SOILYTICS®

Setting the Standard in Soil Health

You Cannot Manage What You Can't Measure

Vox 2024

PERSISTENCE DATA MINING

Site information:	
a. Name of owner and/or operator	Farmer A
b. Farm location and mailing address	USA
c. Name of TSP developing plan	TSP
d. Date of plan development	04/10/2025
e. Farm number	######
f. Field and/or tract number	#####
g. Property lines and field boundaries	########
h. Acres of fields and total acres of the operation by land use	40

Persistence Data Mining, Inc.
www.persistencedatamining.com
penny@persistencedatamining.com
858-342-3753
858-454-1062 Ext 2
3103 N. 1850 E Rd.
Mount Auburn, IL 62547

PERSISTENCE
DATA MINING

Report Date:
Report Number:
Operator:
Farm:
Field:
Acres:

Sample #	pH	P1	K	OM	Ca	Mg	CEC	S	Na	Zn	Fe	Mn	Cu	B
1	6.2	87.7	148	2.8	829	110	3.3	26.7	19.1	4.3	144	30.8	1	1.1
2	6.2	90.4	115	2.7	918	115	2.9	26.5	21.8	4.6	133	26.2	1.1	1.2
3	6	121	141	2.5	922	114	2.9	23.4	19.5	3.9	142	24.7	1.3	1.2
4	6.5	123	129	2.7	947	126	3.2	26.6	23.3	4.6	121	28.4	1	1.2
5	6	97.9	147	2.7	825	111	3.1	22.7	19.5	4.2	135	25.3	1.1	1
6	5.5	95.3	116	2.4	943	108	2.6	23.8	15.5	3.9	127	25.2	1	1.1
7	6.8	135	154	2.8	990	112	3.6	28.6	23.5	4.4	157	28.8	1.2	1.2
8	5.8	144	143	2.5	844	118	2.7	24.9	19.1	4.3	146	28.8	1.2	1.1
9	6.7	116	130	3.1	778	129	3.4	28.1	22.2	4.3	151	28.5	1.1	1.3
10	6.6	121	122	2.9	922	111	3.5	27.6	19	4.4	137	30	1.1	1.1
11	5.4	115	90.1	2.4	807	94.2	2.6	20.5	23.2	3.9	106	23.3	1.2	1
12	6.1	104	108	2.6	858	111	3.1	25.3	18.9	4.3	143	28.2	1.2	1.1
13	6.1	131	122	2.7	830	103	3.2	25.3	23	4.3	138	29.3	1.1	1
14	6.2	156	105	2.8	757	121	3.2	23	23.2	3.8	154	30.5	1.2	1.3
15	6	118	97.3	2.7	721	102	3.3	24.1	20.3	4.3	159	30.8	1.1	1
16	6.4	93.1	143	2.7	930	115	3.4	25.3	22.1	4.8	129	28.9	1.2	1.1
17	6.1	120	104	2.7	857	100	3.2	23.9	21.7	3.8	113	28.9	1	0.9
18	6.6	145	94.5	3	829	111	3.3	24.3	21.1	4	116	31	1.1	1.2
19	6.9	145	138	2.9	930	119	3.5	24	19.7	4.8	142	28.3	1.3	1.1
20	6.1	133	142	2.8	878	114	2.9	26.3	21.7	4.6	137	29.8	1.3	1.2
21	5.8	119	119	2.5	914	115	2.7	22.9	22.9	4.6	139	26.9	1.3	1.1
22	6.3	130	129	2.7	903	124	3.1	25	23.3	4.6	114	29.8	1.2	1.1
23	6.4	137	139	2.7	913	124	3.2	27.8	21.2	4.9	145	33.1	1	1.1
24	6.8	122	101	2.9	968	115	3.4	25.7	21.2	4.8	132	27.2	1.4	1.1
25	6.6	127	97.7	2.8	904	119	3.3	25.7	22.5	4.9	125	29.1	1.3	1
26	6.6	133	82.5	3.1	700	105	3.2	24.1	18.1	4.7	82.4	27.7	1.1	1.1
27	6	118	112	2.6	906	108	2.8	24.9	20.6	4.1	136	28.1	1.1	1.1
28	5.7	132	122	2.4	819	113	2.8	25.1	23.5	4.4	174	28.3	1.2	1
29	6.4	130	141	2.6	901	114	3.2	23.7	21.2	4	148	26.9	1.2	1
30	5.8	109	145	2.4	815	107	2.7	20.2	19.7	4	114	25	1.2	1
31	5.7	125	97.5	2.3	878	104	2.7	22	18	4	117	26.6	0.9	1
32	6	147	103	2.5	822	107	2.7	19.6	21.3	3.8	114	26.4	1.2	1.1

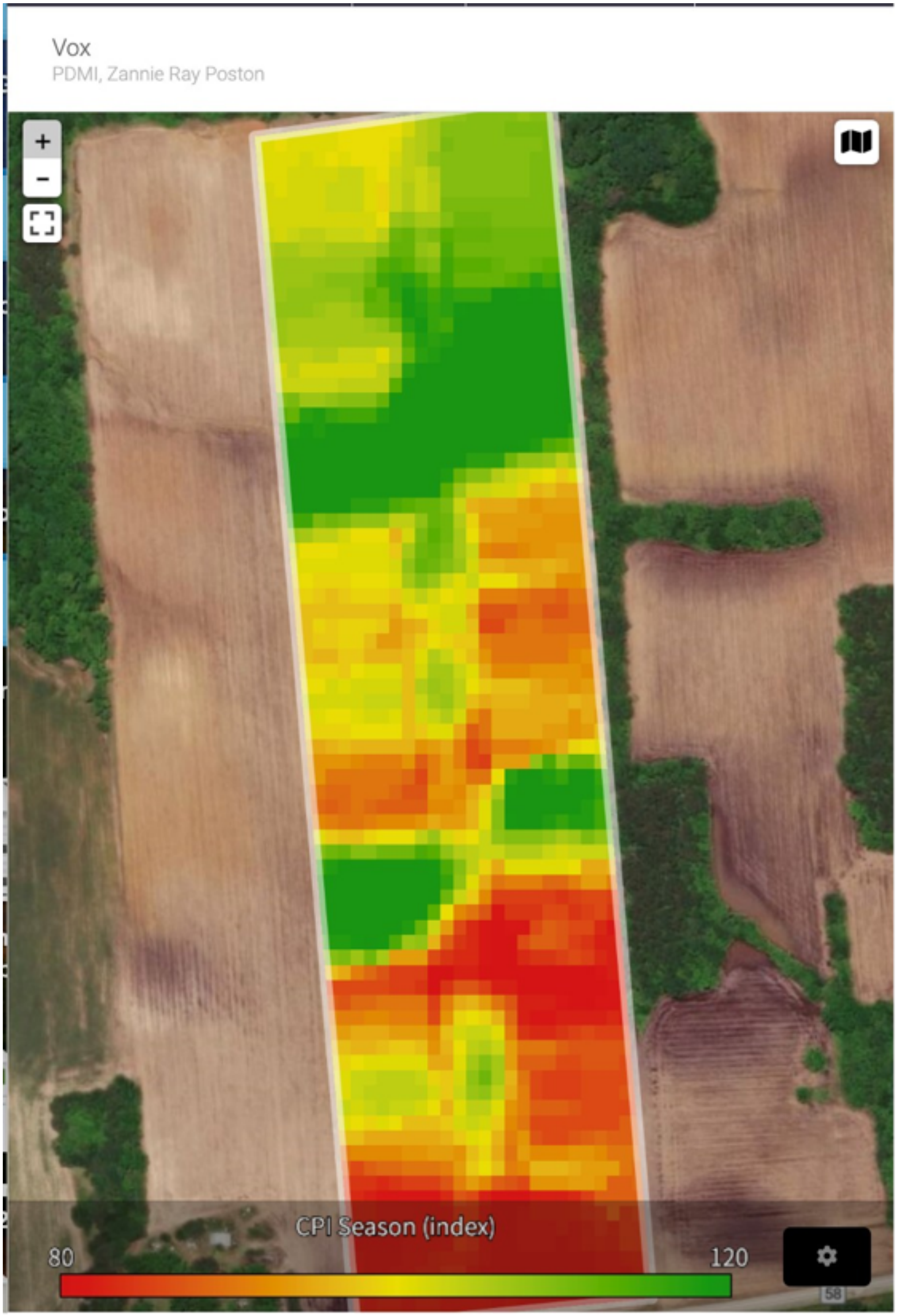
33	6.6	176	114	3	900	118	3.3	24.1	25.6	3.7	136	31.8	1.3	1.3
34	5.9	142	107	2.7	764	104	2.8	25.6	23.6	4	126	31.6	1.2	1.2
35	5.9	119	114	2.6	955	107	2.7	23.5	25.4	4	134	28.2	1.1	1.2
36	6.4	139	116	2.7	825	109	3.3	21.8	22	3.6	119	27.6	1	1.2
37	6.4	142	105	2.8	856	106	3.4	23.4	22.6	4	164	29.5	1.2	1
38	6.2	123	96.4	2.7	764	110	3	21.9	18.8	3.9	126	24.7	1.2	1.2
39	6.7	147	96.5	2.8	828	108	3.4	22.6	21.8	3.4	136	30.4	1.1	1.2
40	6.4	145	106	2.9	825	115	3	20.8	20.9	3.8	131	27.2	1.3	1.2

Samples Grids

Traditional Labs at 1 sample to every 4 acres

Spectral results on a 1-acre grid

Satellite Data from Lasts year's crop growth cycle Not to be compared to other fields but a single field comparison of growth



Your results and what they mean

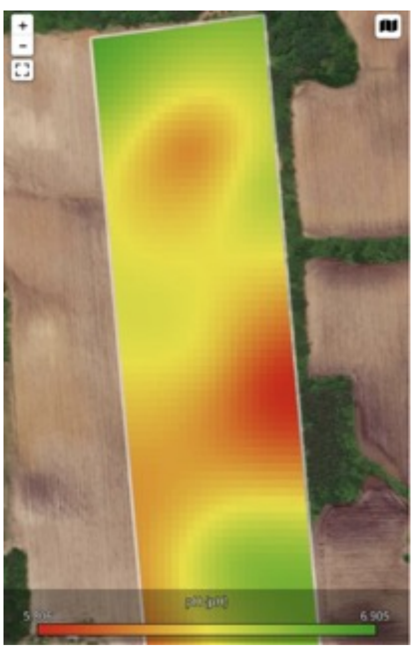
The nutrients in soil have interdependence, understanding this interdependency is essential to understanding how each input will be absorbed by your crop.

