Use of Compost in Landscaping

Frequently Asked Questions (FAQs)

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Remade Scotland

Frequently Asked Questions about the

Use of Compost in Landscaping

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REMADE Scotland
Caledonian Shanks Centre for Waste Management
3rd Floor
Drummond House
1 Hill St
Glasgow
G2 6RN
Tel: 0141 404 8890
Fax: 0141 404 8891

http://www.remade.org.uk

A synopsis on behalf of the REMADE Scotland Programme by:

Dr. Robin A. K. Szmidt & Andrew W. Dickson
SAC, Auchincruive, Ayr, KA6 5HW
Tel. 01292 525388, Fax 01292 525389
E-mail: szm@au.sac.ac.uk

Ron Alexander
Enviros, 16 Telegraph House, Waterfront Quay,
Salford Quays, Manchester, M50 3XW
Tel: 0161 874 3600, Fax 0161 848 0181
E-mail: alexassoc@earthlink.net

Paulo Cruz
REMADE Scotland
C/O Caledonian Shanks Centre for Waste Management
Drummond House, 3rd Floor, 1 Hill Street, Glasgow G3 6RN
Tel. 0141 5820460, Fax 0141 5820451
E-Mail: p.cruz@gcal.ac.uk

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1. Introduction

Three predominant strategies are available to dispose or re-utilise waste or residue produced by human activities, *viz:* incineration, sanitary landfill, and recycling. The three practices are not necessarily exclusive. They may be used as part of an integrated waste management strategy. A strong political will is necessary in order to orientate the choices that technical operators are called to make. To implement good policy may be a major challenge and it may prove fruitful not in the short term but only in the medium or long term[1]. Environmental decision-making tends to follow this pattern and so choices should not be lightly made.

A substantial part of recyclable material may be organic, for instance kitchen or garden waste in the municipal waste stream. As a relatively easily addressed component of the waste stream, and because of biodegradable municipal waste diversionary targets of the Landfill Directive, recovery of this organic waste stream has been given a priority[2]. At the same time there is a general trend for cleaner, more "environmentally friendly" waste disposal to predominate. One appropriate way of recycling organic matter is by composting. Using composting as an alternative to incineration and landfill in the overall waste management strategy can be a sound option for the treatment of certain waste products. Unlike incineration or controlled landfilling, composting provides a management option that allows for the generation of a truly recycled organic product.

However, the proportion of waste which is organic, and therefore potential feedstock for composting, from any particular community, needs to be assessed. The proportion that is compostable varies depending on a number of factors. Variation can be due to socioeconomic and geographic factors. For England, with clear contrasts between rural and urban areas it is not possible to give a single definitive proportion of commodities in the waste stream. Various 'text book' figures suggest a typical proportion of domestic refuse might be in the range 25 – 45% organic. However, to provide useful data for waste managers, local waste-inventories are essential before embarking on large-scale composting[3]. For instance, in Scotland, Fife Council has carried out determinations of waste streams that reveal organics make up 48% of West Fife domestic refuse[4].

While many readers may be aware of the concept of 'back garden compost heaps' few may be aware of the issues surrounding large-scale composting. In particular the use of commercial-scale quantities of compost are not widely considered.

This paper considers Frequently Asked Questions (FAQ's) about why compost is a useful product for the recycling of organic matter. Emphasis is given to the use of compost on a large scale, particularly in landscaping.

Although some reference is made to technical issues of compost-production, readers should refer to other texts [5,6,7].

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[1] Sequi, P. 1996. The role of composting in sustainable agriculture. In: De Bertoldi, M., P. Sequi, Lemmmes, B. & T. Papi (Edit.) The Science of Composting. Pub: Blackie, London. 23 - 29.

[2] Anon. (1993). Council Directive on The Landfill of Waste (Amended). (93/C 212/02; COM(93)275). OJ No C 211

[3] Jackson, D.V., J-M. Merillot & P. L'Hermite, 1992. Composting and Compost Quality Assurance Criteria. Pub. Commission of The European Communities.

[4] Mr. R. Hannah (Personal communication). Fife Council

[5] De Bertoldi, M., P. Sequi, Lemmmes, B. & T. Papi (Edit.) The Science of Composting. Pub: Blackie, London. **1,2**, pp1405

[6] Hoitink, H.A.J. & H.M. Keener, 1993. Science and Engineering of Composting. Pub. Renaissance Publications, Worthington, USA. pp 728.

[7] Szmidt, R.A.K. 1997. Principles of Composting. T446. Pub. SAC

There has been a marked increase in interest in composting over the last few years, especially in the processing of Municipal Solid Waste (MSW). MSW may contain a wide variety of materials. These materials vary substantially in particle-size, moisture, chemical, and nutrient content. MSW will also contain a mixture of compostable organic substances and non-compostable wastes mixed with potentially hazardous constituents. MSW is sourced from households and small-scale industry and the business sector. Any decision to compost raw MSW compared to source-separated wastes (e.g. garden or kitchen waste) is not an easy one to consider. While source-separation may facilitate recycling by improving the quality of the waste stream for each type of commodity, there are other factors to consider. However, source separation creates a burden of cost on waste managers and a new level of cooperation and responsibility on those that generate waste.

Composting of municipal waste streams should not be considered in isolation. It must be considered as part of an integrated waste solution. In the USA there is increasing interest in integrated processes[8]. In the UK there is also increasing awareness of this, for instance in the need to process sewage sludge on a large-scale basis. This may be considered for co-composting with MSW or other material such as paper or forestry waste.

[8]Brown, S., S. Angle & L. Jacobs, 1998. Beneficial Co-utilization of Agricultural, Municipal and Industrial By-products. Pub. Kluwer, Dordrecht,NL.

2. What is compost?

Various authors have offered definitions of compost.[1,2,34,5,6.] However, because the process of composting is dynamic there is no clear end-point, and therefore no one product that can be 'benchmarked'. Compost should be considered as:

Compost: **Any product of a composting process that is effectively free from pathogens, weed seeds and inert contaminants that is fit for an intended purpose.**

The process from which compost must be derived is defined as:

Composting: **The controlled decomposition and appropriate stabilisation of blended organic substrates under aerobic conditions that allow the development of thermophilic temperatures as a result of biologically produced heat.**

Some part-finished material can still qualify as compost, for instance mushroom compost is still active biologically, but is generated by a composting process for a particular purpose.

Some authors extend the definition to: "Controlled biological decomposition of organic material that has been sanitised through the generation of heat and stabilised to the point that it is beneficial to plant growth". Compost bears little physical resemblance to the raw material from which it originated. Compost is an organic matter resource that has the unique ability to improve the chemical, physical, and biological characteristics of soils or growing media. Also it contains plant nutrients[2].

It is a peculiarity of the English language that in the UK the term 'compost' has come to be synonymous with organic growing-media such as peat-based material. Elsewhere in the world the term compost is specifically used to describe any product of a composting process.

The degree of process control implicit in these definitions mean that to have a heap of rotted farmyard manure in the corner of a field is not to have compost!

