

PLANTS ARE A NICE AMENITY, BUT THEY DON'T REALLY *WORK* ALL THAT HARD, DO THEY?

We're glad you asked! And please keep your questions coming.

1. Has anyone conducted “real life” office studies to measure the direct relationship between clinical health complaints and plant installations? Sick Building Syndrome is a serious and expensive issue, and we need to know the degree to which interior plants can positively affect our employees’ health.

Professor Tove Fjeld of the Agricultural University in Oslo, Norway carried out several conclusive studies regarding health claims relating to Sick Building Syndrome among workers.

This crossover study was conducted among 51 offices. During one period, plants were included in the offices. And during another, plants were not included. All participants worked in identical, single offices, with a floor area of 10 m² and a window covering most of the outer wall. When plants were included, the participants were exposed to 13 commonly used foliage plants placed in three containers on a window bench, and a terracotta container with plants in the back corner of the office.

Data from the study can be found in the table below.

Recorded Health Improvements at the Statoil Offices After the Introduction of Interior Plants

AILMENT	% REDUCTION
Fatigue	20
Headache	30
Sore/dry throats	30
Coughs	40
Dry facial skin	25
Well-being	84

It was found that the score sum, as a mean of 12 symptoms, was 23% lower during the period when the participants had plants in their offices (mean score sum was 7.1 during the period without plants, vs. 5.6 during the period with plants (P=0.002)). If the symptoms were clustered, a significant reduction was obtained in neuro-psychological symptoms and in mucous membrane symptoms, while skin symptoms seemed to be unaffected by the plant intervention (Fjeld et al. 1998).

Nearly identical results were verified by Dr. Fjeld when measuring the effects of indoor foliage plants together with full-spectrum fluorescent lighting on health and discomfort symptoms among personnel working in a hospital radiology department. A 25% decrease in complaints was observed after introducing plants into the rooms and changing to full-spectrum lighting (mean score sum was 9.0 before intervention, vs. 6.7 after intervention ($P=0.001$)). Particularly significant reductions were found for the following symptoms: fatigue; feeling heavy-headed; headache; dry, hoarse throat; and skin symptoms on hands. Grouping subjects by percentage of work time spent in the planted location showed a 34% decrease in complaints among those who spent most of their day in the room, compared to 21% and 17 % respectively among those spending approximately 50% or less than 40% of their day in the room.

2. Right now, productivity is everything. Is there any valid measure of the effect of office plants on worker productivity?

One such study was conducted in a computer lab at by Dr. Virginia Lohr at Washington State University (Pullman, Wash.). Subjects were asked to participate in an experiment that measured stress levels among people using computers. Test subjects were randomly assigned to be tested in the computer lab when plants were absent or when they were present. Interiors plants, when present, were placed around the sides of the room. Subjects' blood pressures and emotional states were monitored while they performed a slightly stressful computer task that measured reaction times in response to seeing and decoding the shape of a simple object on the screen.

When plants were added to the lab, the subjects were more productive (12% quicker reactions on the computer task) and less stressed (systolic blood pressure lower). They also reported feeling more attentive when the plants were present.

3. Can you provide us with legitimate documentation linking interior plants to stress reduction?

Numerous studies indicate that plants have a positive psychological impact on people (see, for example, Lohr et al, 1977). This study verified that, once exposed to plant settings, test persons demonstrated more positive emotions such as happiness, friendliness and assertiveness and less negative emotions such as sadness and fear.

As stress rises in the modern working and living environment, the incidences and expenses of stress-related disorders increases. Working with plants has been used as a therapy to relieve stress since the earliest recorded history, and recent studies are beginning to document the value of working with plants (Doxon et al, 1987).

Simply viewing plants has even been shown to reduce stress. In one study, students who had just completed an exam were experiencing some anxiety (Ulrich, 1986). Their stress levels were measured through questionnaires before and after they viewed slides of nature scenes with vegetation, or urban scenes without vegetation. Students exposed to the vegetation scenes reported significantly improved emotional states.

Another study documented people's ability to recover from stress within five minutes of being exposed to nature settings (including plants) by quantifying physiological measures such as muscle tension, skin conductance, and pulse (Ulrich and Simons, 1986).

4. Can interior plants seriously impact my hard IAQ numbers? Exactly how do interior plants remove harmful chemical toxins from the air in office buildings?

