An update on citrus nutrient BMP research Project

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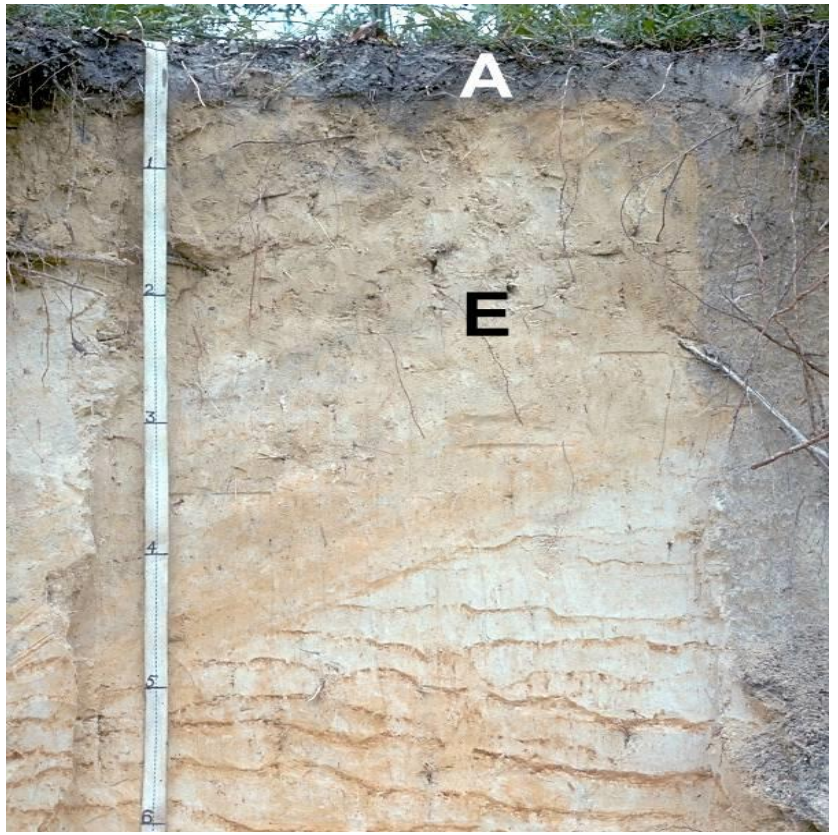
Take home messages

- Leaf nutrient concentrations variable with season but comparable across nitrogen (N) levels.
- About 50% of soil ammonium (NH4-N) was less than the topsoil (0-6 inch) and only 25% accumulated in the middle (6-12 inch) and bottom (12-18 inch) soil horizon.
- Soil nitrate (NO3-N) showed on average about 30% between consecutive soil horizons indicating probable soil nutrient leaching from the topsoil horizon.
- Soil nitrate (NO3-N) showed no treatment effect but more accumulated in the 0-6-inch soil layer than the 6-12-inch and 12-18-inch soil depths.
- High to excess levels of P but optimum to high for N in Cold Hardy Citrus in leaf analysis.
- Our findings indicated that there were no yield differences regardless of treatment effect and nutrient application rates, but fruit quality analysis is still under way.

The case for citrus best management practices

- 100% endemic HLB situation in contrast to pre-HLB era
- Sandy soils (>95%) with
  - low organic matter
  - low cation exchange capacity
  - low water holding capacity



Profile of Astatula sand, an Entisol, showing surface (A) and subsurface (E) horizons.

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Sources: SL253, Obreza and Morgan, 2008

The case for citrus best management practices (2)

- Severe defoliation
- Root loss in young presymptomatic and symptomatic trees (30-38% root loss) and fully symptomatic trees up to 80% root loss

Schematic of root loss.