I. Primary Factors:

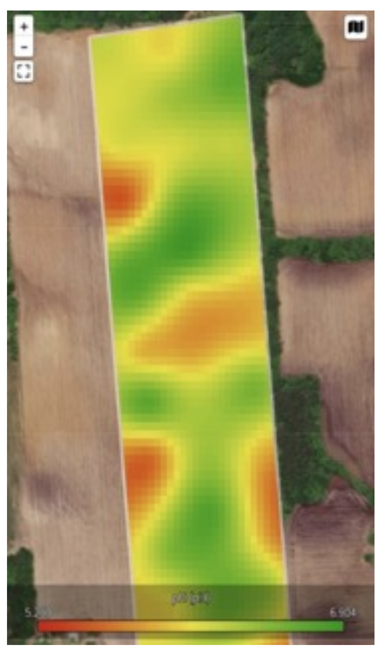
1. **Soil pH** plays a crucial role in crop growth by influencing several key factors:

Nutrient Availability: The pH level affects the solubility of essential nutrients in the soil. For instance, nutrients like nitrogen, phosphorus, and potassium are most available to plants within specific pH ranges. If the soil is too acidic or too alkaline, these nutrients can become less accessible, leading to deficiencies.
Microbial Activity: Soil pH impacts the activity of beneficial soil microorganisms, such as bacteria and fungi, which are vital for processes like nitrogen fixation and organic matter decomposition. Optimal pH levels support a diverse and active microbial community, enhancing soil health and fertility.
Soil Structure: Proper pH balance contributes to good soil structure, which is essential for root development and water retention. Extreme pH levels can lead to poor soil structure, affecting root growth and plant stability **Crop-Specific Preferences**: Different crops thrive in different pH ranges. For example, blueberries prefer highly acidic soils (pH 4.0-5.5), while most vegetables grow best in slightly acidic to neutral soils (pH 6.0-7.0).
Understanding and managing soil pH according to crop requirements can optimize growth and yield.
Maintaining the appropriate soil pH through regular testing and amendments, such as lime to raise pH or sulfur to lower it, is essential for healthy crop production.

Traditional Labs at 1 sample to every 4 acres

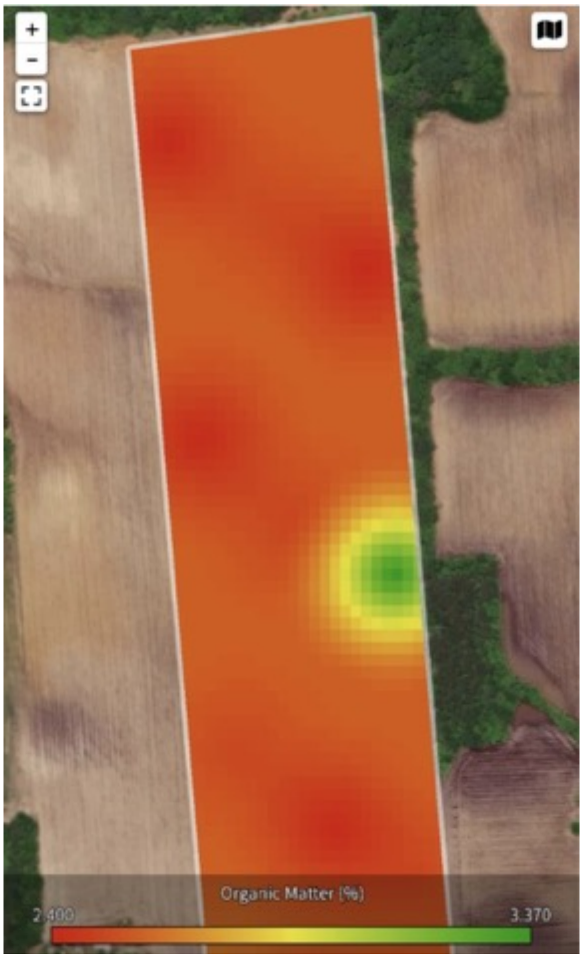


Spectral results on a 1-acre grid

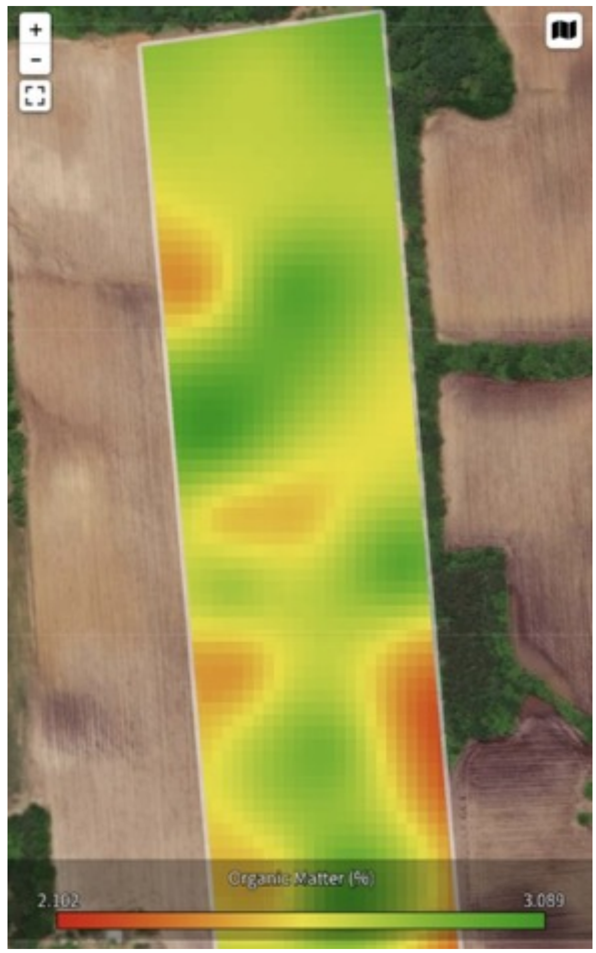


2. **Soil Organic Matter (SOM)** is one of the most vital constituents of the soil, forming the backbone of soil health and fertility, it is a complex mixture of plant and animal materials in varying stages of decomposition, plus, microbes, and the substances that convert nutrients to usable building blocks for plant growth. SOM plays a critical role in numerous soil functions, contributing to soil structure, nutrient cycling, and water holding capacity. The importance of SOM in agriculture cannot be overemphasized, it improves soil structure and enhances both nutrient and water retention capacity. SOM plays a crucial role in supporting a diverse microbial bed in the soil. Biodiversity is an integral part of the soil ecosystem, contributing to soil fertility, suppressing soil-borne diseases, helping the nutrient cycle, decomposing organic matter and residues, and enhancing crop nutrient availability

