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Particle dispersal induced by coherent flow structures near oscillating leaves[1] ZIXUAN WU, SUNGHWAN JUNG, Cornell University, SAIKAT BASU, South Dakota State University — Plant pathogens like rust spores are ongoing issues for agricultural practices. Past studies have shown that liberation of rust spores from leaf surfaces can result from vortices induced by impacting droplets. Our experiments suggest that heaving leaf motions indeed generate shear layers along leaf surfaces with periodic shedding of counter-rotating vortex tubes that enhance particle mixing and spatial transport. We utilize Finite Time Lyapunov Exponents (FTLE) to map out coherent structures that emerge over 2D flow maps on the transverse cross-section of vibration, while investigating particle advection properties owing to such oscillatory, unsteady flow patterns. The vorticities are extracted from smoke visualization data and matched with theoretical predictions based on 2D velocity potentials commonly adopted in oscillatory airfoil theory. We then applied a ballistic model with modification on velocity from vortex tubes and airfoil theory to simulate trajectories of ejected particles from host leaf surfaces. In summary, the study visually captures vortical airflow patterns from induced leaf vibrations, uses FTLE to characterize the coherent flow structures that facilitate dry-advection, and compares experimental data on transport with theoretical estimates.

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