



2022

FIELD REPORT

Increase ROI.

Reduce expensive,
synthetic, NPK
inputs.

Improve soil
biology, water
holding capacity &
stress resistance.

A LETTER FROM

STUART WILLIAMS, CEO

i.

Dear Colleagues,

It is said that necessity is the mother of all invention, and given that very few in the Ag industry have been spared the problems created by the increased costs and reduced availability of NPK, it is time for a better way, and one where we are not reliant on any foreign nation.

At Enlightened Soil Corp we could wax lyrical all day long about how EnSoil promotes soil health, that it is 100% natural, made in America, OMRI listed, etc., etc.-- but what really matters is that it is available on demand, is materially cheaper than NPK, and, as you shall see from reading the customer and test lab testimonials, it can increase yield. Even though we live in a crazy world, I still think that what I learned in economics i.e., that higher revenues and lower costs are generally a good thing for financial margins, remains correct.

However, given that everyone is quite rightly from "Missouri" these days, we have produced this document so that our new customers can read (and often get live) testimonials from our existing customers, and/or the nation's leading independent soil health/testing companies.

EnSoil was invented in South Carolina and is 100% produced in the United States. Our company currently has two production facilities (SC and KS) and is in the process of building another 22 across our great nation. By the end of 2024, no delivery will be more than 200 miles; however, long before that, we will be able to supply our customers with unlimited amounts of EnSoil, almost on a real time basis, and we are already taking large orders for the 2023 planting season.

We take pride in serving the great farmers and our great nation, and in doing so, if we can help them make higher profits while also making a greater difference, then we will have done our job.

If you choose to become a customer, you will often hear our team say, "what is good for soil, is good for people, profit, and planet." To date, we have not heard a single negative about removing chemicals from our soils, foods, watersheds and citizens, and it might not shock you that we get a lot of praise when we are able to help increase ROIs.

I personally hope that this document will allow you to see that American ingenuity and innovation is alive and well, and that it is being used to wean our country off reliance on foreign nations for at least part of our Ag and food supply chains. Our team is here to help you in anyway it can, and I thank you for all you do to keep this country moving forward.

Kind regards,



Stuart Williams
CEO



2022 FIELD REEPORT

EnSoil Algae is a humble green algae—*Chlorella vulgaris*—that happens to be a powerful bio-stimulant.



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It's Simple.

With EnSoil Algae you increase your ROI
by significantly reducing NPK inputs...

...all while increasing yield, stress resistance,
water holding capacity, and soil biology.

Reduced Inputs
Higher Yields
Greater ROI

www.enlightenedsoil.com

Made in U.S.A.



A LETTER FROM TUCKER & MERIDETH

We would like to express our enormous gratitude to everyone who has committed their time and energy to helping us further our mission this year. This includes farmers, ranchers, soil scientists, crop advisors, university educators, and friends who want to help us succeed. Our mission is big. We want to improve the quality of life on Earth by having a positive impact on the health of our soils. We have come to understand the deep and almost countless ways that healthy soils impact us all. We are inspired by the many allies we've met and learned from in the pursuit of our mission.

We've recognized the tremendous response in plant and soil in all our work with EnSoil Algae (*Chlorella vulgaris*) in South Carolina. This year we set out to understand if the impacts would be consistent across a diverse set of soils, geographies, crops, and farming practices. The results have been fortifying and exhilarating. We have worked with farms and ranches in 37 states where EnSoil Algae was applied to row crops, forage and native grasses, fruits & vegetables, root vegetables, greenhouses, hemp & cannabis, citrus groves, woody perennials, and turf grass.

There has been remarkable soil response. There is benefit to soils when EnSoil Algae is applied. These include increased soil respiration, increased water extractable carbon and nitrogen, significant increase in soil organic matter, growth of microbial populations, a balancing of bacteria/fungi ratio, and improved water infiltration and holding capacity.

Plant response has been logically positive and affirming. Plant health, stress adaptation, nutrient uptake, root mass and biomass development, and production are all improved with application of EnSoil Algae. This has shown to be true when applied with fertilizers and without. There is a great deal more to learn regarding application frequency and timing for specific crops. We will continue to study application of EnSoil in conjunction with other biological inputs, but we can demonstrate positive response to application and a clear return on investment from use of EnSoil Algae. Our partners in farming and ranching are invaluable as we work to build ROI models and case studies to help future clients understand how to incorporate EnSoil Algae into their management decisions.

We hope you find the content in this report useful and encourage you to reach out to us with any questions. Our mission is long term and will only be realized through development of meaningful partnerships with our growers. We are committed to transparency and to an open-minded approach to finding answers that benefit us all in a balanced and profitable manner.

Sincerely,

Tucker and Merideth Garrigan

Directors of Partner Development
Enlightened Soil Corp



05

What we've done & what we've learned..

By George Taylor

American university research has proven that EnSoil Algae, live *Chlorella vulgaris*, is an effective alternative to NPK. Eighty-five American farmers and ranchers in 37 states have used EnSoil Algae since 2021, reporting improved yields, improved soil health, and a meaningful return on investment from use of EnSoil Algae. EnSoil Algae is Organic Materials Review Institute (OMRI) listed and is registered for sale in 48 states with two pending. Enlightened Soil Corp is independent and unrelated to, the synthetic-chemical fertilizer industry, instead offering growers an effective soil nutrition alternative that costs less, promotes fertility, and does not add greenhouse gasses.

How it works

EnSoil Algae is regenerative. Live algae work by releasing signaling molecules (auxins, cytokinins and others) that stimulate plant growth. These also stimulate growth and activity of soil microbials that provide plant macronutrients by (1) fixing atmospheric nitrogen and (2) releasing abundant, but soil-bound phosphorus and potassium. Soil microbial mass, which is fertility, increases.

Algae are grown in translucent tanks with LED grow lights. Photosynthesis draws down carbon and releases oxygen, the only byproduct of production. A 2,500 sq ft production facility in laboratory-clean space uses less than 2,000 kWh electricity/month. There is no hydrocarbon input; production and cost are unaffected by natural gas prices.

EnSoil Algae is unique because it is living *C. vulgaris*. Live algae have a broad spectrum of effects. However, live algae could not be stored or transported previously, because when in storage without light, photosynthesis ceases, and algae die. Our innovative production method has enabled the commercial use of live algae by inducing heterotrophic metabolism (patent pending). This allows EnSoil Algae to consume organic nutrients when in the dark, while growing autotrophically with photosynthesis when there is light. Thus, EnSoil Algae are viable in dark storage resulting in a 4-month shelf life.

NPK fueled the Green Revolution, but unintended consequences of seven decades of use have been a decline in fertility and yield stagnation. The climate smart, Regenerative Agriculture movement is a reaction to this.



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Synthetic NPK fertilizer supplies macronutrients in forms that can be absorbed by plant roots. But fertility is about the soil's microbial community. Soil bacteria fix atmospheric nitrogen, and they release enzymes that solubilize phosphorus and release potassium. Bypassing this natural system has led to its degradation. EnSoil Algae, a biostimulant, works by expressing signaling molecules including auxins and cytokinins that promote microbial growth and activity, so that the macronutrients are produced naturally.

Serial soil testing, including Haney testing and measurement of phospholipid fatty acids, (PLFA), has documented that EnSoil Algae promotes growth of the microbial community (biomass measured by PLFA analysis), and activity (measured as soil respiration). That is to say, fertility increases. The use of synthetic NPK fertilizer provides no longterm fertility benefit, and research has shown that over time there has been a decline in organic nitrogen, carbon, and organic matter.

The priority of the American growers who have been early users of EnSoil Algae has been crop yield and return on investment, and results have been consistently positive. But they are also interested in their ground's fertility, have done serial soil testing, and have confirmed the soil-health benefit.

Serial soil testing, including Haney testing and measurement of phospholipid fatty acids (PLFA), has documented that EnSoil Algae promotes growth of the microbial community ...



Climate Benefits of EnSoil Algae

Growing EnSoil Algae is a carbon-neutral process using photosynthesis:

Algae inoculant + water + light + CO₂ → More algae + glucose + O₂.

The only byproducts of production are glucose and oxygen. CO₂ is removed from the atmosphere. There are no greenhouse gas emissions, and the process requires no hydrocarbon input. Electricity powers the production laboratory's climate control and equipment. It is not an industrial process, and the electricity needed to supply a 2000-3000 sq ft production laboratory averages less than 2000 kWh per month, slightly more than a 3500 sq ft home. (With early profits there will be a transition to solar power, and delivery will be with leased electric vans.)