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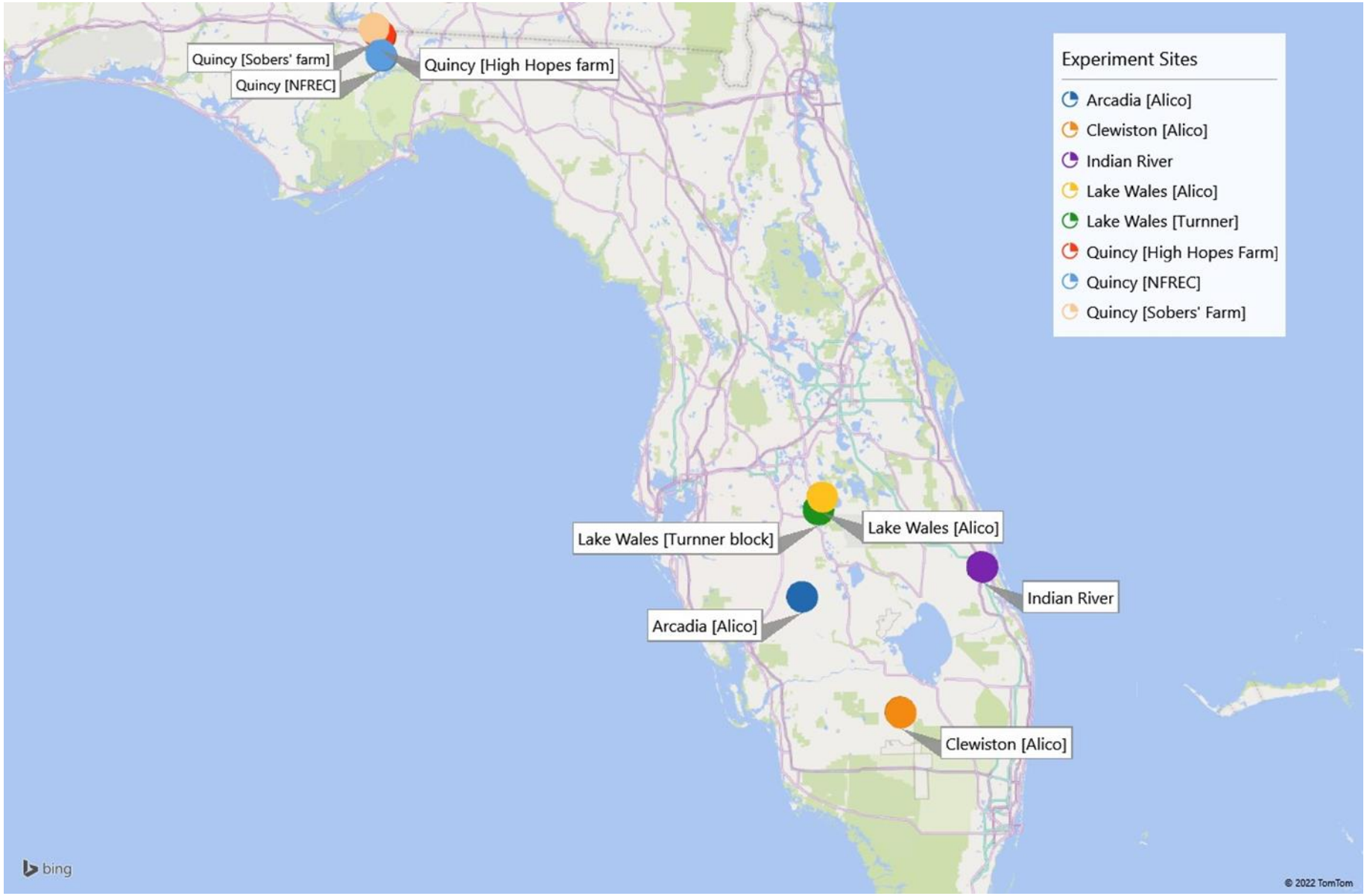
Source: Graham et al. 2013; Johnson et al. 2014; 2021; Photo Credit: UF/IFAS Communications

Project sites



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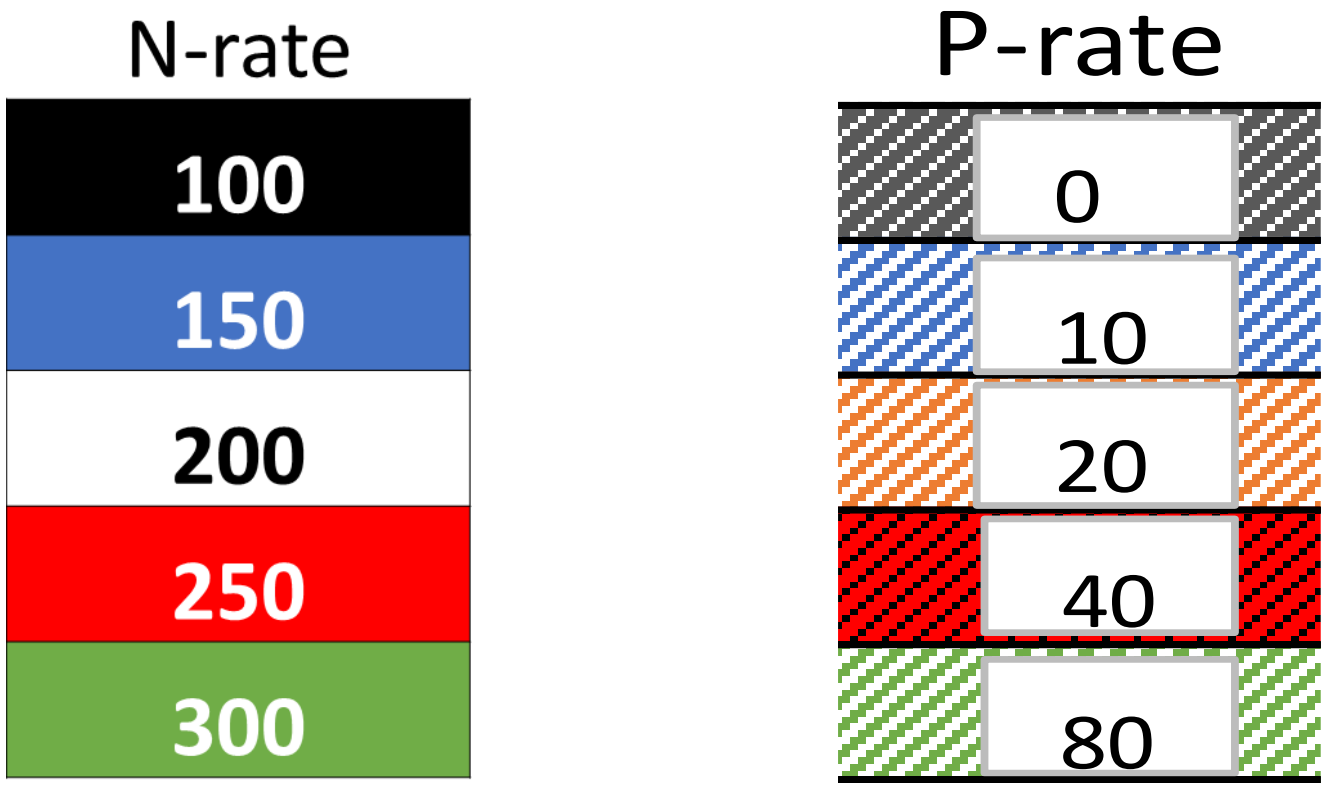
Fertilizer treatments



Each treatment is replicated 5 times.

