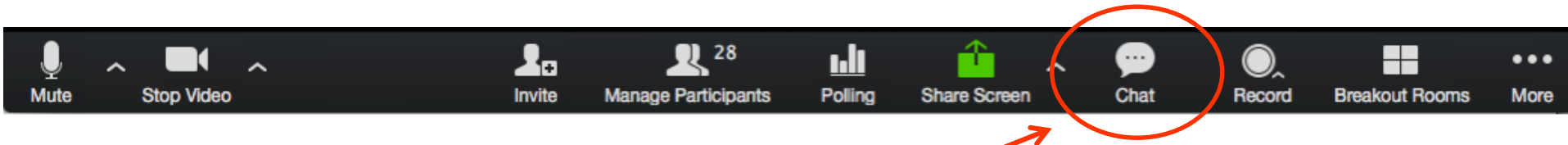
Welcome!



Please use the chat button to tell us:

1. Your Name
2. Your Email address
3. Your Nutrient Management Certification # (if you have one)
4. Your favorite tomato variety for a high tunnel

Soil Health in New England High Tunnels

Katie Campbell-Nelson
UMass Extension / Northeast SARE

New England Vegetable & Berry Grower's Assoc.

UMass Extension

1865 The University of Maine

University of Vermont Extension

University of New Hampshire Cooperative Extension

University of Rhode Island Cooperative Extension

2018 High Tunnel Survey Goals

- Share successful practices
- Teach how to take soil and tissue tests
  - How to analyze them
- Share recommendations

Greenhouse Production

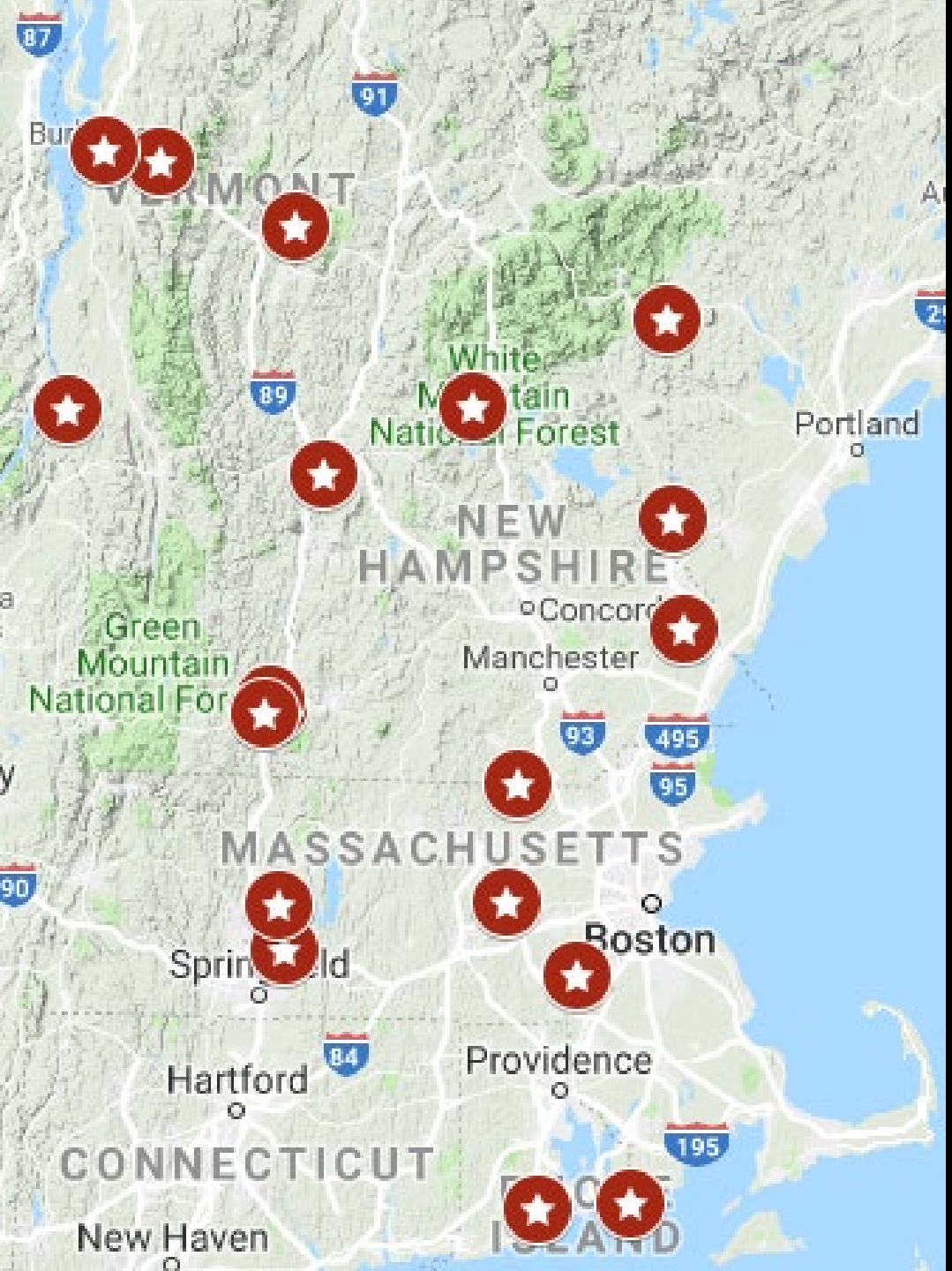
State	# farms	Production ft^2
MA	227	744,199
NH	198	532,328
RI	48	101,962
VT	263	659,911
Total	736	2,038,400

from 2017 U.S. Census of Agriculture; includes greenhouses, high tunnels and all types of production systems.

Delaware Greenhouse Production

Crops	# farms	Production ft^2
Tomatoes	25	80,146
Other Veg	17	42,304
Fruit	4	26,875
Total	46	149,325

from 2012 U.S. Census of Agriculture; includes greenhouses, high tunnels and all types of production systems.