The finished product, EnSoil Algae, is a concentrate in water with at least 10 million algae cells/mL. One liter of algae concentrate, weighing 1 kg, is diluted with water to treat 4.5 acres of cropland or pasture, so the delivery weight is far less than that of granular NPK fertilizer (about 450 lbs/acre) or composted products (usually higher). Algae can be applied to crops and soil with irrigation water or standard spraying equipment. Consider this, the energy needed to produce, deliver, and apply EnSoil algae is much less than that required to produce and deliver milk, and the effect on climate is far less.

In striking contrast, the production of synthetic NPK fertilizer is an industrial process. Methane is burned to synthesize urea (N), and phosphorous and potassium compounds are mined. Estimates vary, but US agriculture produces as much as 5% of our greenhouse gasses, much of that from the production and use of chemical fertilizers. To quantify the environmental benefit of switching from NPK to live algae, multiply the number of acres where EnSoil Algae has replaced synthetic NPK fertilizer by the known environmental cost of NPK/acre. It is that simple.

The only byproducts of EnSoil Algae production are glucose and oxygen. CO₂ is removed from the atmosphere. There are no greenhouse gas emissions, and the process requires no hydrocarbon input.

To quantify the environmental benefit of switching from NPK to live algae, multiply the number of acres where EnSoil Algae has replaced synthetic NPK fertilizer by the known environmental cost of NPK/acre. It is that simple.

Crop yield and cost

Researchers and farmers consistently report more vigorous plants and improved yield, and many have calculated return on investment. With discounts based on acreage and application frequency, the annual, material cost of EnSoil Algae for growing corn is about \$60/acre, less than half the cost of granular NPK fertilizer. **See references section.**

Effects on soil health and fertility

How bio-stimulation with live algae work has been reviewed. The fertility and soil health benefits can be documented with serial soil testing including Haney testing and measurement of phospholipid fatty acids (PLFA). When growers begin to use EnSoil Algae, they usually try it on a fraction of their ground and compare that with their crop or pasture grown using synthetic NPK fertilizer. Most have done soil testing early and late in the growing season, so they are able to document the changes in fertility comparing EnSoil Algae vs synthetic NPK fertilizer. Soil test data from a large group of farmers will provide the real-world fertility effect of switching from chemical fertilizer to EnSoil Algae. Repeating those studies yearly will allow assessment of long-term benefits (this has never been studied).

Photosynthetic capacity

Many studies have included leaf chlorophyll measurement and have documented higher levels when comparing live algae with synthetic NPK fertilizer. Elevated chlorophyll means greater photosynthetic capacity. Synthetic NPK fertilizer has little effect on chlorophyll unless there is severe nitrogen deficiency, which is rare, nor does it cause a rise in soil organic nitrogen. Grower surveys commonly describe a more intense green color of foliage. Many are beginning to use leaf chlorophyll meters. With a regional system, the company will purchase these instruments for shared use.

**Elevated chlorophyll
means greater
photosynthetic capacity.**



Pest Resistance

Live algae are not a herbicide or pesticide and there are no data proving an alteration of plant immunity. However, the bio-stimulant promotes plant vigor, and more vigorous plants are naturally more resistant to disease and pests. A rancher opined that thicker grass inhibited broadleaf growth in his pasture. This is anecdotal information, but if observations are shared by a large number of growers, the validity increases.

Abiotic stress resistance

Ample scientific data indicate that live algae boost resistance to drought and salinity in irrigation water. Plants treated with live algae produce higher levels of the antioxidant enzymes that mitigate these stresses. Reports of increased drought resistance with EnSoil Algae have been common, and they include photographic documentation.

A note on performance metrics

Many of these performance metrics depend on farmers collecting the data. All the grower data are observational. There are control areas treated with NPK, but no randomization. That said, when observational data are extensive—from many hundreds of growers—they are more convincing (and more likely valid). Furthermore, observational data are hypothesis-generating. A grower's data will only be used with permission.

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An Agronomist's Support for EnSoil Algae

I am a career agronomist, farmer, and crop advisor with 40 years in the field. I have worked with many of the major laboratories and soil testing facilities in the United States. I led Business Development efforts for Waypoint Analytical's Specialty Crop Division. I was Head of Agronomy for Biome Makers Inc. and led the launch of their genomics testing platform in North America. I am now Chief Agronomist at BTI AG LLC., focused on development and implementation of biological solutions for large, commercial farming operations. The purpose of all my work is to provide analytical insights to farmers in looking at soil health and to provide recommendations that can better build their crop health, soil health, and help build the farms' productivity.

In my role as Head of Agronomy for Biome Makers Inc., I was introduced to Enlightened Soil Corp and their product EnSoil Algae. We conducted soil analysis on farms in several regions, on multiple crops and soil types. Our testing demonstrated the application of EnSoil Algae will positively impact soil health and plant growth. Key observations include studies on how EnSoil Algae helps in building plant stress adapters, such as building the soil structure with improved levels of exopolysaccharides. Salicylic acid levels, abscisic acid levels, salt tolerance, and heavy metal solubilization is also a big benefit in using EnSoil Algae. Ultimately the benefits of EnSoil Algae have proven to reduce plant stresses and this quality greatly improves plant nutrient uptake and shows up in better crop performance.

I am interested in continuing to work with Enlightened Soil Corp to promote the use of EnSoil Algae as a valuable solution for crop production and soil health. The promise of microalgae extends well beyond fertility as it is sustainable, scalable, and can have enormous impact on water quality and crop nutrition.

Al Toops

Chief Agronomist, BTI Ag LLC



2023

Where we are going...

Our growth is being driven by a small, but passionate sales team and partnerships with growers and experts who have well aligned missions. This is about improving soil health

and production while lowering input costs to benefit the quality of life for producers and products for consumers. Early adopters of EnSoil Algae are expanding use of the product in their farming operation. Word of its effectiveness has spread among neighbors who are also placing orders, and success with the technology is being discussed in regional agriculture conferences. At present we project to apply to more than 250,000 acres in 2023, with each acre receiving three applications during the growing season.

Enlightened Soil Corp has optimized the design and development of its production facilities. The company built its initial facility on Johns Island in South Carolina, then moved it to a more suitable location on Johns Island. The move was seamless without any interruption in production or quality. The company built its first remote production facility in Wamego, Kansas, and is working on a facility in Jasper, FL. The recent supply chain issues have clearly shown that American farmers require a reliable, on-demand, supply of fertilizers that do not display the wild increases in prices that have affected NPK.

To achieve the above, Enlightened Soil Corp has worked with the GIS mapping department at the College of Charleston to create a workplan that lays out a production footprint where 22 production facilities can service this entire nation, with no delivery being more than 200 miles. All facilities will be in rural, Economic Development areas.

The EnSoil Algae production system has been robust, with no down time. Business development has been rapid: Research and development at Sweetgrass Garden began with the spring growing season in 2018, incorporation of Enlightened Soil Corp happened in September 2020, registration of EnSoil Algae for sale in 49 states and OMRI listing were accomplished by mid-2021, and there have been accelerating sales in the 2022 growing season.

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Research and Development.

An important component of project maturity is the research history. This is a data-driven business. Although academic research proving efficacy dates to the early 1970's, it was international. Adoption of this new technology in America has required American data, both real-world and academic. That is now available. Real world experience is documented (**see client references section**). All of the early users have reported benefits with EnSoil Algae which has now been used on pasture, sorghum, hay, alfalfa, clover, corn, beans, strawberries, blueberries, radishes, cotton, peanuts, sugar beets and citrus trees. During 2022, academic field trials have been conducted at Clemson University, the University of Georgia, the University of Kentucky, with studies planned for 2023 at the University of Florida. They have studied warm weather grass, cool weather grass, golf course turf, hay, squash, peppers, sweet potatoes and strawberries. Preliminary results from the Clemson University squash trial have shown increased yield. **See the Clemson results in testing section.** The investigators have indicated that EnSoil Algae works, and they are planning to present results at conferences this winter. Both real world and academic studies are confirming soil health benefits. Funded university trials, and data collection from farmers and ranchers, will support marketing.



During 2022, academic field trials have been conducted at Clemson University, the University of Georgia, the University of Kentucky, with studies planned for 2023 at the University of Florida.



Expected scale and longevity of benefits

The scale of the climate benefit will be the result of how much EnSoil Algae is used, or conversely, how much synthetic NPK is removed from use. The long-term effect of live algae on soil health has not been studied. Haney testing has shown an increase in soil organic matter, organic nitrogen, and organic carbon, and soil respiration, and phospholipid fatty acid testing has documented growth of soil's microbial mass with one year of use. One would expect expansion of those effects with continued use—and a progressive restoration of fertility. Since many growers are starting to use EnSoil Algae, yearly collection of Haney and PLFA testing data will answer questions about long-term benefits.

