PGRs to improve health and productivity of HLB-affected trees

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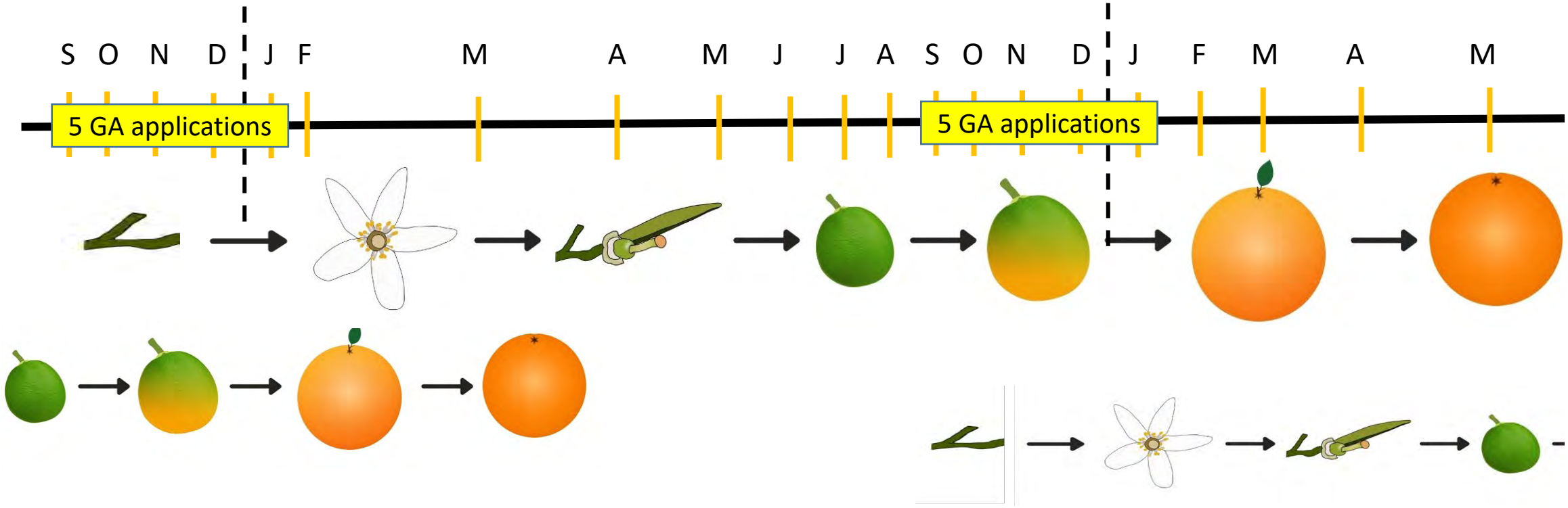
Take home message

