Managing Soil and Soil Health in High Tunnels

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RESEARCH & EXTENSION
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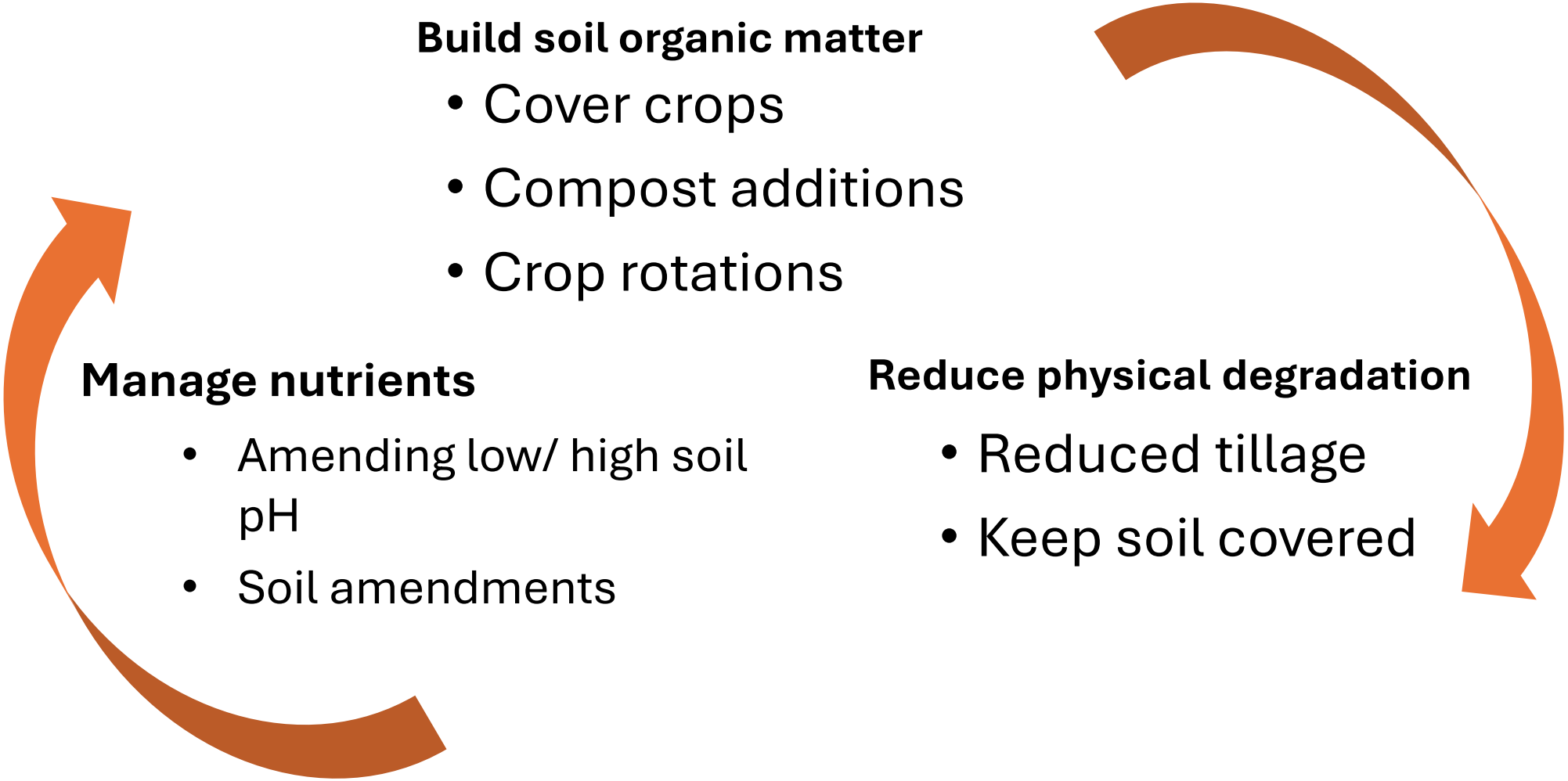
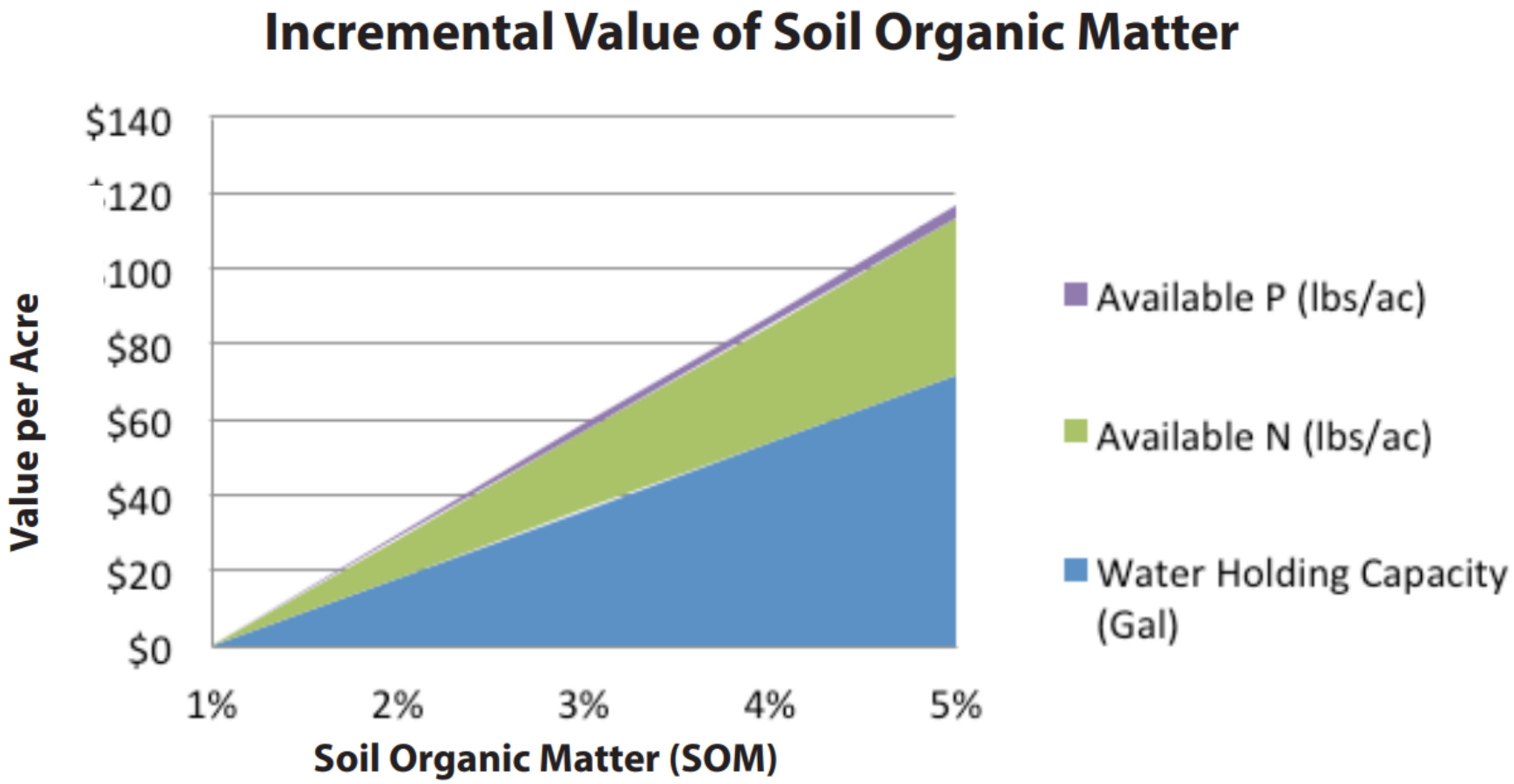
Overview

