TALKING TIMBER

TREES, TRAFFIC AND POLLUTION

***Martin Ansell** considers the role of trees in controlling airborne pollutants*

The felling of streetside trees by Sheffield City Council from 2012 as part of a £2.2bn, 25-year street improvement project led to widespread protests by local residents who understood the environmental benefits of trees and their ability to take up airborne pollutants. Initially, the Council insisted that dangerous, dead, diseased or dying trees were to be felled but by 2018 a compromise agreement was reached with protesters, whereby healthy trees were to be saved. A 2020 report by the local government ombudsman identified a "lack of transparency, openness and, on occasion, honesty" after many trees had been felled (https://www.bbc.co.uk/news/uk-england-south-yorkshire-59999064).

As well as their aesthetic and shade attributes, trees are known to be a valuable source of pollution control. The Woodland Trust describes the impact on human health of harmful pollutant gases including carbon dioxide, nitrogen dioxide and sulphur dioxide (https://www.woodlandtrust.org.uk/trees-woods-and-wildlife/british-trees/tackling-air-pollution-with-trees/). Also, airborne particulates including dust particles and rubber debris from tyre wear may represent a serious health hazard. So, what are the mechanisms by which trees control these agents of pollution and which species are most effective for pollution control?

In a 2024 paper Slaveya Petrova compared the relative efficiency of lime *(Tilia tomentosa)*, ash *(Fraxinus excelsior)* and pine *(Pinus nigra)* trees in removing three airborne pollutants, including PM_{10} and $PM_{2.5}$ particulates and nitrogen dioxide. PM stands for Particulate Matter. PM_{10} particulates, which include dust and pollen, are 10 micrometres or less in diameter and $PM_{2.5}$ particulates, which include products from the combustion of fossil fuels, are 2.5 micrometres or less in diameter. The latter particles are the most dangerous as they can penetrate the lungs and enter the blood stream resulting in the respiratory conditions which can affect the heart and lungs. Petrova conducted chemical analysis of heavy metals in leaves from lime, ash and pine trees exposed to different levels of urban pollution and calculated their pollutant removal efficiencies. The evergreen pine species possessed the highest removal efficiency, but the deciduous species were also effective in reducing pollution.

Leaves are clearly able to absorb pollutants but what is the mechanism? In another 2024 paper Jongkyu Lee, Myeong Ja Kwak and Su Yung Woo investigated the absorption and adsorption of particulate matter and uptake of metal and non-metal elements from particulate matter in the leaves of pine *(Pinus densiflora)* and oak *(Quercus acutissima)*. Absorption involves the mass transport of particles into another material whereas adsorption is the adhesion of particles to the surface of the material. Stomata, found on the surface of leaves and stems of trees, are openings which can vary in size from a few to 50 micrometres. They control the exchange of gases between the external atmosphere and internal leaf cavities. For example, in the process of photosynthesis carbon dioxide is absorbed and oxygen is released in the presence of sunlight. Lee *et al.* observed that stomatal size, leaf roughness, and wax content played a crucial role in PM_{10} absorption and adsorption. Transpiration (loss of water) and leaf boundary layer conductance (determined by the thin zone of calm air that surrounds each leaf) influenced the level of $PM_{2.5}$ adsorption. The larger stomata of pine leaves compared to oak leaves allowed a greater concentration of PM pollutants to be absorbed and accumulated consistent with published literature.

The annual cycle of regrowth of leaves and needles in deciduous and coniferous trees ensures the long-term uptake of pollutants. In conclusion, there are clear environmental benefits of siting trees, and indeed shrubs and hedges, on busy polluted roadsides. ■

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Below: Heavy traffic on Bathwick Street, Bath under a canopy of London plane trees