Posted on Mon, May. 17, 2004

GrandForksHerald.com

Scum of the Earth

Glomalin, a gluelike molecule, is what keeps your soil together

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Who would have thought that the scum of the earth would be so important?

Technically, the stuff is called glomalin, a term that's been around since the 1990s.

"Some people call it scum," says Kris Nichols, a scientist at the U.S. Department of Agriculture's

Northern Great Plains Research Laboratory in Mandan, N.D., for nearly a year.

Glomalin is a gluelike molecule in soil that can create and protect "aggregates," or small lumps of soil particles. The more of these aggregates, the more air and water can move through the soil and the less soil washes or blows away.

Nichols is considered one of the nation's experts on the stuff. She worked on it at USDA-ARS in Maryland before coming to North Dakota. She joins colleagues who have been working on the topic for several years.

Releasing nutrients

Nichols says the process starts with something called "mycorrhizal fungi," a class of fungi associated with 80 percent to 90 percent of all plant species, particularly grasses. These fungi form threadlike filaments called hyphae, which extend out beyond areas where the plants have removed all nutrients.

Glomalin acts like a sticky glue on these hyphae, coating and binding it together. The fungi improve soil structure and fertility. The hyphae form a "net" that collects soil particles and debris to form the aggregates. Hyphae also can absorb nutrients the plants could not otherwise obtain.

When released from the hyphae, the glomalin forms a scum on the surface of water. It can prevent soil aggregates from bursting and becoming susceptible to erosion. The more aggregates, the slower the release of the nutrients, acting like a "time-release fertilizer pellet," according to one USDA description.

In semi-arid regions, the theory is that the more these fungi can be developed, the less water it will take to produce crops. Plants take carbon dioxide from the atmosphere and deliver it to the fungi in the plant roots.

"Plant roots are very leaky; they leak a lot of sugar, or carbohydrates, to attract microorganisms to help process material in the soil for the plant's food," Nichols says. "It releases all of these carbohydrates, and when it does, it also releases water at the same time.

"If you have a good microbial population in your soil already, it won't lose as much water and you can grow crops better, with less water," she says. "I think that's going to be a big advantage. You don't have to add as much synthetics (fertilizer) to replace the nutrients the plant needs to grow."

Enhancing production

Nichols is designing experiments to look for best management practices to enhance production of these fungi. Crops such as canola and crambe that are grown in North Dakota are not hosts for the fungi.

"I'd like to see what happens when those crops are grown in rotation in production of these fungi and glomalin in subsequent years," Nichols says. "How well can the fungi come back and provide the benefits they normally provide in getting these nutrients and helping soil structure?"

Studies like this may take five or six years of effort before they can produce conclusive results and recommendations for farmers. A better understanding of the system may lead to better information about carbon sequestration, the practice of tying up carbon in soil. Markets are developing that would pay farmers some amount for storing carbon in their soils and selling the "credits" to companies whose manufacturing processes put carbon into the air as a pollutant.

"Within those (soil) aggregates, you have organic matter, plant roots and other types of organic debris," she says. "When they're not within the aggregates, they're more susceptible to being eaten by other organisms. It cycles that organic carbon back into the atmosphere."

The same thing happens when farmers plow. It exposes organic matter to microorganisms that degrade or "eat" it.

"They're going to consume it until it's gone," Nichols says. "When you plow it, it's like laying out a banquet table for the organisms to eat."

Nichols, who grew up on a farm near Lake Benton, Minn., says she has spent much of her first several months in North Dakota simply studying how cropping systems in the state work.

"I've actually spent quite a bit of time just talking with farmers in North Dakota," Nichols says.

Many types of 'no-till'

Among other things, she's discovered there are many definitions for "no-till" farming.

"It surprised me how much no-till is actually going on," she says.

Nichols will study no-till vs. conservation tillage and conventional tillage at a number of locations.

"We have a crop sequence study site at the Mandan station - 10 different crops there, and a crop matrix and comparisons of crops planted north to south and next year, east to west. So we have 100 types of sequences to look at."

In the future, scientists at the Mandan site will focus on the potential of mycorrhizal fungi to increase productivity of switchgrass as a bioenergy source, as well as their ability to improve carbon sequestration.