Isoprene emission from plants -- a volatile answer to heat stress

Isoprene is a hydrocarbon volatile compound emitted in high quantities by many woody plant species, with significant impact on atmospheric chemistry. The Australian Blue Mountains and the Blue Ridge Mountains in the Eastern United States are so called because of the spectral properties of the huge amounts of isoprenes emitted from the trees growing there.

Although a positive correlation has been observed between leaf temperature and isoprene emission in plants, the physiological role of isoprene emission, which is clearly quite costly to the plant, is still under vigorous debate.

One of the most popular hypotheses suggests that isoprene protects the metabolic processes in the leaf, in particular photosynthesis (the process by which plants use light energy to fix CO2 and produce their own “food”), against thermal stress.

To test this hypothesis, scientists Katja Behnke and Jörg-Peter Schnitzler from the Institute for Meteorology and Climate Research of the Research Centre Karlsruhe in Garmisch-Partenkirchen in Germany, together with colleagues from the Universities of Braunschweig and Göttingen, also in Germany, and British Columbia, in Canada, recently applied genetic engineering techniques to obtain transgenic Grey poplar (Populus x canescens) trees with decreased isoprene emission, and examined their tolerance to heat. Their findings have been published in *The Plant Journal*.

Behnke et al. engineered such poplar trees by suppressing the expression of the gene encoding isoprene synthase (ISPS), the enzyme producing isoprene, by RNA interference (RNAi). They then subjected these trees to transient heat phases of 38-42°C, each followed by phases of recovery at 30°C, and measured the performance of photosynthesis.

In these experiments, Behnke et al. observed that photosynthesis in trees that no longer emitted isoprenes was much less efficient under such repeated “heat shocks” (a situation that is similar to what happens in nature, where temperatures around the leaves often oscillate, with short heat spikes). Thus, their results clearly indicate that isoprenes have an important role in protecting the leaves from the harmful effects of high ambient temperature.

How does isoprene confer heat tolerance? Does isoprene act as an antioxidant due to its chemical reactivity? And more generally: Is this effect of significance under natural conditions for poplar and other isoprene-emitting species" The researchers aim to analyse the biophysical and biochemical mechanisms of heat effects on photosynthesis and chloroplasts, and future long-term field trials will test whether the isoprene effect represents a positive adaptive trait for isoprene-producing species.

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