Eliminating peat and plastic from propagation using growing media blocks

Guidance and Information Note 5 - Results of testing nursery-made growing media

The growers at the three nurseries in the Sow and GrowBlocks Field Lab each made two types of compost -based growing media (a vegan and a non-vegan mix). The growers at Tombreck included a third medium and all three nurseries used one or two commercially-available control media.

This guidance note is intended for anyone who is considering testing home-made media or is considering making growing media on a bigger scale and wants to start testing to ensure quality of composts or media across larger batches. It outlines the results of laboratory testing of these growing media and explains what the results mean in practical terms.

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)

Growing media recipes

All three trials hosts used the same control medium: Moorland Gold®. It was chosen because it is a good quality, widely-available product, which is in common use by small growers and because it had an appropriate physical composition and structure to allow it to form blocks. (Many peat-free and reduced-peat growing media, including some very good ones, will not form cohesive blocks, because they contain insufficient fine material and/or contain too much fibrous material). Although Moorland Gold is peat-based, the peat in it is not extracted from bogs but is instead filtered from drinking water supplies as they are processed. One nursery included a second control (a Klasmann reduced-peat propagation medium based on peat, coir and wood fibre) which they use for propagation.

All trials hosts used the same recipes to make vegan and non-vegan growing media. The recipes used for the nursery-made growing media were based on composts made on the trial host nurseries in insulated hot-boxes (“Aerobins”) over a period of 16 to 37 weeks (see project Guidance Note 2; The composting process for details). The Tombreck growers also used a medium based on an additional local compost made from similar ingredients over a 26 to 42-week period.

The recipe for the compost-based growing media was:

- 4 parts by volume of Aerobin compost (either vegan or non-vegan, [see project Guidance Note 2, The composting process] sieved through a 10 mm then 6 mm sieve)
- 4 parts by volume of leaf mould (sieved through a 10 mm then 6 mm sieve)
- 1 part by volume of coarse river sand (sieved through a 6 mm sieve)
- 1 part by volume of loamy soil (sieved through a 6 mm sieve)

Further details on the media and their preparation are provided in Guidance Note 3 (Making and using growing media). We recognised (and embraced the fact that) none of these ingredients were sterile (unlike sphagnum peat from most sources) and we made every effort to try to ensure that microorganisms present in the materials were likely to be beneficial rather than harmful.

Types of tests

Growing media used in the GrowBlocks trials were tested using a range of physical, chemical and biological tests. The main purpose of testing was to give some basic ideas about growing media quality and also, potentially, to help explain the reasons behind growing media performance. Details of the tests used, additional useful tests, the reasons for conducting each test type and target values are provided in Guidance Note 4 (Testing growing media). The results of tests done on the media produced in this project are summarised and discussed in this note. The results of key physical and chemical tests are summarised in Table 1. Colour coding has been used to help interpret the results in the table. If the value for a parameter is broadly within the desirable range, then the cell is coloured in green. If the value is outside the desirable range, then the cell is shaded in orange.

The results of biological assessments are summarised in Table 2. If the number is within the desirable range set by the lab or above it (if that is considered a good thing) then the cell is coloured in green. If the value is considered by the lab to be too low, the cell is shaded in orange. If the value is considered undesirable, it is shaded in red.

In the interests of simplicity, values for less relevant chemical parameters tested have been omitted from Table 1 and only the ranges in which values were placed for biological parameters are shown in this guidance note. Actual numbers in the form of raw laboratory data will be provided to interested parties on request.

Performance of each of the twelve growing media is summarised in Table 3, along with a summary of the main points drawn from laboratory testing so that the test results can be put in context.

Table 1. Results of chemical and physical tests conducted on growing media used in the Sow and GrowBlocks Field Lab[1]

