Citrus Nutrition Box Program: The Final Results

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Key messages

- Nutrient patterns can develop over time
- More severely HLB-affected trees (more dieback) had higher nutrient levels than trees with less dieback
- Numerically numbers are low, visually the trees are improving
- Regardless of variety, nutrients are needed the same
- Fertilizing based on leaf nutrient analysis is doable and can improve tree health

Program recap: How it began

- Provided resource box
  - Instructional documents
  - Calendar
  - Sampling bags
  - Pre-addressed envelopes/boxes

Photo Credit: T. Weeks, UF/IFAS

Program recap: How it worked – Step 1

- Collaboration between growers and UF
- Quarterly leaf and annual soil sample collection
- Bags provided and labeled with a unique grower number

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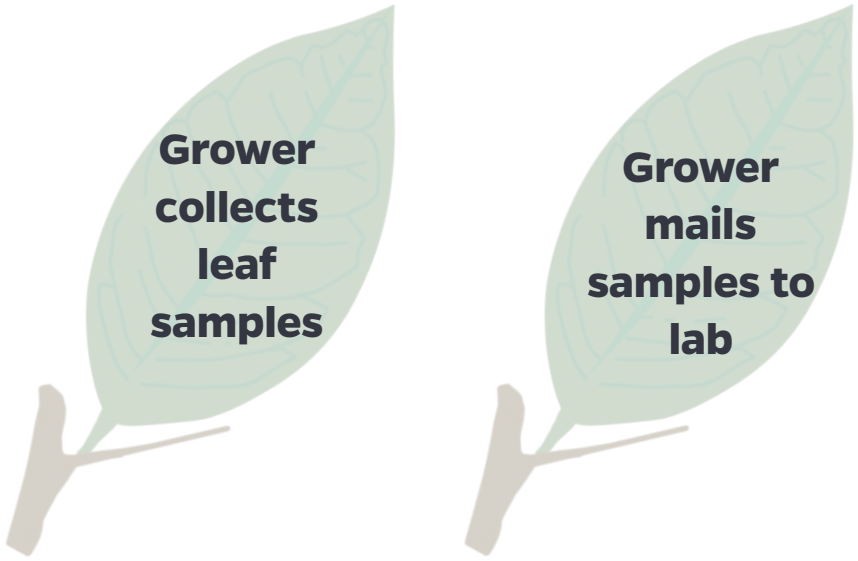
Graphics: T. Weeks, UF/IFAS

Program recap: How it worked – Step 2

- Only cost to grower
- Pre-addressed envelopes provided



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Graphics: T. Weeks, UF/IFAS

Program recap: How it worked – Step 3

- Lab processed samples
- Provided results to citrus nutrition team

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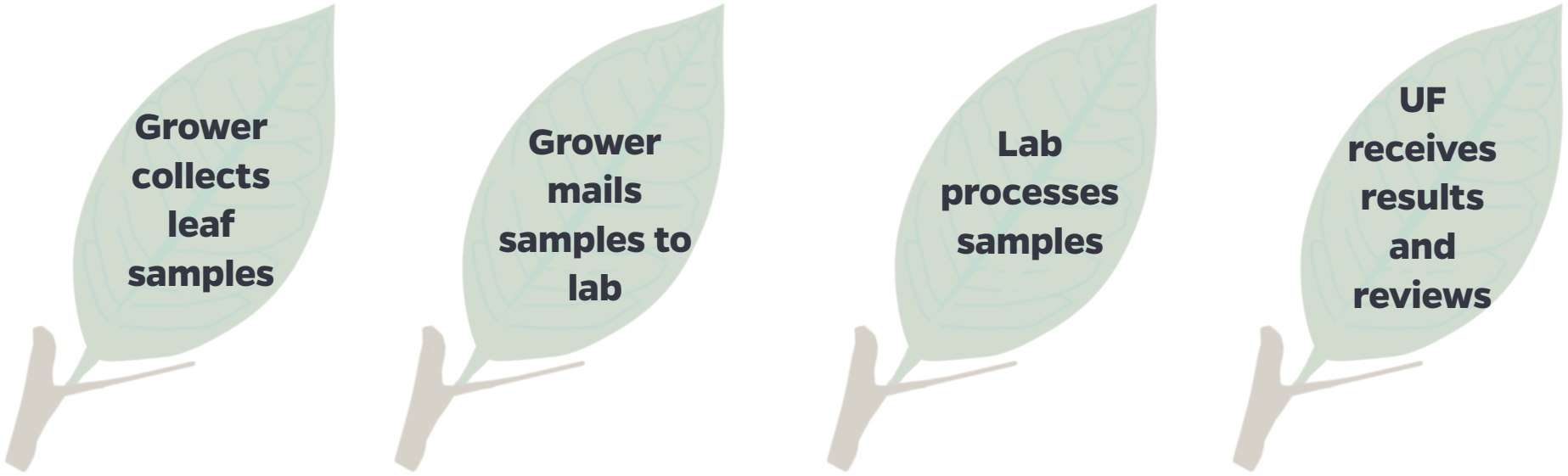
Graphics: T. Weeks, UF/IFAS

