Interactions with the water cycle as a driver of microbial evolution: clues from the life history of plant pathogens

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Interactions with the water cycle as a driver of microbial evolution: clues from the life history of plant pathogens

Cindy E. Morris[1] and David C. Sands[2]

1. INRA, UR407 Plant Pathology, Montfavet, France
2. Montana State University, Dept. Plant Sciences and Plant Pathology, Bozeman, MT

The last decade has witnessed a conceptual leap toward the idea that air-borne micro-organisms have reciprocal interactions with the atmosphere that surrounds them: They are subject to the physico-chemical conditions of this environment and they can also contribute to modifying these conditions as the case of microbial ice nucleation activity illustrates particularly well. There is a surge of research to understand the importance of these interactions for the atmosphere and the implications for the biology and evolution of micro- organisms. In the case of ice nucleation activity, we have observed that plant disease epidemiology gives several interesting clues to the selective pressures endured throughout the life history of ice nucleation active (INA) micro-organisms *(Pseudomonas, Pantoea* and *Xanthomonas* species and rusts in particular) that have driven the evolution of this property- and that might also provide insight into the potential significance for atmospheric processes. These epidemiological clues concern the capacity of micro-organisms to enhance frost sensitivity of plants and insect vectors, the resistance of INA micro-organisms to sub-zero temperatures or the capacity to over-winter in association with plants, the host range and aggressiveness of INA strains of plant pathogens, the importance of rainfall in initiation of disease epidemics, and the climatic conditions of air-masses that bring precipitation carrying INA micro-organisms. The ensemble of this information corroborates the hypothesis that ice nucleation activity contributes to the capacity of micro-organisms to avoid lethal sub-zero temperatures or other stressful conditions during long distance aerial transport by providing a mechanism of precipitation with growing ice crystals.

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