



National Interior Plantscape Association

Greening the Great Indoors for Human Health and Well-Being

Horticulture Australia Project No: NY06021

**Milestone Report No. 106
Project Report Date 31st July 2009**

HAL Project Number: NY06021

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NIPA Executive Committee Member and Treasurer

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Purpose of Report:

This report fulfils the Milestone Reporting requirements for the **Greening the Great Indoors for Human Health and Well-Being** Project – HAL Project Code NY06021 – Milestone Report No. 106 – agreement between Horticulture Australia Ltd (HAL), University of Technology Sydney (Faculty of Science) and the National Interior Plantscape Association.

Acknowledgement of Support:



Know-how for Horticulture™

Date of Report: 31st July 2009

Disclaimer:

Any recommendations contained in this publication do not necessarily represent current Horticulture Australia policy. No person should act on the basis of the contents of this publication, whether as to matter of fact or opinion or other content, without first obtaining specific, independent professional advice in respect of the matters set out in this publication.

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Vol 33, July 2009

Research Findings Submitted by:

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1. SUMMARY

1.1 Aims

The aims of the project are to determine the minimum numbers of indoor plants that can be beneficial to both indoor air quality and human health and wellbeing; to laboratory-test the capacity for removal of air-borne volatile organic compounds (VOCs) in three untried species; to help increase industry and public awareness of the health benefits of indoor-plants; and provide information to enhance measures for the marketing and use of indoor foliage plants in any type of building.

1.2 Progress

1.2.1 Office study

Air quality

In earlier Milestone Reports we have summarised the results of our study of the effects of four plant treatments on physicochemical air quality variables in 55 staff offices, from two Rounds of sampling (Autumn and Spring Semester, 2008), each Round of approximately a 10-week period. The variables so far reported include total VOCs (TVOCs), CO₂, CO, humidity, and temperature. We have not previously reported on counts of air-borne mould spores and their speciation, for which we sampled three times in each Round. We did this sampling because, although there is a considerable body of evidence confirming the benefits of indoor plants to building occupants, there is also a small, and somewhat inconclusive, number of publications indicating the possibility that indoor plants could be a significant contributor to mortality in severely immunocompromised individuals, due to mould infection or allergy, notably by *Aspergillus fumigatus* a mould found in soils and potting mixes¹⁻⁸. We considered that testing would not be complete without considering whether plant presence might significantly affect types and loads of air-borne mould spores. We used an RCS air sampler fitted with strips of agar gel containing Sabouraud's dextrose selective growth medium. Single samples of 80 L of air were taken from every office in each sampling. Results from the first week of each Round (mid March and late August) are summarised here. *However, confident findings must await analysis of the remaining four sets of samples.*

Results: Seasonal differences in spore loads were found between the two first samplings of each Round. Mean counts in March ranged between 35 and 50 colony forming units (cfu)/m³ in offices, whereas August counts were higher and more variable - between 50 and 150 cfu/m³. However, in neither case were there any significant differences among the four plant treatments, or between planted and unplanted (reference) offices. The counts compare favourably with the WHO guideline for maximum air-borne spore loads of phylloplane fungi - 500 cfu/m³. There was also no significant difference in counts between plants with and without a coconut-fibre finish. About 20 fungal genera and 25 species have been identified, the commonest being *Cladosporium*, *Penicillium* and *Rhizopus*, which are among the most cosmopolitan of genera wherever air is sampled, and generally regarded as harmless. About the same numbers of vegetative (unidentifiable) species were also found, which are stored preparatory to further culturing for possible identification. Only two occurrences of any *Aspergillus* species were detected in March, and six in August (*A. ochraceus*). There is thus no evidence so far that pot-plants make any difference to mould spore counts or species in offices and the incidence of any *Aspergillus* species has been very rare.

1.2.2 Occupant wellbeing

Two psychological survey questionnaires were administered twice, ie before plant installation, and after plants had been in offices for about 10 weeks. The General Health Questionnaire (GHQ) is used to assess levels of stress in the general population. The Profile of Mood States (POMs), tests six separate mood states, and yields an overall score of what might be termed 'low mood'.

Both the GHQ and POMs showed significant reductions in stress and associated symptoms with plant presence, with no significant differences among plant treatments. On the POMs surveys, plant presence was associated over time with significant reductions in: overall low mood, and on each of the specific states of tension, depression, anger, fatigue and confusion, plus increases in vigour. These are very gratifying results.

1.2.3 Laboratory studies

We have tested VOC removal capacity in a third species not previously investigated at UTS, *Chamaedorea elegans* (Parlour Palm). We used the same methods as previously reported. The initial dose of 5 ppm benzene took several days to eliminate, but by the third dose full induction was obtained, the dose being eliminated within about 24 hours. When the 25 ppm dose was then applied, the dose was again removed in approximately 24 hours.

Thus, 12 species have now been tested in this laboratory, all of which show virtually identical results. We postulate, therefore, that the weight of evidence indicates that any normal indoor plant foliage species is likely to be equally useful in reducing indoor VOC pollution. This conclusion/hypothesis is at variance with results of pioneering screening studies by Wolverton et al.⁹⁻¹¹; however, their tests were very short, and did not show the stepped inductions of VOC removal which we have now amply demonstrated after much more detailed and thorough experimentation.

2. NEXT STEPS

2.1 Office study

Air quality Mould spore counts from the remaining four samplings are in progress, and will be compared also with outdoor levels so that indoor/outdoor ratios and species profiles can be compiled. We have also stored strips with vegetative hyphae, preparatory to culturing them on agar plates in an effort to find reproductive structures for identification.

2.2 Psychological surveys

Two other surveys were administered in this project, to provide pre-planting, baseline data of the population (UTS staff) participating. Analyses will be made of these data, for inclusion in the Final Report.

3.COMMUNICATIONS/EXTENSION ACTIVITIES

In February, Margaret Burchett attended the NGIA Conference in Canberra with NIPA, to answer questions on the project, and has given talks to the Horticulture Media Association's Queensland and Sydney branches (May/June, the latter attended also by Fraser Torpy) and its Melbourne branch (31 July). Margaret has also given about 10 radio interviews on the project, and has addressed a meeting of a Sydney branch of the Garden Club of Australia. Margaret will be a participant in the late August UTS/ABC Science Week 'Meet the Geek' event, and will present a paper from the Group at the International People Plant Symposium, 2009, in October in the USA.

