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Variation in Quality of Composted Green Wastes of UK Origin and Their Suitability for Inclusion in Growing Media

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Abstract

Great variation in physical and chemical characteristics was evident in a comprehensive survey of composted green wastes from the UK. Variations in bulk density, organic matter and plant nutrients, notably nitrate were seen. The levels of nitrate in the samples varied considerably from 469 mg/L (± 2.7 mg/L) to negligible amounts in other samples. From fifteen samples surveyed four were chosen as candidates for inclusion in growing media. The germination and growth of tomatoes and lettuce was linked to the physical and chemical characteristics of peat media amended with composted green waste. In some, poor plant growth was evident at concentrations of composted green waste as low as 20%: in others seedling growth was acceptable at concentrations of composted green waste as high as 70%. Clearly the adoption of good practice, for example 'The Composting Industry Code of Practise' by producers of composted green waste advocated by The Composting Association, would enhance the use of this material by manufacturers of growing media.

INTRODUCTION

Variability of composted green waste (CGW) is of major concern to manufacturers of growing media who may wish to incorporate this material into their products. Many research papers on CGW have observed the variation within samples, and stated the need for further investigation. (Prasad et al., 2001; Eriksen et al., 1999; Veeken et al., 2004).

About 25.4 million tonnes of municipal waste were produced from household sources in the United Kingdom in 2003/04, accounting for 87% of the total amount of municipal waste (Defra, 2005). Household waste typically consists of 20% green waste (Defra, 2003); consequently the annual production of green waste is estimated to be around 5 million tonnes per year. Green waste includes vegetation and plant matter from household gardens, local authority parks and gardens and commercial landscaped gardens (Defra, 2000). Within the East Midlands, 124,000 tonnes of material from household sources was collected for recycling and composting by local authorities in 2002/03 (Defra, 2003).

Within the United Kingdom most green waste has historically been disposed of in landfill sites. This has particular reference in the East Midlands, for example Nottinghamshire as 'At current rates of filling, landfill capacity is set to run out in less than 8 years time.' (EMRLGA, 2002).

Part of the aim of the current research programme is to identify the extent of variability within locally sourced CGW. The study was undertaken using fifteen samples of CGW collected within the East Midlands region of the UK. From the fifteen samples, physical and chemical analysis led to the selection of the four samples for further experimentation and growth trials.

MATERIALS AND METHODS

Fifteen samples, which were obtained after a survey of local authorities' handling/production of CGW from domestic and other sources via a questionnaire (Unpublished data), were analysed. The analytical procedures used to gain this baseline analysis were derived from the International Society for Horticultural Science (ISHS) – Laboratory Manual from the Comité Européen de Normalisation (CEN) – Standards for Chemical and Physical Analysis of Growing Media. Many of these techniques have been utilised in the work undertaken by Turner and Carlile (1982), and Dickinson (1995) at Nottingham Trent University. Selections of representative parameters are presented in this paper. These include bulk density, nitrate, potassium, and phosphorous concentrations.

From the fifteen samples, four samples were identified for inclusion in further work. Several factors influenced selection of the four samples. As one focus of this project is on CGW production in Nottinghamshire the samples used in the trial needed to be accessible and situated around Nottinghamshire. The second issue was time, as a number of parameters were going to be investigated; only a limited number of samples could be used. Data produced from the baseline analysis conducted on the original fifteen samples was also considered in the selection of the four samples.

For each of the four samples of CGW selected for extended analysis, mixes were prepared at 10, 20, 30, 40, 50 and 70% by volume with sphagnum peat, with the addition of dolomitic limestone, where appropriate, to achieve a pH ranging from 5.5 – 6.5 during the mixing of the CGW/Peat. The control was an all peat mix, with a standard commercially produced nutrient mixture added.

Growth studies were carried out using *Lactuca sativa* 'Winter Density' and *Lycopersicum esculentum* 'Money Makers'. For the growth trial, 9cm pots were sown with 10 seeds equally spaced in each pot. Germination counts for *Lactuca sativa* were taken after one week. The tomatoes were left until they had grown to a reasonable size. Plants chosen at random were potted on into 7.5cm pots. The plants were then left for a further period of time, 14–21 days according to season. The plants were then cut from the bottom of the stem and the fresh weights were taken.

RESULTS

Overall the baseline analysis conducted for the original fifteen samples showed that there was a huge variation in the samples of CGW. This variation can be seen even in appearance as seen from two of the fifteen samples (Figs. 1 and 2).

A large variation in bulk density was seen; for example Sample 3 had a bulk density of 243 g/L (± 9.2 g/L), compared to Sample 15 which had a bulk density of 837 g/L (± 2.8 g/L), as shown in Fig. 3.

