

Greening the Great Indoors for Human Health and Wellbeing

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A synopsis of the research by Margaret Burchett et al, University of Technology Sydney (YTS)

In March last year the report of a recent study into the effect of indoor plants on air quality, Volatile Organic Compounds (VOC) removal, mould spores in the air and wellbeing of building occupants was published in Australia.

The study looked at four areas:

1. Laboratory trials of VOC removal with three previously untried plant species
2. An office study to find minimum number of plants to remove VOCs and CO₂
3. A preliminary study into whether plants could increase airborne mould spore loads
4. An investigation of effects of plants on psychological wellbeing of staff

The four studies in more detail:

1. Laboratory study: Three plant species were used in test-chamber trials: *Aglaonema modestum*, *Chamaedorea elegans* and *Philodendron 'Congo'*. The plants were in 200 mm pots – a size usually supplied to offices by interior landscapers. Plants were growing in a standard potting mix for these species.

After initial acclimatisation (1 week) by exposure to initial dose of VOCs i.e. benzene, toluene, xylene and n-hexane¹ for this study, all three plants types could remove repeated doses within approximately 24 hours. Increased concentration of the doses accelerated the removal.



VOC removal is achieved by the plant/potting-mix bacteria working together.

This is the same as with previous studies using 9² other plant species. With this evidence it is likely that almost any species will have a similar VOC removal capacity

2. Plants and office air quality: Working from the position of knowledge from a previous study, when 3 plants reduced VOC levels in a 12m² office to below 100ppb and where the same number of plants or more reduced CO₂ levels by between 10 – 25%, this study looked at the affects of using less plants

Sample:

- 55 offices (approx 12m², single occupancy) in two buildings on the university campus
- 2 x 10 – 12 week periods: March to June and August to October 2008
- Groups of offices were randomly selected for plants – either 1 or 3 Spathiphyllum ‘Petite’ in 200 mm pots or 1 or 2 Dracaena ‘Janet Craig’ in 300 mm pots. Plus a group with no plants as the control
- During the second period plants were allocated randomly again including some of the previously no plant offices
- Weekly air quality measurements were taken
- VOC and CO₂ reductions were recorded. These were higher in the second period which could be a seasonal change (spring and more ventilation etc)

The reductions were less than previous studies probably due to lower levels of VOCs in the buildings, more efficient air conditioning systems (more modern) and inadequate lighting needed for photosynthesis when the removal of CO₂ takes place. The number of plants used was less than in previous studies.

It is recommended that indoor plants are located to accommodate their shade tolerance for best CO₂ removal.



N B Laboratory tests suggest that 2 plants make a considerable difference to reductions in VOCS but adding a 3rd plant makes less difference.

3. Plants as a potential source of mould based health risks: Air-borne mould spore samplings were also taken in the offices. Indoor and outdoor counts were compared. Results showed no significant effects of plants on spore counts indoors. Indoor counts were 1/20th of levels outdoors.

Method:

- Samplings were taken from all 55 offices twice in both Rounds 1 and 2 (a total of 244 samples)
- On the last three of these occasions, samplings of air outdoors was also taken
- Under microscopic investigation no signs of the named mould spore *Aspergillus fumigatus* were found

NB: *Aspergillus fumigatus* – often linked to damp building - is a significant contributor to fungal respiratory disease which in extreme immunocompromised patients – transplant, receivers of chemotherapy, HIV/AIDS patients – is likely to cause infection and has a high mortality rate of over 40%

4. Plants and staff wellbeing: Body of evidence from earlier international research reports positive effects of plants on health and wellbeing. Research has also shown that negative mood states reduce workplace productivity.

This investigation's aim was to examine the extent to which plants in offices can significantly improve mood states and create a sense of wellbeing and consequently improve productivity.

Method:

- One general lifestyle questionnaire was used with the delegates in the 55 offices before the trials began.



- This was followed by two psychological survey questionnaires to assess mood states which were administered at the beginning of Round 1 and again at the end of Round 2 to all delegates including those in the no-plant control group.

Plants were associated with 40 – 60% reduction of negative mood states measured by the surveys i.e. anger, anxiety, depression, confusion, fatigue and stress were all lower.

In the control group with no plants, stress levels rose by 20%.

Just one plant either on the floor or on the desk was enough to affect the difference.

Outcomes in brief:

1. Laboratory trials confirmed that three species tested have similar capacities to remove VOCs as nine previously tested species. Indicating that any species likely to have strong VOC removal capacity
2. Office study recorded VOC and CO₂ reductions but differences less marked than earlier studies. Likely reasons: greater efficiency of modern air conditioning systems, inadequate lighting
3. No significant effects were found on mould counts or types and no spores found in over 175 individual air samples from offices with plants (indoor counts about 1/20th of outdoor counts)
4. Highly significant reductions in negative mood states with plants – in anger, anxiety, depression, confusion, fatigue and stress. Just one plant can make the difference!

Notes:

- ¹ benzene, toluene, xylene - from the BTEX group found from both outdoor and indoor sources; used as industrial solvents for furnishings, finishes etc and n-hexane = also used as a solvent



² The 3 plants used in; laboratory tests in this investigation were:
Aglaonema modestum, Chamaedorea elegans, Dracaena deremensis
'Janet Craig'

The 9 other plant species are: Dracaena marginate, Epipremnum aureum,
Howea forsteriana, Philodendron 'Congo', Sansevieria trifasciata,
Schefflera 'Amate', Spathiphyllum 'Petite', Spathiphyllum 'Sensation' &
Zamioculcas zamiifolia

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