		Control	Tombreck trial 1			Tombreck trial 2				W Lawrenceton		East Neuk	
Physical tests	**Unit**	**MG**	**TV(16)**	**TNV(16)**	**TD(26)**	**TV(30)**	**TNV(30)**	**TD(42)**	**TK**	**WV(32)**	**WNV(32)**	**EV(37)**	**ENV(37)**
Air-filled porosity	%	37	30	38	28	9	9	12	8	6	6	11	11
Chemical tests	**Unitj**												
pH	pH unit	6.9	7.5	7.5	6.4	7.2	7.1	6.8	6.2	7.0	6.8	6.7	5.4
Conductivity (1:6) fresh	µS/cm	1041	202	408	83	250	625	215	610	1,046	1,507	1,313	1,972
C[1]:N ratio	-	24:1	22:1	19:1	16:1	19:1	20:1	30:1	27:1	12:1	23:1	15:1	15:1
Ammonium-N	mg/kg DM	< 10	46	50	44	< 10	< 10	< 10	649	< 10	26.4	< 10	19.2
Total N	g/kg of fresh media	4.5	2.7	3.0	3.1	3.9	3.3	6.0	4.3	6.3	10.1	4.4	3.9
Total P		1.8	1.3	1.3	1.2	1.4	1.4	1.5	0.5	2.7	4.1	1.3	1.2
Total K		4.3	1.6	1.4	0.7	1.7	1.4	1.7	0.76	2.7	2.8	1.9	2.4

[1]If the value for a parameter is broadly within the desirable range, then the cell is coloured in green. If the value is outside the desirable range, then the cell is shaded in orange.

[2]Growing media labels are: (**Tombreck trial 1**) **MG**=Moorland Gold; **TV(16)**=Tombreck vegan media based on 16 week-old compost; **TNV(16)**=Tombreck non-vegan media based on 16 week-old compost compost; **TD(26)** = vegan media based on 26 week-old local (Dalnashian) compost. (**Tombreck trial 2**) **TV(30)**=Tombreck vegan media based on 30 week-old compost; **TNV(30)**=Tombreck non-vegan media based on 30 week-old compost compost; **TD(42)**= vegan media based on 6 month-old local (Dalnashian) compost; **TK**=Tombreck Klasmann reduced-peat media. (**W Lawrenceton trial) WV(32)**=Wester Lawrenceton vegan media based on 32 week-old compost; **WNV(32)**=Wester Lawrenceton non-vegan media based on 32 week-old compost. (**East Neuk trial) EV(37)**=East Neuk vegan media based on 37 week-old compost; **ENV(37)**=East Neuk non-vegan media based on 37 week-old compost.

[3]Chemical names are abbreviated as follows, according to convention: C=carbon, K=potassium, N=nitrogen, p=phosphorus;

Table 2. Results of biological tests conducted on growing media used in the Sow and GrowBlocks Field Lab[1]

Biological tests	Control	Tombreck trial 1			Tombreck trial 2				W Lawrenceton		East Neuk	
	MG[2]	TV(16)	TNV(16)	TD(26)	TV(30)	TNV(30)	TD(42)	TK	WV(32)	WNV(32)	EV(37)	ENV(37)
Compost stability (CO_2 evolution)	3	11	9	6	6	6	5	1	5	4	5	4
Active bacteria	low	low	good	low	low	absent	low	low	low	low	low	low
Total bacteria	good	good	good	good	good	good	good	good	good	good	good	good
Active fungi	good	low	high	low	low	absent	low	low	low	low	low	low
Total fungi	good	high	high	good	high	low	good	good	low	low	good	good
Active fungi/active bacteria	good	good	high	low	low	N/A	low	high	high	high	good	low
Total fungi/total bacteria	good	good	good	good	good	low	good	good	good	good	good	good
Nematode numbers (total)	high	high	high	low	high	good	low	high	high	low	high	high
Nematode types (%)												
Plant parasitic	75	0	10	40	25	30	0	0	0	0	0	25
Fungal feeders	10	30	40	40	45	35	50	40	50	50	80	50
Bacterial feeders	10	40	40	20	15	35	50	40	50	50	20	25
Predatory	5	30	0	0	15	0	0	20	0	0	0	0
Flagellates	low	high	high	high	high	high	low	low	high	high	absent	absent
Amoebae	low	high	high	low	good	low	low	low	low	high	low	low
Ciliates	high	high	high	low	high	high	high	high	good	high	high	high

[1]Actual numbers in the form of raw laboratory data are to interested parties on request. In the interests of simplicity, only the ranges in which values were placed are shown. If the number is within the desirable range set by the lab or above it (if that is considered a good thing) then the cell is coloured in green. If the value is considered by the lab to be too low, the cell is shaded in orange. If the value is considered undesirable, it is shaded in red.

