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Guidelines for the Specification of Quality Compost for use in Growing Media

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A world in which resources are used sustainably.

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WRAP's mission is to accelerate the move to a sustainable, resource-efficient economy through:

re-inventing how we design, produce and sell products

re-thinking how we use and consume products

re-defining what is possible through re-use and recycling

Guidelines for the Specification of Quality Compost for use in Growing Media

These guidelines have been written to help composters who want to supply the horticultural growing media market meet the quality standards required by this sector. They have been produced by ADAS , Earthcare Technical and WRAP in consultation with the growing media sector, composting industry, and the Organics Recycling Group (ORG), which is part of the Renewable Energy Association (REA). The guidelines will help a composter manufacture compost with the most suitable characteristics for use in growing media. They are not intended to be prescriptive; the actual detailed specification for compost will need to be agreed with the growing media manufacturer or grower who is purchasing the compost, and will depend on the types of plants to be grown in the mix it is used for. Quality compost is already being used as a constituent of many retail growing media products (for example in reduced peat/peat free 'multi-purpose compost' and 'grow bags') and is also being successfully used by some professional growers, particularly for hardy ornamental plants.

Only the highest quality composts with consistent physical, chemical and biological characteristics are suitable for use in horticultural growing media and this document offers guidance on the properties of suitable composts. Regulatory requirements should always be adhered to and are subject to change. Composters/manufacturers/users should ensure that they are always up to date with current regulatory requirements. All composts destined for use in growing media should be produced and used in accordance with current regulations and already be produced in accordance with the requirements of BSI PAS 100 and the Compost Quality Protocol (the latter is not applicable in Scotland).

The Compost Quality Protocol (CQP) was launched in 2008 and revised and re-published in 2012. It defines when compost is considered a product, and no longer falls under the waste management regulations. One of the requirements of the CQP is that composts are produced to a recognised standard e.g. BSI PAS 100. (NB. Compliance with the Compost Quality Protocol is not required in Scotland at the time of publication however as part of Scotland's end of waste position statement, SEPA requires that compost is produced to BSI PAS 100).

1.0 Introduction

High quality composted materials made from source-segregated biodegradable feedstocks can be useful ingredients in peat-free or reduced peat growing media. There are a number of advantages of using compost in a growing medium:

- compost provides major and minor nutrients and increases chemical buffering and water holding capacity in the growing medium in a similar way to loam;
- compost may assist in the suppression of some plant diseases because it is more biologically active than other growing media constituents; and
- compost may reduce the growth of liverworts, moss and algae when used in blends that retain a drier surface than 100% peat mixes.

However, because of its naturally high nutrient levels and relatively high bulk density, rates of compost inclusion in a growing medium are limited (usually to a maximum of 40-50% by volume) and therefore the compost must be blended with an appropriate low nutrient/ low bulk density material such as peat, bark or coir fibre. For professional growers it is essential for new growing media containing compost to be trialled on a small scale first on the nursery, in the same way as any other new growing media formulation is trialled before being introduced and used more generally. This is also necessary as different growing media need specific watering and feeding regimes, so crop management strategies need to be matched accordingly.

Growing media are handled by both the gardening public and workers on nurseries and therefore any ingredients used in them must be safe from a human health point of view. Material free from human pathogens and any glass or sharp material is therefore essential. Contaminants such as plastic, whilst not dangerous, are also undesirable because the visual appearance of the end product is important.

The end use of the growing medium must be taken into account when using compost as an ingredient. Crops which are sensitive to high pH and/or high Electrical Conductivity (EC) (for example seedlings and ericaceous species such as azalea and rhododendron) are less suited to compost inclusion than more vigorous general shrubs. Crops grown to schedule and stringent supermarket specifications are also in a higher risk category (for example indoor pot plants). General shrubs and trees grown for landscaping have less stringent quality control than other horticulture applications and may be more suited to compost use. The slow release nutrients provided by compost can be beneficial for these longer term crops.