3.2 NIPA MARKETING ACTIVITIES – GLOBAL COVERAGE

The National Interior Plantscape Association produces ongoing industry and international media coverage of the work and findings of the Greening the Great Indoors for Human Health and Wellbeing acknowledging HAL's role as a key supporter of this key global research.

A paper summarising the UTS Team research and world research on the benefits of indoor plants (see Appendix II) was published in the March 2009 (Volume 32) edition of ***Interior Plantscape***. The magazine, published by the National Interior Plantscape Association was distributed throughout the interior Plantscaping industries within Australia and the Pacific Asia region. This edition was also distributed throughout the Australian building/facility management industries to increase the dissemination of information on the benefits of greening buildings. The article was replicated in other industry publications including ***Leaflet*** magazine – the communication tool of the Nursery and Garden Industry Association in Queensland.

Appendix I appeared as a feature page in **HortiQ Magazine** in March 2009 featuring the activities of NIPA and acknowledging HAL as a key contributor to the success of the Association in 2008.

Appendix III contains extracts from NIPA's 2008 Annual Report which maintains a long term presence on NIPA's international website.

In May 2009, NIPA published a Media Release in ***Outdoor Design Source E-Newsletter*** promoting the latest findings of the ITS HAL funded project. (refer Appendix IV)

The recently release Vol 33 of ***Interior Plantscape*** also features a series of articles on the most up to date research and activities associated with this HAL funded project (refer Appendix V).

NIPA continues to promote this project via its global website facility, through its international newsletter distributed across four countries at general interior plantscape industry meetings and via report updates in other industry publications to achieve the greatest awareness of this project.

The research findings and progress of the HAL funded UTS project continue to provide NIPA with credible content to produce professional editorial features for many Australian magazines since the last Milestone report including, *Living Wisdom* magazine, *Human Resources Monthly* magazine, *Facility Perspectives* magazine, *HortiQ* magazine, *Australian Corporate Wellness* .

NIPA has also taken an active role exhibiting in the first half of 2009 at major industry Expos in Queensland, New South Wales and the ACT all the while promoting the support of HAL and the value of the R & D associated with this HAL funded project.

NIPA ensures the Australian Government support of this project is consistently published and verbally acknowledged at all mediums.

4. Additional Commercialisation/IP Issues

Nil

5. Other issues

Postgraduate student, Jason Brennan, was on compassionate leave from his scholarship during most of first semester 2009, because of family bereavement and illness. He returned to study in July for this semester. His absence has resulted in inevitable delays in some aspects of experimentation and analysis; however we anticipate no difficulty in completing the project by the end of 2009.

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Extract from HortiQ Magazine - Issue 5 – March 2009

INDUSTRY UPDATE

NIPA – National Interior Plantscape Association

It was true 200 years ago, and it's even truer today ... Association membership will advance your business. Association membership is valuable and never more so than in times of business stress and national recession. Members of the National Interior Plantscape Association come together for information, advocacy, research and statistics, standard-setting, and networking. Businesses that have been NIPA members for life have seen economic highs and lows before and know that when times are tight, you should hold onto your Association membership and use it as a resource to strengthen your business.

NIPA has adopted national mass media strategies targeting facility managers, property developers, Human Resource Professionals and other potential plant hirer clients to promote the benefits of indoor plants, is using its global website facility to best advantage and has been distributing its newsletter across the globe in support of its members. The most recent edition of NIPA's newsletter, *Interior Plantscape*, has been produced targeting industry clients rather than interior plantscapers. NIPA members can then use this special edition as a professional marketing resource no matter how big or micro the scale their business is.

In February, NIPA released new Industry Standards produced as a reprintable brochure as another business resource for plant hirer members. The standards reinforce that plants should have healthy growth and vigorous appearance and be actively growing. The Standards are written for plant hirers who have professional horticultural knowledge and expertise in interior plantscaping.

Also in February, NIPA held its Annual General Meeting re- electing outgoing President Peter Dolley of Queensland's Action Indoor Plant Hire along with Councillors representing all Australian States.

PHOTOGRAPH

Photo Caption (from Left)

John Daly - Scotts Australia, Arthur Stacey - Sunnydale Indoor Plant Services, Vice President John McSweeney - Trans-plant Indoor Plant Hire, Treasurer Christine Johnson – The Container Connection Group, Phil Sattler - Living Simply, Steve Bretts – Bretts Better Indoor Plants, Trevor Murphy – The Container Connection (Qld).

Other elected 2009 Councillors -

Paul McCandless (Qld) - Prestigious Indoor Plants
Lodi Van Dijk (Vic) - E-Plants On-line
Shane McCue (NSW) - TLC Indoor Gardens
Peter March (SA) - Plantscape Interiors
Scott Eastman (WA)

Detailed Membership (including Accreditation), Marketing, Revenue (Audit and Treasury) and Presidential Reports were tabled at the meeting and are being compiled into an Annual Report to feature on NIPA's global web. of **The NIPA reports highlight the successes of the Association in 2008 acknowledging that three factors were keys to its success. These were the ongoing support and commitment of industry members, the financial support Horticulture Australia Limited (HAL) in funding research and development conducted by the UTS team;** and, the patronage of The Container Connection Group who has remained a strong loyal financial supporter of the Association and UTS research and development projects for more than two decades.

NIPA's plan for 2009 is to continue supporting its member base through mass media strategies and by working with allied organisations to get the message across as strongly as possible that it is not only healthy to maintain indoor plants in the work place but the benefits and profit savings in increased employee attendance and productivity far outweigh many of the other economies managers may try to achieve via cost cutting.

APPENDIX II

Articles published in *Interior Plantscape NEWSLETTER Vol 32* *March 2009*

(references to HAL in bold)

MISSING LINK IN SIGHT

AUSTRALIAN SCIENTISTS MOVE ONE STEP CLOSER TO PROVING THE LINK BETWEEN THE HUMBLE INDOOR PLANT AND HUMAN HEALTH AND WELL BEING

Last year, Australia's National Interior Plantscape Association joined forces with the global leaders in plant ecotoxicology, based at the University of Technology Sydney, and the Commonwealth Government to undertake a three year research and development study to test if low numbers of indoor plants do benefit both human health and air quality.