[2]Growing media labels are: (**Tombreck trial 1**) MG=Moorland Gold; TV(16)=Tombreck vegan media based on 16 week-old compost; TNV(16)=Tombreck non-vegan media based on 16 week-old compost compost; TD(26) = vegan media based on 26 week-old local (Dalnashian) compost. (**Tombreck trial 2**) TV(30)=Tombreck vegan media based on 30 week-old compost; TNV(30)=Tombreck non-vegan media based on 30 week-old compost compost; TD(42) = vegan media based on 6 month-old local (Dalnashian) compost; Tombreck Klasmann reduced-peat media. (**W Lawrenceton trial)** WV(32)=Wester Lawrenceton vegan media based on 32 week-old compost; WNV(32)=Wester Lawrenceton non-vegan media based on 32 week-old compost. (**East Neuk trial)** EV(37)= East Neuk vegan media based on 37 week-old compost; ENV(37)= East Neuk non-vegan media based on 37 week-old compost.

Table 3. Interpretation of lab results in relation to performance of growing media on nurseries		
General point: All media were "stable" as defined by the carbon dioxide evolution test used in this project. However, this test is really designed for composts rather than growing media. It was used here to give some idea of "readiness for use". A very high value (> 16) would have meant that the media would be unstable, unsuitable for use and probably still physically warm. However, none of the nursery-made media had high values like this. It makes sense that the two youngest composts (Tombreck vegan and non-vegan media based on 16 week-old compost) were the most biologically active and those based on filtered peat (Moorland Gold) or peat, coir and wood fibre (Klassman) rather than true composts were the least biologically active.		
Medium[1, 2]	**Performance in growing trials**	**Conclusions from testing**
Control (Moorland Gold)	A good medium, which generally performed well with all three species across all four trials. In four cases (lettuce and kale growth at Tombreck Trial 2; lettuce growth at East N; lettuce growth at WL) performance was occasionally significantly poorer in the control than in nursery-made media though. It did not perform as well as the Klasmann reduced peat used in Tombreck Trial 2, which was significantly better in several measures on the one trial in which it was used.	The medium had a fairly high AFP for a medium of this type (this is less likely to be relevant for media used for blocks and it is not likely to have caused problems). It had a surprisingly high conductivity for a propriety growing medium and this may be one reason why the medium did not perform better than it did. It contained useful amounts of nutrients for early seedling growth and contained low ammonium concentrations (which was good). It was a biologically active medium (certainly not sterile like extracted peat can virtually be). It contained low numbers of active bacteria, flagellates and amobae, but good numbers of microorganisms on other measures. However, it did contain high numbers of plant parasitic nematodes, which was unexpected and certainly not good. It is not known what species these were and whether they could attack the species of plants grown in the trial.
Control (Klassman)	An outstanding medium which formed blocks easily and which performed very well in the one trial in which it was used.	The medium had a typical AFP for a propagation medium of this type (though it is less likely to be relevant for media used for blocks). It had an acceptable pH, conductivity and it contained useful amounts of nutrients for early seedling growth. It contained high (potentially damaging) ammonium concentrations, and it was surprising that this did not cause problems for seed germination and early growth (that high ammonium concentrations in growing media are a frequent cause of propagation losses). It also had a high C:N ratio, which can indicate potential problems, but this test is less relevant to media not based on compost and it can be counteracted easily through the addition of appropriate amounts of N of appropriate forms for the media concerned. It was a biologically active medium (certainly not sterile, as media based solely on extracted peat can be). It contained low numbers of active bacteria and active fungi, flagellates and amobae, but good or very good numbers of microorganisms on other measures and high numbers of beneficial nematodes.