Program recap: How it worked – Step 4

- Nutrition team reviewed individual results



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Graphics: T. Weeks, UF/IFAS

Program recap: How it worked – Step 5

- Results sent to grower via email
- Requested additional information to assist in future recommendations

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Graphics: T. Weeks, UF/IFAS

Disclaimer: Wide range of variables

- Varieties and rootstocks
- Processed vs. fresh
- Location
  - Soil type
  - Rainfall
- Tree age
  - 6 months to 30+ years
- Tree health
- Submitted samples varied year to year

Tree 1

Asymptomatic/ mild symptoms

Tree 2

Producing fruit, symptomatic

Tree 3

Symptomatic, declining

Not a replicated trial that could determine statistical significance, but can define trends

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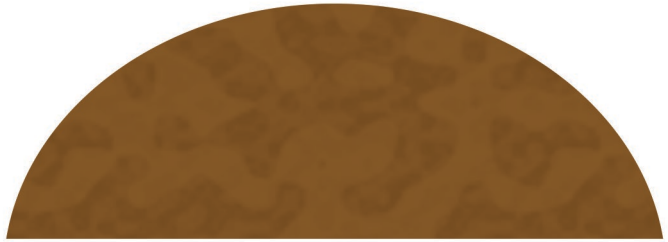
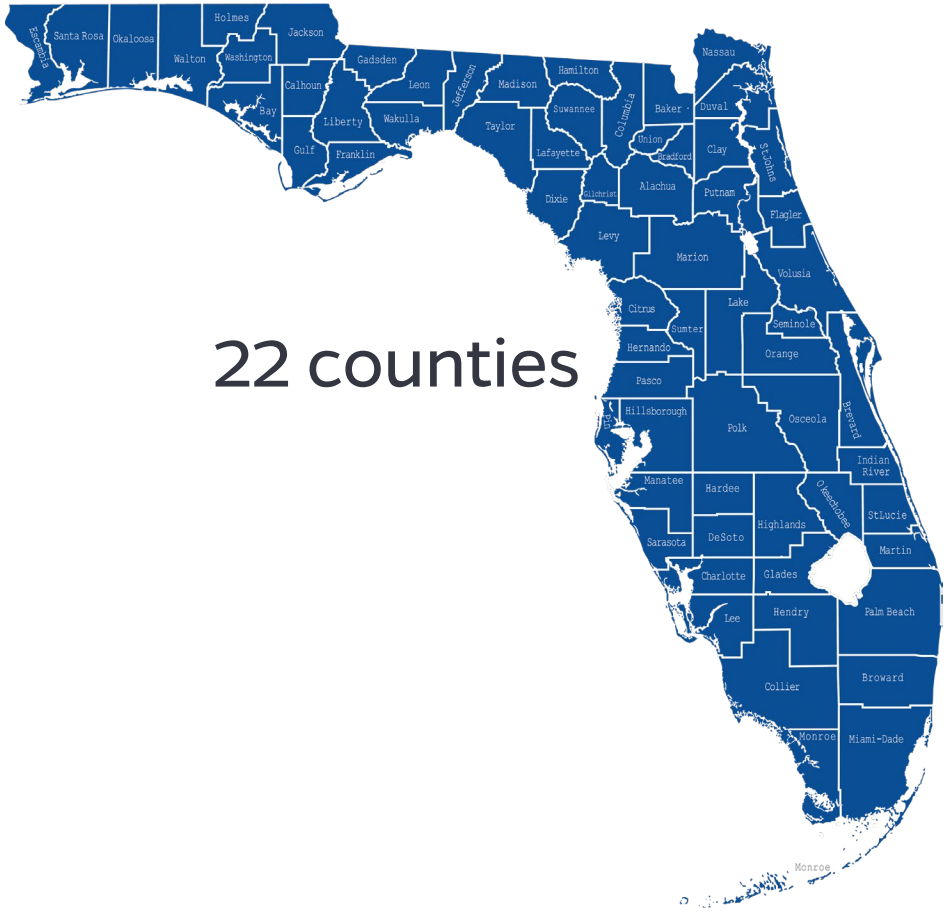
Photo Credit: L. Tang, UF/IFAS

