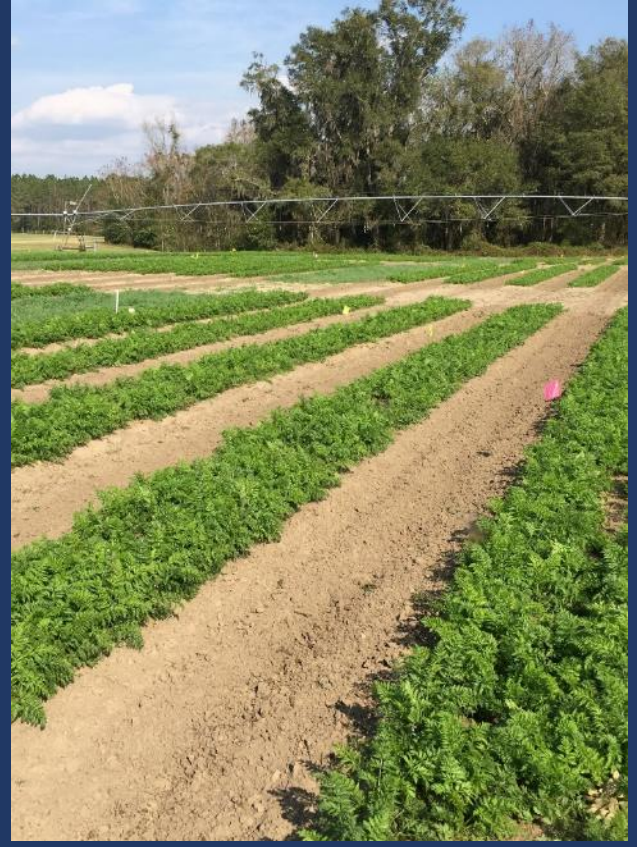



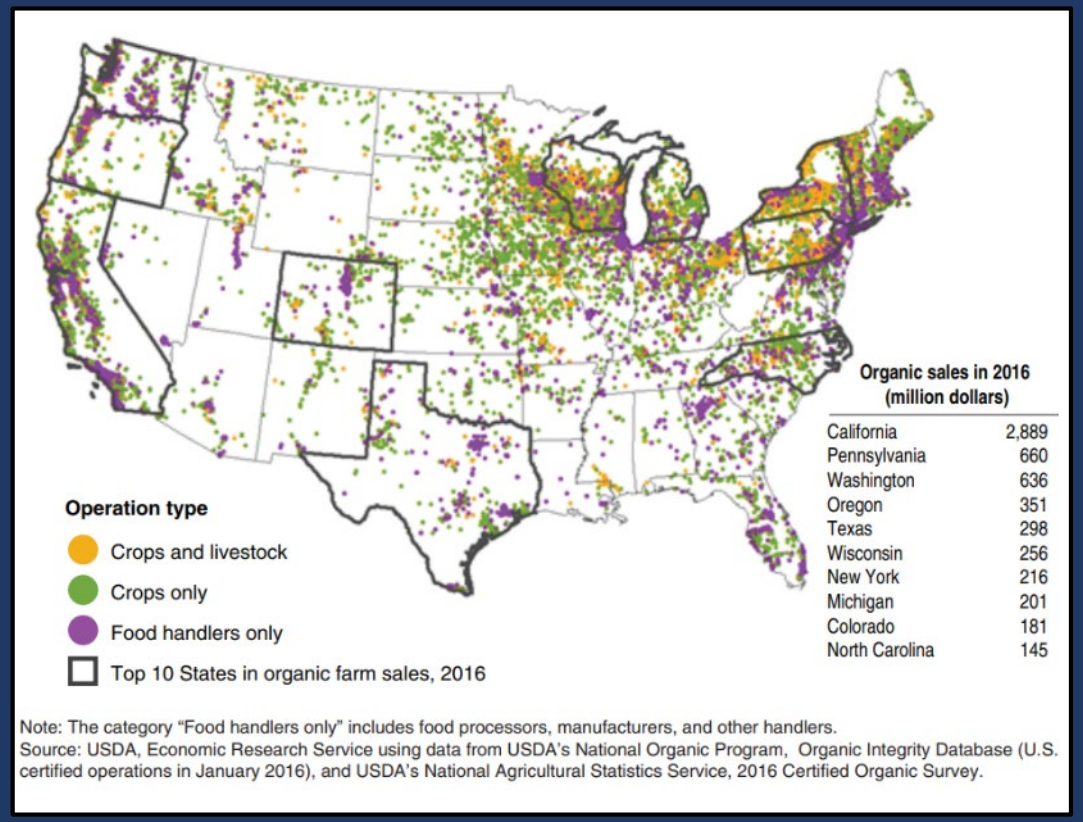
Developing BMPs for Organic Systems, the Carrot Example

UF IFAS UNIVERSITY of FLORIDA

New Technology for Commercial Crop Production IX – IST/2021
Danielle Treadwell, Horticultural Sciences ddtreadw@ufl.edu

