High Tunnel: Fertility Management

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DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

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Overview

- Soil testing
- Soil preparation prior to HT construction
- Soil fertility maintenance in HT
- Common issues

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Soil Testing

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How to Use Soil Test Results

1. Amend soil pH
   - Ideal Range: 6.0-7.0
2. Make fertilizer applications
   - *Monitor Phosphorus (P) and Potassium (K), Boron (B)*
   - *Often Nitrogen content will not be reported on a soil test; use standard recommendations or results from plant tissue N testing*

3. Check salt levels

- *(EC) electrical conductivity*

4. Monitor Soil Organic Matter

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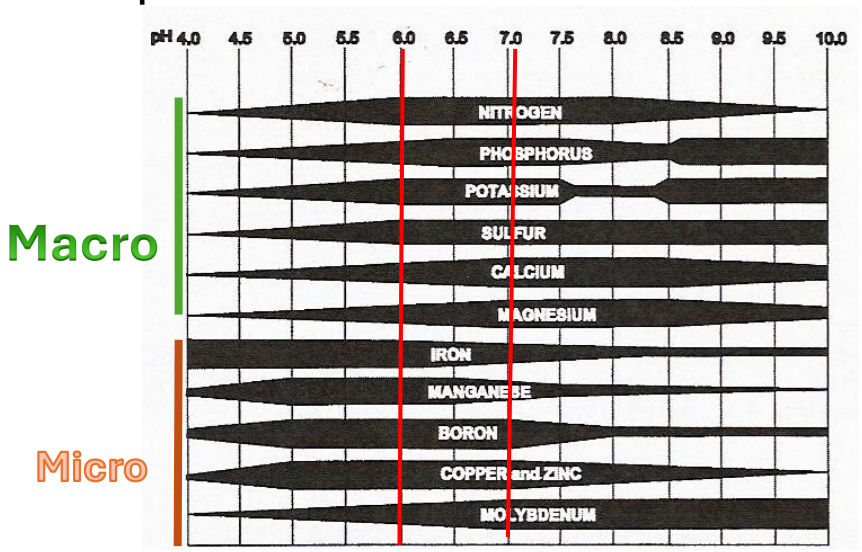
Soil pH

Nutrient Availability at Different pH values. Maximum availability is indicated by widest part of bar



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Soil pH

Biggest limiter of crop yields in Southeast

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How to Pull Soil Samples

Use your Local County Agent's Expertise!

Timing	Fall is ideal *Consistent timing-> to be able to compare from year to year*
Pull 20-30 samples per acre	Depth of 12-16'' Not immediately after fertilizer/lime application Where: In-row vs. whole field.
Mix individual samples in a bucket	
Submit a sub-sample	Submit separate samples based on: *Soil type, Management history and Problem areas*
Tell them Your Planned Crop!	

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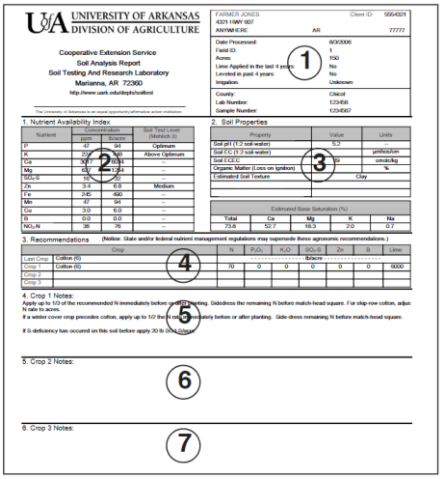
Reading your Soil Test



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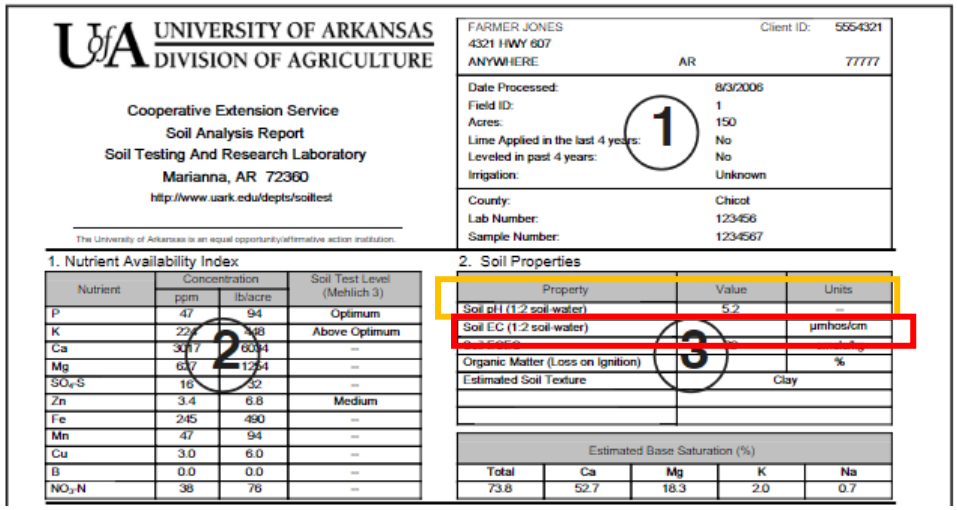

UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE

Cooperative Extension Service
Soil Analysis Report
Soil Testing And Research Laboratory
Marianna, AR 72360
http://www.uark.edu/depts/soiltest

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FARMER JONES
4321 HWY 607
ANYWHERE AR 77777

Client ID: 5554321

Date Processed:	8/3/2006
Field ID:	1
Acres:	150
Lime Applied in the last 4 years:	No
Leveled in past 4 years:	No
Irrigation:	Unknown
County:	Chicot
Lab Number:	123456
Sample Number:	1234567

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1. Nutrient Availability Index

Nutrient	Concentration ppm	Concentration lb/acre	Soil Test Level (Mehlich 3)
P	47	94	Optimum
K	224	448	Above Optimum
Ca	3017	6034	--
Mg	627	1254	--
SO_4-S	16	32	--
Zn	3.4	6.8	Medium
Fe	245	490	--
Mn	47	94	--
Cu	3.0	6.0	--
B	0.0	0.0	--
NO_3-N	38	76	--

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2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	5.2	--
Soil EC (1:2 soil-water)		µmhos/cm
[illegible]		[illegible]
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Clay	

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Estimated Base Saturation (%)				
Total	Ca	Mg	K	Na
73.8	52.7	18.3	2.0	0.7

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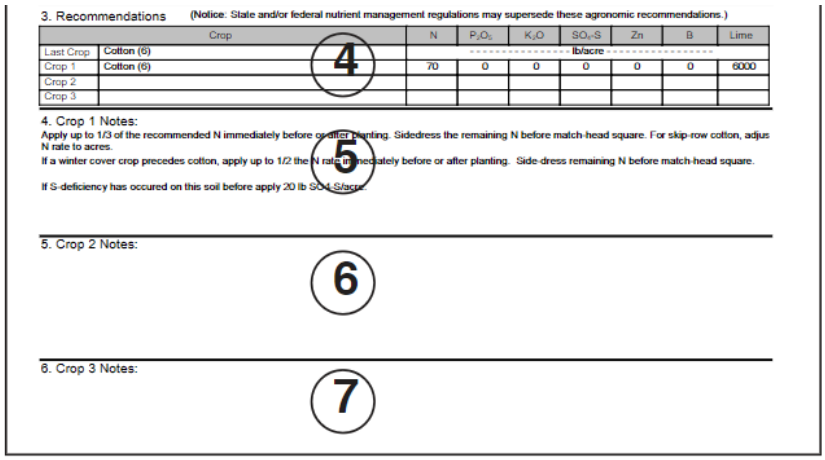

3. Recommendations (Notice: State and/or federal nutrient management regulations may supersede these agronomic recommendations.)

Crop		N	P_2O_5	K_2O	SO_4-S	Zn	B	Lime
		lb/acre						
Last Crop	Cotton (6)							
Crop 1	Cotton (6)	70	0	0	0	0	0	6000
Crop 2								
Crop 3								

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4. Crop 1 Notes:
Apply up to 1/3 of the recommended N immediately before or after planting. Sidedress the remaining N before match-head square. For skip-row cotton, adjus N rate to acres.
If a winter cover crop precedes cotton, apply up to 1/2 the N rate immediately before or after planting. Side-dress remaining N before match-head square.

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If S-deficiency has occured on this soil before apply 20 lb SO_4-S/acre.

