



UNIVERSITY OF GEORGIA
EXTENSION

Getting Started in Soil Fertility Mapping & Resources Available within UGA Extension

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UGA Agricultural & Environmental Services Laboratories

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**Utilizing Precision Ag
Technology Workshop**

Disclaimer

*Reference to a particular software or product does
imply an endorsement of that product*

Variable-Rate Nutrient Management Process



Define sampling locations



Collect soil samples



Map soil characteristics
(soil nutrient content)



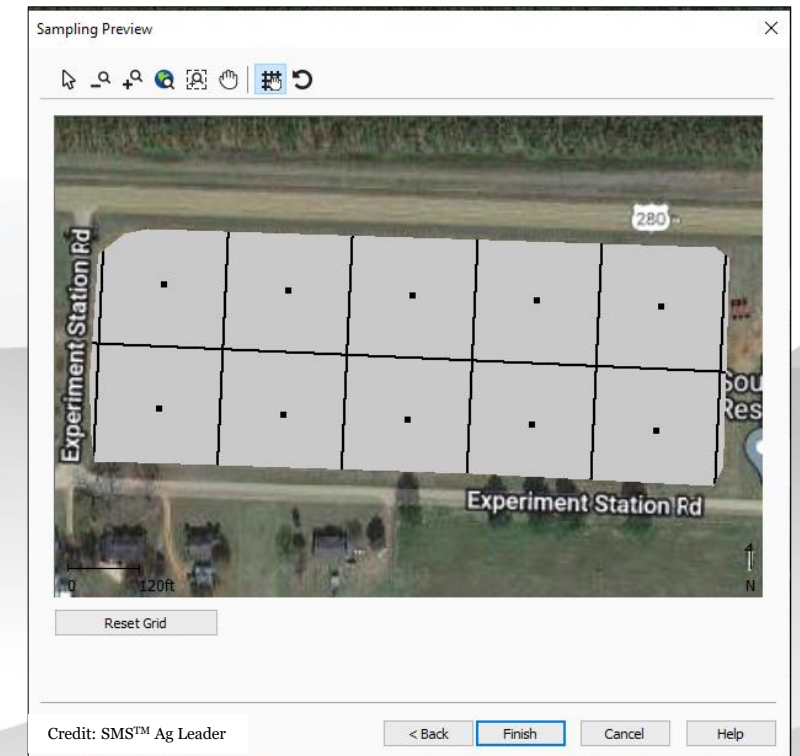
Map prescription rates
(nutrient recommendations)



Make variable-rate
applications

Defining Sampling Locations

- Unlike traditional composite soil sampling, precision ag uses technology to identify sampling locations (grid points, grids, or zones).
- Uses Ag GIS software, mobile apps, or mapping programs to specify sampling locations (GPS coordinates)



Ag GIS Software

The screenshot displays the main interface of the Ag GIS software. The central map shows an aerial view of a field with a grid of 12 sampling points (numbered 1-12) overlaid. The field is bounded by 'Experiment Station Rd' and 'U.S. 280 W'. The software interface includes a menu bar at the top, a 'Project Workspace' on the left with a 'Management Tree' showing a hierarchy of 'Plains Research Station', 'Office 9-Acres', 'Boundary', 'NO Product', and '2022' data layers. A 'Preview Window' at the bottom left shows a 'Create New Map' dialog with 'Add to Current Map' selected. A 'Map 2 Layers' panel on the right shows a list of feature IDs and their corresponding areas. A 'Statistics' panel at the bottom right shows summary statistics for the selected area.

Credit: SMS™ Ag Leader

The 'Sampling Parameters' dialog box is shown, allowing users to configure sampling plan creation. It includes options for 'Create Sample Points', 'Create Sample Grids', and 'Create Sample Regions'. The 'Use area for grid size' checkbox is checked. The 'Grid Size (X)' and 'Grid Size (Y)' are both set to 208.71 ft, resulting in a 'Grid Area' of 1.000 ac. The 'Grid Pattern' is set to 'Center', 'Grid Start' is 'N.E. Corner', and 'Grid Direction' is 'North-South'. There is also a 'Merge Polygons Smaller than...' option set to 10%.

Credit: SMS™ Ag Leader

Utilizing Precision Ag
Technology Workshop

Ag GIS Software

Advantages:

- Fully integrated
 - Sampling, mapping, yield monitoring, reporting
- Many come with mobile/ tablet apps
- Data repository
- May wirelessly connect to equipment
- May support other aspects of farm operations
 - Chemical/supply inventory
 - Expense/budget monitoring
 - Satellite imagery

Disadvantages:

- Expensive (\$2,000->\$5,000 per year)
 - Some have per acre charges and/or user fees in addition to annual license fee

Examples:

- Agrian- Telus
- Ag Studio- Granular
- Farmer Pro- Trimble
- FieldAlytics- EFC Systems
- FieldView-Climate
- Operations Center- John Deere
- SMS- Ag Leader
- Many more

