Title:
Bacterial motility effects on leaf surface exploration

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Abstract (300 words maximum): :
Plants, like most living organisms, host a wide diversity of microbial life. The aerial part of the plant — the Phyllosphere — which consists of leaves, stems, and flowers, harbors a variety of microbial communities crucial for plant health (Vorholt 2012). Current research aims to understand
their adaptations and distribution on leaves. While extensive studies have elucidated late-stage colony distribution and composition, the mechanisms governing initial bacterial distribution remain unknown. We show that hydrodynamic attraction to the surface guides the initial distribution
of bacterial colonies inducing trapping on the epidermal grooves. To probe the physical interactions between bacteria and leaf surfaces, we developed a model system of leaf morphology,
allowing experimental study of microorganisms with single-cell resolution. Combining laser scanning microscopy and two-photon nanolithography, we replicate real leaf surfaces in microfluidic PDMS chips, isolating their morphological and physical properties from chemical/biological variables. We explore the interplay between motile bacteria and leaf topography, observing surface exploration and initial colony development. On a short timescale, bacteria exhibit preferential attachment within the epidermal cells' grooves, giving rise to small colonies, as evidenced by microscopy imaging and previous research (Lindow, 2003). Our data indicates
that bacterial surface interactions leading to trapping during surface exploration happen more frequently in grooves than in other leaf regions. This observation underscores the preferential
attachment observed during colony development and is supported by the findings of a 2-dimensional mathematical model of near-surface swimming on curved surfaces (Sipos, 2012).
We expect our results to shed light on the effects of motility and hydrodynamics in the Phyllosphere
and provide a deeper understanding of the mechanisms guiding bacterial distribution during plant growth. These outcomes could also be a step towards characterizing the effects of topographical roughness of living systems on their respective microbiomes.