More than 900 papers from over 100 journals and conferences have already been catalogued by the US National Science and Technology Council supporting the link between live indoor plants and human health. Europe also has a very large body of technically sound studies and documentation linking health and productivity with specific building designs and operations. On the basis of these and earlier findings, the Green Building Council of Australia has adopted a "Green Star" rating for the inclusion of indoor plants in new buildings.

However, Australia's National Interior Plantscape Association, the Federal Government arm – **Horticultural Australia Limited (HAL)** and the University of Technology Sydney team acknowledge there is further research and development needed to prove beyond all doubt that the indoor potted plant microcosm (PPM) is indeed a remedy for the 400 volatile organic compounds (VOC's) identified in indoor air.

This research includes questions about indoor plants in the workplace that are commonly asked by professionals in the interior plantscape industry, office workers, building owners and managers and other would-be buyers of indoor plants: "Do indoor plants really make a difference on how people feel at work?". "Can one or two

indoor plants really have an effect on indoor air quality?" and, "How many plants are actually needed?" These "issues" are being addressed in the three year study. A study by Virginia I. Lohr, et al from the Department of Horticulture and Landscape Architecture, Washington State University records productivity increases up to 12 per cent in the presence of indoor plants. Other estimates of productivity increases by office workers gained from working alongside live indoor plants go as high as 50 per cent. Increased numbers of CH2 type "green star" buildings are the result of greater environmental awareness by office employees and unions. Council House 2 – CH2 is a visionary building leading the way in ecologically sustainable design and facility management. The building is located at 240 Little Collins Street, Melbourne. Reduced litigation related to VOCs in the workplace is also an anticipated benefit. The bottom line will be relief for interior plantscapers who can look forward to supporting their current assertions with quality Australian based research in the future.

PLANTS ARE CONNECTED TO GOOD HEALTH

With Adjunct Professor Margaret Burchett, Faculty of Science, University of Technology, Sydney

Pot plants provide many benefits to staff wellbeing. Separate studies show that pot plant presence can reduce sick leave absences by 25 and 60%. Pot plants also lower complaint rates, increase retention rates, improve performance on computer tasks, reduce noise and promote feelings of calm. They also absorb urban air pollution (mainly caused by fossil fuel emissions) - carbon monoxide, oxides of nitrogen and sulfur, 'air-toxics' (organics, e.g. benzene etc), fine particulates, and (with adequate lighting) carbon dioxide.

Since urbanites spend 90% of our time indoors, that's where we breathe air pollution, which is almost always higher indoors than out. Our own research shows pot plants can reliably reduce air toxins plus indoor-sourced volatile organics (continually outgassing from petroleum-based plastics /synthetics in furnishings, computers; solvents, etc), to below 100 ppb – a harmless concentration. Indoor airborne organics pollution, even at imperceptible levels, can cause sore eyes, nose and throat, 'woozy head' or nausea.

We also found pot plants reduced office CO₂ levels by 10-25% (depending on building) and carbon monoxide levels by 90%. We are now studying how to optimise pot plant CO₂ absorption to reduce energy consumption of air-conditioning units. Pot plants are an aesthetically pleasing, psychologically and physiologically healthful, self-regulating air filtration system that can improve effectiveness of any air-conditioning system. Calculations indicate that pot plants will more than repay their hire costs in terms of improved staff performance.

The UTS Plants and Indoor Environmental Quality Group are undertaking a three year research project jointly funded by NIPA and Horticulture Australia Limited (HAL). The research is attracting worldwide attention with some funding also coming from the United States and New Zealand's PAWA donated \$2,000NZ to the project in 2008.

Combat Urban Air Pollution

Greening workplaces indoors with living plants will improve indoor air quality and in turn the health of those who live and work within. International research supports that indoor-plants remove airborne volatile organic compounds (VOCs), carbon dioxide and carbon monoxide. Providing live plants into your indoor surroundings will decrease nitrogen oxides by over 30 per cent, reduce dust levels, refresh air, stabilise temperature and humidity levels, reduce noise levels and raise the

productivity level of staff as well as increase their psychological and physical well-being.

The move to city-living has had great benefits, but at some costs to health and wellbeing. Urban air pollution is a world-wide health concern, as is indoor air quality. Urban air pollution in Sydney alone causes at least 1,400 deaths per year, and we spend 90% of the time indoors, where air is generally more polluted than outdoors. Research has proven that sick-leave absences can decline by over 60 per cent following the introduction of live indoor plants. Better performance has been recorded, with plant presence, on test computer tasks, card-sorting jobs and creative thinking tests. In other studies, reductions have been found in pain perception, anxiety, depression and feelings of hostility. Indoor potted-plants absorb and degrade all types of air pollution, and are self-regulating in operation.

National Interior Plantscape Association (NIPA) members can provide building owners and managers with cost-benefit analyses for using indoor plants showing the savings will more than cover the costs. VISIT www.nipa.asn.au for contact details.

Additionally, NIPA Patron and international member, The Container Connection, supplies Australian made eco specified planter products; sub-irrigated, recyclable and guaranteed for 10 years, to meet your progressive environmental policies.

NIPA, The Container Connection, **Horticulture Australia Limited and a specialist team of University of Technology Sydney scientists have joined forces advancing global research into the benefits of live indoor plants.**

The World Health Organisation (WHO) in 2000 predicted that, by 2010, responsibility for healthy indoor air quality (IAQ) will rest with facility managers.

It is expected that, in the future, along with normal fittings, indoor plants will be utilised as a portable, flexible, beautiful, useful, effective, and a relatively low-cost, standard installation to improve indoor environmental quality. Hence, the Green-Star ratings from the Green Building Council for building designs that include indoor-plant installations.

