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Tillage Practices, Soil Health and Using Humic Products to Reduce Tillage

Tillage has become a hot topic in farming circles, with various forms of what is called “conservation tillage” becoming much more the norm than the conventional tillage practices used for decades. Farmers are adopting soil management practices that take into account not only current soil conditions but also those that will have long-term effects on soil condition, reduction of chemical inputs, and water conservation.

In addition to switching to conservation tillage practices, growers have other options to improve soil condition and health. The application of humic products to soil in a comprehensive soil remediation program has been shown to naturally improve soil tilth and sub-soil microbial health regardless of tillage practices, but especially when conservation tillage practices are followed. This article presents an overview of three categories to help explain the interrelationship of Tillage; Soil Health; and Humic Products.

The State of Tillage

When growers utilize tillage, they are assuming that breaking or turning the earth in some way will increase the physical fertility of soil by opening it up to more water and air. However, many tillage practices actually damage the soil, as carbon in the soil is freed up and the microbes and other soil organisms use this bonanza as a greatly enhanced food source. But that feast eventually comes to an end. The naturally occurring web of microbes, fungi, and other soil organisms, exposed to the environment and without food, die off in great numbers and nutrients are no longer recycled. As other pests take advantage of their absence, growers react by resorting to chemical agents to counteract the pests and a negative cycle is established and becomes a self-replicating burden to the soil and a significant extra cost to the grower. Therefore, reducing the amount of tillage and tillage depth is becoming a more prevalent practice as the effects of tillage on microbes is better understood.

More than 1/3 of farms in the U.S. have moved to a no-till program (37% as of 2019 government numbers), with no-till now accounting for over 50% of the conservation tillage being practiced.

Before going further, let’s review the basic types of tillage practices:

Conventional tillage is broken into two groups, primary and secondary tillage. Primary tillage includes such practices as moldboard plowing, deep tillage, subsoiling. These practices turn the earth over and leave the soil surface rough and cloddy. In turning over the soil they also expose underground life to the air and sun, which is intended to kill off weed seeds and pests but instead results in damaging the sub-soil biome. Secondary tillage involves discing, harrowing and cultivating to break up surface clods and prepare a smooth seedbed of loose, bare soil particles. This in turn make fields susceptible to the erosive forces of wind and water. So conventional tillage practices are actually a negative double-whammy to the soil.

Conservation tillage practices reduce erosion by protecting the soil surface and allowing water to infiltrate instead of running off. The Conservation Technology Information Center (CTIC) defines conservation tillage as any tillage and planting system that leaves at least 30 percent of the soil surface covered by residue after planting. Conservation tillage practices are grouped into three general types: **No-till**, **Ridge- till**, and **Mulch-till**. A fourth type, **Strip-till**, is a hybrid of Ridge-till.

No-till leaves the soil undisturbed from harvest to planting. Planters or drills can be equipped with roller/crimpers, coulters, row cleaners, disk openers, in-row chisels, or roto-tillers, which create a slot for accepting the seed, along with various inputs. Following along after the seed is dropped, a press-wheel provides firm soil-seed contact. No-till planting can be done successfully in chemically-killed sod, in crop residues from the previous year, or when double-cropping after a small grain. Herbicides are the primary method of weed control in conventional programs, and organic programs utilize a variety of weed control options such as cover crops. The use of a soil cultivator is reserved for use only in excessive weed pressure circumstances. Soil conservation results from multiple positives: the high percentage of surface covered by crop residues; undisturbed sub-soil becomes more friable and able to handle both drought and excessive rain; and there are significant increases in soil microbial populations and quality.

Ridge-till involves planting into a seedbed prepared on ridges with sweeps, disk openers, coulters, or row cleaners. Except for nutrient application, the soil is left undisturbed from harvest to planting. Ridge-till systems leave residues on the surface between ridges. Soil conservation depends on the amount of residue left and row direction. **Strip-till** also involves leaving residue between crop rows, but instead of creating a raised ridge to plant into, the grower tills a narrow (6”-12” wide) surface level strip with varying depth. These strips correspond to planter row widths to be used for the next crop. Precision farming equipment is used to match up the planter with rows. Fertilizer is often placed in this strip in the fall or spring. Both of these conservation methods allow the populations of soil microbes to recover somewhat due to the undisturbed rows between planted rows.