Traditional Labs at 1 sample to every 4 acres

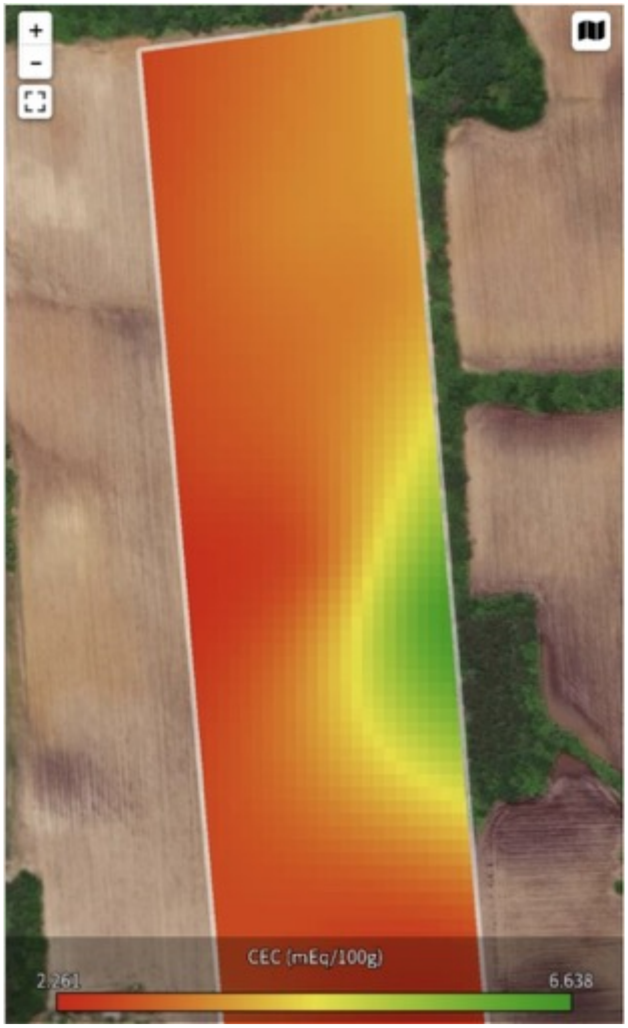


Spectral results on a 1-acre grid

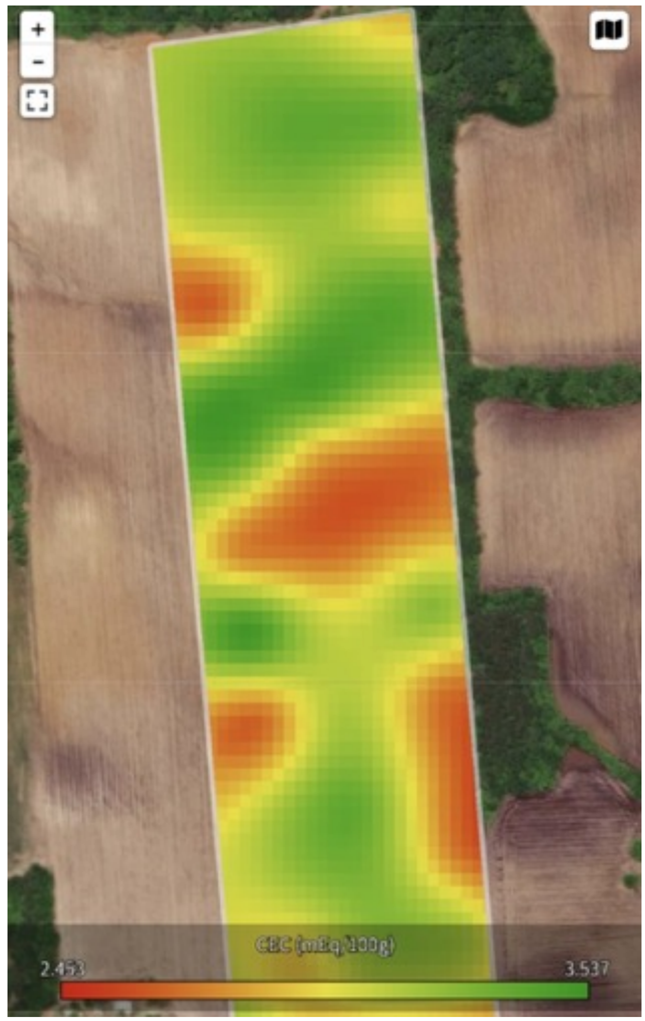


3. **CEC (Cation Exchange Capacity):** CEC measures the soils ability to retain and release cations. Cations are essential nutrients for plants, and their availability in the soil directly affects plant growth and development. The CEC value provides insight into how well a particular soil can hold onto and supply these nutrients to plants.

Traditional Labs at 1 sample to every 4 acres



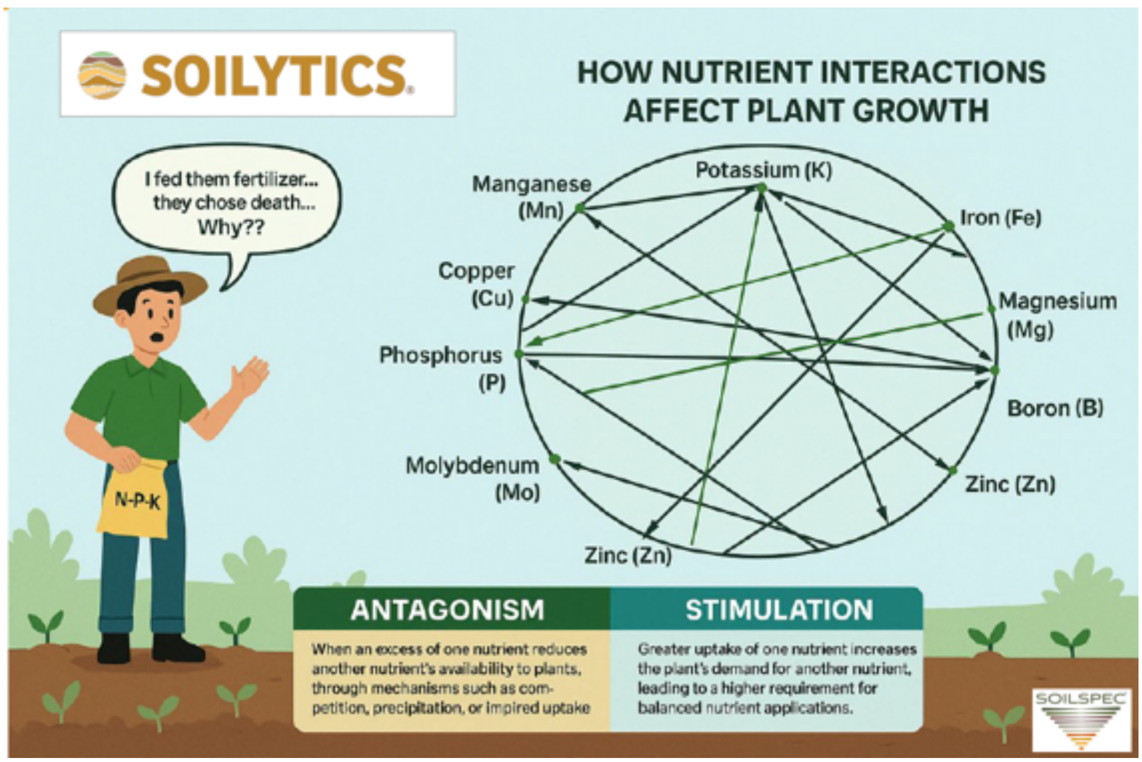
Spectral results on a 1-acre grid



I. **Macronutrients**

1. **Nitrogen (N)** is the backbone of various plant functions. It is present in all plant cells, proteins, hormones, and chlorophyll. Nitrogen is the growth factor that encourages lush, green development. It is a primary protein component found in all living cells. Therefore, compared to other nutrients, nitrogen is typically more responsible for enhancing plant development. Nitrogen is transformed within the plant into amino acids to make proteins. Since all enzymes are proteins, nitrogen is required for plant enzymatic processes. Additionally, it is a part of the chlorophyll molecule and directly contributes to photosynthesis. It supports the plant's ability to make and use carbohydrates. The first figure displayed on a fertilizer bag or box is the nitrogen percentage concentration.

   Low nitrogen levels can cause slower, stunted growth, the falling of older leaves, and light green or yellowish foliage in certain plants. Nitrogen fertilizers are an easy way to make up for a shortfall. However, overfertilization can harm the soil, so be cautious.

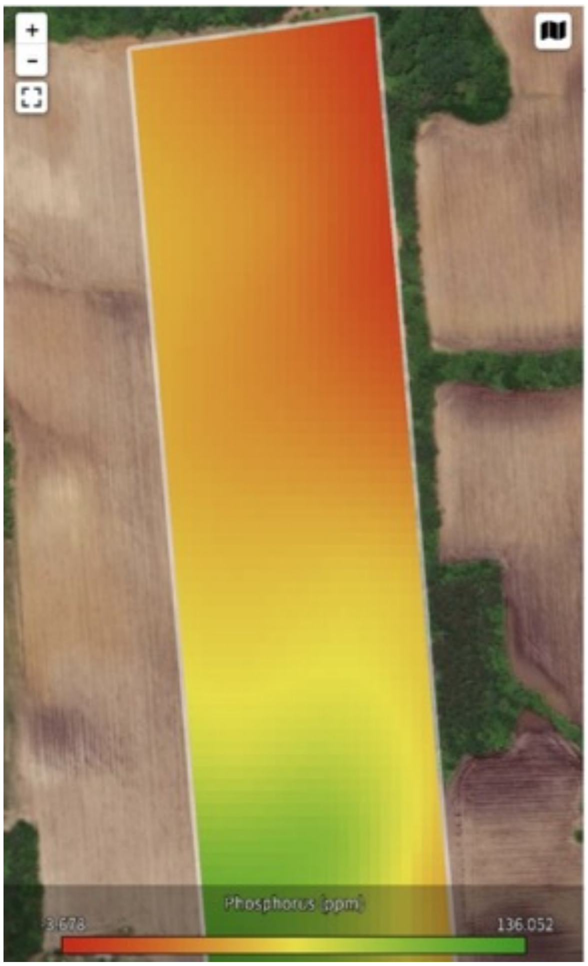


2. Phosphorous (P)

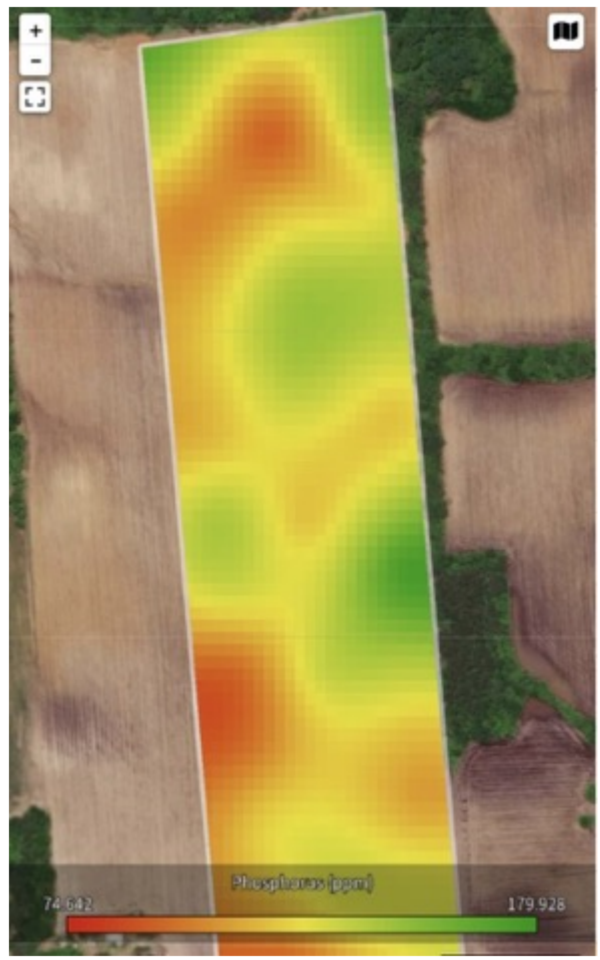
Phosphorus helps plants absorb sun energy, accelerates maturity, and encourages early root and plant growth. A lack of sufficient phosphorus prevents the transportation of carbohydrates produced in the leaves to the flower or growing fruit and their storage in the roots or bulbs. Typically, it is linked to fruiting, flowers, and the storage of carbohydrates in roots, tubers, and bulbs.

Phosphorus is not as mobile in soil as nitrogen. Because of this, it is a nutrient that is simple to examine in a lab. Don't add extra if it's already accumulated in the soil; add some if it's low. Diagnosing phosphorus deficiency in most plants is challenging because it results in reduced growth that can mimic other health issues. The leaves, fruit, and stems may show dead spots when a severe nutrient deficiency occurs. Gardeners can use phosphate-based fertilizers to cover up such symptoms.