The British Standards Institution's Publicly Available Specification 100 (commonly referred to as PAS 100) for composted materials was developed by WRAP in conjunction with the Association for Organics Recycling (AfOR) now the Organics Recycling Group (ORG) and BSI, launched in 2002 it has been updated regularly since then. It acts as a baseline specification which covers the entire production process for composts and which assures that compost is produced to a level of consistency, reliability and safety laid down by the specification.

1.0 Introduction cont.

BSI PAS 100 is a baseline specification and the resulting composts are suitable for a range of markets in addition to horticulture. It does not therefore set limits for all characteristics required by specific horticultural end users such as growing media manufacturers. The guidelines in this document are an update of those previously published by WRAP in 2011 (WRAP,2011). They are designed to assist producers of composted green materials to better understand and meet the specific requirements for composts to be used in growing media. They have been developed in partnership with key stakeholders, including growing media manufacturers and compost producers, with input from ORG and other experts. They are guidelines only and a compost producer will need to agree exact specifications for compost products with the customer. For the production of food crops, human health standards set by the retailer or farm assurance scheme may be more stringent than those set out in this guide and should also be referred to.

One basic physical grade is specified herein (0-10 mm) and composted material meeting these general guidelines is expected to be suitable for a wide range of applications. However, for some specific applications such as growing media for longer-term crops such as nursery stock in larger containers, a proportion of coarser grade material might be more appropriate. Similarly, finer grades of compost may be required for production of seedlings or cuttings in small modules. Particle size specification should be set by the customer and agreed prior to delivery.

1.1 Fundamental qualities of a compost to be used as a component of a growing medium

For compost to be suitable for the horticultural market it must be:

a. Produced only from approved feedstocks in accordance with the standards set out in the Compost Quality Protocol/PAS 100:2011 taking into account the exclusions listed in section 2.

b. Compost Quality Protocol compliant (not required in Scotland).

c. Sanitised, stable and mature, as defined in PAS100:2011 and detailed in section 6 of the guidelines.

d. Free from all 'sharps' (as defined in PAS 100:2011).

e. Free from materials, contaminants, weeds, pathogens, pesticides/herbicides or potentially toxic elements (PTEs) that may adversely affect the user, equipment or plant growth.

f. Acceptable to the customer in appearance and odour.

g. Free-flowing and friable and neither wet and sticky nor dry and dusty.

h. Acceptable in physical and chemical properties, as defined in PAS100:2011 and in section 6 of these Guidelines.

2.0 Permitted and prohibited ingredients

Composted materials as defined in these guidelines shall be made from source segregated feedstocks as defined in the CQP/PAS 100:2011, such as green wastes from parks and gardens.

Prohibited ingredients:

a. Sewage sludge.

b. Mixed municipal waste (unseparated domestic waste from dustbins etc.).

c. Post-consumer wood waste (e.g. window frames and other demolition waste that may be contaminated with metal, glass and PTEs).

With the full knowledge and prior written agreement of the purchaser, compost might include food wastes that have been composted to the standards set in the Animal By-products Regulations (ABPR). Inclusion of food waste may increase the electrical conductivity of the finished compost and in practice the rate of inclusion of such materials should therefore be limited to a low percentage (<20% by volume).

Clean cardboard may also be suitable (i.e. brown, white or coloured card which is free from plastic, metals, non-biodegradable coatings and plastic fittings such as lids) if adequately moistened at the start of and during composting and/or the compost is allowed time to mature.

Manures/animal bedding may also be allowed with the written agreement of the purchaser, however composters must ensure that such materials are not sourced from animals that have grazed or fed upon pasture treated with persistent herbicides, unless the supplier of manures/animal bedding can guarantee that the herbicide manufacturers' label requirements have been correctly followed. This may mean that manures/animal bedding cannot be accepted for composting within a year of the original application of herbicides to grazed land. Where there is any doubt over their source, ensure that composted animal manures/bedding are sent for use in non-sensitive applications.