5. Crop 2 Notes:

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6. Crop 3 Notes:

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Soil Preparation- Fertility Amendments

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Broadcast Applications prior to Construction

- Lime
- Phosphorus
- Potassium
- High quality compost

- Should be tilled in to 6-8'' depth

- *Wait to apply N just prior to planting*

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Amending the soil pH

- When?
  - Ideally 6 months before planting.
    - *Takes about a year for full effects to be seen for standard limestone*
- How much?
  - To pH 6.0-6.5ish in SE.
  - **Sandy soils need less lime <u>but more frequently</u> than clayey/high humus soils because of lower CEC in sandy soils**
- How deep?
  - To rooting depth (6-8”). Needs to be tilled in or will take much longer
  - Ensure even application across the field, Apply in cross-hatch pattern
- How often to soil test (to monitor nutrients and soil pH)?
  - About every 3 years, or annually if you suspect a problem
  - Collect samples do not sample after recent fertilizer applications

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How to apply fertilizer in a high tunnel system?

Broadcast

Side dress

Fertigation

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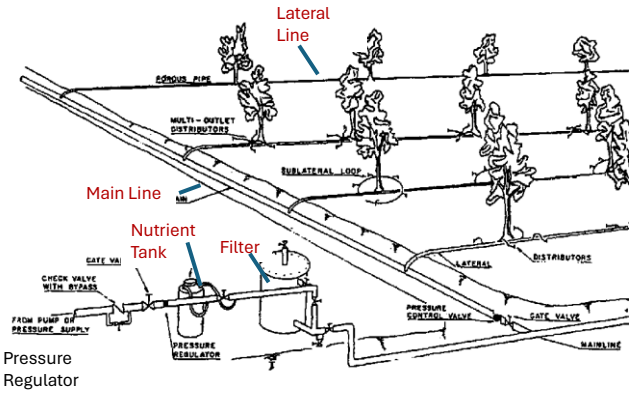
Example Drip Irrigation System



Pressure Regulator

Figure 18. Drip or Microspray Irrigation Syster

Due to the small diameter of the emitter openings, filtration of the water is normally required to reduce potential blockages in these systems (Figure 18).

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Fertigation

- Method to inject fertilizer into drip irrigation system and spoon feed fertilizer with irrigation water
  - Supplies nutrients to rooting zone
  - Spoon fed throughout the season
  - Most Efficient method

  - *Get irrigation water tested*
  - *High iron content or high pH may require an acid injection system*

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Calculating Rate

Fertigation or banding

- **Base the rate off** ***linear row feet for fertigation and banded applications***
- **20 rows x 100' long x 5' wide= 0.22 of an acre**

Broadcast

- **Actual square feet for** ***broadcast applications***
- **340' x 100' = 0.78 of an acre**

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Fertilizing by "Linear Bed Feet"

Calculating Recommended Fertilizer Rates for Vegetables Grown in Raised-Bed, Mulched Cultural Systems[1]
George Hochmuth and Edward Hanlon[2]

Table 2. Conversion of fertilizer rates in pounds per acre to pounds per 100 LBF[z].

Typical bed spacing (ft)	Recommended fertilizer rate (N, P_2O_5, K_2O) (pounds per acre)								
	20	40	60	80	100	120	140	160	180
	Resulting fertilizer rate (N, P_2O_5, K_2O) (pounds per 100 LBF)								
3	0.14	0.28	0.41	0.55	0.69	0.83	0.96	1.10	1.24
4	0.18	0.37	0.55	0.73	0.92	1.10	1.29	1.47	1.65
5	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84	2.07
6	0.28	0.55	0.83	1.10	1.38	1.65	1.93	2.20	2.48
8	0.37	0.73	1.10	1.47	1.84	2.20	2.57	2.94	3.31

[z] This table is used correctly by (1) determining the typical bed spacing from Table 1 for the crop; (2) locating the column containing the recommended fertilizer rate in pounds per acre; and (3) reading down the column until reaching the row containing the typical bed spacing. The resulting number in pounds per 100 LBF should be used even in situations where the farmer's bed spacing differs from the typical bed spacing. Use of the table will involve doubling the rate, for example where the column for 100 pounds per acre was used in the calculation of pounds per 100 LBF for a recommended rate of 200 pounds per acre.

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Fertigation

Research based fertigation schedules

**SUGGESTED FERTIGATION SCHEDULE FOR TOMATO*
(high soil potassium)**

Days after planting	Daily nitrogen (lb / A)	Daily potash (lb / A)	Cumulative Nitrogen	Cumulative Potash
Preplant			50.0	125.0
0–14	0.5	0.5	57.0	132.0
15–28	0.7	0.7	66.8	141.8
29–42	1.0	1.0	80.8	155.8
43–56	1.5	1.5	101.8	176.5
57–77	2.2	2.2	148.0	223.0
78–98	2.5	2.5	200.5	275.5

*Adjust based on tissue analysis.