Ag GIS Software

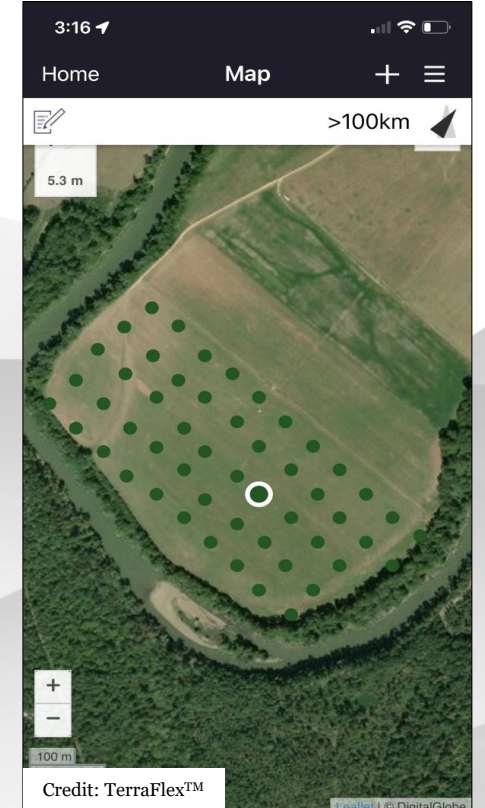
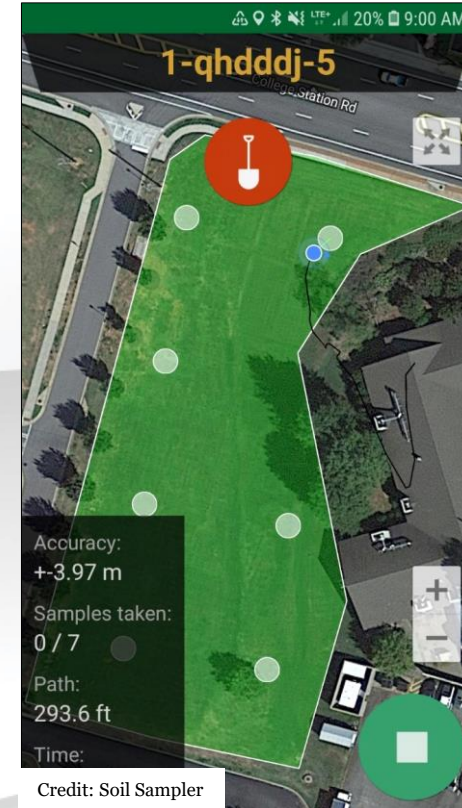
- Considerations when selecting an Ag GIS software:
 - Cost/ fee structure
 - Functions/tasks
 - Equipment supported
 - Platforms (desktop, mobile, tablet)
 - Size of your operation (acres)
 - Cloud, web, or desktop based
 - # of users
 - Technical support



Credit: Trimble® Ag Software

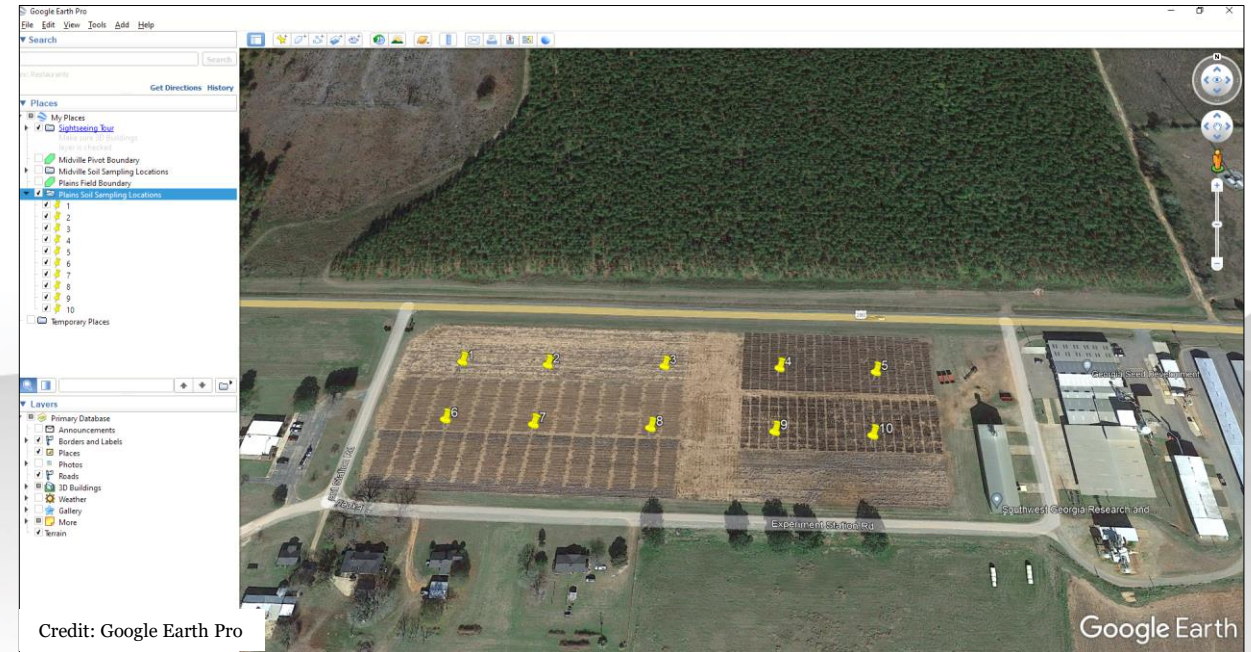
Soil Sampling: Low Cost/No-Cost Options

- Mobile Apps:
 - Soil Sampler (Andriod only)
 - TerraFlex (subscription based)
 - Traction (subscription based)
 - Soil Test Pro (associated with specific labs)
 - AgPhD (associated with specific labs)
 - Many more



