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Use of pruning waste compost as a component in soilless growing media

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Abstract

The objective of this work was to study the use of pruning wastes compost (PWC) as a growing media component for ornamental plants. The main physical, chemical and biological characteristics of PWC were analysed in order to evaluate its suitability for use in soil-less cultivation. Six growth substrates were prepared by mixing PWC with peat (P), ground leaves (GL), sand (S) and spent mushroom compost (SMC) in different proportions. Two different pot experiments were carried out to test its characteristics of production using perennial ryegrass (*Lolium perenne* L.) and cypress (*Cupressus sempervirens* L.) as indicators and the different media as treatments.

The growth experiments showed that PWC required mixing with a nutrient-richer material to produce higher results. Therefore, substrates containing SMC (PWC + P + SMC and PWC + SMC) seems to be the most adequate growing media. After the statistical analysis, we concluded that the PWC could be used as a growing media component.

Keywords: Pruning waste compost; Growing media; Peat substitute; *Cupressus sempervirens*

1. Introduction

During the last two decades, evolution of plant growth techniques and substrates has increased demands for *Sphagnum* peat, but the supply has been decreasing (Inbar et al., 1990). Depletion of a non-renewable resource such as peat, and environmental deterioration because of peat mining together with its high price in the market have favoured the utilization of alternative materials as growth substrates (Abad et al., 2001). Developing inexpensive and nutrient-rich organic media alternatives cannot only eliminate environmental impacts, but it also means to reduce fertilization rates, irrigation rates and nursery costs (Wilson et al., 2001).

Traditionally, residues such as urban solid wastes, sewage sludge, spent mushroom substrate and even green wastes were considered as non-desirable or with little value. Nowadays, numerous studies have demonstrated that these organic residues, after proper composting, can be used with very good results as growth media instead of peat (Verdonck, 1984, 1988; Raviv et al., 1986; Chen et al., 1988; Bugbee and Frink, 1989; Piamonti et al., 1997; García-Gómez et al., 2002).

Among organic residues used successfully as plant growing media is the compost from green residues. Hartz et al. (1996) found that tomato production was similar when using either peat or green waste compost

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mixed with perlite 50% by volume. Spiers and Fietje (2000) got similar conclusions when comparing a mixture of green waste compost (30% v/v), bark (50% v/v) and sand (20% v/v) with pine bark also for tomato production.

Literature shows great variability between pH values, electrical conductivity, or nutrient contents among these types of compost (Hegberg et al., 1991; Hartz et al., 1996; Spiers and Fietje, 2000; Benito et al., 2000), but all conclude that they must be considered as good quality plant growth substrates. The end product variability will depend not only on the predominant vegetation in the area or the composting process but the type of collection as well as the season of the year. For this reason it is essential to know the physical, chemical and biological characteristics of the material and to compare these with those required for its use as a growth medium.

Although there is a wide range of wastes that have been studied as peat substitutes, there is no information concerning the use of pruning waste compost as an alternative to commercial composts used as substrates. The closest materials to pruning waste compost are green wastes or yard wastes but they have a much larger amount of leaves and grass clippings.

The aim of the present work was to evaluate the use of compost made from pruning waste in the preparation of substrates for ornamental plants in pots in order to determine if there is any limitation to its use.

2. Methods

2.1. Materials

The Department of Parks and Gardens of the City Hall of Madrid manufactured the compost used in the present study from pruning waste, leaves and grass clippings in the composting facility of "Migas Calientes". Although there are some seasonal variations in the quantities and characteristics of green waste in the city of Madrid, approximately 60–70% of the waste volume manufactured is woody material, mainly from pine, plane, smoothleaf elm and horse chestnut and the rest of it varies from leaves to grass clippings.

Windrow piles 2.5 m high by 30 m long were constructed using shredded material. Forced aeration was used for the first eight weeks (bio-oxidative phase), followed by a ten-month maturation period during which the piles were turned periodically to maintain adequate O_2 levels. During the bio-oxidative phase of composting air was blown through the holes of two tubes placed at the base of the pile. The ceiling temperature for continuous aeration was 70 °C. The O_2 saturation level was also controlled and when it fell below 82% the aeration system was turned on. During the maturation phase the pile was turned every 15 days in order to improve both the O_2 level inside the pile and the homogeneity of the material. Pile moisture was controlled weekly by adding enough water to obtain a moisture content of not less than 50%. The end product was passed through a 10 mm sieve.

Table 1
Composition of growing media used in the study

Media	Formulation
PWC	PWC (100%)
M1	PWC (90%) + peat; P (10%)
M2	PWC (75%) + peat (25%)
M3	PWC (60%) + peat (20%) + ground leaves; GL (10%) + sand; S (10%)
M4	PWC (60%) + peat with corrected pH (20%) + ground leaves (10%) + sand (10%)
M5	PWC (50%) + peat (25%) + spent mushroom compost; SMC (25%)
M6	PWC (50%) + spent mushroom compost (50%)

PWC: pruning waste compost.
% Volume in brackets.

Taking into account PWC characteristics, it was mixed with other materials in order to prepare suitable PWC-based media for potted plants. Table 1 shows the volumetric formulations of the different media used in this study. Ground leaves (GL) and sand (S) were chosen because they are conventional potting materials in the nurseries. The spent mushroom compost (SMC) was used because it is being studied to replace peat in some nurseries of Madrid. A Canadian *Sphagnum* peat was also mixed with the materials described above. Its main characteristics were: pH = 4.8, electrical conductivity = 0.13 $dS\,m^{-1}$, total organic carbon (TOC) (% dry wt) = 52.82, total N (% dry wt) = 0.66, cation exchange capacity (CEC) = 167.3 $cmol_+\,kg^{-1}$ and C/N = 80. After amending with $CaCO_3$, the pH reached a value of 5.9.

2.2. Analytical methods

The pruning waste compost and the different substrates were analysed for total organic C (TOC) by the dry combustion method at 540 °C (Nelson and Sommers, 1982) and total N (TN) by Kjeldahl digestion (Bremmer and Mulvaney, 1982). Electrical conductivity (EC) and pH were analysed in a 1:5 (v/v) water extract. After water extraction (1:5 v/v), NO_3^--N and Cl^- contents were evaluated with selective ion electrodes, K by atomic absorption and P was determined colorimetrically following the Murphy and Riley (1962) method. The cation-exchange capacity (CEC) was determined with 1 M ammonium acetate at pH = 7 (Soil Conservation Service, USDA, 1972).

The physical properties of the materials were determined according to the methods of De Boodt et al. (1972, 1974), Samples of air dry media were passed