2016 Vegetable Crop Handbook for Southeastern United States

Incorporate no more than 50% of N and K requirements prior to planting

Water Soluble Fertilizers

- Ammonium Nitrate Solution (20-0-0)
- Urea-ammonium Nitrate Solution (32-0-0)
- Calcium Nitrate (15.5-0-0-19 Ca)
- Potassium Nitrate (13-0-46)
- Urea Solid (46-0-0) and Urea Solution (23-0-0)

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Actual Nitrogen vs. Applied Fertilizer

60 lbs. of <u>Actual N</u> =

176 lbs. Ammonium Nitrate (34-0-0)

387 lbs. Calcium Nitrate (15.5-0-0, 19)

461 lbs. Potassium Nitrate (13-0-44)

$$\frac{\text{Desired Rate of Nitrogen}}{\text{Percent Nitrogen in a Given fertilizer}} = \text{Lbs. of Fertilizer must apply to achieve rate of N}$$

$$\frac{60 \text{ lbs. of N}}{0.34} = 176 \text{ lbs. of 34-0-0}$$

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Fertilizers affect on Soil pH

NH_4^+ (fertilizer) + $2O_2$ → *Nitrification: soil bacteria oxidize ammonia (NH_4^+) to Nitrate (NO_3^-)* → NO_3^- + H_2O + $2H^+$

NO_3^- → *Leached through the soil profile*

$2H^+$ → *Soil Solution*

- Ammonium will convert to nitrate in the soil, a process called nitrification, and will release hydrogen (H+) ions, thus dropping the pH.

Table 1. The acidity and basicity of some common fertilizer formulations (Hawkes, 1980).

Fertilizer Material	Analysis N-P-K-S	Acidity per lb of N supplied	Basicity
Urea	45-0-0-0	1.8	
Urea ammonium nitrate	34-0-0-0	0.9	
Anhydrous ammonia	82-0-0-0	1.8	
Aqua ammonia	20-0-0-0	1.8	
Potassium Nitrate	13-0-44		2.0
Calcium Nitrate	16-0-0		1.3
Triple superphosphorus	0-46-0-0	Neutral	
Monoammonium phosphate	11-52-0-0	5.4	
Diammonium phosphate	18-46-0-0	3.6	
Ammonium phos. sulfate	16-20-0-15	5.5	
Potassium sulfate	0-0-50-18	Neutral	
Potassium magnesium sulfate	0-0-22-22	Neutral	

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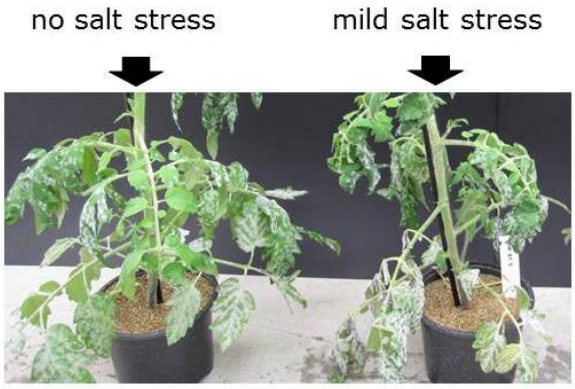
Salt Build Up In Tunnels

- No leaching rains to remove build up of salts (fertilizers)
- When replacing the plastic every 3-4 years leave off for several weeks-months.
- Monitor EC on soil test yearly.
  - Over 1 dS/m may mean trouble (check the method used)



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Strawberries and Foliar Boron

Boron is able to move from leaves to fruits in certain crops, good evidence for strawberry

https://pdfs.semanticscholar.org/c735/46fdea0370a9f6979b34173111f8e241620d.pdf

Low boron? Use plant tissue nutrient testing to determine

Apply 0.125 lbs B/ acre

1 lb of Borax (11% B)

0.5 lb of Solubor (20.5% B)

Boron Toxicity

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Blossom End Rot

Low Calcium
Determined by tissue levels at the time the fruit is pollinated.

Calcium is taken up by the plant with water
Calcium does not readily move from the leaf to the fruit.

Low soil pH or irregular watering at bloom or early fruit set.

Stem End ⬇

Blossom End ⬆

Foliar Ca: Likely not an efficient source of calcium

Blossom end rot, M. Grabowski

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Stay in Touch!

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