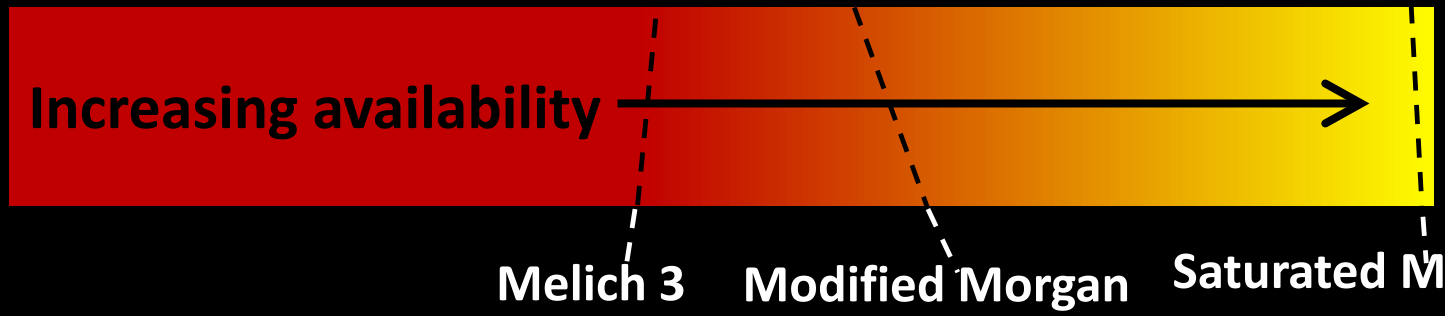


Data

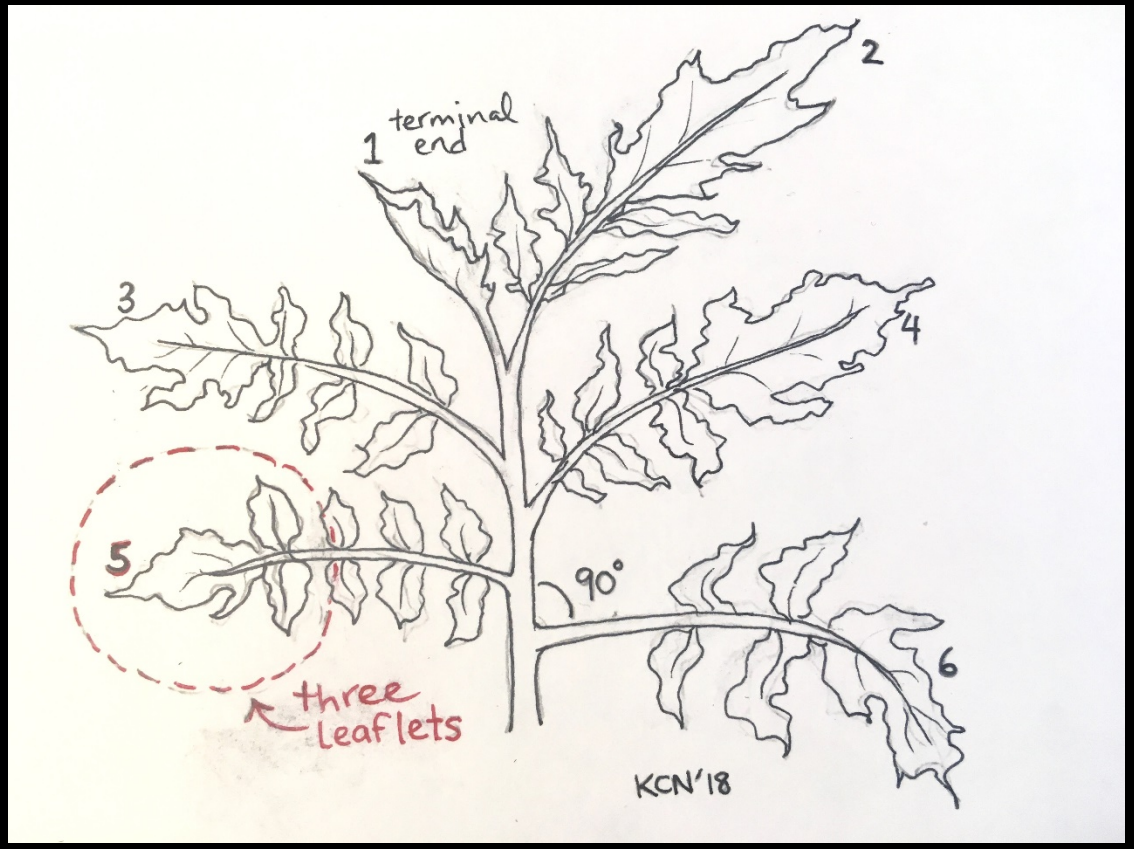
- Compaction
- Spacing / # of leaders
- Irrigation
- Fertilizer
- Pesticides
- Varieties
- Yield
- Monthly Lab Analysis:
  - Modified Morgan
  - Saturated Media
  - Leaf Tissue

Monthly Lab Analysis

Soil



Leaf



Results For : PURE HARVEST FARM
Location : MILTON DE
Sample ID : T3

AgroLab
Serving Agriculture and Soil Fertility Professionals

Extraction Method: Mehlich 3

	Analysis	Sufficiency Levels (Deficient / Low / Sufficient / High)
pH	6.2	
Buffer pH	6.9	
Soluble Salts 1:2, EC mmho/cm	0.05	
Nitrate-N, ppm N	1.7	
Nitrate-N, Lbs N/A	4.00	
Depth	0 - 8 in	
Ammonium-N ppm	3.6	
Phosphorus, ppm P	157	
P Saturation	59	
Potassium, ppm K	25	
Calcium, ppm Ca	507	
Mg % Saturation	20	
Na % Saturation	1	
Organic Matter, %	1.6	
Aluminum, ppm Al	550.0	
Iron, ppm Fe	100.0	

Recommendations
In Actual Pounds of Plant Nutrients per Acre

Crop : (AgroLab)
Sub-Soils :

Nitrogen Credit : 0
Yield Goal : 1

N	P2O5	K2O	S	Zn	Mg	Fe	Mn	Cu	B	Ag-Lime Tons/Acre
10	0	120			0	0				

Recommendations
In Actual Pounds of Plant Nutrients per Acre

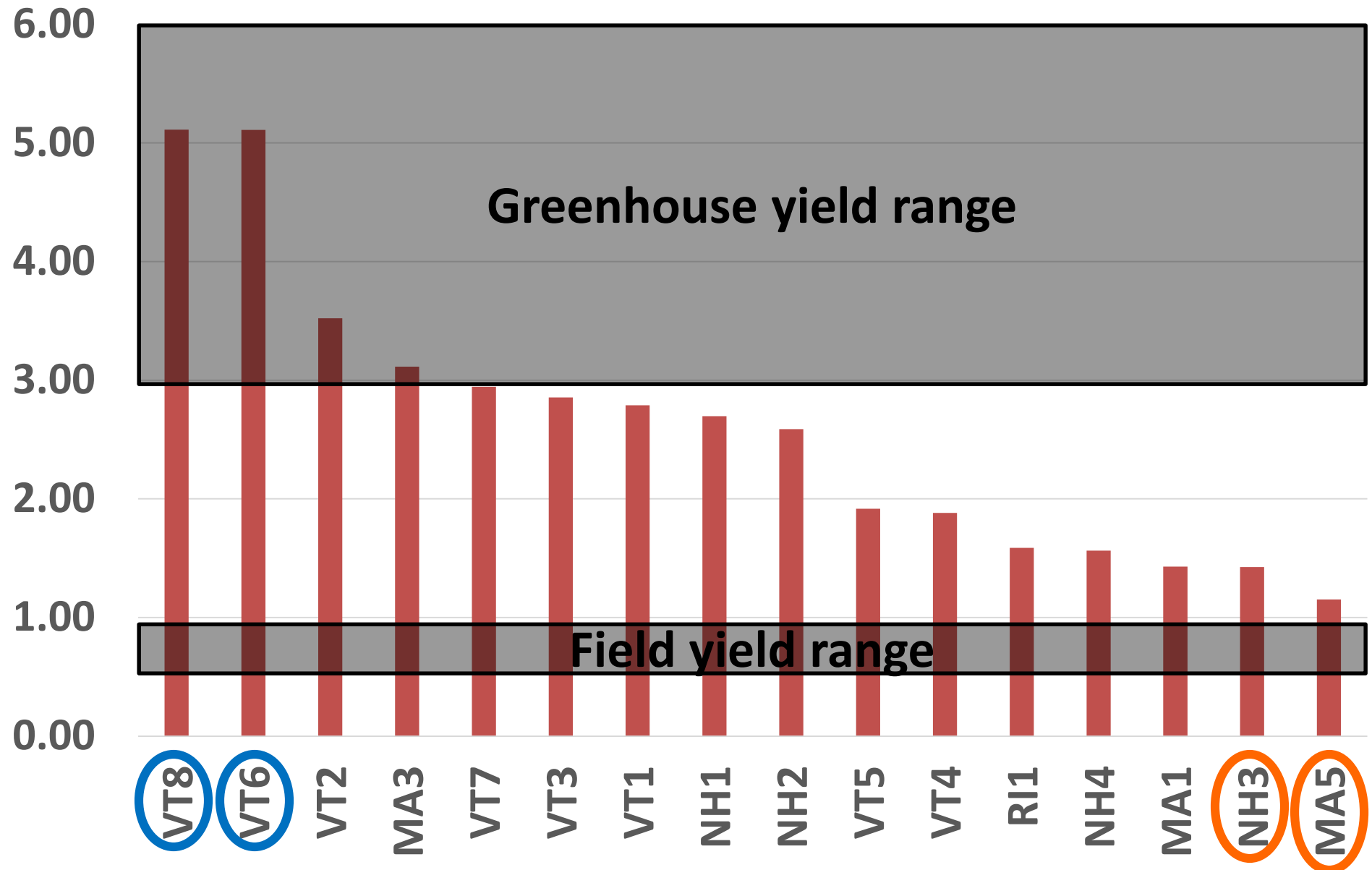
Production Practices

Production Practice	# Farms out of 20
Geronimo	13
grafting	12
Organic	11
fertigation	11
multiple leaders	9
Mulch: black plastic (6), white plastic (4), none (3), landscape fabric (3), weed mat (2), silver (1)	

