UNIVERSITI PUTRA MALAYSIA

OIL PALM WASTES AND SEWAGE SLUDGE COMPOSTS AS POTTING MEDIA FOR CHRYSANTHEMUM

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MASTER OF SCIENCE
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OIL PALM WASTES AND SEWAGE SLUDGE COMPOSTS AS POTTING MEDIA FOR CHRYSANTHEMUM

By:

KALA DEVI RAMAHSAMAY

Thesis Submitted in Fulfillment of the Requirement for the Degree of Master of Science in the Faculty of Agriculture
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SPECIALLY DEDICATED TO :-

My Beloved Grandparents, Eswaran,

Kavitha, Nerimala, Siva & Ramu

ACKNOWLEDGEMENTS

This project paper is specially dedicated to my beloved parents, who gave all the necessary strength and support through thick and thin from young till now, in order for me to embark upon and complete my Master of Science.

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Abstract of the thesis Presented to the Senate of Universiti Putra Malaysia in Fulfillment of the Requirements for the Degree of Master of Science

OIL PALM WASTES AND SEWAGE SLUDGE COMPOSTS AS POTTING MEDIA FOR CHRYSANTHEMUM

By

KALA DEVI RAMAHSAMAY

JULY 2004

Chairman : Assoc. Prof. Dr. Rosenani bt. Abu Bakar

Faculty : Agriculture

The use of oil palm wastes, particularly the empty fruit bunch (EFB), frond and trunk as compost are now receiving greater attention by researchers. Another organic waste that needs to be disposed off in Malaysia is sewage sludge. This research is important in reducing waste management problem and conserve plant nutrients. Therefore the objective of this study was to determine the optimum blend of oil palm wastes (EFB, frond and trunk) and sewage sludge that will produce a compost physically similar to peat which can be used as potting media.

Analysis of samples of sewage sludges collected from ten different Indah Water Consortium treatment plants in Peninsular Malaysia, showed that the chemical characteristics of the sludges varied greatly, i.e. 6.13 to 57.67% C, pH_{water} 3.57 to 6.43, 0.68 to 2.90% total N, 0.24 to 1.62% P, C/N ratio 4.13 to 37.94, 112 to 2902 $mg.kg^{-1}$ Mg, 401 to 1209 $mg.kg^{-1}$ K, and 0.16 to 2.16% Ca. The concentrations of heavy metals in sludges also varied greatly, i.e. 36 to 308 $mg.kg^{-1}$ Pb, 0.51 to 6.49 $mg.kg^{-1}$ Cd, 63 to 732 $mg.kg^{-1}$ Cu, 32 to 420 $mg.kg^{-1}$ Mn, 10 to 151 $mg.kg^{-1}$ Ni, 1.22 to 4.01% Fe and 153 to 7012 $mg.kg^{-1}$ Zn. Sewage sludges produced by Indah Water Konsortium (IWK) has low levels of heavy metals (except for Zn) and may be used on ornamental plants but caution should be taken for plants that are sensitive to Zn.

A study on composting different oil palm wastes with sewage sludge was carried out on a small scale in the glasshouse by using a polystyrene box. Shredded oil palm wastes (EFB, frond and trunk) were mixed with sewage sludge in different ratios (100:0, 3:1 and 4:1 ratio) and moistened to 50 % moisture content. Based on the temperature, C/N, NH_4^+-N and NO_3^- - N + NO_2^- -N patterns of the oil palm wastes-sludge blends during 12 weeks composting, all EFB, frond and trunk with added sludge composts seemed to perform similarly. After 12 weeks of composting, the trunk composts had finer particle size, similar to peat, compared to the other composts. However, the EFB-sludge and frond-sludge composts still contained long strands of fibres. These composts may need to be composted for more than 12 weeks to achieve finer particle size. The trunk:sludge (4:1) compost was selected to be the best compost in terms of particle size, colour, nutrient and heavy metals content. It had 2.05 % total N, pH_{water} 6.2, 18.96 C/N ratio, 0.71% Ca, 0.64% P, 1.39% K, 0.23% Mg and heavy metals concentrations of 26.30 $mg.kg^{-1}$ Pb, 671 $mg.kg^{-1}$ Zn, 6306 $mg.kg^{-1}$ Fe, 91.93 $mg.kg^{-1}$ Mn, 1.63 $mg.kg^{-1}$ Cd and 68.83 $mg.kg^{-1}$ Cu, which is within the recommended levels of Council of European Communities guidelines, CEC (1986) in compost.