Traditional Labs at 1 sample to every 4 acres



Spectral results on a 1-acre grid

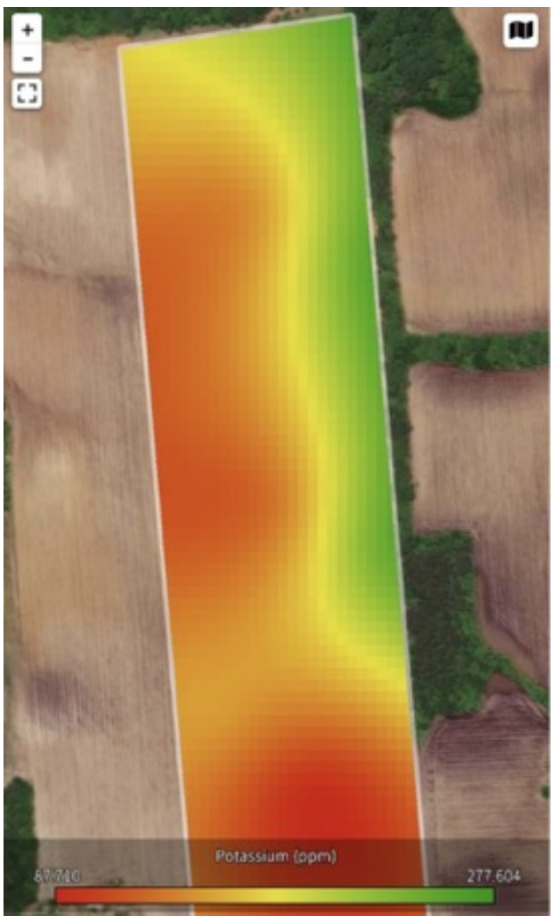


3. Potassium (K)

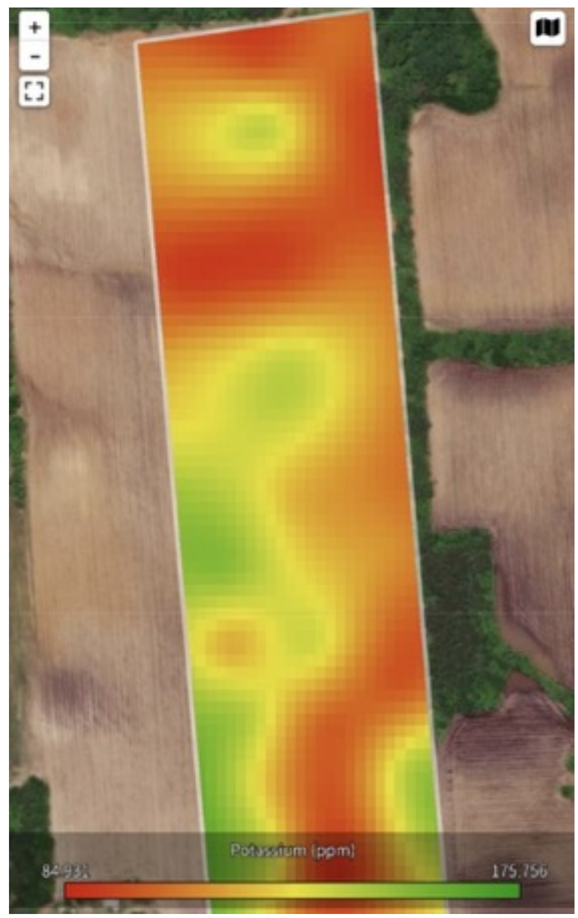
Potassium is required for photosynthesis and regulates cell turgidity, respiration, and plant water flow. It also regulates stomatal opening and closure. Potassium is absorbed as a cation and stored by the soil's cation exchange capacity. Higher clay or organic matter soils are better able to exchange cations and hold onto more potassium.

Among the most typical symptoms of a potassium deficit is yellowing of the elder leaves' margins. Plants lacking in potassium grow slowly, have weak stalks, and have underdeveloped root systems. Sufficient potassium-based fertilization promotes winter hardiness, disease resistance, crop quality, and the ability of plants to withstand drought stress. Potassium fertilizer is soluble in water and will be absorbed by the plant in proportion to the amount in the soil.

Traditional Labs at 1 sample to every 4 acres



Spectral results on a 1-acre grid



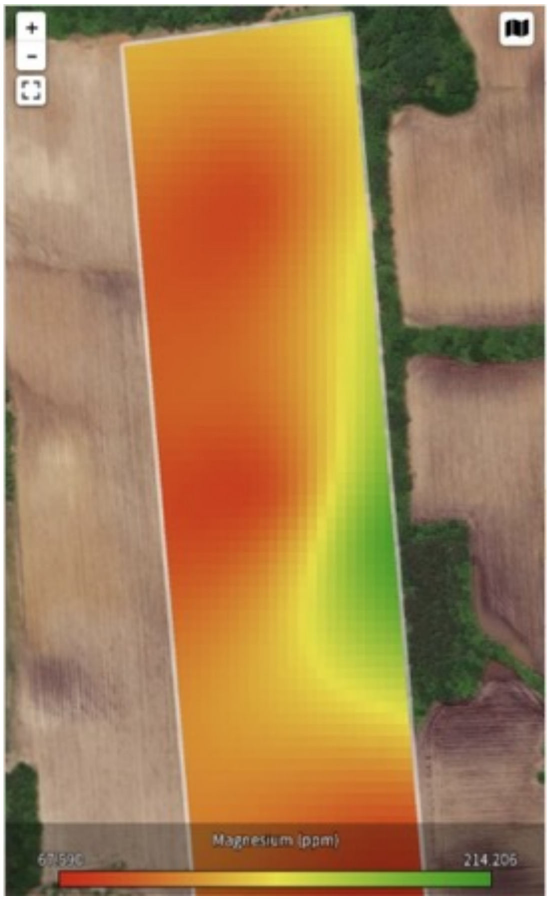
III. Secondary Macronutrients

Like primary macronutrients, secondary macronutrients are necessary for plants to grow and develop to their full potential. Below are the three secondary macronutrients that plants require to thrive.

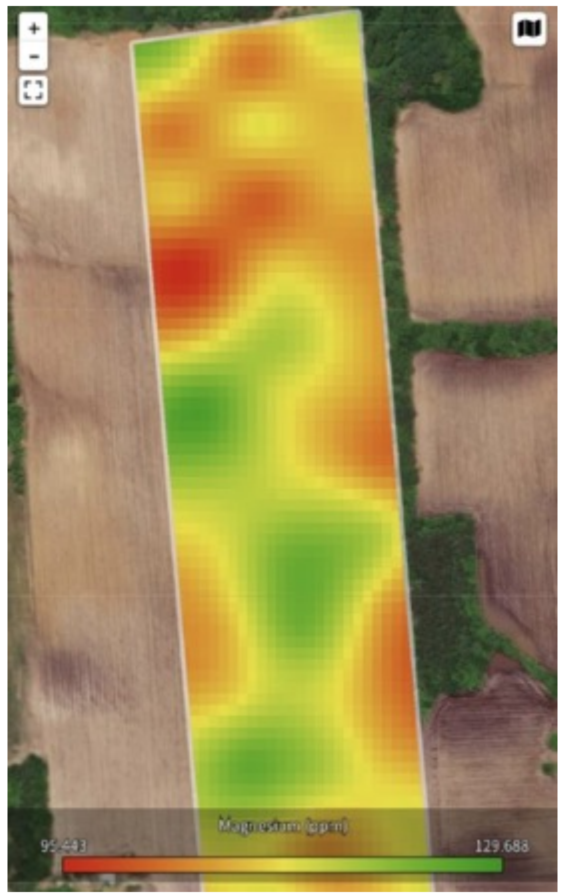
1. **Magnesium (Mg)**

   Magnesium actively participates in photosynthesis since it is a component of the chlorophyll molecule. It also acts as an activator for various plant enzymes necessary for growth, sugar metabolism, and mobility.
   Magnesium deficiency generally affects older leaves which can turn yellow, copper, or reddish, while leaf veins stay green. Soil tests are one way to assess magnesium demands. Magnesium sulfate is the best source of magnesium for plants to ward off such deficiencies.