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Interpretation of tissue test for different essential nutrients in citrus

Element	Unit of Measure	Deficient	Low	Optimum	High	Excess
N	%	< 2.2	2.2–2.4	2.5–2.7	2.8–3.0	> 3.0
P	%	< 0.09	0.09–0.11	0.12–0.16	0.17–0.30	> 0.30
K	%	< 0.7	0.7–1.1	1.2–1.7	1.8–2.4	> 2.4
Ca	%	< 1.5	1.5–2.9	3.0–4.9	5.0–7.0	> 7.0
Mg	%	< 0.20	0.20–0.29	0.30–0.49	0.50–0.70	> 0.70
Cl	%	---	---	< 0.2	0.20–0.70	> 0.70[1]
Na	%	---	---	---	0.15–0.25	> 0.25
Mn	mg/kg or ppm[2]	< 18	18–24	25–100	101–300	> 300
Zn	mg/kg or ppm	< 18	18–24	25–100	101–300	> 300
Cu	mg/kg or ppm	< 3	3–4	5–16	17–20	> 20
Fe	mg/kg or ppm	< 35	35–59	60–120	121–200	> 200
B	mg/kg or ppm	< 20	20–35	36–100	101–200	> 200
Mo	mg/kg or ppm	< 0.05	0.06–0.09	0.10–2.0	2.0–5.0	> 5.0

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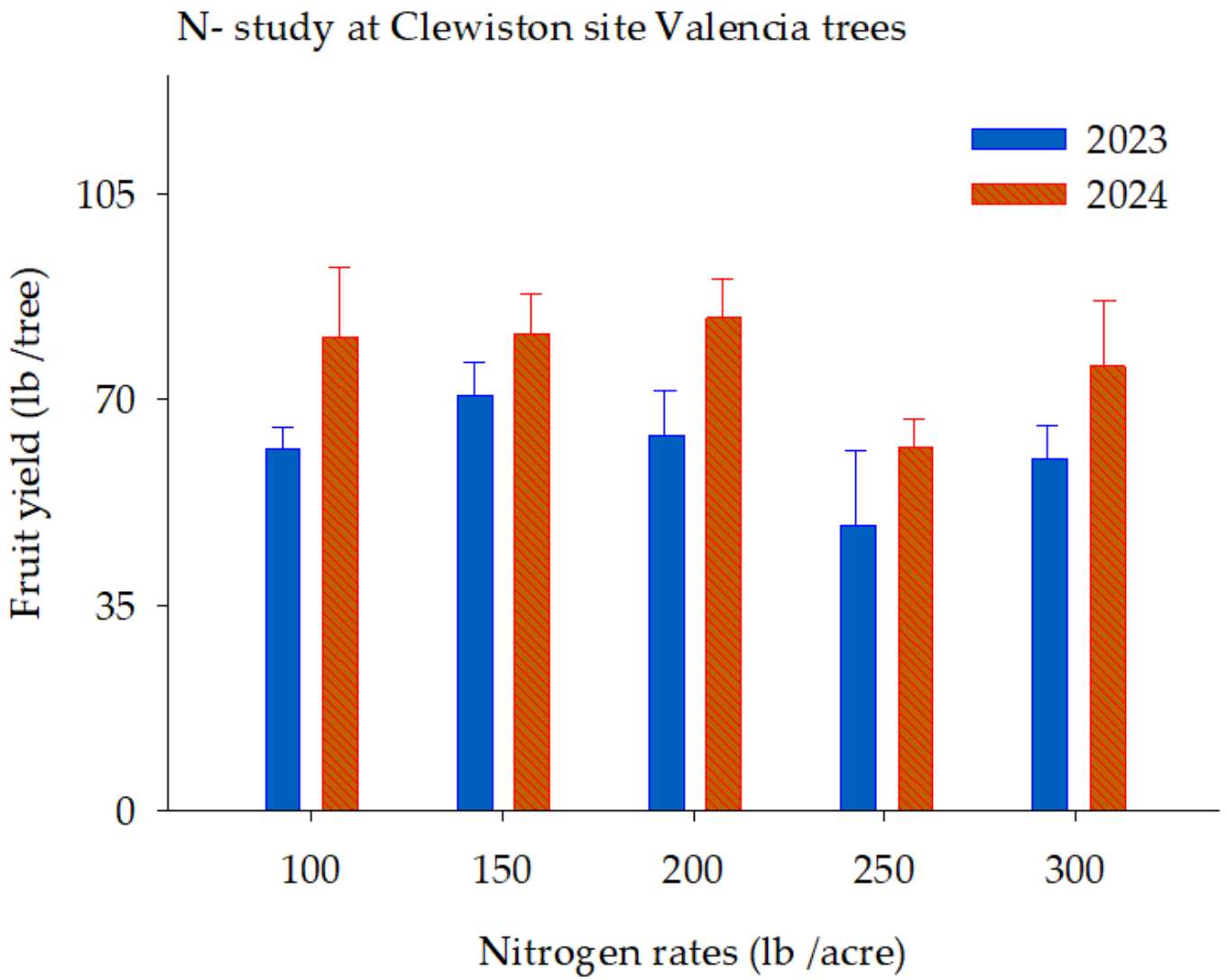
(Obreza et al. 2020)

Impacts of N rate on fruit yield – ‘Valencia’ orange



Increases in the second year but no differences between treatments.

