Benefits and drawbacks of composted materials as a constituent of peat-based growing media

M. Prasad and W.R. Carlile

Bord na Mona Horticulture Main Street, Newbridge, Co Kildare Ireland
e-mail munoo.prasad@bnm.ie

Summary

The effect of compost addition to peat on the physical and chemical properties, and enzyme activity within growing media based on research carried out by Bord na Mona and elsewhere is briefly reviewed. Addition of compost can lead to a reduction in nutrient, lime, and wetting agent input and lead to reduction in soil borne disease. However, there are also certain negative effects such as increase in bulk density, increase in breakdown of peat and the processing of compost requires a large investment in long term research and costly rigorous quality control.

Key index words: Plant nutrients, Micronutrients, Physical properties, enzyme activity, disease suppression.

Introduction

Currently in the UK and elsewhere, pressure is being exerted to reduce peat usage in horticulture. For example a major UK multiple retailer has aspirations to reduce overall peat usage within its horticultural operations to 10% by 2010. Although inorganic materials can be added to dilute peat with no or very little pre-treatment, in most cases these materials are not financially viable when used at high levels of dilution, and their energy intensive production results in an adverse C footprint. Composted organic waste of botanical origin is an attractive candidate for peat dilution. The objective of this research review is to briefly indicate the benefits and drawbacks of adding such green compost to peat based media, and is based on more than a decade of research carried out by Bord na Mona and elsewhere. The use of composted materials in growing media is extensively reviewed by Prasad and Carlile (2008)

Beneficial effects:

Financial

A modest amount gate fee may be available when certain types of organic wastes are delivered to the factory. Until recently in Ireland, organic waste has been diverted to landfill. However, very recently the Irish government has decided to increase the gate fee by 33%. Indeed, in future, the government may pay a small subsidy if a high quality product (suitable for example for inclusion in growing media) is produced from recycled material.

Chemical Properties

Most biodegradable waste of botanical origin has high levels of many plant nutrients. Peat naturally has very low levels of K but many composted materials have very high levels of K (Table 1) (Prasad *et al.*, 2007). It is therefore not necessary to add K fertiliser, when peat is diluted with composted materials of botanical origin. However the EC levels are often the limiting factor on how much green compost can be added to peat. Depending on feedstock of the composted materials there can be saving on the amount of N and P required to be added, with a concomitant financial saving. Similarly the addition of other feedstocks such as poultry manure or N rich dairy processing waste as feedstock for the compost could reduce significantly or even eliminate the need for additions of mineral fertilizer.

In a trial carried out in Bord na Móna, the effect of addition of composted material (based on greenwaste/

Table 1. Chemical Properties of composted materials and peats(CGW = composted green waste and CBW = Composted biowaste)

	pH units	EC µs/cm	NH_4-N (mg/L)	NO_3-N (mg/L)	P (mg/L)	K (mg/L)	OM %
CGW	8.15	1074	72	66	55	1232	40
CBW	8.02	4440	70	254	40	2156	55
Swedish Peat	3.7	88	4	2	2	3	99
Irish Peat	3.9	150	5	1	1	5	98

Table 2. Effect of additions of CBW on pH, EC and exchangeable cations

Compost Rate %	Limestone Rate, g/L	pH Compost effect	pH Lime effect	Ex. CA mg/L Compost effect	Ex Ca mg/L Lime effect	Ex. Mg mg/L Compost effect	Ex.Mg mg/L Lime effect
0	0	3.51	3.51	141	141	99	99
10	1	4.37	4.02	454	257	135	159
15	2	4.64	4.70	559	468	193	164
20	3	4.83	5.57	689	507	248	241
30	4	5.16	5.70	874	654	318	262

brewery waste) on pH, exchangeable Ca and Mg was studied (Prasad unpublished 2006 and Table 2) The trial showed that composted material can increase pH and exchangeable Ca and Mg. Thus the lime addition to growing media could be eliminated or reduced considerably. Further trials in Bord na Mona have shown that certain micronutrients can be dispensed with when certain composted materials are added at an adequate rate (Prasad and Maher 2006). Where no compost was added omitting boron, copper and iron severely reduced plant growth (Figure 1). At 5% of compost addition there was still a significant response to the addition of micronutrients but where compost was added at a rate of 10% or more the effect of addition of micronutrient disappeared. This example illustrates clearly that there can be saving on micronutrient addition when green compost is added.