The sustainability of EnSoil Algae production and supply is not an issue. None of the inputs are extractive, and none will be depleted (CO₂, water, and light).

Regional impact and support

The decision to produce EnSoil Algae in regional production laboratories rather than centrally was based on a number of considerations. Limiting delivery distance reduces transport costs, and it reduces the carbon footprint of the production system. Regional production adds redundancy that mitigates risks to production, and it positions the business closer to its consumers. Management calculates that being a local, rural business providing a locally produced and cost-effective product confers a marketing benefit.

Regional production will expand local employment. Each of the 22 production laboratories will require a laboratory manager. One employee is enough to start production. A mature laboratory that is operating 32 photobioreactor tanks at capacity, producing EnSoil Algae to supply 110,000 acres yearly, will have many more employees: at least 4 to manage and operate the lab, 2-4 for sales and delivery, and 4 more to operate a bottling and packaging facility.



The production of EnSoil Algae is not an industrial process. It is grown in small laboratories with a small footprint, minimal infrastructure, and no emissions. It will not encroach upon or negatively affect wild-life habitat. For example, the South Carolina algae production laboratory occupies the second floor above a doctor's office, overlooking a tidal marsh.

A photograph of an elderly man with grey hair and glasses, wearing a white lab coat and blue gloves. He is holding a tablet computer and looking at the screen. The background is a lush green tomato plant in a greenhouse setting. A semi-transparent green rectangular box is overlaid on the image, containing the text "Independent Research".

Independent Research

After 25 years of working in field research

for Bayer Crop Science, I am currently operating a commercial citrus grove and research farm. I have had the opportunity to evaluate the EnSoil Algae product in a replicated field trial. We have looked at impacts on the soil microbiology and subsequent fertility by using the most detailed testing methods available: BeCrop DNA analysis, the Haney soil health test, and PLFA. Results have been significant in terms of microbiology changes, nutrient availability in the soil, and tree growth. *Chlorella vulgaris* algae is proving to be a very unique organism that can address plant growth and fertility.

In the last 10 years, regenerative soil research has clearly proven the impact of the soil microbiome on fertility. I am a clear example of growing a high demand crop (particularly micro-nutrients) solely with bio-stimulants and organic fertility. Enlightened Soil could play a significant part in this rapidly expanding segment of the crop nutritional industry.

I whole-heartedly endorse and support their efforts to expand their production facilities which would enable them to supply a wider range of the agricultural industry in the U.S. and do it economically. Production of *Chlorella vulgaris* supports every one of the USDA's objectives for the advancement of American agriculture. Sustainability, climate change, carbon sequestration, and, ultimately, support of the American farmer, are all the result of a movement towards this regenerative practice.

As the evidence is being compiled that human health is unequivocally linked to soil health, companies like Enlightened Soil will emerge as leaders in the evolution of modern agriculture.

Herb Young

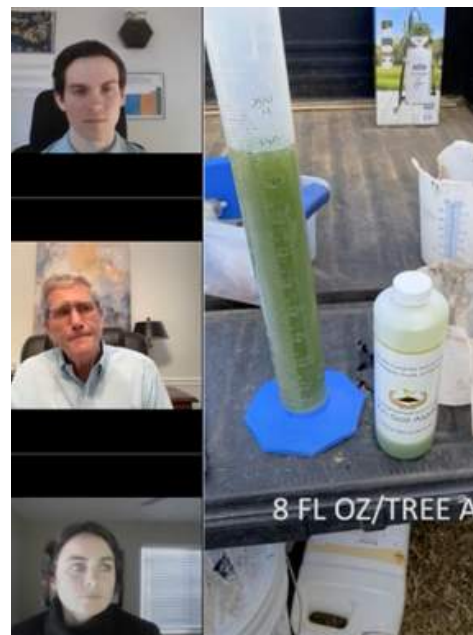
Squeeze Citrus, LLC



Citrus Results with Dr. Herb Young

Herb Young is a small, regenerative citrus grower and researcher from Thomasville, GA that has transformed his land by using cover crops and a pure biological nutrition system. Herb recognized tremendous plant and soil response with application of EnSoil Algae, confirmed by his BeCrop test results. He shares his results in this Biome Makers Webinar. We have highlighted some key findings below:

Check out this interview with Herb: [INTERVIEW](#)



Q: What is leaf flush and how did application of EnSoil Algae improve it?

Herb: "There was a completely different leaf flush from the untreated and the [EnSoil Algae] soil application. Leaf flush range is what percentage of branches have a new flush of leaf coming off the end. When that [EnSoil] algae, which is probably hormonally charged, was applied to the soil, we have a complete response. At 2 1/2 weeks, the leaf flush jumps to 55%. I want as much leaf canopy as I can possibly get that's going to grow in to grow roots, scaffold, and wood. For decades, that's always been a citrus grower's goal, is to get additional leaf flushes... to have that much more production capacity in a tree."





Q: What did you learn from BeCrop test results?

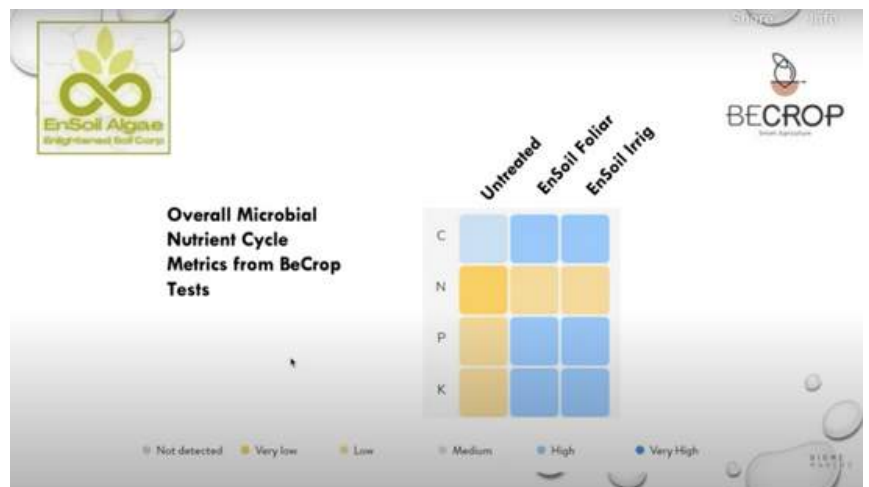
Herb: "It's exactly what I saw above ground. The below ground DNA confirms it. We've got a little bit of increase in the number of species in the soil. The real differences was the soil quality... overall soil quality range bumped up on my injection treatment and so did the biodiversity. All three [nutrient pathways] N, P, and K, increased dramatically with the foliar and with the soil treatment [of EnSoil Algae]."

	Untreated	EnSoil Foliar	EnSoil Irrigation Injection
Number of microbe Species	626	671	652
Soil Quality			+
Biodiversity			+
N Pathway		+	+
P Pathway		++	++
K Pathway		++	++

Q: What did you learn about the microbial potential?

Herb: "Both [foliar and injection] treatments of EnSoil Algae caused carbon to increase (darker blue)... The nitrogen was fastening. It was reduced... and the Haney Test [showed that] all of the nitrate and most of the ammonium in the soil applied with EnSoil was converted to organic nitrogen. By putting all of these tests together... we see that we've got microbes being activated by the [EnSoil] algae... consuming all of the nitrate and ammonium, and actually producing amino acids and proteins, providing that to the trees. And then we get this explosive growth."

Meri: "Every pathway was improved in EnSoil applications versus the untreated. Nitrogen went from "very low" to "low"... which still means... an increase in overall nitrogen cycling... going from inorganic to organic forms of nitrogen that are going to stay in the soil and have less leaching. Plants can consume amino acids so we are improving nitrogen cycling overall... and the phosphorus and potassium are significantly higher.. in the... EnSoil application."





Dr. Young Applying EnSoil Algae

A large stack of hay bales is the central focus, with a green semi-transparent box overlaid on it. The background shows a field of crops under a clear blue sky.

Client References:

Producer Observations & Outcomes

JRH Grain Farm

Russell Hedrick- Hickory, North Carolina

Russell is co-owner of Soil Regen and a leading voice in the regenerative farming movement. He is raising non-GMO corn and non-GMO soybean. Russell is in year one of application studies with EnSoil Algae.