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Macronutrient concentrations in citrus leaves (g/kg) under different level of N during different growing season

Macronutrient concentrations (P, K and Mg) in citrus leaves similar by level of N but differed by season growing season

Factor	N	P	K	Mg
N (kg/ha)				
112	19.55±0.21	1.28±0.02	8.55±0.31	2.21±0.05b
168	20.40±0.16	1.39±0.03	8.24±0.26	2.43±0.04a
224	20.02±0.17	1.37±0.03	8.22±0.31	2.23±0.05b
280	20.11±0.19	1.35±0.04	8.97±0. 31	2.24±0.05ab
336	19.46±0.15	1.31±0.03	8.65±0.27	2.27±0.04ab
LSD(0.05)	1.15	0.13	1.24	0.96
Season				
S_2023	19.99±0.18	1.46±00.07a	10.90±0.12 a	2.70±0.03 a
F_2023	19.93±0.15	1.03±0.02b	7.28±0.21b	1.96±0.03 c
S_2024	19.82±0.21	1.52±0.02a	7.40±22b	2.18±0.02 b
LSD(0.05)	0.89	0.10	0.96	0.15
Significance				
N	ns	ns	ns	ns
S	ns	**	**	**
N × S	ns	ns	ns	ns

LSD (0.05), least significance difference at $p<0.05$; ** and ns respectively indicate $p<0.01$ and not significant, Data are the mean ± standard error of four replications

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Micronutrient concentration in citrus leaves (mg/kg) under different level of N during different season

Micronutrient concentration in citrus leaves similar under different level of N but differed by season

Factors	Zn	B	Mn	Fe	Cu
N (kg/ha)					
112	28.81±1.83	52.08±1.83	27.9 ±2.28	39.78 ± 1.11a	10.08±0.81
168	31.02±1.89	56.06±1.89	31.41±2.54	48.37±1.02ab	10.64±0.76
224	31.76±1.99	54.26±1.99	32.12±2.46	45.02 ±1.32ab	9.69±0.79
280	30.52±2.30	56.23±2.30	31.74±2.65	43.84 ± 0.81b	10.74±0.86
336	28.02±1.60	53.20±1.6	27.54±2.03	41.22 ± 0.81b	10.00±0.66
LSD	5.23	6.6	6.04	6.21	1.88
Season					
S_2023	27.65±1.28b	71.14±0.78a	52.51±1.48 a	48.15 ±1.2a	17.72±0.15a
F_2023	47.10±0.48a	48.78±1.28b	24.72 ± 0.55b	38.59± 0.95b	7.78 ±0.46b
S_2024	15.33±0.29c	43.18±0.93c	13.20 ± 0.33c	44.2 ±0.62a	5.19 ± 0.11c
LSD	4.05	5.11	4.67	4.81	1.46
Significance					
N	ns	ns	ns	ns	ns
S	**	**	**	**	**
N × S	ns	ns	ns	ns	ns

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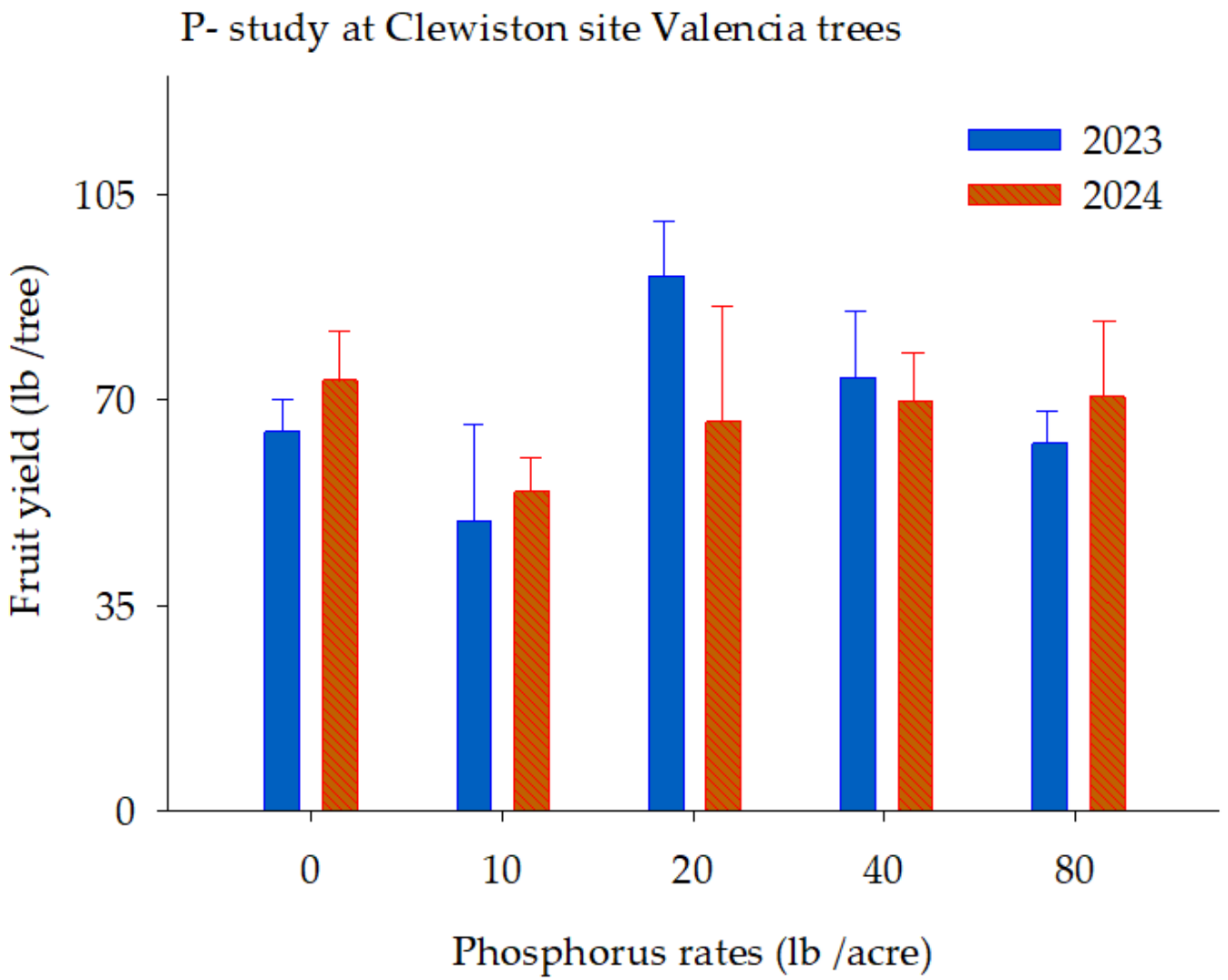
Impacts of P rate on fruit yield – ‘Valencia’ orange