3.0 Product declaration and laboratory report

Each batch of compost supplied for use in growing media must be clearly identifiable and traceable in line with BSI PAS 100:2011 requirements.

A 'batch' is defined as a quantity of composted material, produced from the same input materials, by the same methods and under the same conditions over a set period of time and having the same properties.

The supplier should also provide the following data:

- A full declaration of the physical and chemical properties of the compost (as listed in section 6).
- A laboratory report on a representative sample from the batch* that demonstrates that the properties described are within the ranges (limits) specified.

* the sampling frequency to be agreed with the customer. It may be less than a one per batch basis for some parameters. In such cases the composter will make available representative data based upon their sampling history.

If the result for one or more parameters is outside the specified limits, the customer should be informed immediately and given the opportunity to reject the batch prior to delivery.

4.0 Sampling and frequency of analysis

Compost batches should be sampled and tested after any screening that produces the final product grade and as close to the time of distribution as possible. It should be remembered that the turn-around time for the integrated plant response and weeds test is at least 6 weeks. The date of sampling should be stated on the results sheet.

Proper sampling, preparation and storage of the final sample are vital and these must be carried out in accordance with the procedure set out in BS EN 12579:2000. This standard specifies that for a batch of bulk material of up to 5,000 cubic metres, the minimum number of incremental sampling points is 12 and the number increases as the batch volume increases, up to a maximum of 30 incremental sampling points. For example, for a batch of 1,000 cubic metres the prescribed number of sampling points is 16 and it is recommended that this number is adopted as a standard for batches of less than 1,000 cubic metres as well. The incremental samples from each sampling point must be combined together and thoroughly homogenised before a representative portion is taken as the final sample for analysis.

All analyses should be carried out by a competent and Renewable Energy Assurance Ltd. (REAL) approved laboratory. Any preliminary on-site testing (such as with a Solvita® kit for checking compost stability/maturity) must be carried out by a suitably trained individual.

The frequency of sampling should be agreed with the customer, however the absolute minimum frequency of analysis for all parameters should be a minimum of either one analysis per 5000m^3 of screened compost produced or one analysis every 6 months, whichever occurs sooner (Note: the minimum frequency of analysis for each parameter required by BSI PAS 100 (post validation) is once every 5000m^3 or once every 12 months, whichever occurs sooner).

5.0 Product liability

The supply of compost as a growing media ingredient is subject to the normal contractual and legal obligations in respect of product liability. Accordingly, the following basic points should be noted.

a. It is the responsibility of the compost supplier to assure the customer that the material supplied meets the agreed purchasing specification and is sourced, processed and stored appropriately.

b. It is the responsibility of the purchaser and growing media manufacturer/formulator to determine the appropriate rate of use of compost in a growing medium for a particular application.

c. The composter must ensure that the appropriate labelling information, including safe use instructions required by PAS 100, is given to customers. REAL require information and safe handling information to be provided as part of their PAS 100 accreditation scheme. Appropriate labelling should be made clear at all stages of the supply chain through to end user.

6.0 Quality parameters

This section gives recommended targets and limits for the main quality parameters of composted material that is to be used as a growing medium constituent. The actual specifications required will depend on the type of plants being grown in the growing medium, the rate of inclusion of the compost and the physical and chemical nature of other constituents being used in the growing media. Depending on the actual analytical values for any batch and its intended application, the appropriate rates of use may be as low as 5% but could be up to 40-50%. The growing media formulator must evaluate the suitability of any particular source of composted green material and must determine the appropriate limits and rate of use according to technical and commercial factors.

Stability and Maturity

Parameter	Test method	Units	Target	Upper Limit	Comments
CO_2 evolution test	ORG0020 method*	mg CO_2/g organic matter/day	8	10	PAS 100:2011 limit is 16 but a more stable compost is needed for growing media uses. A lower value indicates greater stability.
Solvita® test (optional but useful)	On site testing**	CO_2 score	8	7 or 8 (8 is max score achievable for this test)	A CO_2 Score of 6 is thought to be equivalent to the PAS 100:2011 limit. A higher value indicates greater stability.