[1] Szmidt, R.A.K. 1997. Principles of Composting. TN446. Pub. SAC
[2] Alexander, R. 1996. Field Guide to Compost Use. The Composting Council, USDACSREES Grant 91-COOP-1-6159
[3] Anon. 1999. Report of The National Waste Strategy for Scotland - Composting Task Group
[4] Jeangille, P. 1991. Substrata for horticulture in subtropical and tropical regions. Pub. FAO
[5] Hoitink, H.A.J. & H.M. Keener, 1993. Science and Engineering of Composting. Pub. Renaissance, Worthington, USA.
[6] Anon. Supporting Document for Compost Quality Criteria. National Standard of Canada (CAN/BNQ 0413-200)

3. Are all composts the same?

The simple answer is no! While, to the untrained eye, various composts may look similar they may each have different characteristics.

Chemical analysis may differ between composts. From the point of view of a user this can be critical. Most compost users will require to know content in terms of major plant nutrients (fertilisers), particularly nitrogen, phosphate and potassium (NPK). This is sufficient for most agricultural uses but magnesium and calcium content may also need to be determined. There is a requirement for anyone applying fertilisers (or nutrients) to land to know the value of the applied material and not to exceed limits. There is therefore a duty for suppliers to state the nature of their products. This can be done by periodic analysis of compost samples.

Acidity, measured as pH of a water extract, is a major issue and can determine the usefulness of compost for instance as a liming material. This will vary between sources of compost. This is particularly important for ericaceous plants.

Salinity is a measure of the soluble salt content of compost and is determined from a water suspension using a conductivity meter. This determines total salts and is not the same as the level of plant-nutrients (fertiliser-value) of the material. For instance, there may be substantial amounts of sodium present in compost which plants do not require. Too high a level of salinity is harmful to plants and can result in run-off to water when applied to land. However, controlled leaching can be a practical solution to improving quality of stored compost and the leachate may be useable as a liquid fertilizer, so called "Compost Tea".

Physical structure may vary between sources of compost and even between batches of compost from any one site. Measures of physical structure may include bulk-density, particle size distribution and moisture holding capacity. Compost should be uniformly screened to be usable in chosen applications.

Maturity of compost has 'taxed' compost technologists for a considerable time. Composting is a dynamic process that results in a number of physical and chemical changes due to microbial action on the material. While the early part of any composting involves generation of heat and the highest microbial activity at a time of greatest degradation of the feedstocks the latter part of the process is closer to ambient temperatures. This latter phase is the period when compost 'matures' and uniform populations of microbes are established. The degree of maturity and therefore quality of a compost is greatly influenced by the care and attention paid to compost after the initial high-rate activity of the material.

Stability of compost is important, particularly in respect of marketability and sales. Closely linked to maturity, stability is a measure of the ability of a material to retain physical and chemical consistency at the end of the process. Composting may have ceased but it does not mean in all cases that material is stable. For instance, if a composting process has stopped due to lack of moisture, such material could reheat if placed in a damp storage area and would be deemed unstable. This is largely a function of the balance between available Carbon and Nitrogen in the mix and can be determined by chemical analysis. Unstable material should be considered as unacceptable as it can generate odorous off-gases such as ammonia. Unstable material may change in volume or other physical parameters if the process restarts. This then can cause problems in determining volumes, plant-nutrient content and quantities sold.

At the time of writing, there is no single database which can provide a match between compost feedstocks, process design and management and how these relate to production of composts of a particular standard. Users should satisfy themselves that the materials they may choose to use meet their own requirements.

The Publicly Available Specification 100 (PAS 100) for composts, however, may be a helpful tool to those purchasing compost. This voluntary scheme was sponsored by the Waste and Resources Action Programme (WRAP) and developed by The Composting Association (TCA). It specifies the minimum requirements for the selection of input materials, process of composting and the quality of compost products, as well as specifies labelling requirements for the finished product. Section 8 provides additional information on PAS 100.

4. What are the benefits of using compost?

A wide range of uses for compost exist and as research into compost increases, so will the uses for those products manufactured. Developing new products from recycled materials often requires considerable work. Issues facing the developers include not only the manufacture of the commodity, but also how to market, evaluate and educate or secure public acceptance of a new product.[11]

Use of compost as a soil improver in landscaping is becoming increasingly more common. This is because compost can enhance the relations between water, soil, and plants in many ways: improving infiltration, reducing runoff, decreasing loss through evaporation, ameliorating drainage and improving root penetration. Compost can literally improve soils physically, chemically and microbiologically. Compost has even been shown to enhance the biodegradation of petroleum, as well as bind and immobilise heavy metals in contaminated soils. Compost is being used to improve turfgrass growth on athletic fields, football pitches, golf courses, and parks. The leisure industry itself is a huge potential market for compost producers in the UK. Green keepers have used fish-based compost to reduce winter 'snow mould' and 'die back', and compost has also been used to alleviate problems of soil compaction, and increasing drainage as well as lawn growth.[2,3]

Benefits of Compost Use[4]

- Improves the soil structure, porosity, and bulk density of soil it is blended with – creating a better plant root environment
- Increases moisture infiltration and permeability of heavy soils – improving drainage and reducing erosion and runoff
- Improves moisture holding capacity of light soils – reducing water loss, watering frequency and nutrient leaching
- Improves and stabilizes soil pH
- Improves cation exchange capacity (CEC) of soils – improving their ability to retain nutrients for plant use
- Supplies a variety of macro- and micro-nutrients – reducing the initial need for chemical fertilization
- Supplies significant quantities of organic matter
- Supplies beneficial microorganisms to the soil – improving nutrient uptake and suppressing certain soil-borne diseases
- Binds and degrades specific pollutants

For road-verge construction, particularly motorways, erosion is a major factor with subsequent non-point source pollution. Recent years have seen the use of compost as an erosion control material,

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[1] Smith, D.R., J Edwards, C Gilliam, B Behe, 1999. What kinds of mulches do buyers want? *Biocycle* 1, 28-29.

[2] Duerr, B Jr. 1999 Tree farm evolves into a compost business. *Biocycle* 1, 30-31.
[3] Allison, F.E., 1973. Soil Organic Matter and its role in crop production Vol. 1 Elsevier Scientific Publishing Co.
[4] Alexander, R. 1996. Modified from the Field Guide to Compost Use. US Composting Council.

often in a blend with a mulch (woody fraction). Compost demonstrated high performance in preventing or minimizing runoff. It's nutrient and organic content have overcome difficult growing conditions establishing vegetation in areas of high wind erosion. This ultimately provides the best erosion control. The feedstocks that are used for the manufacture of appropriate compost vary from source to source.[5,6,7]

Humus content is a determinant of soil structural stability and aggregation. As a consequence, the addition of small amounts of organic matter to soil will induce the formation of stable aggregates. This favourable effect, though, seems to be significantly smaller in clay soils than in sandy loam soils. [8, 9,10,11,12,13.]