Early season untreated on left, treated on right



Mid Season untreated with EnSoil Algae



Mid Season treated with EnSoil Algae

Feedback Corn: *“Corn plants have shown exceptional growth and plant health. During the growing season, plants sprayed showed a noticeable color change to a darker green. Plant growth was accelerated by 2-3 leaves within the first 2 weeks. Ear weight has been 1-3 ounces heavier in density. Yields and test weight will be determined this fall and are expected to be greater in the treated areas.*”

Feedback Soybeans: *“Since spraying, soybeans have shown more retained pods per plant on 3’ row measurements ranging 5-8%. Disease pressure has been minimal this season until the middle of August with heavier rain falls. Plants sprayed with algae haven’t had noticeable frog eye leaf spot or rust like their untreated counterparts. Soybean yields are hard to determine until harvest, but based upon pod retention, we expect an increase in yield. Plant health and growth have been dramatically evident this season, and expectations are high for harvest. We treated 5 fields with EnSoil Algae to measure vs a control. In every field EnSoil had a meaningful impact on yield. In addition, there was a significant dry down effect and great standability.”*



Outcomes:

- EnSoil Algae showed the effect of optimizing plant nutrient uptake, energy value, and improved plant health everywhere it was applied.
- Improved stress adaption.
- Significantly quicker dry down where EnSoil Algae was applied. The farm average was a difference of 2.1% in moisture content.
- EnSoil Algae delivered a yield bump of 6-8 bushels when added to a late season fungicide pass compared to fields that received the fungicide without EnSoil Algae.
- Overall 90% rate of profitability based on yield. Total cost per acre of EnSoil was calculated at \$60. Farm average was 12.5 bpa gain.
- Largest gain was a 17 bpa in a field where EnSoil was applied in furrow at planting and twice more over the top in season.

EnSoil Algae delivered a yield bump of 6-8 bushels when added to a late season fungicide pass compared to fields that received the fungicide without EnSoil Algae.



GCG Farms

Darren Bryant-
Moultrie, Georgia

Darren's farming operation consists of 1100 acres of cotton, 360 acres of peanuts, and 200 acres of cattle pastureland. He has applied EnSoil Algae three times to both the cotton and the peanuts.



Outcomes Cotton: Soil fertility tests, DNA soil samples, total soil digestion samples, and tissue analysis on the treated and untreated plots and the treated fields show two crops are using all the nutrients available to them with very high bio-controls, hormone production, and stress adaptations.

- The EnSoil Algae treated fields yielded an additional 200 pounds per acre of high quality cotton (conservatively).

- 10 acre field of dryland cotton. The Cotton had three applications of EnSoil algae.
- This field had some very weak spots and had been noted to be a disaster in recent years for crop production.
- EnSoil Algae applications were started 20 days after emergence, just before squaring. The first application of algae was tank-mixed with an herbicide. Easy process.
- We noticed where we treated the cotton with the algae herbicide mix we had a better degree of weed control as to where we applied no algae with the herbicide.
- Subsequent EnSoil Algae applications were applied 15 to 20 days apart (weather).
- Crop scout reported this field was developing/loading up with fruit with close node settings on the limbs.
- During our dry weeks this cotton crop seemed to hold up better under the drought conditions and shed very little fruit.
- After defoliation the EnSoil Algae treated crop was loaded from top to bottom. There was very little hard locks with short internodes between bolls on the limbs. It appeared that every boll opened on the stalk in a reasonable time showing a quicker maturity. Even in the weak spots we had strong yield potential and in the strong parts of the field we even had stronger yield potential. The color of the crop was outstanding; however we have no grades at this point. We anticipate them to be good.
- Another interesting observation was the treated cotton had a bottom crop. Where the untreated cotton had no bottom crop and a lot of hard locks. The plants showed less stress.

No EnSoil Algae



Treated with EnSoil Algae



Feedback Cotton: A crop scout checks fields weekly. The scout reported recommending replications of EnSoil treatment to other non-treated fields.

The cotton plants treated with EnSoil were fruiting heavier and were setting bolls at shorter node intervals on the limbs. The cotton plants also looked healthier with a darker green appearance and appeared to be holding the extra fruit it had set instead of shedding it. They showed better canopy development along with flowering and boll set.

Darren is hoping this leads to improvement in the maturation of the plant. He feels if he can tighten the stages of development, then he can better manage his crop for higher yields and better grades resulting in a better ROI. Darren is also pleased with the ease of application of the EnSoil. He can mix it with just about anything he wants to put out whether it be an insecticide, herbicide, or fungicide.

The cotton plants treated with EnSoil were fruiting heavier and were setting bolls at shorter node intervals on the limbs.

The algae-treated peanuts had a yield of 4000 lbs per acre. The untreated peanuts had a yield of 3400 lbs per acre. There was a 600 lb per acre improvement.

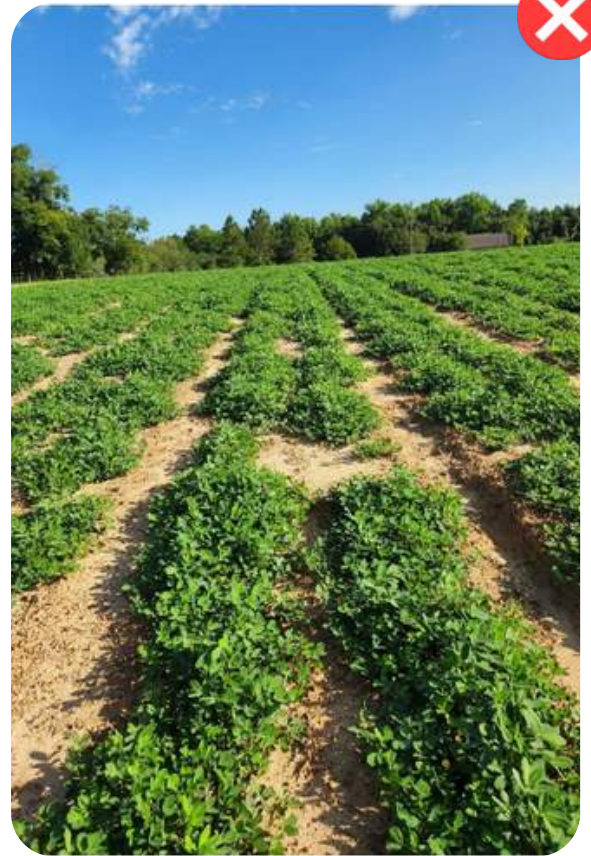
Outcomes Peanuts:

- The Ensoil algae was easily mixed and applied at 8oz per acre with yellow herbicide before planting. Easy process.
- Two tons of chicken manure was the only fertilizer applied. We did ad a ton of calcium later. There was no insecticide applied on the treated peanuts and only one fungicide application and it was applied with the algae in a tank mix. Easy process.
- Peanuts were dryland with no irrigation period. The peanuts went through some stressful days but seemed to hold up better where EnSoil Algae was applied.
- The peanuts were harvested at 145 days with treated vines showing very little if any at all disease pressure. The untreated had disease pressure.
- We have not received \ official grades on this tract however most of our grades have been between 74 the lowest to 80 the highest so far. We expect a high grade.
- The algae-treated peanuts had a yield of 4000 lbs per acre. The untreated peanuts had a yield of 3400 lbs per acre. There was a 600 lb per acre improvement.
- We rolled the peanut vines for cattle hay this year due to concerns over hay shortages. When the algae treated vines were tested for feed value, they were 3 points higher in protein and TDN values over the untreated vine hay. The treated vines also doubled the number of rolls per acre produced verses the untreated.
- It appears where the algae was applied the soil seems to take on a fluffy texture and it absorbs moisture better. With the soil taking on this characteristic it makes it easy to plant the next crop getting good seed to soil contact for quicker emergence.
- We truly believe the EnSoil algae stimulates microbes that have been in our soil from the beginning of time to work harder in our environmental conditions and our soil to solubilize nutrients to feed your plants.



Feedback Peanuts: Darren applied 8 oz per acre of EnSoil along with a yellow herbicide at its recommended rate before planting his peanuts into a closely grazed multi species cover crop. After the peanuts emerged, he applied another 8 oz per acre application. The peanuts were in drought conditions but visually appeared to be holding up better than the untreated peanuts in the adjacent field. After finally receiving much needed rainfall a third application of EnSoil was applied at 8 oz per acre with a fungicide treatment. At this point the peanuts look to be pegging as they should be to produce a decent crop of nuts.

The peanuts were in drought conditions but visually appeared to be holding up better than the untreated peanuts in the adjacent field.