- Soil health
- Soil preparation
- Soil maintenance

A soil is not considered "healthy" if it is managed for short term productivity at the expense of future degradation
(Doran et al., 1994)

Practices that promote soil health





NRCS, IOWA. Value of Soil Health. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1270795.pdf

Soil Organic Matter in Arkansas

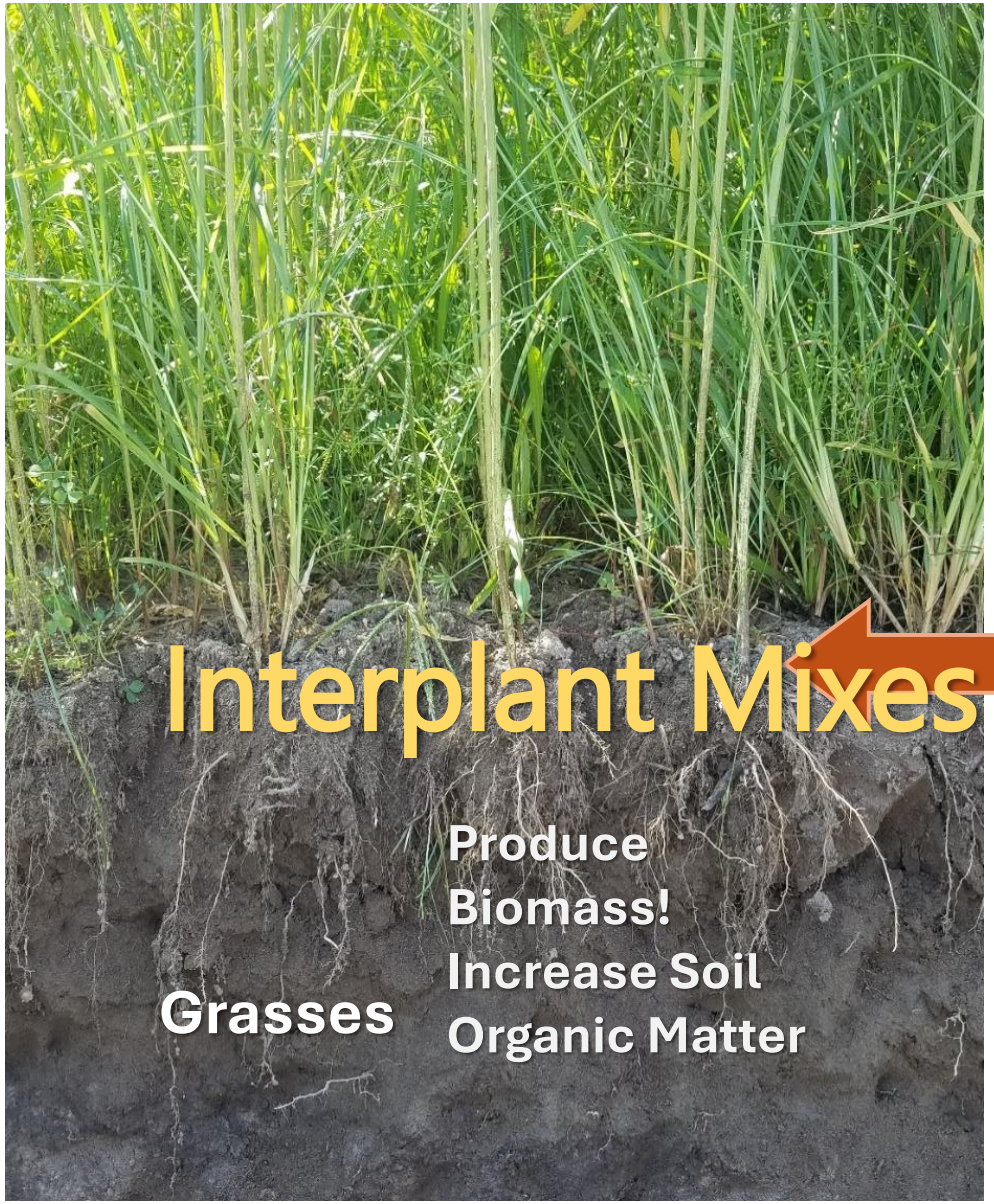
- In the SE organic matter ranges from 0.05-3%.
  - A change in 0.5% is HUGE
- Can track changes over time
- In tilled systems cannot expect to see big increases over time

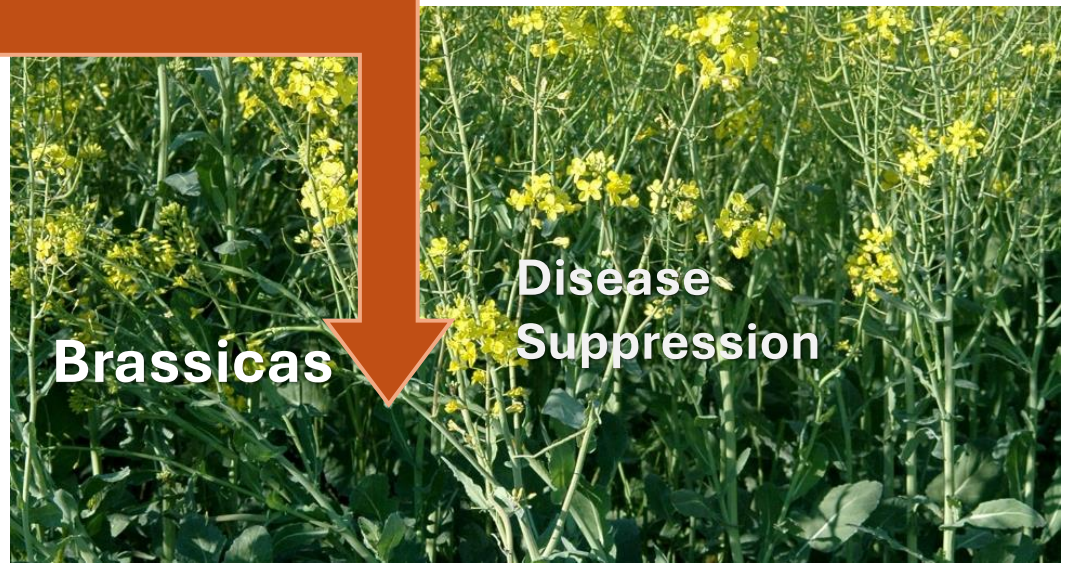
Compost

- **Increases soil organic matter over time**
- **Research into ‘suppressive soils’**
- **Supplies N-P-K and micronutrients**
- **5-8 Tons/ acre**
- **Possible salt content**
  - *Apply well in advance of transplanting*
  - Manure?
- Careful with source!