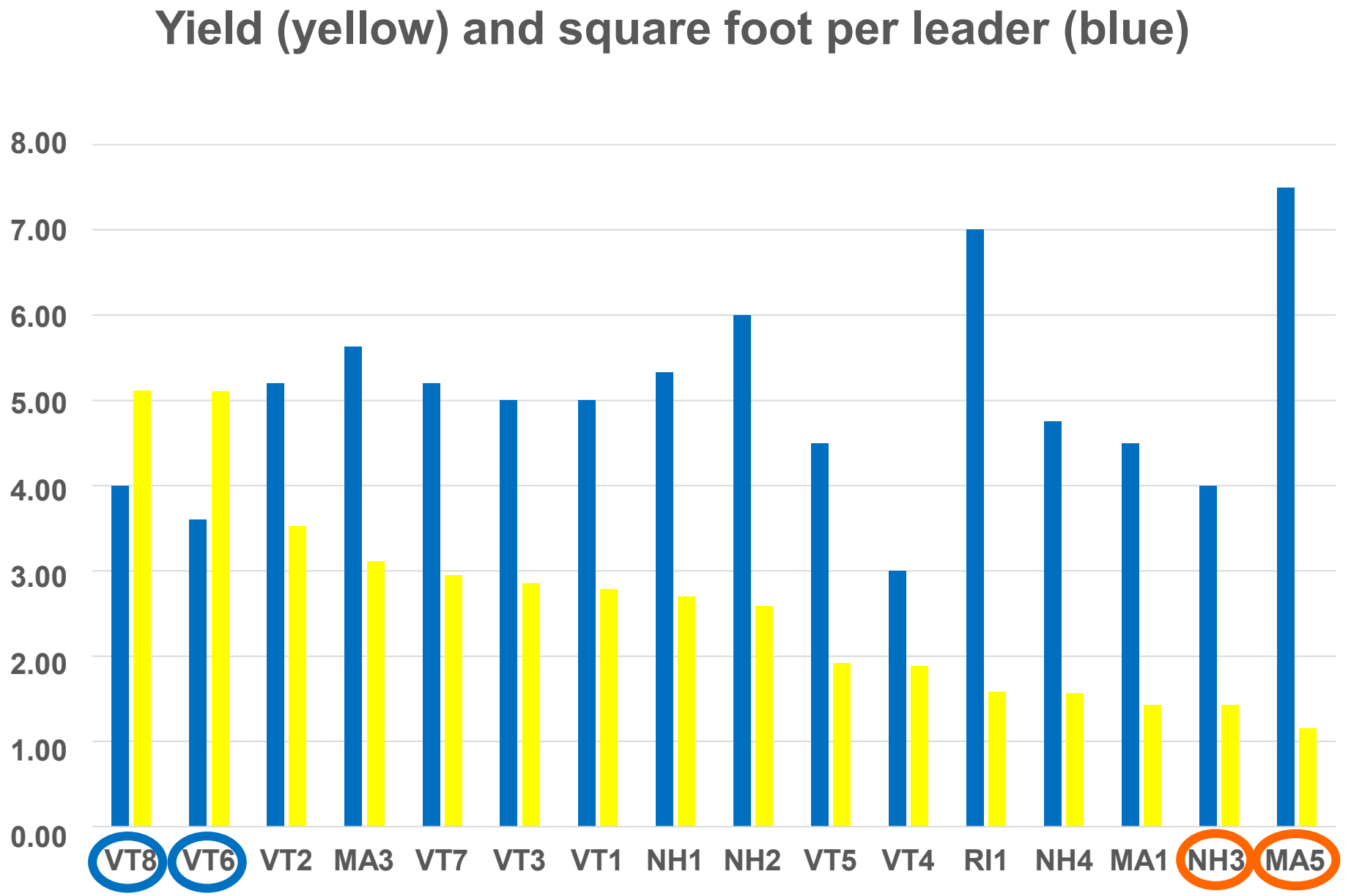
Transplant dates: March 31 – May 20

Harvest period: 6 weeks – 6 months

Yield lbs per ft^2



Total yield and plant spacing



VT

May 1st

June

July

