5th International Conference on Fog, Fog Collection and Dew
Münster, Germany, 25–30 July 2010
FOGDEW2010-15

'Dew nucleation' by hygroscopic particles on leaves

J. Burkhardt (1), M. Hunsche (2), and S. Pariyar (1)

(1) University of Bonn, Crop Science and Resource Conservation, Plant Nutrition, Bonn, Germany (j.burkhardt@uni-bonn.de),
(2) University of Bonn, Crop Science and Resource Conservation, Horticulture, Bonn, Germany (mhunsche@uni-bonn.de)

Theoretical explanations of dew formation usually consider a pure, plain surface and do not include any contributions of hygroscopic material present on this surface. A significant amount of hygroscopic material, however, is present on most real leaves, due to accumulated deposited aerosols, salt exudations, leached ions, or agricultural sprays. Similarly to cloud nucleation, hygroscopic material on leaves leads to a significant reduction of saturation vapor pressure and enables ‚dew nucleation', where the condensation of minute amounts of water is still too small to be visible without a microscope. This may happen at humidities far below saturation, dependent on the composition and deliquescence point of the particles; additionally plant transpiration often raises the humidity on the leaf surface.

While the amounts of water involved are not significant in terms of the energy or water balance, the ecological consequences of such condensation mechanisms on leaves may be considerable. Highly concentrated but mobile solutions are formed by the deliquescence of hygroscopic particles, which may provide important nutrients for the plant. Their chemistry differs considerably from dilute solutions. When viewed by an environmental scanning electron microscope (ESEM), oscillating humidity led to the expansion of salts even on hydrophobic leaf surfaces. This may lead to the 'hydraulic activation of stomata (HAS)', a process leading to the extension of liquid water films into the plant and subsequent transport of liquid water and solutes on the stomatal pathway, a meanwhile well-proven contradiction to previous concepts.

Apart from the nutritional aspects, hygroscopic substances on leaves will interact with plant water relations. Depending on the degree of stomatal activation, this may trigger useful hydraulic signaling or provoke deleterious wicking and reduced drought tolerance of the plant.