

Healthy Soil
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The term “Healthy Soil” has about as many definitions as there are people. However, for those who make their living off of or through the soil, a concept known as Soil Quality began in the 1990s. This “thing” beneath our feet had some life. That idea has evolved to today’s concept of Soil Health. For something to have health, it must be alive and to maintain its health, inputs and surrounding conditions must be managed. In comparison, we have learned that human health is impacted by the quality of our air, water, and, lately, soil.

To go along with this thinking, the concept of “Soil” has evolved from that of a growing medium to that of a live eco-system which is a sub-ecosystem of the earth and the universe. Many already know that soil is a resource, and resources like money need to be treated with respect otherwise it isn’t there when needed. So too, the soil needs to be managed.

With research we now know that Soil is a regenerative biomass which contains live organisms, water, nutrients, and other materials that are delicately balanced. Soil, if it is taken care of, managed, gives life to crops, ornamentals, animals, and affects human health. Water runoff from soil, if contaminated, can pollute rivers and kill fish and animals. The biomass Soil allows plants to contribute oxygen to the air we breathe. Without Healthy Soil our oxygen and food supplies are limited.

Farmers learned that by planting the same crop in the same fields year after year wears out the soil; the soil is depleted of the necessary nutrients for that crop. Crop rotation, different crops in the same field over the years, allows the soil to recover, replenish, and achieve nutrient balance. Thanks to over 30 years of research by universities’ agricultural research programs, we now know Healthy Soil is an ecosystem teeming with life that not only supports crops but contributes to clean water, and animal and human health. Through testing by Dr. Phillip Barak at the University of Wisconsin – Madison determined that 30 years of normal acid agricultural inputs (synthetic fertilizers and chemical-based pesticides, fumigants, and herbicides) aged the soil the equivalent of 5,000 years under natural source acid inputs. Keep in mind, Healthy Soil is a resource; how long can this go on without permanent, irreparable side effects.

Healthy Soil should be teeming with microbes (life). These microbes convert sun, water, CO₂, and crop residue into nutrition for the next round of crops. Microbes:

- Build soil highways to efficiently transport and store moisture, gases, and nutrients
- Decay organic matter and convert it into a nutrient form plants can use
- Unlock chemical bonds in soil nutrients to make them available to plants - nitrogen and phosphorus
- Increase carbon content
- Increase soil stability

- Better mediation of soil temperature and moisture – retain moisture during hot dry times and release water when its cooler or plenty of water (rain) is available.
Clapperton, Ph.D. Montana State University

The benefits microbes provide include releasing crop nutrients that are strongly locked in the soil such as Ca, Fe, and Al. Phosphorus is also one of those crop nutrients that doesn't make itself readily available for plant metabolism. Lastly, microbes help improve soil structure and suitability and sustainability for future crops.

The Soil Food Web at Oregon State University took an acre of Healthy Soil and measured its contents six inches deep and compared its contents against Depleted Soil. The weight of each mass was 2-million pounds; however, the presence of life was dramatically different:

<u>Life Form</u>	<u>Healthy Soil</u>	<u>Depleted Soil</u>
- Bacteria	2,600 pounds	< 500 pounds
- Actinobacteria	1,300 pounds	< 300 pounds
- Fungi	2,600 pounds	<1,000 pounds
- Algae	90 pounds	<90 to 200> pounds
- Protozoa	90 pounds	<50 pounds
- Nematodes	45 pounds	>100 pounds
- Earthworms	445 pounds	<50 pounds
- Insects/arthropods	830 pounds	<200 pounds

This comparison shows what can happen when soil isn't managed and is abused with an abundance of modern chemical inputs. Microbes allow the soil to hold water and maintain its nutritional balance. Chemical fertilizers and pest controls kill the soil's natural organisms, interrupt the organic matter cycle (OM Cycle), rob the soil of its nutritional balance, and water regulation. The results show up in the USDA data. Yields per acre are flat to down and water and fertilizer usage are up. More input is needed for the same or less output; the world is trying to achieve the opposite.

