Clearing the Air About Indoor Plants

C HANCES ARE, you have at least a few houseplants, and you’ve probably heard that they can clean your air. If not, a quick online search will yield dozens of articles on the subject, and many lists comparing specific plants on their ability to filter airborne toxins. Before you breathe easy though, notice that these lists don’t always agree on which species to grow and are vague at best about the science behind their claims.

What do we really know about the air-cleaning abilities of indoor plants, and how can this inform your selections? As it turns out, the situation is much more complex than growing a few houseplants and expecting them to make a big difference.

IN THE BEGINNING
One of the first investigations into the notion that indoor plants can clean the air was conducted by the National Aeronautics and Space Administration (NASA) in the 1970s. At the time, NASA was tasked with building an international space station in the complex sealed environment was a concern. Bill Wolverton, who was a research scientist in the Science and Technology Laboratory at Stennis Space Center, Mississippi, proposed using plants as a natural air filtration system in imitation of their role on Earth. “Since man’s existence on Earth depends upon a life support system,” Wolverton wrote in the final 1980 report, “it should be obvious that when he attempts to isolate himself in tightly sealed buildings, away from this ecological system, problems will arise.”

And indeed, problems did arise: many common building materials, such as plastics and particle board, were known to release pollutants into the air. Some of these chemicals had been linked to health problems including chronic headaches, asthma, and skin irritation. NASA scientists began studying various plants to see if they could reduce or eliminate these toxins in conditions simulating those in a space station.

FAVORABLE RESULTS
In the earliest studies, a variety of indoor plant species were sealed, one at a time, in Plexiglas® chambers measuring between 15 and 23 cubic feet. For a sense of scale, a 2013 Toyota Prius has about 23 cubic feet of trunk space. So, these chambers were fairly compact. After NASA scientists injected high concentrations of benzene, trichloroethylene, and formaldehyde—common indoor air pollutants—into the chambers, they found that if a potted plant was present, the air was significantly cleaner after 24 hours.

That sounds very promising, but as Wolverton, who is now an environmental consultant, points out, these results should not be taken out of context. “The small Plexiglas chamber studies gave us the ability to control all test parameters and to introduce single chemical at a time,” he explains. NASA “never intended for a single plant to clean a large space such as a home or office.”

To expand upon these initial experiments, NASA built a “closed ecological life support system” called the BioHome at the Stennis Space Center. At 43 feet long by 16 feet wide, it looked a lot like a space-age doublewide trailer. Inside, a kitchen, sleeping area, and bathroom were flanked by a large plant room to test the ability of various species to clean recycled air and raw sewage in a closed loop.

The BioHome allowed Wolverton and his colleagues to conduct “real-world tests, as opposed to a single plant in a small test chamber.” They found that human occupants of the BioHome, who initially reported out, may actually be doing the heavy lifting—for more on this see box, page 22. It wasn’t long before those non-abiotic lists of best plants for improving indoor air quality started popping up.

FIELD TESTING
While laboratory tests were an informative first step, they were never meant to model the complexity of real homes and offices. “In science there is always a need for complementary studies in the real world and in laboratory chambers,” says Margaret Burchett, an adjunct professor at the University of Technology in Sydney, Australia, and a coauthor of one of the few experimental field studies testing the effect of indoor plants on air quality in office buildings, published in 2007. “Field observations and sampling give us information on correlations between air/sf/ water factors and plant behavior.”

To test plants in the “real world,” the Australian researchers conducted a series of trials in three separate office buildings over a nine-week period. Similar to the lab-based chamber studies, the researchers found that spaces with plants had significantly lower concentrations of air pollutants. “We found that three plants per office were enough always to reduce total [air pollution] below health risk levels,” says Burchett.

CHALLENGES TO THE RESEARCH
But when it comes to our homes and office spaces, do these lab and field studies tell us anything definite? John Girman, former director of the Indoor Environments Center for Analysis and Studies at the Environmental Protection Agency (EPA), says no.

In 2009, while working with the EPA’s Indoor Environments Division, Girman coauthored the first critical review of the indoor air phytoremediation research. Published in the Proceedings of Healthy Buildings, the report was coauthored with Tom Phillips, an air pollution specialist in the Indoor Air Quality Program of the California Air Resources Board, and Hal Levin, a research architect and head of the Building Ecology Research Group, a California consulting firm based in Santa Cruz.

Overall, the review took issue with the small size of experimental test chambers, the scarcity of field studies, the unrealistic treatment of pollutants, and other methodological issues. On the results of Burchett’s 2007 field study, for instance, the critique pointed out that “variations in ventilation may have been responsible for any apparent pollutant reductions,” and that individual pollutant “concentrations did not appear to be reduced” in the study. Furthermore, it noted that the five-minute duration of the weekly air sampling was “insufficient to characterise indoor concentrations.”

One of the most glaring problems the review raised was the use of small, sealed test chambers in laboratory studies. Using them, one plant takes up a larger relative...
“There are many variables as to how many plants would be needed to improve indoor air quality,” Wolverton agrees. That’s because people don’t live in sealed Plexiglas houses or NASA-style BioHomes. For example, the ventilation rate of your space is just one variable that’s much harder to control in the real world than in a lab setting. And in the very few field studies that have tested the effects of indoor plants on air quality in office buildings, ventilation rate was considered, but never quantifiably measured.”

**PLANTS VERSUS MICROBES**

Even from the earliest experiments, researchers knew plants weren’t alone in those chamber studies; they were rooted in potting soil that was rich in bacteria, fungi, and other microscopic organisms. Scientists saw air pollutant levels dropping, but they didn’t know for sure how much could be attributed to the plants and how much to the microorganisms.

So research groups began probing the question directly. In one 2006 study, for instance, scientists found that soil could keep cleaning the air in a Flexiglas chamber even after a plant had been uprooted and removed. Curiously, virgin potting mix didn’t have the same effect.

Because of these results and those from similar studies, Margaret Burchett, an adjunct professor at the University of Technology in Sydney, Australia, believes that “the microorganisms of the potting mix are the primary agents of [pollutant] removal.” The plants “exude goodies to attract and multiply the bacteria,” she explains. “The microbes are capable of utilizing [pollutants] as food, even down to amazingly low concentrations.”

However, there’s still no consensus among researchers on whether plants are primarily responsible for removing pollutants, or whether bacteria, fungi, and other decomposers are doing most of the work.

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**Resources**


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**THE BOTTOM LINE**

So now what? Should you compost your good-for-nothing spider plant? Are your palms and philodendrons a waste of space? Definitely not! It’s likely that indoor plants (in sufficient numbers) do have a positive effect on the air you breathe. We just don’t yet know to what extent.

Regardless, you can be sure that indoor plants offer other positive benefits. More and more research indicates that indoor greenery can improve mood and boost performance of creative tasks, and even accelerate the recovery of hospital patients. While these studies are ultimately just as limited as the air quality research, they do dovetail with a larger sensibility that anyone who gardens will agree on: plants just make us happy.

So enjoy your indoor plants, and maybe even find room to grow a few more. As Wolverton advises, “I always recommend a variety of plants and as many as one can reasonably maintain.” Appreciate them for the beauty and sense of well-being they bring to your space. And if you want to capitalize on their tentative potential to filter your air, don’t limit yourself to the top species on those popular lists because it’s simply too soon to judge.

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