Not treated with EnSoil Algae



Treated with EnSoil Algae

Windmill Angus Ranch

Alex Peterson- Haigler, Nebraska

Alex breeds angus bulls and raises beef cattle. He farms over 2000 acres. He has applied EnSoil Algae to his sorghum, alfalfa, corn, oats, and clover crops in Southwest Nebraska.

Outcomes: Initial application of *C. vulgaris* on 160 acres of cane sorghum at Windmill Angus Farms in Haigler, NE, occurred in August 2021 and provided independent feed sample reports showing an approximate 50% increase in protein and 25% increase in tonnage per acre over control acreage. Multiple soil samples from clover at McDonald Apiary in Hay Springs, NE, showed improvement in soil health after application of EnSoil. While the increase in biomass is significant, the corresponding increase in root structure has the potential to better retain moisture, mitigate erosion, and be a useful tool in water management along the Republican River and elsewhere. Haney soil tests showed that soil organic matter increased by 1.3%.



Feedback: *"We are very encouraged by the results we've seen from application of EnSoil Algae. We've seen positive plant color and growth response. Our soil health numbers show improvement. Our yields have been higher where EnSoil was applied, and the nutrient gains are also significant. We believe it can help us grow a quality, nutrient dense crop and offset the cost of nitrogen inputs. We are most excited about working to improve our soil biology and water holding capacity through use of EnSoil. EnSoil Algae was applied to circles of corn and alfalfa as well as the vegetable garden. Western Nebraska faced extreme drought this year, but I was able to produce a decent crop where EnSoil Algae was applied. The corn had excellent pollination and energy value, especially compared with neighbors. We have quality silage. We were able to get 4 quality cuts from our alfalfa this year and the ground is still green on alkaline spots that are normally brown at this point EnSoil Algae and water were our only inputs on the Alfalfa circle. Last year in a comparison trial on sorghum we got a 25% bump in yield and 40% bump in protein values on sorghum where EnSoil Algae was added to our normal fertilizer application."*



The Plant Company

Keith Meadows and Brett Bennett- Moultrie, Georgia

Greenhouses provide plant starts for L&M produce farms and others growing onions, sweet potatoes, peppers, cucumbers, cabbage, broccoli, tomatoes, melons and more, nationally. A trial of 10,000 tomato plants is underway. The first of four applications of EnSoil Algae was at the time of planting/transplanting, then applied at 2-week intervals in greenhouse and also in the fields when transplanted to TN.



Feedback: *“We saw significant visual evidence of improved root mass and plant height plus an increase in copper uptake from the plant tissue analysis. Before harvest in the field, we saw less evidence of disease and more fruiting and flowers on plants treated with EnSoil Algae. The early observations are promising, and we are expanding our studies. We think the algae could be very useful to the greenhouse operations.”*



Bayside Farms

Jay Lane- Elizabeth City, North Carolina

Jay Lane farms 1600+ acres of corn and soybean on the Eastern Shore of North Carolina near Elizabeth City. Jay has been focused on improving soil biology and implementing regenerative management practices as a means of improving his farm's profitability.

Jay recognizes improving soil health, production increases, and reducing synthetic inputs all go together. Use of cover crops and biological inputs offer a better way to farm.

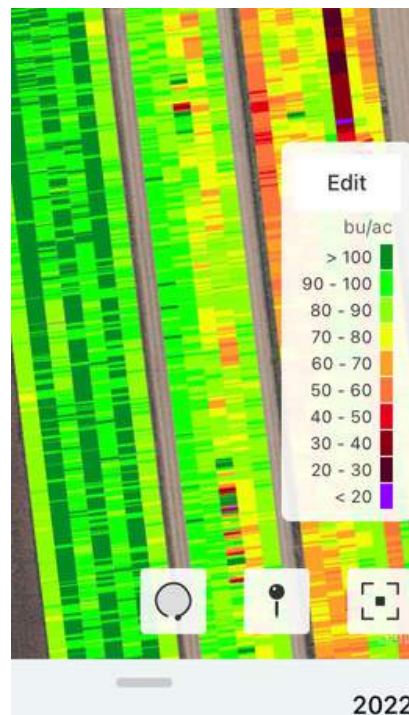
Soybean Results After EnSoil Application

2022

- Applied 8oz /acre at R1
- Saw increase in yield where EnSoil was applied.
- Late season drought and stress tolerance was obvious.
- Top 3-5 nodes did not abort any pods

2023 Plan

- Applying 8oz/acre in furrow on 500 acres
- V8
- R1
- Full elimination of NPK
- Haney Testing and tissue analysis



Ginger Hill Angus

Dr. Brooke Miller- Washington, Virginia

There was a consistent increase of Abscisic acid (ABA), a stress adaptor that effects growth regulation. Both indicators translate to a really healthy plant and increase in yield.

Dr. Miller is a practicing family physician in addition to his work as a rancher and President of the United States Cattlemen's Association (USCA). He has been treating his fields for hay production: fescue, orchard grass, clover cover crop.

Outcomes: Testing showed a higher number of arbuscular mycorrhizae 'hairs'. These mycorrhizae attach to root hairs and are responsible for nutrient movement. There was a consistent increase of Abscisic acid (ABA), a stress adaptor that effects growth regulation. Both indicators translate to a really healthy plant and increase in yield.

Feedback: Dr. Miller has applied EnSoil Algae to his fields for two seasons with excellent results in forage density, hay yield, color, growth, and overall health of his fields. *"We have been using EnSoil Algae for two years now at Ginger Hill Angus. The results have been quite remarkable. After our second year of spraying this algae product we have noted the areas where it was used show tremendous improvement in color and volume of forage in the treated areas compared to the controls. What has really amazed us is the dramatic reduction in broadleaf weeds in areas where the algae has been spread. Clover and forage grasses are thriving and ragweed is gone. We still see a good amount of broadleaf weeds in areas without EnSoil Algae."*

1 and 2 not treated with EnSoil Algae.



Pasture not treated with EnSoil Algae was prone to ragweed and broadleaf weeds.

3 and 4 treated with EnSoil Algae.



Pasture treated with EnSoil Algae experienced improvement in thickness and color



SWC Farms

Steve Clark- Moultire , Georgia

Steve manages a 50 head cow/calf operation on his 250 acres farm. Steve has an Associates degree in Plant Sciences and Ag Business, a BS degree in education, and certification within the Georgia Department of Labor's EXCEL Leadership Program. He also became USDA-certified for livestock grading and worked stockyard cattle sales for the Georgia Department of Agriculture, providing weekly market reports to the USDA, ag lenders, grocery chains, cattle buyers, feeders, and processors, as well as State extension agencies, after retiring from the Georgia Department of Labor. He retired from the Georgia Department of Labor as one of five District Tax Directors.

Steve has a passion for learning best practices in soil science, farm and animal production, and ag banking. His cattle operation consist of what would be recognized as a commercial cattle herd, using genetics from some of the best-known bloodlines for grass fed beef in the industry: Ohlde Angus, Kinloch Angus, Wye Angus, Trask Hereford, and Teddy Gentry's South Poll Breed.

Feedback: *"Kit Pharo, owner of Pharo Cattle Company was a big influence in the direction of the cattle herd. It's not about weaning the heaviest calf. It's about producing pounds of beef per acre and having cattle that work for you in your environment while managing expenses for a better ROI.*

My first big change in the operation was to implement rotational grazing. The second major change was to dramatically reduce the use of synthetic fertilizers.

In 2022, I used no fertilizer opting instead to apply three foliar applications of EnSoil Algae at a rate of 8oz per acre every 10 to 14 days from Mid-May to July. Forage tests and found my grass to have a 7.91 % protein and 61.9% TDN value with no fertilizer applied.

The Bermuda and Bahia grass was responding better to drought conditions where treated with EnSoil Algae and when it did rain there was no runoff whatsoever. The water just soaks right into the soil even with 2-inch downpours.