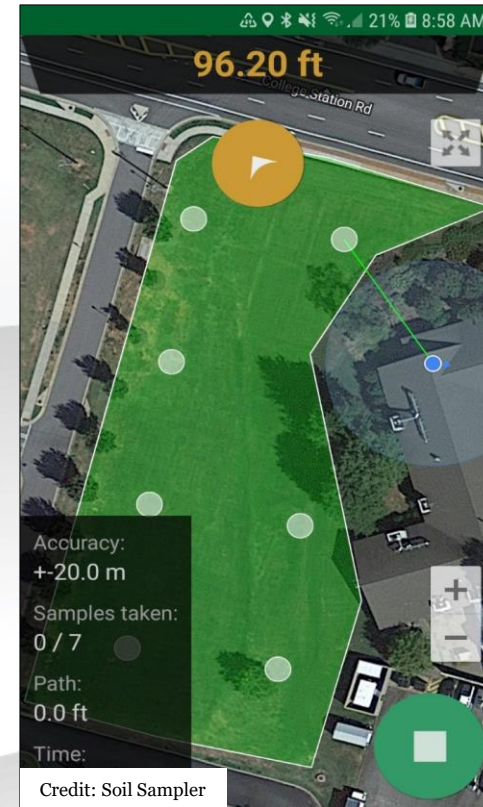
Soil Sampling: Low Cost/No-Cost Options

- Mapping Software:
 - Record Location (coordinates):
 - Apple Maps
 - Google Maps
 - Create Maps (shape files):
 - Google Earth Pro
 - ArcGIS (experience and license required)



Field Data/Sample Collection

- Mobile phone
 - Some apps requires cell service
 - 3-5 meter accuracy
- Tablet
 - Requires GPS receiver
 - <3 meter accuracy



Mapping Soil Characteristics

- GPS coordinates and soil test results must be linked.

UNIVERSITY OF GEORGIA EXTENSION		Soil, Plant, and Water Laboratory																									
Ag & Environmental Services Labs		2400 College Station Road Athens, Georgia 30602-9105 Website: http://aesl.ces.uga.edu																									
Soil Test Report																											
<small>(CE/CSEA Signature)</small>																											
Sample ID																											
Client Information		Lab Information	Contact																								
Virk, Simerjeet Crop & Soil Sciences - Test 334-750-8130 2329 Rainwater Road Tifton, GA 31793 Sample: Test Test: 1 Crop: Cotton - 1500 lbs yield goal		Lab #18211 Received: Nov 24, 2020 Completed: Nov 25, 2020 Printed: Dec 17, 2020 Tests: S1	Soil, Plant, and Water Laboratory 2400 College Station Road Athens, GA 30602 ph: 706-542-5350 e-mail: soiltest@uga.edu																								
Results																											
Mehlich I Extractant		UGA Lime Buffer Capacity Method*																									
<table border="1"> <tr> <td>Very High</td> <td>High</td> <td>Medium</td> <td>Low</td> </tr> <tr> <td>Phosphorus (P)</td> <td>Potassium (K)</td> <td>Calcium (Ca)</td> <td>Magnesium (Mg)</td> </tr> <tr> <td>112 lbs/Acre</td> <td>105 lbs/Acre</td> <td>833 lbs/Acre</td> <td>110 lbs/Acre</td> </tr> </table>		Very High	High	Medium	Low	Phosphorus (P)	Potassium (K)	Calcium (Ca)	Magnesium (Mg)	112 lbs/Acre	105 lbs/Acre	833 lbs/Acre	110 lbs/Acre	<table border="1"> <tr> <td>High</td> <td>Sufficient</td> <td>Low</td> </tr> <tr> <td>Zinc (Zn)</td> <td>Manganese (Mn)</td> <td>pH *</td> </tr> <tr> <td>3 lbs/Acre</td> <td>4 lbs/Acre</td> <td>5.9</td> </tr> <tr> <td colspan="2">Lime Buffer Capacity (LBC)</td> <td>218</td> </tr> </table>		High	Sufficient	Low	Zinc (Zn)	Manganese (Mn)	pH *	3 lbs/Acre	4 lbs/Acre	5.9	Lime Buffer Capacity (LBC)		218
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Recommendations																											
Can't find a specific grade of fertilizer? Try our Fertilizer Calculator: http://aesl.ces.uga.edu/soil/fertcalc/																											
Limestone	Limestone	Nitrogen (N)	Phosphate (P ₂ O ₅)																								
Target pH: 6.0	Target pH: 6.5																										
0.5 tons/Acre	0.75 tons/Acre	105 lbs/Acre	0 lbs/Acre																								
		Potash (K ₂ O)	Sulfur (S)																								
		90 lbs/Acre	10 lbs/Acre																								
		Boron (B)	Manganese (Mn)																								
		0.5 lbs/Acre	0 lbs/Acre																								
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<p>A target pH of 6.0 is recommended for most Agronomic crops. However, a lime recommendation for pH 6.5 is also provided on this soil test report. Liming to pH 6.5 helps reduce low pH areas in highly variable fields.</p> <p>*For information on how the Soil, Plant, and Water Laboratory measures and reports pH and makes lime recommendations, see http://aesl.ces.uga.edu/soil/SoilpH.asp</p> <p>Recommended nitrogen (N) should be split into 2 or 3 applications. Consult the Cotton Fact Sheet for further details on nitrogen management.</p> <p>If no phosphate (P₂O₅) or potash (K₂O) is recommended and none is applied, sample soil again next year.</p> <p>See Cotton - 1500 lbs yield goal Fact Sheet</p>																											



