Why plants can help improve air quality

Green plants can help to purify the air in city streets. Some plants are more helpful in this regard than others, and the way the plants are used, their structure and positioning, will make a difference too. There are many factors to take into consideration, wind and rain for example, and the vortex effect as air circulates in the "canyons" created by high rise buildings.

A detailed review of the scientific work in this field up to 2014, carried out for the Swedish National Road and Transport Research Institute[1], showed that the effects of urban vegetation on local air quality are complex. It came up with these design recommendations:

a) Dilution of emissions with clean air from aloft is crucial: the vegetation should preferably be low and/or close to surfaces.

b) Proximity to the pollution source increases concentrations of air pollutants and deposition: vegetation should be close to the source.

c) Air passing above, and not through, vegetation is not filtered: barriers should be high enough and porous enough to let the air through, but solid enough to allow the air to pass close to the surface.

d) Deposition of coarse particles is more efficient at high wind speeds, while the opposite is true for ultrafine particles, and vegetation density often changes due to strong winds. To improve deposition, the vegetation should be hairy and have a large leaf area index, but still be possible to penetrate.

As for those city canyons, a 2012 study[2] showed that the planting of vegetation in street canyons can reduce street-level concentrations by as much as 40% for nitrogen dioxide (NO_2) and 60% for particulate matter (PM), and concluded that judicious use of vegetation can create an efficient urban pollutant filter, yielding rapid and sustained improvements in street-level air quality in dense urban areas. The diagram below shows what these authors had in mind.

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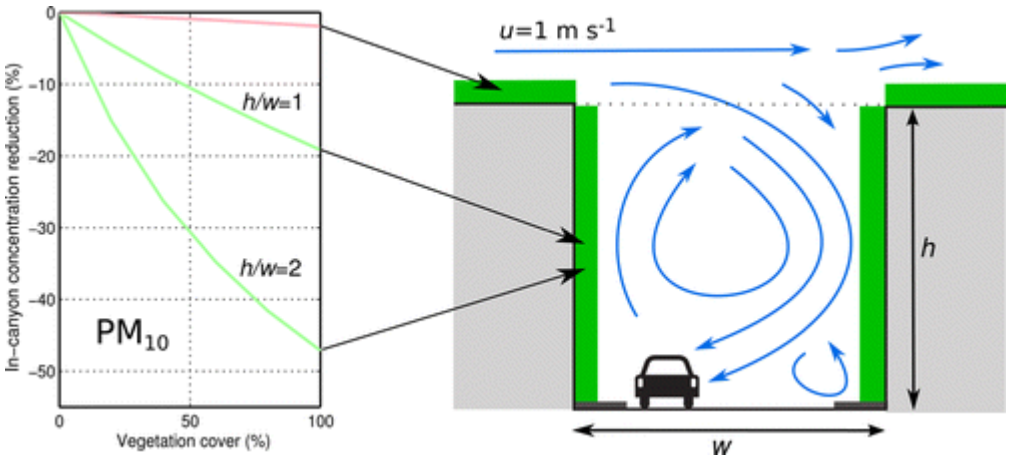
[1] *Review on urban vegetation and particle air pollution – Deposition and dispersion*, Sara Janhäll, 2015, Swedish National Road and Transport Research Institute-VTI, http://www.sciencedirect.com/science/article/pii/S1352231015000758 (accessed 6 January 2017)

[2] *Effectiveness of Green Infrastructure for Improvement of Air Quality in Urban Street Canyons,* Thomas A. M. Pugh*, A. Robert MacKenzie, J. Duncan Whyatt, and C. Nicholas Hewitt, Lancaster Environment Centre, Lancaster University, Lancaster, U.K., LA1 4YQ, *Environ. Sci. Technol.*, 2012, *46* (14), pp 7692–7699 http://pubs.acs.org/doi/abs/10.1021/es300826w (accessed 6 January 2017)



One commentator on this study[3] (www.treehugger.com) reminded us of the need to be thoughtful about planting trees. Plant them too closely and you could make pollution beneath the canopy worse instead of better.

