Use of Compost in Agriculture

Frequently Asked Questions (FAQs)

Updated May 2003

Remade
Scotland

Frequently Asked Questions about the

Use of Compost in Agriculture

Updated May 2003 (1st Edition March 2001)

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

Contents

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, because 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 Scotland, with clear contrasts between rural and urban areas it is not possible to give a single definitive proportion of commodities in the waste stream. The National Waste Strategy for Scotland does not attempt to pre-guess such data[3]. 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[4]. For instance, Fife Council has carried out determinations of waste streams that reveal organics make up 48% of West Fife domestic refuse[5].

While many readers may be aware of the concept of 'backgarden 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 (FAQs) 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 agriculture.

---

[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] Anon. (2000) National Waste Strategy Scotland. Pub. SEPA, Stirling

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

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

Although some reference is made to technical issues of compost-production, readers should refer to other texts [6],[7],[8].

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 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. Source separation will inevitably create 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[9]. 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.

[6]De Bertoldi, M., P. Sequi, Lemmmes, B. & T. Papi (Edit.) The Science of Composting. Pub: Blackie, London. **1,2**, pp1405
[7]Hoitink, H.A.J. & H.M. Keener, 1993. Science and Engineering of Composting. Pub. Renaissance Publications, Worthington, USA. pp 728.
[8]Szmidt, R.A.K. 1997. Principles of Composting. T446. Pub. SAC
[9]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.] Because the process of composting is dynamic there is no clear end-point and therefore no one product which 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 itcontains 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 ot 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 horticlture 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 content may also need to be determined. There is a requirement for anyone applying fertilisers to land to know the value of applied material and not to exceed limits. There is therefore a duty for suppliers to state the value of 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.

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 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 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 12 provides additional information on PAS 100.

4. What is the fertiliser value of compost and how much can I use?

Composts have been successfully used as fertiliser for a range of agricultural crops ranging from grass to maize, grains and horticultural crops such as brocolli[1,2]. Compost can have primary value as a fertiliser but at the same time will secondarily provide benefits of improving physical and microbial soil characteristics. In commercial terms, compost will be considered for application to land against the available alternatives. In agriculture this means that for the immediate future the main competitor will be chemical fertilisers This will change as the market for organic produce changes. The secondary issues of soil improvement mentioned above will only become important where the competitive position of compost as a fertiliser is acceptable. Other alternatives could include farmyard manure (FYM) or sewage sludge and these may also offer similar secondary benefits.

Therefore, commercial value of compost usually will be set against the alternative cost of the equivalent quantity of fertiliser. This is usually judged in terms of nitrogen content. Typical prices paid in spring / summer 2000 for compound fertiliser, N, P (as P_2O_5), and K (as K_2O), were 36, 33 and 21p / kg respectively. Straight nitrogen fertiliser was 36p/kg N, [3].

The commercial value of compost as fertiliser should relate to the dry matter (DM) content of the material. For example, a compost containing 2% N (DM) at 45% moisture would contain 20kg per dry tonne but in reality only 11kg per tonne wet weight.

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 around 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 land than is the case for much of Scotland 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[4]. 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 crop 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. By this rule if availability is 25% in year one, four times the requirement may be applied. In year two the available N from year one application would have to be included in the calculation. To calculate the amount that may be applied there is an obligation to know by analysis the N content. Typically for finished compost this will be in the range 0.5 - 2.5% N.

---

[1]Rodrigues, M.S. 2000, The Use of compost in agriculture. a literature review. Pub. UNESP.

[2]Szmidt, R.A.K. 1997. Composting and Use of Composted Materials for Horticulture. *Acta Horticulturae* **469.** pp. 480

[3]Chadwick, L (Edit), 2000. The Farm Management Handbook, Pub. SAC.

[4]Sikora, L. & R.A.K. Szmidt, (2001). Nitrogen Sources, Mineralization Rates ans Plant Nutrient Benefits form Compost. In: Stoffella *et al* (Edits.). Compost Utilization in Horticultural Cropping Systems. Pub. CRC Press.

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} 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.