No change in fruit yields from first to second year and no differences between treatments.

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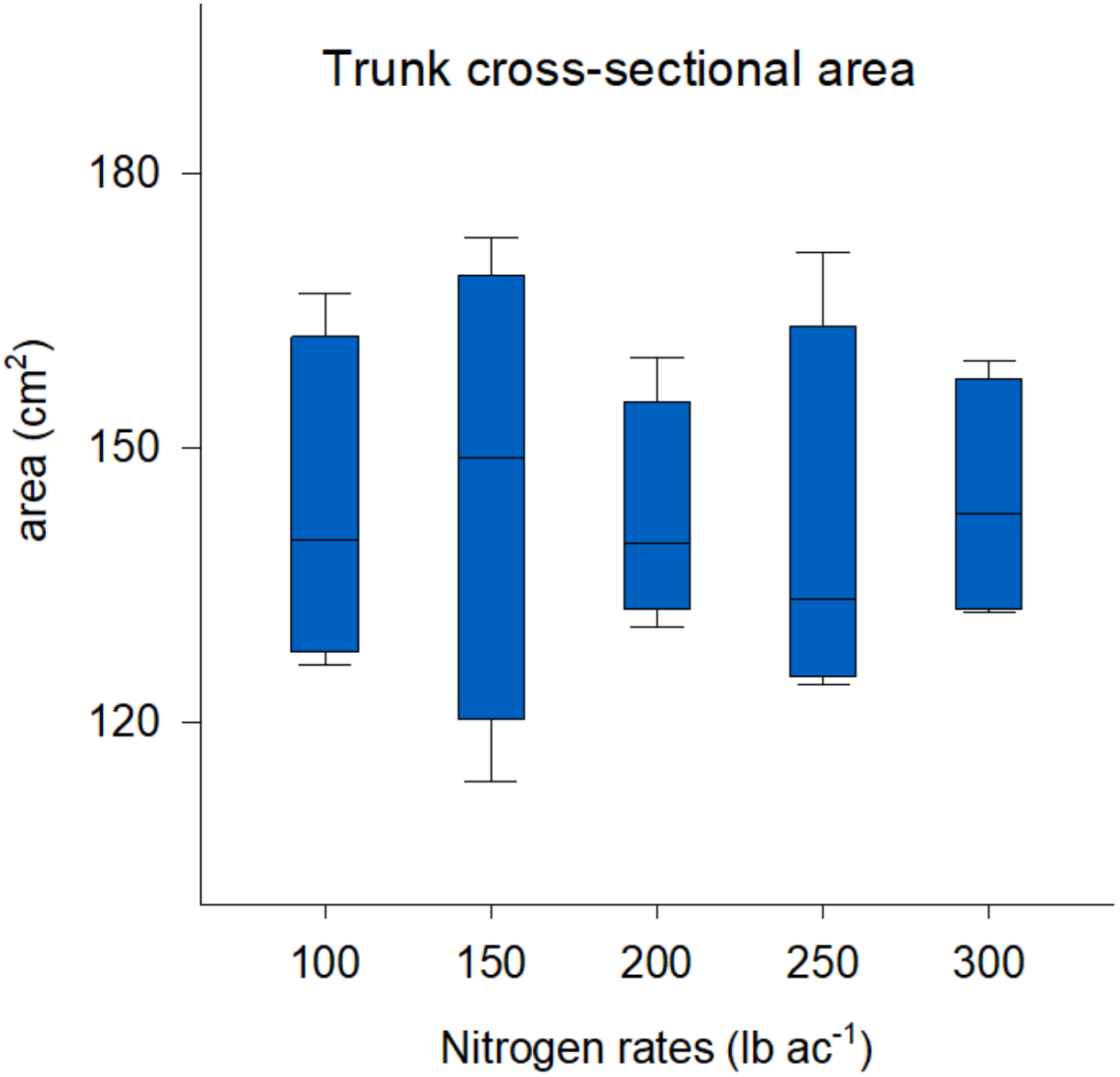
Impact on canopy size

- No differences in canopy volume and trunk size.
- No differences in fruit yield in the first 2 years.

Some of these results may take about 36 months to show effect in HLB-affected trees.