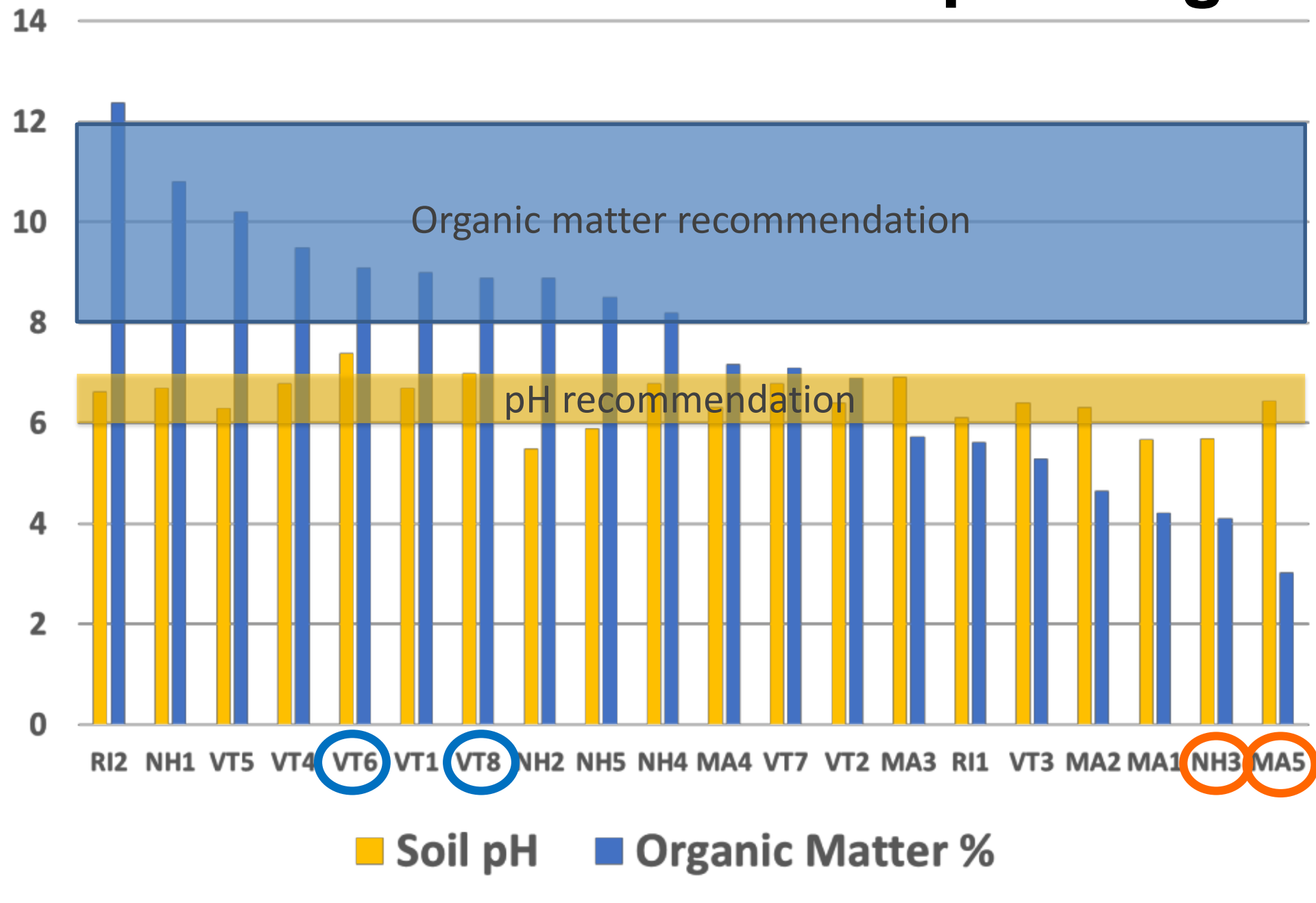
August

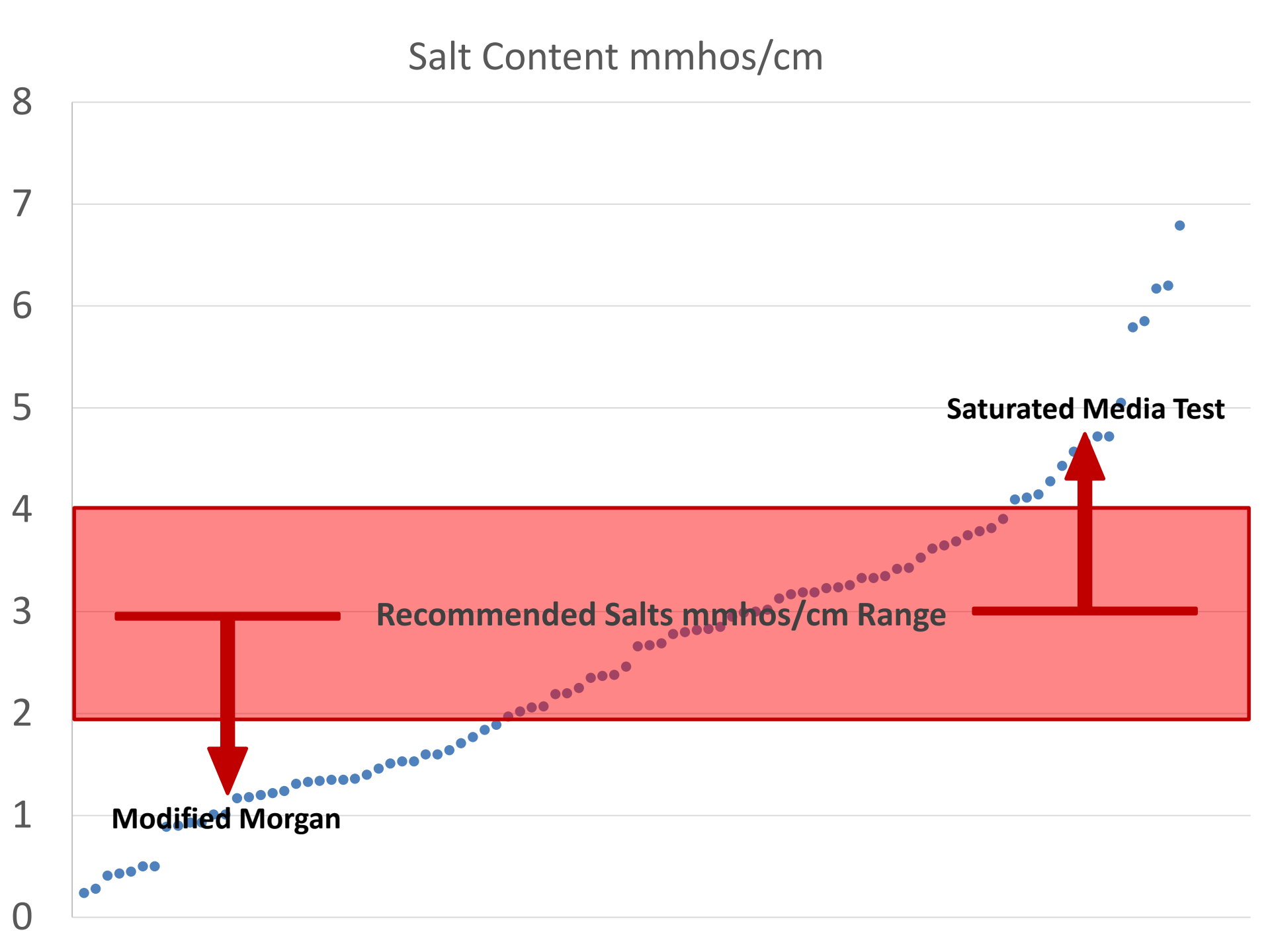
September

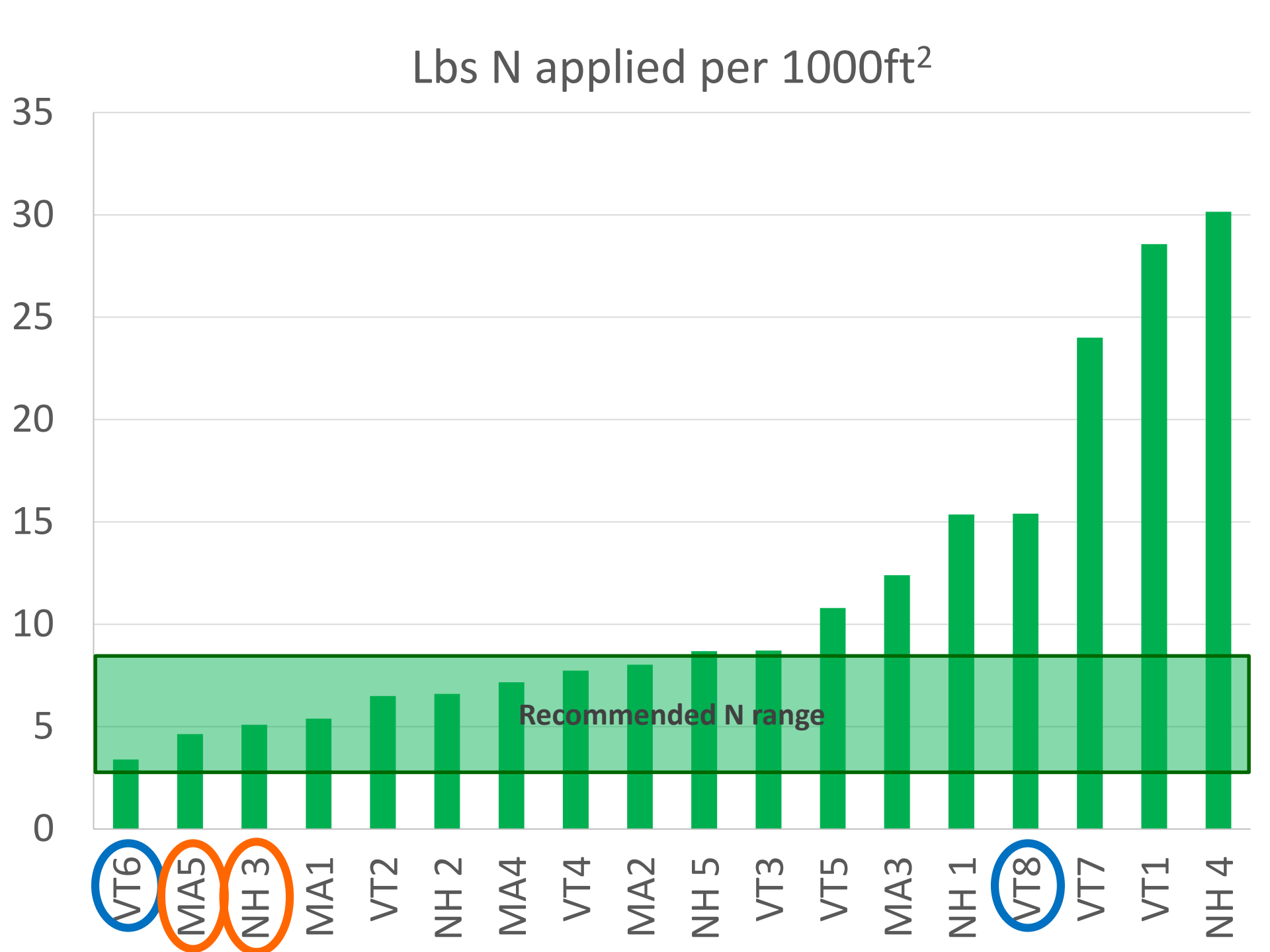
November

MA

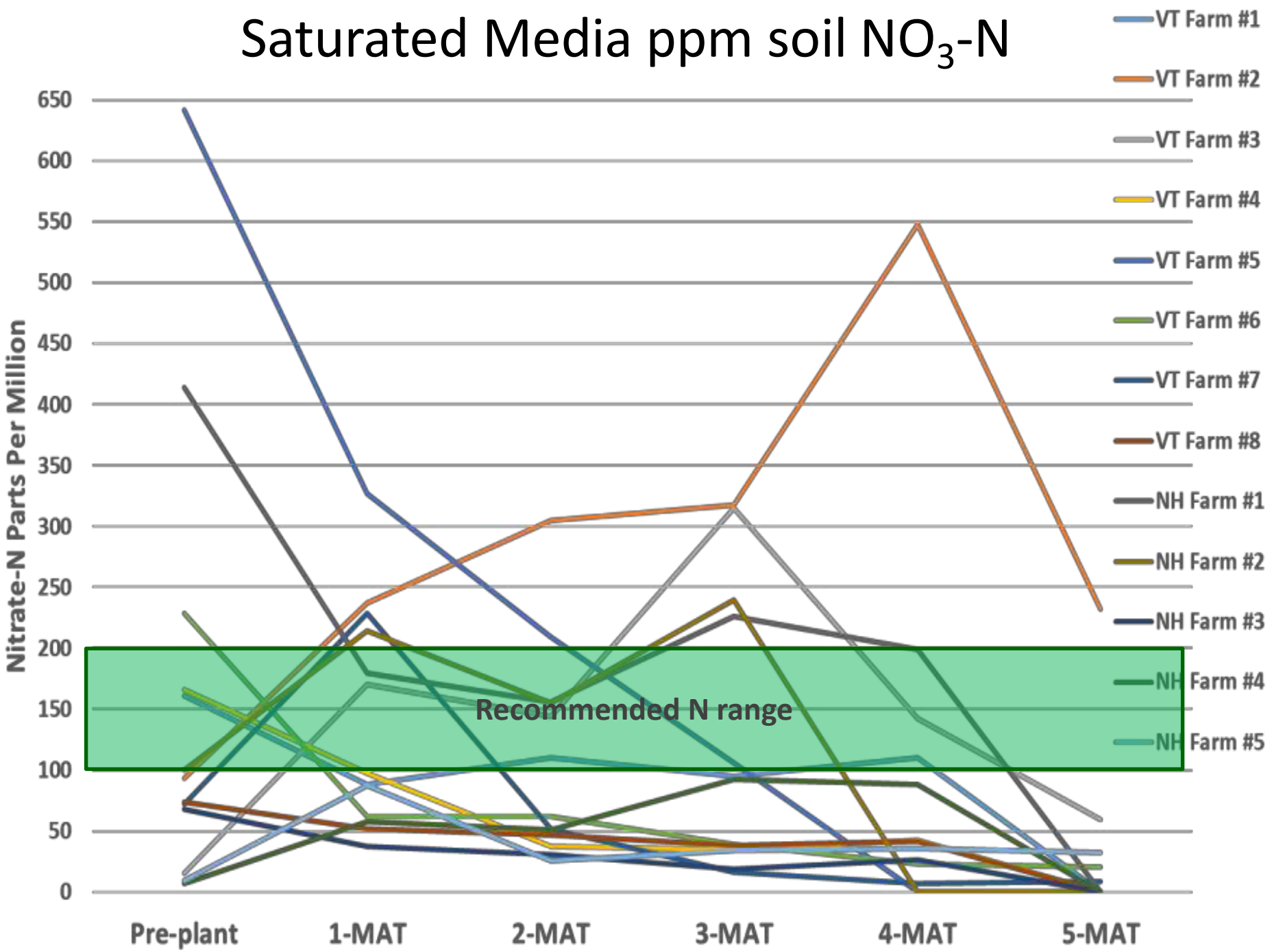