Compost has been used extensively in revegetation and reclamation of marginal and low quality soils. Benefits include improved soil quality, reduced erosion, enhanced plant establishment, immobilisation of toxic metals and supplying of microbes. Sites ranging from landfills, factories, roadsides to mines have been reclaimed and revegetated using compost products[14]. The use of compost in various environmental applications is one of the most intensive areas of compost research being pursued at present.

Deep mulching with green waste compost has been shown to retard weed growth and also establish native shrubs and grasses. The application of compost has also been shown to increase pH, soluble salts and cation exchange capacity. These increases would appear to be due to an increase in soil organic matter and available plant nutrients. Soil fertility therefore will increase with the application of suitable compost, at an appropriate level[15]. Weed control will only be effective if the compost itself is guaranteed free from weed seeds.

Although compost is not a conventional fertiliser, it often contains significant quantities of macro- and micro-nutrients. Work by The United States Department of Agriculture has shown that the typical release of nitrogen into soil from compost is not as rapid as from chemical fertilisers. In many cases, approximately 25% is released in year one, decreasing to 10% in subsequent years. This is because, unlike chemical fertilisers, N is bound during the composting process as microbial protein and other organic forms. Mineralisation rate for N in compost does vary. This can then only be re-released slowly into the soil by natural microbial processes. As this data comes from warmer drier

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[5] Block, D. 1999. Composting for erosion control in Texas. *Biocycle* 9, 40-41.

[6] Block, D. 2000. Controlling erosion from highway projects. *Biocycle* 1, 59-62.

[7] Anon, 2000. Specifying compost use in highway erosion control. *Biocycle* 4, 65-66.

[8] Shiralipour, A., D. McConnel., W.Smith., 1992. Uses and benefits of MSW Compost: A review and an Assessment. Biomass and Bioenergy 3 (3-4), 267-279.

[9] Pagliai, M., G. Guidi., M. La Marca., M. Giachetti., G. Lucamante. 1981. Effects of sewage sludges and composts on soil porosity and aggregation. Journal of Environmental Quality, 10 (4) 556-561.

[10] Gallardo-Lara, F., R. Nogales. 1987. Effect of the Application of Town Refuse Compost on the Soil-Plant system. A Review. Biological Wastes 19, 35-62.

[11] Hornick, S. 1998 Use of organic Amendments to Increase the Productivity of Sand and Gravel Spoils: Effect on Yield and Composition of Sweet Corn. American Journal of Agriculture 28, 398-411.

[12] Hernando, S. M. Lobo., A. Polo., 1989. Effect of the application of a Municipal Refuse Compost on the Physical and chemical Properties of a soil. The science of the Total Environment 81/82, 589-596.

[13] Fortun, C., A. Fortun., G. Almendros., 1989. The effect of Organic Materials and Their Humidiied Fractions on the formation and Stabilization of Soil Aggregates. The Science of the total Environment 81/82, 561-568.

[14] Alexander, R, 1999. Compost markets grow with environmental applications. *Biocycle* 4, 43-48.

[15] Stratton, M.L., Barker, A., Ragsdale, J., 2000 Sheet composting overpowers weeds in restoration project. Biocycle 4, 57-59.

land than is the case for much of England it is likely that release rates may be even less. Manure-based composts tend to have a higher mineralisation rate than MSW or food waste derived composts[16]. This tells us that the figure of 25% available in year one can only be used as a very rough guide. To provide adequate supplies of N to meet plant demand, a considerable amount of compost may be needed.

In the UK, regulations limit the application of compost to cropping land to no more than the calculated crop requirements for available N. For derelict and non-cropped land the maximum application of N should not normally exceed 500kg N ha^{-1}. There is an additional restriction on application to no more than 250 tonnes ha^{-1} of organic material, including compost, in any one year. The appropriate Code of Practice relates principally to wastes applied to land rather than to finished compost but nonetheless these guidelines are believed to apply in their entirety. In revision The Code is expected also to take cognizance of seasonal issues. Care should be taken not to apply to material at a time when potentially polluting leachate can run-off from recently applied compost under heavy rainfall conditions. This is a potential conflict for winter landscape work but can be managed with care and by taking appropriate advice.

For fertiliser elements other than nitrogen, release patterns tend to be similar from compost compared to chemical fertilisers. For instance, potassium is highly soluble and can be readily leached.

The following are typical levels of major plant nutrients from a range of composts derived from a broad palette of feedstocks including MSW, green waste, agricultural / horticultural and food by-products [17,18].

[16]Sikora, L. & R.A.K. Szmidt, (2001). Nitrogen Sources, Mineralization Rates and Plant Nutrient Benefits form Compost. In: Stoffella *et al* (Edits.). Compost Utilization in Horticultural Cropping Systems. Pub. CRC Press.
[17]Various: See: Biocycle, *Acta Horticulturae, Compost Science & Utilization,* Hoitink & Keener, 1993. Science & Engineering of Composting, Pub. Renaissance Publications, Worthington, US. De. Bertoldi *et al.* 1996. Science of Composting, Pub. Blackie, London.
[18]Verdonck, O. 1099. Compost Specifications. *Acta Horticulturae.* **469.** 169 - 177.

Typical analysis of some finished composts (Data as % Dry Matter unless stated)

Component	Green waste	MSW and biosolids
Dry Matter	55 – 65	60 – 70
Organic Matter	16 – 20	24 – 80
Conductivity (mS / cm)	0.8 - 1.8	2.2 - 3.0
PH	7.5 - 8.5	8.0 - 8.5
Total Nitrogen (% DM)	0.6 - 0.8	0.4 - 3.5
Ammonium - N	0-300 mg / l	0-400 mg / l
Nitrate - N	100 - 600 mg / l	100 – 1200 mg / l
Phosphorus	0.3 - 0.4	0.1 - 1.8
Extractable P	300-600 mg / l	600 – 900 mg / l
Potassium	0.5 - 0.6	0.2 - 2.5
Extractable K	2500 - 4000 mg / l	3000 – 6500 mg / l
Extractable Ca	2500-3500 mg / l	6000 – 9000 mg / l
Total Magnesium	0.2 - 0.25	1.5 - 3.0
Extractable Mg	300 - 500 mg / l	500 – 750 mg / l
C : N ratio	13 - 17	10 – 15

In addition to major plant nutrients, composts will, by nature of their diverse range of feedstocks, contain a range of minor elements. Because compost reduces in volume and increases in density during processing these can be concentrated to relatively high levels. Plants require such minor elements in small quantities and compost can therefore be a valuable source. Although unlikely in practice, these same minor elements can be toxic to plants at high levels. Composts where the feedstock is unspecified should therefore be avoided. Examples of elements that are beneficial in small quantities but that can be toxic in excess include but are not restricted to, manganese, boron, copper and zinc. Different plants react differently to levels of microelements and in turn the relative proportion of each may be important for healthy plant growth. When applying compost to brown-field sites it is important that the combined levels of potentially toxic heavy metals do not exceed plant tolerance levels.

In all situations it is important that composts be fully analysed before application to land.

