Soil Health Glossary

Aggregate stability

This is a measure of how well soil holds together in water and it is a good indication of the health of the soil. Micro-organisms and roots exude glues that hold soil in aggregate clumps to keep them from disintegration under stress of wind and water.

These are examples of the slake test in which a clump of dried soil is placed gently in water. The results are quite telling – if the water remains murky, it indicates that this soil has less aggregate stability and is more susceptible to erosion. In test after test, fields under reduced tillage and with diverse cropping rotations come out ahead

Bio solids

Sewage bio solids have been beneficially used in Canada, the U.S. and Europe for more than 30 years. In Ontario, they are used to restore the vegetative cover of disturbed sites (such as mines) or for other non-agricultural applications, but they are most often applied to agricultural land. Agricultural land that receives sewage bio solids is commonly used to grow crops for livestock feed or fuel production (for example, hay, corn and soybeans). It is not usually used for fruits and vegetables.

The application of sewage bio solids to agricultural land helps maintain or improve soil fertility. It contains nutrients that are beneficial and important to plant growth, such as:

- mineral and organic nitrogen
- phosphorus
- micronutrients such as zinc, magnesium and copper

Adding organic matter to agricultural land enhances soil structure, moisture retention and permeability while reducing the potential for wind and water erosion. In Ontario, some sewage bio solids are offered for retail sale as a fertilizer or a supplement and must comply with the Fertilizers Act, 1985, and Fertilizers Regulations.

Buffer strip

If there is a stream, municipal drainage ditch or even a swale running in or near the field, there is potential for soil runoff, crop protection products and fertilizer to get in the water, and cause problems downstream. Leaving a few meters of grass on each side as a buffer strip can filter out the soil, protect the banks from erosion and minimize the risk of getting fertilizers into the water.

CCA Certified Crop Advisor Certified Crop Advisors

[™] (CCAs) are experts in agronomy and provide honest, well thought out advice to farmers. At 650+ members in Ontario and counting, they are a strong voice in support of Ontario farmers, providing information and expertise on crop production, crop protection and natural resource management.

Cover crops

This refers to any crop that is planted to cover the soil and protect it from erosion. Research shows that the most soil erosion in Ontario happens during spring snow melt as the ground is thawing and thunderstorms on bare soil, so it is important that soil is kept in place by roots of a cover crop or with residue. The most common example is to plant clover after wheat is harvested in early August. The clover will protect the soil, feed beneficial micro-organisms and, because it is a legume, it also helps to build soil nitrogen levels for the next year's corn crop. Cover crops are terminated through tillage or through using glyphosate in a no-till system. Farmers also can plant into standing crops if they have suitable equipment, or they can plant after harvest if there is enough growing time left in the season. Many farmers find that planting multiple species, including peas, sunflowers, and radish, help the soil in various other ways as well, including minimizing weed pressure. Cover crop seed is an investment by the farmer that can only be justified if they know they will be farming that land in the next year and may require landowner participation.

Crop rotation

Every farmer will grow different crops, depending on his or her type of farm but if a farmer is planting the same crop year after year, this is probably hurting the soil. Micro-organisms in the soil need a diversity of plant roots in order to survive and soil diseases can build up if there is no rotation of these crops. In most of Ontario, a standard crop rotation is Corn – Soybeans – Wheat and if there are a few years of grass (for hay) included, that's even better for the soil! In some areas however, it is difficult and unprofitable to grow wheat, but there may be other crops a farmer could plant in order to diversify the crop rotation, see cover crops, for example. (Keep in mind that a crop needs to also be profitable in order to be grown.)

Drainage

Much of Ontario's farmland requires tile drainage to maximise productivity. Heavy clay soils are not farmable without some form of drainage. Burying perforated tube (tiles) in the soil speeds up a fields' drainage process and brings the field to a uniform moisture level. This allows farmers to start working the field sooner after rain, reducing compaction. Fields with no-till and strip till systems tend to have better infiltration rates. Tiling is a long term investment but is required in many soil conditions (clay). Tiling projects and alterations should always be designed by Licensed Drainage Contractors.

Erosion

Soil erosion is the movement of topsoil through wind or water. It is a natural process, but erosion rates will depend on the soil type, how hilly the field is, and on the farming practice. For example, a loam soil in Wellington county with a 3% slope over 200 metres can lose 4.9 tonnes/ acre/ year if tilled in the fall, but soil erosion in the same field could be reduced to only 1 tonne/acre/year if no-tilled and if a cover crop is used. Some farmers have success in minimizing erosion on slopes by planting across the slope on contour, instead of up and down. Farmers also avoid erosion by not cropping on floodplain areas. Wind erosion can be minimized through windbreaks and water erosion is minimized through increasing water infiltration rates (see also organic matter)

Erosion control berms (WASCoB)

If a field has a considerable slope then structures can be designed to catch or divert surface water. A water and sediment control basin (WASCoB) is an earthen berm that spans a natural drainage way. It is designed to intercept and temporarily pond concentrated runoff. The ponded water is slowly released (in under 24 hours) through infiltration or a standpipe inlet that discharges into a tile drainage system. The capacity of the tile drainage system must be large enough to drain all of the ponded areas.