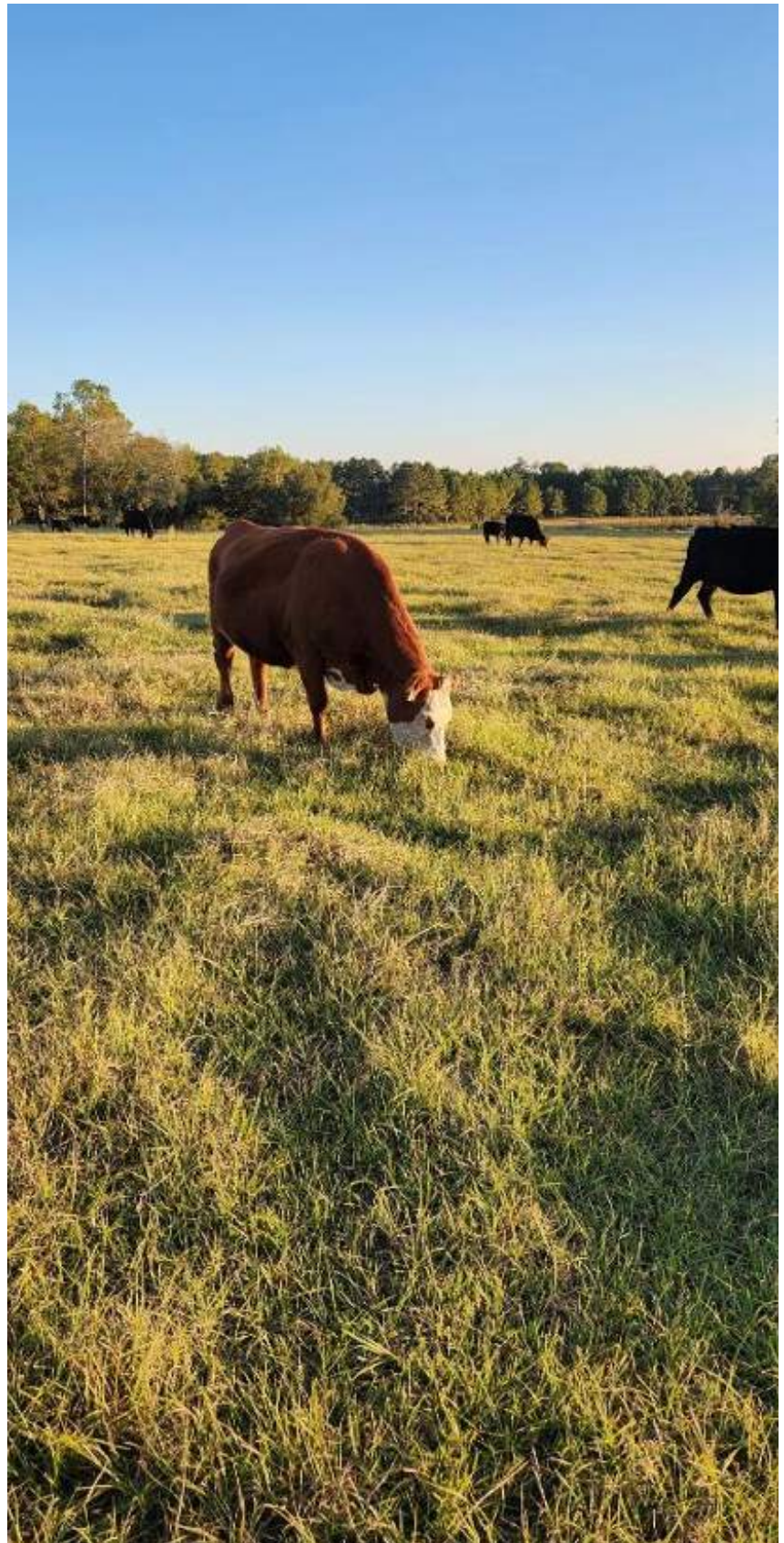
After grazing this pasture over the course of the summer, I started to notice a difference in my cattle's body condition which was surprising to me. The cattle seem to have a healthier looking coat and to be less stressed. I think that help them (the Cows) to breed back in a timely manner after calving. It also helped the calves on those cows to convert the forage into better weight gains. This was just an observation of mine. I have no data to support my observations except my bull was busy.

Results that will lead me to expand my use of the Enlightened Soil product EnSoil next year for sure."

In 2022 I used no fertilizer opting instead to apply three foliar applications of EnSoil Algae at a rate of 8oz per acre every 10 to 14 days from Mid-May to July.

Forage tests found my grass to have a 7.91 % protein and 61.9% TDN value with no fertilizer applied.

The Bermuda and Bahia grass was responding better to drought conditions where treated with EnSoil Algae.





Torske Land and Livestock

Matt and Ross Torske- Hardin, Montana

The Torske's farm and raise cattle in Hardin, MT. They took significant hail damage in late June to one of their circles of corn. As a test they chose to apply EnSoil to one of the circles to see if it would accelerate a recovery. In the pictures below you can see the corn at 2 ft tall on July 5th and 8ft tall on August 5th after two applications of EnSoil. The field receiving EnSoil has caught up to the field that was not damaged and now looks just as good if not slightly better than the other.

Outcomes: Soil testing indicates the treated plot has increased water soluble organic matter compared to the untreated plot. Water soluble, organic C is the key food source for the microbial community which are responsible for nutrient cycling. Increased soil organic matter indicates increased water holding capacity and carbon sequestration.

Feedback: *"We think the EnSoil corn looks healthier for sure, a deeper green. The treated corn could be a bit taller. We are tickled with the crop so far as it has bounced back a lot faster than any other corn in the area that got hail. We think there is a difference for sure. The treated corn was around 2 feet tall when it was hailed to the ground. So this crop has at minimum caught back up and probably surpassed the corn in the area that received no hail. So we believe that EnSoil has benefited us greatly so far."*



"We are tickled with the crop so far, as it has bounced back a lot faster than any other corn in the area that got hail."

WabiSabi Farms

Jimmy Livingston- Cordesville, South Carolina

Wabi Sabi produces organic market vegetables: strawberries, watermelon radishes, greens. Jimmy has decades of organic farming experience at Wabi Sabi. The community has been looking to Jimmy for organic growing techniques and he runs a very popular u-pick operation.

Outcomes: Jimmy uses his senses to know that his soil and plants are healthy. He has shared that his soil looks and feels very healthy.

Feedback: *"We've had very exciting production on strawberries and radishes when incorporating EnSoil Algae into our fertility program. We only grow organically. We love that EnSoil is an OMRI listed biological solution for improving soil health and plant production. The plants we've grown using EnSoil are some of the prettiest we have ever grown."*



"We only grow organically. We love that EnSoil is an OMRI listed biological solution for improving soil health and plant production."





Iron Horse Farm

Allen Reed- Johns Island, South Carolina

Iron Horse is ten acres of horse pastures and stables located on Johns Island, SC. They began using EnSoil to replace synthetic fertilizer in November of 2020.

Feedback: *“Under new management, The Stables at Iron Horse instituted a pasture management program which included the use of Ensoil fertilizer. Over an 18-month period the improvement in both quantity and quality of forage has been substantial. Our horses are enjoying their expanded grazing and feeding opportunities.”*



2020 before application of EnSoil Algae.



2022 after 18 months of EnSoil Algae use.

Wilson Scotch Mountain Angus Ranch

Jeff Wilson- Potomac, Montana

Jeff Wilson is recognized as a leader in the American beef cattle industry. He breeds angus bulls just outside of Missoula. Jeff has been treating his pastures for two seasons with EnSoil Algae. He believes the health of his soil correlates directly with the health of his animals through the forage they eat.

Outcomes: PLFA tests indicate greater total living biomass and functional group diversity in the treated sample. The treated samples showed a greater percentage of total fungi and actinomycetes. Fungi are critical in extending the plant root network and are responsible for transporting nutrients. Actinomycetes serve to cycle organic matter, inhibit the growth of plant pathogens, and produce enzymes conducive to crop production through the decomposition of animal and fungal material. The treated soil also had a greater amount of protozoa in comparison to the control. Protozoa mineralize nutrients making them available for plants and other soil organisms.

"Forage volume looks to be double where we used the algae. We will be treating all of our ground 4 times next year."



The right side of the electric fence received EnSoil Algae.

Feedback: *"We had significant gains in our forage from pastures treated with EnSoil. In addition, we can see and feel a difference in soil structure and improvements to compaction in areas we have applied the algae. It is very exciting. Forage volume looks to be double where we used the algae. We will be treating all of our ground 4 times next year."*

Sweetgrass Garden Co-op

Jennifer Wicker- Johns Island, SC

Sweetgrass Garden grows and distributes free, fresh, naturally grown, local produce to charitable food distribution agencies on Johns Island and Wadmalaw Island. Regenerative farming practices and permaculture principles are utilized to maintain the farm. Sweetgrass has been funded on four USDA Sustainable Agriculture Research Education (SARE) projects. Two of the grants included research of the algae in Enlightened Soil.

Outcomes: When EnSoil Algae was added to poorer soil (Control), tomato yield per plant was increased 45%. Likewise, treating rich soil with algae boosted yield per plant by 16%. Thus, algae boosted yield regardless of baseline fertility.