When the trunk:sludge (4:1) compost was tested with potted chrysanthemum, plants grown in compost and compost:peat (3:1 v/v) potting media had good vegetative growth (top dry matter weight and total leaf area) and other flowering qualities (earlier appearance of first visible bud/flower and higher number of bloomed flowers) which are suitable for sale than the standard peat medium. The growth of chrysanthemum was influenced by the addition of fertilizers. The use of the compost with only slow release fertilizer, agroblend, was found to be sufficient to produce good plant growth of flowers per pot. Thus this would decrease the cost of fertilizer and labour. On the whole the growth performance of compost and compost:peat (3:1 v/v) growth medium were similar. Therefore, this study showed that composted oil palm trunk-sewage sludge has the potential to be used as a soilless potting medium for chrysanthemum, i.e as a substitute for peat. This may convert oil palm waste into a value-added product and provide an alternative disposal method for sewage sludge produced by IWK.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

KOMPOS KELAPA SAWIT DAN ENAPCEMAR KUMBAHAN SEBAGAI MEDIA TANAMAN KEKWA

Oleh

KALA DEVI RAMAHSAMAY

JUNE 2004

Pengerusi : Proffesor Madya Dr. Rosenani bt. Abu Bakar

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Kegunaan sisa kelapa sawit, iaitu tandan buah kelapa sawit kosong (EFB), pelepah dan batang kelapa sawit sebagai bahan untuk kompos kini mendapat sambutan para penyelidik. Satu lagi bahan buangan di Malaysia yang menjadi masalah pelupusan ialah enapcemar kumbahan. Kajian ini penting untuk mengurangkan masalah pembuangan sisa organik dan untuk mengekalkan

nutrien tanaman. Objektif kajian ini adalah untuk menentukan formulasi campuran optimum sisa kelapa sawit (EFB, pelepah atau batang) dan enapcemar kumbahan yang akan menghasilkan kompos yang secara fisikalnya, serupa dengan tanah gambut untuk diguna sebagai media tanaman pokok hiasan.

Analisis enapcemar kumbahan yang diperolehi daripada 10 loji rawatan Indah Water Konsortium di Semenanjung Malaysia menunjukkan ciri-ciri kimia enapcemar kumbahan sangat berbeza, iaitu, 6.13 - 57.67% C, pH_{air} 3.57 - 6.43, 0.68 - 2.90% N, 0.24 - 1.62% P, 4.13 - 37.94 C/N, 112 - 2902 $mg.kg^{-1}$ Mg, 401 - 1209 $mg.kg^{-1}$ K, dan 0.16 - 1.17% Ca. Kandungan logam berat dalam kumbahan-kumbahan juga berbeza iaitu: 36 - 308 $mg.kg^{-1}$ Pb, 0.51 - 6.49 $mg.kg^{-1}$ Cd, 63 - 732 $mg.kg^{-1}$ Cu, 32 - 420 $mg.kg^{-1}$ Mn, 10 - 151 $mg.kg^{-1}$ Ni, 1.22 - 4.01% Fe dan 153 - 7012 $mg.kg^{-1}$ Zn. Enapcemar kumbahan yang diperolehi mempunyai kandungan logam berat yang rendah kecuali kandungan Zn. Maka disyorkan enapcemar kumbahan ini sesuai untuk tanaman hiasan tetapi perhatian perlu diberi kepada pokok-pokok yang terlalu sensitif kepada Zn.