* Work is presently underway to re-evaluate the suitability of the current compost stability test for use with food and food/green composts typically produced in the UK. This may lead to changes to recommended procedures for stability testing of composts.

** Note: Staff carrying out Solvita testing on site must be suitably trained.

Phytotoxicity

Parameter	Test method	Units	Target	Limits	Comments
Bioassay for the presence of phytotoxins	OFW004-006, as specified in PAS 100:2011	Scoring v.known control	Germination and average plant mass 80% or higher than control	Performance at least 80% of control plus zero distortion of growth	Germination should be unaffected and growth normal. Shoots and leaves should exhibit no distortions, lesions, chlorosis or other abnormalities under the test conditions.
Bioassay for presence of herbicide residues (recommended for all batches)	Protocol for the field bean germination and plant growth response test (see ORG's website)	Germination scored v. known control; Herbicide symptoms scored on defined 0-5 scale	Germination of 80% or higher than control; All plants scoring 0	Germination of 80% or higher than control; No plants score higher than 2	Record the number of plants at 28 days after sowing. Record the number of plants with visible symptoms of herbicide damage at 28 days after sowing. Visible symptoms should be categorised in accordance with the methodology described in "Protocol for the field bean germination and plant growth response test", available on the ORG website

* Note: The most recent validated bioassay method should be used and agreed with the end user. A new CEN method is expected to be available in the near future.

Contaminants and Pathogens

Parameter	Test method	Units	Target	Upper limit	Comments
Weed seeds and propagules	OFW004-006, as specified in PAS 100:2011	Number per litre of compost	Absent	Zero	No live plant material shall be visible on delivery.
Sharps	AfOR MT PC&S*** (AfOR, 2012)	Present or absent	Absent	Zero	Physical contaminants that are sharp are unacceptable in any application where compost is handled and/or used in growing media.
Stones	As specified in PAS 100:2011, AfOR MT PC&S	%weight/ weight dry matter retained on lab. sieves	Absent	2 % stones of > 4 mm, no stones > 8 mm	None > 4 mm shall be found on visual inspection at delivery.
Metal, glass and plastic > 2 mm*	As specified in PAS 100:2011	% w/w dry matter retained on lab. sieves	Absent	0.2 % metal 0.05 % plastic 0.1 % glass	None > 2 mm should be found on visual inspection at delivery and a single presence suggests potential non-compliance. *See note below for the overall PAS 100 total limit for glass, metal and plastic and any "other" non stone fragments.
Salmonella spp.	BS EN ISO 6579	n/25 g fresh weight	Absent	Zero	Limit as per PAS 100:2011.
E. coli	BS ISO 16649-2	cfu/g fresh weight	Absent	1000**	Limit as per PAS 100:2011.

* Note: Despite the individual limits above, the overall limit in PAS 100 that must be adhered to for "Total glass, metal and plastic and any "other" non stone fragments > 2mm" is 0.25%. PAS 100 also requires the total level of plastic > 2mm to be no more than 0.12%, however this guide recommends that plastic > 2mm should be no more than 0.05%".

** Note: The reduction of indigenous *E. coli* to this level indicates the likelihood that other human pathogens such as *Campylobacter* are eliminated.

*** Note: AfOR (2010) Method to determine particle size distribution of compost and its physical contaminant and stone contents (AfOR MT PC&S, Issue 1 (05.12.12) revision 2).