Tombreck vegan (16)	A good medium which performed equally as well as the control in most respects. Performance was significantly poorer only in terms of pea germination and lettuce growth.	The medium had a fairly high AFP for a medium of this type (this is less likely to be relevant for media used for blocks and it is not likely to have caused problems). It had an acceptable pH, conductivity, ammonium-N concentration and it contained useful amounts of nutrients for early seedling growth. It had a slightly elevated C:N ratio, which may have restricted N availability to growing seedlings. It was a biologically active medium, as expected, given that it contained non-sterile organic materials including 40% compost. It contained low numbers of active bacteria and active fungi, but good or very good numbers of microorganisms on other measures, high numbers of beneficial nematodes and no plant-parasitic nematodes.
Tombreck vegan (30)	A good medium which performed equally as well as the control in most respects. Performance was significantly poorer only in terms of lettuce germination.	The medium had a low AFP (this is less likely to be relevant for media used for blocks and it is not likely to have caused problems). It had an acceptable pH, conductivity, ammonium-N concentration, C:N ratio and it contained useful amounts of nutrients for early seedling growth. It was a biologically active medium, as expected, given that it contained non-sterile organic materials including 40% compost. It contained very low numbers of active bacteria and active fungi and a low ratio of active fungi:active bacteria. It contained good or high numbers of flagellates, amobae and ciliates and high numbers of nematodes. However, 25% of these were plant-parasitic. It is not known what species these were or whether they could attack the species of plants grown in the trial.
Tombreck non-vegan (16)	A good medium which performed equally as well as the control in most respects. Performance was significantly poorer only in terms of pea germination.	The medium had a fairly high AFP for a medium of this type (this is less likely to be relevant for media used for blocks and it is not likely to have caused problems). It had an acceptable pH, conductivity, C:N ratio, ammonium-N concentration and it contained useful amounts of nutrients for early seedling growth. As expected, given that it contained non-sterile organic materials including 40% compost, it was a biologically active medium. It contained good numbers of microorganisms on all measures and high numbers of nematodes. However, 10% of these were plant-parasitic. It is not known what species these were and whether they could attack the species of plants grown in the trial.
Tombreck non-vegan (30)	A good medium which performed equally as well as the control in all respects and performed better than the control in terms of lettuce and kale growth.	The medium had a low AFP (this is less likely to be relevant for media used for blocks and it is not likely to have caused problems). It had an acceptable pH, ammonium-N concentration, C:N ratio and it contained useful amounts of nutrients for early seedling growth. Its conductivity was higher than ideal and this may have affected germination of sensitive subjects. It was a biologically active medium, as expected, given that it contained non-sterile organic materials including 40% compost. It contained very low numbers of active bacteria, active fungi, total fungi and a low ratio of active fungi:active bacteria. It contained high numbers of flagellates and ciliates, but low numbers of amoebae. It contained good numbers of nematodes. However, 30% of these were plant-parasitic. It is not known what species these were or whether they could attack the species of plants grown in the trial.
Dalnashian (26)	A good medium which performed equally as well as the control in most respects. Performance was significantly	The medium had a fairly high AFP for a medium of this type (this is less likely to be relevant for media used for blocks and it is not likely to have caused problems). It had an acceptable pH, conductivity, C:N ratio, ammonium-N concentration and it contained useful amounts of nutrients for early seedling growth. As expected, given that it contained non-sterile organic materials including 40% compost, it was a