Fertilizer

Crops need Nitrogen (N), Phosphorus (P) and Potassium (K) to grow, along with a host of other nutrients and the level of these nutrients decrease in the soil as the plants take them up and crops are harvested. Farmers replace the fertility in the soil with manure, biosolids, cover crops or with commercial fertilizer and they are replace at rates that are prescribed by accredited professionals CCA based on the current levels in the soil and by the amount that the following crop is projected to remove. With growing public concern over these nutrients in rivers and lakes, farmers are taking extra care to make sure the fertilizers stay in the soil and out of the water. Broadcasting fertilizer on the surface of the ground without incorporation (tillage) can pose a risk, so farmers often place the fertilizer in a band below the surface near the seed. This can be done while strip tilling, at planting or while the plant is growing (called side-dressing). The benefits of side-dressing are that, by giving fertilizer to the plant at the time it needs it the most, farmers can reduce the rate of fertilizer and minimize the risk of fertilizer loss into the environment (through both water and air). Farmers and agri-business are using an approach called the 4- R's to ensure that fertilizer stays on fields and out of waterways: R ight Time, R ight Place, R ight Source and R ight Rate

Flexible rental rate

Renting farmland sustainably requires sharing both the risks (of weather and markets), but also the rewards of farming. A long-term lease can include flexibility, in which the rent is renegotiated each year based on a formula that factors in local rental rates, the productive capacity of the land, the land investment contributions of the renter, and the price of crops, etc. In this way, the contributions of both parties are understood and valued as in a share-cropping agreement, but with the more 'hands off' approach. A flexible rental rate approach is good for the long-term sustainability of the lease because it allows the rates to be fair despite the rise and fall of crop prices.

Floodplain

Floodplains are low lying areas near a watercourse that are subjected to flooding and unstable slopes due to erosion. In much of Ontario, the 1 in 100-year floodplain is the regulatory standard used to identify lands that are vulnerable to flooding. As these areas are prone to flooding care must be taken in their management. Obviously don't built permanent structures on them or even store materials and be cautious to keep the soil covered as much as possible so it is not washed away.

Manure

This probably doesn't need a definition, but animal feces are still the best way to improve the health of the soil by adding nutrients and fiber back to the soil. Manure contains nutrients for

crops and also feeds micro-organisms and improves organic matter in the soil. However, excess manure or manure that makes its way into water, could cause environmental damage and so it is very important for farmers to apply manure at the right time of the year. Spreading manure on frozen ground in the winter can cause problems if it runs off in the spring thaw. One of the better ways to spread manure is onto a living crop like hay in the summer, or onto a cover crop, such as clover after wheat. Manure can also be injected into the soil to minimize risk of runoff, but if it is spread on the soil's surface, it should be when there is no rain in the forecast and should be incorporated (tilled) into the soil within a few days. Livestock farms over a certain size have Nutrient Management Plans to mandate how manure is stored and the rate at which it is spread on fields.

Micro-organisms

There are billions of bacteria, fungi and insects in just a teaspoon of soil and the levels of these micro-organisms are correlated to the amount of organic matter in the soil. They break down crop residue and create glues that hold the soil together and make it hold up against wind and water erosion. Soil life is increased through no-till, cover crops and more diverse crop rotations. There are two simple tests to measure levels of micro-organisms: 1) Measure the number of small earthworm piles (called middens) in a square foot. Ten middens in a square food would indicate a high levels of soil life because earthworms are a good indicator of the presence of other, much smaller, micro-organisms 2) Bury a piece of cotton (some have buried underwear) for several weeks and see the level of decomposition, though this will depend on temperature and precipitation.

No-till and Strip-till

The practice of planting a crop without tilling all or strips in the field. Because this practice does not disturb the soil profile, or cut off worm burrows, it allows for increased water infiltration through pores and worm tunnels. When plant and animal matter is left on the ground, micro-organisms build up the carbon levels in the soil and this is how atmospheric carbon is sequestered into the soil. These reduced tillage practices are one of the most environmentally sustainable practices; however, they require specialized planters that can cut through residue and requires drier and warmer soil conditions at planting.

Nutrient Management Plan

Nutrient Management Plans (NMPs) integrate and balance sources of nutrients (i.e., fertilizer, manure and soil) with crop requirements. An NMP is key to ensuring that nutrients for crop production are used in an economically and environmentally responsible way. On fields that farmers manage, they will have a plan (formal or informal) that when combined with regular soil tests will guide their fertilizer requirements depending on the soil test levels and future crop requirements.