Program participation – October 2019 – October 2023

485 leaf samples



214 soil samples



22 counties

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Graphics: T. Weeks, UF/IFAS; AdobeStock

Tree health and leaf analysis

Tree 1: 24

N	P	K	Ca	Mg	S	Mn	Zn	Cu	Fe	B
2.6	0.16	1.4	3.4	0.4	0.3	38	32	17	62	78

Tree 2: 31

N	P	K	Ca	Mg	S	Mn	Zn	Cu	Fe	B
2.7	0.16	1.5	3.5	0.3	0.3	60	45	19	64	96

Tree 3: 3

N	P	K	Ca	Mg	S	Mn	Zn	Cu	Fe	B
2.8	0.17	1.6	3.3	0.4	0.3	29	33	16	63	90

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Photo Credit: L. Tang, UF/IFAS

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Photo Credit: L. Tang, UF/IFAS

Statewide trends - Oranges

Date	N leaf	P leaf	K leaf	Ca leaf	Mg leaf	S leaf	Mn leaf	Zn leaf	Cu leaf	Fe leaf	B leaf
Oct 19 - Feb 20	2.7	0.16	1.5	3.4	0.38	0.30	52	43	14	63	85
Mar 20 - Jun 20	2.7	0.16	1.5	3.3	0.33	0.31	39	29	8	65	79
Jul 20 - Oct 20	2.7	0.15	1.5	3.2	0.36	0.32	51	36	12	70	91
Nov 20 - Feb 21	2.5	0.16	1.5	2.8	0.34	0.33	45	34	9	66	94
Mar 21 - Jun 21	2.6	0.15	1.3	3.4	0.32	0.34	34	27	8	70	89
Jul 21 - Oct 21	2.6	0.15	1.4	3.1	0.34	0.28	43	39	16	69	98
Nov 21 - Feb 22	2.6	0.17	1.5	2.8	0.32	0.31	39	32	10	72	95
Mar 22 - Jun 22	2.4	0.14	1.5	3.1	0.32	0.32	35	27	9	74	89
Jul 22 - Oct 22	2.5	0.17	1.5	2.9	0.33	0.28	44	47	13	80	91
Nov 22 - Feb 23	2.6	0.15	1.6	2.8	0.31	0.26	49	74	26	70	89
Mar 23 - Jun 23	2.6	0.14	1.6	2.9	0.27	0.28	40	57	14	57	71
Jul 23 - Oct 23	2.6	0.13	1.4	2.8	0.26	0.22	68	80	14	62	73