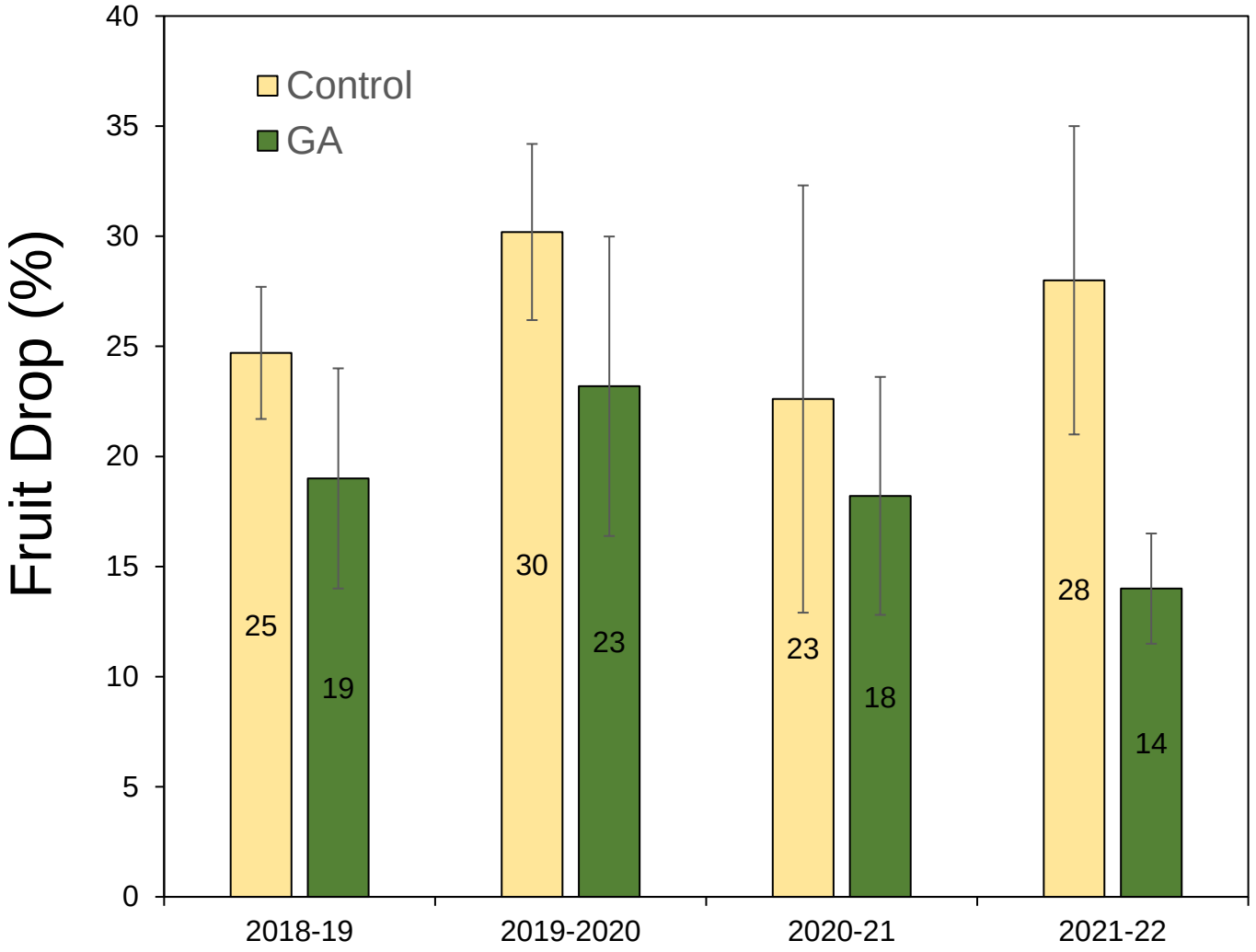
1. Gibberellic acid (GA) efficacy trend continues (as per 2022 harvest)
2. Hamlin are showing a similar to Valencia response to GA
3. Multiple applications are needed, application time is critical
4. GA+2,4D application seems promising
5. Few other PGRs show potential in tree heath improvement

Valencia Orange Field Study (2016-2022)

- 10 year old ‘Valencia’ on swingle
- GA applied monthly from September to January
  - 10 fl oz per acre (Progibb LV plus) + 0.125% surfactant (Induce)
  - 1 gallon per tree spray volume