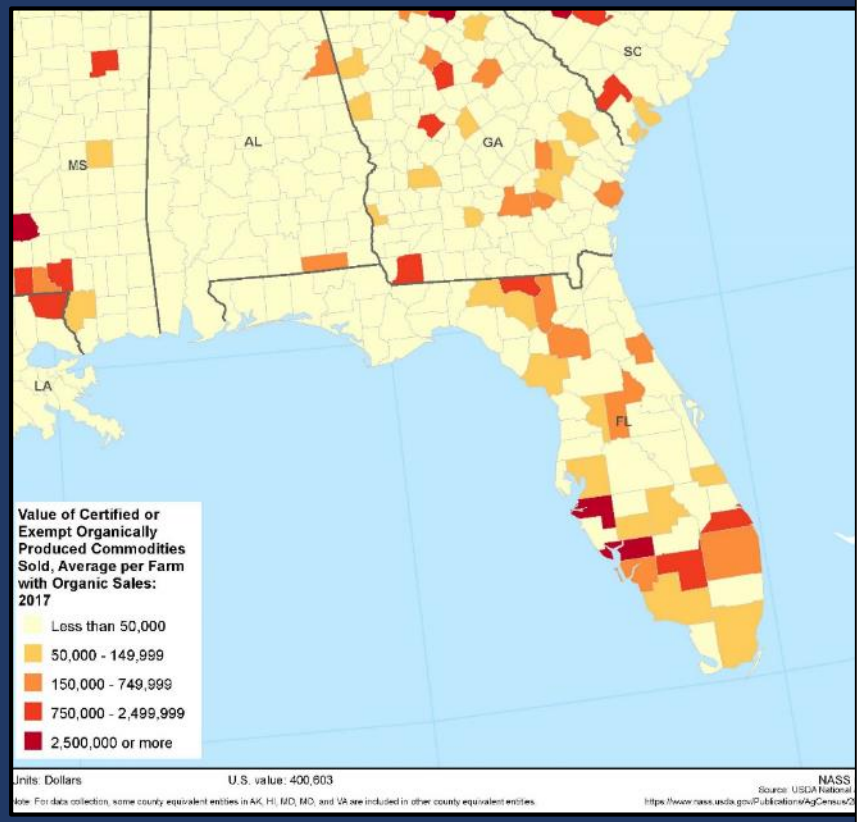
Florida's Organic Industry

Number of certified organic operations in 2016



USDA ERS

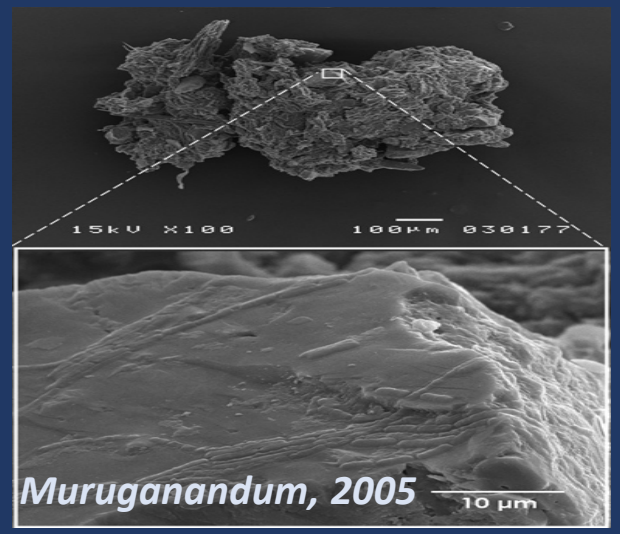
Value of certified organic farms in 2017