Potentially Toxic Elements

Parameter	Test method	Units	Target	Upper Limit	Comments
Cadmium (Cd)	BS EN 13650	mg/kg dry matter	< 0.5	1.5	Limit as per PAS 100:2011.
Chromium (Cr)	BS EN 13650	mg/kg dry matter	< 50	100	Limit as per PAS 100:2011.
Copper (Cu)	BS EN 13650	mg/kg dry matter	< 50	200	Limit as per PAS 100:2011.
Lead (Pb)	BS EN 13650	mg/kg dry matter	< 50	200	Limit as per PAS 100:2011.
Mercury (Hg)	ISO/DIS 16772	mg/kg dry matter	< 0.5	1.0	Limit as per PAS 100:2011.
Nickel (Ni)	BS EN 13650	mg/kg dry matter	< 50	50	Limit as per PAS 100:2011.
Zinc (Zn)	BS EN 13650	mg/kg dry matter	< 150	400	Limit as per PAS 100:2011.

Physical and Chemical Properties

Parameter	Test method	Units	Target value or range	Upper limit	Comments
Bulk density (BD)	BS EN 12580	g/l (fresh weight)	400-500	550	Should be as near to 400 as possible.
Particle size distribution (0-10 mm grade)	As specified in PAS 100:2011	% w/w dry matter retained on lab. sieves	0 % > 8 mm*	To be agreed with customer	Target is for general, multipurpose use but customer may wish to specify other grades. (*Sieve sizes for PAS100 are 31.5 mm, 16 mm, 8 mm, 4 mm, 2 mm and 1 mm).
Moisture content at despatch	BS EN 13040	% w/w (fresh weight)	35-40	50	Should be low at despatch to minimise bulk density.
pH	BS EN 13037	None	6.0–8.0	9.0	Lower levels needed for acid loving plants (mixes for such plants would not include high rates of compost anyway).
Electrical conductivity (EC) in 1:5 water extract	BS EN 13038	µS/cm	< 600	1500	May need to be lower EC if compost to be used at higher inclusion rate or for sensitive species.
NH_4-N	BS EN 13652	mg/l (as received)	< 40	50	As low as possible and below the NO_3-N (nitrate-N) level.
Sodium (Na) in water extract	BS EN 13652	mg/l (as received)	< 100	150	Associated with Cl so will be high if Cl is high.
Chloride (Cl) in water extract	BS EN 13652	mg/l (as received)	< 500	1000	Influences EC. Lower levels needed for more sensitive applications, e.g. young plants and ericaceous species.

7.0 Additional information

The following additional data may be required by the end user:

Nitrate level:

NO_3-N (nitrate-N) level in water extract according to BS EN 13652.

Nutrient content:

Water and CAT extractable nutrient concentrations for iron (Fe), magnesium (Mg), phosphorus (P) and potassium (K). Water extraction can underestimate the levels of these nutrients that can be provided by composts. These are determined by BS EN 13652 and 13651 respectively and expressed in mg/l (as received).

Liming potential:

The liming potential (neutralising value) of the material, expressed as a percentage of the fresh material in terms of calcium oxide equivalent. This will assist a growing media formulator to assess by how much limestone can be reduced to compensate for the acidity of any other components such as peat or bark.

'Fines' content:

The percentage by weight of particles < 1 mm ('fines') on a dry matter basis using the sieve test described in PAS 100:2011.

8.0 Suggested rates of use of compost

Suggested ranges of high quality PAS 100 green compost to be mixed with low nutrient, low conductivity material to make growing media are given below:

Application	% range of composted green material
Seed mixes	5-10%
Bedding plants	20-25%
Pot plants	20-25%
Nursery stock (general)*	30-35%
Nursery stock (vigorous)*	35-50%
Multipurpose growing media	20-40%

*not ericaceous species

If the conductivity of the material is high then lower limit inclusion rates should be used.

Note that these are suggested rates only and inclusion rates actually used by formulators/ manufacturers may vary.

9.0 Further sources of information

Information is available to composters to help them achieve the compost quality requirements in this document and for this market. It can be found in the WRAP document 'Compost Production for Use in Growing Media – a good practice guide (2014)'.
See WRAP website for a copy of this guide.

For more information on BSI PAS 100 go to the ORG website: www.organics-recycling.org.uk

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