One month after transplanting



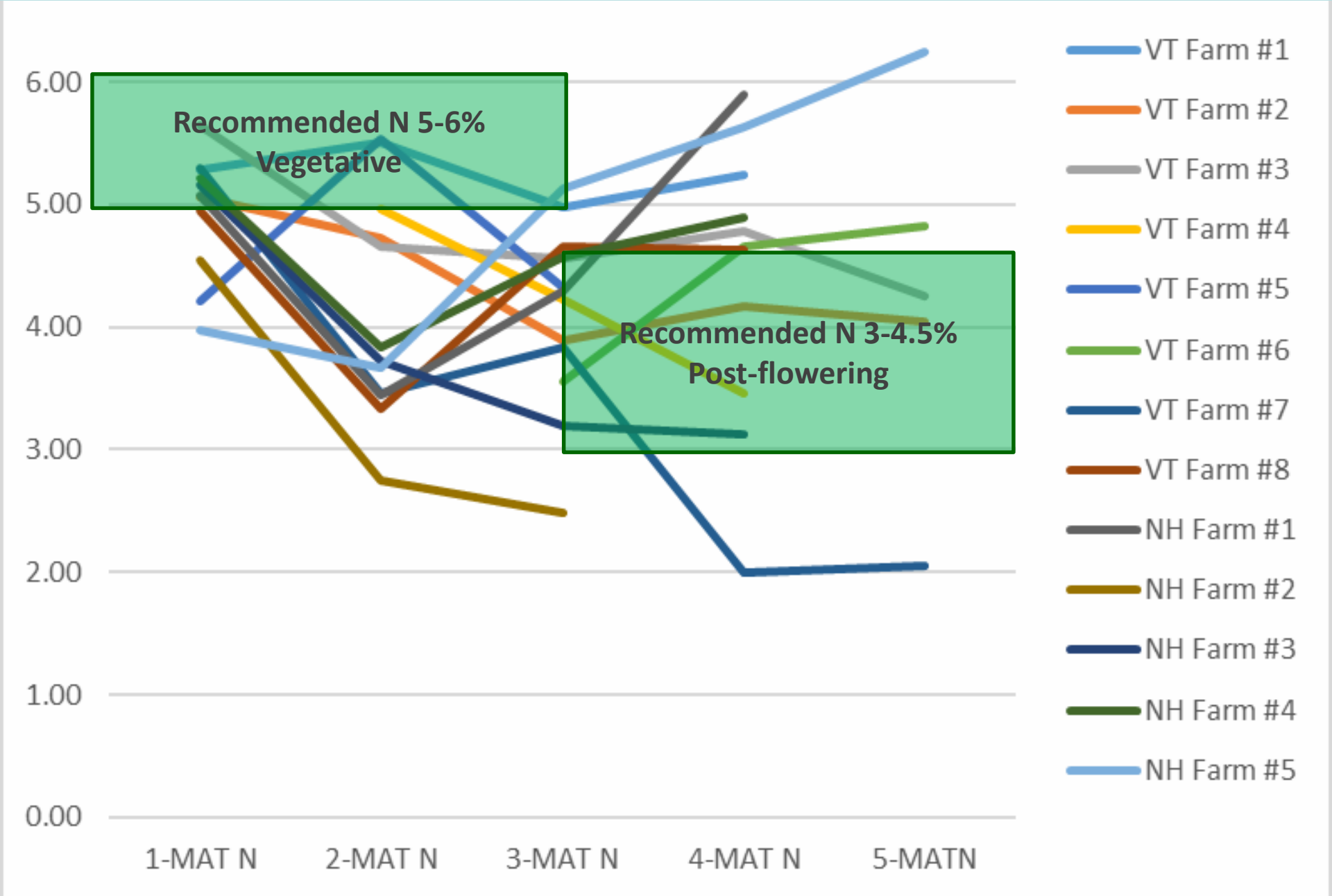

Salt Content mmhos/cm
8
7
6
5
4
3
2
1
0
Saturated Media Test
Recommended Salts mmhos/cm Range
Modified Morgan