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, greenwaste, agricultural / horticultural and food by-products [5],[6].

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

Component	**Greenwaste**	**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. It is likely that the presence of minor elements is a main reason for good performance of land-applied compost, in some cases beyond the yields expected simply on the basis of the NPK analysis.

[5]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.
[6]Verdonck, O. 1099. Compost Specifications. *Acta Horticulturae.* **469.** 169 - 177.

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. This is particularly the case for unanalysed composts derived from unseparated MSW where content of metals may be excessive and will result in toxicity to plants. 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 micro elements and in turn the relative proportion of each may be important for healthy plant growth.

In all situations it is important that a full analysis of compost is carried out before significant application to land. In addition, the degree of compost stability is important. This is because where the composting process continues, the basic analysis for an element, particularly nitrogen, is not a good indicator of agronomic value. For instance, continued degradation will require nitrogen and may even 'lock up' existing nitrogen in the soil to which compost is applied. The net effect of using unstable compost can be a **reduction** in available minerals, not a supply![4]

5. What are the proven benefits to Agriculture?

A substantial body of research data exists that has demonstrated composts can have tangible benefits to crops. This can be in terms of yield, quality and freedom from pests and diseases. Reports tend to be dispersed throughout the biology and agricultural literature. The key developments are most often reported in the journal *Compost Science & Utilization* and in *Biocycle* as well as in a considerable number of specialist proceedings of meetings and conferences. The United States Department of Agriculture (USDA) in particular has carried out extensive trials and results consistently show increase in crop yield from application of compost to a range of field grown crops. This can be viewed at www.USDA.gov and a useful search on the subject can be found at:

http://warp.nal.usda.gov/afsic/AFSIC_pubs/qb9701.htm

There is also a very large body of circumstantial evidence.

For commercial farmers results of research may to be too remote from reality and the circumstantial evidence insufficient proof on which to make commercial decisions. A review of research into the effects of compost on yield of crops has shown that various crops will benefit from compost application. However there is no one paper, which can be used to predict the benefit of a particular compost type on a particular crop.

Nonetheless, the following are but a few examples of real evidence that can be proven and compared to control areas where no compost was used. Wherever in the world the study may have been carried out the comments have been selected because of broad relevance for Scottish conditions. References are available for each of these examples.

Green waste compost applied to land for cultivation of **Spring Barley** resulted in up to 25% increase in plant dry matter and evidence of an increased number of tillers per plant relative to non-compost applied land. Grain quality in terms of N-content and 1000 grain weight was not affected [1].

In trials of **Spring Wheat** some compost gave an increase in emergence at day 20. In terms of plant growth dry matter yield was increased by application of stable compost compared both to unstable material and to comparative plots without compost.[2]

One study compared composted sludge / agricultural wastes with untreated sludge and an equivalent fertiliser regime. Researchers showed that over a six year period of rotation of **Wheat**, **maize** and **sugar beet** compost outperformed the alternatives [3].

---

[1] Cook, J.A., A.A. Keeling & P.F. Bloxham. 1998. Effect of greenwaste compost on yield parameters in spring barley (*Hordeum vulgare*) v. Hart. *Acta Horticulturae* **467** 283-286.

[2] (McCallum, K.R., A.A.Keeling, C.P. Beckwith & P.S. Kettlewell. 1998. Effects of Greenwaste compost on spring wheat (*Triticum aestivum* L. cv. Avans) emergence and early growth. *Acta Horticulturae* **467** 313 – 318).

[3] (Baldoni g. *et al.*, 1996. The influence of compost and sewage sludge on agricultural crops. In: DeBertoldi *et al.*(Edits.) The Science of Composting. Pub. Blackie, London.430 – 438.