5. How can landscapers use compost?

The versatility of high quality compost products allows them to be utilized in a variety of landscape applications. However, to use them effectively, it is essential to match a compost which possesses particular characteristics to its best specific application. Any single compost product is not generally the best product for all landscape applications. For a particular purpose, once the appropriate compost product has been selected, it is necessary to understand how best to apply it, as well as its effects on the overall growing system.

General Guidelines for Compost Applications

The use of compost can influence the short and long-term characteristics of the soil or medium in which you are planting. As discussed earlier, compost can modify the physical, chemical and biological characteristics of a growing medium. For this reason, it is important to understand that typical cultural practices may need to be modified where compost is used.

How to Apply Compost

The method by which compost is applied is typically based on the compost's characteristics, how the compost is being used, the size of the project, and field conditions. For small planting or mulching projects, compost may be obtained in bags and spread by hand using a rake. For larger projects, compost may be obtained in bulk, transported to the site in a dump truck or wheelbarrow and spread by hand, or by using tractor drawn equipment. Where slopes are being mulched for decorative purposes or erosion control, or compost is being applied to sites that are difficult to access, blower type units have been used to propel the compost up to 60 m. Pneumatic blower trucks even exist which can apply product through a wide hose (over 90 m in length) and apply material around plants and other objects. A more common method to apply compost for various uses is with a manure spreader or topdressing unit. A manure spreader uses rotating flails (paddles) to project the compost into the air, whereas a topdressing unit uses a rotating, cylindrical brush to project the compost down towards the soil surface. Both units may be calibrated to apply lower rates (0.6 – 1.3 cm depth) or higher rates (2.5 cm depth) of compost. However, the application of higher rates is slow and may take more than one pass over the site. Side discharge manure spreaders have been used to apply compost inside planted rows and tractor-trailers have been fitted with flails to allow large volumes to be spread. Equipment has even been developed to apply compost to a depth of 1.3 – 2.5 cm over a raised nursery bed. Often, when rates of 2.5 cm or more are applied, piles of compost are strategically placed throughout the site and a grading blade, York rake, or front-end loader/bulldozer blade is used to spread the compost. With experience and care, accurate application rates are achievable.[1]

Continued innovations in compost application equipment will increase compost usage. For that reason, equipment is now available for purchase or rental to allow users to more efficiently apply compost. Users should remember that the moisture content and particle size of the compost will affect its spreadability. Standard "box spreaders" and agricultural or commercial fertilizer/lime spreaders often have difficulty spreading coarse or wet compost.[2]

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[1] Alexander, R. 1996. Modified from the Field Guide to Compost Use. US Composting Council
[2] Alexander, R. 1996. Modified from the Field Guide to Compost Use. US Composting Council

A guide to estimating the volume of compost required to cover a specific area is given in the table below. Readers should note that settlement may occur after application and care should be taken when applying material to rigid contract specifications.

Cubic Meters (m^3) of Compost

Required to Cover $100m^2$

0.7 cm layer	⇒	0.6 m^3
1.4 cm layer	⇒	1.2 m^3
2.7 cm layer	⇒	2.5 m^3
4.1 cm layer	⇒	3.7 m^3
5.5 cm layer	⇒	4.9 m^3
6.8 cm layer	⇒	6.2 m^3
8.2 cm layer	⇒	7.4 m^3

Application Instructions for Specific Uses of Compost in the Landscape

One of the most useful attributes that high quality compost products possess is their versatility. The ability to use compost products in a variety of end uses is one of the primary reasons why the use of compost in landscape applications, both professional and non-professional, has grown so dramatically over the past 10 years. However, to have success *in the field*, the proper compost products must be used and the product itself must be used correctly.

The following is a detailed discussion of common areas of compost use in landscaping.

Garden Beds and Landscape Planters

Probably the most popular use for compost today is in garden bed establishment and renovation. In this application, the product's numerous attributes have allowed for glowing successes, particularly in the US. Two important factors which contribute to the use of compost in planting beds are poor soil conditions on construction sites, and the necessity of landscapers at the outset to be successful in their planting . As a normal practice, builders will scrape soil from a construction site in order to bring it to the correct grade. They will either stockpile the soil, and reapply it later, or sell it to a topsoil dealer. Often, when it is reapplied, the actual topsoil is mixed with subsoil, reducing its quality, or the topsoil is buried under poor quality soil when reapplied. In either case, the need to improve soils around residential and commercial structures exists. When a homeowner or landscaper invests in landscaping a site, they expect that immediate and positive results will occur, and persist. Therefore, using composts as a soil amendment to help ensure their success is a good investment.

Application Instructions: The compost application rate will vary depending upon soil conditions, compost characteristics, and plant species to be established. Compost has been successfully applied at a rate of approximately 1.7 cm to 7.5 cm, then incorporated to an approximate depth of 15 – 20 cm, resulting in an surface inclusion rate of 10% to 50% by volume [3] [4]. Performing a soil test will assist in determining proper compost application rates. Typical application rates are between 2.5 – 5.0 cm layer, 20% to 30% by volume[5]. Lower inclusion rates may be necessary for salt-sensitive crops such as geraniums or where composts with high salt levels are used. Once the compost inclusion rate is chosen, a blend of soil and compost may be produced and analysed prior to planting. This will identify the soil characteristics, including soluble salt and organic matter content, as well as identify the appropriate rate of fertilization and pH adjustment necessary for optimum plant growth. Compost should be broadcast uniformly and incorporated with a shovel or rotavator until the compost/soil mix is homogeneous. The treated area can be smoothed if necessary before planting. The amended area should then be irrigated, if necessary, to settle the soil, provide moisture to the plants and to help leach salts out of the root zone[6].

If desired, materials used to adjust soil pH (e.g., lime or sulphur [S]) may be added to the soil prior to incorporation of the compost, as may any additional nutrients. However, where possible, it would be more beneficial to apply these materials after compost incorporation and soil testing. Once planting is completed, the planting area should be fertilized if necessary with a starter fertilizer and thoroughly watered.

Although compost is typically applied 'as is' (unblended) and incorporated into planting beds, in some locations, garden blend soils containing 20 to 40% compost are sold to establish or renovate garden beds. From a users or specifiers perspective, soils modified for ornamental planting mixes should be designed to contain at least 5% organic matter. However, buyers may specify that material meets particular standards. Although there are no specific British or European Standards that apply solely to composts for landscaping those relating to topsoil (BS3882:1994) may apply, particularly if a blended recycled product is described as soil or artificial soil. By using compost or material containing compost as the organic matter source, landscapers get added benefits, such as various micro and macro-nutrients, a stabilized pH and a healthy supply of microbes. Often, such garden planter mixes contain a 25% to 33% compost inclusion rate. At these inclusion rates, many annual and perennial plants need no additional fertilizer. The compost used in these landscape mixes must meet the requirements of the crops being established. For instance, *Rhododendrons, Azaleas* and other acid-loving crops should not be planted using composts that contain appreciable amounts of lime. Crops which are salt sensitive, such as conifers, should not be planted with compost products which have a high soluble salt

[3] Maynard, A.A. 1992. Growth of woody plants and leaching of nitrate from plots amended or mulched with MSW compost. *The Connecticut Agricultural Experiment Station.*
[4] Beeson, R., Jr. 1995. Enviro-Comp compost utilization in landscapes. Central Florida Research and Education Center, University of Florida, Sanford, Florida.
[5] Smith, E.M. and S.A. Treaster. 1991. Production of annuals and perennials grown in soil amended and mulched with composted landscape waste. Department of Horticulture,The Ohio State University, Wooster, Ohio
[6] Alexander, R. 1995. Suggested compost parameters and compost use guidelines. The Composting Council, Alexandria, Virginia.

content. In general, composts used in planter mixes should possess the same basic characteristics of those described earlier for garden beds[7].