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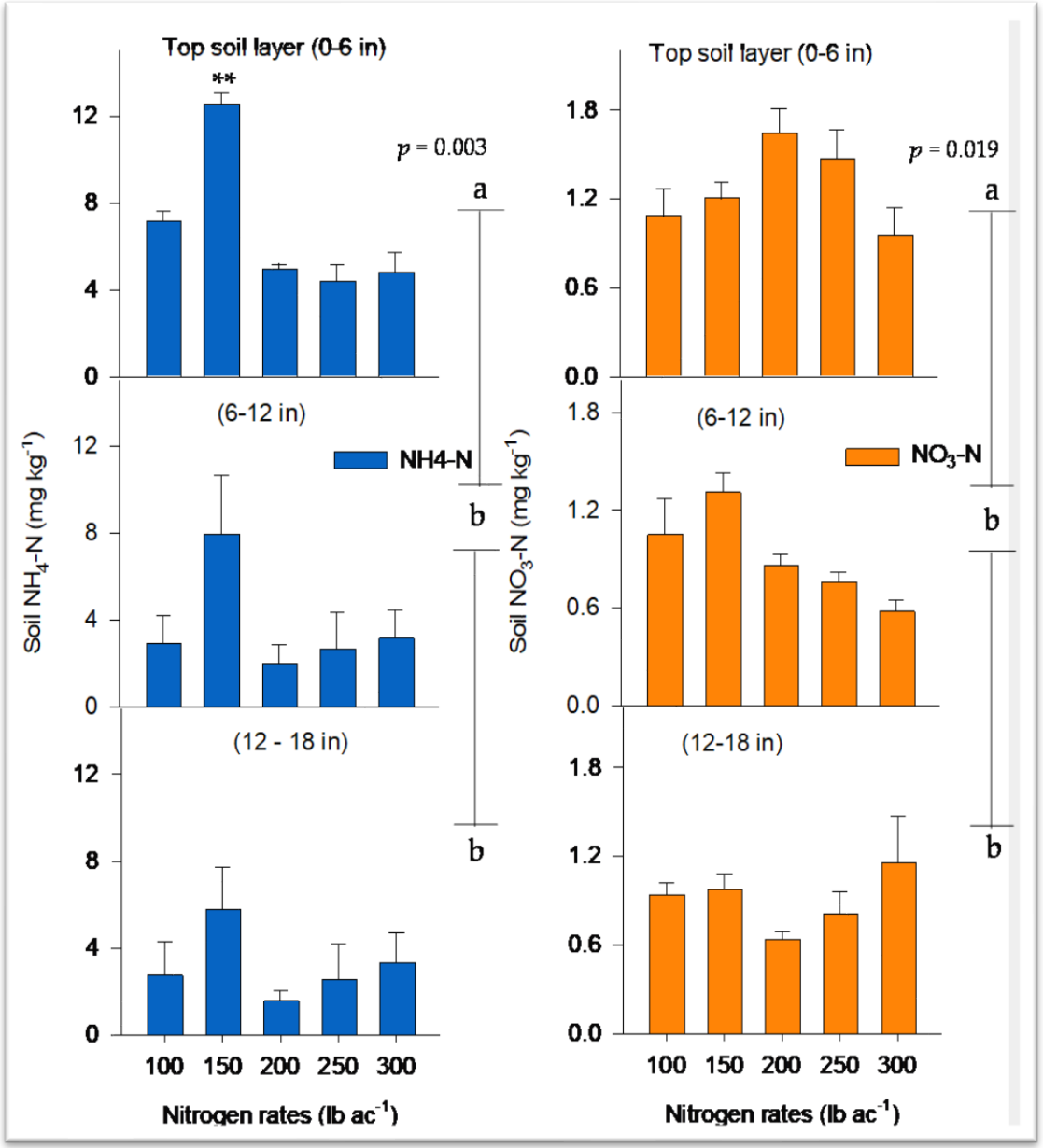
Soil nutrient analyses for ‘Valencia’ orange in Clewiston, FL

- Soil nitrogen (NH_4-N and NO_3-N) nutrient concentration at three soil horizons.
- Most ammonium and nitrate N retained in the top 0-12 inches.