Traditional Labs at 1 sample to every 4 acres



Spectral results on a 1-acre grid

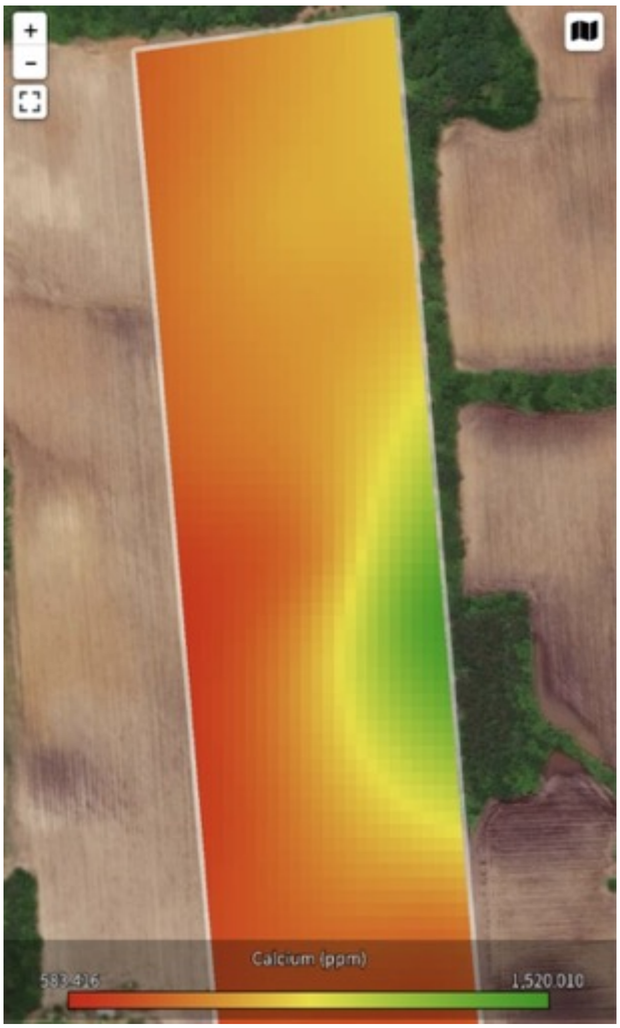


2. Calcium (Ca)

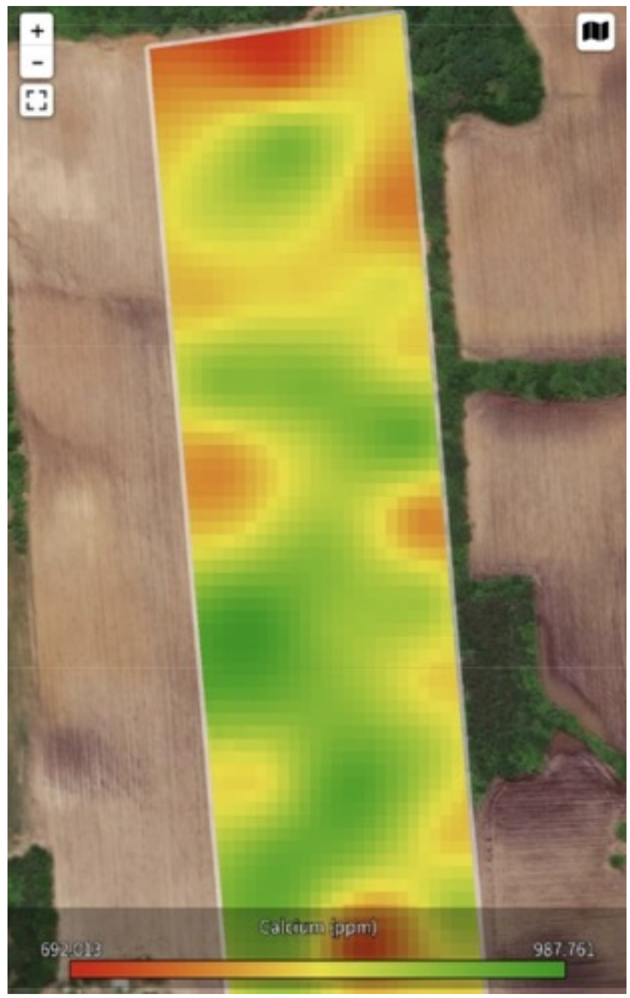
Calcium promotes the growth of roots and leaves. It fortifies plant structure and creates substances that are a component of cell walls. It lowers plant nitrates by activating multiple enzyme systems that counteract the plant's organic acids. Moreover, calcium facilitates the intake of other nutrients, root development, and molybdenum availability. It indirectly increases plant yields by lessening the toxicity of manganese and aluminum in the soil. Poor root growth is one of the most prevalent symptoms of a calcium deficit.

Occasionally, the developing point dies. A shortage of calcium frequently causes roots to decay and turn black. Calcium generates unique symptoms in young leaves and the growing points of shoots because it is not translocated inside the plant like nitrogen, phosphorus, and potassium. Organic calcium fertilizers are the best source to cover up these symptoms.

Traditional Labs at 1 sample to every 4 acres



Spectral results on a 1-acre grid

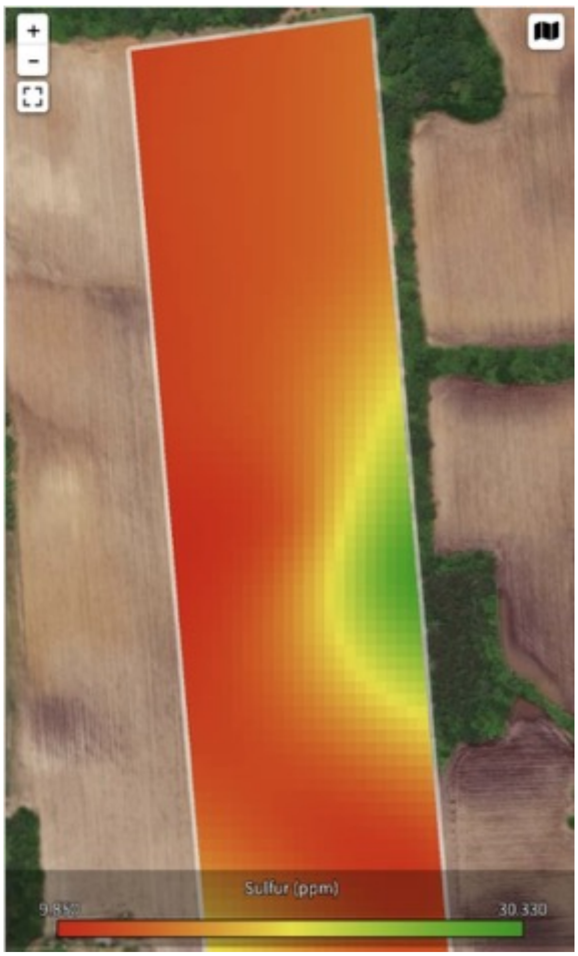


3.

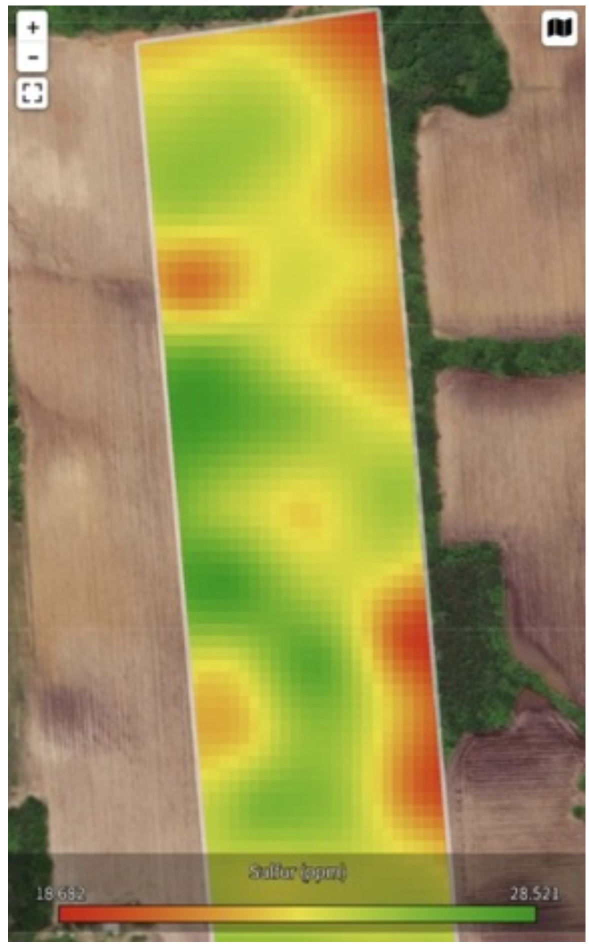
Sulfur (S)

Soil sulfur plays an essential role in protein synthesis. It is found in three amino acids (cystine, methionine, and cysteine), all required for protein synthesis. Furthermore, sulfur is included in the oil molecules that give plants scents like garlic and onion. Additionally, sulfur is necessary for nodule production in legumes. Plants take sulfur from the air through leaves, specifically in industrial areas where sulfur is readily available. Because sulfur is prone to leaching, sandy soils with little organic matter may have sulfur shortages.

Traditional Labs at 1 sample to every 4 acres



Spectral results on a 1-acre grid



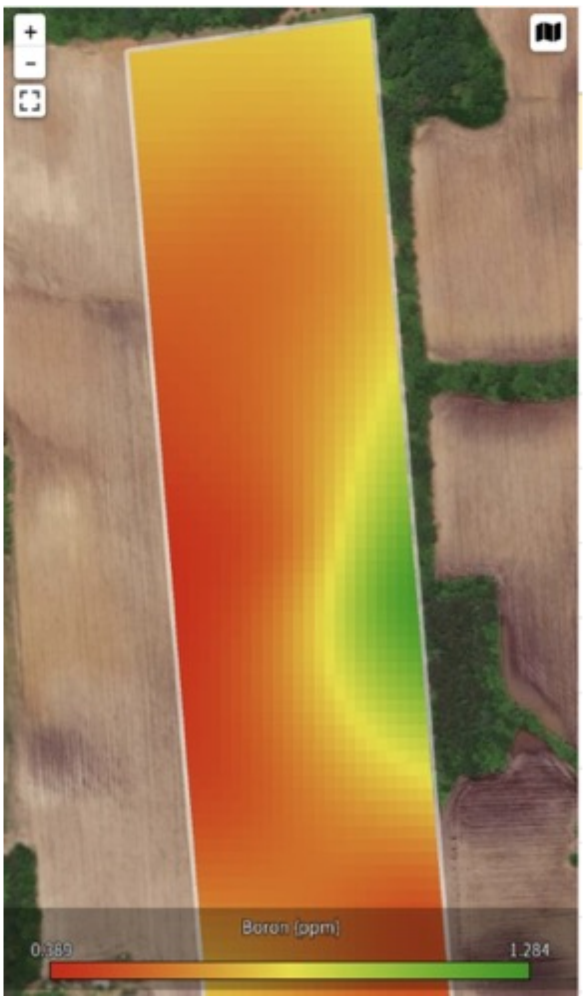
IV. Micronutrients

Micronutrients are equally as essential as primary and secondary macronutrients, yet they are required in smaller quantities. The majority of micronutrients are necessary for specific enzymatic processes in plants. The following soil micronutrients are essential for thriving plants.