- ✓ Dr Margaret Burchett attended the Ideation '08 Conference supported by funding provided to the University of Technology; Sydney by NIPA, to present a paper entitled ***Interior Plants for Sustainable Facility Ecology and Workplace Productivity***. The paper directly related to work being undertaken by the UTS Plants and Indoor Environmental Quality Group including research jointly funded by NIPA and **Horticulture Australia Limited (HAL)**. The overall theme of the conference was 'enabling sustainable communities' and, there were a number of presentations relating to the optimisation of development and uses of technology, for example, smart windows, solar power, etc for sustainable urban development. There was also a concern for the welfare of building occupants which was embraced in the term "facility ecology". Dr Burchett gave Ideation '08 attendees a brief history of human ecology, and proposed that 'greening the great indoors' with **living plants** is an important element in enabling sustainable urban communities of the future, since they will increasingly depend on a healthy 'indoor facility ecology'. Dr Burchett outlined the UTS laboratory and office 'field' studies on indoor-plant removal of airborne volatile organic compounds (VOCs), carbon dioxide and carbon monoxide. She also outlined research evidence from overseas on the direct psychological and productivity benefits of plants. Hence, for example, the Green-Star ratings from the Green Building Council for building designs that include indoor-plant installations. Dr Burchett presented a cost-benefit analysis for using indoor plants—clearly the savings

more than cover the costs, thus achieving a win-win situation for indoor air quality and human wellbeing, and as an essential contribution to 'enabling sustainable communities'. Dr Burchett's name has again been put forward as a speaker for Ideation '09.

- ✓ NIPA members are preparing for the **2009 Urban GreenScapes Symposium & National Conference to be held during February in Canberra**. The 2009 Urban GreenScapes Symposium will unveil the benefits of plants and green-life in the urban landscape and create a stronger platform on which to engage government. With international speakers, the Symposium will position green-life and plants as part of the solution in the global warming debate, with the aim of getting urban green-life on the political agenda for Kyoto Mark II and carbon trading schemes. Held in Australia's Capital, it will bring green-life to the forefront of policy makers and gain universal government support for increased urban greening. NIPA will be actively marketing the UTS research into **indoor air quality and human health and well being** at this event. The research is ongoing with funding provided by NIPA and **Horticulture Australia Limited**.

EXTRACTS FROM THE NIPA ANNUAL REPORT 2008

NIPA MARKETING PROGRAM REPORT 2008 Financial year ending 31st December 2008

Throughout 2008, many activities arising out of the Marketing Program and the Education Program were integrated as the Association placed a heavy emphasis on marketing the Association and the benefits of indoor plants to its member's client base through trade show involvement and through mass media strategies including regular columns and features in magazines including *HortiQ*, *Facility Perspectives*, *Living Wisdom* (aka *Informed Voice*) and Australian *Corporate Wellness*. During 2009, NIPA will maintain this momentum fulfilling its role to keep indoor green-life equally at the forefront of decision makers as is outdoor green-life.

CONFERENCES AND EXPOS

Ideaction '08 - Sponsored by NIPA, Dr Margaret Burchett attended the 'Ideaction' Conference of the Facility Management Association (FMA), held at the Gold Coast, Qld, in May, 2008, the theme of which was 'Enabling Sustainable Communities'. Margaret presented a paper entitled 'Interior Plants for Sustainable Facility Ecology and Workplace Productivity'.

The paper directly related to work being undertaken by the UTS Plants and Indoor Environmental Quality Group including research jointly funded by NIPA and **Horticulture Australia Limited (HAL)**.

Dr Burchett presented a cost-benefit analysis for using indoor plants—clearly the savings more than cover the costs, thus achieving a win-win situation for indoor air quality and human wellbeing, and as an essential contribution to 'enabling sustainable communities'. Dr Burchett's name was put forward as a possible speaker for Ideation '09.

2009 Planning - NIPA members are preparing for the **2009 Urban GreenScapes Symposium & National Conference** to be held during February in Canberra. The 2009 Urban GreenScapes Symposium will unveil the benefits of plants and green-life in the urban landscape and create a stronger platform on which to engage government. With international speakers, the Symposium will position green-life and plants as part of the solution in the global warming debate, with the aim of getting urban green-life on the political agenda for Kyoto Mark II and carbon trading schemes. Held in Australia's Capital, it will bring green-life to the forefront of policy makers and gain universal government support for increased urban greening. NIPA will be actively marketing the UTS research into **indoor air quality and human health and well being** at this event. The research is ongoing with funding provided by NIPA and Horticulture Australia Limited

MEDIA STRATEGIES

Global coverage of R & D - NIPA continues to promote the HAL funded UTS Research & Development project, ***Greening the Great Indoors for Human Health and Wellbeing*** via its global website facility, through its international newsletter distributed across four countries at general interior plantscape industry meetings and via report updates in other industry publications to achieve the greatest awareness of this project.

The research findings and progress of the HAL funded UTS project have provided NIPA with credible content to produce professional editorial features for many industry magazines.

A paper summarising the UTS Team research and world research on the benefits of indoor plants was published in ***Interior Plantscape (Australia)*** and sent to the Editor of Interior Plantscaping in USA.

NIPA distributed a national Media Release in late 2008 - ***Australian Scientists Move One Step Closer to Proving the Link Between the Humble Indoor Plant and Human Health and Well Being***

NIPA published two feature articles in Facility Perspectives magazine – ***With Live Indoor Plants You Can Feel the Difference*** and ***Vodafone proves even with small change you can make a difference.***

NIPA also published a feature article in Human Resource Monthly magazine – ***Live Plants Linked to Professional HR Management Practices.***

NIPA also published a feature article in Informed Voice magazine - ***Sick Building Syndrome.***

NIPA published a feature article in Corporate Wellness magazine - ***Indoor Plants Lead to Corporate Wellness.***

NIPA also received four complimentary pages in the quarterly edition of ***HORTiQ*** during 2008. These pages enable the Association to have a voice in a magazine directly targeting horticultural business in Queensland.

All of these feature articles were accompanied by professionally produced full colour display advertisements promoting the benefits of engaging the indoor plant services of NIPA members.

In all its media ventures, NIPA ensures the Australian Government support of the UTS project is consistently published and verbally acknowledged.

INDUSTRY STANDARDS FOR MAINTAINING INTERIOR PLANTSCAPES

In another cross over of NIPA Program projects, professional interior plantscapers pooled their extensive knowledge mid-year to produce an industry benchmark for maintaining interior plantscapes. These Industry Standards acknowledge that it takes both knowledge and skill to maintain live indoor plants. Industry Standards are being produced as a reprintable brochure at the back of the NIPA newsletter. The standards reinforce that plants should have healthy growth and vigorous appearance and be actively growing. The Standards are written for plant hirers who have professional horticultural knowledge and expertise in interior plantscaping.