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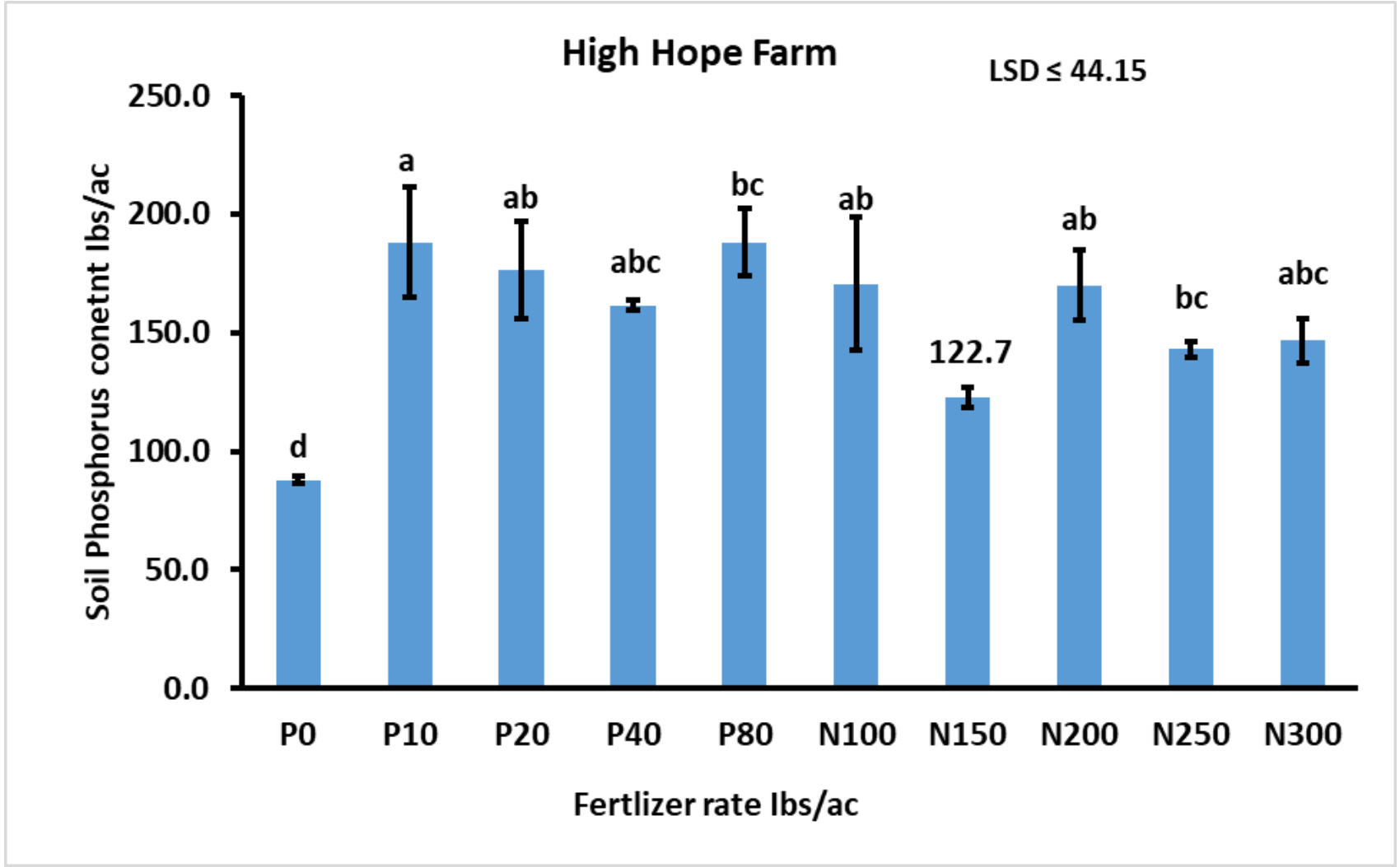
Soil phosphorus concentration in Cold Hardy Citrus

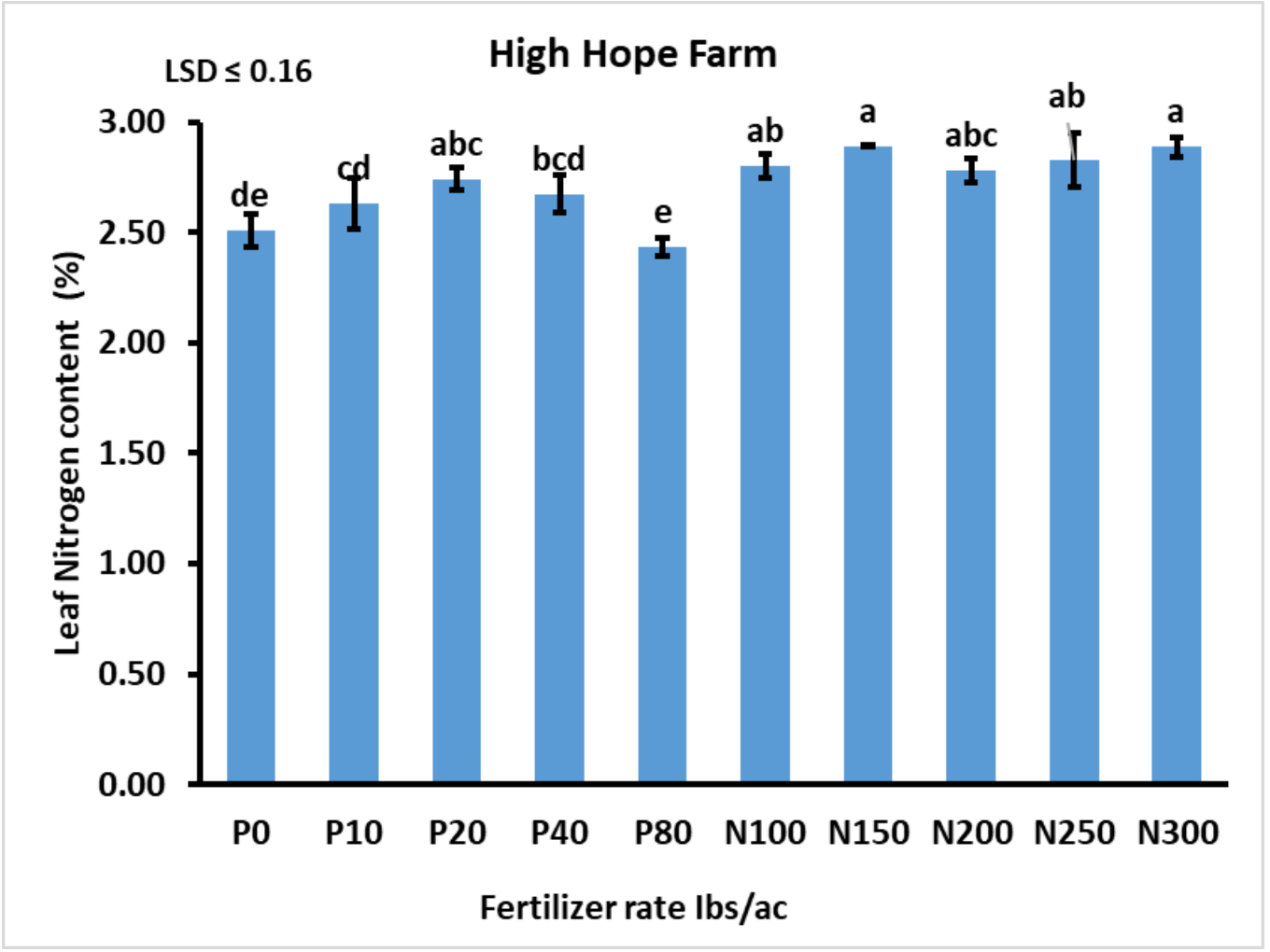
- Soil P levels in varying P and N rates.
- Soil P levels high even in controls probably due to residual



