Live Algae as a Soil Amendment for Turf and Pasture: Positive Effects on Growth, Nutritional Content, and Soil Health

Enlightened Soil Corp

What's Good for Soil is
Good for People, Profit, & Planet. ™

Live Algae as a Soil Amendment for Turf and Pasture:
Positive Effects on Growth, Nutritional Content, and Soil Health

Draft: January 19, 2022

Live algae as a soil amendment has been a subject of study by university agronomists for almost 5 decades, and farmers in lesser-developed countries have used it in place of more expensive chemical fertilizers (NPK). Multiple studies have shown enhanced growth of a variety of vegetables and grains as well as improved soil health, measured as soil organic matter. Live algae in micro quantities produce phytohormones that promote plant growth and stimulate bacterial activity in the rhizosphere. These favorable microbes convert atmospheric nitrogen to organic compounds, nitrate, and ammonium that are used in plant metabolism.

In this report we describe the effects of En-Soil Algae (ESA, a pure culture of *Chlorella vulgaris*) on golf course turf, previously untreated meadow grass, and more recently, on sorghum grown as silage.

Golf Course Studies

These were conducted on the driving ranges of two Kiawah Island golf courses in the summer of 2020, which were planted with a mixture of Seashore Paspalum and Bermuda 419 grass mowed to 1-1.5 inches height (the first cut of rough).

A 3000 sq ft test area on each course was initially treated with two applications of ESA at one-week intervals (a loading dose). This was followed by a third ESA application 4 weeks later.

Soil Testing: Haney testing was done at baseline—before ESA application, and again 2 weeks after the third application. Soil tests from the treated areas were compared with samples from an untreated area 30 feet from the test plot.

Algae Application: En-Soil Algae, live *Chlorella vulgaris*, was obtained from the laboratory-production facility of Enlightened Soil Corp, Johns Island, SC (www.enlightenedsoil.com). The algae concentrate contained 12 million cells/mL. Five ml of the concentrate was diluted to a volume to treat 1000 sq ft, providing a dose of 50,000 cells per sq ft. It was applied directly to the turf using a garden pump sprayer (providing both foliar and soil application).

Results: The golf course plots were mowed regularly, so there are no data comparing rate of growth.

Measures related to soil health were the primary outcome of this study and were similar at the two courses. The Haney Test results from The River Course are summarized in Table 1. There was there was an increase in soil organic matter (SOM), soil respiration, water extractible organic nitrogen (WEON), and water extractable organic carbon (WEOC). The Haney index of soil health based on these measures rose substantially.

Table 1. Effect of En-Soil Algae on measures of soil health (Haney Testing). Baseline testing and follow-up testing 2 weeks after the third application of algae.

Application Frequency	SOM	Soil Resp.	WEON	WEOC	Soil Health Index
Baseline Control (06/09/2020)	2.3	55.8	4.4	79	7.61
Follow-up* Control Untreated turf	1.7	52.9	13	101	8.61
Follow-up: treated turf	6.8	181	10.9	115	18.5

***Two weeks after the third (last) application of EnSoil Algae**
SOM: soil organic matter, %LOI
Soil Resp: soil respiration: CO2-C in ppm;
WEON: water extractable organic nitrogen, ppm
WEOC: water extractable organic carbon, ppm
Haney Soil Health Index: based upon soil respiration, WEON and WEOC

Pasture Study

At the time of the golf course trials, a parallel study was conducted on natural meadow, unused pasture on Johns Island, SC that had not been grazed, cultivated, or fertilized for more than 15 years. It had reverted to native grasses and wildflowers.

A 3,000 sq. ft. section of pasture was treated with ESA as described above: two applications at a 1-week interval, then a third treatment 4 weeks later. Soil testing was done pretreatment and two weeks after the third application. The meadow grass was not mowed during the study which allowed assessment of growth, comparing the treated plot with an adjacent section that receive no soil amendment.

Effect of ESA on Growth:
The grass had been mowed to a height of 5.5 cm at the onset of the study. Eight weeks later grass treated with ESA measured 11 cm (100% increase), and untreated grass measured 9 cm (64% increase). Although not measured, the treated grass appeared thicker **(Figure 1).**

Figure 1: Meadow grass. **Top:** treated with En-Soil Algae. **Bottom:** control, not treated. Photos taken 2 weeks after the third application of En-Soil Algae.

Soil testing at baseline and 6 weeks after the initial treatment showed an increase in soil health measures **(Table 2)** similar to those of the golf course study.

Table 2: Effect of En-Soil Algae on measures of soil health 8 weeks after 3 applications of En-Soil Algae (at baseline and weeks 1 and 6).

	SOM.	Soil Resp.	WEON.	WEOC.	Soil Health Index
Baseline Control	4.7	58	5.3	119	8.74
6 Weeks later	5.5	113	11.7	87	12.30

SOM: soil organic matter, %LOI
Soil Resp: soil respiration: CO2-C in ppm;
WEON: water extractable organic nitrogen, ppm
WEOC: water extractable organic carbon, ppm
Haney Soil Health Index: based upon soil respiration, WEON and WEOC

Silage Study

The effect of En-Soil Algae on the growth and yield of sorghum was conducted at the Windmill Ranch (Haigler, NE) in the fall of 2021. Alex Peterson treated 40 acres with ESA, an application soon after emergence, then 4 weeks later (two applications). This was compared with an adjacent 40 untreated acres. Both test sections had been treated with NPK before planting. His observation: "there did not appear to be an effect early on, and sorghum on the treated section wasn't much taller than untreated sorghum. But near harvest it was clear that the foliage on the treated plants was thicker."