Raised planting beds (berms) can be constructed by blending existing soils with compost at a 25% to 30% compost inclusion rate. In this type of mix, the soil is used for long-term stability of the raised berm. However, in rooftop planter mixes, sand or a sandy loam soil should be used for stability. Sandy soils can usually provide enough ballast for shrubs and small size trees, but they are much lighter than clay and silt based soils. In rooftop mixes, the weight of this mix must be kept to a functional minimum. A standard rooftop mix for shrubs and ground covers should contain 30% to 40% sand or sandy soil, 30% compost, 10 to 20% pine fines and 10% of a light weight aggregate[8].

Where trees are to be planted in rooftop mixes, a good standard mix should contain 40% sand loam soil, 20% sand, 30% compost and 10% pine fines. Pine fines are used in these outdoor
mixes because they provide excellent long-term CEC. Similar to the rooftop planting mixes, large planter mixes (outdoor containers) should contain 60% sand, 10% pine bark fines and 30% compost[9].

Mulching

Many types of products are used successfully as aesthetic and functional mulches. Usage is often based on customer preference, desired functionality and regional trends. For this reason,
common mulch products include decorative stone/rocks, wood chips, tyre chips, ground yard
debris, various types of tree bark and compost. Although the use of compost as mulch is often met with some scepticism, it is being used with much success. Composts which contain coarser wood particles, preferably uniform in size, are typically desired.

Application Instructions: Compost used as mulch is typically transported to the application site using a wheelbarrow and then applied around existing plant materials using a shovel or rake. The product can be smoothed using a rake or by hand. In large beds, the compost may be transported and positioned using a dump truck and then evenly applied using a rake, or may be transported to the site and applied using a pneumatic blower unit. In some instances, the mulch is applied and then planting holes are dug through the mulch layer and into existing soil. Once properly planted in the hole, the compost mulch should be distributed around the plant base. Compost should be applied at a depth of 2.5cm to 7.5 cm around the base of trees, shrubs and other plant materials in garden beds [10,11]. Avoid placing mulch against the tree trunk or main leader of the shrub, to prevent potential disease and insect damage. Biosolids composts used as mulch typically should not be applied at

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7 Alexander, R. 1995. Suggested compost parameters and compost use guidelines. The Composting Council, Alexandria, Virginia.

8 Alexander, R. 1999. Blending improves marketability of compost II. Composting News 7 (11):1-10.

9 Alexander, R. 1999. Blending improves marketability of compost II. Composting News 7 (11):1-10.

10 Smith, E.M. and S.A. Treaster. 1991. Production of annuals and perennials grown in soil amended and mulched with composted landscape waste. Department of Horticulture,The Ohio State University, Wooster, Ohio

11 Ewing, K. 1994. Growth study of a yard waste compost. Center for Urban Horticulture, University of Washington, Seattle, Washington.

rates greater than 5.0 cm deep[12], whereas many greenwaste composts can be applied in up to a 7.5 cm layer[13]. Salt sensitive species may react negatively to application rates greater than 2.5 cm of certain composts. For individual trees and shrubs, the product should be applied at rates described earlier, from the tree's stem/trunk to its drip line, or further if desired[14].

Apply the compost evenly in the garden bed or around the trees and shrubs, creating a mat of compost mulch. For singular trees and shrubs, a rim may be formed at the outside of the mulch layer in order to capture and hold water. Once applied, the mulch may be watered-in to help keep it in place and to help leach salts. If the compost is high in soluble salts, reduced amounts should be applied and the mulch should be well watered. Care must be given when using compost with higher soluble salt contents on herbaceous and salt-sensitive plants[15].

Similar to other mulches, compost should not be over-applied, especially when immature and unstable composts are used. Care should also be given when using composts which possess a
high pH where acid-loving species are planted. For certain applications, adding S to areas where these crops are grown may be necessary.

It may be necessary to rake the compost mulch layer occasionally to help maintain its uniform appearance. When compost is used in annual beds and when perennial beds are being prepared for replanting, the old compost mulch layer should be incorporated into the existing bed. This old layer of mulch will actually become a soil amendment to help prepare the area for replanting. In perennial beds and around trees and shrubs, where the compost has not been incorporated, use a rake or a shovel to break up the existing layer of compost mulch, ensuring that a crusted layer has not formed before reapplying new mulch[16].

Where soluble salt levels of the soil are problematic, field experience has shown that repeat applications should not exceed 2.5 cm per annum if biosolids composts are used. Greater rates may be possible with greenwaste compost; however, some greenwaste products may also possess an elevated soluble salt level, particularly where road salts are applied for snow and ice management. If washouts occur where the compost mulch has been applied, a rake can be used to repair and smooth these areas. Re-application of mulch will likely be necessary on a yearly basis for aesthetic purposes and weed control [17].

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[12] Smith, E.M. and S.A. Treaster. 1991. Production of annuals and perennials grown in soil amended and mulched with composted landscape waste. Department of Horticulture,The Ohio State University, Wooster, Ohio

[13] Ewing, K. 1994. Growth study of a yard waste compost. Center for Urban Horticulture, University of Washington, Seattle, Washington.

[14]Alexander, R. 1995. Suggested compost parameters and compost use guidelines. The Composting Council, Alexandria, Virginia.

[15] Alexander, R. 1995. Suggested compost parameters and compost use guidelines. The Composting Council, Alexandria, Virginia.

[16] Alexander, R. 1995. Suggested compost parameters and compost use guidelines. The Composting Council, Alexandria, Virginia.

[17] Alexander, R. 1995. Suggested compost parameters and compost use guidelines. The Composting Council, Alexandria, Virginia.

Planting Backfill Mixes

While the technique of amending the soil placed around a newly planted tree or shrub has been used extensively throughout the horticultural industry, the concept has been met with much controversy. Conflicting research exists regarding the benefits of improving backfill soils with soil amendments.[18,19] However, many landscapers claim that the use of compost in backfill mixes has reduced the number of dead plants they have to replace on their landscaping jobs. This is plausible since compost provides nutrition, improves the moisture holding capacity of the soil and can assist in the control of soil-borne diseases.[20,21]

Application Instructions: The inclusion rate of compost in the backfill mix may vary based on the species to be grown and the characteristics of the soil to be blended. An inclusion rate of 25 % to 50 % compost by volume,[22,23] blended with the native soil, has been widely used. However, the preferred and most popular inclusion rate is at approximately 33 % compost by volume. Where trees or shrubs are to be planted, adequate drainage in the area is of the utmost importance. Plastic drainage lines, gravel filled holes, and other methods can be used to assure proper site drainage below or around the planting holes. Prior to planting, root-balled containerised, or bare root plants should be prepared in accordance with normal industry standard methodologies[24].

