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Glomalin" a key to locking up soil carbon

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Introduction

Glomalin is a glycoprotein produced abundantly on hyphae and spores of arbuscular mycorrhizal (AM) fungi in soil and in roots. Glomalin can contribute to as much as 27% of the soil carbon especially in temperate zone. By gluing soil particles together, this protein also helps retain other carbon – containing compounds and protects them from decomposing as well. Glomalin was discovered in 1996 by Sara F Wright, a scientist at the USDA Agricultural Research Service. The name comes from Glomales, an order of fungi. Their threads penetrate into the root and secure sugars provided by the plant to fuel their growth. In exchange, these same filaments radiate out from the root into the surrounding soil where they capture nutrients and water and transport these materials back to the plant. It is estimated that mycorrhizal fungal filaments explore hundreds to thousands of times more soil volume than roots alone.[1,2]

Benefits of mycorrhizae include:

i. Improved nutrient and water uptake;

ii. Improved root growth;

iii. Improved plant growth and yield

Some modern agricultural practices reduce the biological activity in soil. Endomycorhizal spores such as these are deposited beneath the soil surface and do not rapidly recolonize agricultural site once they have been lost. Mycorrhizal filaments in the soil extract nutrients and water and leave deposits of carbon-rich glomalin. Certain pesticides, chemical fertilizers, intensive cultivation, compaction, organic matter loss, and erosion adversely affect beneficial mycorrhizal fungi. An extensive body of laboratory testing indicates that the majority of intensively managed agricultural lands lack adequate populations of mycorrhizal fungi. Farming widespread areas affects the plant/mycorrhizal relationship in two fundamental ways. First, it isolates the plant from beneficial mycorrhizal fungi available in natural settings. Second, it increases a healthy crop's need for water.

In an earlier study, Wright and scientists from the University of California at Riverside and Stanford University showed that higher CO_2 levels in the atmosphere stimulate the fungi to produce more glomalin. A three-year study was done on semiarid shrub land, and a six- year study was conducted on grasslands in San Diego County, California, using outdoor chambers with controlled CO_2 levels. When atmospheric CO_2 reached 670 parts per million - the level predicted for the middle to late 21st century mycorrhizal fungal filaments (hyphae) grew three times as long and produced five times as much glomalin as fungi on plants growing with today's ambient level of 370ppm .Longer hyphae help plants reach more water and nutrients, which could help plants face drought in a warmer climate. The increase in glomalin production helps soil build defenses against degradation and erosion and boosts its productivity. Wright says all these benefits can also come from good tillage and soil management techniques rather than higher atmospheric CO_2. "You can still raise glomalin levels, improve soil structure, and increase carbon storage," she notes. Forests, croplands and grasslands around the world are potentially valuable for offsetting carbon dioxide emissions from industry and vehicles. In fact, some private markets have already started offering carbon credits for sale by owners of such land. Industry could buy the credits as offsets for their emissions. The expectation is that these credits would be traded just as pollution credits are currently traded worldwide.[3]

Hidden underground in our planet's root cellar, nature has given us a template to help us resolve a variety of serious environmental issues, including global warming. Often overlooked and underappreciated, the living soil holds the key to the future. Vigorous long-lasting root system and associated tiny fungal threads can accumulate and store vast amounts of carbon.

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Conflict of interest

The author declares no conflict of interest.

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