SOIL AGGREGATES – OUR LIFELINE TO THE FUTURE

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Aggregates (or peds) are those crumbly bits of soil that we find in woodlands and native prairies.

Well-aggregated soil is highly productive even under adverse weather conditions. It has strength that resists water and wind erosion and compaction. It allows water infiltration and internal drainage. It has high levels of organic matter that contribute to moisture retention. Space between aggregates allows air for healthy root systems that can feed from a large volume of soil.

Soil aggregates form when organic matter is bound to soil minerals by glomalin – a sticky exudate primarily from mycorrhizal fungi. These fungi are a type of microbe that thrive in native undisturbed soil. Glomalin accounts for nearly 30 per cent of the carbon found in healthy soil. These fungi form as nearly invisible threads that penetrate plant roots and extend, often several meters out into the soil where they collect nutrients, particularly phosphorus, and also some water, and bring this back to the plant in exchange for sugars and starches taken from the plant. Most of these fungi do not survive soil disturbance. As a result, tillage quickly results in lost soil structure (aggregation) that leads to increased water and wind erosion, slaking, compaction and water loss.

The cropland manager can maintain or improve soil aggregation by eliminating full-surface tillage and planting in narrow strips of disturbed soil. When this is done continuously, mycorrhizal fungi and other soil biota can survive between these strips. Soil aggregation is enhanced when we further mimic nature by adding organic matter – by keeping crop residue on the land, by using carefully managed cover crops, and by applying manure and compost. This provides food for biota, including microbes (bacteria and fungi), earthworms and other soil life that in turn break down plant residue and improve aggregation. Soil microbes are most active in the top five centimeters of soil and populations rapidly decrease at greater depths. Even shallow and intermittent full-surface tillage practices are devastating for aggregate contributors.

Many bacteria thrive when oxygen is introduced to the soil through tillage. This contributes to nutrient release from organic matter and results in increased crop growth. However, tillage-based crop production use-up organic matter and reduces water holding capacity unless large amounts of organic matter are added to the soil. Because tillage destroys mycorrhizal fungi, soil aggregates and stability are lost, regardless of organic matter levels. Thus, tillage-based crop production is not sustainable.

On all landscapes, the development and maintenance of aggregates is critical to minimize soil degradation, particularly by very large storm events. On our flat clay plains, compaction, loss of organic matter and water runoff that carries phosphorus-laden sediment can only be overcome or decreased by using practices that increase and maintain soil aggregation. On complex topography, sheet and rill erosion by water can be controlled by practices that maintain aggregation but must be combined with check dams to manage concentrated water flow. While practices like direct seeding on the Canadian Prairie have maintained crop residue for soil surface protection from wind, if a high percentage of the soil surface under the residue is disturbed, then soil aggregate destruction and tillage erosion are serious issues.

Precision crop production that uses full-surface tillage on complex topography causes eroded areas to constantly increase in size. Alternatively, soil care leaders are using precision yield and soil information

to support landscape restoration – the movement of excess topsoil from depositional areas back to eroded upper slope positions. The result is less yield variability and higher average yield. The reported payback time is remarkably short – as little as two years in some cases. To keep soil in place and retain yield it is necessary to use management that maintains soil aggregation.

We can easily see the benefits of soil aggregation when:

- We see clean water flowing off well-aggregated soil into a stream or drainage ditch that carries silt-laden water from tilled cropland.
- We crop over what has been undisturbed soil, such as an old fence row. This well aggregated soil produces dramatic crop growth and yield improvement compared to adjacent tilled soil.

We do have good farmland managers who are improving and maintaining the aggregation of their soils. They are profiting from their good management and hard work.

Aggregates are the ultimate measure of a healthy soil that will produce in a reliable, sustainable and environmentally friendly way. They are our lifeline to the future.