The planting hole should be dug slightly shallower than the height of the root ball and two to four times its width[25]. In dense soils or poorly drained sites, the planting hole can be dug only two-thirds the depth of the root ball. The soil removed from the planting hole should be stockpiled near the hole and mixed at an appropriate ratio of two parts soil to one part compost. The soil and compost should be blended until uniform. The tree or shrub should be placed in the planting hole and the blended backfill mix should be added around the root ball, firming it occasionally to remove air pockets and assure a firm footing. Once firmed in place, larger trees should be anchored or supported using one of a variety of techniques, guy wires or propping. Supports should be removed when appropriate for the specific tree size and site conditions. Once the planting hole is filled and firmed with the backfill mix, a soil ridge should be constructed around the edge of the plant root ball to help retain moisture. The plant should then be watered well and mulched[26].

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[18] Bridel, R., B.L. Appleton, and C.E. Whitcomb. 1983. Planting techniques for tree spade dug trees. Journal of Arboriculture 9:282-284.

[19] Smalley, T.J. and C. B. Wood. 1995. Effect of backfill amendments on growth of red maple. Department of Horticulture, University of Georgia, Athens, Georgia.

[20] Gouin,F.R. 1997. Selecting organic soil amendments for landscapes. Landscape Architect Specifications for Compost Utilization. *Clean Washington Center (CWC),* Seattle, Washington.

21 Nelson, Eric B. 1992. Biological control of turfgrass diseases. Cooperative Extension Service, Cornell University, Ithica, New York. Information Bulletin 220.

22 Watson, G.W., G. Kupkowski and K. G. von der Heide-Spravka. 1993. Influence of backfill soil amendments on establishment of container grown shrubs. HortTechnology 3:188-189.

23 Smalley, T.J. and C. B. Wood. 1995. Effect of backfill amendments on growth of red maple. Department of Horticulture, University of Georgia, Athens, Georgia.

24 Alexander, R. 1996. Field guide to compost use. The Composting Council, Alexandria, Virginia.

25 Watson, G.W., G. Kupkowski and K. G. von der Heide-Spravka. 1993. Influence of backfill soil amendments on establishment of container grown shrubs. HortTechnology 3:188-189.

26 Alexander, R. 1996. Field guide to compost use. The Composting Council, Alexandria, Virginia.

Turfgrass Establishment and Topdressing

The use of compost in the establishment and renovation of turfgrass has become popular in a variety of situations, including residential and commercial lawns, athletic fields, golf courses, and even utility turf. The use of compost to improve turf performance, especially in sites possessing poor soils, has been extensively illustrated in University research and actual field experience. Benefits of compost include faster turf establishment, improved turf density and colour, increased root growth, and a reduced requirement for fertilizer and irrigation[27]. Regardless of which process is used, using compost to establish turf can give excellent results.

Application Instructions: Compost should be applied at a 2.5 cm to 5.0 depth, then incorporated to an approximate depth of 12.5 – 17.5 cm, resulting in an inclusion rate of 20 to 30% by volume [28,29]. The compost application rate will vary depending upon soil conditions, compost characteristics, and turf species to be established. Compost application rates should be altered depending upon the potential tillage depth. Compost may be applied with a manure spreader, grading blade, front-end loader, raking device, or other equipment. Once applied, the compost should be incorporated using a rotavator, or disc until the compost is uniformly mixed. If compost is suspected to have an elevated soluble salt concentration, the amended soil should be irrigated to leach the salt out of the root zone prior to planting. Once incorporated, a proper seed bed should be established by raking or dragging, and rolling the soil surface until smooth. Seed may be applied using a mechanical seeder, or it may be broadcast over the soil surface, then lightly incorporated using a drag mat or leaf rake. Alternatively, rolled turf may be applied directly onto the soil surface (instead of seeding). Once planting is completed, the planting area should be fertilized with a starter fertilizer, as necessary, and watered on an on-going basis to assure establishment[30].

Topdressing has long been a reliable turf maintenance practice in the golf course industry. The practice entails applying a thin uniform layer of topdressing material over an established and usually declining turf area. Topdressing is performed for many reasons, including promoting seed germination, increasing the organic matter content of the soil and levelling the surface of turf areas. Topdressing is usually done in conjunction with aeration and reseeding. Core aeration should be completed using hollow or spoon tines, 1.3 – 2.5 cm in diameter. The tines will remove plugs of soil, or cores, from the soil surface. After aeration, the topdressing is applied and through mechanical dragging, the holes are refilled with the topdressing material. Typically, a 0.3 – 1.3 cm layer of compost is applied during the topdressing procedure. When the topdressing procedure is performed along with aeration, many other benefits are obtained, including improving water percolation, improved air exchange, thatch degradation, increased water holding capacity of soil and reduced soil compaction[31].

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27 Landschoot, P. 1996. Using compost to improve turf performance. The Pennsylvania State University, Bulletin 5M496ps5733.

[28] Landschoot, P. and A. McNitt. 1994. Improving turf with compost. *Biocycle,* October, pp.54-57.

[29] Angle, J.S., D.C. Wolf, and J.R. Hall. 1981. Turfgrass growth aided by sludge compost. *Biocycle* Nov/Dec pp 40-43.

[30] Alexander, R. 1995. Suggested compost parameters and compost use guidelines. The Composting Council, Alexandria, Virginia.

[31] Alexander, R. 1991. Sludge compost: Can it make athletic fields ore playable? *Lawn &*

Commonly used topdressings are sand, sand-based mixes and compost. Topdressing with finely screened 0.9 cm, or smaller, nutrient rich, stable compost products are preferred. Topdressing is often used as a maintenance practice on turf areas which are overused, or on the decline. When topdressing is applied in conjunction with seeding, seed germination will be improved[32]. Topdressing with compost has become popular, particularly in the US, because few reasonably priced topdressing products are available for maintaining large turf areas.

Topsoil Blending

Worldwide, billions of tons of topsoil are lost every year because of environmental and geologic conditions and phenomena, and poor soil management practices. Farm soils are commonly harvested and sold to the landscape industry, as are soils harvested from construction sites. Even though these soil harvesting practices continue, it has become increasingly more difficult for landscapers, and gardeners alike, to purchase high quality topsoil for use in their landscape projects. This has led to a dramatic expansion of the manufactured or blended topsoils industry. Topsoil blenders typically blend lower quality soils with compost, to produce a blended product which more closely compares to a high quality topsoil. In several parts of the United States, topsoil blenders are the largest users of commercially produced compost and this an substantial growth area for the UK sector.