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Ag & Environmental Services Labs

Soil, Plant, and Water Laboratory

2400 College Station Road
Athens, Georgia 30602-9105
Website: <http://aesl.ces.uga.edu>

University of Georgia Soil Report Maps

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Grower : Simer Virk
Farm : UGA Tifton
Field : Raceway
Year : 2022
Operation : Soil Sampling
Crop / Product : NO Product
GPS Count : 25

UGA Agricultural & Environmental Services Labs
2400 College Station Rd.
Athens, GA 30602-9105
706-542-5350
soiltest@uga.edu
<http://aesl.ces.uga.edu/>

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Mapping Soil Characteristics

- GPS coordinates and soil test results must be linked.
- Use Ag GIS software to create maps representing the spatial variability in soil characteristics
- This process is called spatial interpolation, which uses statistics to estimate the values of unknown locations based on known values and locations.

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Ag & Environmental Services Labs

Soil, Plant, and Water Laboratory
2400 College Station Road
Athens, Georgia 30602-9105
Website: <http://acsl.ces.uga.edu>

Soil Test Report

(CE/CCEA Signature)

Sample ID
svirk@uga.edu

Client Information
Virk, Simerjeet Crop & Soil Sciences - Test 334-750-8130
2329 Rainwater Road
Tifton, GA 31793
Sample: Test Test: 1
Crop: Cotton - 1500 lbs yield goal

Lab Information
Lab #18211
Received: Nov 24, 2020
Completed: Nov 25, 2020
Printed: Dec 17, 2020
Tests: S1

Contact
Soil, Plant, and Water Laboratory
2400 College Station Road
Athens, GA 30602
ph: 706-542-5350
e-mail: soiltest@uga.edu

Results — Mehlich I Extractant — UGA Lime Buffer Capacity Method*

Phosphorus (P)	Potassium (K)	Calcium (Ca)	Magnesium (Mg)	Zinc (Zn)	Manganese (Mn)	pH *	Lime Buffer Capacity (LBC)
112 lbs/Acre	105 lbs/Acre	833 lbs/Acre	110 lbs/Acre	3 lbs/Acre	4 lbs/Acre	5.9	218

Recommendations — Can't find a specific grade of fertilizer? Try our Fertilizer Calculator: <http://aesl.ces.uga.edu/soil/fertcalc/>

Limestone Target pH: 6.0	Limestone Target pH: 6.5	Nitrogen (N)	Phosphate (P ₂ O ₅)	Potash (K ₂ O)	Sulfur (S)	Boron (B)	Manganese (Mn)	Zinc (Zn)
0.5 tons/Acre	0.75 tons/Acre	105 lbs/Acre	0 lbs/Acre	90 lbs/Acre	10 lbs/Acre	0.5 lbs/Acre	0 lbs/Acre	0 lbs/Acre

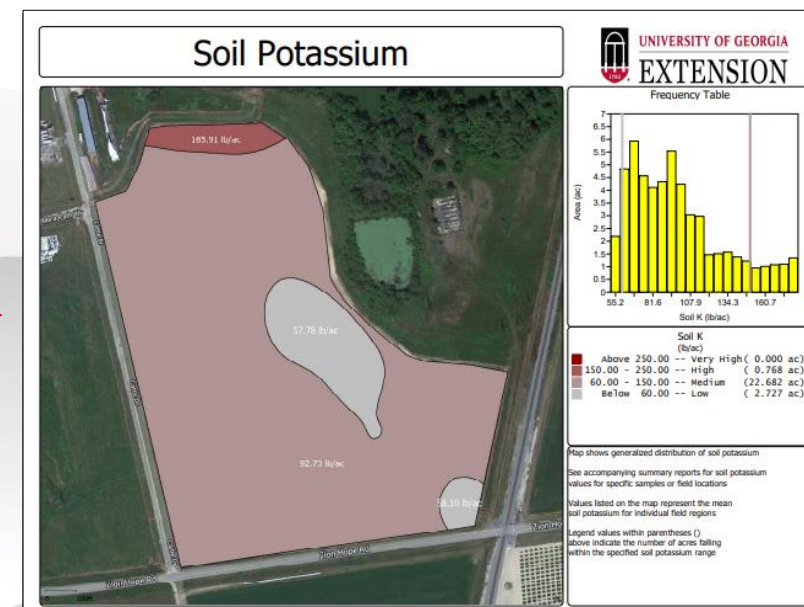
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*For information on how the Soil, Plant, and Water Laboratory measures and reports pH and makes lime recommendations, see <http://acsl.ces.uga.edu/soil/SoilpH.asp>

