BY JEFF LOWENFELS

BIOSLIME CAN WREAK HAVOC

Hydroponics, aeroponics, aquaponics and related water-growing techniques as well as aerated compost tea all have one thing in common with your mouth, and it isn't good: bacterial slime.

When it comes to growing plants, it is mostly the anaerobic bacteria that lurk in the depths of slime that cause concern. They produce, among other things, alcohols that damage roots. There are other concerns. Bacterial biofilms have a pH above 7 and can play tricks with your chemistry. And, bacteria in slime produce chemicals for defense of the colony including antibiotics that can impact chemistry and biology. It is clear that if you want to be a successful grower, you must keep bacterial slime from accumulating and fouling your equipment.

Anton van Leeuwenhoek looked at bacterial slime taken from his cheek as he was perfecting the microscope. Yet there were very few advances in understanding them until about 40 years ago.

The truth of the matter is that bacteria are small, and only recently have scientists been able to develop the techniques to see them in all their glory. Using special stains and powerful electron microscopes, we now know that many bacteria have hair-like structures that extend from inside the cellular cytoplasm through the cell membrane and cell wall. These are called fimbriae, and a single bacterium might possess 1,000 of these protein structures.

Fimbriae (sometimes called pili) are topped by a sticky substance. This enables them to adhere to surfaces, each making a bond that acts like one of those Chinese finger traps: it gets stronger the more force exerted on it. Thus, when water flows by and pulls on the bacterium, the bond gets stronger. This is how bacteria stick in your compost tea piping or the inside of your aeroponics components, despite a flow force that should keep things clean.

The surfaces of fimbriae are electrically charged as well. When two bacteria get close, like magnets, they attach. The organisms communicate, start to co-operate and the cells then start to produce glycocalyx, a polysaccharide or glyco-protein, which is nothing more than a fancy name for a long-chained sugar molecule. Different species of bacteria produce different sugars, probably depending on the host's cellular structure.

Production of these complex molecular chains continues, forming a matrix that to the naked eye looks like a thick slime, or biofilm. As time passes some of the cells differentiate, others multiply and what was a single layer of bacteria becomes a multilayered, complex, micro-world, complete with voids and tunnels and defense systems, including antibiotic production (Andrew Fleming's discovery of penicillin was such an antibiotic found in the soil). The covering created by the glycocalyx reduces the loss of oxygen and provides an important, protozoa-resistant covering under which to hide.

Bacterial slime has at least one additional benefit. In soils, fimbriae bind bacteria to particles, sometimes more than one forming soil aggregates. The spaces between these aggregates become pores through which air, water and organisms can travel.

Sometimes biofilms are comprised of only one single kind of bacteria and other times become real neighborhoods of different bacteria. Regardless, when these slimes form in unwanted places, bad things can happen. You already know that if they form on your teeth. The acids produced can cause cavities.

When slimes get thick enough in your growing systems, on the other hand, it isn't cavities you worry about. Bacteria deep inside a slime layer often operate under anaerobic conditions. Among other things they produce alcohols. Some bacteria, the facultative anaerobes who prefer to get their oxygen from air but can also get it by splitting it off from nitrates, may end up ultimately decreasing the nitrogen in the water of, say, your hydroponics tank. Sometimes bacterial slimes get thick enough to clog flow lines in growing systems.

In many grower's experience, it is the presence of biofilms that make organic hydroponics, aeroponics, aquaponics and hydroponics using compost tea or other organic solutions difficult, if not impossible. It is also often the presence of biofilms that negatively impact plant growth unbeknownst to the grower.

Biofilm Blocker?

What is needed is a natural substance with which we can coat our systems, and one actually might exist. Delisea pulchra is a marine algae found in the waters off Australia. Everything around these plants is coated with bacterial biofilms, but none form on the leaves of this plant. It's suspected this is a developed mechanism to keep films from blocking out the sun needed for photosynthesis.

Studies have shown that D. pulchra produce substances known as furanones that don't kill bacteria but just prevent them from organizing and forming biofilms. These furanones have been isolated from the plants, and products have been developed to prevent fouling boat bottoms in marine waters.

What we need is a furanone or similar substance that will prevent bioslime from forming in hydroponics, aeroponics and similar systems as well as our compost tea makers. Given our increasing understanding of how bacterial slimes form and operate, let's hope this isn't too far off.

Jeff Lowenfels is an avid gardener with a special interest in soil biology and sustainable gardening. You can buy the book "Teaming With Microbes: A Gardener's Guide to The Soil Food Web" from the Growing Edge online bookstore (www.growingedge.com/store/books_multimedia.php).