In examining the value of MSW composts it has been shown that they can provide a consistent source of fertiliser to crops. **Wheat** was grown in a two year trial using MSW compost in comparison to normal fertiliser regimes. Yields were comparable to those from full-rate fertiliser application at equivalent N-values derived form compost. Because of the slow-release N-characteristics of compost it may be advisable to adopt a split-application regime to build up the long-term availability of N in soil [4]. In studies to examine the effect of compost on **vegetable** production good results have been achieved. In research in the USA field-grown **tomatoes** and **sweet corn** in year one were followed by **snap peas**, **broccoli** and **cabbage** in subsequent rotations. Marketable yields of sweet corn reported were up 75% following application of composted Spent Mushroom Substrates (SMS). Yields of snap peas from compost-applied plots were comparable with normal fertiliser regimes. Broccoli yield and 'head' size was greater from compost-amended plots. Cabbage responded in a similar way. Benefits from compost were recorded for three years following application of compost. This agrees with data showing slow release of plant nutrients from compost. The authors calculated that while compost amendments may be initially more expensive than equivalent fertiliser for the first year, greater yields can be expected with a potential net benefit extending over a three year period [5]

Similar work has also shown that for **lettuce** and **broccoli** yield is related to application rate as a function of N-content regardless of N-source. Yield of lettuce was 10% greater in compost-treated plots than from equivalent areas treated with chemical fertiliser. Results also revealed that greenwaste-derived compost produced the least yield increase of the tested composts, which included Biosolids (Sewage sludge) and MSW products[6]. These finding were also supported by results for three-year trials looking at the use of composted agricultural wastes in which yields from composted plots equalled or exceeded those from comparable chemical-fertilised areas[7].

In trials that were well regulated but took place in the normal operational environment of working farms, results were less clear. Yield advantages for lettuce and cauliflower were not repeated for lettuce and broccoli on another similar farm. This tends to support the view that benefits may be soil and management inter-related. However, in this work there were no yield reductions compared to alternative protocols and results continue to support the value of compost as part of an integrated

---

[4] Rodrigues *et al.* 1996. Use of composted societal organic wastes for sustainable crop production. In: DeBertoldi *et al.*(Edits.) The Science of Composting. Pub. Blackie, London. 447 - 456.

[5] Steffen, K.L., M.S. Dann, Fager,K., S.J. Fleischer & J.K. Harper. 1995. Short-term and long-term impact of an initial large-scale SMS soil amendment on vegetable crop productivity and resource use efficiency. In: Environmental Agricultural and Industrial uses for spent mushroom substrates. Edit. Wuest e*t al.*. Pub. JG Press, Emmaus, US.

[6] (Shiralipour A. *et al.*. 1998. Using compost products in vegetable production. In:Beneficial co-utilization of Agricultural, Municipal and Industrial By-products. Brown, B. *et al.* Pub. Kluwer, Dordrecht, NL. 363 – 375. Buchanan, M. & S.R. Gliessman 1991. How Compost fertilization affects soil nitrogen and crop yield. *Biocycle* December 1991. 72-76)

[7] Maynard, A.A. 1994. Sustained Vegetable production for three years using composted animal manures. *Compost Science & Urtilization***2**(1) 88-96.

fertiliser or organic regime [8]. Research has shown that compost derived form sewage sludge and from mixed Municipal Waste can be used as a substitute for a proportion of the normal fertiliser application to **grass** (Tall Fescue),[9]

In a review of the literature by Dick & McCoy positive yield benefits from use of compost were collated for the following:

- **Cereals (Wheat / Barley)**
- **Potato**
- **Sugar Beet**
- **Grass (Tall Fescue)**
- **Corn (Maize)**
- **Sorghum**
- **Rice**

The composts used varied and included those derived from MSW and sewage sludge. Of particular importance is that where no specific yield advantage was noted in year one there was a net benefit where records were kept into years 2 and 3[10] In a similar review positive effects of applying MSW-derived compost on vegetable production land resulted in up to a doubling of yield both of agricultural (maize, sorghum, forage grass) and horticultural crops (lettuce, cabbage, bean and cucumber). In most cases yield effects were highest when compost application became an integrated part of fertiliser use[11].