	poorer only in terms of lettuce growth.	biologically active medium. It contained low numbers of active bacteria and active fungi and a low ratio of active fungi:active bacteria. It contained high numbers of flagellates but low numbers of amobae and ciliates It contained low numbers of nematodes. However, 40% of these were plant-parasitic. It is not known what species these were and whether they could attack the species of plants grown in the trial.
Dalnashian (42)	A good medium which performed equally as well as the control in most respects. Performance was significantly poorer only in terms of lettuce germination.	The medium had a low AFP (this is less likely to be relevant for media used for blocks and it is not likely to have caused problems). It had an acceptable pH, conductivity, C:N ratio, ammonium-N concentration and it contained useful amounts of nutrients for early seedling growth. As expected, given that it contained non-sterile organic materials including 40% compost, it was a biologically active medium. It contained low numbers of active bacteria and active fungi and a low ratio of active fungi:active bacteria. It contained high numbers of flagellates but low numbers of amobae and ciliates It contained low numbers of nematodes. However, 40% of these were plant-parasitic. It is not known what species these were and whether they could attack the species of plants grown in the trial.
WL vegan (32)	A good medium which performed equally as well as the control in most respects. Performance was significantly poorer only in terms of pea germination. This medium did, however, perform better than the control in terms of lettuce growth.	The medium had a low AFP (this is less likely to be relevant for media used for blocks and it is not likely to have caused problems). It had an acceptable pH, ammonium-N concentration and it contained useful amounts of nutrients for early seedling growth. However, it had a high conductivity, which would likely adversely affect seed germination and early growth of sensitive species. It also had a low C:N ratio, but this may not have caused problems. It was a biologically active medium, as expected, given that it contained non-sterile organic materials including 40% compost. It contained low numbers of active bacteria, active fungi and total fungi but good total numbers of bacteria and a high ratio of active fungi:active bacteria. It contained good or high numbers of flagellates, amoebae and ciliates and high numbers of beneficial nematodes, none of which were plant-parasitic.
WL non-vegan (32)	A good medium which performed equally as well as the control in most respects. Performance was significantly poorer only in terms of pea and lettuce germination. This medium did, however, perform better compared with the control in terms of lettuce growth.	The medium had a low AFP (this is less likely to be relevant for media used for blocks and it is not likely to have caused problems). It had an acceptable pH. However, there were several chemical problems with this medium. It had a moderately high ammonium-N concentration, a very high conductivity and a high C:N ratio (which at least may have prevented an excess of N getting into solution). It contained excessive amounts of nutrients for early seedling growth. This medium would probably be good for potting on older plants, but on paper, it is much too nutrient-rich and salty for use as a propagation medium. The reason why it performed as well as it did is unclear. It could be associated with the high C:N ratio, and/or perhaps since the medium (in common with the other compost-based media) was biologically active, with beneficial microorganisms helping to protect germinating seeds and developing seedlings. It contained low numbers of active bacteria, active fungi and total fungi but good total numbers of bacteria and a high ratio of active fungi:active bacteria. It contained high numbers of flagellates, amobae and ciliates but low numbers of beneficial nematodes (none of which were plant-parasitic).
EN vegan (37)	A good medium which performed equally as well as the control in all respects.	The medium had a fairly low AFP (this is less likely to be relevant for media used for blocks and it is not likely to have caused problems). It had an acceptable pH, C:N ratio and ammonium-N concentration and it contained useful amounts of nutrients for early seedling growth. However, it had a high conductivity,

		which could adversely affect seed germination and early growth of sensitive species. It was a biologically active medium, as expected, given that it contained non-sterile organic materials including 40% compost. It contained low numbers of active bacteria, active fungi and total fungi but good total numbers of bacteria and good ratios of active and total fungi: bacteria. It contained almost no flagellates, low numbers of amoebae and high numbers of ciliates. It contained high numbers of beneficial nematodes, none of which were plant-parasitic.
EN non-vegan (37)	A good medium which performed equally as well as the control in all respects. This medium also performed better compared with the control in terms of lettuce growth.	The medium had a fairly low AFP (this is less likely to be relevant for media used for blocks and it is not likely to have caused problems). It had an acceptable C:N ratio, an acceptable ammonium-N concentration and it contained useful amounts of nutrients for early seedling growth. However, it had a very low pH, which could have affected nutrient-availability and the roots of germinating seeds and seedlings. It also had very high conductivity, which is also likely to have this effect. This medium would probably be good for potting on older plants, but on paper, it is much too acid and salty for use as a propagation medium. The reason why it performed as well as it did is unclear. It could be associated related to the fact that the medium (in common with the other compost-based media) was biologically active, with beneficial microorganisms helping to protect germinating seeds and developing seedlings. It was a biologically active medium, as expected, given that it contained non-sterile organic materials including 40% compost. It contained low numbers of active bacteria, active fungi and had a low ratio of active fungi:active bacteria. However, it had good total numbers of bacteria, fungi and a good ratio of total fungi:total bacteria. It contained almost no flagellates, low numbers of amoebae and high numbers of ciliates. It contained high numbers of beneficial nematodes, but 25% of these were plant-parasitic.
[1]The figures in parenthesis represent the age of the compost on which the medium is based (in weeks) where the medium is based on a true compost (which is not the case with either control - Moorland Gold or Klasmann). [2]WL = Wester Lawrenceton; EN = East Neuk		

Discussion

The results obtained from laboratory testing of the growing media used in the Sow and GrowBlocks project form a very complex picture and raise more questions than answers. It has become very obvious that the best tests for characterising peat-free and reduced-peat media (particularly those based on true composts) are not necessarily the same as the long-established physical and chemical tests used to characterise peat-based growing media. Whilst the big growing media manufacturers know this and have altered their test suites accordingly, almost none of them include true compost in professional growing media, so their ideal test suites might be different from those best suited to compost-based media such as those produced in this project. In the rare case where a single UK manufacturer does include compost (in professional products), the amount included is rarely more than 20% by volume.

