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Travel Patterns of Wind-Blown Soil Microbes

A dust storm near Lubbock, Texas, in June 2010. When strong winds carry away soil, microbes in the soil can act like hitchhikers and go along for the ride. ARS scientists are studying the soil microbes carried in the wind and shedding light on wind erosion effects on soil quality.

When strong winds carry away soil, microbes in the soil can act like hitchhikers and go along for the ride. With help from a wind tunnel and the latest DNA technology, Agricultural Research Service scientists are shedding light on the travel patterns of these soilborne hitchhikers. The work has implications for soil health and could lead to management practices that minimize the damage to soils caused by wind erosion.

Scientists have been studying wind-eroded soils since the 1930s, but few studies have focused on wind's effect on soil microbes. Microbes drive a number of critical processes, such as releasing enzymes that spur turnover of organic matter, sequestering carbon in the soil, and making nutrients available to plants.

Soil microbes include bacteria, fungi, and protozoa. Veronica Acosta-Martinez and Terrence Gardner in the ARS Wind Erosion and Water Conservation Unit in Lubbock, Texas, focused on bacterial populations that could be classified by DNA sequencing. Gardner is a visiting scientist in Acosta-Martinez's laboratory, and his position is funded by Alabama A&M University.

The researchers characterized the bacterial diversity in eroded sediments and their soil sources, focusing on the types of bacteria associated with coarse particles and fine dust particles. They classified the bacteria found in each type of soil by phylum, class, and genus using pyrosequencing, a process that allowed them to identify up to 100 times more DNA in each sample than what they would have detected with traditional soil-sequencing methods.

The project was a collaborative effort. Scott Van Pelt, Ted Zobeck, and Matt Baddock, also in the Lubbock unit, collected airborne dust and samples from organic-rich soils susceptible to wind erosion from fields in Michigan where potatoes, beets, and onions had grown a few years earlier. To simulate wind, they used a portable field wind tunnel that they had previously developed for other studies.

The results, published online in the *Journal of Environmental Quality,* showed that certain types of bacteria, in the phylum Bacteroidetes, were more predominant in the fine dust while other types, in the phylum Proteobacteria, were more predominant in the coarse sediments. As part of the study, Francisco Calderon, an ARS scientist in Akron, Colorado, used infrared spectroscopy to assess the effects of wind on the soil's carbon composition, a critical factor in soil health. Those results showed that wind had the same effect on the soil's carbon composition as it had on the bacteria, "fractionating" it so that certain types of soil carbon were more abundant in the dust, while other types were more common in the coarse sediments.

Acosta-Martinez says the fact that Bacteroidetes were associated with fine dust may be significant, because studies have shown that they resist desiccation and have survival mechanisms that make them able to cope with extreme conditions and explore new habitats when carried long distances. On the other hand, the fact that Proteobacteria were associated with coarse eroded sediments, which travel shorter distances, may explain how soils can retain important qualities despite damaging winds. Proteobacteria are critical for carbon and nitrogen cycling in the soil, and the fact that they are more likely to stay close to home during dust storms is good news for soil health, Acosta-Martinez says.—By **Dennis O'Brien,** ARS.

This research is part of Climate Change, Soils, and Emissions, an ARS national program (#212) described at www.nps.ars.usda.gov.

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