A vineyard's soil microbes shape the grapes' microbial community

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In the first study of an entire wine grapevine's microbiome, researchers have found that the microbes associated with the grapes, leaves and flowers are largely derived from the soil microbes found around the plant's roots. The findings, published in *mBio* the online open-access journal of the American Society for Microbiology, could help dissect how microbes affect a wine's properties and pave the way for biotechnological advances for producing hardier crops.

"Growers have been sub-selecting the best regions to grow grapes over thousands of years, but the science of that is poorly understood," says Jack Gilbert, a microbial ecologist at the Argonne National Laboratory in Illinois. "Just the same as the human biome plays a role in health, bacteria have intricate associations with plants that affect disease resistance, stress tolerance and productivity."

Besides making tasty wine, Merlot grapes, Gilbert explains, are a really well controlled, understood crop system. He and his colleagues wanted to understand how different bacteria colonize these plants and also how those microbes might ultimately contribute to the wine's sensory properties. In other words, they wanted to find out if there is a microbiological component of terroir—the wine's properties that are imparted by the ground its grapes are grown in.

The team of researchers, which included winemaker Gilles Martin, looked at four closely related Merlot plants growing in five different vineyards across a 2-mile stretch of the North Fork region of Long

Island, New York. For each location, they sampled the soil, roots, leaves, flowers and grapes throughout a growing season. Then, the team used shotgun metagenomic sequencing to characterize all the bacterial species found on each part of the grapevine. The team found that it's all about location, location, location.

"Where you grow that particular grapevine is the most important characteristic shaping which bacteria will colonize the plant," says Gilbert. The majority of bacterial species found in the plant were also present in the soil it was growing in. A few rare species found in the soil, were enriched in the aboveground grapes and leaves. This indicates that the soil acts as a reservoir for most of the bacteria that are colonizing the plants' structures.

Next, the team compared the New York grapes' microbiome to those associated with Merlot grapes from Bordeaux, France, and crushed Merlot grapes from California. All three hosted similar bacteria species. "No matter where you are in the world, the types of bacteria growing on or in Merlot grapes are quite similar," says Gilbert.

There is immense commercial interest in finding specific bacteria that would add benefits to crops, such as drought and pest resistance. But the findings may also point to new, bacterial ways to massage a wine's outcome.

"From the wine industry's perspective, terroir comes from the plant's physiology, the chemical nature of the grapes, and the yeast that do the fermenting work," says Gilbert. From this study, Gilbert argues that the microbes present in the soil, rather than the soil's physical characteristics, might play a bigger role in influencing terroir.

"We don't have evidence that bacteria are specifically contributing to terroir, but our next step is to figure out how those bacteria are affecting

the chemistry of the plant."

Provided by American Society for Microbiology