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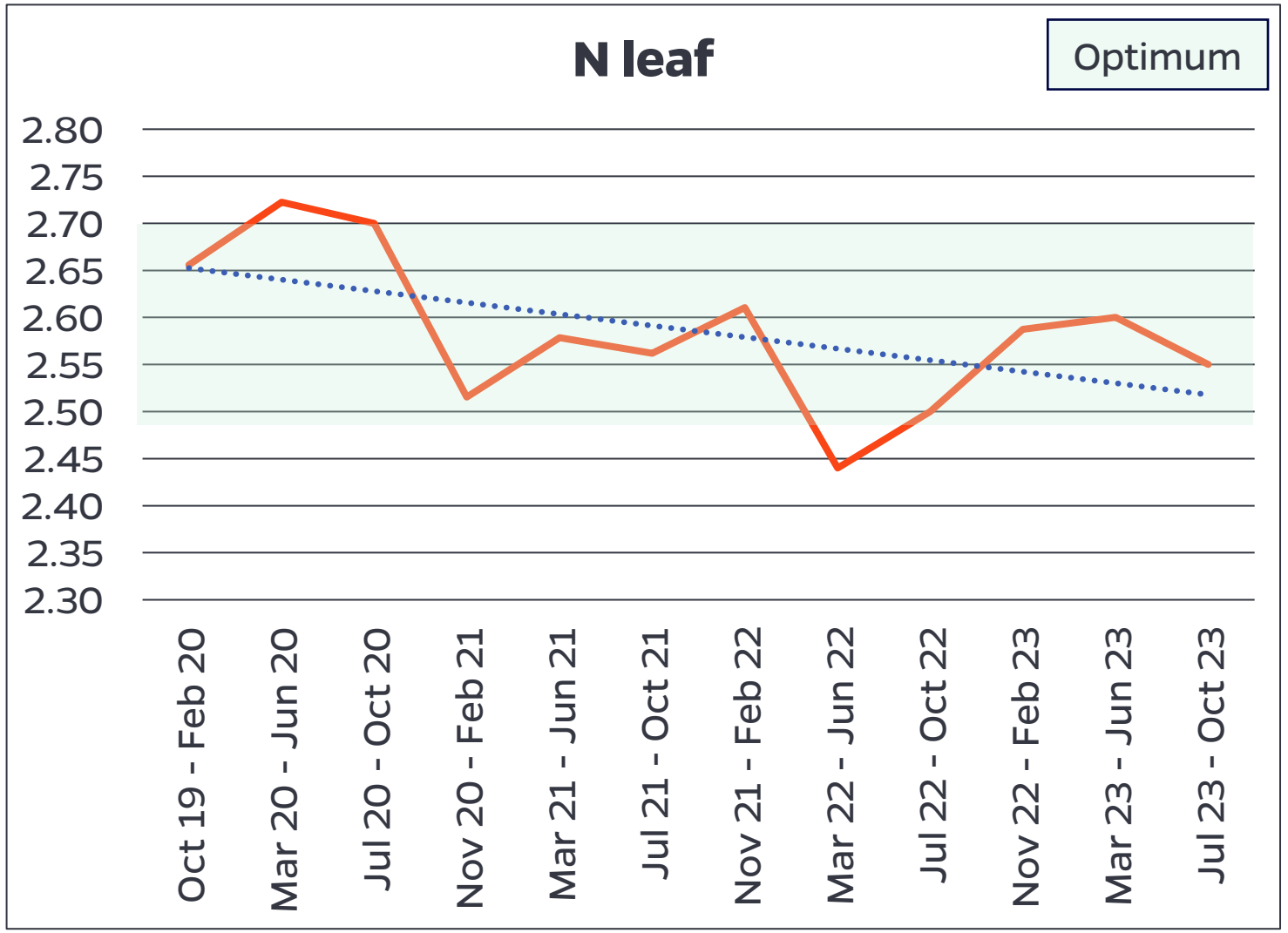
Low	Optimum	High

Statewide downward trend – Nitrogen (N)

- Often in the optimum range
- Saw a gradual decline
- Monitor trends over time, not just one sampling to another



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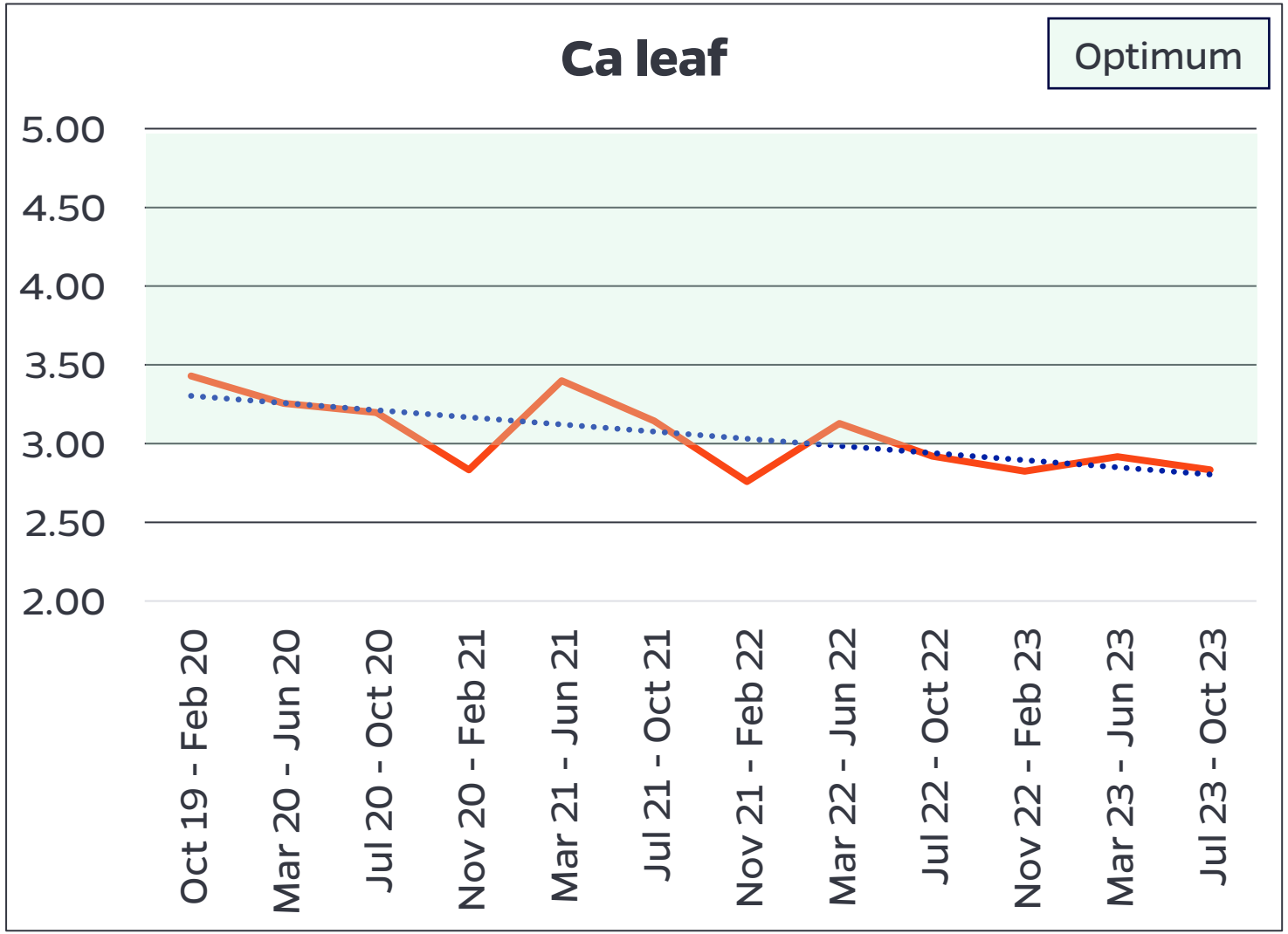
Statewide downward trend – Calcium (Ca)

