Season-long timing of fertilization to match nutrient demand of citrus trees

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Citrus Under Protective Screen

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INTRODUCTION

- *For early- and mid-season citrus varieties:*
- Fruit color break usually occurs naturally during the Fall season
- Reduced daylength & lower temperatures
- Process: the decline in peel chlorophyll content occurs over several months while carotenoid content increases
- Affected by the environmental conditions, nutrient availability and phytohormones such as ethylene
- Artificial degreening with ethylene of some varieties like W. Murcott is not satisfactory, therefore we are researching other options

Incomplete color break & fruit quality in CUPS: Warm Fall weather in FL? Variety? e.g. W. Murcott

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Shading seems to enhance color break

Detrimental effects of excess nutrition on fruit color break and quality: N,P,K :

"Nutrition of Florida Citrus Trees"

https://edis.ifas.ufl.edu/publication/SS478

- Fruit regreening after late application of N
- The damage occurs in the Fall maturation phase when nutrient levels are too high
- Natural ***low*** leaf N, P in the Fall may be related to reduced uptake at lower soil temperatures: root growth ↓ , hydraulic conductivity ↓
- *Can we compensate for warmer Fall temperatures with smart fertilizer timing and improve color break and quality?*

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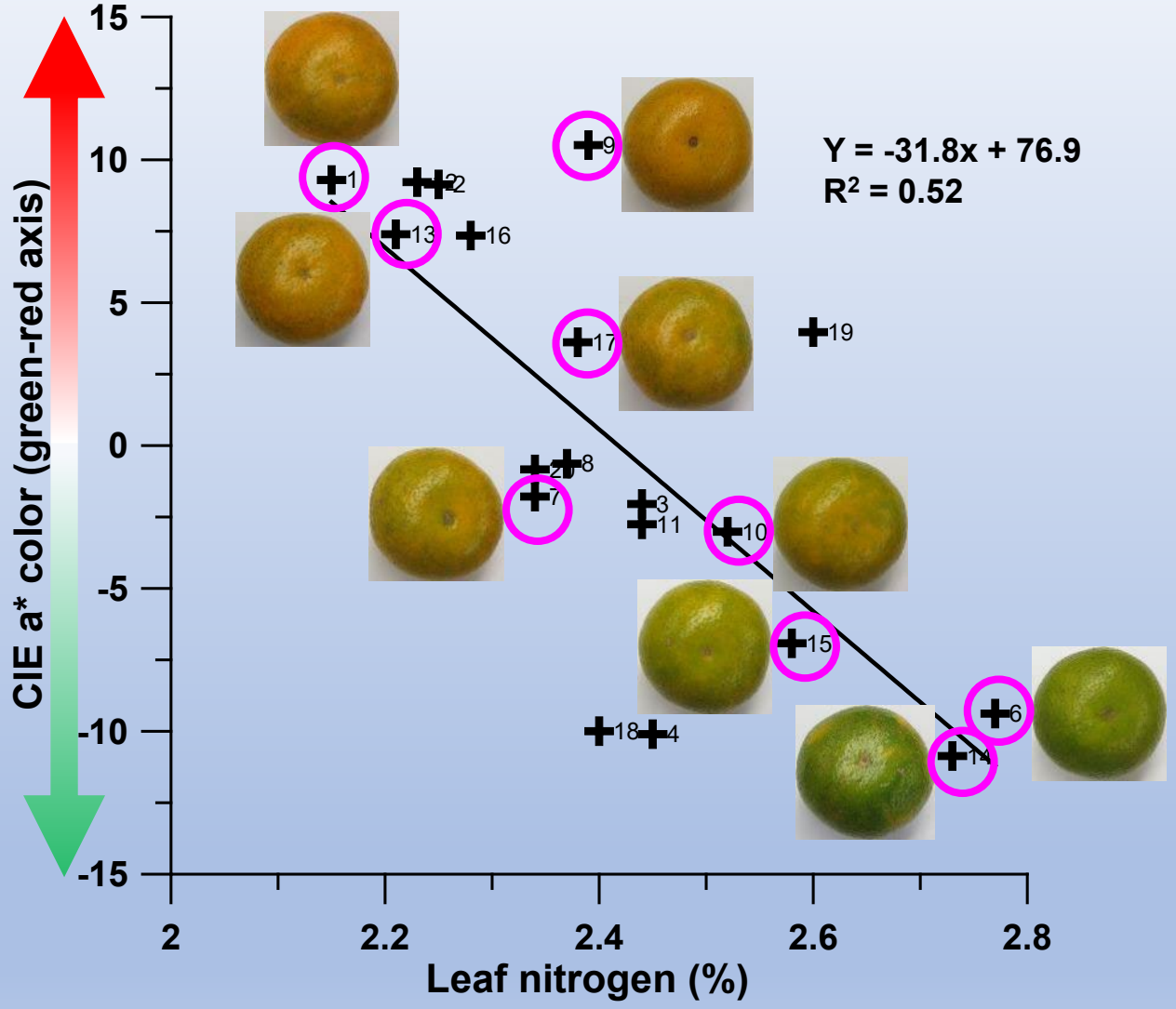
METHODS

