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Lipid droplets (LDs) are organelles dedicated primarily to the storage of neutral lipids, and are found in most of organisms from archaea to eukaryotes. Besides their energy storing capacity, they are also involved in inter-organelle transport of lipids and proteins, stress signalling, and lipid homeostasis. LDs have been shown to be hijacked by positive-sense single-stranded RNA for their replication in animal cells. Like animal viruses, plant positive-strand RNA viruses have to reroute host proteins, intracellular membranes, and lipids to create an optimized lipid/membrane microenvironment for their efficient viral replication compartment (VRC) assembly. However, the possible involvement of LDs in this plant virus infection process has not been explored.

In this study, we monitored LD biogenesis upon infection by the positive single-strand RNA turnip mosaic virus (TuMV, potyvirus) in *Arabidopsis thaliana* and *Nicotiana benthamiana*. Using confocal microscopy, we revealed that infection by TuMV leads to a significant proliferation of LDs compared to mock-inoculated leaves, both in Arabidopsis and *Nicotiana benthamiana*. Both confocal and transmission electron microscopy data also showed that LDs are recruited to TuMV-induced VRCs in infected leaf cells. Consistently, a significant accumulation of neutral lipids was observed in TuMV-infected leaves in *Nicotiana benthamiana*, supporting the premise that TuMV-infection induces LD biogenesis. We also demonstrated that the TuMV propagation is significantly reduced in Arabidopsis *ldap* (*lipid droplet-associated protein*) knock-out mutants and increased in *LDAP1* overexpressing Arabidopsis plants. Taken together, our results indicate that LD biogenesis could play an essential role in a plant virus infection.