Cover Crops

Instead of harvesting as a cash crop, cover crops are grown for the benefits they have on the soil or on subsequent crops





Cover Crops

1. Don’t share the same diseases as many horticulture crops.
2. Root to different depths
3. Have different nutrient use requirements

Legumes can supply up to >40lbs of N to the following crop

Two Cover Crop Termination Methods

Killed by herbicide or mowing and left on the soil surface (no-till)

Weed control potential

Killed by mowing and tilled into the soil 1-4 weeks before planting

Soil preparation prior to building the tunnel

Phase 1

Preparing a Tunnel for Production

✓Year 0 a “planning year”

- Cover crop the land
- Get the soil right before you build and plant!

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*

How to Pull Soil Samples

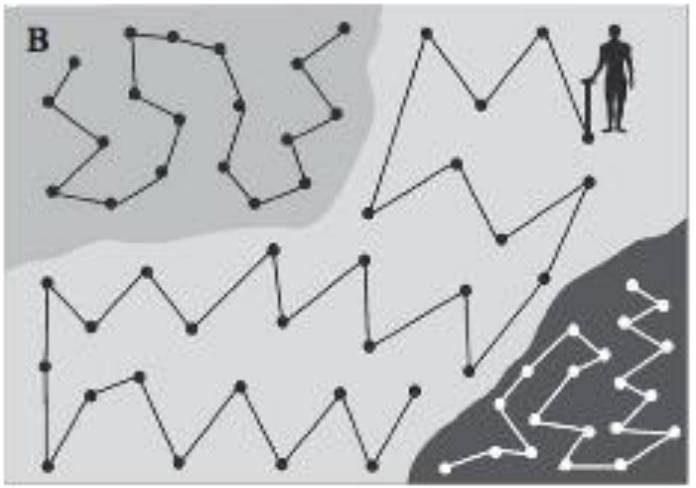
Use your Local County Agent's Expertise!

Timing

- Fall is ideal
- *Consistent timing-> to be able to compare from year to year*

Pull 10-15 cores per tunnel

- Depth of 6-8''
- Not immediately after fertilizer/lime application



Mix individual samples in a bucket

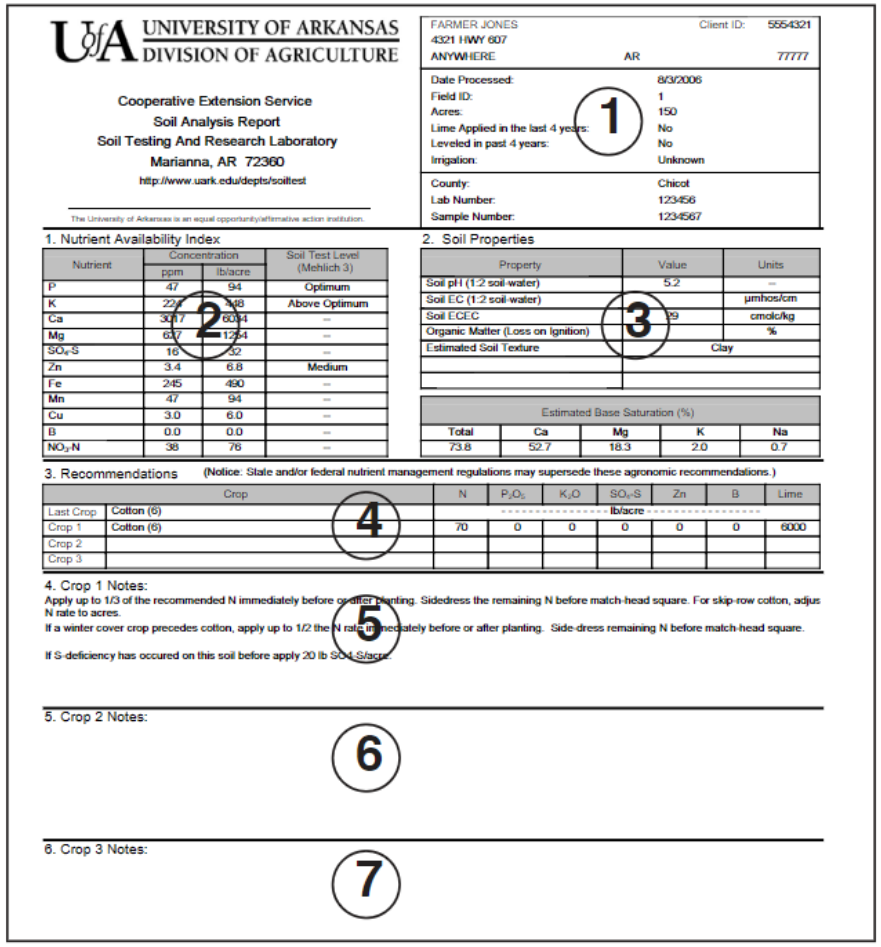
Submit a sub-sample

- Submit separate samples based on:
- *Soil type, Management history and Problem areas*

Tell them Your Planned Crop!

