Geophysical Research Abstracts
Vol. 21, EGU2019-15061, 2019
EGU General Assembly 2019

Stomata Facilitated Sorption of Silver Nanoparticles by Arabidopsis thaliana

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Engineered nanoparticles (ENPs) can enter into plants via foliar exposure as a result of nanopesticides application, reclaimed water irrigation and atmospheric deposition. However, the significance of stomata on leaf epidermis in the internationalization of ENPs into plants remains largely unexplored. This study aimed to investigate the contribution of stomata to the sorption of silver nanoparticles (AgNPs) by model plant Arabidopsis thaliana of ecotypes (Ler and Col-7) and stomata mutants (ost1-2 and scord7) using batch experiments. Compared to control group free of abscisic acid (ABA), stomatal apertures treated with 10 μM ABA remarkably decreased in Arabidopsis ecotypes Ler and Col-7, but remained unchanged in ABA-deficient mutants ost1-2 and scord7 ($p < 0.05$). The sorption kinetics showed that the maximum sorbed amounts of AgNPs were reached by 60 min. The amounts of AgNPs sorbed by Arabidopsis ecotypes Ler and Col-7 treated with 10 μM ABA were much lower than those in ABA-free control group, mainly due to the ABA-induced stomatal closure. There was little difference between the sorbed amounts of AgNPs in the control and ABA treatments for mutants ost1-2 and scord7 because they did not respond to the ABA exposure. The subcellular localization of AgNPs in Arabidopsis thaliana leaves was further determined by ultra-high resolution transmission electron microscopy. Our results highlight the critical role of stomata in the internationalization of ENPs into plants and may have broad implications to not only the study of stomatal biology, but also management strategies for decreasing the ENPs contamination of agricultural crops.