Recommended nitrogen (N) should be split into 2 or 3 applications. Consult the Cotton Fact Sheet for further details on nitrogen management.

If no phosphate (P₂O₅) or potash (K₂O) is recommended and none is applied, sample soil again next year.

See Cotton - 1500 lbs yield goal Fact Sheet



Generating Site-Specific Application Maps

- Use soil nutrient maps to develop fertilizer prescription maps.
- Areas with high soil nutrients are assigned low fertilizer rates.
- Areas with low soil nutrients are assigned high fertilizer rates

Soil K
(lbs./A)



Assign K Fertilizer Rates
(lbs./A)

Target Rate(s)

Soil K (lb/ac)	Target Rate (Mass) (lb/ac)
250.00 - inf	0
150.00 - 250.00	100
60.00 - 150.00	200
0.00 - 60.00	400

Example: Using potash

K Prescription Map
(lbs./A)



File Transfer

- GIS software relies on shapefiles
 - Shapefiles contain ***at least*** 3 file types:
 - .shp - geometry data
 - .shx – index file
 - .dbf - attribute information
 - These files must be transferred together
- File transfer can be done wirelessly or using a flash drive



Making Variable-Rate Applications

- Tractor System Requirements:
 - GPS receiver
 - Display
 - Rate controller



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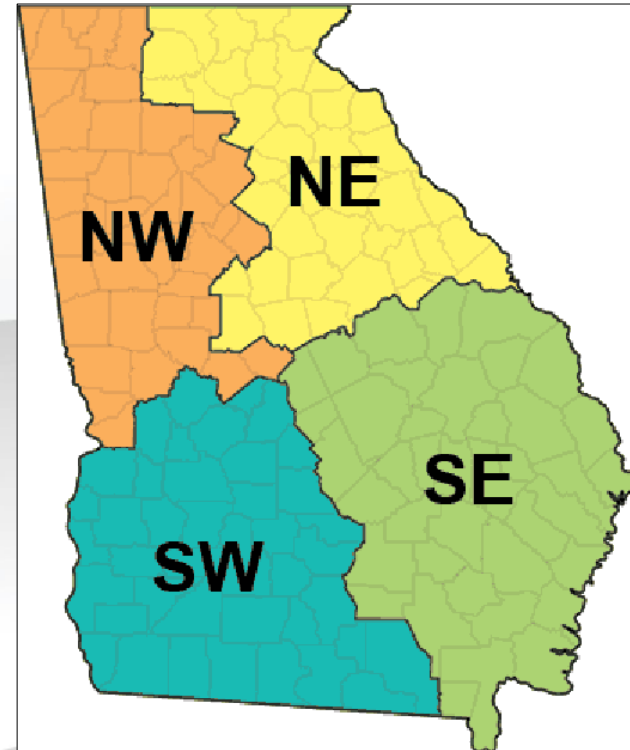
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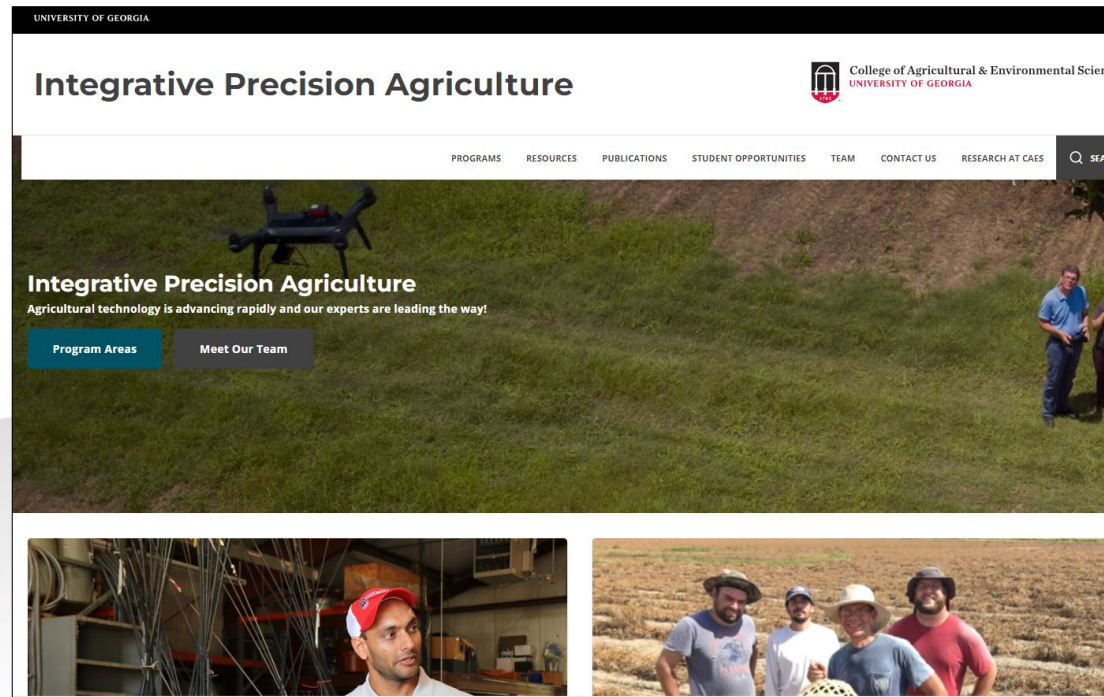
Resources within UGA Extension