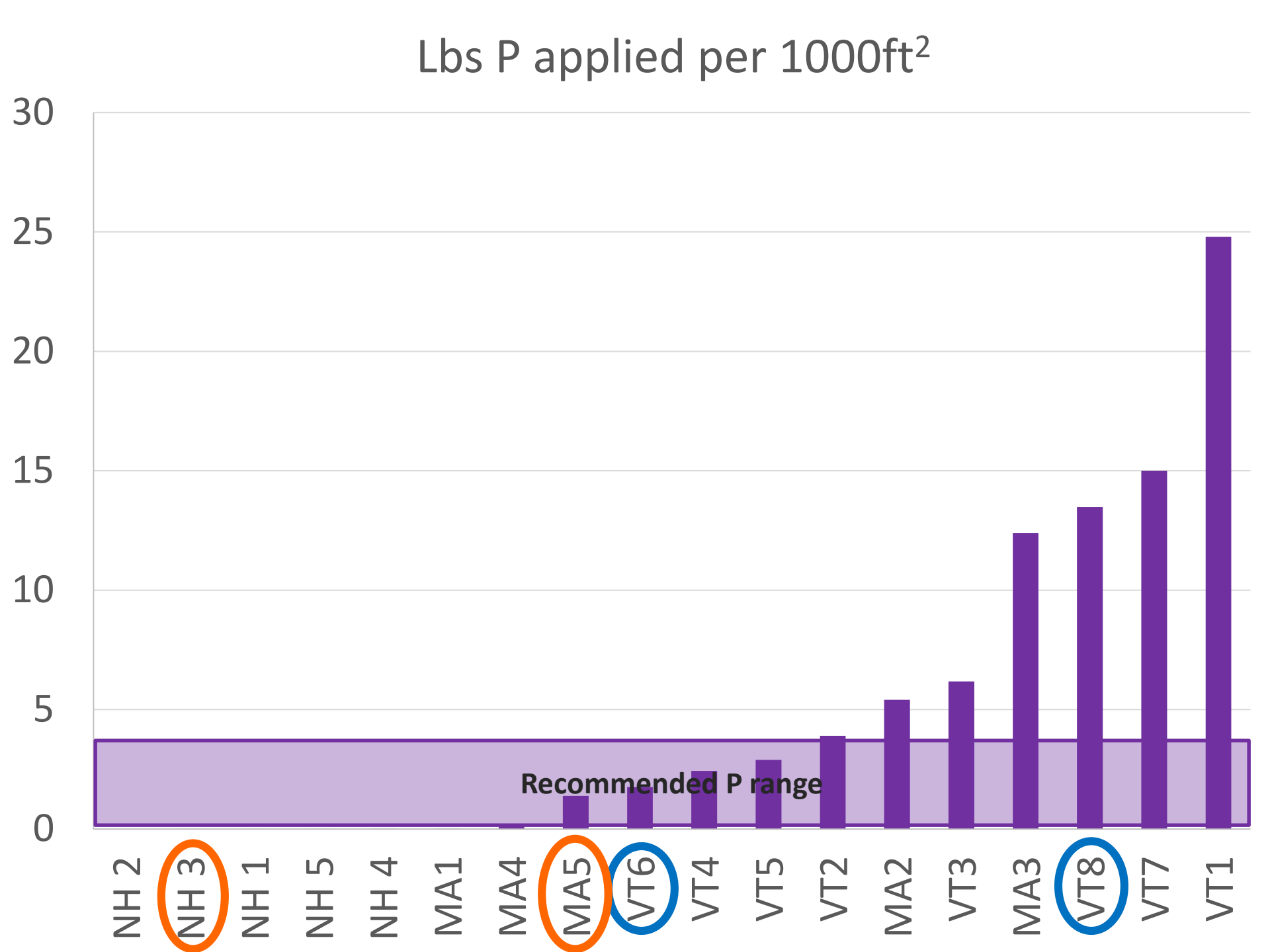

Lbs N applied per 1000ft²
35
30
25
20
15
10
5
0
Recommended N range
VT6
MA5
NH 3
MA1
VT2
NH 2
MA4
VT4
MA2
NH 5
VT3
VT5
MA3
NH 1
VT8
VT7
VT1
NH 4