This result was documented with a 20% increased yield by weight, about 1 ½ tons more per acre.

He did nutritional testing, taking core samples from multiple bales and blending them. The analysis was done by American Agricultural Laboratory.

Table 3: Feed Sample Report (results from oven dried samples)

	Control	Algae treated
Protein, %	5.0	7.5 (+50%)
Crude fat, %	1.0	1.3 (+30%)

The increase in protein and fat was unexpected. To confirm it, additional samples were taken and sent to Ward Laboratory, and the result was the same.

A caveat from this field trial was an increase in nitrates. Nitrate-N (mg/kg) rose from 185 to 1157. We interpret this as a result of over-fertilization since both test sections were also treated with NPK. The field trial is being repeated without application of NPK.

American Agricultural Laboratory, Inc.

700 West D Street / PO Box 370 / McCook, Nebraska 69001
Office: 308-345-3670 / FAX: 308-345-7880
www.AmAgLab.com

FEED SAMPLE REPORT

[redacted]

Account Number: [redacted]

Date Sampled: 10/15/2021
Date Received: 10/18/2021
Date Reported: 10/21/2021

Name: [redacted]
Sample ID: CANE WEST

Lab Number: 279788

Constituent Analyzed	As Received	Oven Dry
Moisture, %	11.7	0.0
Dry Matter, %	88.3	100.0
Crude Protein, %	7.5	8.5
Crude Fiber, %	27.5	31.1
Acid Detergent Fiber %	35.0	39.6
Crude Fat, %	1.5	1.7
Ash, %	9.9	11.3
Nitrogen Free Extract, %	41.9	47.4
Total Digestible Nutrients (TDN), %	51.4	58.2
Calculated Net Energy Lactation, Mcal/lb	0.52	0.59
Calculated Net Energy Maintenance, Mcal/lb	0.50	0.57
Calculated Net Energy Gain, Mcal/lb	0.27	0.31
Nitrate-N, mg/kg		1157
Calcium, %	0.32	0.36
Phosphorus, %	0.15	0.17
Potassium, %	2.28	2.58
Magnesium, %	0.30	0.34
Sulfur, %	0.17	0.19
Sodium, %	0.03	0.03
Iron, mg/kg	216.25	244.90
Manganese, mg/kg	120.35	136.30
Zinc, mg/kg	42.65	48.30
Copper, mg/kg	8.83	10.00

Treated with En-Soil Algae

2021 Certified Chemistry by NFTA

APPROVED BY: Karleigh Kleinknecht

American Agricultural Laboratory, Inc.

700 West D Street / PO Box 370 / McCook, Nebraska 69001
Office: 308-345-3670 / FAX: 308-345-7880
www.AmAgLab.com

FEED SAMPLE REPORT

[redacted]

Account Number: [redacted]

Date Sampled: 10/15/2021
Date Received: 10/18/2021
Date Reported: 10/21/2021

Name: [redacted]
Sample ID: CANE EAST

Lab Number: 279789

Constituent Analyzed	As Received	Oven Dry
Moisture, %	18.9	0.0
Dry Matter, %	81.1	100.0
Crude Protein, %	4.1	5.0
Crude Fiber, %	22.9	28.2
Acid Detergent Fiber %	32.2	39.7
Crude Fat, %	1.0	1.3
Ash, %	9.6	11.9
Nitrogen Free Extract, %	43.5	53.6
Total Digestible Nutrients (TDN), %	47.1	58.1
Calculated Net Energy Lactation, Mcal/lb	0.48	0.59
Calculated Net Energy Maintenance, Mcal/lb	0.46	0.57
Calculated Net Energy Gain, Mcal/lb	0.25	0.31
Nitrate-N, mg/kg		185
Calcium, %	0.36	0.45
Phosphorus, %	0.11	0.14
Potassium, %	1.91	2.35
Magnesium, %	0.19	0.24
Sulfur, %	0.10	0.12
Sodium, %	0.02	0.03
Iron, mg/kg	264.79	326.50
Manganese, mg/kg	83.61	103.10
Zinc, mg/kg	29.36	36.20
Copper, mg/kg	11.92	14.70

Not Treated with En-Soil Algae

2021 Certified Chemistry by NFTA

APPROVED BY: Karleigh Kleinknecht

American Agricultural Laboratory, Inc.

700 West D Street / PO Box 370 / McCook, Nebraska 69001
Office: 308-345-3670 / FAX: 308-345-7880
www.AmAgLab.com

FEED SAMPLE REPORT

[redacted]

Account Number: [redacted]

Date Sampled: 10/15/2021
Date Received: 10/18/2021
Date Reported: 10/21/2021

Name: [redacted]
Sample ID: CANE SILAGE

Lab Number: 279790

Constituent Analyzed	As Received	Oven Dry
Moisture, %	74.9	0.0
Dry Matter, %	25.1	100.0
Crude Protein, %	1.4	5.5
Acid Detergent Fiber %	11.4	45.4
Total Digestible Nutrients (TDN), %	15.6	62.1
Calculated Net Energy Lactation, Mcal/lb	0.16	0.64
Calculated Net Energy Maintenance, Mcal/lb	0.16	0.63
Calculated Net Energy Gain, Mcal/lb	0.09	0.36
Nitrate-N, mg/kg		54

2021 Certified Chemistry by NFTA

APPROVED BY: Karleigh Kleinknecht