A number of macronutrients were also investigated (Fig. 4). Phosphorus was present in low concentrations throughout the samples, as expected and comparable with soils in situ. Potassium was also measured; this was present in high concentrations, but with large variations between samples. The levels of nitrate in the samples varied considerably from 469 mg/L (± 2.7 mg/L) in Sample 8 to negligible amounts in several other samples.

Tomato plants were raised in the four samples chosen for further analysis. From the analysis in Fig. 5, samples 5 and 11 showed that as the percentage of CGW increased, the average mass decreased. This trend was not repeated by samples 4 and 10, which had varying fresh weight masses. Sample 10 had an average mass of 5.008 g (± 0.46 g) in the 10% CGW mix with 6.278 g (± 1.07 g) in the 40% CGW mix. The all peat mix had an average mass of 8.562 g (± 1.67 g).

Trends in germination can be seen in Fig. 6. In general as the percentage of CGW increased, the percentage germination decreased. For example in sample 4, the 10% CGW mix had an average germination of 94%, but for the 70% CGW mix the average germination percentage fell to 24%. There was huge variation between the four samples. The 10% CGW mixes varied from 34% germination with sample 10 to 94% in the case of sample 4. Percentage germination in mixtures of peat with 10% CGW from samples 4, 5 and 11 were higher than in the all peat mix.

DISCUSSION

This study investigated the variability of CGW and its potential for use in growing media. The parameters investigated showed clearly how variable this material is, even in a local region.

Fig. 3 illustrates the variability within the bulk density. This would have great implications on transportation costs for the manufacturers as well as possibly deterring the public from buying the end-product. If CGW is to be included within growing media, the weight of the end-product needs to be consistent, and preferably as low as possible. Indeed for retail sales, the public must be able to lift the product and transport it.

Fig. 4 shows a large variation in macronutrient concentrations. Potassium was present in high concentrations, but with a large variation between samples. Excess levels of potassium can cause adverse effects by reducing the uptake of several other nutrients, for example Ca, Mg, Mn and Zn. Similar conclusions may be drawn for nitrate concentrations where again there was a large variation between samples. Nitrates are of course, essential for plant growth, but can be a problem if available in excess with the resulting high salinity conditions potentially inhibiting seedling growth. Studies conducted for Waste & Resource Action Programme (WRAP) have shown nitrogen availability to be a significant problem for growing media containing green material and other recycled material, with the need to supply additional nitrogen supplement (Peatering Out Ltd., 2005).

The initial analyses (month 1) for fresh weights/ germination counts are shown in Figs. 5 and 6 respectively. Variation within the four samples is evident. The average fresh weights produced from a 40% CGW mix ranged from 0.474 g to 6.278 g. Variation in germination could also be seen. For commercial growers, consistency within crop germination and fresh weight production is desirable.

Overall variation within the representative parameters is evident. These samples have been taken from a small area of England within the East Midlands and even from such a small sampling area, considerable variation is apparent. If this type of study was to be carried out across the United Kingdom, the variation might be very large indeed. There is a clear need for standardisation in the approach to producing CGW material for the inclusion in growing media. To overcome this problem, The Composting Association have recently produced 'The Composting Industry Code of Practice' to enable operators of identify good practise for their own individual sites (TCA, 2005). The dissemination of such knowledge of good practise will hopefully lead to a better quality CGW that could be used as a diluent or replacement for peat in growing media.

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Figures

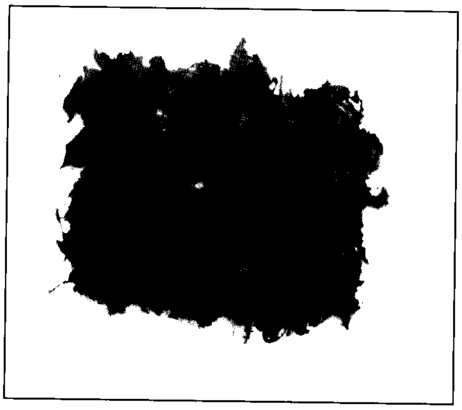

Fig. 1. Sample 12.

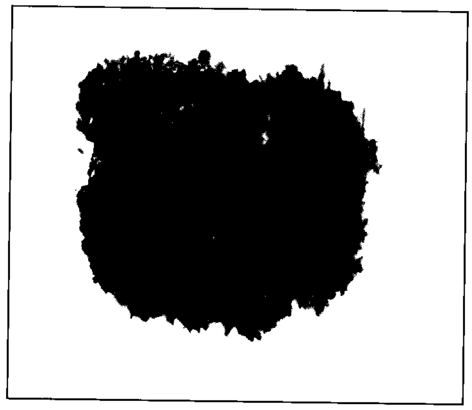

Fig. 2. Sample 13.