- Saw a decline especially going into year 3
- Less samples in year 3
- Possible interaction of HLB-affected trees with calcium
  - Maybe utilizing more?
  - Based on observation, there should be an effort to increase calcium



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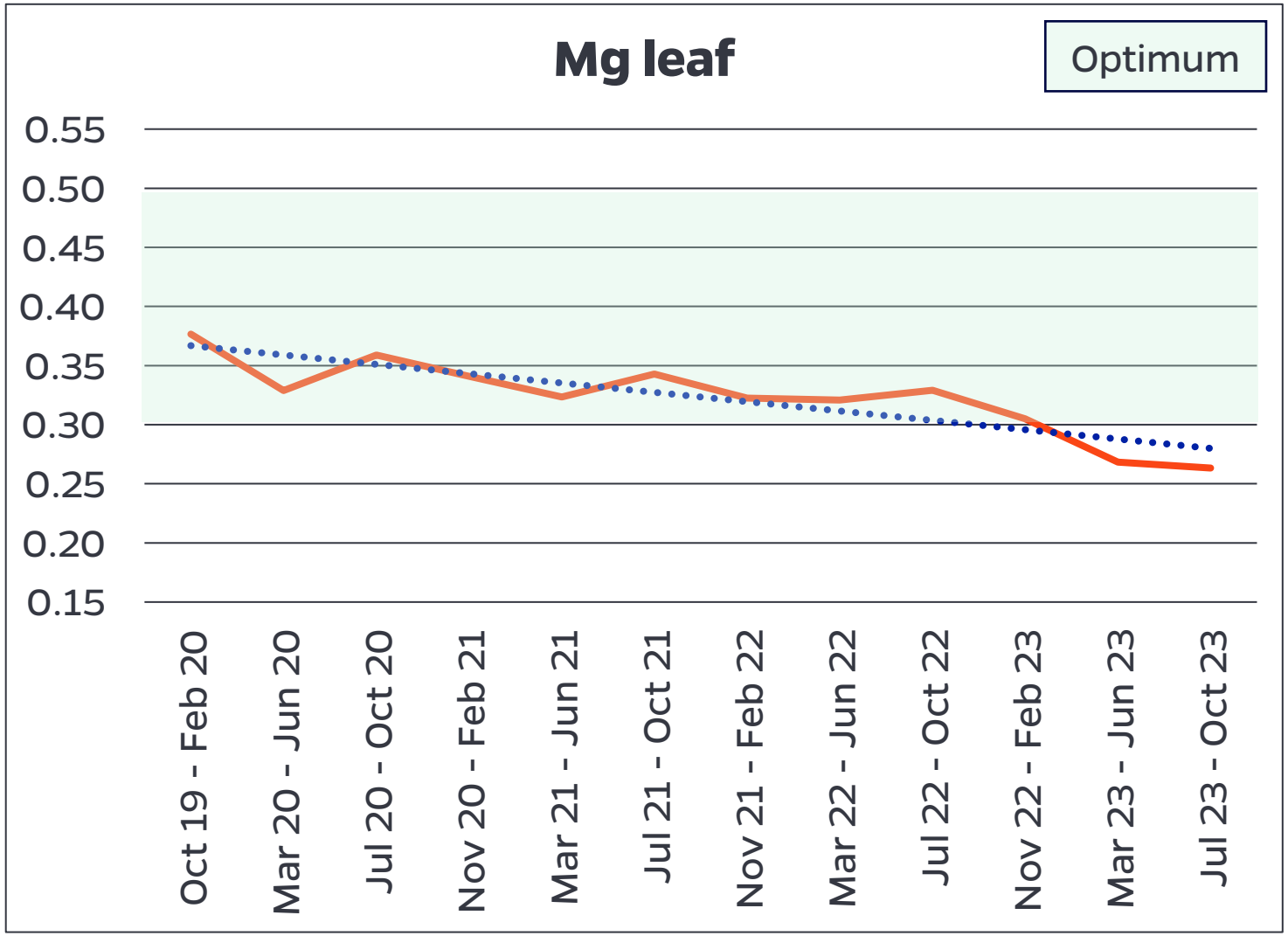
Statewide downward trend – Magnesium (Mg)