PATRONAGE – The container Connection (TCC) has remained a strong loyal financial supporter of the Association and UTS Research and development projects. In addition to their NIPA patronage, TCC has been part of a specific group of industry suppliers who deserve a large mention in this report. They are The Container Connection, Palamont Rotor, Tingalpa Wholesale Nursery, Prestigious Indoor Plants and TLC Indoor Gardens - businesses that are modest in receiving praise for their generosity yet self-sacrificing in supporting and furthering global research into the benefits of indoor plants.

Revenue Program Report 2008

Funding Sub-Committee with Chris Johnson

Association funding in 2008 was generated from a combination of Association membership fees, **Federal Government grants** and major Patronage from The Container Connection. Membership fees have been maintained in 2008 and the Federal grant monies were specific purpose grants. The Container Connection continued as NIPA Patron and has remained loyal to the Association since its inception. Without The Container Connection's support of the Association, many of its activities would cease. In addition to patron dollars, the Container Connection has supplied a significant amount of planters for research purposes at a cost of more than \$5,000 and has sponsored a series of glossy magazine advertisements throughout 2008. TCC Director, Chris Johnson, also worked tirelessly behind the scenes throughout 2008 enabling the Association to maintain professional management standards.

During 2008, NIPA completed its **HAL funded Accreditation project and moved forward with its UTS based Research and Development project.**

The continuing HAL funded project has also received strong industry support from suppliers including the Association Patron, The Container Connection.

Research with University of Technology Sydney for “Greening the Great Indoors for Human Health and Wellbeing” Project.

NIPA in conjunction with UTS was awarded \$150,000 over three years which cover the greater part of costs for the project. The balance of costs is being met through industry assistance via donations of product and finances. The research project covers both a laboratory controlled study and 55 staff offices at the university with certain milestone **reports to be submitted to HAL during the three year period by both UTS and NIPA.**

Project Aims

The experimental aims of the project (with responsibilities of UTS and NIPA indicated) are to:

- a) investigate the ability of indoor plants to improve the health, wellbeing and productivity of office staff (UTS);
- b) determine the minimum numbers of plants that can be beneficial to both human health and indoor air quality;
- c) provide information on plant types and placement in offices for health promoting benefits (UTS);
- d) examine the VOC removal capacity of two previously untested interior plant varieties (UTS);
- e) increase industry and public awareness of the health benefits of indoor-plants (UTS & NIPA) and develop a marketing strategy for their use in any type of building (NIPA)

As you can see there is much to cover. If you are a company or know of any companies that would be prepared to make a tax-deductible donation to this research it would be very much appreciated by UTS and NIPA. You would be investing in global research that also has global benefits to be achieved from the research findings.

Accreditation Grant of \$10,000 was also awarded to NIPA **from HAL to further develop** the existing Australian Indoor Plant Industry Accreditation Scheme, administered by the National Interior Plantscape Association (NIPA):

1. to establish the **renewal of accreditation process** after the initial two years membership period;
2. to ensure all operatives within the Australian interior plantscape industry (including but not limited to indoor plant hire companies both contracting and maintenance as well as industry suppliers) have **equal opportunity through knowledge and awareness** to participate in the scheme; and,
3. to create **public awareness and confidence** with users of interior plantscape industry products and services supplied by accredited businesses; and,
4. to achieve **full implementation** standard by 30th June 2008.

These aims were achieved by the implementation deadline and a final project report was submitted to HAL in 2008.

Early in 2009, NIPA will be investigating future funding options for industry projects including Certification and Education.

ACCREDITATION REPORT 2008

ACCREDITATION - In 2008, NIPA welcomed a new accreditation assessor- Paul Plant. Paul is a nationally renowned horticulturist with several business interests including owner/editor of the very popular "Sub Tropical Gardening" magazine. Paul is active in the Horticultural Radio media scene and is also seen on Queensland current affairs television and in the popular and industry press. Paul has a degree in horticulture and has worked as a nursery person, landscaper and interior plantscaper. He has many years experience in horticultural research.

NIPA's Membership and Accreditation Committee finished the accreditation renewal document in time for the Association's first accredited member (Green Design) to complete their accreditation renewal. The accreditation renewal document is now available on the NIPA web site. Accredited members will be notified two months prior to the second anniversary of their original accreditation. They then have one month to return their documentation for assessment.

The number of accredited interior plantscape professionals across Australia is slowly growing with most of those currently accredited having recently renewed their accreditation which is necessary every two years. Every accredited plant hirer in Australia is listed on the NIPA website at www.nipa.asn.au – simply go to the Member by State page and look for the red stars. While you are visiting the NIPA website browse over the latest industry news from home and abroad.

"You can learn much about the reputation, integrity and sustainability of an operation and the general quality of its management, products and customer service from its Accreditation status".

There has not previously been a standardized high level of quality benchmark for the interior plantscape industry and while the industry's accreditation scheme was introduced in late 2005, by mid-2007 the scheme was in serious need of development to renewal stage as well as support for national awareness and education of the scheme.

In 2008, with the financial support of HAL, NIPA further developed the existing Australian indoor plant hire industry accreditation scheme administered in three ways.

Firstly, NIPA established a renewal of accreditation process to apply after the initial two years businesses had been accredited.

Secondly, NIPA ensured all operatives within the Australian interior plantscape industry (including but not limited to indoor plant hire companies both contracting and maintenance as well as industry suppliers) had equal opportunity through knowledge and awareness to participate in the scheme.

Thirdly, NIPA created public awareness and confidence with users of interior plantscape industry products and services supplied by accredited businesses.

The National Interior Plantscape Industry has developed an accreditation renewal process and has ensured that all of the Australian interior plantscape industry has been made awareness of the program and its benefits.

NIPA Membership is open to all who are involved in the interior plantscape industry. Membership covers plant hirers and technicians, franchisors and franchisees, industry suppliers and students.

Membership details are available on the website, www.nips.asn.au - go to the Member section for current member names, membership benefits and applications forms. Membership forms can be downloaded at your convenience. A copy can be faxed or posted or for specific membership questions call the NIPA office on telephone 07 3888 7300.

