Studies on Indoor Air Pollution
5- A Formulated Potting-Mix Suppressive to Microorganisms

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Abstract: Three types of potting materials (Sand, Peat-moss and Vermiculite) and their combinations beside 5 tree bark (TB, *Eucalyptus camaldulensis, E. citrodora,* pine, cinnamon and olive barks) were used as a potting mix to minimize the microbial content components of soil mix. The aim is to overcome the criticism of health organizations concerning the growth of microorganisms in indoor potting mix. Results indicated that nutrient peat-moss media followed with the mixture of peat-moos and vermiculite, meanwhile sand and vermiculite media amended with tree-bark have the lowest population of microorganisms.

Keywords: Container medium, potting mix, microorganisms, peat-moss, sand, vermiculite.

INTRODUCTION

Potting Mix is a product made from organic and inorganic materials and contains living micro-organisms, including bacteria, fungi, algae, candida and protozoa. It may include new microorganisms. Very little is known about the microbial carrying capacity of the potting mixes. Materials such as sand, vermiculite, peat, tree bark are commonly used in the synthetic potting-mix.

Airborne microorganisms in indoor environments remain a problem of indoor air quality (IAQ). Spores and environmental microorganisms may enter from the outdoors, but once growth (amplification) occurs indoors, they may appear in the return air at higher levels than in the outdoor air. Spores can initially enter a building by various routes, including inlet air or infiltration, or they may be brought in with residents, visitors, carpets, clothes, foods, insects, animals or potting soil (Kowalski, 1998).

Huang and Huang (2000) concluded that some spores of microorganism causing serious health problems in hospitals can be found in ornamental potting mix. They added that the peat media are considered conducive to some pathogens, whereas composted hardwood bark media are considered suppressive.

Hardy and Sivasithamparam (1991) said that a potting medium containing composted *Eucalyptus* barks was suppressive in decreasing order to *Phytophthera* infection. They added that the suppressiveness of the *Eucalyptus* bark appears to be biological. Poole and Conover (1991) mentioned that pine bark is currently the most widely utilized for potting media. They added that several other types of tree products such as olive bark, cinnamon inner bark and *melaleuca* bark are also successfully used as potting mix ingredients.

Senhaji et. al., (2005) and Shan et al., (2007) found that water extract of cinnamon bark displayed antifungal activity on Candida, *Penicillium cyclopium*, *Aspergillus parasiticus*, *A. niger* and *A. flavus*. Hoitink et. al. (1991) revealed that most of the peat sold for use in container media is of a decomposition level that cannot support the growth and activity of microorganisms

Materials such as sand, vermiculite, peat, tree bark are commonly used in the synthetic potting-mix. Selection of these materials was depending on their ability to suppress or repel or kill the microorganisms in the mix. Although container media are generally pathogen-free, infestation of these media by pathogens often occurs in the hospitals. Huang and Huang (2000) concluded that the peat media are considered conducive to some pathogens, whereas composted hardwood bark media are considered suppressive.

For the indoor decorations, selection of the proper materials must depend on their ability to suppress or repel or kill the microorganisms in or reach to the mix. Although container media are generally pathogen-free, infestation of these media by pathogens often occurs indoors specially in the hospitals. The objectives of this study were to develop the medium and to investigate its suppression effect on microorganisms to minimizing the risks associated with the use of potting mix indoors.

There is evidence that the amount of airborne micro-organisms does not increase when plants are added to the space. In a study conducted in a hospital radiology department no changes in content of fungi or fungal spores were recorded after introducing plants (Fjeld 2000). One study reported reduced dust accumulation on horizontal surfaces when plants were put in a room (Lohr and Pearson-Mims 1996).

World Health Organization Media centre concluded that some spores of microorganism causing serious health problems in hospitals can be found in *ornamental potting mix.* So the use of potting-mix for container indoor plants in hospitals needs an important selection.

MATERIALS AND METHODS

This work was carried out during 2005 and 2006 at the Horticulture Department Laboratories of Suez Canal University to study the effect of some potting media components and other additives on the microorganisms found in pots. Treatments were arranged in 3 replications, each containing 10 Pots (8-cm diameter), using a complete randomized block design. The experiment was performed twice. Pots were left for three months and samples were taken to calculate the total number of microorganisms.

Sand, Peat-moss, Vermiculite and equal weights of air dried and shredded into particles small about 0.5-1.0 cm and mixed of *Eucalyptus camaldulensis, Eucalyptus*

citrodora, pine, cinnamon, and olive barks (5 tree bark, 5TB) which having antifungal and antibacterial properties. Bark incorporated at 25% by volume.