- Similar to nitrogen and calcium, downward trend
- Needed for photosynthesis
- Limited Mg affects overall tree growth



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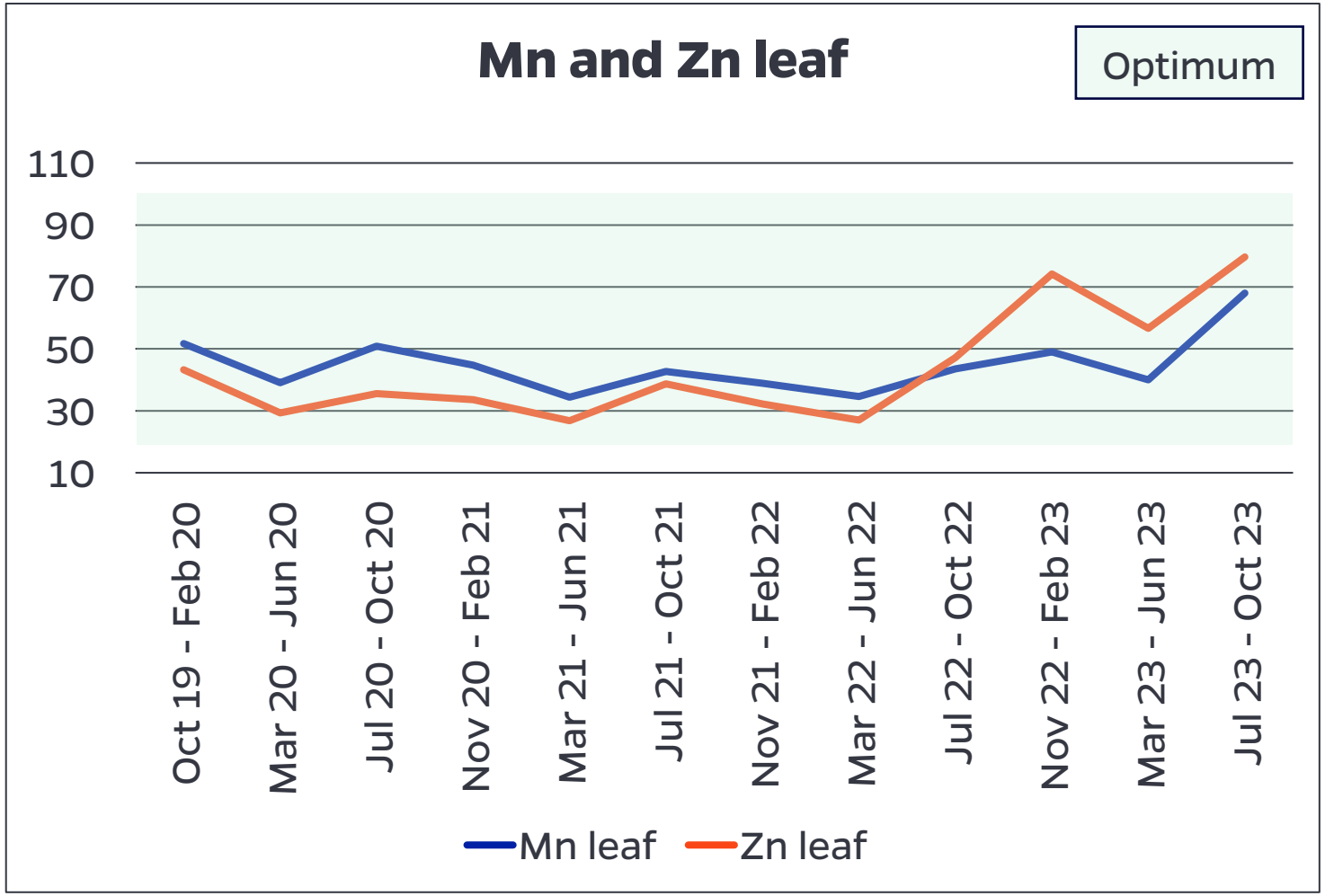
Statewide trend – Manganese (Mn) and Zinc (Zn)