Extra fee for soil organic matter

Reading your Soil Test



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

1

1. Nutrient Availability Index

Nutrient	Concentration ppm	Concentration lb/acre	Soil Test Level (Mehlich 3)
P	47	94	Optimum
K	225	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	--

2

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	5.2	--
Soil EC (1:2 soil-water)		µmhos/cm
Soil ECEC	29	cmolc/kg
Organic Matter (Loss on Ignition)		%
Estimated Soil Texture	Clay	

3

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

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								

4

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.

5

If S-deficiency has occured on this soil before apply 20 lb SO4-S/acre.

5. Crop 2 Notes:

6

6. Crop 3 Notes:

7

https://www.uaex.edu/publications/PDF/FSA-2118.pdf

https://www.uaex.edu/publications/PDF/FSA-2153.pdf

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6. Crop 3 Notes:

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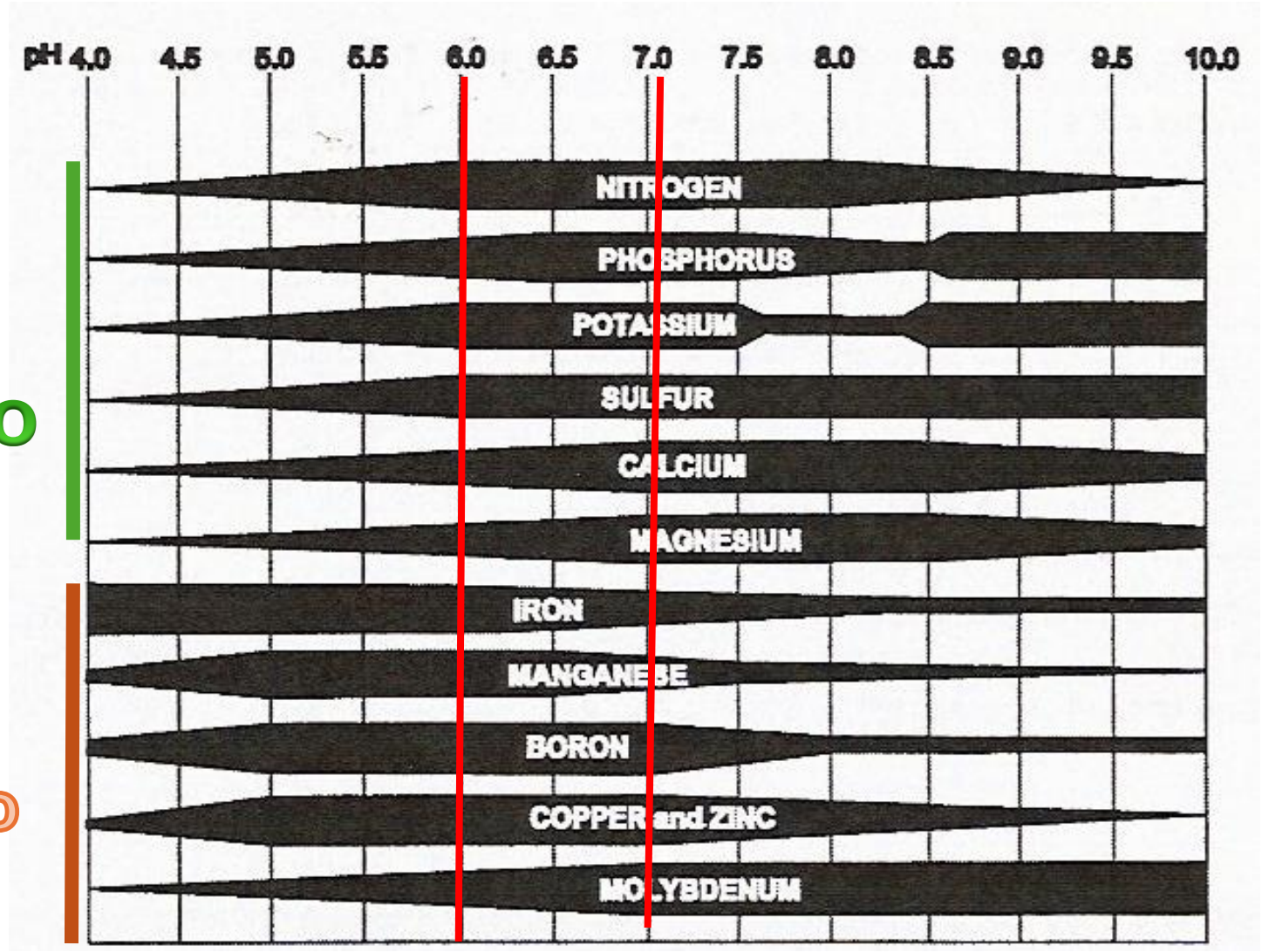
How to Use Soil Test Results