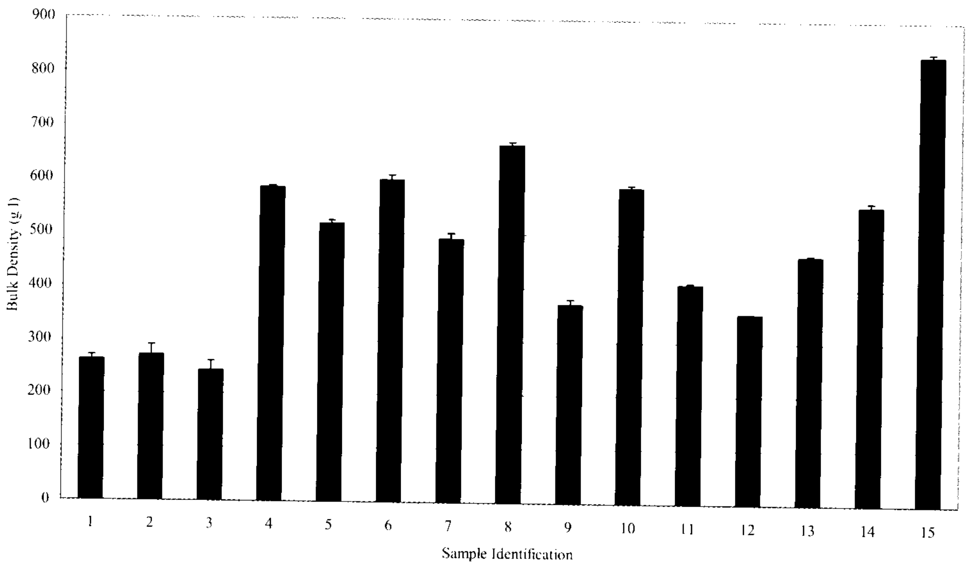

Fig. 3. Bulk Density values from fifteen samples of CGW. The 95% confidence limits are shown by error bars.

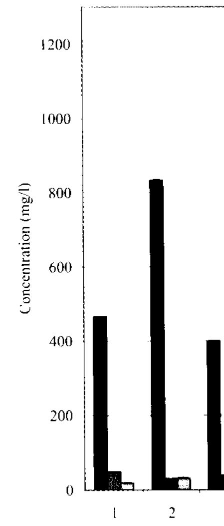

Fig. 4. Macro Nutri
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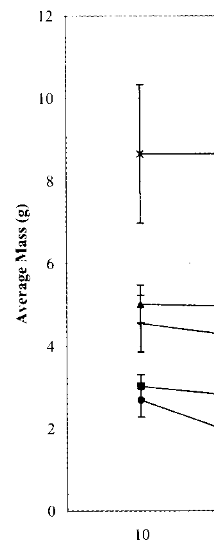

Fig. 5. Fresh Weigh
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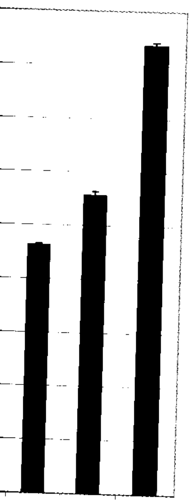

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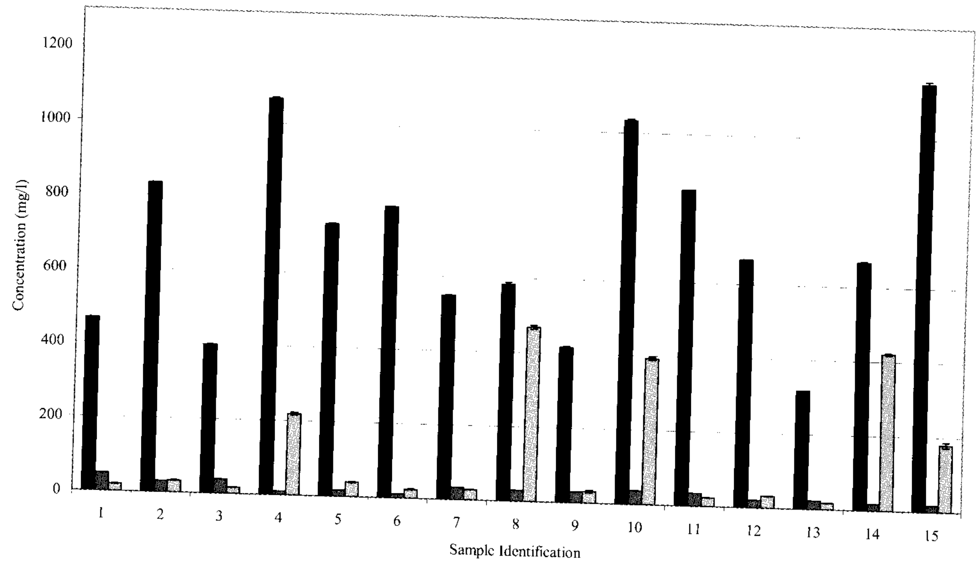

Fig. 4. Macro Nutrient Concentrations from fifteen samples of CGW. ■ indicates potassium concentrations. ■ indicates phosphorus concentrations. ■ indicates nitrate concentrations. The 95% confidence limits are shown by error bars.