For plantation crops such as **strawberry** and **raspberry** there is considerable evidence of the benefits of compost as a mulch. This can be significant in terms of weed suppression as well as part of an integrated fertiliser regime Trials in the USA showed productivity to be 93.4% of normal chemical regimes but with the added systems-benefits of compost use. Costs were broadly comparable[12]. Greenwaste compost and biosolids compost has been successfully used as a component of growing media for **ornamental shrubs.** Substrates containing up to 25% compost were successful and in some cases 50% recycled material was used[13]. The use of composted growing media for production of tender plants such as **pot plants** and **bedding plants** has been less easy to achieve. However use of compost blended with peat (so-called low-peat products) are now successfully used in horticulture and some commercial products for 100% peat-free media are

---

[8] Anon. 1997. Monteray Bay Regional Compost Project. Pub. Integrated Waste Management Board.

[9] Sikora, L.J., 1996. Effect of compost-fertilizer blends on crop growth. In DeBertoldi *et al.*(Edits.) The Science of Composting. Pub. Blackie, London. 447 - 456.

[10] Dick, W.A. & McCoy E.L. 1993 Enhancing Soil Fertility by addition of compost. In: Hoitink H.A.J. & Keener, H.M. (Edit.). Science & Engineering of Compost, 622 – 644 Pub. JG Press. Emmaus, USA

[11] Shiralipour, A. *et. al.*. 1992. Uses and benefits of MSW compost: A review and an assessment. *Biomass and Bioenergy.* **3** (3-4). 267 – 279.

[12] Vollmer, J. 1999. Alternative Strawberry production with compost. Pub. NCDENR.

[13] P. Fischer & W. Popp. 1998. The use of various composts and recycled materials in growing media for ornamental shrubs. *Acta Horticulturae* **467.** 287 – 296

now marketed [14,15]. Growers should demand evidence of success from suppliers. In this sector the problem is that large numbers of ornamental species each react differently to growing media. Before committing large quantities of crop to any new material growers should either have tried a 'pilot crop' in advance or have firm guarantees from suppliers.

For greenhouse crops such as **Tomato** a number of authors have used compost as grow-bag type growing media or as additives to border soil. Similarly, **cucumbers** and **cutflowers** have been successfully grown. Yields are not at the same level as the most intensive hydroponic (soilless) crops but this may fill a niche for organic production and garden centre products. Manure based composts have been used to give yield increases compared to fertilised soils[16].

Perhaps the key question about waste-derived composts used for edible crops is the fate of heavy metals. Six year trials on rotations of **wheat**, **maize** and **sugar beet** showed that while zinc was increased in grain and copper in sugar beet this did not follow for all metals. Other elements (Cadmium, Chromium, Nickel and Lead) did not accumulate in crops, indicating their presence in a bound rather than labile form[17] In trials that have been running since the 1950s in The Netherlands, it was shown that the heavy metal content of soils repeatedly amended with compost will be the regulatory limiting factor[18]. However, this research does not report details of comparative crop performance.

[14] Gouin, F.R. 1998. Using compost in the ornamental horticulture industry. In: :Beneficial co-utilization of Agricultural, Municipal and Industrial By-products. Brown, B. *et al.* Pub. Kluwer, Dordrecht, NL 131-138, Bragg N.C. Personal communication

[15] Bragg, N.C. Personal communication.

[16] Madrid *et al.* 1998. Municipal solid Waste Compost Utilization in Greenhouse cultivated tomato. *Acta Horticulturae*,**467.** 297 – 303)

[17] Cortellini, L. *et. al.* Effects of content of organic matter, nitrogen and heavy metals in plants after application of compost and sewage sludge. In: de Bertoldi *et al.* (edits.) The Science of Composting. Pub. Blackie, London, 457 – 468.

[18] de Haan, S. results of municipal waste compost research over more than fifty years at The Institute for Soil Fertility at Haren / Groningen, NL., *Neth. J. Agric. Sci.*. 1981. 49-61

6. Are there benefits other than fertiliser value?

A wide range of other 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.[1]

Use of compost in landscaping is becoming increasingly common. Organic matter 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. These uses include enhancing biodegredation in oil contaminated soils, using compost in the cover and recultivation layer of landfills for methane oxidation, and improving methane generation in the bottom layer of landfills. When using compost for the biodegradation of contaminated soil materials, mature compost with a low pollutant content is most effective. In practice, the amount of compost added should be optimized in laboratory tests. The degradation rates are optimal up to 33 percent, related to the soil material (dry weight), dependent upon the organic content of the soil[2,3].