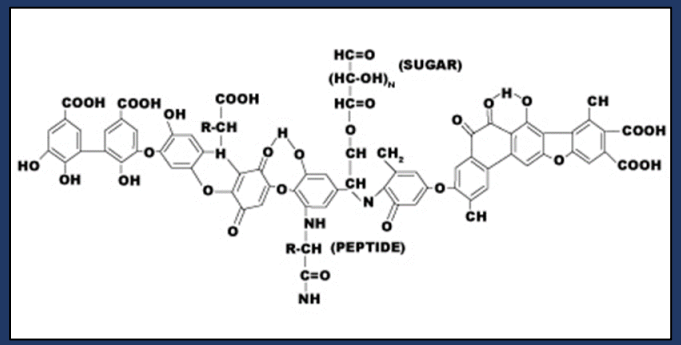


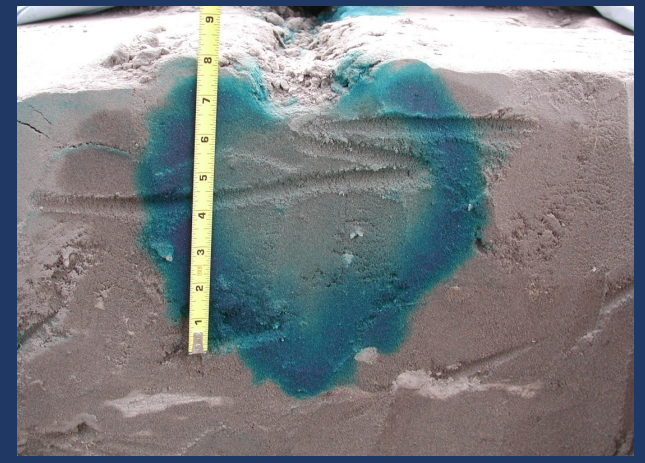
USDA NASS

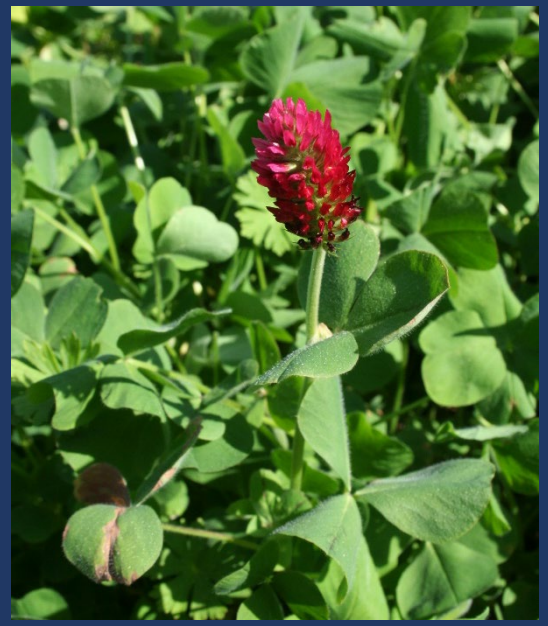
Charlotte
Manatee
Hamilton
Martin
Lake
Lee
Hendry
Palm Beach
Columbia
Alachua
Flagler
Suwannee
Sumter
DeSoto
Madison
Miami Dade
Hillsborough
Highlands
Indian River
Levy
Collier

What do we need to know for N management?

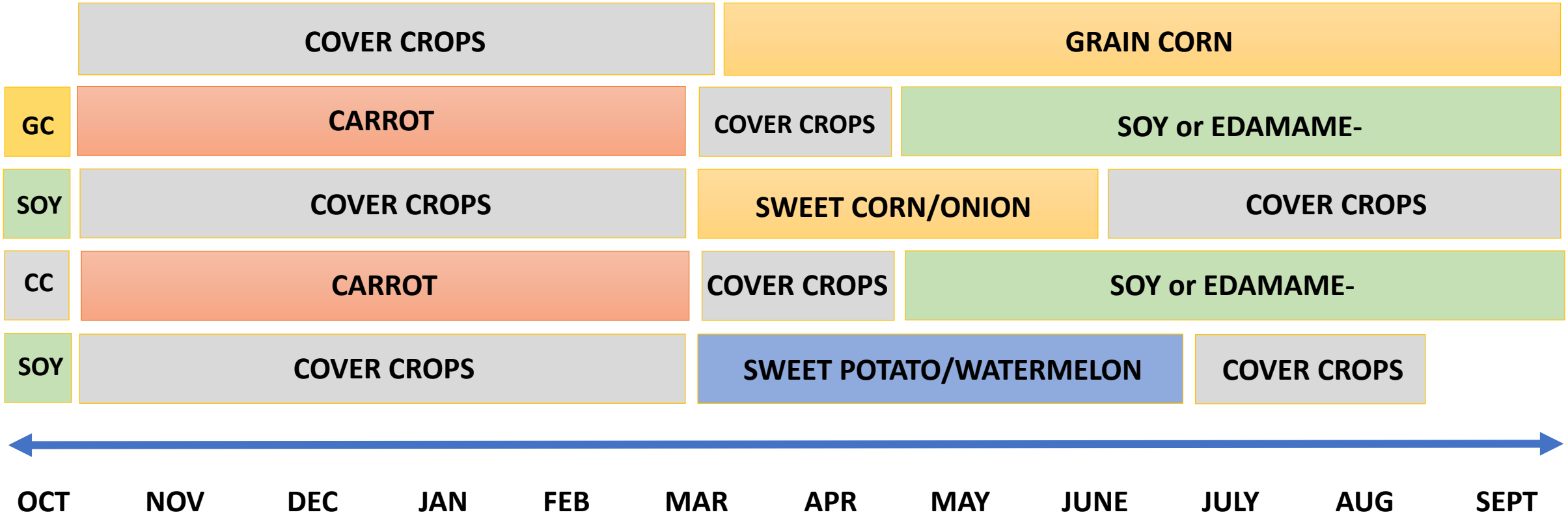




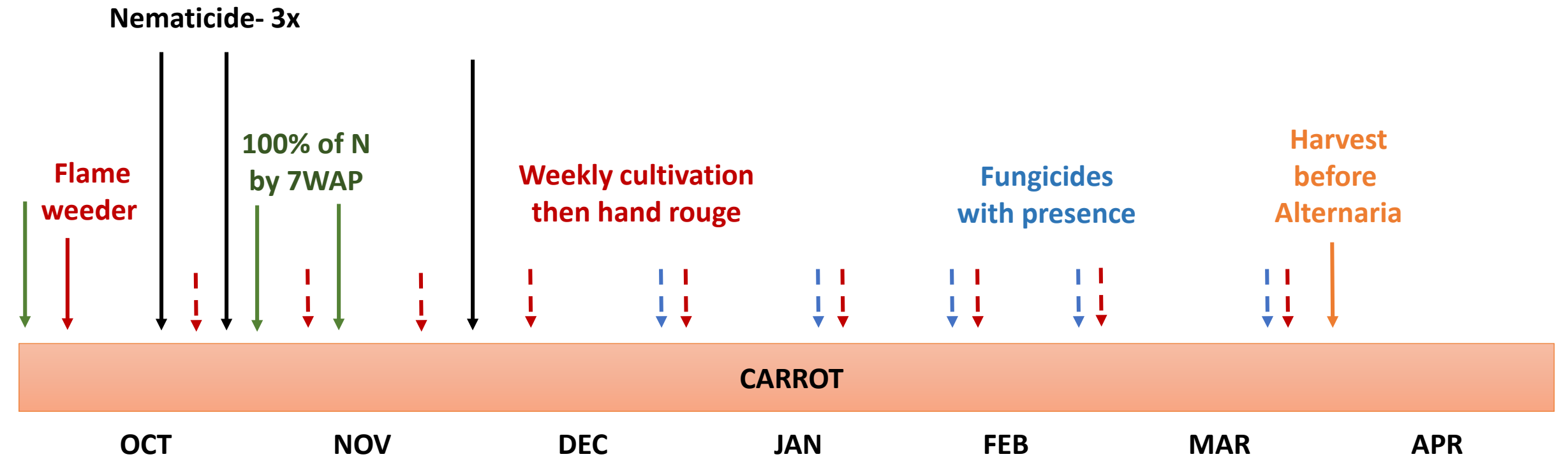




Florida Organic Carrot Rotation



Florida Organic Carrot Production










Organic Carrot Production –UF/IFAS Faculty

Mathews Paret – Plant Pathology.
Alternaria management in organic & conv. carrot.