GA-treated trees drop less fruit



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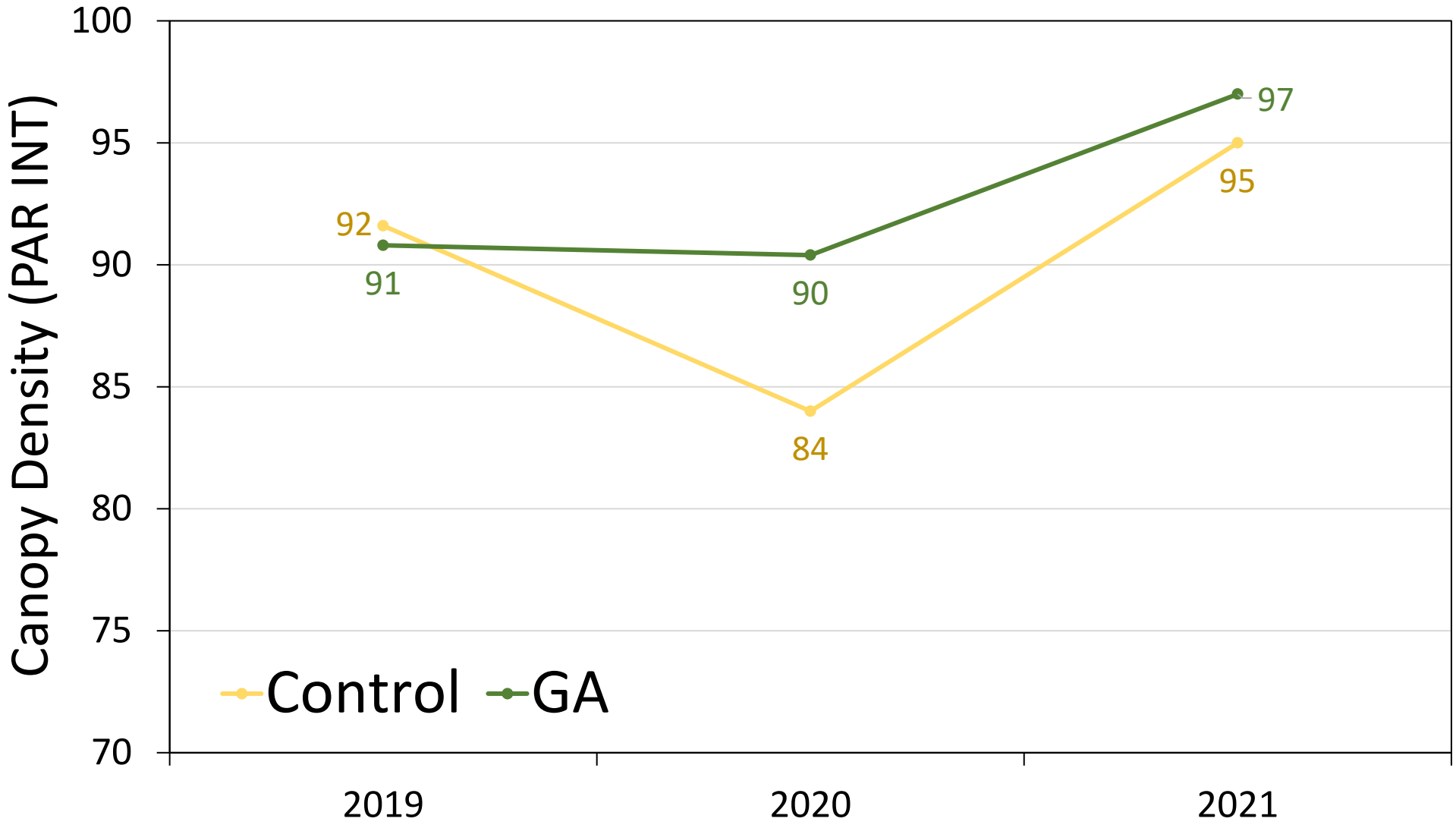
Significant canopy growth in GA-treated trees



Valencia Orange Field Study (2016-2022)

GA increased fruit yields compared to untreated plots

Treatment	Fruit yield (lb/tree) per year					
	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Control	99	213	209	163	119	155
GA	**172**	**255**	**282**	**207**	**169**	**184**
p-value	0.2	0.15	0.02	0.10	0.07	0.15

Increase in number of GA applications

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Valencia Orange Field Study (2016-2022)

Trees treated with multiple GA applications produced more fruit

5 year average

	pounds/tree	Boxes per tree	p value
Control	172 b	1.9	0.05
GA	220 a	2.4	

Extrapolation
(150 trees/acre)