The treatments were:

1. Sand
2. Peat-moss
3. Vermiculite
4. Sand + Peat-moss
5. Sand + Vermiculite
6. Peat-moss + Vermiculite
7. Sand + 5TB
8. Peat-moss + 5TB
9. Vermiculite + 5TB
10. Sand + Peat-moss + 5TB
11. Peat-moss + Vermiculite +5TB
12. Sand + Vermiculite + 5TB

Three samples from each medium were taken and air-dried. Microbial populations were estimated by the serial dilution plate technique, using nutrient agar for bacteria and peptone-dextrose-rose bengal agar for fungi (Huang and Kuhlman, 1991).

RESULTS AND DISCUSSION

Survey of the microorganisms can be found:

The Petri dishes were examined and microorganisms were defined in the microbiology department, faculty of science, Suez Canal University. Following genera belong to different microorganisms groups:

Acremonium, Agoneycete, Alternaria, Aspergillus, Botryclipodia, Botryotrichum, Botrytis, Cladosporium, Epicoccum, Nigrospora, Paecilomyces, Populospora and Rhizopus.

Data of the microbial carrying capacity of the potting mixes as affected by different potting mixes are found in Table (1).

Table (1): Carrying capacity of the potting mixes as affected by different potting mixes and Ec and pH values

Media type	Number of colonies/Petri dish (average of 10 plates)	Ec	pH
Sand	8 f	0.137	7.46
nutrient Peat-moss	94 a	0.395	6.84
Vermiculite	45 d	0.388	6.08
Sand + Peat-moss	59 c	0.093	6.68
Sand + Vermiculite	50 cd	0.133	7.23
Peat-moss + Vermiculite	71 b	0.245	6.24
Sand + 5TB	23 e	0.520	6.35
Peat-moss + 5TB	48 cd	0.906	4.26
Vermiculite + 5TB	20 e	0.849	5.29
Sand + Peat-moss + 5TB	29 e	0.346	6.45
Peat-moss + Vermiculite +5TB	46 d	0.240	6.45
Sand + Vermiculite + 5TB	25 e	0.536	6.68

Data reported in this Table (1) indicate clearly that peat-moss followed with the mix of Peat-moss + Vermiculite led to significant increase in total number of microbial colonies/Petri dish. These results were confirmed by Huang and Huang (2000) who concluded that *the peat* media are considered conducive to some pathogens, whereas composted *bark* media are considered suppressive.

The lowest total number of microbial colonies/Petri dish were recorded with either sand or vermiculite supplemented with 25% grounded barks of the five selected trees. This may be due to that the sand showed low pH value, and the grounded bark contains antibacterial and/or antifungal compounds (Hardy and Sivasithamparam , 1991). Besides, the water extract of cinnamon, which can be obtained from frequent irrigation, can prevent the growth of new spores (Senhaji et al, 2005). Poole and Conover (2005) recommends *Eucalyptus* Bark Mix for Suppression of *Phytophthera* Root Rot by a Composted.

Generally, amendment potting-mix with tree bark significantly increased the suppressiveness to microorganisms. Amendment of peat-moss medium with either sand or vermiculite significantly reduced incidence of microorganisms (Table 1).

Microbial Population in the Container Medium: The suppressive effect of tree bark may be due to the active constituents of all tree barks used. Meanwhile the lower number of microorganisms in sand or its mixture may be due to its lower content of organics and Ec value (Table 2). This study recommend to use a potting-mix contain vermiculite and sand and amended with tree bark of *Eucalyptus camaldulensis, E. citrodora,* pine, cinnamon and olive, to decrease the microorganisms population in indoor pots.

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دِراسات على تلوثِ الهواء الداخلي
٥- بيئة زراعة للإصص لا تشجع نمو الكائنات الحيّة الدقيقة

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استخدمت ثلاثة مِنْ أنواع بيئات زراعة الإصص وهي الرمل والبيتموس والفيرمكيولايت ومخاليطهم، بجانب إضافة مخلوط من القلف المقطع لأشجار الكافور الليموني والكافور كمالديولنسس والصنوبر والقرفة والزيتون. الهدف من الدراسة التغلب على نقدِ منظمة الصحة العالمية التي تتعلقُ بنمو الكائنات الحيّة المجهرية في مخلوط بيئات إصص الزراعة للنباتات الداخلية. أشارتْ النَتائِجُ إلي أنّ البيتموس المغذي منفردا أوالمخلوط مع الفيرمكيولايت كانت أكثر المخاليط إحتواءا علي الكائنات الدقيقة. كانت بيئات الرمل والفيرمكيولايت والمخلوطة بقلف الأشجار هي الأقل في محتوي الكائنات الحيّة الدقيقة.