Compost is being used to improve athletic fields, football pitches, golf courses, and parks. The leisure industry itself is a huge potential market for compost producers in the UK. Greenkeepers have used fish based compost to reduce winter ‘snow mould’ and ‘die back’. Compost has also been used to alleviate problems of soil compaction, and increasing drainage as well as lawn growth[4,5].

For motorway construction erosion is a major factor with subsequent nonpoint-source pollution. Recent years have seen the use of compost as an erosion control material, often in a blend with a mulch. 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 which are used for the manufacture of appropriate compost vary from source to source[6,7,8].

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.

---

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

[2] Hupe, K., K.Heyer,R. Stegmann, 1998. Hazardous sites and landfills utilise compost. *Biocycle* 6, 79

[3] Anon, 2000. Acetone helps microbes remediate TNT-contaminated soil. *Biocycle* 8, 38-39.

[4] Duerr, B Jr. 1999 Tree farm evolves into a compost business. *Biocycle* 1, 30-31.

[5] Allison, F.E., 1973. Soil Organic Matter and its role in crop production Vol. 1 Elsevier Scientific Publishing Co.

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

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

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

This favourable effect, though, seems to be significantly smaller in clay soils than in sandy loam soils.[9,10,11,12,13,14].

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[15,16]. 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

---

[9] 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.

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

[11] 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.

[12] 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.

[13] 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.

[14] 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 Envirnonment 81/82, 561-568.

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

organic matter and available plant nutrients. Soil fertility therefore will increase with the application of a suitable compost, at an appropriate level.[16] Weed control will only be effective if the compost is guaranteed free from weed seeds.

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

7. Can compost suppress plant disease?

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 useage. Nationally and internationally, with a decrease in the use of the soil fumigants, particularly Methyl Bromide, alternative sources will be required to control soil borne pathogens. As large-scale growers seek better ways to control pathogens, meet consumer demand for "cleaner" food and improve profit margins, the market for composted products will expand even faster[2]. 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[1,2].

Even though encouraging data does exist on the benefits of compost, most growers will need crop specific data. To achieve specific benefits, creating custom blends of compost may appeal to some farmers. Soils which are naturally suppressive to soil borne plant pathogens (e.g. compost-amended soils) harbour active populations of biocontrol agents[5]. Several rhizobacteria and fungi can induce protection to foliar pathogens in the leaves of plants[6].

As examples, for sugar beet dairy manure compost has shown an increase in yields of ten percent, even in the presence of microbial disease. The compost appeared to limit the disease *Cercospora* sp.. Researchers have found that the ratio of total fungal to bacterial biomass was a strong indicator of yield potential. Different crops will respond differently to each compost so there is no "one mix fits all".

Onions grow in widely diverse soil types, they grow best in soils that are rich in organic matter with good drainage. Compost added to heavy soils has been shown to improve tilth and drainage. Applied to a light sandy soil it will improve water holding capacity. This factor is especially important as onions have shallow roots. The same benefits would apply to leeks. Over a three year period compost was shown to reduce year-to-year variability and reduce incidence of soft rot disease. Total yields were also increased. A greater percentage of 'jumbo-sized' onions were

[1] De Ceuster, T.J.J., H. Hoitink, 1999. Using Compost To Control Plant Diseases. Biocycle 6, 61-64.
[2] Humpert, C.P. 2000. New trends in sustainable farming build comp ost use. biocycle 7, 30-33.
[1] 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
[2] Hoitink, H.A.J. Personal Communication.
[5] 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.
[6] 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.

produced[7]. The latter may or may not be a market advantage depending on the marketing strategy of farmers. Similar results have been obtained in tomato production[8].

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 as the food stuff for biocontrol agents, therefore appear bright[9].

