Towards process-based isoprene emission models

Ülo Niinemets
Institute of Agricultural and Environmental Sciences, Estonian University of Life Sciences, Kreutzwaldi 1, Tartu 51014, Estonia

Abstract

Isoprene emissions depends on light, temperature and ambient CO_2 and O_2 concentrations, but the existing models cannot yet reproduce all these responses. This presentation reviews the recent experiments by a fast gas-exchange system allowing to determine the in vivo pool size of dimethylallyldiphosphate (DMADP), the immediate substrate for isoprene synthesis. These experiments have provided novel insight into the mechanistic basis of the immediate controls of volatile isoprenoid emissions by light, temperature, and ambient CO_2 and O_2 concentrations, and have made it possible to separate the in vivo controls of emissions by synthase activities and availability of immediate isoprenoid substrate pool sizes. This presentation further covers the longer-term controls of emissions by chloroplastic carbon availability for isoprenoid production and acclimation of isoprene emission capacity to environmental changes. Photosynthesis ultimately provides the carbon for volatile isoprenoid production and under non-stressed conditions photosynthetic rate itself is rarely that low that it limits isoprenoid production. However, various metabolic pathways compete for the early substrate of isoprenoid synthesis, phosphoenol pyruvate (PEP), including mitochondrial respiration, shikimate pathway, and cytosolic PEP carboxylase. This presentation emphasizes that these competing controls can provide a major explanation for longer-term physiological controls of the emissions.