Satu kajian pengkomposan kelapa sawit dan enapcemar kumbahan dijalankan secara kecil-kecilan menggunakan kotak polisterin di rumah kaca. Tandan buah kelapa sawit kosong (EFB), pelepah dan batang kelapa sawit dipotong/dicincang menjadi saiz kecil sebelum dicampur enapcemar kumbahan dengan kadar (100:0, 3:1 dan 4:1) dengan kandungan kelembapan lebih kurang 50 %. Semasa 12 minggu pengkomposan, didapati suhu, nisbah C/N, corak kandungan NH_4^+-N dan NO_3^- - N + NO_2^- -N yang diperolehi daripada campuran EFB, pelepah dan batang kelapa sawit dengan enapcemar kumbahan adalah serupa. Kompos hasil daripada batang kelapa sawit dengan penambahan enapcemar kumbahan mempunyai saiz partikel yang lebih halus, seperti tanah gambut berbanding kompos lain. Manakala kompos EFB dan pelepah kelapa sawit dengan penambahan enapcemar kumbahan masih mempunyai serat-serat yang panjang. Kompos tersebut perlu dibiarkan lebih daripada 12 minggu untuk matang dan mencapai saiz partikel yang halus. Oleh itu, kompos batang kelapa sawit dengan penambahan enapcemar kumbahan (4:1) dipilih sebagai kompos terbaik berasaskan saiz partikel, warna dan kandungan nutrient dan logam berat. Kompos ini mempunyai 2.05% N, pH_{air} 6.2, nisbah C/N 18.96, 0.71% Ca, 0.64% P, 1.39% K, 0.23% Mg dan mengandungi kandungan logam berat, 26.30 $mg.kg^{-1}$ Pb, 671 $mg.kg^{-1}$ Zn, 6306 $mg.kg^{-1}$ Fe, 91.93 $mg.kg^{-1}$ Mn, 1.63 $mg.kg^{-1}$ Cd dan 68.83 $mg.kg^{-1}$ Cu, di bawah paras yang disyorkan oleh Council of European Communities, CEC (1986) untuk kompos.

Apabila kompos batang kelapa sawit dengan enapcemar kumbahan (4:1) ini diguna sebagai media untuk tanaman pokok kekwa, didapati kompos dan kompos:gambut (3:1 v/v) menghasilkan ciri-ciri pokok kekwa yang lebih baik iaitu pertumbuhan pokok yang baik (jumlah berat kering dan luas daun) dan kualiti bunga (bilangan hari kudup/pembungaan yang singkat dan bilangan bunga yang banyak) yang sesuai untuk pemasaran berbanding dengan media tanah gambut. Pertumbuhan kekwa juga dipengaruhi oleh penambahan baja. Pengunaan baja pelepasan perlahan (Agroblend) sahaja didapati menghasilkan pertumbuhan pokok dan bilangan bunga yang bagus. Secara tidak langsung ini boleh mengurangkan kos baja dan buruh. Tiada didapati perbezaan yang bererti di antara media tanaman kompos dan kompos:gambut (3:1 v/v). Oleh itu kajian ini telah membuktikan bahawa kompos batang kelapa sawit dengan enapcemar kumbahan mempunyai potensi digunakan sebagai media tanaman untuk pokok kekwa, menggantikan gambut. Ini boleh menambahkan nilai produk kelapa sawit dan satu alternatif bagi pembuangan enapcemar kumbahan dari IWK.

I certify that the Board of Examiners have on July, 2004 to conduct the final examination of Kala Devi Ramahsamy on her Master of Science thesis entitled 'Oil Palm Wastes and Sewage Sludge Composts as Potting Media for Chrysanthemum' in accordance with Universiti Putra Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981, and the Board recommended that the candidate consists of following persons:

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This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science.The members of Supervisory Committee are as follows:

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CHAPTER 1

GENERAL INTRODUCTION

Currently, very limited choices of potting media are available in the market, i.e. mainly peat, coconut coir dust (CCD) and red clay soils. Therefore suitable substitutes or alternatives need to be sought before shortage occurs. Moreover every time a container-grown plant is sold, the rooting subrate is sold with it, necessitating the need for more substrate.

Peat is one of the traditional organic materials that have been used extensively in ornamental horticultural industries to prepare potting/planting media. However, peat is a finite resource and large scale of peat extraction causes environmental damage (Barber, 1993; Barkham, 1993; Buckland, 1993). Rising prices and decreased availability of fertilizer have also caused growers to