Feedback: *“Sweetgrass Garden is dedicated to using organic, regenerative practices and teaching folks those practices. Donating produce to those in need that is treated with EnSoil helps us stick to our mission while positively impacting our climate.”*

When EnSoil Algae was added to poorer soil (control), tomato yield per plant was increased 45%. Likewise, treating rich soil with algae boosted yield per plant by 16%. Thus, algae boosted yield regardless of baseline fertility.



Byrdland Farms

Nelson Byrd- Charleston, Missouri

Nelson and Hudson Byrd carry on their family legacy farming 5000+ acres of corn and soybean in the Mid-South.

They focus on soil health as the critical component for crop production, resiliency, and risk management.

Outcomes: Testing indicates treated soil has increased microbial respiration, water extractable C values, and an increased soil health score when compared to the control. These data indicate increased microbial activity and soil health from the application of EnSoil.

Feedback: “We can definitely see a noticeable plant health difference, in our corn especially”.



“We can definitely see a noticeable plant health difference, in our corn especially.”

Carter Cows

John Cain Carter- Stephenville, Texas

John raises Akaushi beef cattle in central Texas. He has applied EnSoil to recently acquired pastureland in hopes of improving soil quality and restoring native grasses for grazing.

Outcomes: Soil tests indicate and increase in organic matter, water extractable N and C and overall soil health score.

Soil tests indicate an increase in organic matter, water extractable N and C, and overall soil health score.



EnSoil Treated Pasture is a deep green.

A Cattleman's Support for EnSoil Algae

I operate Windmill Angus Ranch in Haigler, Nebraska. We raise Angus bulls and farm corn, alfalfa, sorghum, and clover for honey production. We made the decision to try EnSoil Algae on our sorghum in 2021, and, based on results, expanded the use of EnSoil to our corn, clover, and alfalfa this year.

Initial applicaon of *C. vulgaris* on 160 acres of cane sorghum at Windmill Angus Farms in Haigler, NE, occurred in August 2021 and provided independent **feed sample reports showing an approximate 50% increase in protein and 25% increase in tonnage per acre over control acreage**. Mulple soil samples from clover at McDonald Apiary in Hay Springs, NE showed improvement in soil health after application of EnSoil. While the increase in biomass is significant, the corresponding increase in root structure has the potenal to better retain moisture, migate erosion, and be a useful tool in water management along the Republican River and elsewhere.

We are very encouraged by the results we've seen from application of EnSoil Algae. **We believe it can help us grow a quality, nutrient-dense crop and offset the cost of nitrogen inputs**. We are most excited about working to improve our soil biology and water holding capacity through use of EnSoil.

Western Nebraska faced extreme drought this year, but I was able to produce a decent crop where EnSoil Algae was applied. The corn had excellent pollination and energy value, especially compared with neighbors. We have quality silage. We were able to get four quality cuts from our alfalfa this year, and the ground is still green on alkaline spots that are normally brown at this point. EnSoil Algae and water were our only inputs on the alfalfa circle

I will continue to work with Enlightened Soil Corp. The team at Enlightened Soil Corp has demonstrated through their actions and investments to be focused on helping American farmers.

Alex Peterson

Windmill AngusRanch

A close-up photograph of a man wearing a straw hat and a red, white, and blue plaid shirt. He is holding a brown clipboard with a silver clip at the top. He is also holding a single stalk of wheat in his left hand. The background is a field of wheat under a bright sky. A semi-transparent grey box is overlaid on the center of the image, containing the text "Testing & Research Data".

Testing & Research Data

Clemson University Squash Study

A Summary of Preliminary Results

We have been satisfied that EnSoil Algae (live *Chlorella vulgaris*) works because of our studies at the Sweetgrass Garden Co-op, and because of the experience reported by other growers. We have not had confirmation of these observations with studies from American universities, although many international studies are available.

This spring (2022) a market garden trial was conducted by Dr. Brian Ward at Clemson University, and this report summarizes preliminary results with summer squash (he is harvesting peppers later in the month).



Methods: The study used standard field-trial methods with six replicates of each treatment group randomly situated in the test garden. Rows were covered with black plastic mulch, and there was drip irrigation. Granular organic fertilizer (PGF) was applied before placement of mulch and planting. Soil application of algae and/or liquid fertilizer was done through drip irrigation. Foliar application of algae was done with a backpack sprayer. Inputs, fertilizer, or algae were applied at 2-week intervals. The application rate of algae was 50,000 cells per sq. ft. of garden whether applied to foliage, ground, or both.

There were 14 treatment groups including various combinations of PGF, liquid chemical fertilizer and algae with foliar or ground application (**Table**). The results from each treatment combination were compared with control replicates that received no fertilizer or algae input. During the growing season, the control (including 6 replicates) yielded 409 squashes with a total weight of 186 lbs. (**Table**). The table presents number of squashes harvested and their total weight for each treatment group. Since produce is sold 'by the pound' the latter is perhaps more important.

Treatment assignments were designed to answer specific questions:

- Does EnSoil Algae work at a dose of 50,000 cells per square foot?
- Is it as effective as synthetic fertilizer?
- Farmers are reluctant to jettison synthetic fertilizers altogether. Is there a benefit with adding algae to fertilizer, perhaps with a lower fertilizer dose? Could that allow reduction of costs?
- What is the most cost-effective approach?



Table: Squash yield comparing EnSoil Algae alone or in combination with other fertilizers.

Treatment	# Harvested	Weight (lbs)		
		(%of control)*		= %of control)*
Control (no input)	409 squashes	0	186 lbs.	0
100% PGF (granular fertilizer)	546 squashes	+ 33%*	249 lbs.	+ 33%*
Algae (Alg)—soil application (app.)	498	22%	260	40%
Alg—foliar app.	451	10%	214	27%
Alg—soil + foliar app.	429	5%	206	11%
100% PGF + Alg—soil app.	499	22%	246	32%
100% PGF + Alg—foliar app.	491	20%	226	22%
100% PGF+ Alg—soil + foliar app	540	32%	260	39%
25% PGF + Alg—soil app.	480	17%	232	25%
25%PGF + Alga—foliar app.	568	39%	271	46%
25%PGF + Alg—soil + foliar app.	465	14%	225	21%
25% PGF + Alg—soil app. + 75% drip Irrigation fertilizer**	540	32%	274	49%
25%PGF + Alg—foliar app. + 75% drip Irrigation fertilizer	514	26%	252	35%
25%PGF + Alg—soil + foliar app. + 75% drip Irrigation fertilizer	448	10%	224.8	20%

PGF = Preplant granular fertilizer.

**75% drip irrigation fertilizer = 75% of the nitrogen input for the season divided and applied at 2-week intervals with drip irrigation (this + the 25% PGF = the season’s total calculated nitrogen input).

*Percent of control: A sample calculation for number of harvested squashes with 100% PGF: (546 – 409) / 409 = 33%



Discussion:

A consistent result is that EnSoil Algae—when compared with the control—effectively promoted squash yield when measured by number of fruits or total weight of the crop. This was true when it was used alone or in combination with synthetic fertilizer. When algae alone were compared with the usual fertilizer dose (100% PGF), the result is uncertain. Soil application of algae looked better, and foliar application somewhat worse, but these results were close.

Another issue is whether there is a benefit to adding algae to synthetic fertilizers. Combining algae with the usual dose of fertilizer (100% PGF) was of no benefit. If a grower wants to continue input with synthetic nitrogen—a slow wean of the farm from synthetic fertilizer—the dose can be reduced. ***A winning combination was 25% of the usual fertilizer input plus foliar application of algae (a 46% increase in crop weight). However, soil application of algae alone looked quite good as well (a 40% increase).*** Of interest, adding a massive dose of fertilizer—granular at the beginning of the season, plus the remainder of a 100% dose in combination with irrigation water plus soil application of algae—boosted the yield by 49%. These differences among treatment combinations are uncertain and await statistical analysis.

A reasonable interpretation at this time is that (1) algae works at a dose of 50,000 cells per sq foot of garden, (2) it can work in combination with fertilizer, and (3) full dose fertilizer isn't needed when algae is used in combination.