An earlier review (1989) concerned with the issue of sick buildings and carried out for NASA[4], looked at indoor pollution and how plants can reduce common toxins in the air, specifically benzene, trichloroethylene and formaldehyde. See the Wikipedia entry for a handy chart of plants https://en.wikipedia.org/wiki/NASA_Clean_Air_Study. Here is an extract, showing the invasive Ivy we sometimes love to hate as one of the good guys in reducing toxins in the air, and the ordinary chrysanthemum in a whole new light:

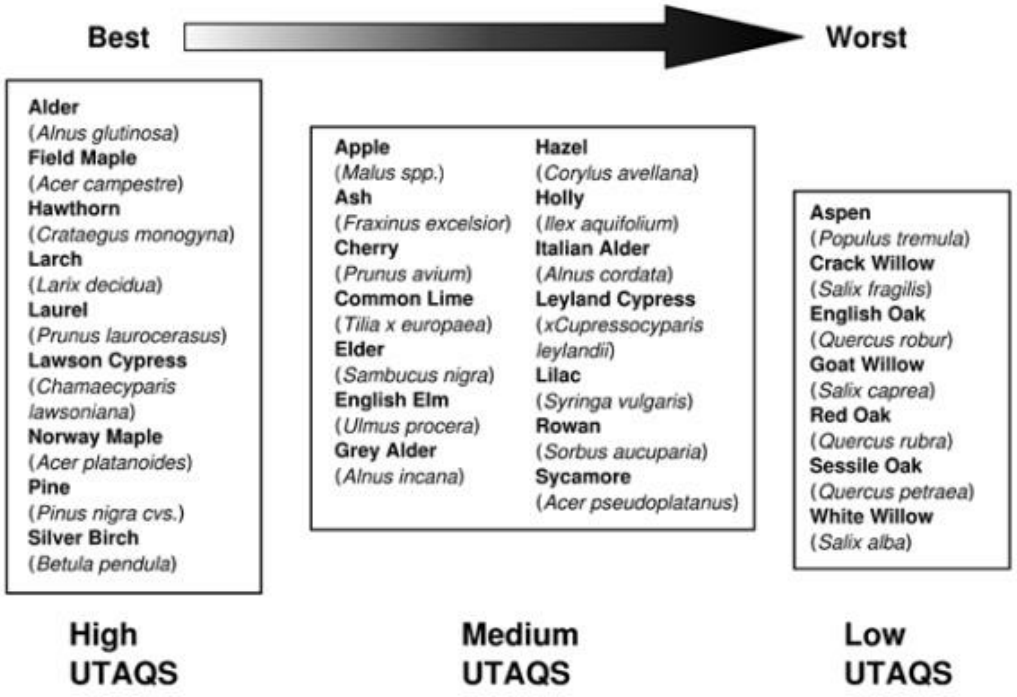
	benzene	formaldehyde	trichloroethylene	xylene and toluene	ammonia
Dwarf date palm	No	Yes	No	Yes	No
Boston fern	No	Yes	No	Yes	No
Ivy	Yes	Yes	Yes	Yes	No
Chrysanthemum	Yes	Yes	Yes	Yes	Yes

[3] http://www.treehugger.com/natural-sciences/urban-vegetation-reduces-pollution-8x-more-previously-believed.html (accessed 5 January 2017)

[4] BC Wolverton; WL Douglas; K Bounds (July 1989), A study of interior landscape plants for indoor air pollution abatement (Report). NASA. NASA-TM-108061 https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19930073077.pdf (accessed 6 January 2017)

A 2012 report from the Woodland Trust[5] gives a useful table to show which trees have the best "air quality scores" and goes on to explain how the size of the tree also affects its ability to capture particles. Trees with a large leaf area can remove many times more particulate pollution per year than small ones although younger trees tend to be disproportionally effective (relative to their leaf area) due to their greater leaf densities.

Urban tree air quality score (UTAQS) classification for 30 tree species common in the West Midlands metropolitan area, UK



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Forest Research Evidence Note[6] points out that some tree species can have a negative effect and can form pollutants in the atmosphere, for example willow and poplar. Trees may emit gases known as volatile organic compounds. When these combine with the man-made oxides of nitrogen (NOx), they can contribute to the production of other pollutants, especially ozone.

Forest Research also notes that conifers capture more particulate matter than broadleaved trees because they have a larger total surface area of needles, and the needles are not shed during the winter when the air quality is usually worse. On the other hand, coniferous trees are sensitive to air pollution and deciduous trees are better at absorbing gases. A mix of species therefore seems to be the best alternative.

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[5] https://www.woodlandtrust.org.uk/mediafile/100083924/Urban-air-quality-report-v4-single-pages.pdf (accessed 5 January 2017) See page 4 for a diagram reprinted with permission from Donovan et al. (2005). Copyright 2005 American Chemical Society. More details can be found at http://www.es.lancs.ac.uk/people/cnh/docs/UrbanTrees.htm

[6] http://www.forestry.gov.uk/fr/urgc-7edhqh (accessed 6 January 2017)