- Extension agents
 - Located in every county across the state
 - provide local support



Resources within UGA Extension

- Extension agents
- Integrative Precision Agriculture Team
 - Experts in latest research and technology



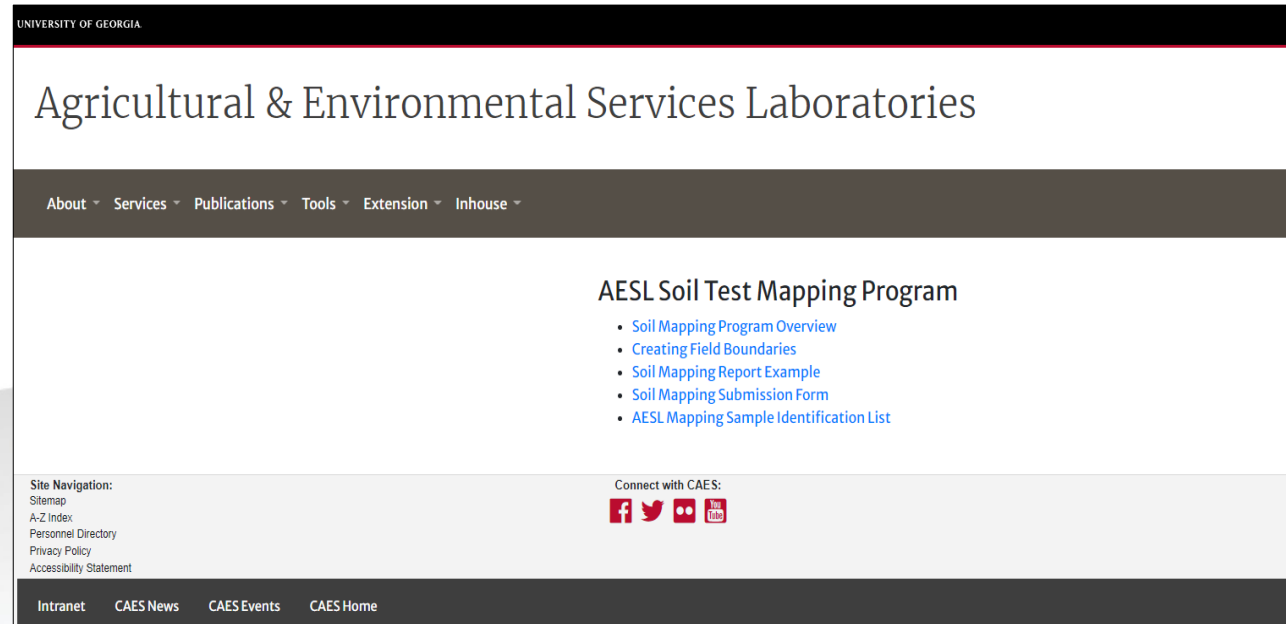
<https://precisionag.caes.uga.edu/>



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Resources within UGA Extension

- Extension agents
- Integrative Precision Agriculture Team
- Agricultural & Environmental Services Labs (AESL)
 - Soil & plant tissue testing
 - New mapping service



The screenshot shows the website for the Agricultural & Environmental Services Laboratories (AESL) at the University of Georgia. The page features a navigation menu with options: About, Services, Publications, Tools, Extension, and Inhouse. The main content area highlights the AESL Soil Test Mapping Program, which includes links to: Soil Mapping Program Overview, Creating Field Boundaries, Soil Mapping Report Example, Soil Mapping Submission Form, and AESL Mapping Sample Identification List. A footer section provides site navigation (Sitemap, A-Z Index, Personnel Directory, Privacy Policy, Accessibility Statement) and social media links for Facebook, Twitter, YouTube, and LinkedIn. The bottom navigation bar includes links for Intranet, CAES News, CAES Events, and CAES Home.