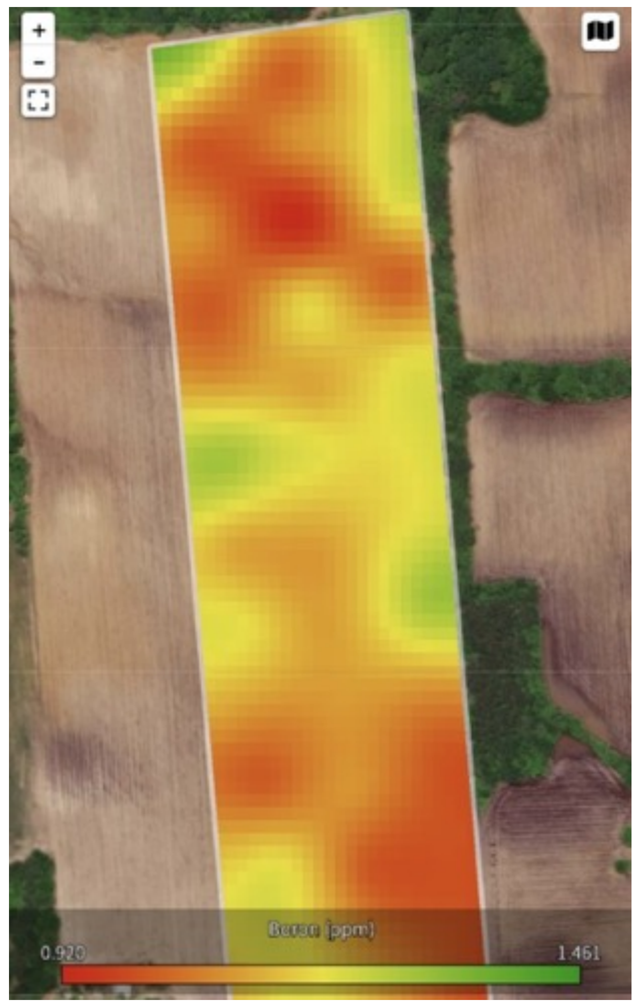
4. Boron (B)

Boron controls the metabolism of carbohydrates in plants. Different plants require different amounts of boron. Cauliflower, broccoli, turnip, Brussels sprouts, apples, celery, and alfalfa are plants that require a lot of boron. Too much boron can be harmful. Therefore, boron should be handled according to the recommendations of specific crop soil tests. too much boron can be harmful when placed with the seed.

Traditional Labs at 1 sample to every 4 acres



Spectral results on a 1-acre grid

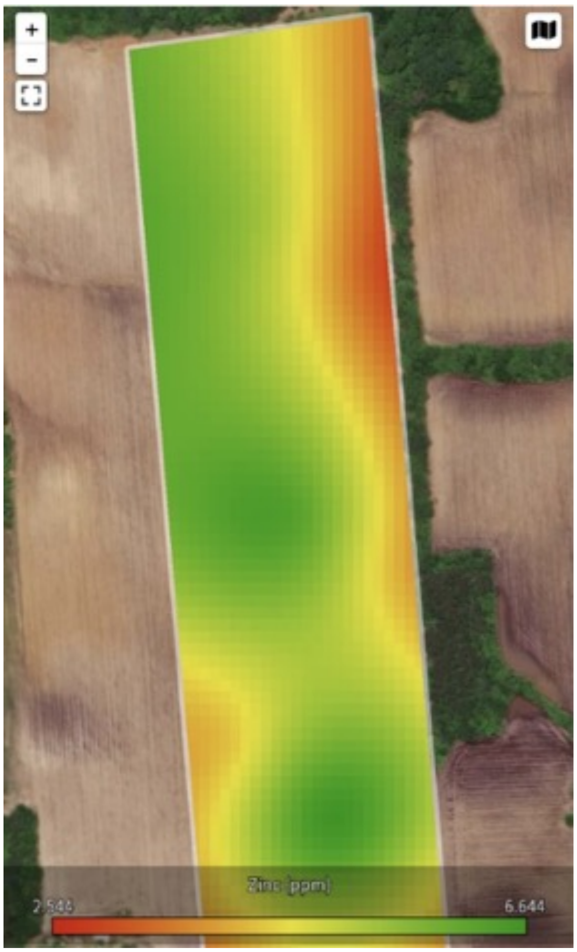


5.

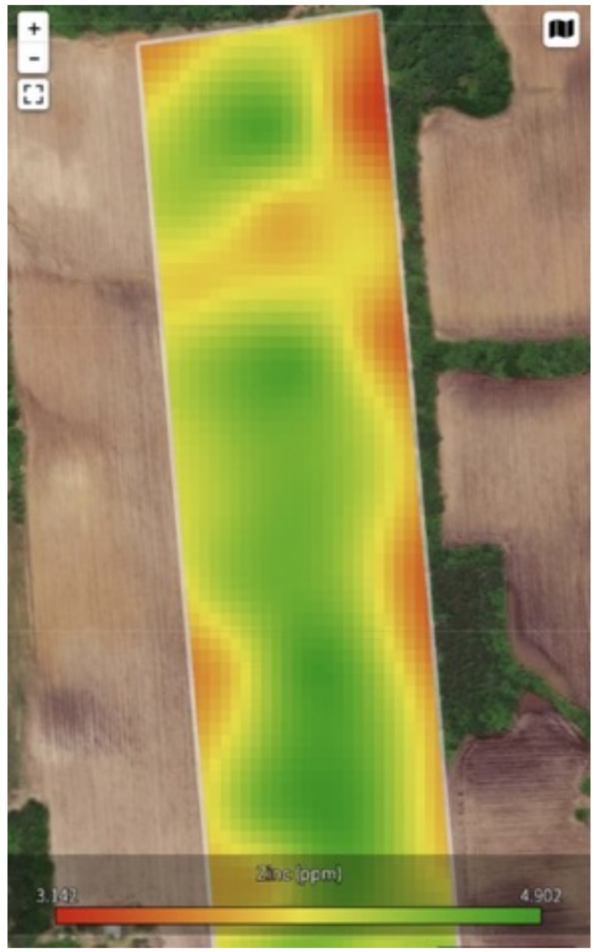
Zinc (Zn)

Several plant enzymes require zinc as a necessary component. It is involved in synthesizing protein and chlorophyll and regulates the synthesis of indoleacetic acid, a crucial regulator of plant growth. Zinc has a relationship with phosphorus. Zinc deficiency is more likely to occur in sandy soils with low quantities of organic matter. Zinc becomes less accessible and soluble in high-pH soils, such as high-lime soils. Zinc and phosphorous act differently in soil. Consequently, soils with a high phosphorus content also make zinc available. Zinc shortage can result from damp and cold soil conditions since these factors slow down the growth of roots and the release of zinc from organic matter.

Traditional Labs at 1 sample to every 4 acres



Spectral results on a 1-acre grid

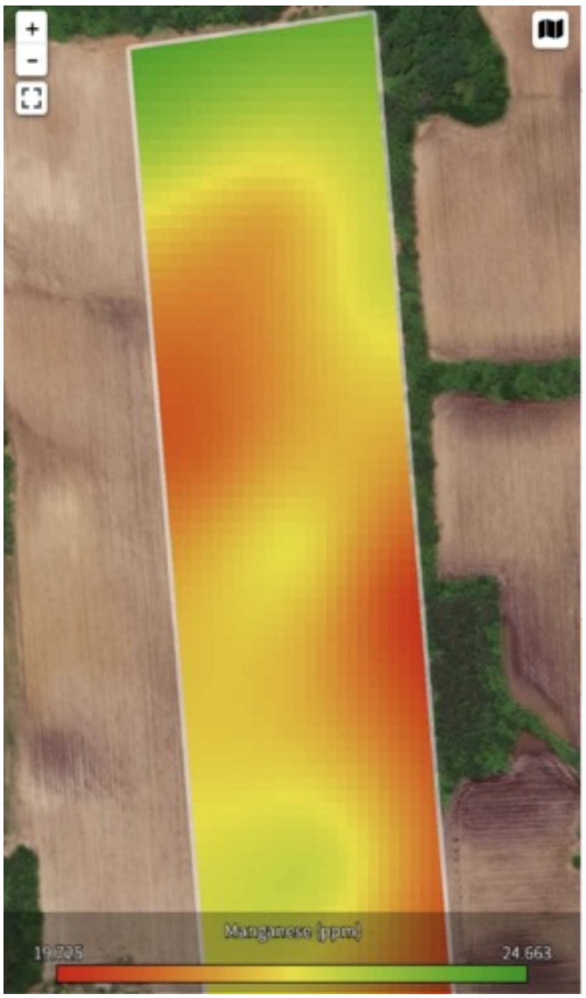


6.

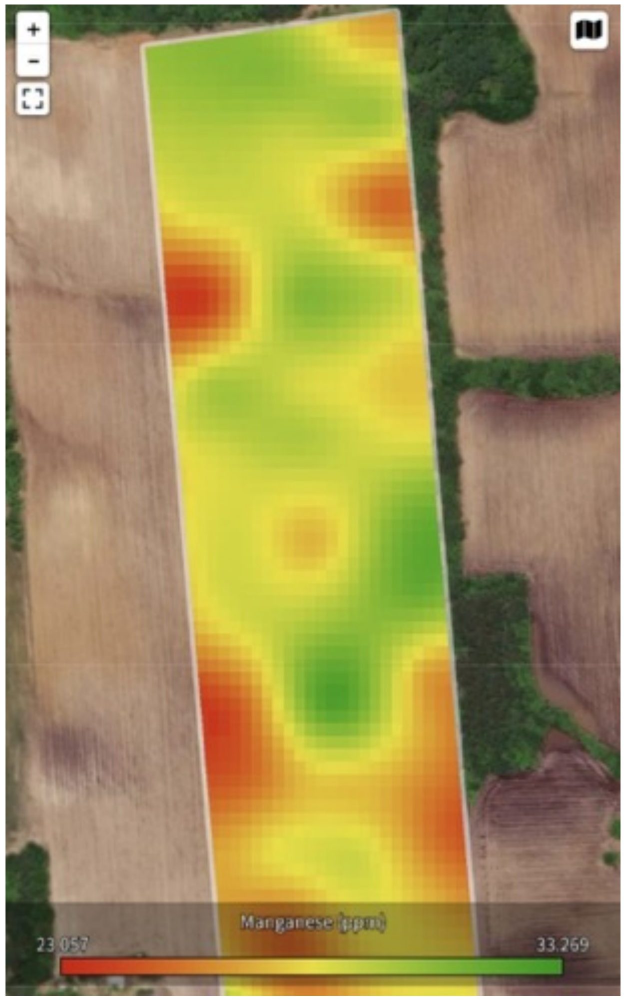
Manganese (Mn)

Manganese acts as an enzyme activator in plant growth processes and helps iron formation. Manganous ions (Mn^{+2}) are the form of this nutrient that plants take up from the soil. Although uncommon, sandy soils with a pH of 8 may have manganese deficiency. The pH of the soil is a valuable predictor of manganese availability, which in severely acidic soils (pH <4.5) can rise to lethal levels. Onions, beans, potatoes, spinach, tomatoes, peas, raspberries, strawberries, apples, and grapes are the crops that react to manganese the best.

