BY JEFF LOWENFELS

NEW WORLDS, NEW WORDS

My spell-checker does not recognize the word "glomalin." I suppose this is understandable given the age of my word-processing program and the fact that the substance wasn't discovered until 1996. A soil scientist named Sarah Wright discovered the sticky protein and named it after a group of fungi, Glomales, that produced it.

Given the fact that glomalin appears to be the very substance that glues soil together and is the basis of everything "organic" in the soil, one might think Microsoft or the folks at Webster's would have added glomalin to one of its updates. No matter, I added it manually.

The fungi that produce glomalin, technically a glyco-protein (a long-chained molecule with a protein unit and a carbohydrate unit), most probably use it to coat the outer cell wall to act as waterproofing and structural support for the fragile walls that hold in the fungus' flowing water and nutrients.

Glomales are mycorrhizal fungi, that is, they form a symbiotic relationship with plant roots, subsisting on carbon from the sugars in the plant root exudates and supplying the plant with water and nutrients such as P, N, Ca, K, Cu, M and Zn. Actually, they are a particular form of mycorrhizal fungi known as arbuscular mycorrhizal fungi, or AMF. Inside the root they form arbuscules, (which means "tiny trees"), structures that have a multitude of branches that grow in between the root's cells but don't invade them. The cells wrap around these branches creating a great deal of surface area. This allows a bi-directional adsorption of nutrients by the plant and the fungus. After about a week, the AMF arbuscule dies and is absorbed by the plant.

AMF also produce vesicles, or storage units, which grow in between and sometimes inside cells. These most probably store fungal nutrients that are used when the plant isn't supplying enough food to the fungi. These vesicles are the end cells, or root, of the fungi. The other end of the fungi grow into complex net-like networks seeking nutrients in the soil, including phosphorus which AMF are particularly good at freeing up from its chemical lock-up.

As the roots grow, fungal strands die off and the glomalin is left behind in the soil. There it binds to sand, silt and clay, and becomes the organic glue that literally holds particles together, forming soil aggregates. The spaces between these irregular-shaped aggregates serve as air passageways and water reservoirs and serve as condominiums for microbes and micro-arthropods that further develop soil structure.

If this wasn't enough, glomalin contains lots and lots of carbon that's produced by the host plants. In fact, a whopping 27% of the soil's carbon is held in glomalin. This compares to 12% held in humic acids. Glomalin then is the soil's primary carbon sink. When AMF are destroyed, either physically such as by tilling or removing plant hosts from the soil, the concentration of glomalin decreases.

As it turns out, glomalin might have a part to play as atmospheric CO_2 increases, a source of much concern of late. Experiments have shown that increasing CO_2 results in an increase in the colonization of plants by AMF, more growth of AMF, and thus greater production of glomalin. In fact, doubling the CO_2 in the atmosphere resulted in a five-fold increase in glomalin. This, in turn, results in increased carbon storage and increased soil aggregation and thus stability. In plain terms, as more CO2 appears you get more and longer fungal hyphae. This helps prevent erosion. Add in the glomalin glue and not only is erosion positively impacted but so is growth in soil structure and hence water retention.

It appears that all of this information about a substance scientists didn't even know existed 10 years ago is just the beginning. Recently, I read an article that soil bacteria appear to use glomalin on fungi as a transport liquid and another that glomalin has the ability to sequester toxic elements in the soil. Stay tuned.

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).