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*

Soil pH

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



Macro

Micro

Soil Preparation and Maintenance

Phase 2 and 3

How to Use Soil Test Results

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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*

3. *Check salt levels*
    - *(EC) electrical conductivity*

Preparing the soil for planting

1. Till and loosen the soil, layout planned rows
2. Pre-shape the beds
3. Apply fertilizer to pre-shaped beds(no more than 40% of season long needs)
4. Incorporate fertilizer
5. Lay plastic (optional) and drip tape

Irrigated Deserts

Example Drip Irrigation System

Fertilizer is injected into the irrigation system and delivered with water

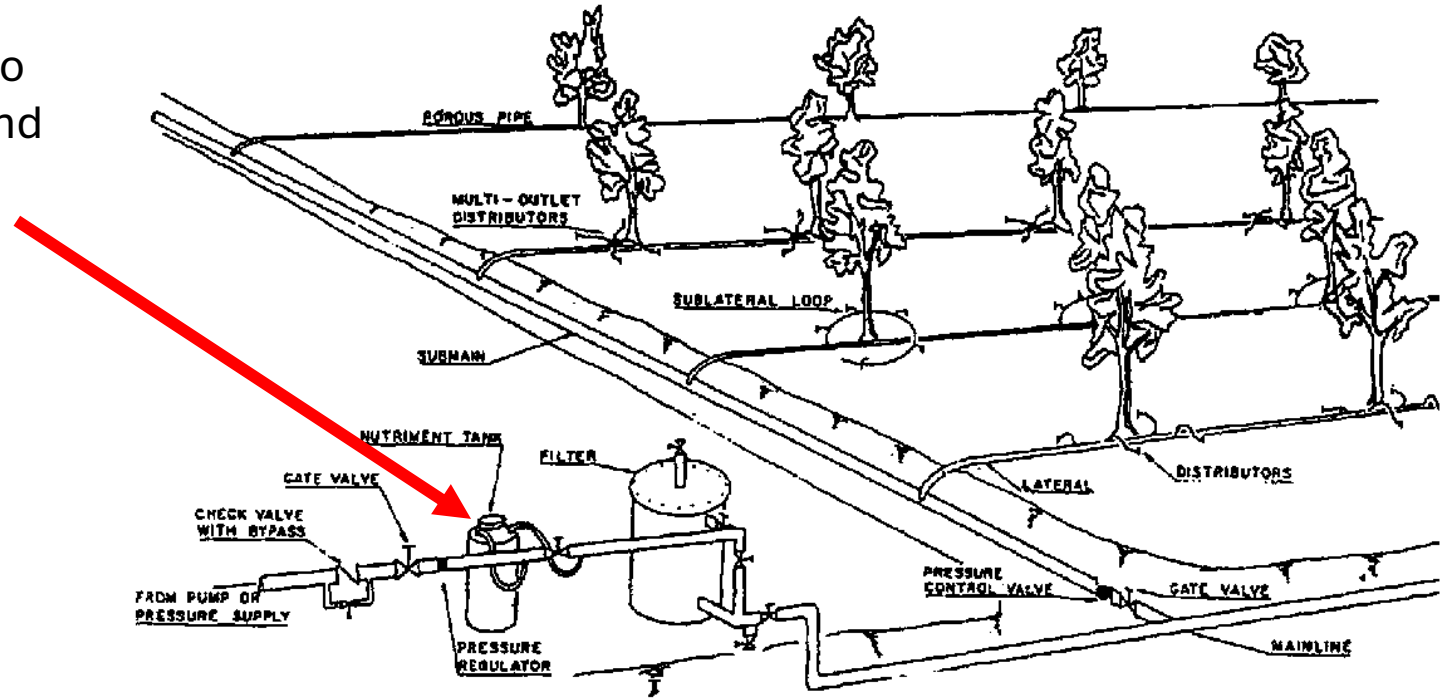


Figure 18. Drip or Microspray Irrigation System (ESCAP, 1989).

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).