Plant leaves can absorb certain organic chemicals and destroy them through a process called "metabolic breakdown." A group of German scientists proved this when they labeled formaldehyde with a radioactive carbon 14 tag and followed its absorption and metabolic destruction inside a spider plant (*Chlorophytum comosum*). The formaldehyde was metabolized and converted into tissue products such as organic acids, sugars and amino acids as demonstrated by the radioactive carbon 14 tag. This information was published in the *Plant Physiology Journal* in 1994. Martina Giese, Ulrike Bauer-Doranth, C. Langebartels, and Henrich Sanderman, Jr. "Detoxification of formaldehyde by the spider plant (*Chlorophytum comosum*)." *Plant Physiology*, 1994, 104: 1301-1309.

When plants transpire water vapor from their leaves, they pull air down around their roots. This supplies their root microbes with oxygen. The root microbes also convert other substances in the air, such as toxic chemicals, into a source of food and energy. Microbes, such as bacteria, can rapidly adapt to a chemical contaminant by producing new colonies that are resistant to the chemical. As a result, they become more effective at converting toxic chemicals into food the longer they are exposed to the chemicals. It is also important to remember that the efficiency of plants or a filtering device decreases as the concentration of chemicals in the air decreases. For example, the removal rate of a chemical is much higher at 7 parts per million (ppm) exposure than at 2 ppm. (Information taken from study listed above.)

5. How can my FM team determine the number of plants required to remove the common toxins found in our firm's facility?

The amount of leaf surface area influences the rate of air purification by plants. Generally, larger leaf surface areas have higher transpiration rates and an increased ability to absorb airborne toxins.

The basis for recommending the number of plants needed per room is based upon the average amount of air pollution found in public buildings that were tested by the U.S. Environmental Protection Agency (EPA). The EPA monitored indoor air quality in hospitals, nursing homes and office buildings for several years and published their findings. This data can be found in the EPA report on *Indoor Air Quality in Public Buildings: Vols. I and II*, August 1988, EPA/00/6-88/009ab.

Data was extracted from the above report to produce the following tables:

**Mean Indoor Air Concentrations of Chemicals Found in Various Buildings
Micrograms Per Liter (µg/l)**

CHEMICAL	OFFICE BUILDING	HOSPITAL
Chloroform	.002	--
Trichloroethylene	.005	.002
Benzene	.005	.003
Xylene	.022	.013
Formaldehyde	.173	.106

A 100 ft.² (9.3 m²) office with an 8 ft. (2.4 m) ceiling contains a volume of 800 ft.³ (22,640 liters) of air. Based upon this data, if the air contained 0.173 µg/liter of formaldehyde, the room would contain a total of approximately 3,917 µg of formaldehyde. The table below allows you to estimate the number of plants required to remove formaldehyde. Formaldehyde was the predominant chemical found in the EPA's test buildings. If sufficient numbers of plants are added to remove formaldehyde, other chemicals will likely be removed.

Removal of Formaldehyde from Sealed Chambers by Plants Grown in Potting Soil

PLANT NAME	REMOVAL RATE (Micrograms/Hour)
Boston fern (<i>Nephrolepis exaltata</i> "Bostoniensis")	1863
Dwarf date palm (<i>Phoenix roebelenii</i>)	1385
Bamboo palm (<i>Chamaedorea seifrizii</i>)	1350
Janet Craig (<i>Dracaena deremensis</i>)	1328
English ivy (<i>Hedera helix</i>)	1120
Weeping fig (<i>Ficus benjamina</i>)	940
Peace lily (<i>Spathiphyllum "Clevelandii"</i>)	939
Areca palm (<i>Chrysalidocarpus lutescens</i>)	938
Corn plant (<i>Dracaena fragrans "Massangeana"</i>)	938
Lady palm (<i>Rhapis excelsa</i>)	876

6. Our modern buildings present major HVAC challenges. Maintaining optimum humidity levels is one of them. Is there any research supporting the claim that interior plants help to keep these levels where we need them?

Dr. Lohr's study, "The Contribution of Interior Plants to Relative Humidity in an Office," demonstrates that plant transpiration in an office environment creates a humidity level exactly matching the recommended human comfort range of 30% to 60%. Similarly, the same study concludes that in an absence of plants, the relative humidity in offices runs below this recommended range. When the relative humidity of office air is too low, costly materials such as wood can become damaged and cracked. When the relative humidity is too high, the condensation of windows and exterior walls can result in costly structural damage.

GET THE FACTS:

THERE IS A COST FOR NOT KNOWING THE VALUE OF INTERIOR PLANTS!

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