Plant-plant and plant-microbe interaction mediated by volatile organic chemicals

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Abstract

Plants form and emit a wide array of volatile organic chemicals. Some of them are important ingredients in foods as flavor, and the others attract us as ingredients in perfumes. Of course, plants form volatiles for their own sake. For reproductive organs, such as flowers or fruits, volatiles are essential to recruit pollinators and seed-dispersers. On the contrary, physiological significances of the volatiles formed in vegetative organs, such as leaves, stems, or roots, have not been completely understood. I have been studying on volatile compounds, especially those formed from fatty acid, in leaves. I noticed that the volatiles mediate plant-microbe, and plant-plant interaction in ecosystems. Herewith I would like to present some examples.

When leaves of *Arabidopsis thaliana* were mechanically wounded, six carbon volatile aldehydes were instantly formed at the wounded sites. The aldehydes suppressed germination of conidia of pathogenic fungi at the concentration found at the wounded leaves. Because pathogenic fungi usually attempt to invade into plant tissues through their wound sites, rapid formation of the aldehydes should be beneficial in protecting the leaves from infection[1)]. Some fungi also form volatile compounds. One of them, 1-octen-3-ol, induced a subset of defense-related genes in plants[2)]. This fact made us assume that plants recognized approaching fungal pathogens with their smell.

Some of the six carbon aldehydes formed are converted into more volatile compounds, such as six carbon alcohols[3)]. Tomato leaves could take up the alcohols from the surrounding atmosphere, and converted them into glycosides. We found that the glycosides showed weak but substantial activity to suppress growth of herbivores[4)]. Accordingly, tomato plants seemed to communicate by using volatile compounds.

Because of the functions of volatiles in ecosystems, we expect that taking advantage of the function would lead novel strategies for eco-friendly agriculture.

1) Shiojiri et al. (2006) PNAS, 103, 16672-16676. 2) Kishimoto et al. (2007) J Gen Plant Pathol, 73, 35-37. 3) Matsui et al. (2012) PLoS ONE, 7, e36433. 4) Sugimoto et al. (2014) PNAS, 111, 7144-7149.