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Biological Nutrient Uptake

Regenerative farming practices emphasize nutrient uptake from soils through natural soil biological cycles. This ecologically-based agricultural approach uses microbes and carbon compounds to produce crops naturally rather than relying entirely on highly soluble "salty" nutrient inputs for plant nutrition.

Before commercial synthetic fertilizer, historically, soil microbes provided about 80% of soil nitrogen (N) through the efficient process of microbial N fixation. However, soil compaction and over-use of nitrogen fertilizers are having a negative impact on N fixing microbes. For the first time, the total fixed N supplied by microbes is less than the amount of applied synthetic N from fertilizer. Excess salt based or soluble fertilizer is disrupting the natural soil balance.

Soil microbe interact with plant roots and soil minerals to releases plant nutrients from soil minerals. Biological release of plant nutrients has far greater potential for plant mineral uptake than relying entirely on soluble nutrients from fertilizer. Plants have devised complex systems of breaking down minerals into nutrients and then use active transport mechanisms to move them through their roots. Active transport, biological activity, and complex organic substances are critical components for efficient plant nutrient uptake. There are many natural biological ways to efficiently, profitably, and ecologically uptake plant nutrients without using soluble or salty fertilizers. Currently, our understanding of these biological processes is just starting to blossom.

To be highly soluble in water, fertilizers must easily dissociate in water into highly charged positive ions (cations) and negatively charged ions (anions) called salts. "Salts" are the simplest soluble fertilizers, but the most wasteful and ecologically soil damaging. Fertilizers are categorized by their salt index, which ranks the potential to injure germinating seeds and plants. The salt index of a fertilizer is directly related to its water solubility. The so called "burn" to plant roots is caused by dehydration of the soil, a natural soil reaction to counteract high salt inputs. Other soil reactions to highly soluble fertilizers are "leaching" and nutrients becoming "tied-up" by soil colloids. The soil is trying to buffer or maintain these soluble salty nutrients at low concentrations so that the soil biology can survive.

The soil is a living system that is sensitive to highly soluble salt inputs. In low input (sustainable, biological, organic, regenerative) agriculture, highly soluble soil inputs are used sparingly. The disruption from salts is dealt with primarily by water, which surrounds and neutralizes high

cation and anion charged fertilizers. Theses salts can cause a plant root to desiccate or dry out because the water is tied up and not plant available.

The soil water contains both dissolved and un-dissolved substances in it. The portion of soil water with dissolved substances is called the soil solution. The total nitrogen dissolved in soil solution per acre is in the range of approximately 0.4 to 1.5 pounds per acre. For dissolved phosphorus, the range would be 0.001 to 0.003 pounds in one acre! Just a trace. Most soil nutrients are soluble at very low concentrations to keep the soil healthy.

In countries where crops are fertilized with synthetic N fertilizer, nitrogen use efficiency is very low. In the USA, about 54% of all N fertilizer applied to corn crops is wasted. In biological based systems, nitrogen is used efficiently by both microbes and plants. About 1# of total elemental N grows 1 bushel of corn or 150# of total N to grow 150 bushels corn/Acre. There is only about 1# N/Acre naturally in the soil solution at one time. Corn uptake for N is huge when corn starts to pollinate until grain fill. Soil microbes use biological N fixation to convert atmospheric N into plant available forms of N (50% of total N) to feed our crops. Soil compaction and poor soil structure robs soil microbes of needed oxygen and nitrogen, destroying the opportunity to reduce N inputs. Soil compaction also promotes many crop diseases.

When highly soluble salty fertilizers are applied to a soil, the soil system has to achieve chemical and biochemical equilibrium. Leaching, denitrification, and tying up salts in soil colloids is a natural biological reaction. If you have ever tried drinking a glass of water that has a teaspoon of table salt dissolved in it, you know what I mean. If you don't vomit, you will at least get an upset stomach and will be extremely thirsty for a long time. Heavy use of salt fertilizers means soils will either leach out or use large quantities of water to offset the high salt inputs. Using regenerative practices (cover crops, no-till, manure, compost, humates) enhances soil life and improves nutrient efficiency. Article adapted from "Solubility versus Biology" by Larence Mayhew.