	Boxes per acre
Control	287
GA	367

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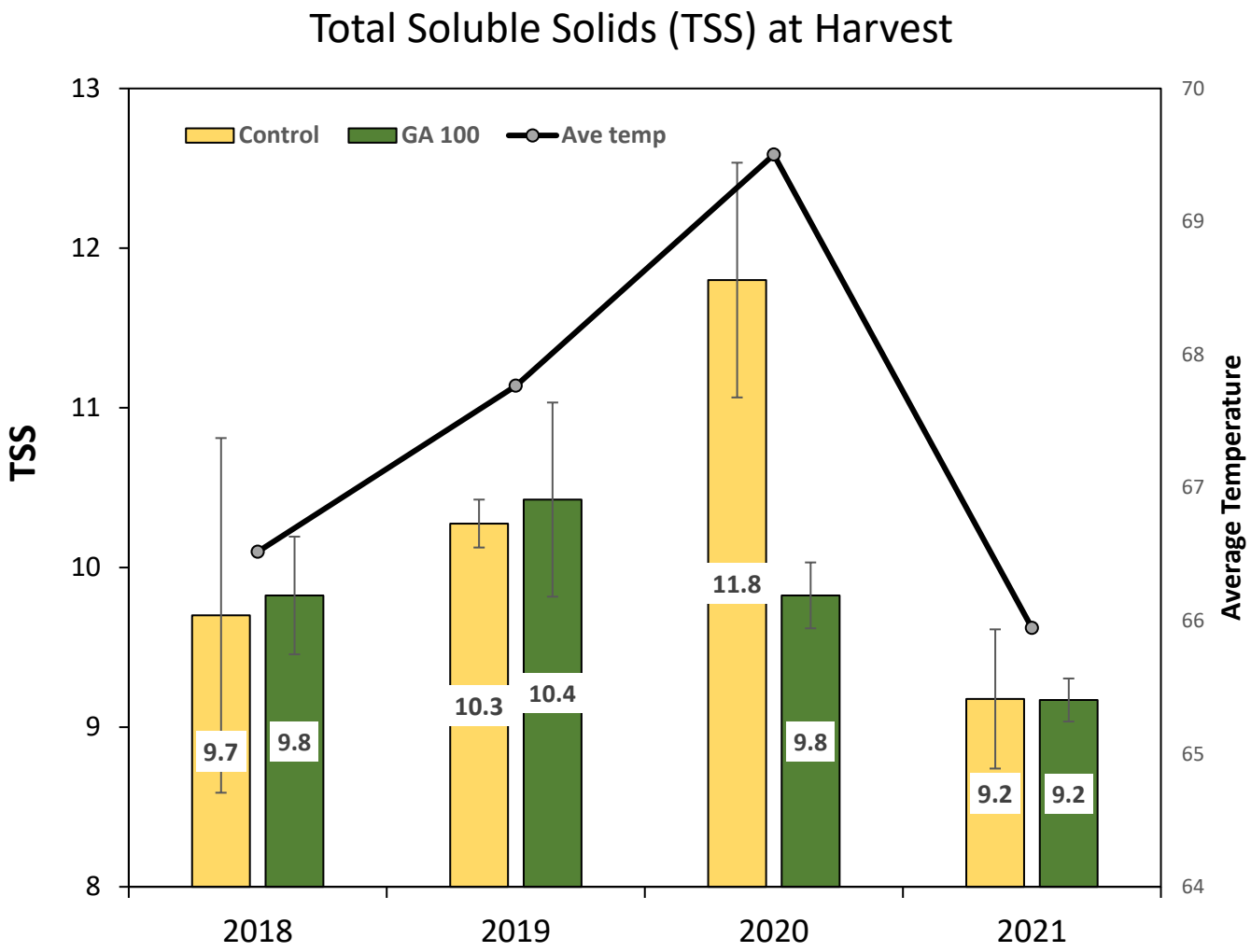
Fruit Quality



- Two rationale for low Brix in 1/5 year:
  - Higher temperatures may exacerbate GA effects on fruit
  - Fruit size significantly larger with GA treated in 2020 (dilution effect)

