Fungi: Another tool in bacteria's belt?

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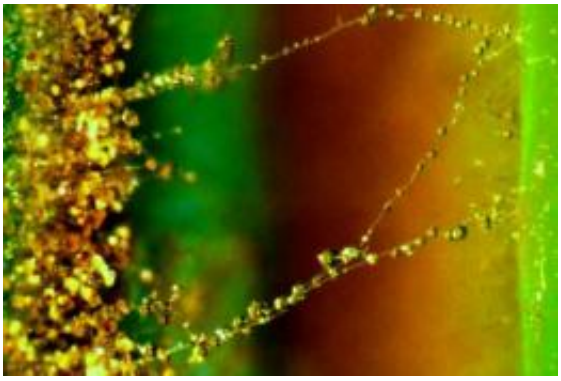

Bacteria use a bridge of fungi to cross a "canyon." Credit: Colin Ingham/American Friends of Tel Aviv University (AFTAU)

Bacteria and fungi are remarkably mobile. Now researchers at Tel Aviv University have discovered that the two organisms enjoy a mutually beneficial relationship to aid them in that movement — and their survival.

Fungal spores can attach themselves to bacteria, "hitching a ride" wherever the bacteria travel. And while this allows them to travel further than they would on their own, says Prof. Eshel Ben-Jacob of TAU's Raymond and Beverly Sackler School of Physics and Astronomy, it's certainly not a one-way street. Bacteria live largely in the rhizosphere — the environment that surrounds plant roots — where air pockets can interrupt their progress, he explains. When faced with a gap, the bacteria can drop the fungal spores to form a bridge, and continue across the

chasm.

The research, which was recently published in *PNAS*, was done in collaboration with Dr. Colin J. Ingham of Wageningen University and JBZ Hospital in the Netherlands, the paper's lead author; post-doctoral fellow Dr. Alin Finkelshtein; and graduate student Oren Kalishman working in Prof. Ben-Eshel's TAU lab.

This discovery contributes to our understanding of the way bacteria and fungi spread. Confirmation that the two organisms work in collaboration will help scientists fight disease-causing bacteria, or promote the spread of "good kinds" of bacteria or fungi, such as those that contribute to the health of plants. "In addition we now know that when you fight fungi, you are also fighting bacteria — and vice versa," notes Prof. Ben-Jacob.

A bridge to mutual survival

Mobile or "motile" bacteria, such as *Paenibacillus vortex*, are known to be able to carry cargo. With this in mind, the researchers were motivated to test whether *P. vortex* would be able to carry non-motile fungi, aiding in its dispersion. In fact, they observed that not only can the bacteria transport the fungi over long distances, like humans being carried by air travel, but they are also able to recover fungal spores from life-threatening locations, moving them to new and more favorable places where they can germinate and start new colonies. "The bacteria entrap the spores and wrap them in their flagella, which are like arms," explains Prof. Ben-Jacob. "This is similar to the way the Lilliputians moved the giant Gulliver by trapping him in a mesh of ropes."

But the bacteria's services aren't free. In an experiment, the researchers created air gaps or "canyons" too large for bacteria to cross. When confronted with this challenge, the bacteria used the fungi's mycelia — branch-like structures on the spores — as natural bridges, enabling them

to cross otherwise impenetrable gaps, notes Dr. Ingham.

"We see that upon encountering impossible terrains, the bacteria can bring fungal spores to help," Prof. Ben-Jacob continues. "The bacteria allow the fungi to germinate and form a colony, and then use the mycelia to cross obstacles."

Taking over new territories

Ultimately, this collaboration helps both the bacteria and the fungi to spread and thrive in highly competitive habitats. It's a sophisticated survival strategy, say the researchers, and contributes to our understanding of bacteria as smart organisms with an intricate social life. "The bacteria never let us down," Prof. Ben-Jacob says with a smile. "Just present them with a new challenge and you can be sure they'll provide new surprises."

These observations can also be applied to agriculture and medicine, showing new mechanisms by which bacteria and fungi can help one another to invade new territories in the rhizosphere — as well as in hospitals and within our own bodies.

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