Fertilizers are Salts

- Fertilizers dissolve in water into ions
  - (+) and (–) charges
- Not just chemical fertilizers, manures and composts can have very high salt levels too!
- Evaporation wicks salts back to the soil surface
  - Salt content may be very high in the top 1’’ of soil
- No leaching rains to remove build up of salts (fertilizers)

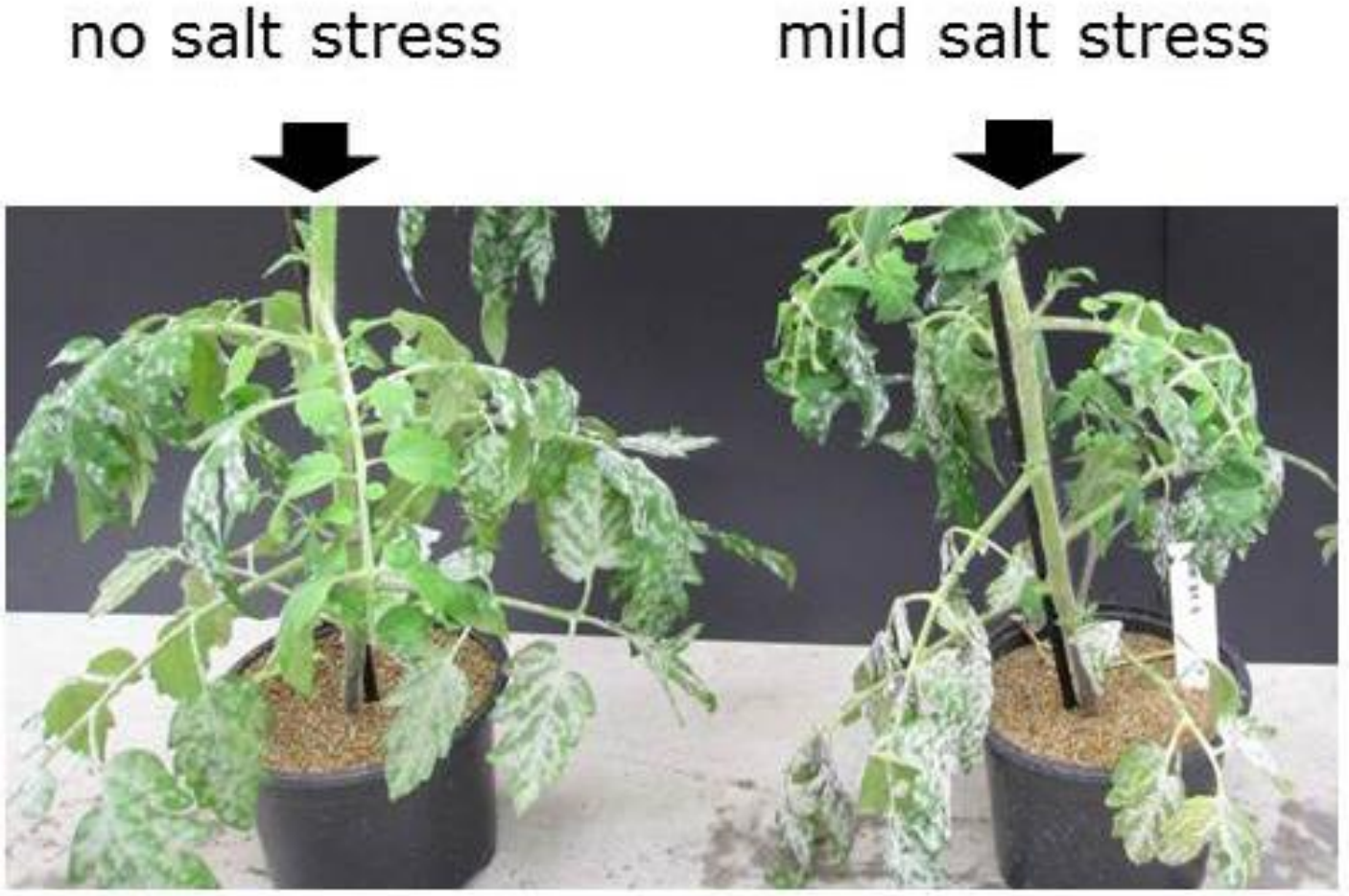
Figure 1. Stunted growth of tomato plants due to salt damage. Note the accumulated salt in the form of white crust on top of the soil between the rows (Photo by Dan Egel).

https://vegcropshotline.org/article/salt-accumulation-for-vegetable-production-in-high-tunnels/

Salt Build Up In Tunnels

- Monitor EC on soil test yearly.
  - Over 1 dS/m may mean trouble (check the method used)

- Check your irrigation water for it's salt level



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3. *Check salt levels*
    - *(EC) electrical conductivity* **FREE**, but must request

Using your soil test results

2. Soil Properties

Property	Value	Units
Soil pH (1:2 soil-water)	5.2	–
Soil EC (1:2 soil-water)		µmhos/cm
Soil ECEC	9	cmolc/kg
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

- Check the method used and the units being reported
  - 1:2 water extract vs saturated paste

1 dS/m = 1 mmho/cm= 1,000 µmhos/cm

1 deciSiemens per metre = 1 millimho per centimetre= 1,000 *micromhos per centimeter*

