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Trees could be used to monitor air pollution simply and cheaply

It may be possible to use trees to monitor levels of air pollution in cities, new research suggests. A Belgian study found evidence that leaves of urban trees change both chemically and physiologically when exposed to different levels of air pollution. If these changes are carefully quantified, trees could provide cheap and widespread 'bio-indicators', the study's authors suggest.

Air pollution can present serious risks to both human health and the environment. However, accurately monitoring air pollution requires expensive equipment which is often only placed in a small number of sites. The bio-indicator approach uses the chemical and physical changes in organisms to directly assess the effects of air pollution on the environment.

In this study, carried out in the city of Gent, Belgium, researchers chose two species of lime tree (also called linden trees), a 'hairy'-leaved and a smooth (non-hairy)-leaved variety. Seven or eight trees were selected in two areas; one industrial area with high air pollution levels and the other area containing urban green spaces and semi-natural habitat with lower air pollution. The air pollution levels in the two areas were verified by government monitoring stations.

During August 2009, three to four leaves were collected from different branches of each tree. Researchers then measured the chlorophyll content (a green pigment, essential for photosynthesis) and how much light was reflected by the leaf from both adaxial (upper) as well as abaxial (lower) sides.

The results demonstrated that chlorophyll content was significantly lower in the more polluted area in both species of tree. Furthermore, for the hairy-leaved species, adaxial leaf reflectance significantly increased in the more polluted area. Adaxial leaf reflectance was also higher in the smooth-leaved species; however, this result was marginally significant.

The higher reflectance in the more polluted area was likely to have been caused by the lower chlorophyll content, a link which has been demonstrated in other studies. The higher sensitivity of the hairy-leaved species to pollution may suggest that the leaf hairs trap pollutants, increasing exposure. This shows that any bio-indicator approach to air pollution monitoring must take into account differences between specific species, say the authors.

The researchers also looked to see if leaves with reflective adaxial sides were also reflective on their abaxial sides. For both species, both sides were more likely to be more reflective in the polluted area. This indicates structural changes to the leaf, the authors say, resulting in a thinner leaf. The lower chlorophyll content again might also play a role.

The study concludes that using plants as bio-indicators could provide a simple and cheap method of monitoring air pollution and its environmental impacts in particular. However, care must be taken to ensure that differences between species are fully accounted for.

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