Traditional Labs at 1 sample to every 4 acres



Spectral results on a 1-acre grid

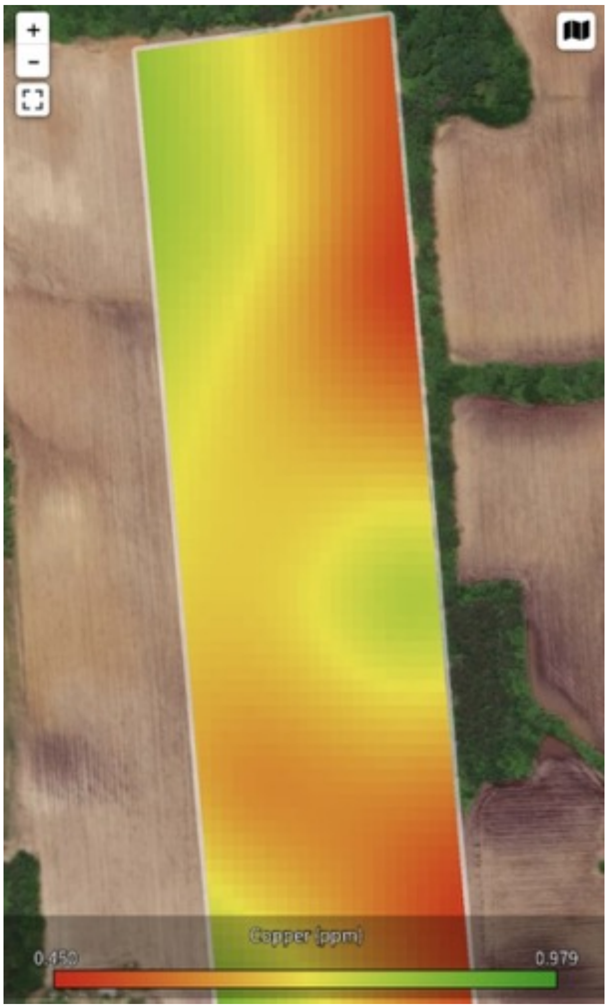


7.

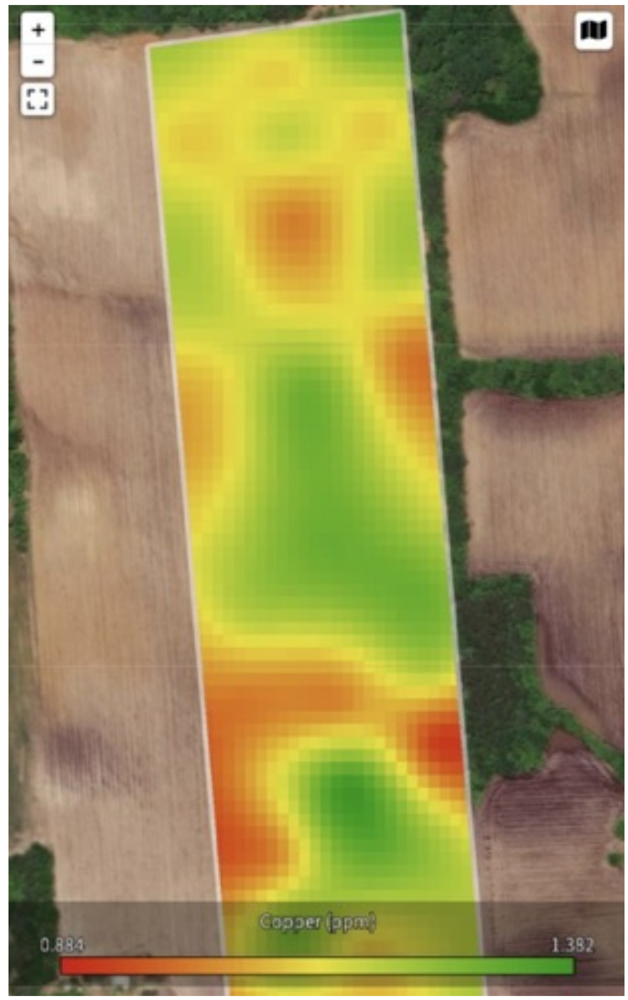
Copper (Cu)

Copper stimulates several plant enzymes. It might be involved in the synthesis of vitamin A. Deficiency disrupts Protein synthesis. Soil rarely lacks copper. The crops that react most to copper are spinach, carrots, lettuce, and onions.

Traditional Labs at 1 sample to every 4 acres



Spectral results on a 1-acre grid

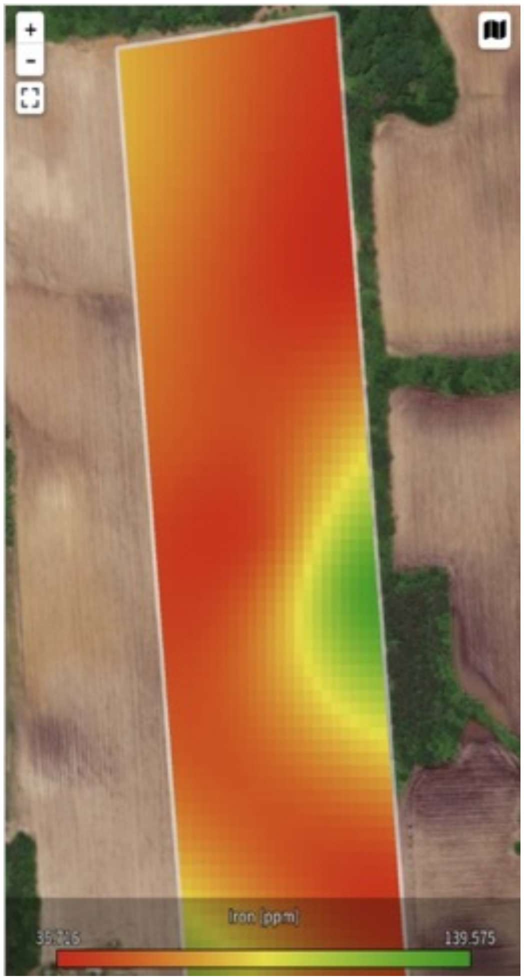


8.

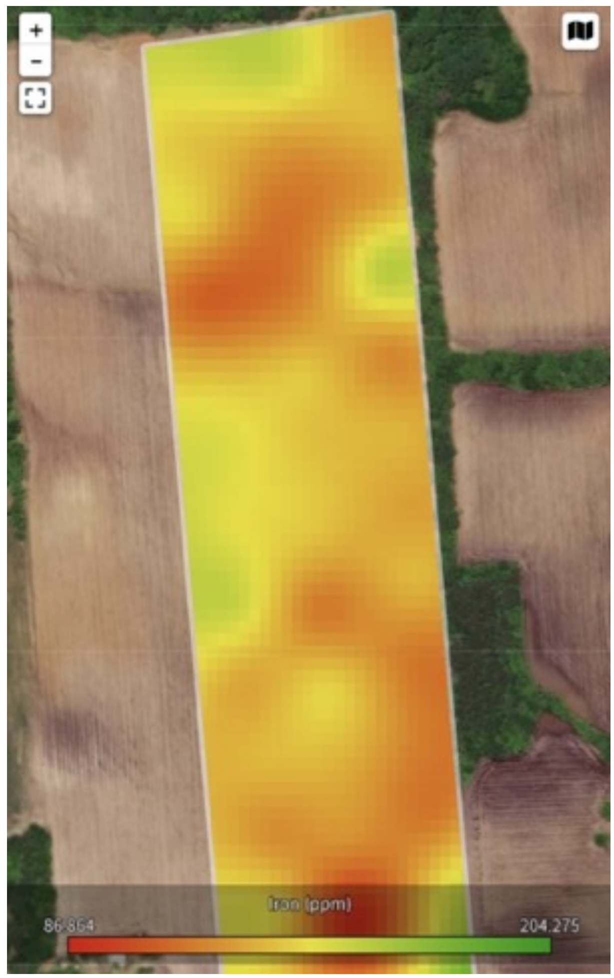
Iron (Fe)

Iron is necessary for chlorophyll formation in plants. Plants absorb iron as the ferrous ion (Fe+2). It acts as an activator for symbiotic nitrogen fixation, respiration, and photosynthesis, among other metabolic processes. Although a lack of iron in the soil is generally not an issue, turf, ornamentals, and some trees are particularly vulnerable to iron deficiency. Iron deficiency symptoms might appear in soils with a pH above 7.0. Visual symptoms and soil and tissue tests can be used to identify specific iron requirements.