Examples of proven plant disease suppression[10]:

Target Pathogen	**Crop**	**Principal Compost Ingredients**
Aphanomyces euteiches	Pea	Cattle manure
Botrytis cinerea	Strawberry Bean	MSW 'tea'
Erisyphe graminis	Barley Wheat	MSW 'tea'
E. polygoni	Phaseolus Bean	MSW 'tea'
Fusarium oxysporum	Nursery Stock Tomato Radish Sweet Basil	Cattle manure Chicken manure MSW Bark
F.culmorum	Wheat	Greenwaste
Phoma medicaginis	Peas	Greenwaste Paperwaste
Plasmodiophora brassicae	Cabbage	SMS Greenwaste Paperwaste
Phytophthora cinnamomi	Nursery Stock Sweet Basil Lupin	Pine Bark Vegetable waste Citrus
P.capsici	Sweet Pepper	Vegetable waste
P.fragariae	Strawberry	Greenwaste Paperwaste

[7] Maynard,A.A., Hill, D.E. 2000 Leaf Compost Suppresses Disease, Improves Onion Yields. Biocycle 5, 69-71.
[8] Maynard, A.A. 1999. Reducing fertilizer costs with leaf compost. Biocycle 4, 54-55.
[9] Hoitink, H.A.J., A.G. Stone., M.E. Grebus., 1996 Suppression of Plant Disease by composts. The Science of Composting. A4, 373-381.
[10] Szmidt, R.A.K. & Bragg, N.C. (In press). Composted Hortuicultural Media. Pub. Nexus

P.infestans	Tomato Potato	MSW 'tea'
P. nicotianae	Peas Cucumber Tomato Lupin	Greenwaste Biosolids MSW Citrus
Examples of proven plant disease suppression (continued)		
Pythium ultimum	Cucumber Nursery Stock Chrysanthemum Peas Sugarbeet Iris	Pine BarkCattle manure / leaves Poultry manure / leaves Bark Grape marc MSW (organic fraction) Greenwaste Biosolids
P. graminicola	Creeping Bent Grass	MSW Brewery waste Biosolids Poultry manure
P.myriotylum	Cucumber Tomato Watermelon	MSW Greenwaste SMS Papermill sludge
P. irregulare	Cucumber	MSW Greenwaste
P.aphanidermatum	Cucumber	MSW Greenwaste Sugarcane Liquorice root
Rhizoctonia solani	Nursery Stock Cucumber Tomato Radish Bean	Cattle manure Hardwood Bark Poultry manure Vegetable waste Biosolids
Sclerotinia minor	Lettuce	Biosolids Grape marc
Sphaerotheca fuliginea	Cucumber	MSW 'tea'
Venturia inaequalis	Apple	SMS 'tea'

8. 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 has proposed a quality standard appropriate for UK composters. This standard is based upon standards applicable elsewhere in the EU and are expected to be ratified as the 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. The limits as laid down by the UK Composting Association are more stringent than those which have been agreed by the Canadian authorities.

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.

[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 Agir-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).

9. Does all compost qualify as organic?

The general principle of organic agriculture is a process which develops a viable and sustainable agro-ecosystem. Sufficient quantities of biodegradable material of microbial, plant or animal origin should be returned to the soil to increase or at least maintain its fertility and the biological activity within it.

Not all composts will qualify as being organic. Organic farming is a carefully devised system of food production which is defined by EU law[1] and is based on the following principles:

- Building Soil Fertility
- Minimal use of non-renewable resources (no chemicals)
- Minimise pollution and damage to the environment
- Working with, not against, natural systems
- Respect for animal welfare
- Minimal processing or additives

Where the feedstock sources are known and are assured to be chemical free, compost can be considered organic. Agricultural wastes must only be sourced from farms producing to organic standards if subsequent compost is to be approved. Composts such as those with feedstock from garden waste are normally compliant but must be approved. Organic fertilisers offer phased release of nutrients. This can add to the humus content, increasing soil fertility. The rate of conversion of farmland to Organic has been higher in Scotland than any other part of the UK. However, most of this has been hill or rough grazing to date.