Saturated Media ppm soil NO_3-N

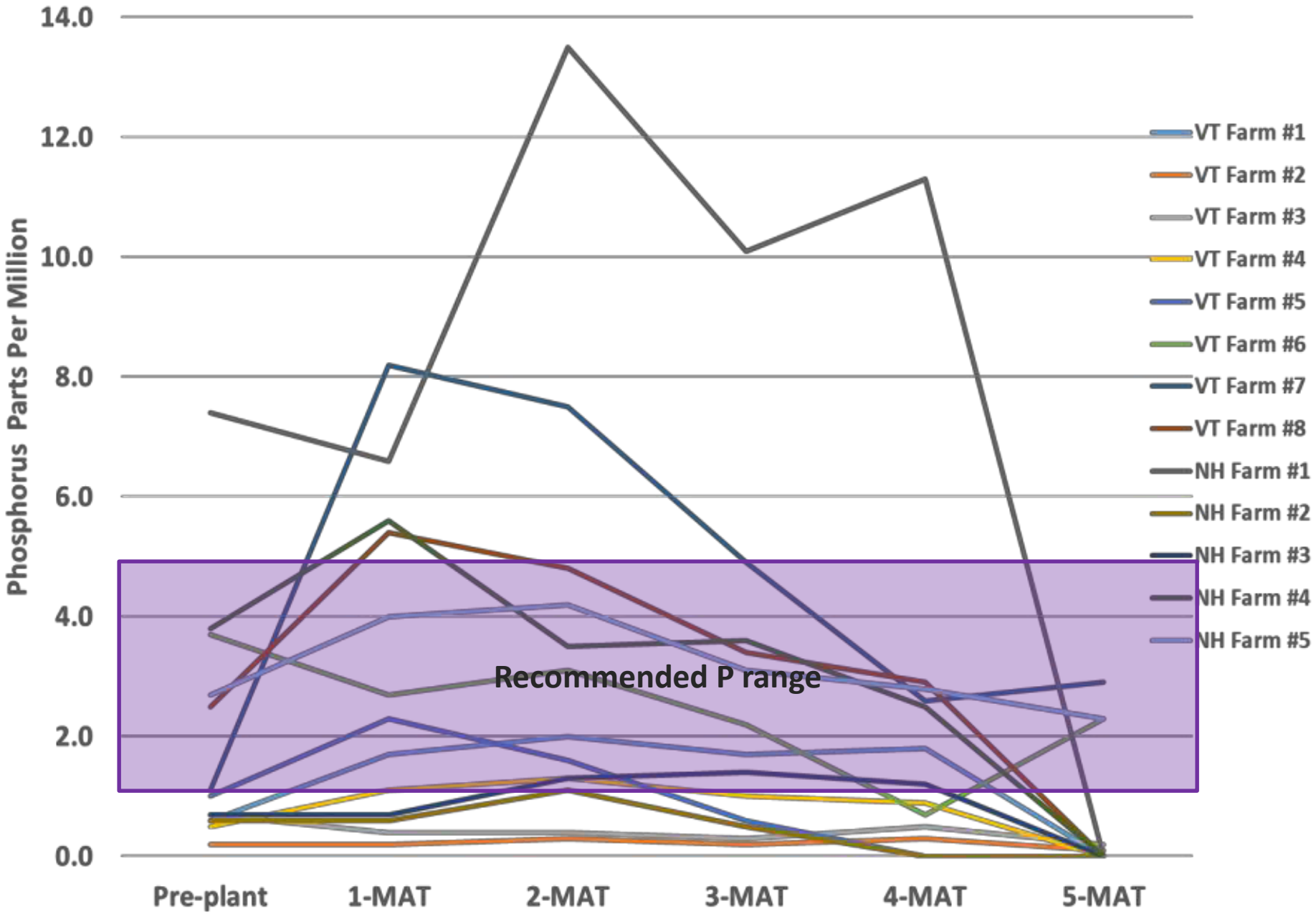


% N in leaf samples

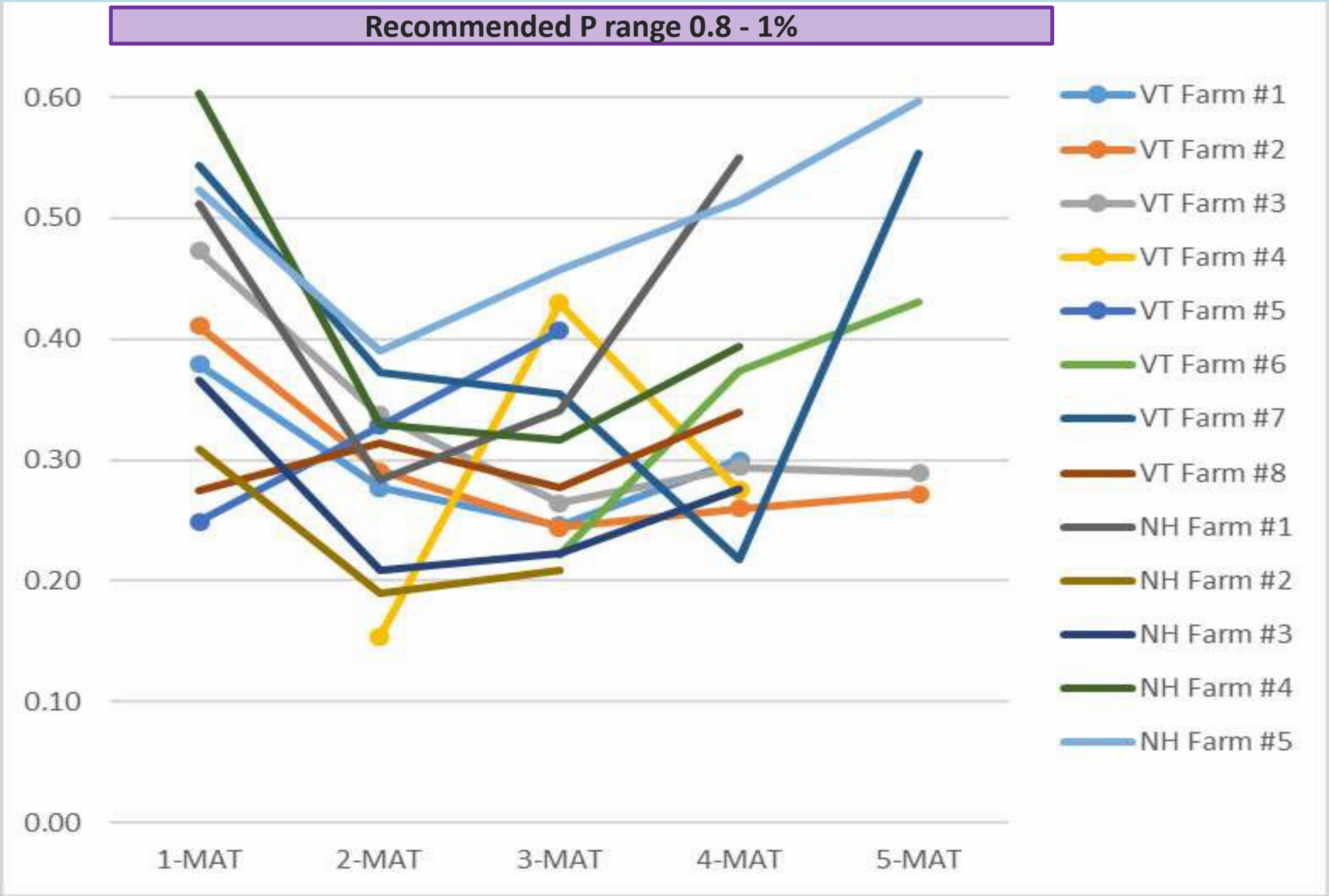


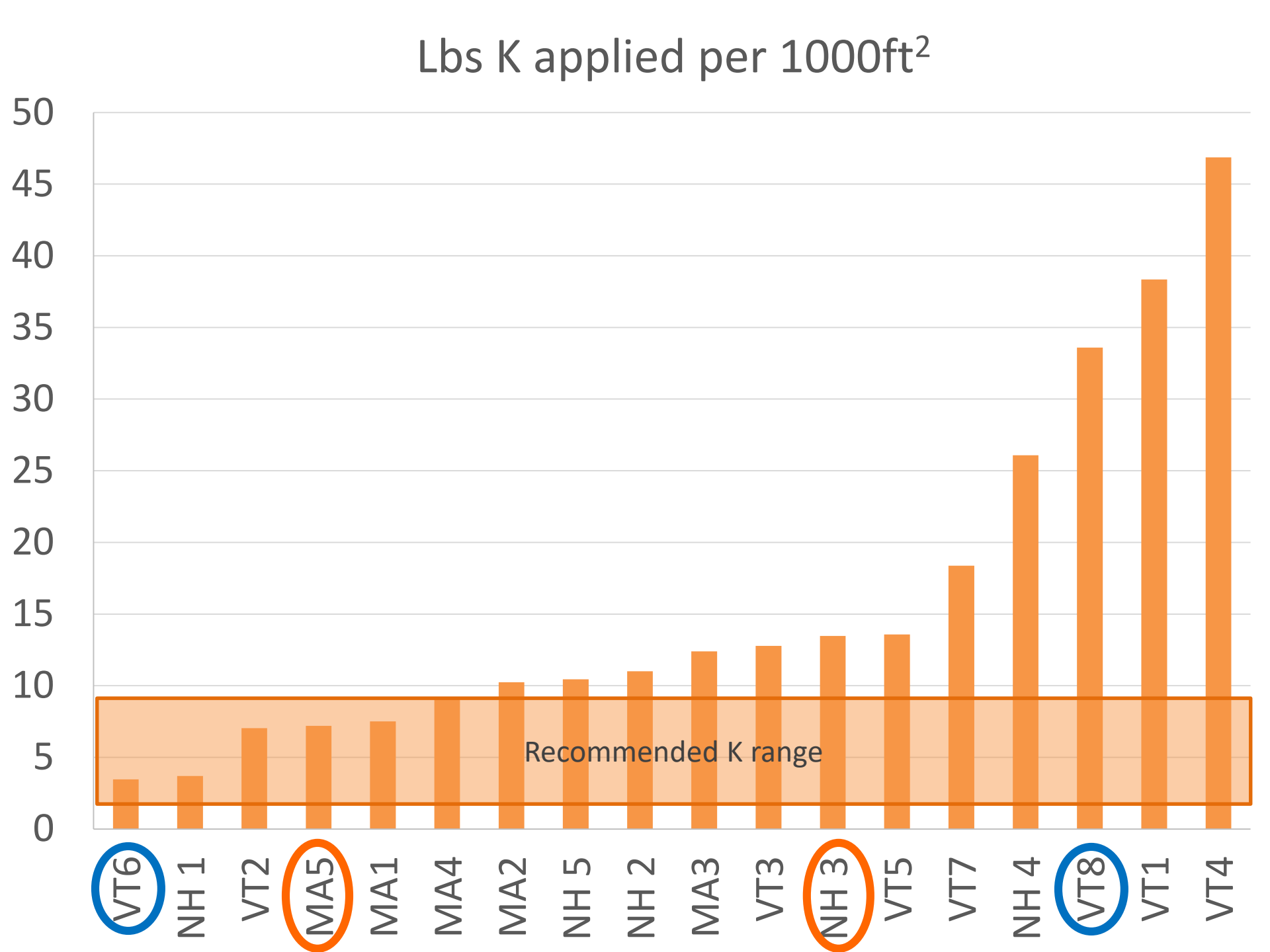

Lbs P applied per 1000ft²
30
25
20
15
10
5
0
Recommended P range
NH 2
NH 3
NH 1
NH 5
NH 4
MA1
MA4
MA5
VT6
VT4
VT5
VT2
MA2
VT3
MA3
VT8
VT7
VT1