Traditional Labs at 1 sample to every 4 acres



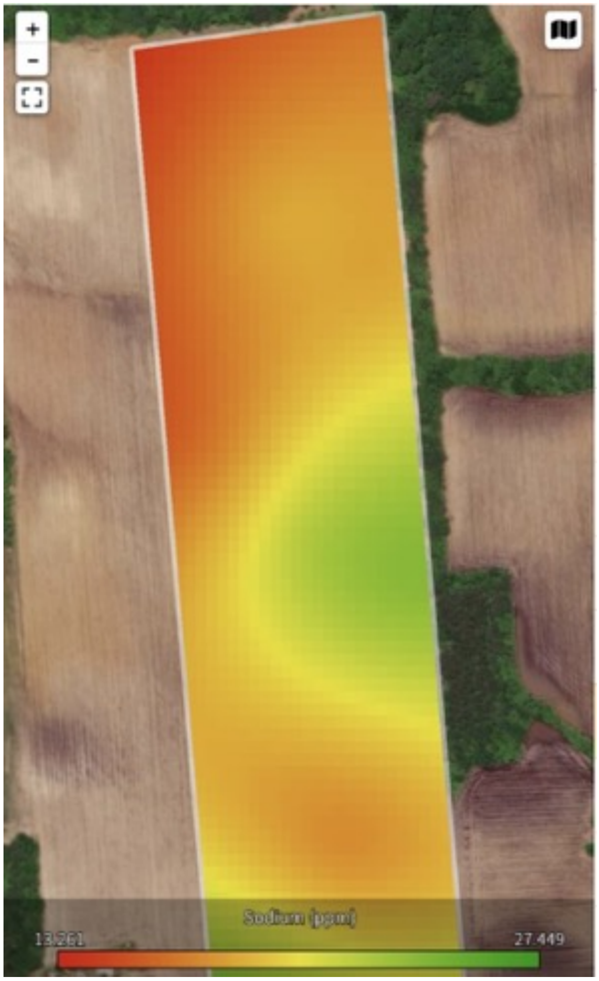
Spectral results on a 1-acre grid



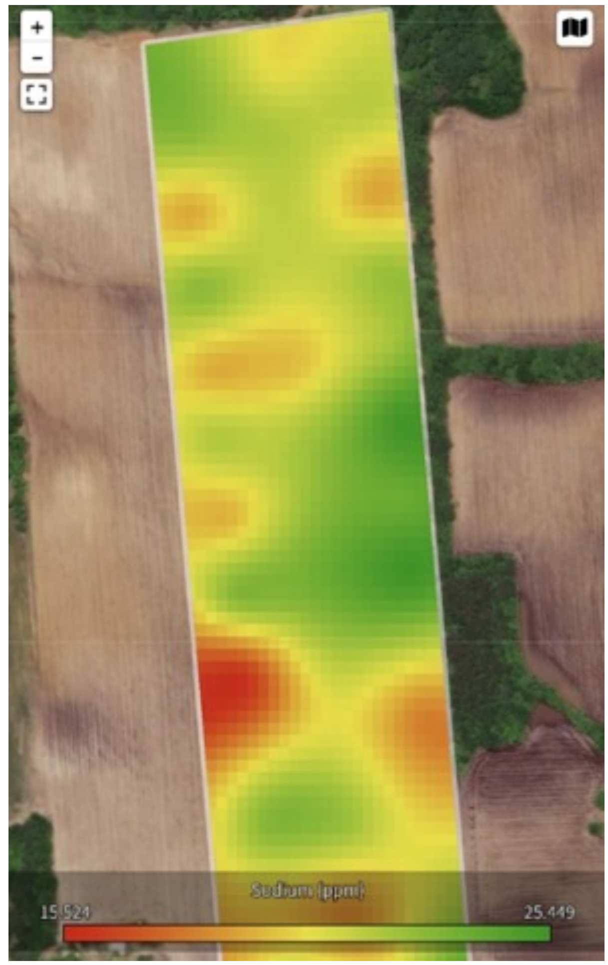
Sodium (Na):

Salinity is a global challenge to agricultural production. It does not help plant growth in anyway but understanding if there is a problem is important to consider and mitigate. Planting in high salinity soils affects crop choice and seed selection.

Traditional Labs at 1 sample to every 4 acres



Spectral results on a 1-acre grid



Symptoms of Soil Nutrient Deficiencies

A lack of soil nutrients can greatly affect plant growth and development. Identifying symptoms early can help prevent many issues. Below are common signs of nutrient deficiencies in plants:

pH (potential hydrogen): Low and high pH affected the ability of the plant to access nutrients. It is a measure of the acidity or alkalinity of the soil and is based on hydrogen.

Soil Organic Matter (SOM): Impacts your lands ability to retain and convert nutrients to the plants Soil

Organic Carbon(SOC): Acts as a buffer for soil to help decrease extreme fluctuations in pH.

Nitrogen: Slow, stunted growth; yellowing leaves (especially mature ones); leaf margins turning.

Phosphorus: Growth retardation; purplish foliage; dark green leaf tips; delayed maturity; poor fruit formation.

Potassium: Leaf tip and margin burning; weakened stalks; slow growth and fruit production.

Calcium: Tip burning; death of growing stems; premature leaf and flower shedding; stunted root development.

Magnesium: Yellowing and curling of older leaves; green midrib surrounded by yellow areas.

Sulfur: Young leaves turning from light green to yellow; slow growth and maturity; small plants.

Zinc: Shorter stem length; decreased fruit bud production; mottled leaves.

Iron: Chlorosis of young leaves; death of limbs and twigs.

Manganese: Poor distinction between veins and intervenes; pale green areas surrounded by darker green; yellowing interveinal regions.

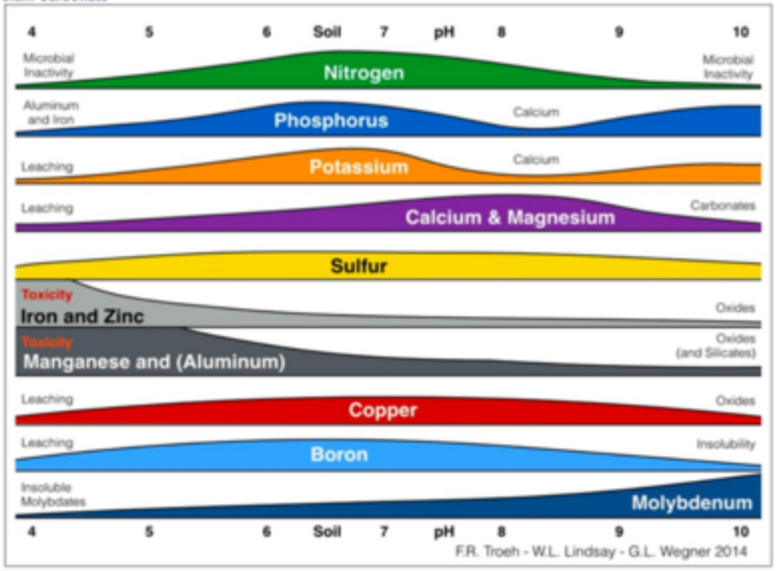
Copper: Slow, retarded growth; shoot death; decreased pigmentation; wilting leaf tips.

Boron: Yellow, thick, curled leaves; terminal bud death; necrotic spots on fruits; decreased flowering.

Molybdenum: Reduced vigor; scorching and cupping of leaf tips.

Chlorine: Yellowing and bronzing of leaves; extreme root branching.

Nickel: Urea accumulation in leaf tips; leaf tip necrosis.



4
5
6
Soil
7
pH
8
9
10
Microbial Inactivity
Nitrogen
Microbial Inactivity
Aluminum and Iron
Phosphorus
Calcium
Leaching
Potassium
Calcium
Leaching
Calcium & Magnesium
Carbonates
Sulfur
Toxicity
Iron and Zinc
Oxides
Toxicity
Manganese and (Aluminum)
Oxides (and Silicates)
Leaching
Copper
Oxides
Leaching
Boron
Insolubility
Insoluble Molybdates
Molybdenum
4
5
6
Soil
7
pH
8
9
10
F.R. Troeh - W.L. Lindsay - G.L. Wegner 2014

Understanding your Soil

Soil survey data showing variations in soil type across the field from the US Soil Survey

The type of soil in your field can be an indicator of fertility potential, water/ irrigation needs, types of crops that will be successful. This is for your reference to help you understand your land.

https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Florence County, South Carolina (SC041)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Cv	Coxville fine sandy loam	0.4	1.1%
DuB	Duplin and Exum soils, 2 to 6 percent slopes	3.1	8.1%
Ex	Exum sandy loam	1.0	2.5%
Go	Goldsboro loamy sand	0.2	0.4%
NoA	Norfolk loamy sand, 0 to 2 percent slopes	31.5	82.2%
NoB	Norfolk loamy sand, 2 to 6 percent slopes	2.2	5.7%
Totals for Area of Interest		**38.3**	**100.0%**

DS Hub Water Quality Model Report

This report was generated from the Dynamic Soils Hub Site Risk for Water Quality Application.

Field Parameters

Field Location	Drainage	Furrow Irrigation	Irrigation (Inches)	Soil Test Phosphorus	Est Acres
33.81194N, 79.62675W	Drained	Not Present	0 to 11.9	High or Unknown	40.05416

Soil Vulnerability Maps

The maps below show the soil vulnerability ratings for runoff and leaching for the delineated area of interest. Each rating is associated with a soil map unit. The values for each mapunit are derived from aggregated values derived from its soil components.

Leaching Vulnerability Map **Runoff Vulnerability Map**

Area of Interest Ratings and Threshold Values

Soil Vulnerability Ratings in the table below are based on an area-weighted average for the soil map units in the selected area of interest. These ratings are combined with a rating for local climate and irrigation to help guide nutrient management planning with field-specific leaching and runoff thresholds.

Soil Vulnerability Ratings		Leaching Thresholds		Runoff Thresholds		
Leaching	Surface Runoff	Nitrogen	Phosphorus	Nitrogen	Phosphorus	Sediment
(Low-High)	(Low-High)	(25-50)	(10-55)	(25-90)	(15-100)	(1-100)
High	**Low**	**50**	**55**	**30**	**30**	**40**

This report uses the ESRI World Imagery (For Export) Tile Imagery Service. Information about this service can be found on this link: https://www.arcgis.com/home/item.html?id=226d23f076da478bba4589e7eae95952. The USDA does not support or endorse any external links or content.

Example Interview with Operator				
Operator:	Farm No.		Tract No.	Date:
Owner:				
Overall Farming Operation (total acres, crop rotations, acres of each crop, CRP, livestock, all operators, etc.)				
Landowner &/or Operator Objective				
Tillage/ Cropping System (typical system from harvest to harvest, ever deep rip, etc.)				
Equipment Notes (planter setup (coulters, row cleaners, starter), tillage equipment owned i.e. vertical tillage tool, deep ripper, etc.)				

Nutrient Program (P&K program, soil test program, manure used (kind, rate, when, acres, etc.), Nitrogen program (principal, w/ pre, starter, side dress, anhydrous bar used), Liming program - how often, do they incorporate
Pesticide Program (weed resistant issues, herbicide program, insecticide use, over all week control issues)
Hay Production (acres, species, how its seeded, nurse crop, following crop, N credits)
Erosion Issues (sheet, rill, ephemeral, gully)
<u>Cover Crop Experiences</u> (species, rate, how, termination, etc.)