Organic matter

This is an important way to measure the health of soil and it refers to the percentage of the soil that is made up of plant and animal material in various stages of decomposition (like crop residue or manure). Soil organic matter is the fraction of the soil that consists of plant or animal tissue in various stages of breakdown (decomposition). Most of our productive agricultural soils have between 3 and 6% organic matter. The more organic matter, the more the soil can absorb

water and nutrients. Organic matter is made up of different components that can be grouped into three major types: 1. Plant residues and living microbial biomass. 2. Active soil organic matter also referred to as detritus. 3. Stable soil organic matter, often referred to as humus. Organic matter gives soil structure which allows it to better drain water and retain it. Soils with higher organic are more productive, have less compaction and perform better in dry and wet years.

Pesticide Use

Modern agriculture employs a wide array of tools and techniques to cultivate healthy and robust crops. However, despite modern farming techniques there are weeds, insects and fungus that sometimes attack crops reducing crop quality, lowering yield and potentially destroying an entire crop. (i.e. grasshoppers) Farmers utilize pesticides for several reasons. Just like a homeowner might use a pesticide on their vegetables or to kill insects in their house, farmers use pesticides in agriculture to shield crops from pests and disease in order to prevent plant death and yield losses. There are three main types of pesticides that farmers use:

- **Herbicides**: A herbicide is a type of pesticide used to kill weeds and other undesirable plants that compete with corn and other crops for nutrients and water.
- **Insecticides**: An insecticide is a type of pesticide that kills insect predators that eat corn and other crops.
- **Fungicides**: A fungicide is a variety of pesticide used to protect against and kill fungus that could afflict crops like corn, wheat and vegetables, particular in wet humid weather.

Pollinator habitat

Pollinators play a key role in maintaining healthy ecosystems and abundant food by enabling flowering plants to reproduce. Actions that support pollinators improve the farm environment as well as the resilience of your farm business. Three simple ways to support pollinators on your farm: 1. Keep the natural habitat you already have. 2. Enhance habitat where you can, especially in combination with other Best Management Practices. 3. Reduce the use of pesticides where possible

Residue

This is the plant material that remains on the soil after harvest, ie. The roots, stalks, leaves, etc. This is a good food for micro-organisms and will become organic matter, and if left undisturbed and on the surface, it protects soil from erosion. Residue can be measured by throwing a meter stick on the ground and counting the number of centimeter marks that have some form of crop residue beneath it. Farmers should aim to have levels of over 50% residue because this will protect topsoil from the impact of rain. High amounts of residue can become an issue for no-till practices although farmers are finding solutions to this problem.

Soil Compaction

With heavy equipment like manure tankers, wet soil conditions and frequent driving on the field, soil can lose its sponginess and becomes packed down. This decreases water infiltration and increases the risk of soil erosion, and also makes it very difficult for roots to penetrate. Farmers often use tillage to try loosening the soil, but a more effective way to reverse compaction is through planting cover crops with aggressive roots that will add pores

back into the soil managing traffic flow patterns and using special tires and tire pressure systems.

Soil sampling

Soil testing plays an important role in crop production and nutrient management. On farms that use commercial fertilizer as the main nutrient source, it is the best way to plan for profitable fertilizer applications. On livestock farms, knowing how much nutrient is present in the soil to start with is critical. Only then can a nutrient management plan be developed to properly manage both the nutrients that have been generated on-farm and any nutrients that are being imported to the property as biosolids or commercial fertilizer.

Soil testing is really a three-step process: the collection of a representative sample from each field or section, proper analysis of that sample to determine the levels of available nutrients, and use of the results to determine optimum fertilizer rates. Keeping records is an integral part of the soil-testing process; they will help determine if soil test levels are increasing, decreasing or being maintained over time.

Tillage, No-Till and Strip Till

Tillage is the practice of disturbing soil in order to terminate weeds or a cover crop, bury crop residue, or work up compaction. Some tools overturn the soil profile completely (moldboard ploughing), while others aim to cut up residue with minimal soil disturbance (vertical tillage). Some tillage tools only disturb the strips in which the seeds will be planted (strip-till). Though there are many perceived benefits to tillage, it is one of the greatest contributors to soil erosion and especially if done in the fall. Many farmers also believe that it damages the beneficial soil micro-organisms, and releases soil carbon into the atmosphere. In no-till systems all of the residue is left on the soil surface to prevent erosion. Planters must be modified to plant into this cover. Although no-till fields may look "dirty" they are part of a system that minimizes disturbance to the soil and reduces soil erosion. Strip till systems, till a strip leaving a corduroy pattern in the field. Precise GPS systems then allow the planter to lay seed and fertilizer into the strip the following spring.

Windbreak

This usually refers to a row of trees around a field that slow down the wind to protect the soil from erosion and protect the crops from wind damage.