Municipal Solid Waste (MSW) and biosolids-derived compost on the other hand will have a mixture of unknowns present from the feedstock source, and are unlikely be approved as organic. There could also be some unknown residuals, such as inerts or foreign matter, content post composting.

Therefore, all relevant measures should be taken to eliminate contamination of feedstocks before processing. To be sold as organic and to be applied to registered organic land, compost must fit criteria specified by an appropriate approval body. The most significant authority in the UK is the Soil Association. Free advice on organic conversion for agriculture is available from SAC and is sponsored by The Scottish Executive Rural Affairs Department (SERAD).

Garden waste derived composts appear to be the most acceptable to the Soil Association. Whether kitchen waste composts will gain their approval requires clarification

---

1 Anon (1991). Council Regulations (EEC) no. 2092/91

10. What is Compost Tea?

Compost Tea is liquid extracted or leached from compost. It will contain soluble nutrients, both organic and inorganic, and microorganisms, including bacteria, fungi, protozoa, and nematodes. The benefits Tea provides depends on what can be extracted from the compost. Poor compost means poor Tea. Good compost can produce Tea with useful characteristics. Mistakes can be made during the "brewing" cycle, however, and a good Tea can be turned bad. Using water to extract compost to produce Tea can be done in any number of ways. The most common method is to suspend the compost on a screen and run water through it.[1] The resulting liquid will have a short shelf life and must not turn anaerobic. Compost Tea microbiology is most influenced by oxygen availability, nutrient availability, and the microbiology of the compost.[2] In large quantities, aeration may be essential.

In the literature, optimism for Compost Tea is high, but understanding its limitations and having realistic expectations is necessary.[2] Compost quality issues, including maturity and microorganism content, become very important for making Compost Tea. The transformation of compost into Compost Tea cannot improve on the original quality of the compost. Even so, the relative proportions of microorganisms in the Compost Tea may differ from the original compost.[1,2]

The desirable condition in Compost Tea is to have a wide diversity of bacteria, fungi, protozoa, and nematodes. When the diversity of beneficial organisms is high, disease suppression will tend to be greater, nutrient retention will be higher, availability of plant nutrients will occur at a rate more beneficial to plant requirements, soil aggregation will improve, along with water holding capacity, break down of toxic materials[3] and decomposition rates.

Compost Teas are applied to soil or to plant foliage. Those applied to soil will move into the root zone and affect the rhizosphere of the plant. Nutrients carried in the Tea will be used by the plant as well as the microorganisms in the soil.[2]

Tea sprayed on leaf surfaces will typically alter the set of organisms on the foliage, both through innoculation of organisms from the Tea and through supply of nutrients that help support survival of leaf colonising organisms. Thus, if the applied organisms or the food resources select against disease-causing organisms on the leaf surface, or ones that will arrive, suppression of foliar pathogens is possible. However use of Tea will immediately impact the plants and any toxic effects from bad Tea can be catastrophic.[1,2]

One of the real benefits that Tea offers is that it can be applied through the irrigation system or through a spray rig. This can become part of an integrated approach to improving compost quality. By controlled leaching of excess salts the resulting effluent can be processed as Compost Tea. The ratio of water to compost depends on the analysis of compost but a typical quantity would be of the order of (4 parts water : 1 part compost, i.e. 4,000 litres of Tea leached from 1 tonne of compost).[1, 4] Recycling of water may reduce substantially the amount required but this must be carefully calculated.

---

[1] Ingham, E. 1999. What is Compost Tea ?. Biocycle 3, 74-75.
[2] Bess, V.H. 2000. Understanding Compost Tea. Biocycle 10, 71-72.
[3] Block, D. 1998. Composting Breaks Down Explosives. Biocycle 9, 39-40.

Compost Tea can be inconsistent from batch to batch so it's important to consider the major factors that influence Tea quality. If there are pathogenic or pest organisms present in the compost, they could be extracted into the Tea so good compost is essential.[5] The first step in creating a saleable Compost Tea is to eliminate potentially harmful pathogens. Therefore a pasteurisation phase for the Tea, of which there are various methods,[6] may be necessary. Compost Tea should be analyzed for the same microbiological parameters as compost. This includes beneficial microorganisms, as well as pathogens such as *Escherichia Coli* and *Salmonella sp.*.

