Environmental stress shapes the evolution of a potyvirus towards a mutualistic relationship with its host

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Traditionally, virology has been focused in studying the pathogenic effect of viruses. In the recent years, however, this perception is changing and viruses are being studied as mutualistic components of ecosystems (Roossinck, 2011). Even pathogenic viruses can be beneficial for its host under certain circumstances: e.g., virus-infected plants showed a higher drought tolerance than the non-infected ones (Xu et al. 2008). We are studying the evolutionary dynamics of a pathosystem under drought stress conditions. To do so, we evolved turnip mosaic potyvirus (TuMV) in the model plant Arabidopsis thaliana. Viruses have been subjected to five evolutionary passages in four natural accessions (ecotypes) of A. thaliana that were previously shown to have different transcriptomic responses to potyviral infection (Hillung et al. 2012). In each accession, three independent viral lineages were evolved in normal conditions (SD) and another three were evolved in water-deficient conditions (DT). After evolution, DT-evolved viruses showed a higher infectivity than SD-evolved viruses. All infections increased the drought tolerance of the host, although DT-evolved viruses induced a significantly higher tolerance to water deficit than SD-evolved viruses. DT-evolved viruses provided its host with higher survival rates when facing water withdrawal. As TuMV is a sterilizing virus, plants infected with SD-evolved viruses barely produced seeds. However, plants infected with DT-evolved viruses produced larger amount of seeds than plants infected by SD-evolved viruses, a direct measure of increased plant fitness. Interestingly, the magnitude of this beneficial effects is ecotype-specific. The genetic and physiological causes of these differential host responses to both viruses are being characterized with targeted metabolomic and transcriptomic approaches. Preliminary results are consistent with a virus-induced activation of salicylic acid signaling pathway, which is also involved in drought tolerance. This research shows how environmental conditions shape the evolutive dynamics in a plant-virus pathosystem, modifying the relationships between the virus and the host. Effects are variable among natural ecotypes but in all cases DT-evolved viruses were more virulent but less pathogenic for the host, providing the host an increased tolerance to drought.

References: