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Microbial ice nucleators are scavenged from the atmosphere during artificial rain events

Regina Hanlon (1), Craig Powers (2), Kevin Failor (1), Boris Vinatzer (1), and David Schmale (1)

(1) Virginia Tech, Plant Pathology, Physiology, and Weed Science, Blacksburg VA, United States (dschmale@vt.edu), (2) Virginia Tech, Civil and Environmental Engineering, Blacksburg, VA, United States

Some microorganisms associated with rain may catalyze the nucleation of ice crystals at significantly warmer temperatures than would normally be required for ice formation, suggesting that they may play an important role in the onset of precipitation. Rain samples collected near the surface of the earth contain an array of microbial ice nucleators, but the little is known about their source(s) and life history. We conducted a series of field experiments to test the hypothesis that microbial ice nucleators are scavenged from the atmosphere by rainfall. Thirty three artificial rain events were conducted over four months (Nov 2014, Dec 2014, April 2015, and June 2015) off the side of the Smart Road Bridge in Blacksburg, VA, USA. In each event, sterile water was dispensed over the side of the bridge and recovered in sterile containers following gravitational settling from the bridge to an open fallow agricultural field below (a distance of ∼55m). Microbes scavenged from the artificial rain events were cultured on six different types of agar media (R2A, TSA, CA; +/-cycloheximide), and the ice nucleation activity was examined for colonies cultured from the different media types. Mean CFUs scavenged by artificial rain ranged from 2 to 267 CFUs/mL. Microbial ice nucleators were cultured from 94% (31/33) of the simulated rain events, and represented 1.4% (121/8871) of the total number of colonies assayed. This percentage is similar to the percentage of culturable microbial ice nucleators occurring in about half of the natural rain events studied in Blacksburg, VA. Sequence-assisted identification of the repeatable microbial ice nucleators that were scavenged from the atmosphere showed a number of unique prokaryotic and eukaryotic taxa. This work expands our knowledge of the scavenging properties of rainfall, and suggests that at least some ice nucleators in natural precipitation events may have been scrubbed from the atmosphere during rainfall, and thus are not likely to be involved in the onset of precipitation.