composts, media that contain too much nitrogen and where media have been stored badly. Non-peat media naturally tend to have higher values and target values based on peat media may have to be changed.
Total nutrients (N, P & K)	kg/fresh tonne	2 - 10 (N) 1 – 4 (P) 1 - 8 (K)	Not critical for growing media (very important for composts). These values give an indication of the long-term nutrient value in the medium.
Extractable plant nutrients	mg/l	nitrate, P, K, Mg, C, S, trace elements	Values are transient, but can give an idea of nutrients available to plants.
N drawdown index (NDI)	index	Varies. Results are used to set N fertiliser inclusion rates in growing media and also to determine the likely need for subsequent N fertiliser applications.	The NDI is based on a test which measures how quickly N is immobilized in organic components of growing media. Test is routinely conducted in-house by growing media manufacturers but it is not currently available in commercial UK labs, which is a problem, since alternative tests (as above) are not as useful. It gives an idea of how available (or not) N will be in a medium. (N availability is a major factor determining the ability of a medium to support plant germination and growth.)
Chemical names are abbreviated as follows, according to convention: C=carbon, K=potassium, N=nitrogen, p=phosphorus			
Biological tests			
Compost stability (CO_2 evolution)	mg CO_2/gV/day	< 16.0	Target is really for compost rather than growing media, but value should certainly be < 16.0 for growing media. Higher values indicate an unstable material which may contain breakdown products toxic to young seedlings.
Active bacteria	µg/g	15 - 25	Target is published by the lab and is based on expert judgement by the lab technician.
Total bacteria	µg/g	100 – 3,000	As above
Active fungi	µg/g	15 – 25	As above
Total fungi	µg/g	100 - 300	As above

Hyphal diameter	µm	>2.5	As above
Active fungi/active bacteria	ratio	0.8 – 1.5	As above
Total fungi/total bacteria	ratio	0.1 – 1.5	As above
Nematode numbers (total)	no./g	10 - 20	As above
Nematode types (beneficial and plant parasitic)	% within total nos. present	No plant parasites	As above
Flagellates	no./g	>10,000	As above
Amoebae	no./g	>10,000	As above
Ciliates	no./g	50 - 100	As above
Vesicular arbuscular mycorrhizae	% of plant roots with them	40 - 80	As above
Ectomycorrhizal fungi	"	40 - 80	As above

Where to get the tests done

Whilst there are reputable laboratories for soil and growing media testing in many countries, the use of a UK lab is always recommended, particularly for biological testing, since the organisms present in compost and growing media samples can suffer very badly in transit. Labs in mainland Europe also use different testing methods to those in the UK, and results cannot therefore be interpreted using UK frameworks. Samples should be packaged securely with plenty of air in sealed bags and send in insulated containers with cool packs, using 24 hour recorded delivery.

Labs which regularly test agricultural and horticultural soils for chemical and physical parameters typically also test composts and growing media for these parameters. There are many such labs in the UK. The laboratories approved to test composts by the UK Compost Certification Scheme all provide a good service.

Those testing for microorganism species and groups tend to specialise only in that type of testing. At the time of writing, there are several UK labs providing such testing, but given the lack of standardised methods, it is not possible to recommend one over another. An internet search using keywords such as “UK, compost, soil foodweb, testing” will yield useful results. It is important to tell the lab that you intend to test growing media or named constituents, rather than soil, since the test methods may differ.

Why is the quality of some growing media so poor?

It is much easier to make consistent, high-quality peat-based media than it is to make peat-free or reduced-peat media. Peat was not only very cheap, it was also extremely consistent (within individual bogs) and had a good, stable structure, with a uniform pH and consistent, low nutrient content. It was free from harmful organisms and weed seeds (or any other types of organism for that matter) and for that reason, it did not continue to decompose during storage. The only required additives in peat-based media are typically lime and nutrients.

No single constituent (perhaps other than some types of coir in some applications) can replace peat entirely as the bulk constituent of growing media. All other constituents are associated with one or more challenges. They often have structural instabilities and/or are too coarse or too fine, many contain too much nutrient or salts, many are too expensive or are in short supply, some are associated with risks due to the presence of undesirable microorganisms and many require expensive or energy-intensive processing.

Most growing media manufacturers therefore create blends containing several constituents in order to make peat-free or reduced-peat media, but given the variable nature of many peat-alternative constituents, that means a considerable amount of expensive laboratory testing of constituents to determine optimal blend ratios. Media produced for demanding professional markets uses the best quality constituents, which are tested frequently during production, as are the finished media. Constituents and media intended for amateur markets are tested less often and in some cases not frequently enough to ensure consistently high quality. Because the amateur growing media market is extremely competitive, there is constant pressure to produce it for less and therefore the funds available to optimise quality through the best choice of constituents and processing methods are limited.

Added to that is the fact that amateur media are not always stored in an appropriate manner at retailers premises (in cool dark places, with provision for air but not water to get into the bags, which are, unlike peat-based media, filled with a living, breathing mass). It is unfortunately also common for peat-based and reduced-peat media to be used long after they were produced. Whilst this can work, it often does not. These types of media are designed to be used in the year of manufacture.

Conclusions

Whilst the quality of some peat-free and peat-reduced media is now superb and certainly at least as good as some of the peat-based media, there are still some very poor products out there. Evidence from the GrowBlocks project has shown that it is possible to produce nursery-made media which are as good as one of the industry standards. In order to get the best from home-made media, it is a good idea to test key constituents prior to blending, then test the final medium for the parameters listed in Table 1. It is also essential that you conduct basic germination and growth trials with at least three species before committing to use the media for important purposes.

Future Guidance Note

The final guidance note will cover results from testing constituents and growing media used in the GrowBlocks project. The results and interpretation of the germination and growing trials, along with a discussion on the potential for producing home-made growing media blocks for propagation using the methods described are provided in the main project final report.

Get involved:

The project team is keen to engage with others. Growers, horticultural scientists and other interested parties are invited to sign up to receive:

- Guidance notes on techniques being used in the project
- Project updates
- Invitations to online and in-person meetings.

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