NIPA

Membership applications are assessed by a membership committee who make recommendations to the NIPA Board for approval. Depending on the applicant and meeting times, assessment is relatively quick. Members also having the added option of becoming accredited businesses further value adding to their professional credibility.

Appendix IV

NIPA MEDIA RELEASE

13th May 2009

AUSTRALIAN SCIENTISTS MOVE ONE STEP CLOSER TO PROVING THE LINK BETWEEN THE HUMBLE INDOOR PLANT AND HUMAN HEALTH AND WELL BEING

Initial laboratory results coming out of Sydney clearly indicate the potential of indoor plants to help reduce indoor CO2 levels. Also, for reasons yet to be explored, it has been found that the presence of coconut fibre finish significantly increased the efficiency of the pot plants in reducing both CO2 and CO.

Other results include indoor plants having greater effect in newer buildings. Presumably in the newer buildings the furniture and fittings have intrinsically lower toxin levels and air-conditioning systems are more efficient. Scientists also concluded that wet and windy weather conditions may also contribute to cleaning the air generally during testing.

Building occupant reaction has also been very encouraging, helping confirm the growing international body of evidence that greening the great indoors contributes to building occupant satisfaction.

Last year Australia's National Interior Plantscape Association joined forces with the global leaders in plant ecotoxicology, based at the University of Technology Sydney, and the Commonwealth Government to undertake a three year research and development study to test if low numbers of indoor plants do benefit both human health and air quality.

More than 900 papers from over 100 journals and conferences have already been catalogued by the US National Science and Technology Council supporting the link between indoor plant and human health. Europe also has a very large body of technically sound studies and documentation linking health and productivity with specific building designs and operations. On the basis of these and earlier findings, the Green Building Council of Australia has adopted a "Green Star" rating for the inclusion of indoor plants in new buildings.

However, Australia's National Interior Plantscape Association, the **Federal Government arm – Horticultural Australia Limited (HAL) and** the University of Technology Sydney team acknowledge there is further research and development needed to prove beyond all doubt that the indoor potted plant microcosm (PPM) is indeed a remedy for the 400 volatile organic compounds (VOC's) identified in indoor air, coming from outdoor air.

The issues being addressed through this research include questions about indoor plants in the workplace that are commonly asked by professionals in the interior plantscape industry, office workers, building owners and managers and other would-be buyers of indoor plants are: "Do indoor plants really make a difference on how people feel at work?". "Can one or two indoor plants really have an effect on indoor air quality?"; and, "How many plants are actually needed?". These "issues" are being addressed in the three year study.

Estimates of productivity increases by office workers gained from working alongside live indoor plants vary from zero to as high as 30-50 per cent. Increased numbers of CH2 type "green star" buildings are the result of greater environmental awareness by office employees and unions. Reduced litigation related to VOCs in the workplace is also an anticipated benefit. The bottom line will be relief for interior plantscapers who can look forward to supporting their current assertions with quality Australian based research in the future.

For all your interior Plantscaping needs contact the National Interior Plantscaping Association for professional contacts, products and services – just visit www.nipa.asn.au

FOR LOCAL, NATIONAL OR INTERNATIONAL MEDIA COMMENT/PHOTOGRAPHIC OPPORTUNITIES PLEASE CONTACT PETER DOLLEY, NIPA PRESIDENT ON 0419 029 859

Appendix V

Articles published in *Interior Plantscape Newsletter* *Vol 33, July 2009*

Psychological Benefits of Indoor Plants

Margaret Burchett, UTS

Everyone loves a garden (though not necessarily the weeding in it). History shows that humanity has for thousands of years recognised the value of gardens as places of peace and restoring the spirit. However, in Australia, 80% of us now live in urban areas and spend 90% of our time indoors, so most of us will not be found in a park or garden very much. Of course, we continue to place great value on planted views - check out the real estate ads or note the positions of directors' offices in city buildings. But many Australians (like others in the developed world) spend their working lives in situations where the outside world is not much in evidence. In these indoor situations the calming and restorative values of foliage plants are very important to staff health and wellbeing. Studies from around the world clearly demonstrate these benefits.

American environmental psychologists, Kaplan and Kaplan (1990, 1995), consider that plants in view benefit us because they relieve the 'attention fatigue' that always builds up while we are concentrating on any type of doing or thinking (whether or not we notice fatigue at the time). They believe that just glancing at the greenery acts as a restorative moment, by briefly catching our effortless (almost unconscious) attention, giving a quick break from 'busy thoughts', a temporary feeling of 'awayness' from the object of concentration, and providing a reminder of our 'being part of a wider whole'. The calm mental relaxation and resetting takes just a few moments to achieve.

The well-known Norwegian studies of Fjeld et al. (1998, 2002), found that sick leave among staff in the radiology unit of a hospital was reduced by over 60% when indoor plants were installed. They also found less sick leave among primary school children with plants in their classroom, and that staff in planted offices showed significantly fewer health and discomfort problems. These included - 37% less coughing, 30% less 'fatigue', 23% in overall discomfort, which included symptoms such as headaches, sore eyes, nose or throat, 'heavy-headedness' or lowered concentration. USA studies by Lohr and colleagues (1996 – 2000) have also shown productivity gains, and reduced perceptions of pain and discomfort, when plants were present. A more recent Texan study with over 400 respondents (Dravigne et al., 2008) showed that job satisfaction went up significantly on all 10 criteria surveyed, among staff in buildings with indoor plants, and that they preferred them to planted window views. (Could this perhaps be because the indoor plants were nearer, or because they felt more 'related' to the in-house foliage than to outside vegetation?)

A USA Medical Group Management Association newsletter (Gilhooley & Rice, 2002) reported that the literature showed that “Plants...are likely to enhance patients’ perceptions of their surroundings upon entering a health care facility. An interior viewed as welcoming and relaxing helps accelerate the healing process”. And a Swedish study (Rappe and Linden, 2002), using surveys of nursing staff in 10 nursing homes for patients with dementia, reported a beneficial impact of indoor plants, including better-stimulated senses and more positive emotional states among the residents. A Dutch experiment (Dijkstra et al., 2008), that involved showing photos of hospital rooms with participants, and afterwards measuring their stress levels, found that those show rooms with plants recorded less stress than those shown pictures of rooms with a painting of an urban scene on the wall. They concluded the planted rooms led to less stress because of their “perceived attractiveness”. – a reminder that the aesthetics of indoor plants is a positive benefit, and commonly remarked upon.