Zane Grabau – Entomology and Nematology. Ecological nematode management in organic & conv. carrot.

Danielle Treadwell – Horticultural Sciences.
Nitrogen management and organic carrot development.

Gabriel Maltais-Landry - Soil and Water Science.
Mineralization rates of organic fertilizers in carrot.

Xin Zhao – Horticultural Sciences.
Beta carotene content in organic carrot.

Peter Dittmar – Horticultural Sciences.
Cultural weed management in organic carrot

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Objective

- To support our farm clientele and achieve the state's water quality goals, a two-year study was designed to contribute to the development of Best Management Practice recommendations for nitrogen management in organic carrot in north central Florida.

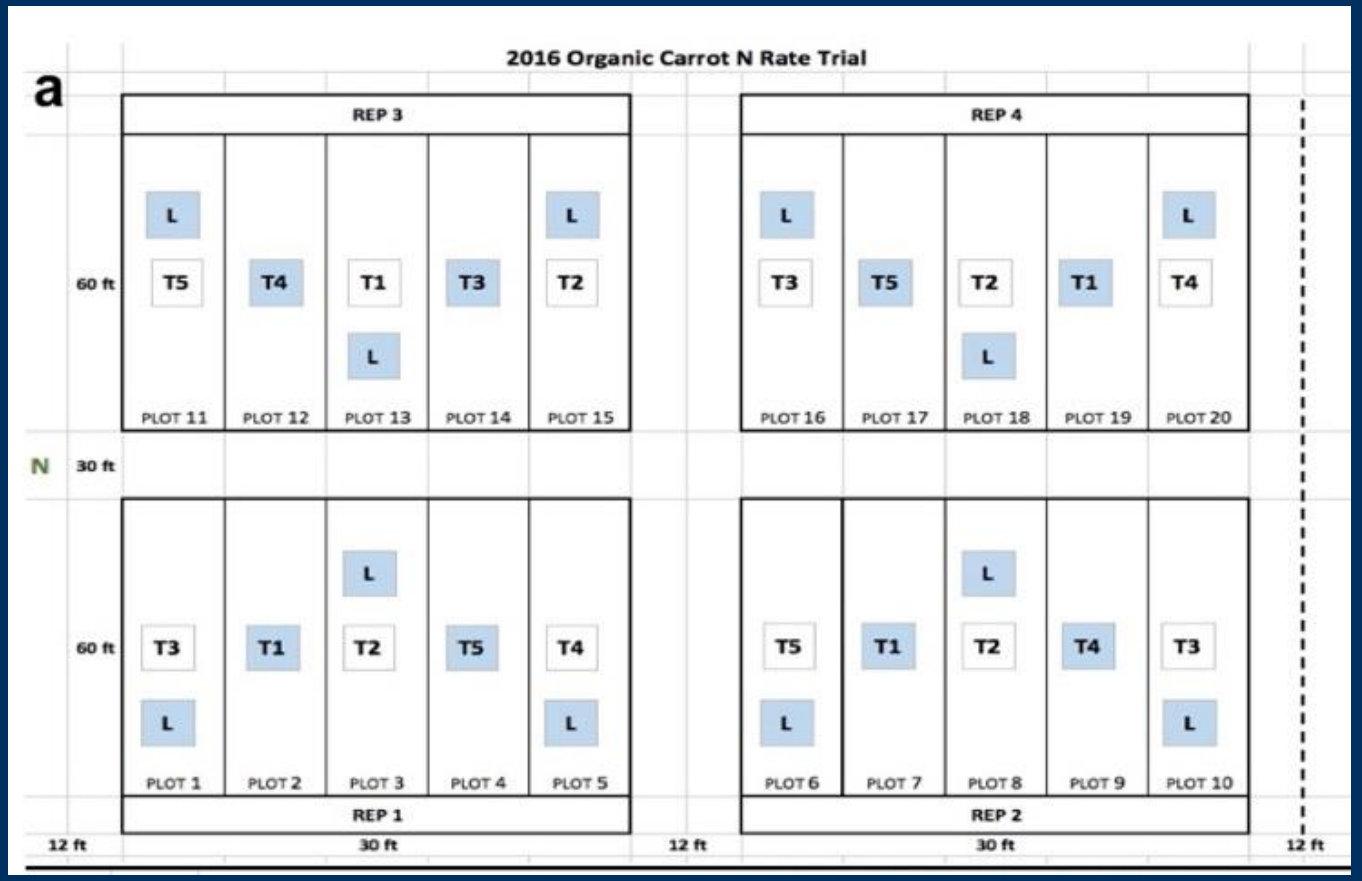
Experimental Design

- Five treatments in a RCBD and replicated four times on certified organic land (QCS, Gainesville, FL)
- Each plot measured 18 m long and 1.3 m wide.
- Treatments were equal to, and greater and less than the existing IFAS N recommendations (196 kg $ha^{-1}N$ / 175 lb a^{-1} N)

168, 224, 280, 336, and 392 kg $ha^{-1}N$

Orange squares indicate the four blocks of the N Rate study. The dashed blue line is the curvature of irrigation reach from the center pivot.