- On 8 December 2020, 20 Murcott trees in the CREC CUPS were selected to represent a wide range of fruit peel colors in the block (greenest to full orange color; *purposive* sampling)
- Each tree produced paired samples of a) 5 fruit pieces, b) 25 leaves
- Leaves were washed, dried and ground for pooled nutrient analysis
- Fruit pieces were photographed at fixed white balance, AP and the CIE L* a* b* color of the fruit peel was calculated with ImageJ
- Fruit diameters were measured, cut in half, and juice extracted for Brix & acid measurement of the juice, while the peel was dried and ground for nutrient analysis

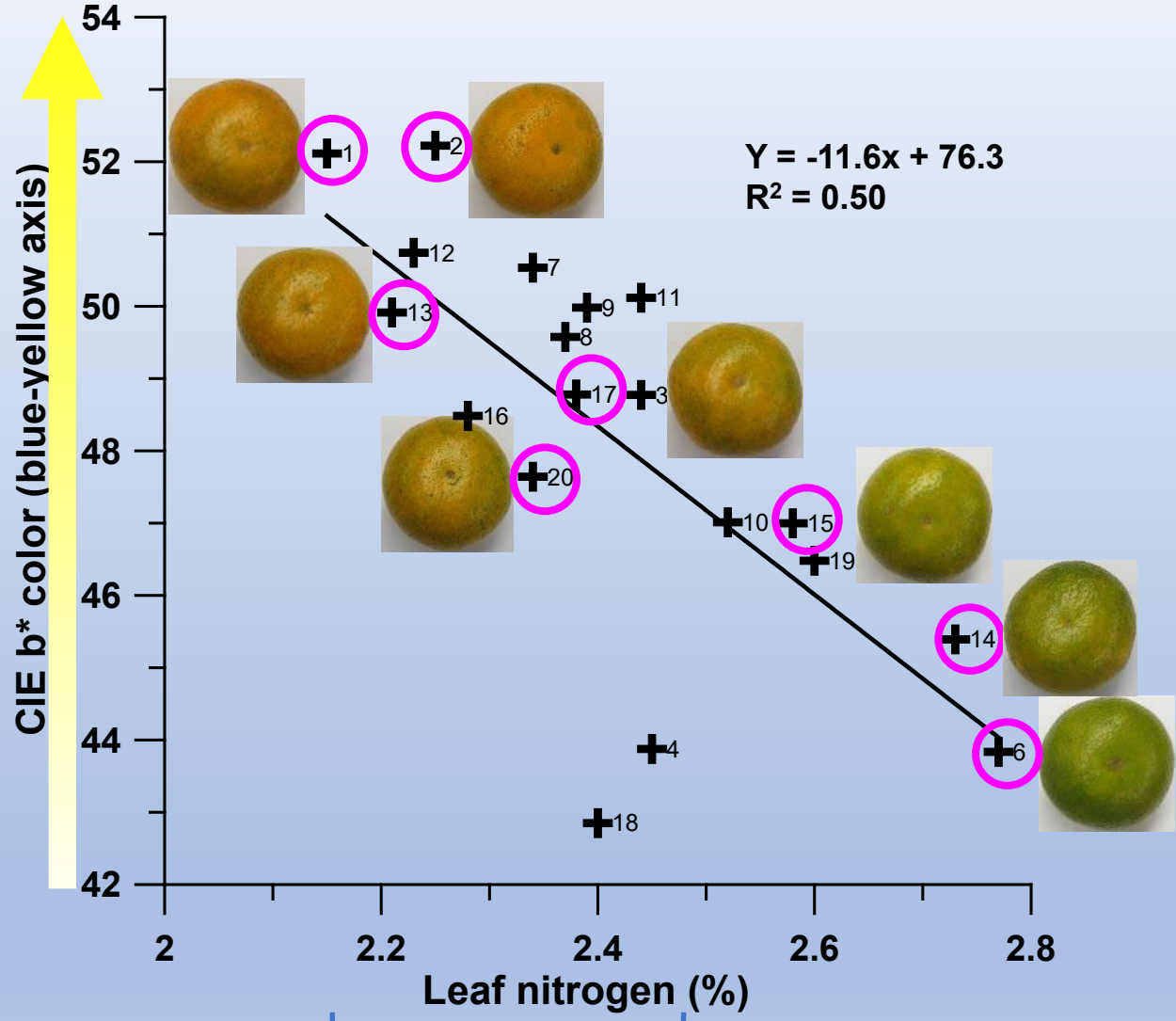
RESULTS

a* (green-red peel color)



Early color break at
lower leaf N concentrations

b* (yellow peel color)



Early color break at
lower leaf N concentrations

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RESULTS

Pearson's correlation coefficient (r) for peel **a*** (**green-> red color**)

Fruit variables

		a*
Diameter		-0.367
L*		0.333
b*, yellow	***	0.805
Brix %	***	0.816
Juice %		-0.059
Acid %		0.308
Ratio	*	0.538
SS /box	*	0.459

Leaf nutrients

		a*
N %	***	-0.723
P %	***	-0.762
K %	**	-0.630
Mg %	*	0.490
Ca %		0.353
S %	***	-0.687
B mg/kg		-0.253
Zn mg/kg		0.124
Mn mg/kg		-0.368
Fe mg/kg	**	-0.607
Cu mg/kg		0.107

Peel nutrients

		a*
N %	**	-0.665
P %		-0.417
K %		-0.343
Mg %		0.342
Ca %	*	0.530
S %	*	-0.536
B mg/kg	*	-0.472
Zn mg/kg		-0.021
Mn mg/kg		-0.050
Fe mg/kg	*	-0.460
Cu mg/kg		-0.142