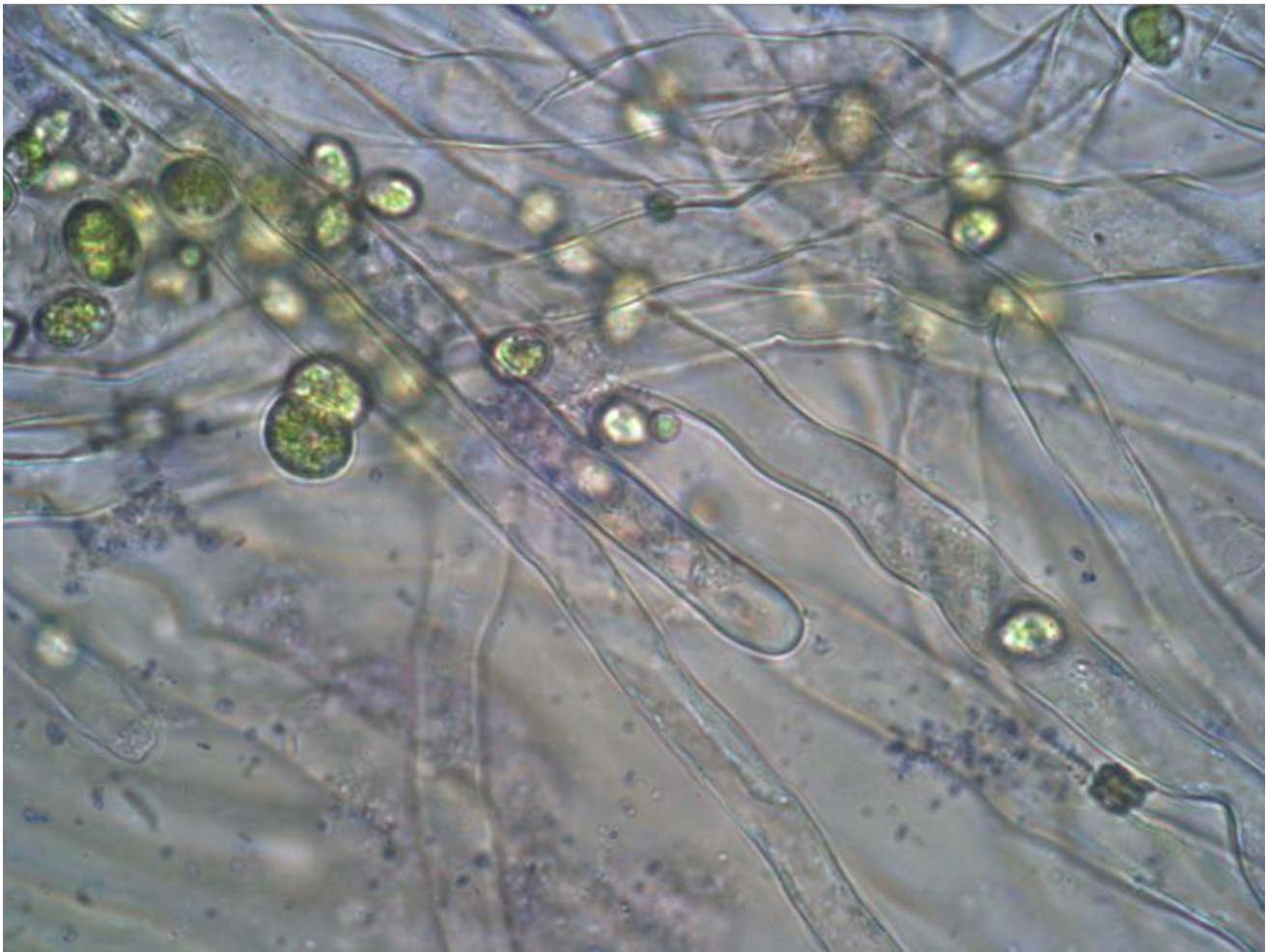
The bottom line for a grower is the return on investment. Given the high cost of fertilizer relative to the cost of algae and these results, we anticipate algae will prove to be cost-effective.

[Link to the full Clemson Study Here](#)



Rutgers University

Laboratory Tests Using EnSoil Algal product in Creeping Bluegrass (*Poa reptans*), Clover (*Trifolium repens*) and Soybean (*Glycine max*)



James White and Xiaoqian (Ivy) Chang Department of Plant Biology
Rutgers University, New Brunswick, NJ 08901
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3/28/2023



Methodology

- Seeds of *Poa reptans* were subjected to surface disinfection by shaking in a 3% sodium hypochlorite solution for 1 hr.
- Seeds of Clover (*Trifolium repens*) were surface disinfected for 1 hr by shaking in 3% sodium hypochlorite.
- Seeds of soybean were surface disinfected by sequentially treating with 70% ethanol for 2 minutes, followed by a 4% sodium hypochlorite solution for 2 minutes, and soaking in a 200 ug/mL streptomycin solution for 10 minutes.
- Seeds were subsequently placed onto agarose culture medium supplemented with varying concentrations of Algal product (0.01, 0.1, 1 and 5%). We used 3 or 4 replicates per treatment.
- Seeds on agarose were germinated and grown in lab ambient conditions for 8-10 days depending on the plant being tested.
- Nitro blue tetrazolium (for superoxide) and potassium permanganate (for ethylene) staining was done to visualize endophytic bacteria in plant cells.

Table 1. Stimulation of Root and Root Hair Growth in *Poa reptans* Through Application of Ensoil Algal Product at Various Concentrations in agarose-based 8-day seedling assays

	Germination Rate	Gravitropic Response	Lateral Root Number per plant	Root Length	Root hairs	Root Exudates
Control	80%	2	0.77	+	-	No
0.01%	90%	5	0.77	++	+	No
0.1%	87%	5	0.90	++	++	No
1%	80%	9	1.00	++	++	Yes
5%	90%	5	0.90	+++	++	Yes

Results:

- Ensoil algal product application promoted seedling growth, exhibiting 6 positive growth promotional characters – germination, lateral root number, root length, root hair growth, root exudates and gravitropic response.

Table 2. Stimulation of Root and Root Hair Growth in Clover (*Trifolium repens*) Through Application of Ensoil Algae Product at Various Concentrations in agarose-based 8-day seedling assays

	Germination Rate	Gravitropic Response	Lateral Root Number per plant	Root Length	Root hairs
Control	83%	1	0.07	+	-
0.01%	90%	1	0.10	+	+
0.1%	90%	1	0.04	++	+
1%	87%	1	0.20	++	+
5%	97%	3	0.27	++	++

Results:

- Ensoil algal product application promoted seedling growth, exhibiting 5 positive growth promotional characters – germination, lateral root number, root length, root hair growth and Gravitropic Response.
- 5% product application performed best in seedling growth promotion.

Table 3. Stimulation of Root and Root Hair Growth in Soybean Through Application of Ensoil Algal Product at Various Concentrations in agarose-based 8-day seedling assays

	Germination Rate	Gravitropic Response	Root Length	Root hairs
Control	83%	5	+	+
0.01%	94%	14	+	+
0.1%	83%	6	+	+
1%	83%	8	++	++
5%	83%	6	++	++

Results:

- Ensoil Algae Product application promoted seedling growth, exhibiting 4 positive growth promotional characters – germination, root length, root hair growth and Gravitropic Response.



Conclusion:

Based on the experimental results, the application of algae improves the growth of creeping bluegrass, clover, and soybean. The mechanism behind this phenomenon is attributed to the symbiotic interaction between algae and endophytic bacteria and plants, whereby the algae eject or release bacteria and facilitate the colonization of the plant roots. This, in turn, promotes the growth of root hairs, ultimately leading to an overall enhancement of plant growth.

[Link to the Full Rutgers Study Here](#)



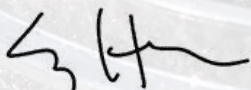
Algal application promoted the growth of root hairs.

Support for EnSoil Algae from Liz Haney

"Preliminary soil testing indicates that the live algae increases soil respiration (a measurement of microbial activity) when analyzed with the Haney test. Results also indicate increases in available P in some soils. In some cases, we have seen increases in water soluble and total organic matter. Water-soluble organic C is the key food source for the microbial community in the soil, which are responsible for nutrient cycling. Increased soil organic matter results in increased water holding capacity and indicates increased carbon sequestration.

Various soils treated with algae have shown increases in total living microbial biomass and functional group diversity. Samples show increases in total fungi, protozoa and actinomycetes. Fungi are critical in extending the plant root network and are responsible for transporting nutrients. Actinomycetes serve to cycle organic matter, inhibit the growth of plant pathogens, and produce enzymes conducive to crop production through the decomposition of animal and fungal material. The treated soil also had a greater amount of protozoa in the sample compared to the control sample. Protozoa mineralize nutrients, making them available for plants and other soil organisms."

Liz Haney, PhD





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