Agricultural bacteria: Blowing in the wind

May 9 2012

The 1930s Dust Bowl proved what a disastrous effect wind can have on dry, unprotected topsoil. Now a new study has uncovered a less obvious, but equally troubling impact of wind: Not only can it carry away soil particles, but also agriculturally important bacteria that build soil and recycle nutrients.

It was all too evident during the Dust Bowl what a disastrous impact wind can have on dry, unprotected topsoil. Now a new study has uncovered a less obvious, but still troubling, effect of wind: Not only can it carry away soil particles, but also the beneficial microbes that help build soil, detoxify contaminants, and recycle nutrients.

Using a powerful DNA sequencing technique, called pyrosequencing, a team led by USDA-ARS scientists Terrence Gardner and Veronica Acosta-Martínez analyzed the bacterial diversity in three Michigan agricultural soils, and in two eroded sediments generated from these soils during a wind tunnel experiment: coarse particles and fine dust. Not only were the microbial assemblages on the coarse particles distinct from those on the dust, report the scientists in the current issue of the *Journal of Environmental Quality*, but the two types of eroded sediments were each enriched in certain groups of microbes compared with the parent soil, as well.

The findings suggest that specific bacteria inhabit specific locations in soil—and thus different groups and species can be carried away depending on the kinds of particles that erode. "It's important to know which microbes are being lost from soil," says Acosta-Martínez, a soil microbiologist and biochemist at the USDA-ARS Cropping Systems Laboratory in Lubbock, TX, "because different microbes have different roles in soil processes."

For example, the *Proteobacteria*—a diverse group critical to carbon and nitrogen cycling—were more associated in the study with eroded, coarse particles (those larger than 106 microns in size) than with the fine dust. Similarly, the dust housed its own community, in this case *Bacteroidetes* and other bacteria that are known to tolerate extreme dryness, gamma radiation, and other harsh conditions that may develop on dust particles as they float through the air, says Gardner, a postdoctoral researcher who is also affiliated with Alabama A&M University.

What this means is that wind erosion can both reduce the overall microbial diversity in farm fields, as well as deplete topsoil of specific groups of essential bacteria, say the researchers. At the same time, certain important groups, such as *Actinobacteria* that promote soil aggregation, remained in the parent soil despite the erosive conditions generated in the wind tunnel. And while fine dust can travel extremely long distances, coarse particles rarely move more than 20 feet, suggesting that they—and their associated microbes—should be fairly easy to retain with cover cropping and other soil conservation measures, Acosta-Martínez notes.

Helping farmers and land managers adopt practices that better conserve soil is one of the main goals of the USDA-ARS team's work, which also includes Ted Zobeck, Scott Van Pelt, Matt Baddock, and Francisco Calderón. In the Southern High Plains region, for example, intense cultivation of soil combined with a semi-arid climate can result in serious wind erosion problems. In fact, last summer's drought brought Dust Bowl-like conditions to the area, says Acosta-Martínez.

But "wind erosion is a national problem," she adds, with significant erosion occurring even in places where the growing season is humid and wet. Organic histosol soils in Michigan and many other parts of the country, for instance, are very susceptible to wind erosion when dry, especially since they're usually intensively farmed and often left bare in winter. Cover cropping or crop rotations not only help keep these soils in place, but can also build soil organic matter, which in turn promotes soil aggregation, water penetration, and general soil health.

It can take years, however, for farmers who've adopted new management practices to detect noticeable changes in levels of soil organic matter and other traditional soil quality measures. This is why Acosta-Martinez and Gardner have been analyzing soils with pyrosequencing, a method that yields a fingerprint of an entire microbial community, and well as identifies specific groups and species of bacteria based on their unique DNA sequences.

In this study, these microbial signatures told the researchers what's potentially being lost from soil during wind erosion events. But the fingerprints can be early indicators of positive outcomes, too.

"The microbial component is one of the most sensitive signatures of changes in the soil," says Acosta-Martínez, because of microbes' involvement in soil processes, such as carbon accumulation and biogeochemical cycling. "So, we're looking for any shifts in these signatures that could lead us to think that there are benefits to the soil with alternative management."

Provided by American Society of Agronomy

Citation: Agricultural bacteria: Blowing in the wind (2012, May 9) retrieved 27 April 2024 from https://phys.org/news/2012-05-agricultural-bacteria.html