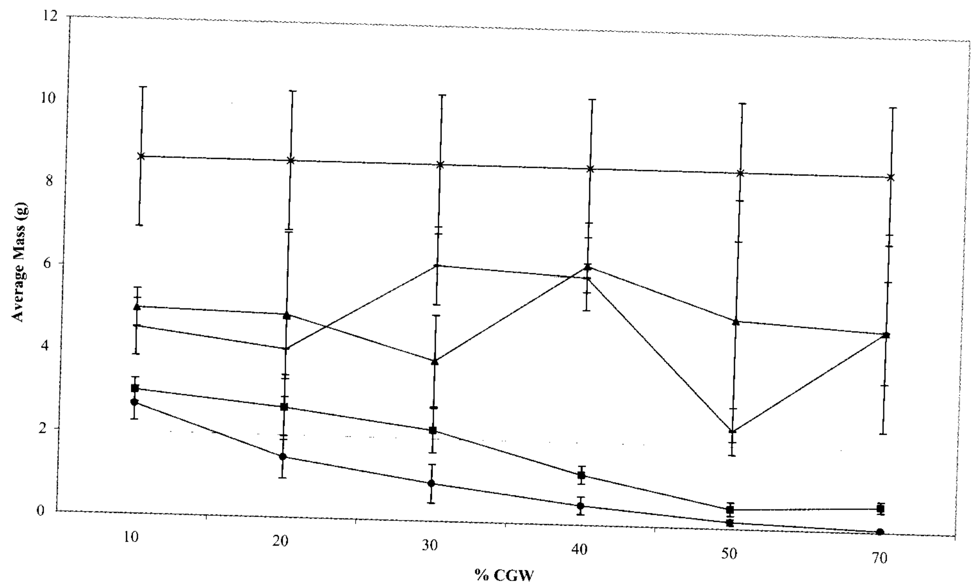

Fig. 5. Fresh Weights obtained from tomatoes grown in samples containing Peat/CGW mixtures, and an all peat medium. × indicates the 100% peat mix – indicates sample 4. ■ indicates sample 5. ▲ indicates sample 10. ● indicates sample 11. The 95% confidence limits are shown by error bars.

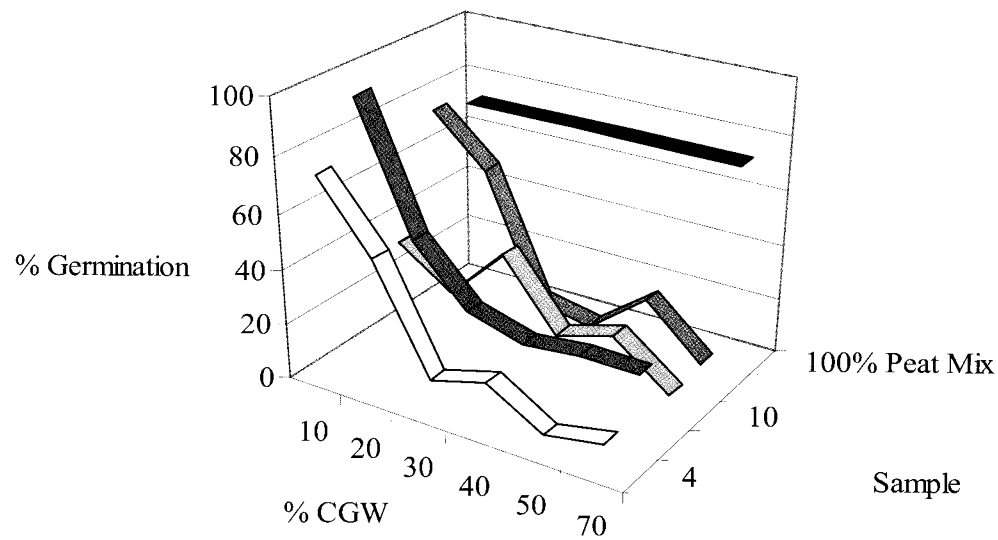

Fig. 6. Germination of lettuce seeds from samples containing Peat/CGW mixtures, and an all peat medium. ■ indicates 100% Peat Mix. □ indicates sample 4. ▪ indicates sample 5. indicates sample 10. ▪ indicates sample 11.

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Institute of Agricultura
Estonian Agricultural
Tartu
Estonia

Keywords: ornamenta

Abstract

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INTRODUCTION

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