Application Instructions: The inclusion rate of compost in the blends may vary based on the types of crops being grown, the characteristics of soil to be blended, the specific application of the topsoil blend, and the specific needs of the end user. For instance, compost may be used at higher rates specifically to modify the physical and chemical characteristics of soil, or maybe added in more specific quantities to produce a topsoil blend which meets a specific organic matter level.

The addition of other products such as lime or S to modify pH, or the addition of bark, sand or other topsoils to adjust physical parameters of the finished topsoil blend, may also be desirable. The necessity of adding these amendments will depend on the qualities of the compost, the requirements of the specific plant species being grown, and customer preference. An inclusion rate of 20% to 30% compost by volume is recommended [33,34] depending upon the quality and physical property of the soil to be amended and the organic matter content of the compost. However, rates of 10 - 50% are also commonly used. An inclusion rate of 20% may be sufficient where organic matter-rich composts are used, while a 30% inclusion rate would be recommended in sandier soils and when using composts with a lower organic matter content. Higher rates of compost inclusion may yield superior results

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Landscape Maintenance Magazine, July, p. 46-52.

[32] Alexander, R. 1991. Sludge compost: Can it make athletic fields more playable? *Lawn & Landscape Maintenance Magazine*, July, p. 46-52.

[33] Smith, E.M. and S.A. Treaster. 1991. Production of annuals and perennials grown in soil amended and mulched with composted landscape waste. Department of Horticulture, The Ohio State University, Wooster, Ohio

[34] Landschoot, P. and A. McNitt. 1994. Improving turf with compost. *Biocycle*, October, pp.54-57.

if blended with extremely poor quality soils[35], certain subsoils, or soil-like aggregate by-products. The pH of the blended topsoil should be adjusted to meet crop requirements[36].

The compost should be blended with the topsoil and any other amendment until a homogeneous mix is achieved. Blending can be done by using front-end loaders, rotating drum-type mixers, augers, or soil shredders. The ingredients can be effectively blended using a front end loader by layering the ingredients, then rolling the pile by lifting and dumping the mix forward with the loader bucket. Various amendments and additives may also be added during the mixing process to develop specialized blends ideal for specific crops or sites. The finished blend can be screened to a specific size to meet customer requirements[37].

Although there are no specific British or European Standards that apply solely to composts for landscaping those relating to topsoil (BS3882:1994) may apply, particularly if a blended recycled product is described as soil or artificial soil. Producers should be aware of compliance necessary when claiming nature of a particular product.

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[35] Tester, C.F. and J.F. Parr. 1983. Intensive vegetable production using compost. *Biocycle* Jan/Feb pp. 34-36. Watson, G.W. and G. Kupkowski. 1991. Soil moisture uptake by green ash trees after transplanting. *Journal of Environmental Horticulture* 9:226-227.

[36] Alexander, R. 1995. Suggested compost parameters and compost use guidelines. The Composting Council, Alexandria, Virginia.

37 Alexander, R. 1995. Suggested compost parameters and compost use guidelines. The

Composting Council, Alexandria, Virginia.

6. Can compost suppress plant disease?

Plant losses due to soil borne diseases on some field, nursery and greenhouse-grown crops can be very substantial. The nursery industry first observed that composted tree bark suppressed *Phytophthora* root rots[1]. This type of disease suppression can now be repeated for other crops and pathogens and offers substantial benefits, particularly in terms of reduced pesticide usage. Nationally and internationally, with a decrease in the use of the soil fumigants, particularly methyl bromide, as well as the loss of several popular fungicides, alternative sources will be required to control soil borne pathogens. As landscapers and horticulturalists seek better ways to control pathogens, meet consumer demands for "less chemical inputs on the landscape", the market for composted products will expand even faster. The use of compost to suppress plant diseases is a central 'plank' of organic farming developments.

The most comprehensive research in this area has been led by Prof. Hoitink (Ohio State University, USA). Substantial progress has been made in not only cataloguing the types of compost that are suppressive but also the actual mode of biochemical action that generates the phenomenon[2].

Even though encouraging data does exist on the benefits of compost, most landscapers will need to test the product 'in the field'. To achieve specific benefits, creating custom blends of compost may appeal to some landscapers. Soils which are naturally suppressive to soil borne plant pathogens (e.g. compost-amended soils) harbour active populations of natural biocontrol agents[3]. Several rhizobacteria and fungi can induce protection to foliar pathogens in the leaves of plants[4].

Success in biological control of diseases is possible only if all factors involved in the production and utilisation of composts are defined and kept constant. Most composts are variable in quality and so if this particular benefit of compost is to be exploited the basis for variability and its moderation must be understood. This new field of biotechnology is in its infancy. Major research and development will need to be directed into this approach to disease control. From the research being carried out at present, the opportunities for both natural and controlled-induced suppression of soil borne plant pathogens using compost for biocontrol agents appear bright[5].

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[1] De Ceuster, T.J.J., H. Hoitink, 1999. Using Compost To Control Plant Diseases. Biocycle 6, 61-64.
[2] Hoitink, H.A.J. & M.J. Boehm, 1999. Biocontrol within the context of soil microbial communities: A substrate dependent phenomenon. *Ann. Rev. Phytopathology*.**37:** 427-446
[3] Boehm, M.J., L. Madden., H.A.J. Hoitink., 1993. Effect of organic matter decomposition level on bacterial species diversity and composition in relationship to Pythium damping-off severity. Applied Environ. Microbiology 59, 4171-4179.
[4] Wei, G., J.W Kleopper., & S. Tuzun., 1991. Induction of systemic resistance of cucumber to *Colletotrichum orbiculare* by select strains of plant growth-promoting rhizobacteria. Phytopathology 81, 1508-1512.
[5] Hoitink, H.A.J., A.G. Stone, M.E. Grebus., 1996. Suppression of Plant Disease by composts. The Science of Composting. A4, 373-381.

Various examples of proven plant disease suppression[6,7]:

Target Pathogen	Crop	Principal Compost Ingredients
Fusarium oxysporum	Nursery Stock Tomato Radish Sweet Basil	Cattle manure Chicken manure MSW Bark
Typhula spp.	Creeping bentgrass, annual bluegrass	
Sclerptinia homoeocarpa	Creeping bentgrass	Biosolids, green waste
Rhizoctonia solani	Creeping bentgrass, annual bluegrass	Manure, leaves
Phytophthora cinnamomi	Nursery Stock Sweet Basil Lupin	Pine Bark Vegetable waste Citrus
P.capsici	Sweet Pepper	Vegetable waste
P.fragariae	Strawberry	Green waste Paper waste
Laetisaria fuciformis	Perennial ryegrass	Brewery waste
P. nicotianae	Peas Cucumber Tomato Lupin	Green waste Biosolids MSW Citrus
Pythium ultimum	Cucumber Nursery Stock Chrysanthemum Peas Sugarbeet Iris	Pine BarkCattle manure / leaves Poultry manure / leaves Bark Grape marc MSW (organic fraction) Green waste Biosolids
P. graminicola	Creeping Bent Grass	MSW Brewery waste Biosolids Poultry manure
Rhizoctonia solani	Nursery Stock	Cattle manure

[6] Szmidt, R.A.K. & Bragg, N.C. (In press). Composted Horticultural Media. Pub. Nexus

[7] Nelson, E.B., 1992. Biological Control of Turfgrass Diseases. Cornell Cooperative Extension, Information Bulletin 220.