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Mapping Program: UGA Agricultural & Environmental Services Labs (AESL)

- Current Status:

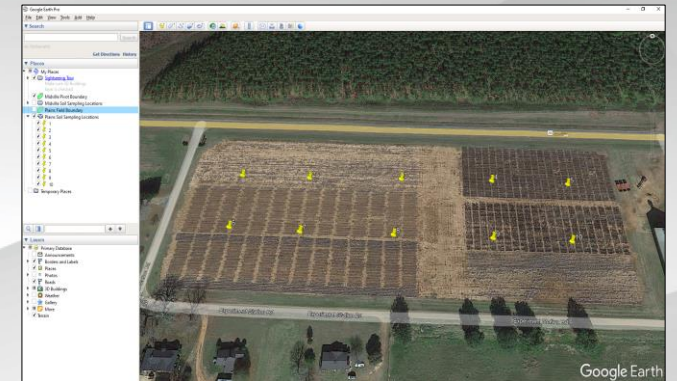
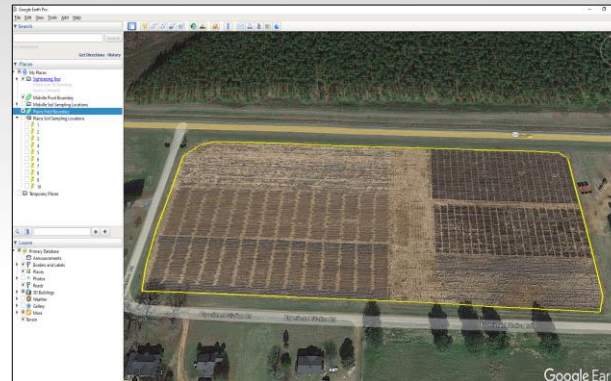
- New, pilot program
- No charge at this time
- Details may change

- Submission Requirements:

- Submission form
- Sample ID list
- Field boundary (.shp or .kml)
- Sampling locations (.shp or .kml)

Sample Information	
Date Submitted: _____	Date Received: _____ Lab Numbers: _____
Number of Samples: _____	Crop Code: _____ Grower: _____
Farm: _____	Field: _____
Return Results To: (complete mailing address)	
Bill To: (if address different from Return to)	
Name: _____	Name: _____
Address: _____	Address: _____
City: _____	City: _____
State: _____ Zip: _____	State: _____ Zip: _____
Phone: _____	Note any Special Instructions: _____
Email: _____	
Instructions:	
<ul style="list-style-type: none"> • Coordinates for sampling locations must be emailed to the lab (soiltest@uga.edu) in spreadsheet (excel or csv) or shapefile (.shp or .kml) format and include the sample information as listed on the sample bag. • Field boundaries should also be emailed to the soiltest@uga.edu and be provided in the form of a shapefile (.shp or .kml). Shapefiles containing field boundaries can be created using any precision farming software program, many handheld GPS receivers, or several free mobile phone apps (we recommend "Soil Sampler", but several others exist as well). • If samples are not paid for through an Extension office, payment must be included. • All samples listed on the sheet should be enclosed in the same box. Enclose forms inside envelope and place inside the box. • Soils must be dry. • *AE samples will be analyzed for Routine Test (S1): pH, lime buffering capacity, P, K, Ca, Mg, Zn, Mn 	

Client Name		Field		Sample IDs		Crop1	Crop2	Crop3	Crop4	Crop5
Farm Name	Field Name	1-15		500						
	Field Name	16-22		500						
	Field Name	16-23		500						
Client Name		Field		Sample IDs		Crop1	Crop2	Crop3	Crop4	Crop5
Farm Name	Field Name	33-48		502						
	Field Name	49-56		502						
Client Name		Field		Sample IDs		Crop1	Crop2	Crop3	Crop4	Crop5
Farm Name	Field Name	57-63		502						
	Field Name	64-73		500						
Farm Name	Field Name	74-79		036						
	Field Name	80-92		010						



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Mapping Program: UGA Agricultural & Environmental Services Labs (AESL)

- Clients receive a unique link to access their results.
- Soil test results are reported in several formats.
 - Graphical
 - Summary spreadsheet
 - Maps

Fiscal Year: **2021**

Grower	Farm	Samples	Dates	Graphical (PDF)	Summary (PDF)	CSV	Maps	Shape Files
Simerjeet Virk	Test	25	11/25/2020	Report	Summary	Zip	Maps	Zip
		Total Samples	25					

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Ag & Environmental Services Labs

Soil, Plant, and Water Laboratory
2400 College Station Road
Athens, Georgia 30602-9105
Website: <http://soiltest.uga.edu>

Soil Test Report

Client Information: Virk, Simerjeet Crop & Soil Sciences - Test 334-750-8130
Sample: Test Test - 1
Crop: Cotton - 1500 lbs yield goal

Results Summary:

Phosphorus (P)	Potassium (K)	Calcium (Ca)	Magnesium (Mg)	Zinc (Zn)	Manganese (Mn)	pH	Lim. Buffer Capacity (LBC)
112	105	853	110	3	4	5.9	218

Recommendations:

