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A LITTLE BIT COUNTRY
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Carbon Key To Soil Health

When I taught land evaluation to 4-H members we focused primarily on soil texture (amount of sand, silt, and clay particles) and slope of the land as the primary ingredients of soil quality. In recent years I have heard several speakers and read many articles which convince me that I have a lot more to learn about the ground we walk on.

Soil quality and soil health are now being defined by how well the soil functions. These functions include resistance to erosion, water infiltration, water retention, gas exchange, biological activity, and nutrient cycling which impact plant growth and health. Soil aggregates, or small pellets of soil ranging in size from 0.002 to 0.4 inches, provide pore space, or empty space between aggregates, for water and air movement, root penetration, and earthworm and insect movement. As pore space decreases, the soil becomes more dense or compacted.

According to research scientists at the Northern Great Plains Research Laboratory (NGPRL) near Mandan, ideally, soil should be about 50% pore space; about 50% sand, silt and clay minerals and 5% organic matter. Soil aggregates themselves provide a habitat for soil organisms and help resist erosion by combining fine soil particles into larger pellets which take more energy to move.

Research at the NGPRL is exploring how aboveground management such as tillage intensity, crop rotation, cover crops and grazing impacts the size, amount, and stability of the soil aggregates. Research at the lab has led to a recently published index, called a "Whole Soil Stability Index" (WSSI). The index is used to quantify aggregate formation

and aggregate stabilization separately to identify management practices which may result in aggregate formation, but not in the stabilization of these aggregates.

The WSSI was developed to rank aggregates based on size. There will be more pore space between large (0.01 to 0.4 inches) aggregates (macroaggregates) than small (‹ 0.01 inches) aggregates (microaggregates).

The research has found that soils which were not disturbed by tillage and had continuous plant cover such as moderately grazed pasture or ungrazed grassland had a higher WSSI than cropland sites. The WSSI values were statistically lower for a no-till spring wheat-fallow site and a conventionally tilled continuous fallow site. Even without soil disturbance from tillage, the lack of a growing plant in the fallow systems impacted soil aggregation, particularly aggregate stability.

Further research is currently examining stable and unstable aggregates to identify what, if any, biological molecules are involved in aggregate formation and aggregate stabilization and how this may differ depending on the size of the aggregate.

In most cases microaggregates are held together by chemical and physical processes, while macroaggregates are stabilized by molecules formed by soil organisms. Approximately 70% of the carbon dioxide fixed by a plant through photosynthesis remains in or near the roots. This feeds soil organisms and becomes part of the bodies of the organisms and the molecules they produce. Therefore, the limiting nutrient in soil aggregation and soil health is carbon.

More information on this research and others being conducted at the NGPRL can be obtained at www.mandan.ars.usda.gov