*, **, *** indicate statistical significance at 5%, 1% and 0.1%

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RESULTS

Pearson's correlation coefficient (r) for **Brix%**

Fruit variables

		Brix %
Diameter	**	-0.562
L*		-0.075
a*, red	***	0.816
b*, yellow	*	0.469
Juice %		0.286
Acid %	*	0.488

Leaf nutrients

		Brix %
N %	**	-0.577
P %	***	-0.789
K %	**	-0.61
Mg %		0.349
Ca %		0.146
S %	**	-0.658
B mg/kg		-0.333
Zn mg/kg		0.035
Mn mg/kg		-0.263
Fe mg/kg	*	-0.553
Cu mg/kg		-0.061

Peel nutrients

		Brix %
N %	*	-0.445
P %		-0.392
K %		-0.261
Mg %	*	0.475
Ca %		0.398
S %		-0.286
B mg/kg	*	-0.458
Zn mg/kg		-0.132
Mn mg/kg		0.21
Fe mg/kg	*	-0.446
Cu mg/kg		-0.14

*, **, *** indicate statistical significance at 5%, 1% and 0.1%

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Large-scale demonstration in CREC CUPS: 2020/21 season:

- Stopped all N fertilizer on 22 September 2020
- Remaining daily fertigation reduced to 25% of max. to allow depletion of leaf nutrients in the Fall: to low or lower range of optimal.
- Resulted in excellent early color break and Brix quality in all varieties grown in the CUPS; visible symptoms of N deficiency developed
- This was the most successful and practical intervention for improving color break and quality in CUPS fresh fruit

Honey Murcott with full color break on 12/22/2020

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6 January 2021, post-harvest grapefruit: pale green leaves, yellow veins showing low N status