2022	
	TSS
Control	9.0
GA	8.3

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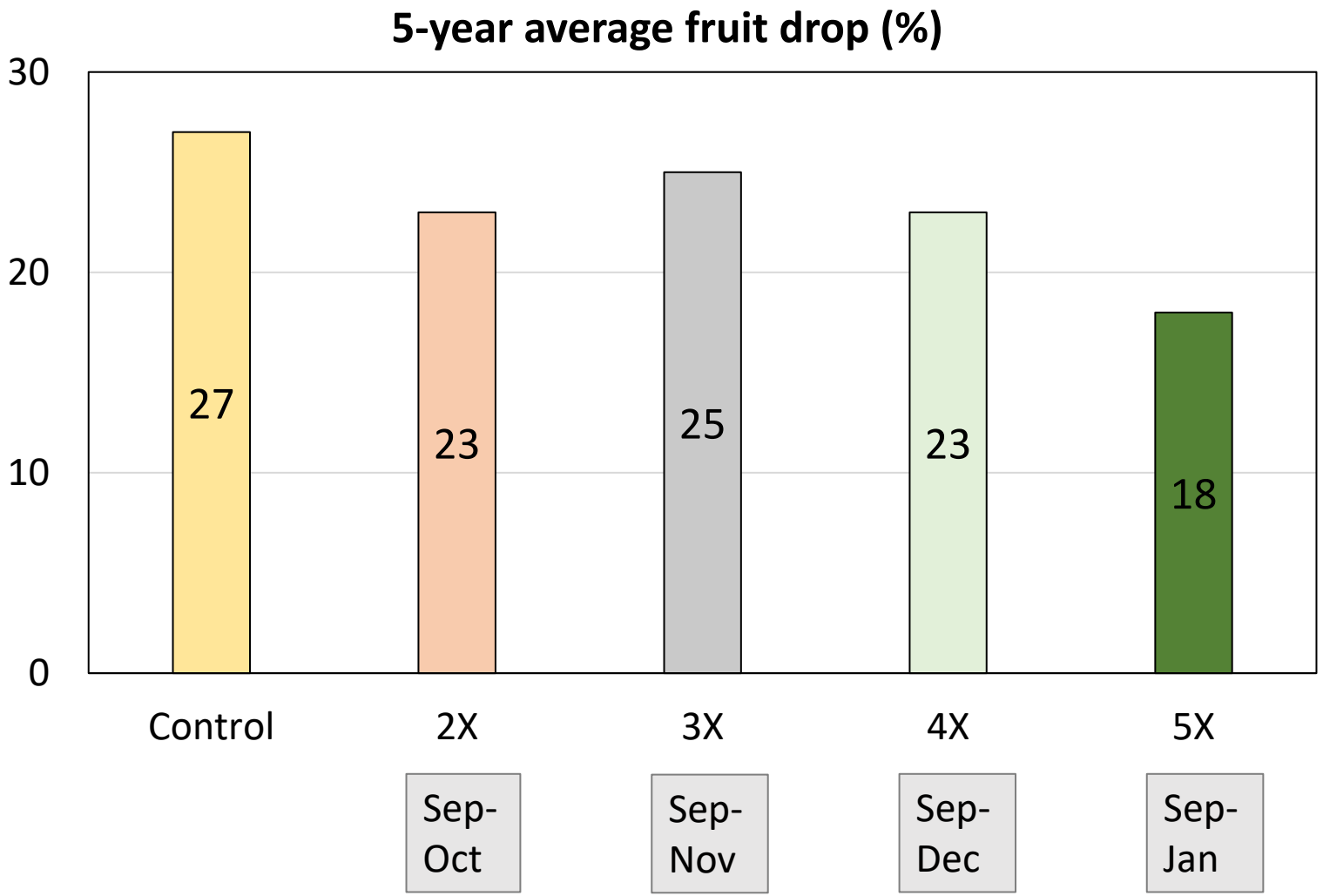
6 year-GA field trial has shown that GA:

- Reduces the number of flower
- Increases the number of leafy inflorescence
- Synchronizes flowering
- Enhances leaf growth
- Enhances fruit growth
- Improves carbohydrate metabolism, observed less starch build-up in leaves
- Improves tree defense response
- Improves yield

Timing of application and repeated applications are the key!

The level of GA effect depends on number of applications (September-January)



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Year 1 results for GA-Hamlin trials with growers

GA application on Hamlin

- Hamlin have a shorter fruit development period
- Preferred GA application in August, September, and October
    - 10 fl oz Progibb LV per acre per application
        - GA 20 g ai or 33 mg/liter per acre per application
    - 0.125% Surfactant (nonionic, low foam; Induce)
    - Spray volume: 125-150 gallons per acre
- GA application will keep the fruit green
- May extend harvest window