7. Is compost safe to use?

Feedstocks used to manufacture compost may contain harmful contaminants. However, one of the greatest benefits of composting is that the process can eliminate these. Once feedstocks have been pasteurised during composting, the product should be free of biological, chemical, and physical properties, which may otherwise act as a human health hazard.

In order that an end user can be assured of safety with respect to the handling of the compost, certain guidelines / regulations require to be adhered to by the producer. A Standard which can be recognised would give users confidence in the product they are buying. Producers should implement Quality Assurance and Due Diligence protocols. The UK Composting Association providesa quality standard appropriate for UK composters. This standard is based upon standards applicable elsewhere in the EU and are expected to be compliant with the proposed BSI standard and appropriate CEN standard (CEN/TC223).

Limit levels of defined parameters, proposed by the UK Composting Association:

Parameter	**PAS 100 limit level**	**Most lenient EU std.**	**Typical UK result**	**Most rigorous EU std.**
PTEs	mg/kg	mg/kg	mg/kg	mg/kg
Cadmium	1.5	40	7	0.52
Chromium	100	750	50	15.8
Copper	200	1750	25	49.5
Lead	200	1200	65	100
Mercury	1	25	0.2	0.16
Nickel	50	400	10	16.1
Zinc	400	4000	75	185
Human Pathogens				
Salmonella spp	Absent in 25g	n/a	Absent in 25g	Absent
Escherichia coli 0157:H7	1000 cfu/g	n/a	n/a	n/a
Physical Contaminants				
Total glass, metal & plastic of >2mm	0.5% of total dry mass (of which 0.25% is plastic)	n/a	n/a	0.13%
Total stones and other contaminants >2mm	7% of total dry mass			
Weed propagules	<5 viable per litre			
Plant tolerance	No less than 20% below control			

Source[1]

[1] The Composting Association.

The above table shows the characteristics to be analysed and the limits expected. Ongoing product sampling and testing is necessary to attain the PAS 100 certification. In this programme, the larger the producer, the greater the sampling and testing frequency.

Canadian government agencies are involved in the development of standards and regulations for compost, and composting.[2] The categories of quality concerned are : maturity, foreign matter, trace elements, pathogenic organisms, and organic contaminants.

In the absence of statutory regulation, a commonly quoted measure is the United States Section 503 of the Clean Water Act.[3] This proposal represents a comprehensive assessment including ecological as well as human health effects. The regulations are based on risk assessment-based research and call for a reduced and specific level of chemical contaminants and pathogens to be met. This protocol also lays down minimum process procedures to manage human pathogens. This applies particularly for the time material is exposed to recorded pasteurisation temperatures**.**

It is an important aspect of any Due Diligence protocol that producers should implement routine analysis for detection of hazards, particularly human pathogens.

8. What is BSI PAS 100?

BSI PAS 100 was commissioned by the Waste and Resources Action Programme (WRAP) early in 2002. This was as a result of recommendations from consultation with those in composting, and related industries, about how to develop the market for compost. The Composting Association (TCA) worked with the British Standards Institution (BSI) to develop the PAS, which is a revised version of TCA Standards for Composts. The scope of BSI PAS 100 only covers biodegradable materials that have been source-separated from non-biodegradable and composted at centralised, community, on-farm and other similar types of facilities. The PAS is not intended to apply to: end products of home composting for self-use; and biodegradable materials that have undergone a biological treatment process prior to being landfilled.

BSI PAS 100 specifies the minimum requirements for the selection of input materials, the process of composting and control of it, the quality of composted materials, and the marking and information labelling of the product(s). It also covers key aspects of quality management systems such as establishment of a quality policy, document control, record keeping, staff training and reviews of the process control system.

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[2] Support Document for Compost Criteria: National Standard of Canada (CAN/BNQ 0413-200) The Canadian Council of Ministers of the Environment (CCME) Guidelines. Agriculture and Agri-Food Canada (AAFC) Criteria.

[3] Regulation of Municipal Sewage Sludge under the Clean Water Act, Section 503: A model for exposure and Risk Assessment for MSW-Compost has been submitted to the US-EPA (Environmental Protection Agency).

BSI PAS 100 requires that all input materials be sanitised in a defined and identifiable phase and that the producer operates the sanitisation step(s) according to the Hazard Analysis and Critical Control Points (HACCP) approach. BSI PAS 100 also requires stabilisation of all material composted. This is assessed by performing a plant germination and growth test on samples of compost.

BSI PAS 100 requires that the producer carries out a process validation phase, followed by a post-process validation phase in order to be certified. BSI PAS 100 requires monitoring and recording of composting conditions throughout the actively managed composting phase. Compost sampling must be carried out by staff trained in obtaining a representative sample, based on British Standard method BS EN 12579.

BSI PAS 100 requires that the compost is sampled and tested:

- as close to the time of distribution for use as possible;
- after any product preparation that creates one or more grades; and
- before any blending of the compost with other wastes, material, compost, products or additives.

Samples must be taken and sent for testing at least at the minimum frequency specified in BSI PAS 100 for the corresponding phase. These requirements allow composters to optimise their composting process, but also produce consistent products which are ‘fit for purpose’. Minimum standards are outlined in the table in Section 7.

In order for potential users to judge whether a particular compost is fit-for-purpose, they need to have particular product characterisation data. The aim of BSI PAS 100 is to ensure that appropriate and accurate product information is supplied, or at least readily available, to those end users, specifiers or suppliers. BSI PAS 100 requires that all consignments of compost leaving the composting facility be accompanied by product documentation (a label). Specific information is required for labels accompanying bulk product, as well as packaged product.

Those products that meet BSI PAS 100 and are independently certified by the TCA as such, may use the logo below in their promotion. For additional information on BSI PAS 100 or the TCA Certification Scheme, contact the TCA.

COMPOSTING
ASSOCIATION
CERTIFIED

9. Where do I go for more information?

Some useful links

REMADE Scotland
Caladonian Shanks Centre for Waste Management
Drummond House, 3rd Floor
1 Hill Street
Glasgow, G3 6RN
Tel.: 0141 582 0460
www.remade.org.uk

Enviros
Telegraphic House, Waterfront Quay
Salford Quays, Manchester M5 2XW
Tel: 161 874 3600 Fax: 161 848 0181
www.enviros.com

The Composting Association
Avon House
Tithe Barn Road,
Wellingborough
Northamptonshire, NN8 1DH
Tel: 1933 227 777 Fax: 1933 441 040
www.compost.org.uk

Soil Association
Bristol House
40-56 Victoria Street
Bristol
BS1 6BY
Tel: 0117 929 0661 Fax: 0117925 2504
www.soilassociation.org.uk

WRAP
The Old Academy
21 Horse Fair
Banbury
OX16 0AH
www.wrap.org.uk