Whilst it is known that the major growing media manufacturers have their own labs and spend a great deal of time and money testing both constituents and finished media, their methods and results are not publicly- available. There is no published guidance on an appropriate suite of tests for different types of peat-free growing media, and no published target values for test parameters. It is also known that some of the smaller manufacturers spend comparatively little on testing, and this is likely a key reason for poor growing media performance in some cases. On testing several examples of extremely poor-quality media available on the amateur market (some of which are frequently used by small-scale professional growers) several had very high conductivity and ammonium concentrations (confidential data held following testing by the author) which would explain, at least to some extent) the poor seed germination and growth being observed by disgruntled customers.

Tests worth doing for composts prior to their use in nursery-based media

Composts intended for immediate use in nursery-based media could usefully be tested for: compost stability, pH, conductivity, ammonium, nitrate and ammonium:nitrate ratio, total C, total N and C:N ratio, total N, P and K. These tests will help the grower determine whether the compost is ready for use and will help them decide what and how much to dilute the compost with when making different types of media. Expert help may be needed to interpret the results.

Inclusion of composts in growing media

Based on discussions with several industry professionals and growers, those wishing to use true compost as a constituent of growing medium are advised to use it at no more than 40% by volume if it is less than 1 year old. At less than 1 year old, it is likely to be unstable, have high salt levels, high ammonium concentrations and potentially a high C:N ratio. True composts are better diluted with other bulk constituent(s) which contain lower salt and ammonium concentrations (e.g. coir or leaf mould). It is acknowledged that some very experienced and successful growers are using composts at higher concentrations, but they are typically using little or no very high-nitrogen feedstocks (such as animal manures or fresh grass) and using main fine (ramial) woodchip. They generally also produce their composts over a much longer period in order to render them sufficiently stable and mature for use in propagation media.

Physical and chemical tests worth doing for compost-based media before they are used for plant production

The most useful established tests for compost-based media include: pH, conductivity, ammonium-N and total N, P and K content. Rather than test for air-filled-porosity, which did not work well in this project, it might also be useful to test for particle size fractions (the target % ranges for the different size fractions will differ depending on the intended use of the medium). Nitrogen drawdown is an important and very useful test used by commercial growing media manufacturers to determine how much N (the most critical nutrient determining plant growth) will be released from the medium over time. However, at present, this test is not available at commercial labs. Water extractable nutrients (including nitrate, phosphorus, potassium, magnesium, sulphur and others) can be useful in some contexts, because values give an idea of how much of each nutrient is likely to become available to plants. Expert help may be needed to interpret the results.

Why did media with poor values for key chemical parameters still perform fairly well?

The short answer is, we don't know. The very high conductivity values in the Wester Lawrenceton and East Neuk media and the excessively high nutrient concentrations in the Wester Lawrenceton media did not result in performance which was overall much poorer than in the control media (Moorland Gold). On saying that, Moorland Gold itself had a high conductivity, which is likely to have inhibited germination to some extent. It is worth noting that performance in the Klasmann reduced peat media (used only in the second Tombreck trial) was significantly better than all the other media used in that trial on several measures. Klasmann reduced-peat media is used by many larger professional UK growers and it has a very high reputation for consistently high quality. Many UK growers do use media which is sold to both amateur and professional markets and many use Moorland Gold, so it was probably a reasonable choice for the control, albeit certainly not the best product on the market in terms of its ability to support good seed germination and early seedling growth.

The relatively good performance of seeds and seedlings, particularly in compost-based media at both Wester Lawrenceton and East Neuk (based on their adverse chemical properties) was unexpected. However, the nature of the media made in this project is very different to those manufactured for mass distribution. It may be that the dynamic nature of the media (in which decomposition will constantly be taking place) and the living component within it will be helping to protect germinating seeds and growing seedlings. We simply do not yet know.

Biological tests worth considering for compost-based media before they are used for plant production

Although some of the peat-free and reduced-peat media are likely to contain a lot more microbial and nematode life than media based solely on extracted peat, they are likely to contain fewer of these organisms and a far lower diversity of organisms than media based on composts will. However, we are at a very early stage in our understanding of what's going on biologically in peat-free and reduced-peat growing media, and learning more will be expensive because the cost of microbial analysis is high.