Physical Properties.

There is anecdotal evidence that adding "fine" compost can increase the amount of water that is held strongly and possibly reduce the time to wilting. This means that watering frequency can be reduced somewhat. Preliminary work (Carlile, unpublished data) at Bord na Mona has shown that the wetting properties may be improved when composted material is added to peat. Thus wetting agent rates could be reduced.

Biological Properties

Trials conducted by Bruns and Schuler (2002) showed clearly that by adding yard waste and biogenic compost up to 60% to peat resulted in suppression of several pathogens (*Pythium ultimum, Phytophthora*) for a number of plant species. Reduction in disease incidence ranged from 30 to 80% when disease incidence in the control peat was 70 to 90%. A number of other workers have also reported similar results.

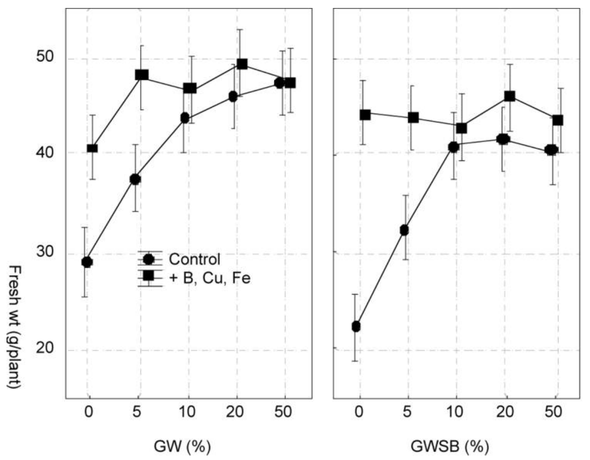

Figure 1. Effect of compost type, compost rate and trace element addition on the fresh weight of tomato seedlings (Error bars show 95% confidence intervals).

Fluorescein diacetate (FDA) is considered to be an index of overall hydrolytic enzyme activity in soils and has been shown to be an indicator of disease suppression (Hoitink and Boehm 1999). However the FDA method has not been very successful in predicting disease suppression in all cases (Pettitt 2002). This is because the effect is largely unpredictable due to limited knowledge factors influencing disease suppression.

At Bord na Mona, trials were conducted on the effect of addition of two types of compost to two types of peat on FDA activity (Prasad and Ni Chualain 2007). The results showed that the increases of FDA and dehydrogenase, another indicator of microbial activity, are more obvious in H_5 peat than with H_2 peat especially with compost at the higher rate (Fig 2). This would indicate that there is a likelihood of reduced soil borne disease when compost is added to peat. However more work needs to be done to develop tests that would be able to predict this property of disease suppression,

There are reports that show that the addition of compost to peat leads to reduction of liverwort and moss growth (Rainbow 2007). This is presumably due to the fact that compost amended peat tends to dry out faster especially on the surface.

Drawbacks

The stability of growing media during storage is very important particularly for retail products as often growing media in bags are stored for a year or more. The storage stability of two peats mixed with composted greenwaste (Greenwaste) at two rates was studied by Richardson and Rainbow (2005). These results showed that there is nitrogen "lock up" particularly with less humified Finnish peat. As compost rates went up, there was, as expected, an increase in the "lock up". Our results showed however that CGW added to Irish peat showed no "lock up" of nitrogen. Obviously the stability of the compost is significant.

Maher and Prasad (2002) studied the effect of adding composted green waste (CGW) to peat-based growing media. The peats were relatively un-decomposed (H_2) and moderately decomposed peat (H_5). In the presence of compost, H_2 peat degraded at a much greater rate than the H_5 peat. Addition of immature green compost increased degradation of both peats whereas the mature green compost only increased degradation in the H_2 peat (Fig 3). The addition of greenwaste leads to an increase in bulk density and a decrease in easily available water (Prasad and Maher 2000). The increase in bulk density increases transport costs. In addition the decrease in easily available water would lead to growing media needing more frequent watering during cropping (see Table 2).