A recent Taiwanese study (Han, 2008) found quite remarkable results from a project conducted with the eight grade junior high school students (76 in total) in two classes, over one semester. Six pot-plants were arbitrarily placed at the back of one classroom but not in the other, and students were surveyed every two weeks. Students in the planted classroom showed positive results right from the start, which surprised the researchers and teachers. The class with plants not only displayed stronger positive feelings of “comfort and friendliness”; they also had significantly less sick leave, and lowered “punishment records due to misbehaviour”, than the other class. The author added “In addition to the visual and psychological mechanisms that contributed to restoration, there may have been other factors at work”. (Yes, well, we do know that the air would be cleaner and fresher too, which would no doubt help comfort and concentration.) Could our Federal Minister for Education be persuaded to have plants installed in all classrooms as part of the education reform package?

A hot-off-the-press article by Smith & Pitt (2009) in the (British) Journal of Corporate Real Estate, reports that surveys show that “occupants of planted offices feel more comfortable, more productive, healthier and more creative, and feel less pressure than occupants in unplanted offices”. The results of our just-completed UTS office study, jointly funded by NIPA and **HAL**, are in line with these results. We administered two questionnaires, on each of two occasions, once before plants had been installed, and once after participants had had their plants for nearly three months (apart from an unplanted, control group). Scores from those with plants showed clear trends towards lowered feelings of both stress and depressed mood, compared with the control group.

In the words of the editor of Health Promotion International (St Ledger, 2003), the mass movement of people from rural to urban areas over the last 200 years “has facilitated their disengagement from the natural environment” (more simply – us city-dwellers suffer from plant depravation!). The evidence is that indoor plants benefit our health, wellbeing, job satisfaction, and - the bottom line for facility managers – productivity. And that evidence is being reported in a variety of periodicals, from horticulture to health to real-estate journals. This is in line with the ‘triple-bottom-line’ that now has to be satisfied in outdoor environmental projects, namely, ecological, social (including health and wellbeing) and economic. The evidence is that they will earn their keep in human ecology in the built environment, whether office, health care facility, classroom, home, or elsewhere.

Please Note: A full and comprehensive list of references for Dr Burchett’s article can be found at www.nipa.asn.au

HOW AND WHY INDOOR PLANTS IMPROVE OUR HEALTH

Margaret Burchett, Fraser Torpy & Jason Brennan

Plants & Indoor Environmental Quality Group,

Faculty of Science, University of Technology, Sydney (UTS)

Research has now shown that indoor plants do in fact significantly improve a whole range of aspects of our indoor environment. Cover a spectrum from physically cleaner air to direct beneficial effects on psychological health, task performance, illness reduction and productivity. The findings are important since, in Australia over 80% of us live in urban areas, where we spend an amazing 90% of our time indoors, so the quality of the indoor environment is crucial to our wellbeing. This article summarises what we now know of the benefits of indoor plants for health and wellbeing.

On the matter of air quality, many people do not know that air pollution is almost always higher indoors than outside, even in the city centre, and air-conditioning systems are almost never designed to remove outdoor gaseous pollutants from air drawn into the building. Everyone does know that urban air pollution comes mainly from fossil fuel combustion, the resultant emissions containing a mixed brew of pollutants. These include carbon dioxide (CO₂) and monoxide (CO); various nitrogen oxides (NO_x); sulfur oxides (SO_x); ozone (O₃); 'air toxics' (volatile organic compounds, VOCs, eg the 'Big Four', Benzene, Toluene, Ethylbenzene, Xylene - 'BTEX' for short); and fine particulate matter (black 'sooty' particles, 'PM'). As the polluted air moves indoors, it mixes with more indoor contaminants from unflued gas appliances and VOCs outgassing from 'plastic'/'synthetic' (ie petroleum-derived) furnishings, finishes, solvents, etc.

The health costs of urban air pollution in Australia (a comparatively clean country by world standards) are estimated at about \$12 billion per year. It accounts for about 1,400 deaths p. a. in the Sydney area alone, from increased strokes, heart attacks, asthma, etc. International studies show that plants can reduce every type of urban air pollutant, from outdoors or inside.

The UTS research group has carried out laboratory and 'real-world' office studies on the ability of indoor plants to reduce VOCs, CO₂ and CO. They have so far laboratory-tested 11 indoor plant species for VOC removal*, using four test VOCs (three of the BTEX group, plus *n*-hexane). The US EPA has identified over 900 VOCs found in indoor air (not all at once, fortunately – usually a cocktail of 12 to 20 or so in any one building). UTS obtained remarkably similar results with every species tested. After a week of acclimatisation to exposure to any test VOC, they *all work equally well* - eliminating repeated doses of the VOC within about 24 hours. UTS trialled both high concentrations (at or above Australian maximum 8-hour-averaged occupational exposure limits), and low doses such as can be found in office or home air. Plants also work equally well in light or dark (24/7), and UTS discovered this is because it is primarily the potting mix microorganisms that remove VOCs. The plant contributes to the process by nourishing its root-zone microbial community (as any plant does).

The UTS findings extend and modify those of the pioneering studies of Wolverton and colleagues (1988-1993), who reported big variations in effectiveness over the 50 or so species they tested. Their studies were mainly short-term (1-2 days), so they were not aware of the acclimatisation process, which is necessary to rev up the removal response in the bacteria. So their results actually under-estimated the 'power of the pot-plant microcosm'. The UTS results lead the team to suspect that almost *any* indoor species will probably remove VOCs equally well – and UTS are testing more species anyway.

The plants themselves are directly involved in other aspects of air cleansing. Green shoots do the CO₂ removal, via photosynthesis. This needs adequate lighting, however, which can be problematic indoors. Plants also help remove dust, having a slightly negatively charged surface which attracts air-borne particles. And both the plants and root-zone microorganisms absorb and metabolise NO_x, SO_x and CO.

Overall, the pot-plant acts as a symbiotic microcosm that cleans and freshens indoor air.

