

Science for Environment Policy

Vegetative Vigour Terrestrial Plant Test adapted for assessment of atmospheric pollution

It is important to understand the extent to which atmospheric (air) pollution damages plants (i.e. its phytotoxicity) as well as the wider ecosystem (i.e. its ecotoxicity). For this reason, researchers have adapted the Organisation for Economic Cooperation and Development (OECD) [Vegetative Vigour Test](#)¹ for the assessment of the ecotoxicity of samples of aerosol (suspensions of fine solid particles or liquid droplets in air). Typically, the test involves spraying the trial liquid on above-ground portions of the plant, such as the leaves. The adapted protocol involves extracting water-soluble aerosol compounds from aerosol samples to spray on the plant. The new protocol is sensitive enough to determine phytotoxicity and establish a clear cause–effect relationship, and as such has the potential to serve as a useful tool for the assessment of the effects of air pollution on environmental and human health.

While it is well-established that plants are highly sensitive to air pollution, an improved understanding of the cause–effect relationship between airborne contaminants and plant health is required. The Vegetative Vigour Test for terrestrial plants provided a promising method for achieving this, as it is designed to assess the effects of chemical, biocidal and crop-protection products on plants and is often used to determine cause–effect relationships. The original test protocol involves spraying the above-ground portions of the plant with the liquid being tested.

A team of Hungarian scientists has used this protocol, or guideline, as a starting point and evaluated its effectiveness at assessing ecotoxicity. First, they collected aerosol samples and extracted water-soluble compounds to produce an aqueous extract. Laboratory tests were used to measure the concentrations of heavy metals, polycyclic aromatic hydrocarbons (PAHs), benzenes and aliphatic hydrocarbons in the extract. The researchers then followed the test protocol given by the OECD Guideline, using the *Cucumis sativus L.* (cucumber) plant. As the test was originally developed to assess the phytotoxicity of plant-protection products that are typically applied in a single spraying, only one application at the start of the experiment was recommended. In order to more accurately simulate exposure to real-world air pollution, however, the scientists experimented with applying the test substance on repeated occasions. At the end of the experiment, plant growth and visible symptoms of necrosis (death of plant cells) were measured and assessed.

Overall, the experiment demonstrated that the adapted protocol can be used to evaluate the ecotoxicity of aqueous extracts taken from aerosol samples. Moreover, the results indicate that the appearance of visual symptoms, such as necrosis (when plant tissue turns brown to black in colour), appears to be a better indication of phytotoxicity than growth inhibition, and that repeated applications of the extract are necessary.

While the adapted protocol cannot link specific effects to specific pollutants, it is sensitive enough for the assessment of air-pollution phytotoxicity and the establishment of a clear cause–effect relationship. This makes it particularly well-suited to comparing either the potential phytotoxicity of aerosols from different origins (such as different geographic areas or areas of different land use) or the sensitivity of different species.



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1. OECD Guidelines for the Testing of Chemicals, Section 2, Effects on Biotic Systems – Test No. 227: Terrestrial Plant Test: Vegetative Vigour Test