Pre-Plant Methods: Lysimeter Installation



Pre-plant Methods: Cover Crop Management

Above-Ground Biomass August 18, 2017 (48 DAP)	Dry Weight (kg ha^{-1})
Sorghum Sudangrass	3,421.7
Iron and Clay Cowpea	1,416.3
Total Cover Crop Biomass	4,838.0
Weeds	149.1
TOTAL BIOMASS	**4,987.1**

Methods: Fertilizer Input Summary

- Field was limed as needed; soil pH 6.0 to 6.5
- Each year, 2.2 kg ha^{-1} B was applied per pre-plant soil analysis with fertilizer.
- Pelletized poultry litter labelled 3-2-3 (N - P_2O_5 - K_2O)
- Carrots were seeded in early to mid November each year. One year, reseeding was necessary.

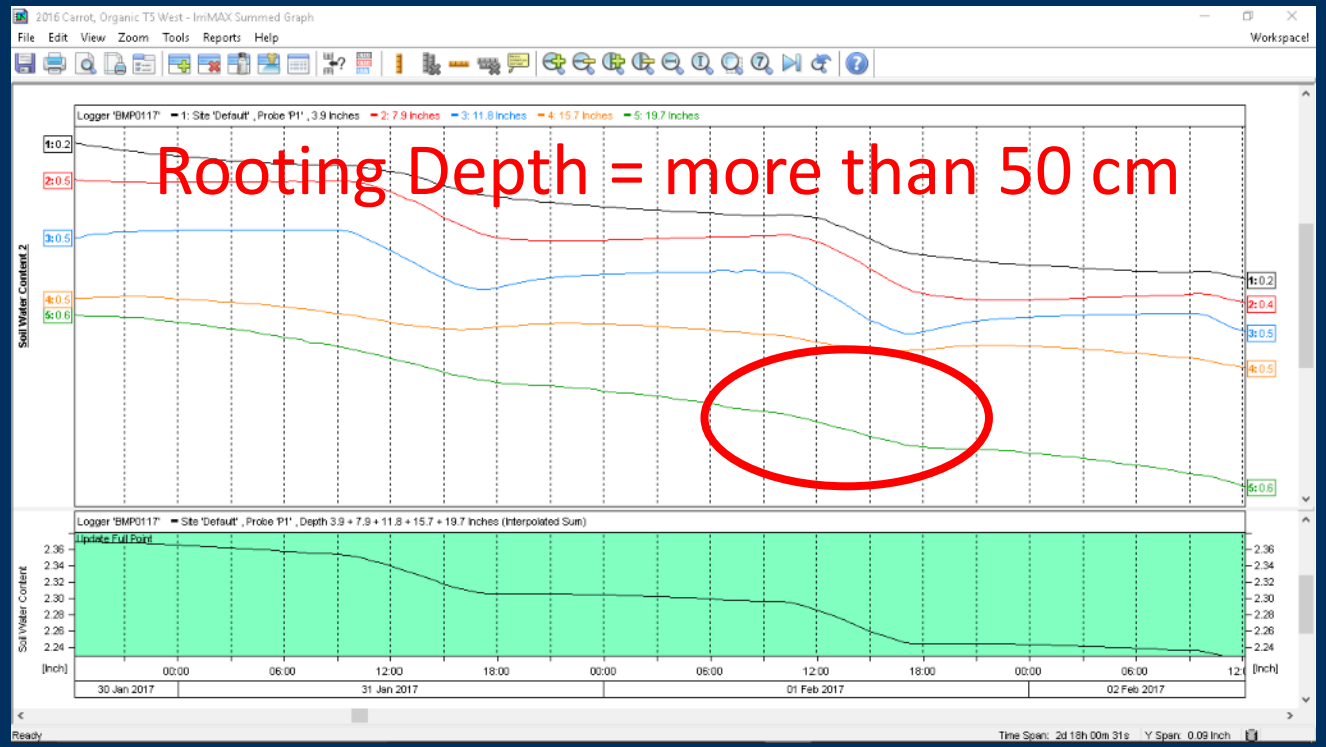
TRT kg ha^{-1} N (lb a^{-1} N)	25 DBP (50% N)	16 DAP (75% N)	30 DAP (100% N)
	-----	kg ha^{-1} N	-----
168 (150)	84	42	42
224 (200)	112	56	56
280 (250)	140	70	70
336 (300)	168	84	84
392 (350)	196	98	98

Methods: Carrot Planting and Management

- **‘Choctaw’** organic seed (Nunhems USA, Parma, ID) were coated with organic-compliant zeolite material to reduce static charge in the planter. **‘Maverick’** was substituted in 2018.
- Seeded **November 14, 15, and 29 in 2016, 2017, and 2018, respectively.**
- The stand increased annually from 410,000 plants $acre^{-1}$ (77 live plants per bed meter) to 500,000 plants $acre^{-1}$
- Row configuration was 2 sets of 4 rows each per bed (0.63 cm deep and 17.8 cm between row spacing)

Methods: Irrigation Management

- Soil moisture probe installed at start of season for 125 days.
- Root profile was greater than 20 inches.
- Soil water data indicate at least 93% of irrigation and precipitation was beneficial to the crop.
- Crop did not appear to be under drought stress.