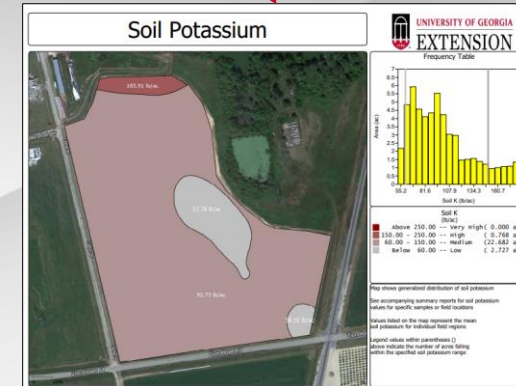
Limestone	Nitrogen (N)	Phosphate (P ₂ O ₅)	Potash (K ₂ O)	Bulfin (B)	Boron (B)	Manganese (Mn)	Zinc (Zn)
0.5 tons/Acre	105 lbs/Acre	0 lbs/Acre	80 lbs/Acre	10 lbs/Acre	0.5 lbs/Acre	0 lbs/Acre	0 lbs/Acre

Simerjeet Virk
Farm: Test
FARM: Test
Layer: Test
503 Cotton - 1500 lbs yield goal

Soil, Plant, and Water Laboratory
2400 College Station Road
Athens, Georgia 30602-9105
<http://soiltest.uga.edu>

Soil Potassium

Lab	Sample	P	K	Ca	Mg	Zn	Mn	pH	LBC	Limestone	N	P ₂ O ₅	K ₂ O	S	B	Mn	Zn
18211	1	112	105	853	110	3.3	3.6	5.9	218	0.50	105	0	90	10	0.5	--	--
18212	2	90	51	509	62	3.6	3.6	5.5	206	0.25	105	60	130	10	0.5	--	--
18213	3	90	72	746	90	3.5	2.9	6.0	187	0.00	105	0	110	10	0.5	--	--
18214	4	93	58	455	60	3.3	3.0	5.3	196	0.75	105	0	120	10	0.5	--	--
18215	5	85	53	402	52	2.9	3.8	5.2	196	0.25	105	0	130	10	0.5	--	--
18216	6	73	181	686	112	4.7	5.2	5.6	228	0.50	105	20	30	10	0.5	--	--
18217	7	74	85	501	69	3.2	3.4	5.6	173	0.50	105	20	110	10	0.5	--	--
18218	8	95	63	417	63	2.2	3.2	5.3	180	0.25	105	60	120	10	0.5	--	--
18219	9	79	53	481	58	2.4	3.9	5.5	174	0.50	105	20	130	10	0.5	--	--
18220	10	111	65	679	84	3.0	3.0	5.6	205	0.50	105	0	120	10	0.5	--	--
18221	11	85	75	542	81	3.8	2.9	5.4	187	0.50	105	0	110	10	0.5	--	--
18222	12	141	63	855	101	4.4	4.0	6.1	174	0.00	105	0	120	10	0.5	--	--
18223	13	220	103	1030	110	10.0	6.6	6.0	196	0.00	105	0	90	10	0.5	--	--
18224	14	130	74	712	100	4.2	4.4	5.8	176	0.50	105	0	110	10	0.5	--	--
18225	15	115	71	764	93	4.1	3.6	5.8	182	0.50	105	0	120	10	0.5	--	--
18226	16	98	73	605	76	3.7	2.8	5.6	186	0.50	105	0	110	10	0.5	--	--
18227	17	123	74	556	69	3.4	2.6	5.3	213	0.75	105	0	110	10	0.5	--	--
18228	18	132	94	822	78	4.1	4.8	5.7	192	0.50	105	0	100	10	0.5	--	--
18229	19	102	154	781	111	4.9	5.1	5.8	216	0.50	105	0	50	10	0.5	--	--
18230	20	171	113	802	105	4.4	2.6	5.6	213	0.50	105	0	90	10	0.5	--	--
18231	21	127	87	672	69	3.2	1.8	5.5	201	0.50	105	0	100	10	0.5	--	--
18232	22	122	91	615	79	3.2	2.3	5.5	205	0.50	105	0	100	10	0.5	--	--
18233	23	154	83	888	110	5.5	4.4	5.8	200	0.50	105	0	110	10	0.5	--	--
18234	24	138	82	627	111	4.6	5.0	5.8	203	0.50	105	0	110	10	0.5	--	--
18235	25	150	118	1018	122	3.1	4.1	6.2	197	0.00	105	0	80	10	0.5	--	--



Utilizing Precision Ag Technology Workshop

Mapping Program: UGA Agricultural & Environmental Services Labs (AESL)

- Soil test map shapefiles are also provided.
- Growers can work with their local consultant or fertilizer dealer to develop prescription maps based on the fertilizer availability in their area.

Fiscal Year: 2021								
Grower	Farm	Samples	Dates	Graphical (PDF)	Summary (PDF)	CSV	Maps	Shape Files
Simerjeet Virk	Test	25	11/25/2020	Report	Summary	Zip	Maps	Zip
	Total Samples	25						