Saturated Media ppm soil P_2O_5

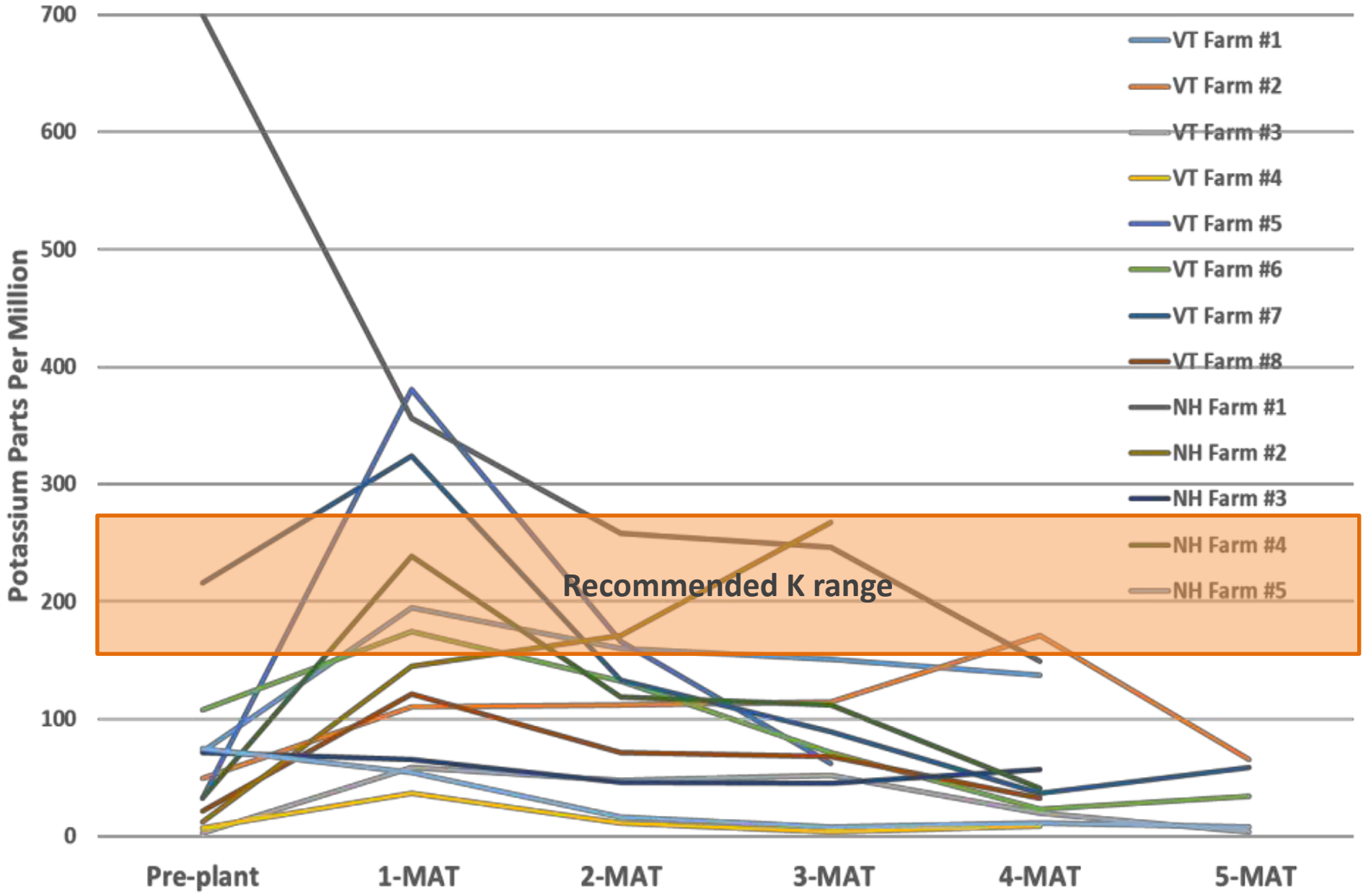


% P in leaf samples

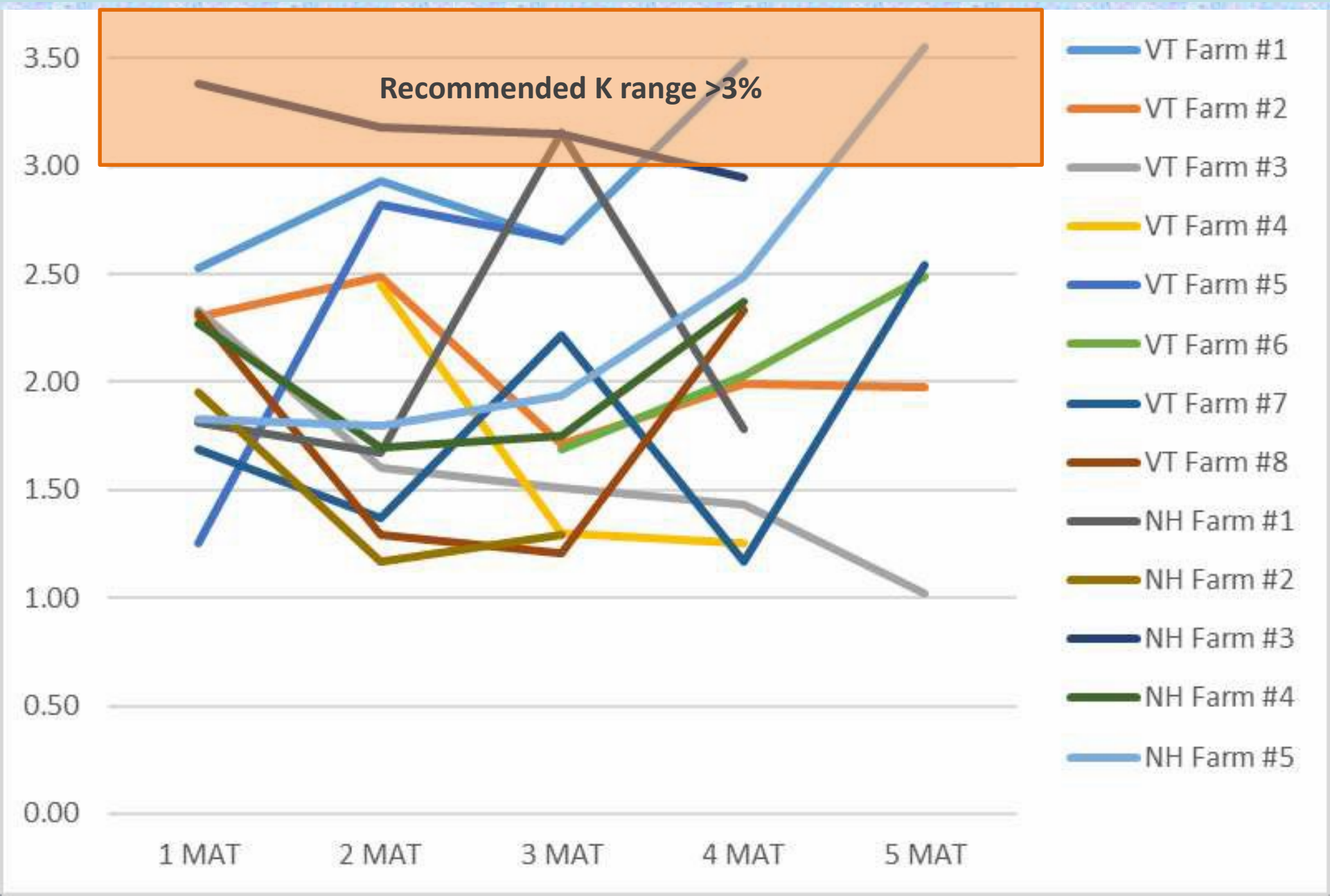



Lbs K applied per 1000ft²
50
45
40
35
30
25
20
15
10
5
0
Recommended K range
VT6
NH 1
VT2
MA5
MA1
MA4
MA2
NH 5
NH 2
MA3
VT3
NH 3
VT5
VT7
NH 4
VT8
VT1
VT4

Saturated Media ppm soil K_2O



% K in leaf samples



Pests

60%
hornworm

35%
powdery mildew

25%
aphid

20%
leaf mold

20%
nutrient def.

15%
early blight

10%
botrytis

10%
spider mite

10%
rodents

10%
w
d
la

5%
white
rot

5%
RK
nemat
ode

5%
whitefly

What went wrong?

Tomato Hornworm
Manduca quinquemaculata

What went wrong?

Botrytis canker
(*Botrytis cinerea*)

What went wrong?

Leaf Mold
(*Passalora fulva*)

What went wrong?

Powdery Mildew
(*Oidium lycopersici, Leveillula taurica*)

What went wrong?

Root knot nematode
(*Meloidgyne hapla*)

	Top Yield (5lbs/ft^2)	Bottom Yield (1lbs/ft^2)
Years in Production	20	6
Variety	Geronimo grafted	Geronimo grafted
Compaction	None	15 cm
Fertigate?	No	Yes
Pests	Hornworm	Hornworm and Powdery Mildew
Feet^2 per Leader	4.15	7.5
Nutrients applied lbs/1,000 ft^2	15 N, 14 P, 34 K	5 N, 2 P, 3 K
pH	6.9	6.4
Soil Organic Matter	9.1%	3.9%

What can I do?

- Consider early, denser planting
- Measure compaction
- Add irrigation lines
- Keep up with pruning
- Scout and Manage Pests
- Track yield by tunnel
- Apply 2/3 fertility up front, 1/3 fertigate weekly
- Stay low with P applications
- Increase K applications at bloom (14-17 lbs/1,000 ft^2)
- Provide sufficient N (6-9 lbs/ 1,000 ft^2)
- Test Regularly (monthly?)
  - soil and tissue nutrients – Organic matter – pH – Salts

Considerations for Delaware

- Use Melich 3 soil test if saturated salts are below 3 mmhos/cm
- Use Saturated Media Test if saturated salts are above 3 mmhos/cm
- Try high tunnel varieties Geronimo or Rebelski.

Considerations for Delaware

DELAWARE SOIL TESTING PROGRAM

Cooperative Extension

- NUTRITION, FOOD SAFETY & WELLNESS +
- SUSTAINABLE PRODUCTION SYSTEMS +
- 4-H, PERSONAL & ECONOMIC DEVELOPMENT +
- ENVIRONMENTAL STEWARDSHIP −
  - CLIMATE VARIABILITY AND CHANGE
  - DELAWARE SOIL TESTING PROGRAM −
    - General Information on what, how, why and where soil is tested
    - Testing for lead and heavy metals
    - Soil Testing Program Forms
  - FORESTRY
  - LAWN AND GARDEN +
  - DELAWARE MASTER GARDENERS +
  - MASTER NATURALIST PROGRAM
  - NUTRIENT MANAGEMENT +
  - PEST MANAGEMENT FOR HOMEOWNERS +
  - SALT IMPACTED AGRICULTURAL LANDS

Information Sheets for Routine Fertility, PSNT and Lead Soil Test Samples

- Commercial Sample Information Sheet (2 pages) – *Use for commercial production of agronomic, vegetable, forage, orchard, and nursery crops*
- Home Lawn, Garden and Landscape Information Sheet (2 pages) – *Use for home lawn, gardens and landscapes and similar uses (e.g., schools, etc)*
- Professional Lawn Care and Landscaper Sample Information Sheet –*For use by professional lawn care and landscape companies and golf courses*
- PSNT Sample Information Sheet (1 page) – *Use for the Pre-sidedress Soil Nitrate Test*
- Soil Lead Test Information Sheet – *Use for the Soil Lead Screening Test*

Analysis Request Forms

Use these request forms when submitting samples to the Soil Testing Laboratory for analyses not requiring nutrient recommendations.

- Soil Analysis Request Form
- Plant Analysis Request Form
- Extract / Solution / Water Analysis Request Form
- Greenhouse Media /Solution / Hydroponics Solution Analysis Request Form