- **On our soil test in Arkansas: Strawberries may show toxicity at >500 umhos/cm**

Managing Salt Build Up In Tunnels

01

Crop rotation, cover crops

02

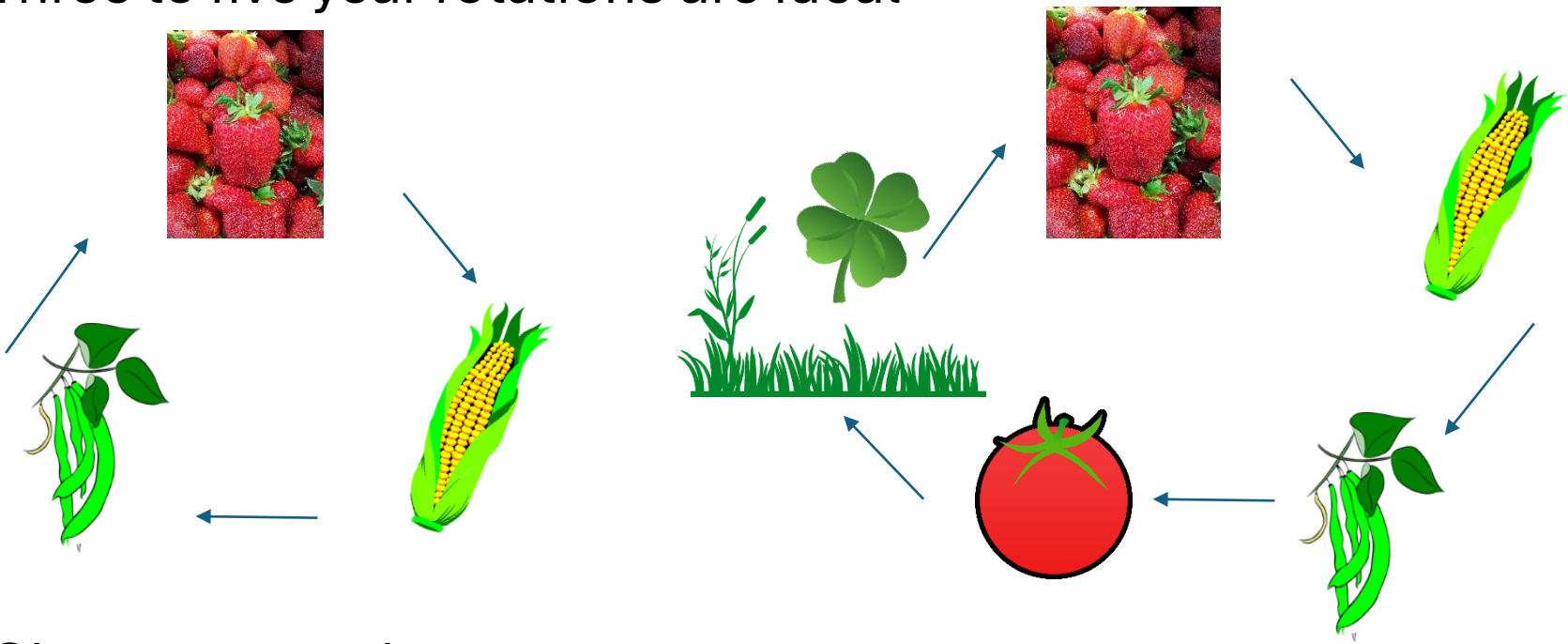
Leave plastic off every 3-4 years

03

Irrigate and flush with water (6’’)

Crop Rotation

- Three to five year rotations are ideal



- Choose crops that:
  1. Don’t share the same diseases.
  2. Root to different depths
  3. Have different nutrient use requirements

Cover Crops in High Tunnels

- Grow in off-season
  - Will need irrigation
- Material removed (SOLD?) to remove some of the nutrient build up
  - Sorghum sudan
  - Sunflower (salt accumulator)
  - Cereal rye
- Terminate 2 weeks prior to bed preparation
  - Immediately till into the soil
  - Decomposition will be rapid under higher temperatures
    - Mineralization may be very rapid
  - Ensure adequate moisture

UAEX Fruit and Vegetable Channel

Introduction to Cover Crops Video Series

- Why Cover Crops?
- Summer Cover Crops
- Winter Cover Crops
- Cover Crop Mixes
- Cover Crop Seeding & Establishment
- Cover Crop Termination

Every 3-4 years time to replace that plastic…

- Leave plastic off and allow >4’’ of rainfall to flush salts out
  - (so about 6-100 days in Arkansas ☺)

  OR
- “Flood” Apply:
  - 6 inches of water to leach about 50% of the salts
  - 12 inches to leach about 80% of the salts
  - 24 inches to leach about 90% of the salts
    - (California Fertilizer Association, Western Fertilizer Handbook, 8th Ed.)

Thanks and stay in touch!

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