Mulch-till is the closest “conservation” method to conventional tillage. It uses chisel plows, field cultivators, disks, sweeps, or blades to incorporate residue into the soil before planting, but does not turn the soil over. The field surface is left rough and cloddy, and surface residue cover is dependent on the various types of chisel points or sweeps used by the grower. Whether done in fall (8”-10” depth) or spring (6” depth), Mulch-till is the simplest soil conservation method, but still has a negative effect on soil microbiology.

Tillage and Soil Health

Most farmers will acknowledge that tillage is not the best thing for soil health. Certainly, it can provide an immediate reward in terms of the ease of growing a crop with minimum effort, but the long-term damage to soil structure, soil organic matter, and the myriad of microbial life residing in the soil is proving to be an unacceptable cost. It is the role of that microbial life in soil health that is fast becoming acknowledged as the “infrastructure highway” that is responsible for nutrient retention and movement within the soil and serves as the naturally occurring trough from which crops derive their food.

There can be billions of microbes in a thimbleful of fertile soil. Most numerous of the soil microbes are bacteria, then (in decreasing numeric order) the actinomycetes, fungi, algae, protozoa and viruses. Nematodes also play a role. Each group of soil microbes has different characteristics that define the organisms and different functions in the soil it lives in. And most importantly, these organisms do not exist as independent players; they interact with all other groups and these interactions influence soil fertility as much or more than the organism’s individual activities.

Numerous studies have been done regarding the effects of tillage and soil microbial health, but most have been done at the field-by-field level rather than from a more global perspective. In 2016, several members of the University of Illinois Department of Crop Sciences published a paper detailing their efforts and analyzes of comparing 62 tillage/soil microbe studies from around the world. The comparison measured microbial biomass and metabolic activity in no-till and tilled systems. They accounted for the various types of tillage equipment and tillage depth. They also allowed for the nitrogen fertilization rate, mean temperature and precipitation, the presence or absence of cover crops, and other variables.

In quick summary, the authors found that microbial biomass and enzymatic activity were considerably greater in no-till than in tilled systems. When tillage was used, the type of tillage equipment mattered. The use of conservation tillage equipment, such as chisel plows, resulted in greater microbial biomass when compared to primary tillage such as moldboard plows or heavy discs. They note that these results indicate soil microbial biomass and enzymatic activity may actually be able to overcome reduced or damaged soil quality, and therefore growers should consider no-till or conservation tillage as both a way to build soil quality and to reduce costs associated with excess inputs.

Using Humic Products to Improve Soil

Researchers studying soil health in agriculture have noted an increase in the overall activity of most types of soil microorganisms with the addition of humic substances. Since they chelate various elements and help in the formation of molecular bridges, humic substances can prolong the availability of nutrients needed for soil microorganisms which have no other means (such as plant photosynthesis) of obtaining that energy. Humic substances increase soil water holding capacity and improve soil structure, increasing nutrient availability and thereby giving soil microbes optimum conditions to grow and thrive.

Humic products are considered plant bio-stimulants, which are defined as “any substance or microorganism applied in minor quantities to plants with the aim of enhancing nutrition efficiency, abiotic stress tolerance, and crop quality traits, regardless of nutrients content”. The benefits of applying humic products to enhance crop productivity have been fairly well documented, with the positive effect seen on plant growth commonly associated with direct interaction with the plant root (“hormone-like activity”) and the activation of physiological processes in the plant. But multiple indirect effects have also been seen. For example, humic products buffer pH, increase water retention and mobilize nutrient availability.

Humic substances are key components of a friable (loose) soil structure. As the humic substances are added, they utilize charged electrical processes (+/-) to form colloidal aggregates with soil particles. Once formed these aggregates help to create a desirable crumb structure in the top soil, making it more friable. Soils with good crumb structure have improved tilth and more porous openings (open spaces). These pores allow for gaseous interchange with the atmosphere, and for greater water infiltration and retention. The colloidal action loosens soil, letting roots penetrate more easily. The soils increased water holding capacity within the top soil means that it is there when needed, provided a carrier medium for nutrients required by soil organism roots. Soils which contain high concentrations of humus substances hold water for crop use during periods of drought.

So, in summary, the use of humic products in an integrated program can do many of the things for soil quality and health that tillage was originally intended to do. Soil becomes more friable, more capable of allowing deep root penetration, more capable of handling water, and more capable of retaining plant nutrients in the forms needed for easy uptake by plants when they need it. All of this serves to improve good soils and return poor or depleted soils to optimum condition naturally without the need for expensive equipment and multiple field passes.