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Short Communication

The Soil Microbiome and Human Health

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At Bolster's Adirondack Farm we focus on studying the microbial life that lives deep within the soil microbiome. Our health is dependent on the collaboration of many different microbes including but not limited to bacteria, fungi, protozoans, and algae. Our interactions, whether it benefits or degrades it, determines the health of our environment, our microbial counterparts, and inevitably ourselves. Displaced pollution, such as microplastics, is just one example that has led to large-scale die off and to the extinction of different microbial species and even whole communities. When these die-offs occur, the world's microbiome is thrown more out of balance causing a fluctuation in our food supply and fresh water availability.

We are now just beginning to comprehend the different roles beneficial microbes play in our daily lives. Bacteria were some of the first microbes to shape our history. Among other health benefits, bacteria provide us with the ability to properly digest our food in our gut microbiome, make vitamins and increase our immunity (Source). It provided one of the first antibiotics and makes some of the tastiest aged cheese connoisseurs can find. Fungi are commonly used to make alcohol or provide the basis to make a fresh loaf of bread. More importantly, it also provides several different antibiotics we use just as bacteria do. However, one of the most important ways beneficial microbes impact our lives is the active role they take in the health of the soil microbiome, aquatic microbiome and the health of our food.

We know that the soil microbiome has a profound affect upon our health and our resilience and resistance to disease. Bacteria, fungi, protozoa, and algae all have different roles in aiding the health of the soil and plants. Bacteria can increase nutrient availability, start and finish the decomposition of organic matter in the soil and compost systems, fix nutrients such as nitrogen gas (N2) from the air, and stimulate plant growth. Fungi help other soil microbes by breaking down harder organic materials such as lignin (found in branches, wood pulp) making it easier for them to break those materials down faster. One of the most important roles of fungi is the symbiotic and mutualistic relationship they form with our plants. This interconnectedness makes it easier for plants to obtain out of reach plant readily available nutrients and water that they would otherwise not reach with their shallow fibrous root systems. Algae can be mostly found in water, however they still have a presence in the soil and above ground. More commonly they are found in the form of lichen on rocks, breaking it down to form parts of new topsoil. Although more protozoa species are sinister than not, there are some that aid in health of the soil and our plants.

Figure 1

One of their sole functions is to be a secondary consumer of organic material and mineralize the nitrogen needed in the field (Source).

Figure 2

Although there are many beneficial microbes that benefit the health of our lives, the soil microbiome, and the environment, there are several others that live and move through the various systems on our planet that can cause disease, famine and unviable soil and water conditions. Many of our practices such as manufacturing, mining, drilling and conventional farming provide a way for these pathogens to migrate and infect areas beyond their sites of origin through pollution and displaced pollution.

Microplastics are one of the biggest displaced pollutants that aid the movement of pathogens such as Cholera. Studies have proven that pathogens like Cholera can live on the surfaces of microplastics. The residual affect of their manufacture and use is extensive. They contaminate the air we breathe, the water we drink, and the food we eat. They act as a sponge and delivery system for chemical contamination of the environment and our bodies (Source). An estimated total of 8 million tons of plastic waste enters the ocean yearly, and 236,000 tons of that are microplastics (Source). The affects on marine life are vast. Many young hatchlings from different marine species of animals mistake these pieces of plastics as food; a necessary commodity to survive their first weeks of life in such a rugged environment. This inevitably leads to a decrease in population and other health affects of the marine ecosystem.

Figure 3

Chemical pesticide use has been a common practice throughout the history of conventional farming. As the human population increases over the decades, a necessity for higher yields of staple crops is increasing rapidly. More applications of these pesticides are necessary to hold back the disease and pest damage that a society of monoculture harbors and breeds. With these increased applications, the soil microbiome takes a heavy hit. Made out of heavy metals and other additives, these pesticides not only kill their target they also kill the beneficial microbial life and lock up important plant readily available nutrients.

Figure 4

The affects of chemical pesticides have long lasting impacts on the health of the soil microbiome and the health of the food that sustains us. Not only do they kill every living thing in the soil upon application, they also allow the pests and disease that were meant to be eradicated build up a tolerance and overcome future appli-

cations as well as overrun natural beneficial microbes and insect species. For example, the case of Florida crops, particularly strawberries, and methyl bromide (Source). Methyl bromide is one of the harshest chemical pesticides to be used in the history of agriculture to date. Used as a fumigant (gas poured over raised mounds of soil), methyl bromide kills all living things in its path: pathogens and beneficial microbes alike, pests and beneficial insects alike. After years of use and a recent ban on this chemical, farmers feel it is hard to produce enough yield to flood the market. What they do not realize is that because of its prolonged use, methyl bromide has made the soil completely unviable and a breeding ground for disease and pests (like the current plant infesting nematodes). It will take many years and hard work to restore the soil back to its natural balance.

Figure 5

Figure 6

The mining of coal and drilling of oil can affect both land and waterways, disturbing the delicate balance of theses crucial microbiomes. Underground mining of coal can contribute to water pollution, air pollution, loss of water resources, change in landscapes (ex. wetlands can be formed) and several other environmental problems. It can disrupt the hydrological cycle of rivers and lakes, thus affecting the habitats of different aquatic species (including microbes). One of the biggest disasters to occur to any ecosystem is an oil spill. The residual affects of the BP oil spill, which took place in April 2010 in the Gulf of Mexico, still continues on today. Biodiversity of microorganisms, populations and the health of marine animals, and landscapes such as wetlands are all still feeling its affects. During the time of the spill, there was protection and regulations put forth to decrease the possibility of the same incident occurring. However, during Trump's administration, the pursuit of wealth overrides the pursuit of a protected and healthy environment. Now all of the U.S. coastal waters are open to offshore drilling, with the power of drilling safety in the state's hands and our country's "energy security" top priority (Source). It is only a matter of time before we see another disaster with our oceans. We cannot afford this. Is your environment and health worth this?

Figure 5

Our growing systems have proven to be effective and productive. We use zero chemical pesticides and fertilizers. It takes a little more work, but our effort proves to be fruitful and successful. We are doing our jobs to help protect, conserve and preserve each element of the environment.