- Moving together in the same direction as it should
- Always in the optimum range, but HLB-affected trees should be near the higher end of optimum



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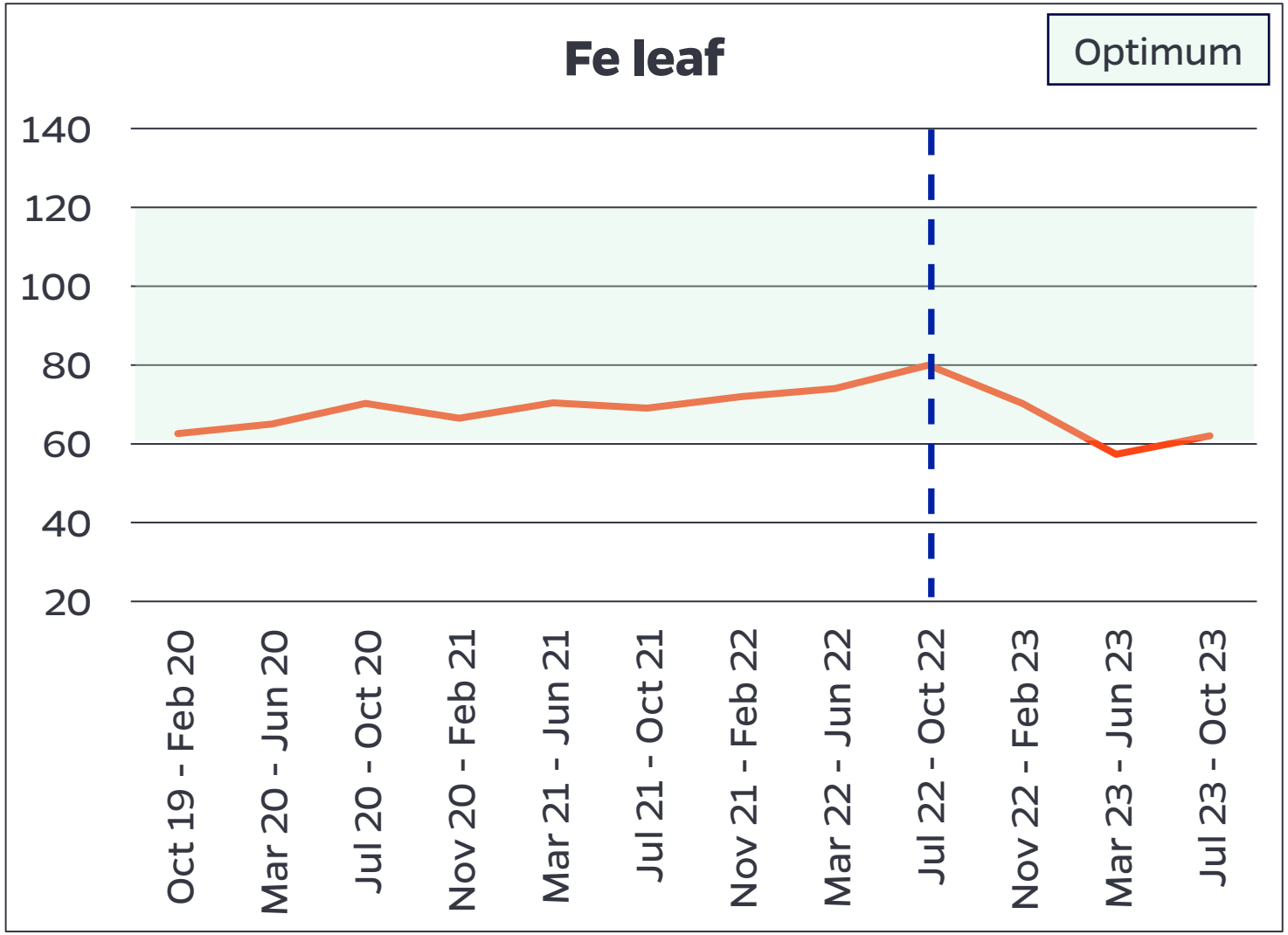
Statewide upward trend – Iron (Fe)