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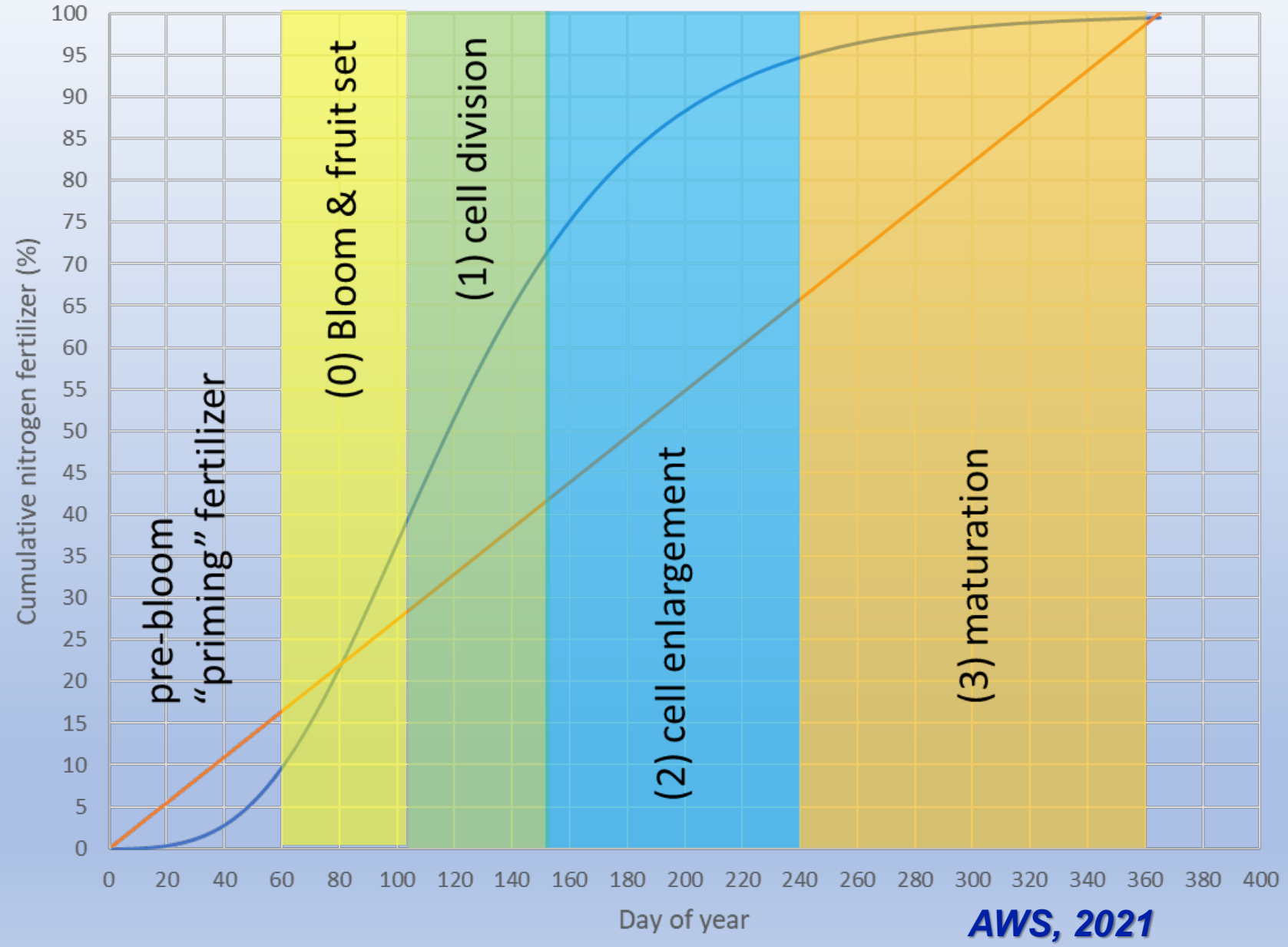
Correct and incorrect fertilizer timing strategies:



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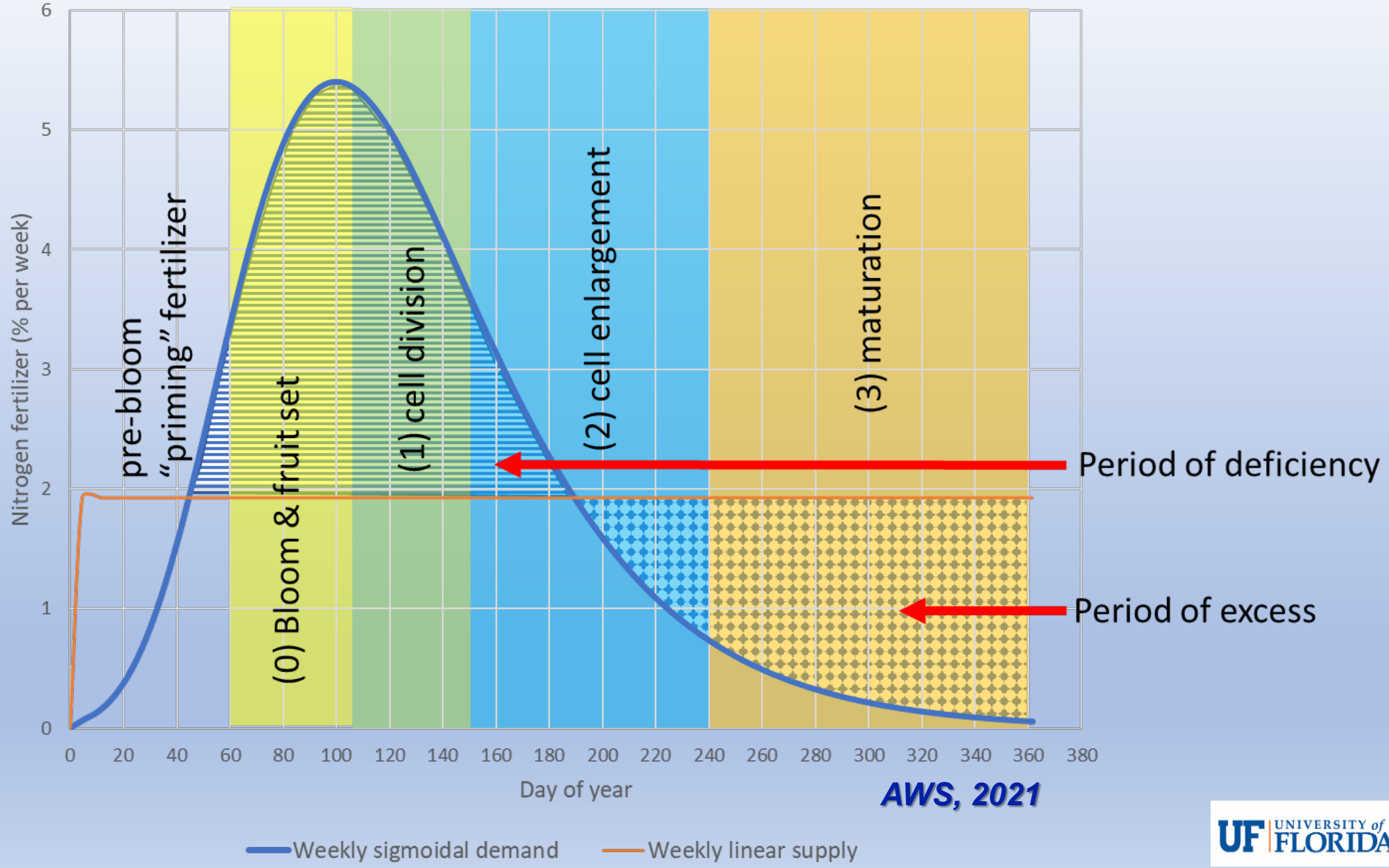
Avoid nutrient deficiencies and excesses which can harm fruit quality and quantity



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CONCLUSIONS

- The leaf nutrients N,P,K,S,Fe were negatively correlated with peel color and Brix, suggesting that surplus amounts in the Fall could harm fruit quality and color break

- Leaf Mg was positively correlated with both peel color and Brix, suggesting that a sustained supply of Mg nutrition could support higher Brix and complete color break in the Fall

- Leaf N,P,S -correlations with peel color were strongest. Leaf P correlation with Brix was strongest. Focus on N and P fertilizer timing to ensure best fruit color break and quality

Recommendations*

- Apply most P fertilizer in pre-bloom to post-bloom period. Omit P if leaf and soil levels are high.
- Apply 50% N by post-bloom period.
- Apply 75% N by physiological fruit drop (May/June).
- Apply 100% N by mid to end of summer, depending on the maturity date of the variety.
- **Leaf N, P concentrations: aim for high end of optimal in spring to early summer, and low optimal or low in late summer, fall.**

- *** Parts adapted from "Fruit Size Management Guide", Part 1**
- https://www.dpi.nsw.gov.au/data/assets/pdf_file/0005/138830/Fruit-Size-Guide-PART-1.pdf

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