En-Soil Algae
The Natural Path to Enhanced Soil Fertility

Introduction to the Bio-Stimulant Concept: Live Algae as an Effective Soil Amendment

Agriculture = growing species of plants in large quantities that are not necessarily native to a particular region. These crops usually require more nutrients than would native flora. There are three general approaches to that can be used to provided needed nutrients:

#1 Synthetic-chemical fertilizers: Modern agriculture applies essential nutrients such as nitrogen, phosphorus, and potassium (NPK) in a form that can be directly absorbed by plant roots, bypassing natural processes. NPK works to promote growth and yield, but after 60 years of use in the United States, it is apparent that it comes with a price, including steadily declining soil fertility, nitrate runoff into watersheds, and manufacturing pollution— each contributes to a huge environmental cost.

#2 Compost and other organic inputs: Good quality compost also provides nutrients, natural forms of NPK as well as carbon. It also adds microbials to the soil, the engines of fertility. There is no downside to composting apart from convenience; it tends to be bulky. With this class of soil treatment, we include other organic inputs like molasses (carbon), fish blood-meal (carbon and nitrates), and the direct application of soil bacteria and fungi.

#3 Bio-stimulants: This approach has been used in the developing world since the 1970s, and is gaining interest in North America. The U.S. Farm Bill of 2018 addresses this and defines a bio-stimulant as "a substance or micro-organism that, when applied to seeds, plants, or the rhizosphere stimulates natural processes to enhance or benefit nutrient uptake, nutrient efficiency, tolerance to abiotic stress (drought or salinity), or crop quantity and yield." En-Soil Algae fall under this classification and approach.

Approach	Growth	Plant Growth Soil Fertility/Health	Cost	Sustainability of Use	Manufacturing Impact
Synthetic NPK	+++	- - - - (declines)	+++	Unsustainable (Depletes soil and contaminates water)	Manufacturing is expensive & harmful to environment.
Compost	+++	+++	++ (labor intensive)	Sustainable	Expensive to deliver and apply. Usually involves tonnage.
Live Algal Bio-stimulant	+++	+++	+	Sustainable	Inexpensive to produce, deliver, and apply. (Starter algae + light + CO_2 + water = more algae + O_2)

Soil basics: The atmosphere is 78% nitrogen and 21 percent oxygen. Atmospheric nitrogen is used by plants for photosynthesis. Most of us were taught that plants "fix nitrogen," but that is not the case. Rather, soil bacteria in the rhizosphere, the neighborhood of the roots, convert atmospheric nitrogen to a form that can be absorbed by plant roots. The rhizobacteria also solubilize phosphorus. Essentially, fertility can be equated to the soil's biome, the microbial factory that is nature's way of providing nutrients for plant growth. Soil that has more bacteria, fungi and other microbials is more fertile.

Bio-stimulants on the market: There are a number of bio-stimulants on the market. Most of them are compounds that stimulate the activity of microbes in the soil as well as directly promote plant growth (auxins, cytokines, gibberellic acid). Many are algae extracts.

Live algae as a bio-stimulant: When applied to soil and foliage, *Chlorella vulgaris* (a common green algae) produces growth-promoting compounds. Compared with algae extracts, an additional benefit of live algae is the production of compounds that enhance plant immunity and resistance to abiotic stress (drought and salinity). Live *C. vulgaris* provides the complete package. After application of live *C. vulgaris* a measurable increase in soil organic matter and respiration are evidence of a richer biome. Fertility is enhanced, so live *C. vulgaris* has a role in regenerative farming and growing practices— **it's actually "farming the soil!"**

En-Soil comes in 4 sizes to meet every grower's needs.

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