Untilled soil contains a minimum of \$2,600 worth of free crop nutrition per farmable acre in the top 6 inches. Probably much more in some locations. I heard one soil scientist tell a farmer he had enough soil nutrients that they could be mined. Soil carbon feeds microbes to improve the availability of plant nutrients and harvest quantity and quality. Microbes increase the speed of organic matter (OM) and nutrient residue conversion into available forms of N, P, and other key nutrients.

Healthy soil performs five functions. With the help of microbes, it regulates water content through soil structure. Rain, snowmelt, and irrigation water with their dissolved solutes can flow over the land and into river systems or can penetrate into the soil. Healthy soil sustains animal and plant life. The diversity and the propagation of living things depends on the soil. Healthy soil filters pollutants. The soil's organisms and nutritional content buffer, filter, degrade, immobilize, and detoxify organic and inorganic materials including industrial and municipal materials and

atmospheric deposits. Healthy soil provides a circuit for nutrients (carbon, nitrogen, phosphorus, potassium, and others) to be inventoried, metabolized, and cycled back into the ground. And, something we never think of, buildings require a healthy foundation. In some areas of the world the soil is so poor, as one builds a block wall, the first section is crumbling before the last is completed.

As mentioned above, water retention is a vital function of healthy soil. Soil organic matter (OM) provides a vital service. As it increases from 1% to 3%, water-holding capability doubles.

Microbes, a delicate form of life, are essential to the healthy soil mass. Microbes produce glomalin (soil glue) that create needed soil aggregates essential for nutrient exchange and water circulation. Hence, they reduce ponding and runoff. Water remains in the soil mass. Without the subsurface paths created by glomalin, crops require more fertilizer for the same yield. These soil aggregates are a storehouse of soil carbon where slow-acting microbes reside.

Microbes also create plant fine root hairs that more efficiently grab nutrients and require less carbon. Microbes also unlock the soil's chemical bonds on N, P, and S making them more readily available for plant metabolism. In multi-crop situations, microbes can help transfer N and other nutrients from legume root systems to root systems of non-legumes.

We know that erosion and runoff are annual issues. A USDA 2019 study claims that about 70% of a fertilizer application is utilized by a crop; the rest remains in the soil or runoff into streams and rivers and plays havoc with fish and water supplies downstream. The same above study claims 55% of rivers and streams, 71% of lakes, and 84% of bays and estuaries have impacted water quality. Agricultural chemicals are deemed the second greatest contributor. We see what the agricultural chemical accumulation can do by the expanding of the "Dead Zone" in the Gulf of Mexico every late summer/fall.

The OM level in the soil increases its holding capacity with every percentage point increase. A 2% OM level holds 32,000 gallons of water and 5% OM holds 80,000 gallons. At 8% we have 128,000 gallons of water content. We lose billions of tons of soil every year through erosion because the soil lacks organic matter.

How long would it take to increase OM by 2%? For forage crops, it would be the fastest. It would take about 5 years. For other crops, it would depend on the amount of the crop harvested (the residue of the plants left in the field), or the amount of the crop left to recycle in the field. You can understand why no-till farming is gaining interest.

Soil is a basic resource just like air and water and must be managed to ensure its future viability and sustainability as a giver of crops, and a sustainer, in general, of the quality of life we enjoy. Poor practices using synthetic fertilizers and chemical agents destroy our soil's ability to provide us with healthy crops and other life's qualities. BIOMAX Soil Enhancer with SumaGrow™ reduces synthetic fertilizers by 50% at planting, increases yields by 10% or more and crop nutritional quality for people and livestock. BIOMAX Soil Enhancer with SumaGrow™ helps

place you on the path to achieving Healthy Soil. BIOMAX Soil Enhancer is cheaper than the fertilizer it replaces.

For further discussion you can reach me at jim.mcclain1842@sbcglobal.net or call me at 714-728-0376. Have a good day!

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