Credit: M. Shahid, UF/IFAS NFREC

Leaf nitrogen concentration in Cold Hardy Citrus

- Leaf N levels in varying P and N rates.
- Leaf levels mostly in optimum range.



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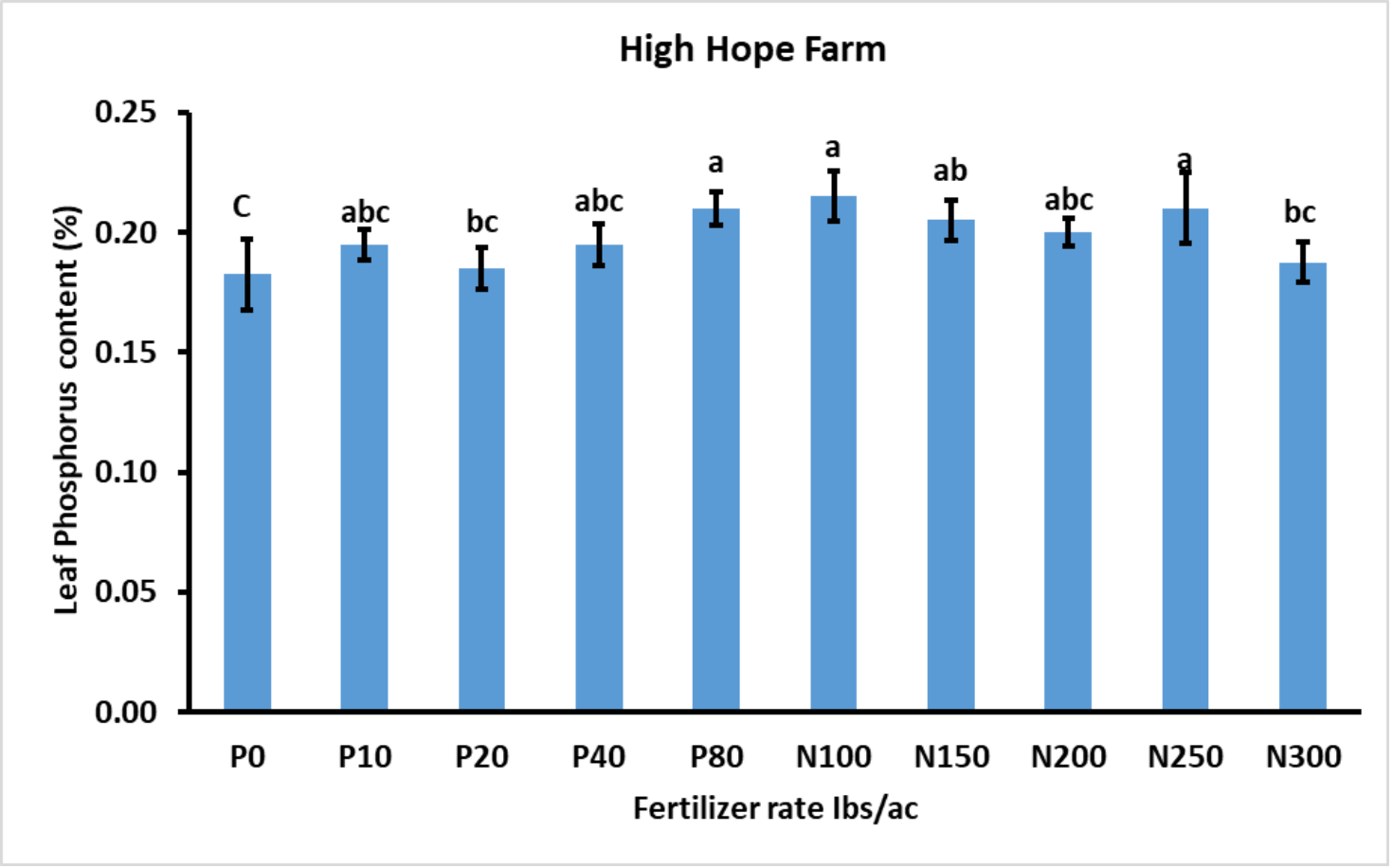
Credit: M. Shahid, UF/IFAS NFREC

Leaf phosphorus concentration in Cold Hardy Citrus

- Leaf P levels in varying P and N rates.
- Leaf P levels mostly in very high or excessive range including in the controls.



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- Our findings indicated that there were no yield differences regardless of treatment effect and nutrient application rates, but fruit quality analysis is still under way.

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Acknowledgements

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https://crec.ifas.ufl.edu/people/faculty/davie-kadyampakeni/publications/

Scan the QR code to learn more about the Kadyampakeni research program.

Photo Credit: T. Weeks, UF/IFAS CREC

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Thank You

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