Methods: Carrot Planting and Management

- Plots were hand-weeded four times during the season

- Following confirmation of Alternaria in plots, weekly applications of fungicides were applied from February to March (two weeks prior to harvest) and included a rotation of copper (Nordox) and *Streptomyces lydicus* (Actinovate)

Methods: Carrot Yield and Quality Determination

- Carrots were harvested in April (~150 DAP) within a 3m length of bed, predetermined to avoid lysimeter areas.
- 20 plants were selected from the 3m sample for fresh and dry weight, length, diameter, appearance.

Methods: Accounting for Nitrogen at Harvest

One 0.25 m^2 frame over each lysimeter (1 per plot):

- Fresh and dry weights and %N of roots, shoots, and weeds
- Residual fertilizer on soil surface
- Soil samples to 8”
- Lysimeter solution pumped

Statistical Analysis

- Data were analyzed using General Linear Model test, and when differences were present, means were separated using the Least Significant Difference method in SAS V. 9.4 (Cary, N.C.)
- Significance reported at $P \leq 0.05$

Organic Carrot Marketable Yield from 2017-2019

TRT kg ha^{-1} N (lb a^{-1} N)	Yield		
	kg ha^{-1}	lb a^{-1}	
168 (150)	37,619	33,358	c[z]
224 (200)	39,795	35,531	c
280 (250)	46,378	41,409	b
336 (300)	50,019	44,660	ab
392 (350)	50,815	45,370	a

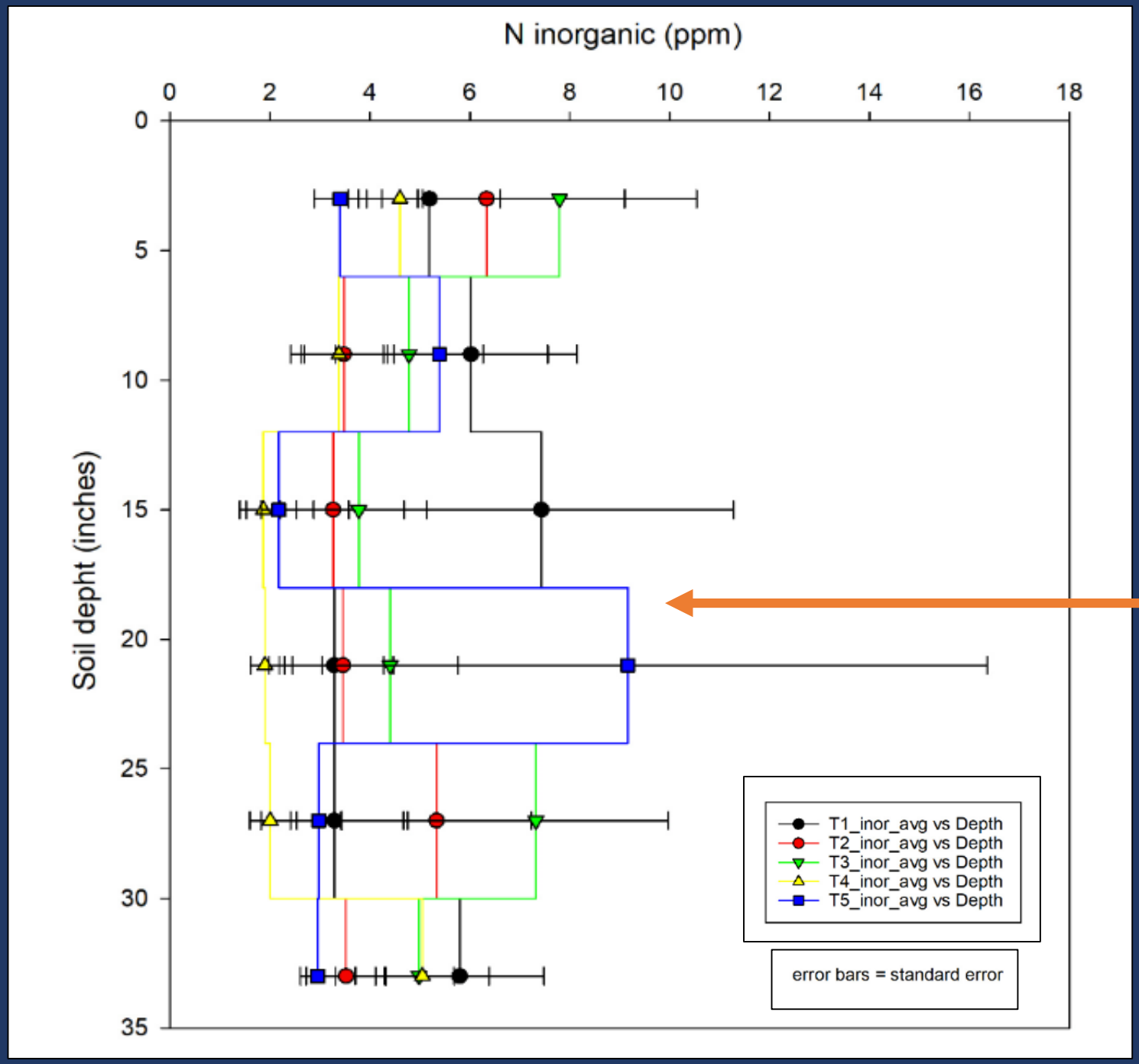
[z]Mean separation by Fisher's LSD test at 5% level (Alpha=0.05). **P = 0.043**

Typical conventional yield:

- 800 50# bags per acre
- (44,800 kg ha-1)
- 700-1100 bags per acre

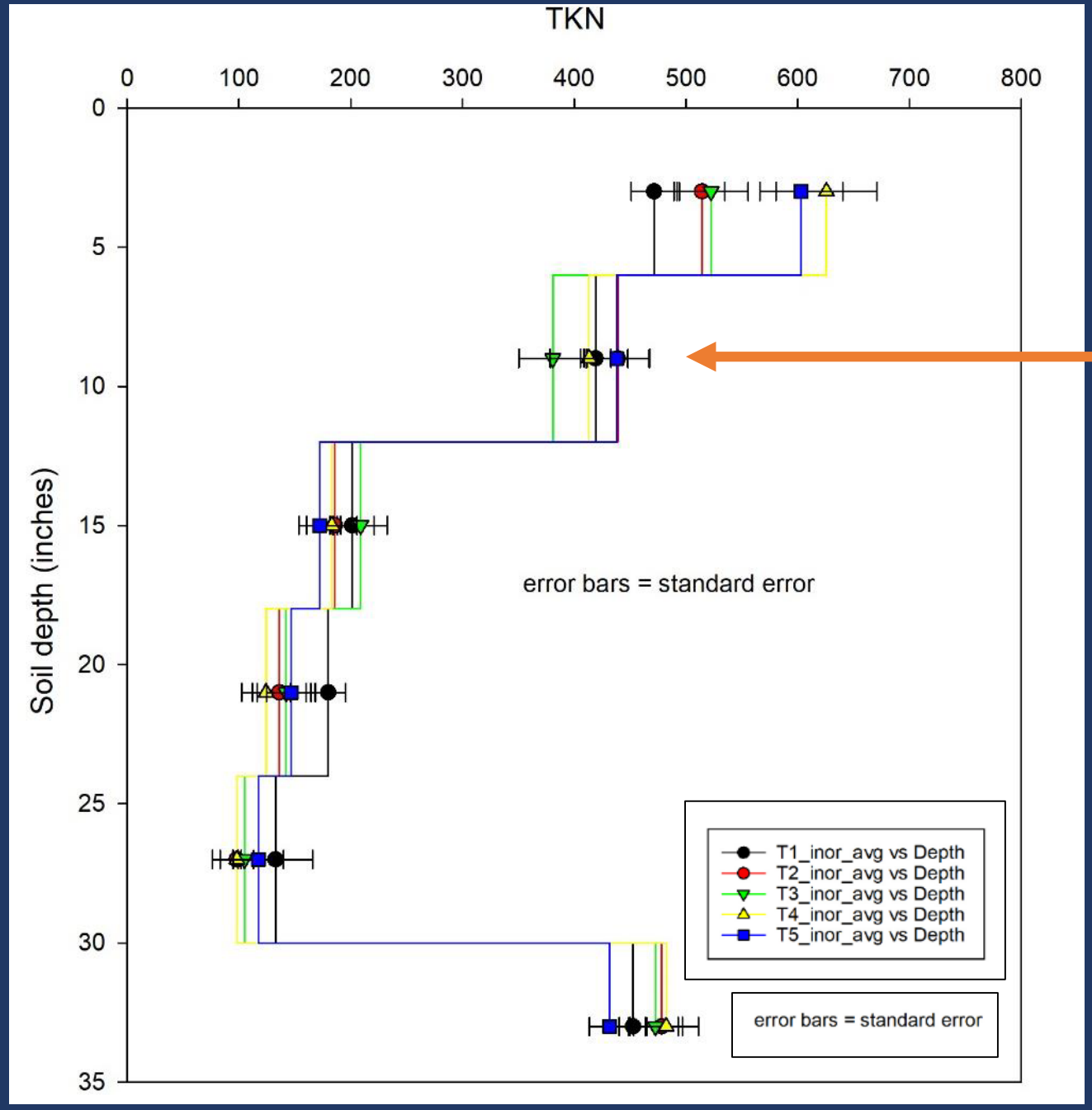
Nitrogen at Harvest in Crop and Soil 2017-2019

TRT kg ha^{-1} N (lb a^{-1} N)	Whole Carrot	Whole Carrot + Weed	Soil TKN Remaining
	-------- kg ha^{-2} N --------		mg kg^{-1}
168 (150)	183.8	196.8 c	483.20
224 (200)	298.8	320.8 ab	532.45
280 (250)	275.8	289.5 ab	547.93
336 (300)	253.7	264.1 bc	516.40
392 (350)	365.5	370.4 a	589.90
	P = 0.6585	P = 0.0090	P = 0.1055



Soil inorganic N (ppm) from 0-35 inches remaining at harvest in 2019

- Very little soil inorganic-N at harvest
- More organic N remained
- Therefore, some fertilizer was not mineralized or utilized by carrot.