There is little evidence of significant commercial production of Compost Tea in the UK.

---

[4] Szmidt, R.A.K. & P. Conway, 1995. Leaching of Recomposted Spent Mushroom Substrates. Science and Cultivation of Edible Fungi. Vol 2, 901-905.
[5] Ingham, E. 1999. Making a high quality Compost Tea. Biocycle 4, 94.
[6] Peot, c. McIntyre, O. 2000. Generating revenue from compost run off. Biocycle 6, 34-36.

11. Do we know all there is to know about the benefits of compost?

Composting and use of compost are deceptively simple activities. In truth they are complex biological and biochemical processes. Continual research will be necessary in order that a greater understanding of the complexities may be exploited.

There are a number of key research groups working throughout the world and there exists a good level of communication and co-operation between them. This is encouraged by a number of societies and associations.

From a Scottish perspective the following areas are of prime importance:

- Agronomic benefits are not understood well enough. Although there is a body of evidence that proves compost can be a useful fertiliser, soil amendment and growing-medium this does not always apply to Scottish conditions. The benefit of application of compost to soil under high rainfall, high organic-matter soils and cool climate is simply untested. While some benefits may be less under Scottish conditions, others may be greater. As examples, relatively low Scottish soil temperatures could be reflected in relatively low microbial benefits from compost. However, under high rainfall conditions the benefit of compost as a slow release fertiliser that is not readily leached may be higher than average.

- The role of composts derived from a range of feedstocks specifically in organic farming needs to be further developed.

- The ability of compost to control disease suppression is still in its infancy. The research into biochemical complexities of composting is most notable at Ohio State University and a number of institutes in Israel.

- Market developments all point to the fact that there is a clear need for compost only with a high degree of uniformity, known fertiliser content and predictable agronomic performance in terms of soil amendment and disease suppression. Composting process control is inextricably linked with agronomic characteristics of the product. A number of research centres and commercial companies are working in this area, both in Europe and the USA. However, this tends to be from an engineering perspective rather than an understanding of the effect of engineering on the biology of the process. This continues to require investigation.

- Maturity and Stability of compost remains a complex subject and one in which further research is needed. Significant advances have been made in this area, in the UK most importantly at Leeds University.

- Health and Safety of compost remains a key issue. This is both in terms of operators handling and applying compost and in the safety of land, water and crops. There is crucial evidence that existing guidelines do not guarantee safety of compost and this must be urgently addressed if consumer confidence is to be secured.

12. 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-biodegradables 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.

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

13. Where do I go for more information?

Some useful links

Scottish Agricultural College
Environment Division
Auchincruive
Ayr
KA6 5HW
Tel: 01292 525388 Fax: 01292 525389
www.sac.ac.uk

SEPA
Erskine Court
The Castle Business Park
Stirling
FK9 2ND
Tel: 01786 457700 Fax: 01786 446885
www.sepa.org.uk

Scottish Compost Development Group
C/o Dr. R. Szmidt
Scottish Agricultural College
Auchincruive
Ayr
KA6 5HW
Tel: 01292 525388 Fax: 01292 525389
SCDG@au.sac.ac.uk

The Composting Association
Avon House
Tithe Barn Road,
Wellingborough
Northamptonshire
NN8 1DH
Tel: 01933 227 777 Fax: 01933 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

SERAD
Rural Affairs Department Secretariat
The Scottish Executive
Room 440
Pentland House
47 Robbs Loan
EDinburgh
EH14 1TY
Tel: 0131 244 6023 Fax: 0131 244 6116
www.scotland.gov.uk

For Organic Information contact:

David Younie
Scottish Agricultural College
Fergus Building
Craibstone Estate
Bucksburn
Aberdeen
AB21 9YA
Tel : 01224711072 Fax: 01224 711293
www.sac.ac.uk

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