- Iron was almost always in the optimum range
- Fewer samples in year 3
- Over time, there was a gradual increase
- Undetermined reason why, this is just a good thing!



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It’s more than just being in the optimum range

- Goal: Be in the optimum range

- **But wait, there’s more!**
  - Monitor levels often because the slightest change can cause you to fall out of where you need to be

- Watch over time, not just sample to sample

Comparison – Grower A

Beginning	N	P	K	Ca	Mg	S	Mn	Zn	Cu	Fe	B
Statewide	2.7	0.16	1.5	3.4	0.38	0.30	52	44	14	63	85
Grower A	2.6↓	0.12↓	1.5	3.7	0.2↓	0.33	32↓	28↓	5↓	53↓	83↓

Ending	N	P	K	Ca	Mg	S	Mn	Zn	Cu	Fe	B
Statewide	2.6	0.17	1.5	2.8	0.33	0.32	39	32	10	72	94
Grower A	2.6	0.15↓	1.7	2.6↓	0.24↓	0.28↓	38↓	28↓	16	83	112

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↓ Grower sample is lower than statewide average

Comparison - Grower B

- Permission given to share results
- Grapefruit on Swingle, Central Region
- Severely HLB symptomatic and significant dieback
  - Tree rating #3 (50% or more dieback)
- Fully applied recommendations

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Comparison - Grower B leaf analysis

Sampling Date	N	P	K	Ca	Mg	S	Mn	Zn	Cu	Fe	B
Oct 19 - Feb 20	3.2	0.16	1.4	4	0.46	0.23	14	20	10	26	113
Mar 20 - Jun 20	2.9	0.14	1.5	3.4	0.44	0.33	16	112	3	31	121
Jul 20 - Oct 20	3	0.15	1.9	2.8	0.37	0.23	13	47	5	47	98
Nov 20 - Feb 21	2.7	0.14	2	2.9	0.4	0.29	13	25	5	39	107
Mar 21 - Jun 21	3	0.13	1.7	3.2	0.4	0.39	21	30	4	50	112
Jul 21 - Oct 21	2.7	0.11	1.6	3.1	0.39	0.26	46	54	7	43	102
Nov 21 - Feb 22	**2.7↓**	**0.13↓**	1.5	**2.5↓**	**0.35↓**	0.26	30	26	**6↓**	46	107

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↓ Ending levels were lower than the beginning

Low	Optimum	High

Comparison - Grower B photo comparison

March 2020

Summer 2020

November 2020

The difference a year can make

← 2020

March

2021 →

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Take home message

- Nutrient patterns can develop over time
- More severely HLB-affected trees (more dieback) had higher nutrient levels than trees with less dieback
- Numerically numbers are low, visually the trees are improving
- Regardless of variety, nutrients are needed the same
- Fertilizing based on leaf nutrient analysis is doable and can improve tree health

Now what?

- Nutrient patterns can develop over time
  - **ACTION:** Do frequent leaf analysis and watch for long term trends.
- More severely HLB-affected trees (more dieback) had higher nutrient levels than trees with less dieback
  - **ACTION:** Grow leaves first! You need leaves for photosynthesis and then fruit will happen.
- Numerically analysis is low, visually the trees are improving
  - **ACTION:** Keep fertilizing! It's a long process.
- Regardless of variety, nutrients are needed the same
  - **ACTION:** Nutrient recommendations are for all species, follow the guidelines.

Fertilizing based on leaf nutrient analysis is doable and can improve tree health.

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Thank you!

- Program participants
- Extension agents, faculty, and CREC staff
- Citrus initiative funding from the state legislature

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Photo Credit: J.D. Burrow , T. Weeks, UF/IFAS

Thank You

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