Soil Total N (ppm) from 0-35 inches remaining at harvest in 2019

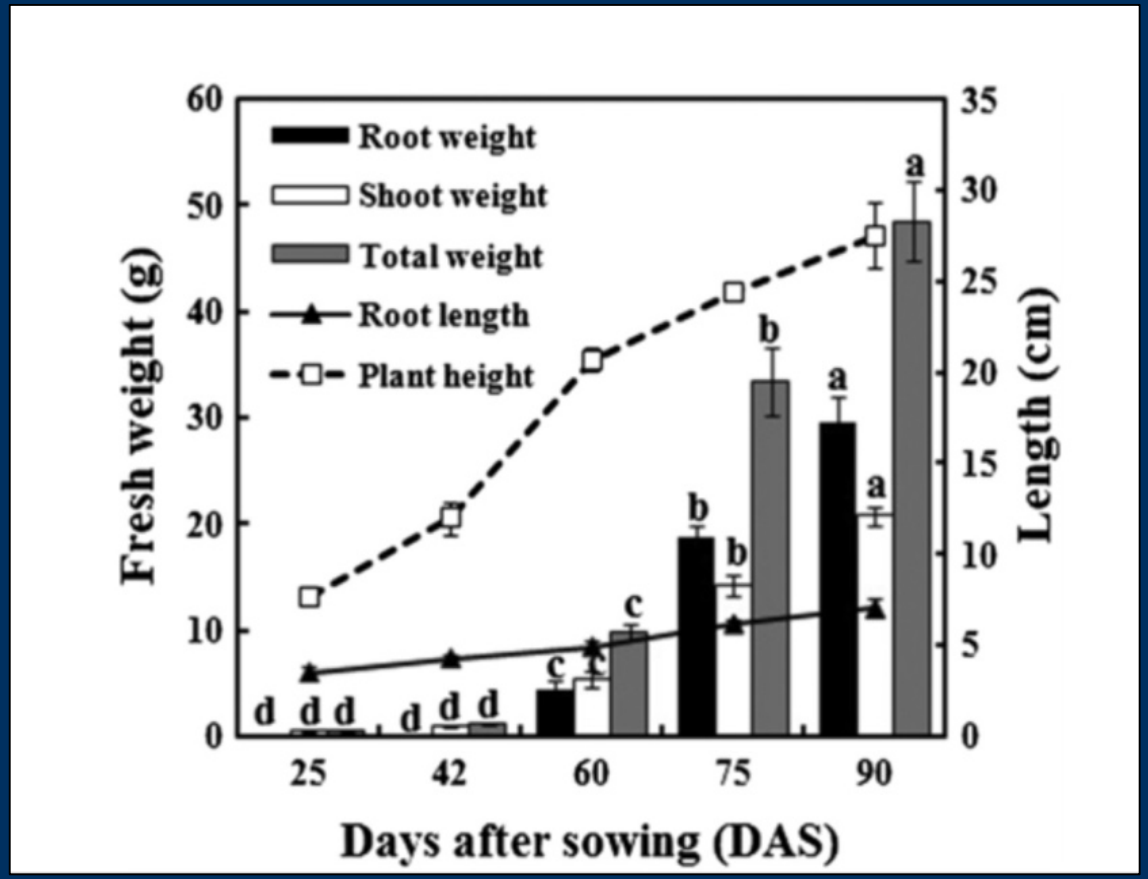
- Significant TKN at harvest
- Despite efforts to incorporate, visible fertilizer on soil surface at harvest.
- Therefore, fertilizer was not mineralized nor utilized by carrot.

Summary of Results

- Overall, carrot yield was competitive with grower yields, and yield increased with increasing rates of N.
- In this study, our crop management methods resulted in fertilizer inefficiencies; pellet size, method of incorporation, and timing of application have been modified for our current study.

Continuing Research

- In our current study (UF/IFAS SEEDIT grant), we are refining our understanding of the physiological development phases in carrot to improve the timing of N applications.
- Integrate findings of this study into the other future research from the UF Carrot Team.



(Guanglong, 2016)

Additional Resources

- eOrganic webinars

https://eorganic.org/node/4942

- Organic Trade Association Market Overview

https://ota.com/resources/market-analysis

- 2017 Census of Agriculture Highlights: Organic Farming

https://www.nass.usda.gov/Publications/Highlights/2020/census-organics.pdf

- University of Georgia Organic Nitrogen Calculator* (don't rely on this for FL recommendations) http://aesl.ces.uga.edu/calculators/nitrogen/

*This includes a link to the cover crop N calculator

Thank You

This study is funded by the Florida Department of Agriculture and Consumer Services (FDACS), Office of Ag Water Policy. We thank the UF-IFAS Office of Research and North Central Florida carrot producers for their support.

Results: Carrot Root and Shoot Fresh Weight (per plant)

TRT kg ha^{-1} N (lb a^{-1} N)	Shoot Length	Root Length	Plant (R+S) Length	Shoot Fresh Wt.	Root Fresh Wt.	Plant (R+S) Fresh Wt.
	---------- cm ----------			---------- g ----------		
168 (150)	47.0 bc	23.7	70.7 b	34.7 b	117.8	152.5
224 (200)	46.4 c	23.6	69.9 b	32.8 b	113.0	145.7
280 (250)	49.5 ab	23.3	72.8 b	39.6 ab	121.9	161.6
336 (300)	49.1 abc	23.9	73.0 b	40.4 ab	135.2	175.6
392 (350)	50.1 a	29.6	79.8 a	47.5 a	136.6	184.1
	P = 0.0517	P = 0.0831	P = 0.0063	P = 0.0447	P = 0.2775	P = 0.1899

Results: Dry Weights of Carrot and Weeds

TRT kg ha^{-1} N (lb a^{-1} N)	Weeds	Shoots	Roots	Root:Shoot
	----------	kg ha^{-1} Dry Biomass ----------		Ratio
168 (150)	731.0	2,833.1 b	8,220.5 c	2.99
224 (200)	1,440.4	4,415.5 a	12,733.8 ab	2.97
280 (250)	741.3	4,129.7 ab	11,049.5 bc	2.65
336 (300)	549.1	3,902.8 ab	11,094.0 bc	2.85
392 (350)	253.3	5,219.2 a	15,034.6 a	2.88
	P = 0.5918	P = 0.0476	P = 0.0141	P = 0.2420