There are currently no agreed UK methods for assessing numbers of different microbial species and no established frameworks for interpreting the results in different types of media. However, it is likely that an understanding of the biology within growing media could well provide the key to producing high quality bespoke media for different purposes, such as vegetable propagation or tree production. Such media might include high functional diversity within named microorganism groups, the presence of particularly, useful fungi, bacteria or nematodes and the absence of certain types of organisms (such as plant-parasitic nematodes). Some growing media companies are already working on ideas along this line, but much of their work is privately-funded and thus highly confidential.

Overall conclusions from testing growing media

- Tests showed that Moorland Gold (the main control medium) had appropriate physical and chemical properties for a propagation medium, other than an elevated conductivity level. This medium performed generally well in terms of seedling germination and growth. This was a biologically active medium, with low numbers of active bacteria and some protozoa types, but otherwise generally good numbers of measured organisms. However, numbers of plant parasitic nematodes were high and the implications of that for seeds and seedlings are unknown.

- Tests showed that the Klasmann reduced-peat propagation medium (used alongside Moorland Gold and three compost-based media in the second trial at Tombreck) had appropriate physical and chemical properties for a propagation medium, other than a slightly elevated ammonium concentration. This medium performed extremely well in terms of seedling germination and growth. This was also a biologically active medium, very unlike the type of products based purely on peat, which the majority of growers used until recently. This product contained low numbers of active fungi/bacteria, but otherwise generally good numbers of measured organisms.

- Tests showed that the three types of compost-based media used in both trials at Tombreck had appropriate physical and chemical properties for propagation media, other than elevated C:N ratios in the vegan medium based on 16-week-old compost and in the Dalnashian medium based on 42-week-old compost. These media were all biologically active, with the greatest numbers of organisms being present in media based on the youngest composts. Although most contained high numbers of nematodes, some contained plant parasitic nematodes and the implications of that for seeds and seedlings are unknown. These media performed generally well in terms of seedling germination and growth; in most cases as good as the Moorland Gold Control. Some scientific work has clearly shown that compost age is critical in terms of the likelihood that it will contain high numbers of beneficial organisms, with stable, but relatively young composts containing more disease suppressive organisms than older composts. For that reason, further work is required to look at the effect of compost type and age on the microbiological profile in finished media.

- Tests showed that the two types of compost-based media used at Wester Lawrenceton had several chemical properties which suggested that they would not make ideal propagation media. These included high conductivity and (in the case of the non-vegan mix) a high C:N ratio and excessively high nutrient concentrations. Both media were biologically active, although the medium based on vegan compost had higher numbers of organisms than that based on non-vegan compost. It is possible that the high conductivity present in that medium would adversely affect microbial activity. Nematode numbers varied between the two media, but neither contained plant parasitic species. Despite undesirable values for some parameters, these media performed better than expected in terms of seedling germination and growth; in most cases as good as the Moorland Gold Control. Lettuce germination was poorer in the non-vegan media than in the control and pea germination was poorer in both media than in the control. Biomass of the lettuce was greater in both compost-based media compared with the control, possibly due to the higher nutrient content in the media.

- Tests showed that the two types of compost-based media used at East Neuk had high conductivity and the non-vegan medium also had a low pH, both which might indicate unstable, immature constituent composts. Both media were biologically active, although both contained relatively low numbers of active bacteria, fungi, flagellates and amoebae. It is possible that the high conductivity present in that medium would adversely affect protozoa numbers. Nematode numbers were high. The non-vegan medium contained plant parasitic nematodes and the implications of that for seeds and seedlings are unknown. Despite undesirable values for some parameters, these media performed better than expected in terms of seedling germination and growth; in all cases as good as the Moorland Gold Control. Biomass of the lettuce was in fact greater in the non-vegan compost-based media than in either the control or the vegan compost-based medium.

- In conclusion, the best suite of physical, chemical and biological tests for compost-based growing media is going to be different to that for peat-based media and needs further refinement. Further work is also required to define the ideal range of values for each chosen parameter. These ranges may well be different for different types of media. The amount of work required to develop reliable, meaningful biological tests will be significant but holds great potential to help us develop high quality, biologically-active media based on recycled organic materials for the future.

Get involved

The project team are 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
- The project final report

December 2024