In the first UTS real-world office study, using 60 staff offices, they found that three floor plants reduced total VOC loads (TVOCs) by up to 75%, keeping levels below 100 parts per billion (ppb), which is well below established health risks. The study also found reductions in CO₂ of from 10 to 25% (depending on building), and reductions in CO concentrations of about 90%. Overseas studies have shown plants also improve humidity in offices dried out with air-conditioning, and reduce noise. *Indoor plants earn their keep as quietly effective improvers of air quality – while looking good as well.* The world-wide body of evidence underlies the Green Building Council (Aust) Green Star ratings for commercial building plans that include indoor plant installations.

UTS are now completing a second office study, to investigate minimum plant numbers for air-cleansing purposes, and psychological responses to plants in the office. In a concurrent laboratory project they are examining relationships between pot-sizes and VOC removal capacity in several species. The studies also include testing more plant species.

Research from other investigators highlights the directly measurable benefits of plants on the wellbeing of building occupants. A number of research studies have shown the benefits of plant views from windows on, for example, recovery in hospital patients and job satisfaction in office staff. Psychologists consider that plant views benefit in this way by acting as 'restorative environments', giving a reminder of 'being part of a wider whole', relieving 'attention fatigue', and providing a break from 'busy thoughts'. All of these effects assist a calm resetting of our mental processes. Plants indoors have been shown to assist in similar ways, leading to lowered feelings of anxiety, depression and hostility, and increased productivity and job satisfaction. In one Norwegian study, indoor plants were found to reduce sick-leave absences in hospital staff by over 60%, and to reduce illness absences among primary-school children as well.

In UTS's current office study, with 55 staff participants, they recorded consistent trends from two sets of psychological questionnaire surveys that point to reductions of about 50% in feelings of both stress and depression among participants with plants in their offices, as compared with the 'no-plant' control group. Comments from participants included – *'Well, you would feel better wouldn't you?'; 'It feels more spacious, even though the plants take up a bit of room in this small office'; 'I work better with plants; I feel restless if there's no plants in my office'.*

In summary, evidence from studies around the world (including those at UTS) show clearly that indoor plants significantly improve the wellbeing of building occupants - and that includes most of us, most of the time! Their benefits to health and productivity will, in dollar terms, more than repay the cost of their purchase or installation.

Acknowledgements

UTS wishes to thank the National Interior Plantscape Association (NIPA), Ambius Tropical Plants, **Horticulture Australia Ltd (HAL)** and the Container Connection Group for funding support for their research. The UTS team also thank their UTS colleagues, past and present, Drs. R. Wood, R. Orwell, J Tarran & A Pulkownik, Prof. A Craig, and numerous others who have participated in their office studies.

*Species laboratory-tested at UTS to date: *Aglaonema modestum*, *Dracaena 'Janet Craig'*, *D. marginata*, *Howea forsteriana* (*Kentia palm*), *Pothos*, *Philodendron*

'Congo', Sansevieria trifasciata, Schefflera 'Amate' (Qld. Umbrella Tree), Spathiphyllum 'Petite' (Peace Lily), S. 'Sensation', Zamioculcas zamiifolia (Zanzibar).
Research literature (references) relating to Dr Buchett's article has not been published within this newsletter but can be accessed at the NIPA website at www.nipa.asn.au

An industry THANK YOU TO Australian Horticulture magazine, Ecospecifier, NGIA (Qld), Outdoor Design Source E-Newsletter and Horticultural Journal for publishing Margaret Burchett's article on the UTS research. Most of these contacts were made from NGIA conference, Green Cities and NIPA direct.

NIPA – National Interior Plantscape Association

Getting Stronger Every Year ...with more member support in 2009 than ever before.

It was true 200 years ago, and it's even truer today ... Association membership will advance your business. Association membership is valuable and never more so than in times of business stress and national recession. Members of the National Interior Plantscape Association come together for information, advocacy, research and statistics, standard-setting, and networking. Businesses that have been NIPA members for life have seen economic highs and lows before and know that when times are tight, you should hold onto your Association membership and use it as a resource to strengthen your business.

NIPA has adopted national mass media strategies targeting facility managers, property developers, Human Resource Professionals and other potential plant hirer clients to promote the benefits of indoor plants, is using its global website facility to best advantage and has been distributing its newsletter across the globe in support of its members. The last edition of *Interior Plantscape* was produced targeting industry clients rather than interior plantscapers. NIPA members have since had use of this special edition as a professional marketing resource no matter how big or micro the scale their business is.

NIPA also released new Industry Standards produced as a reprintable brochure as another business resource for plant hirer members. The standards reinforce that plants should have healthy growth and vigorous appearance and be actively growing. The Standards are written for plant hirers who have professional horticultural knowledge and expertise in interior plantscaping.

In February, NIPA held its Annual General Meeting re- electing outgoing President Peter Dolley of Queensland's Action Indoor Plant Hire along with Councillors representing all Australian States.

Photo Caption (from Left)

Phil Sattler - Living Simply, Vice President John McSweeney - Trans-plant Indoor Plant Hire, Paul McCandless - Prestigious Indoor Plants, Arthur Stacey - Sunnydale Indoor Plant Services, President Peter Dolley – Action Indoor Plant Hire, Treasurer Christine Johnson – The Container Connection Group, Steve Bretts – Bretts Better Indoor Plants, Trevor Murphy – The Container Connection (Qld).

Other elected 2009 Councillors –

John Daly - Scotts Australia, Lodi Van Dijk (Vic) - E-Plants On-line, Shane McCue (NSW) - TLC Indoor Gardens, Peter March (SA) - Plantscape Interiors, Scott Eastman (WA)

Detailed Membership (including Accreditation), Marketing, Revenue (Audit and Treasury) and Presidential Reports were tabled at the Annual General Meeting and were compiled into an Annual Report now featured on NIPA's global web. The NIPA reports highlight the successes of the Association in 2008, acknowledging that three factors were keys to its success. These were the ongoing support and commitment

of industry members, the financial support of **Horticulture Australia Limited (HAL)** in funding research and development conducted by the UTS team; and, the patronage of The Container Connection Group who has remained a strong loyal financial supporter of the Association and UTS research and development projects for more than two decades.

NIPA continues supporting its member base through mass media strategies and by working with allied organisations to get the message across as strongly as possible that it is not only healthy to maintain indoor plants in the work place, but the benefits and profit savings in increased employee attendance and productivity far outweigh many of the other economies managers may try to achieve via cost cutting.