The success of the peat dilution from experience at Bord na Móna depends on rigorous quality procedures; regular measurements of CO_2, temperature and moisture in windrows, stability tests, growth studies and phytotoxicity of the end product prior to incorporation into growing media. All these tests add to the cost of the product. In addition research in Bord na Mona on peat dilution started around the mid nineties and the peat dilution programme is based on this research. Bord na Mona had the foresight to put this considerable investment in research.

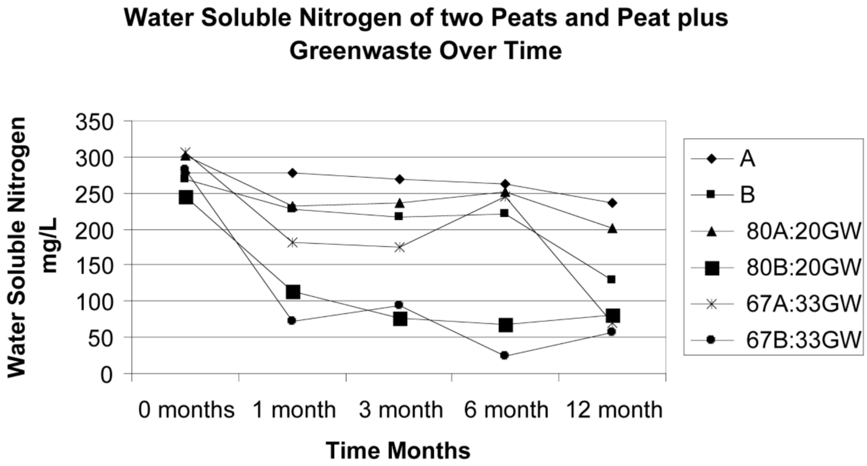

Figure 2. Changes in soluble N over Time A= Irish peat (H5), B= Finnish peat (H_2-H_3)

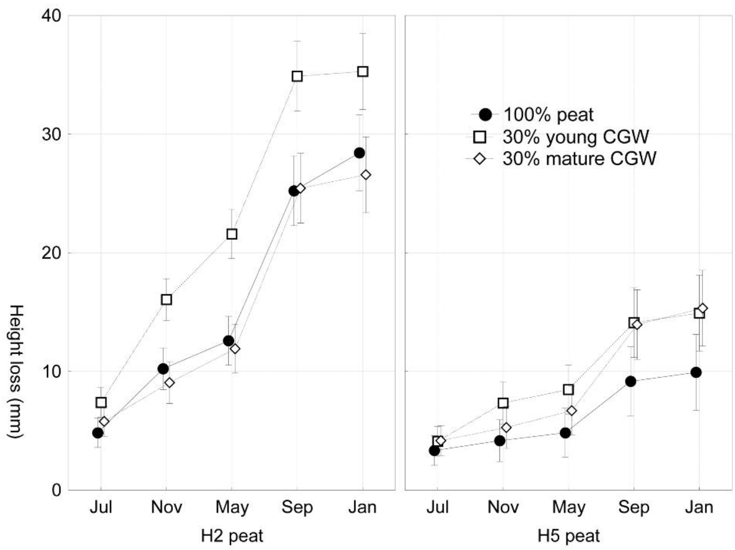

Figure 3. The effect of addition of young and mature green compost to two types of peat on the physical degradation of the growing medium.

Table 3. Physical analysis of peat mixes with CGW

Rate	BD[1] (g/L)	TPS[2] (%)	AS 10 cm	EAW[3] (%)	WBC[4] (%)
CGW					
12.5	168	89.8	23.7	19.5	2.9
25	194	89.0	27.9	17.3	2.1
50	251	86.5	30.2	14.5	1.4

[1] Easily Available Water: water content at 10 cm – water content at 50 cm tension, BD= Bulk density, TPS= Total Pore Space, AS=Air Space, WBC=Water Buffering Capacity

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