Latest Hamlin Grower Trial

GA applied		FDF		Fruit Drop %		Yield (lbs)		Brix		Size (mm)	
		GA	Control	GA	Control	GA	Control	GA	Control	GA	Control
Aug, Sep, Nov	Site 1	7.05*	5.49	23*	33	380	316	8.96	8.70	63.84*	59.36
Sep, Oct	Site 2	7.33*	5.61	57*	81	60 F	42 F	7.2	7.57	58.34	58.42
Oct, Nov	Site 3	6.98*	6.39	27	23	293	310	10.1*	9.29	65.67	65.89
Oct, Nov	Site 4	6	6.15	25	21	225	303	8.46	9.55*	63.51	63.21
Oct, Nov	Site 5	NA	NA	NA	NA	229	224	11.75	11.36	60.07	58.05

Multiple GA application reduced the FDF value in Hamlin

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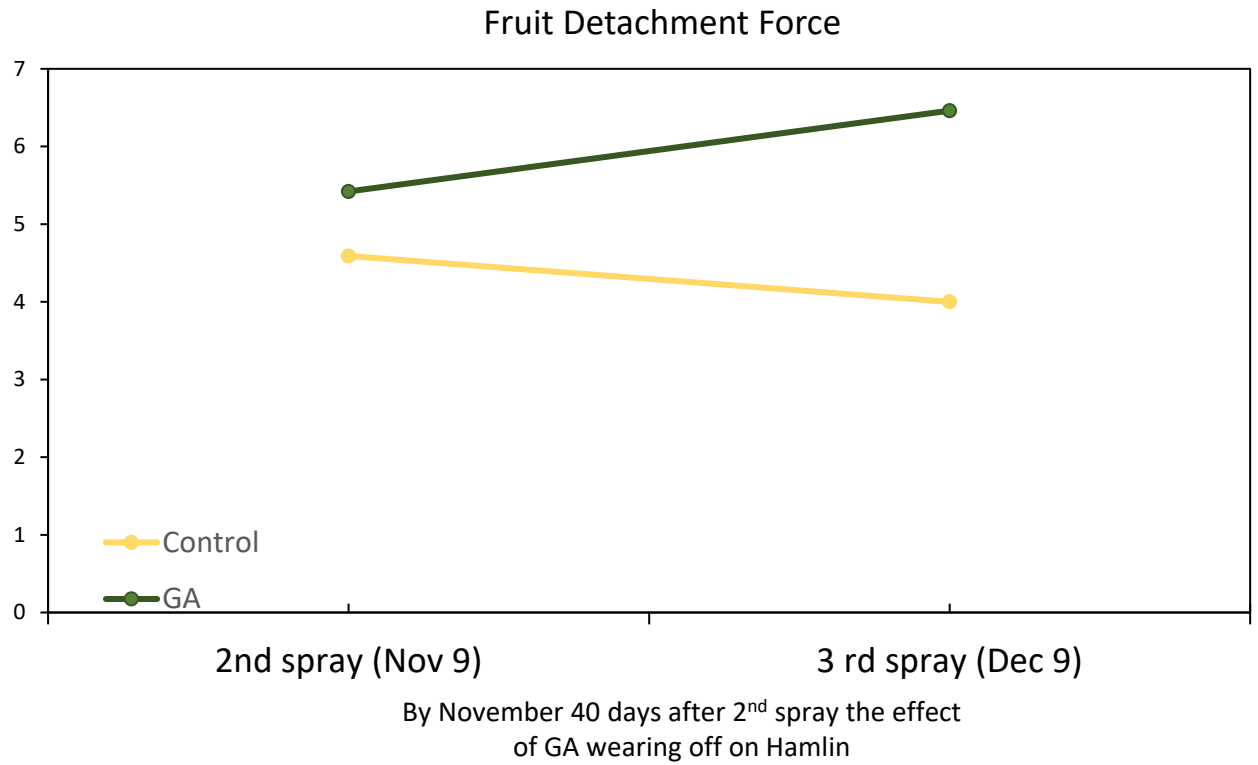
Site 1: In-depth look at fruit drop

Application dates on Hamlin	29-Aug 29-Sep 17-Nov
Harvest dates	3-Jan

	Total fruit drop	P value
Control	33 %	0.03
GA	22 %	



By November 40 days after 2nd spray the effect of GA wearing off on Hamlin

- Multiple applications and an early start in the season are needed
- Dr. Albrigo's work also suggests that one application of GA is not sufficient to reduce fruit drop

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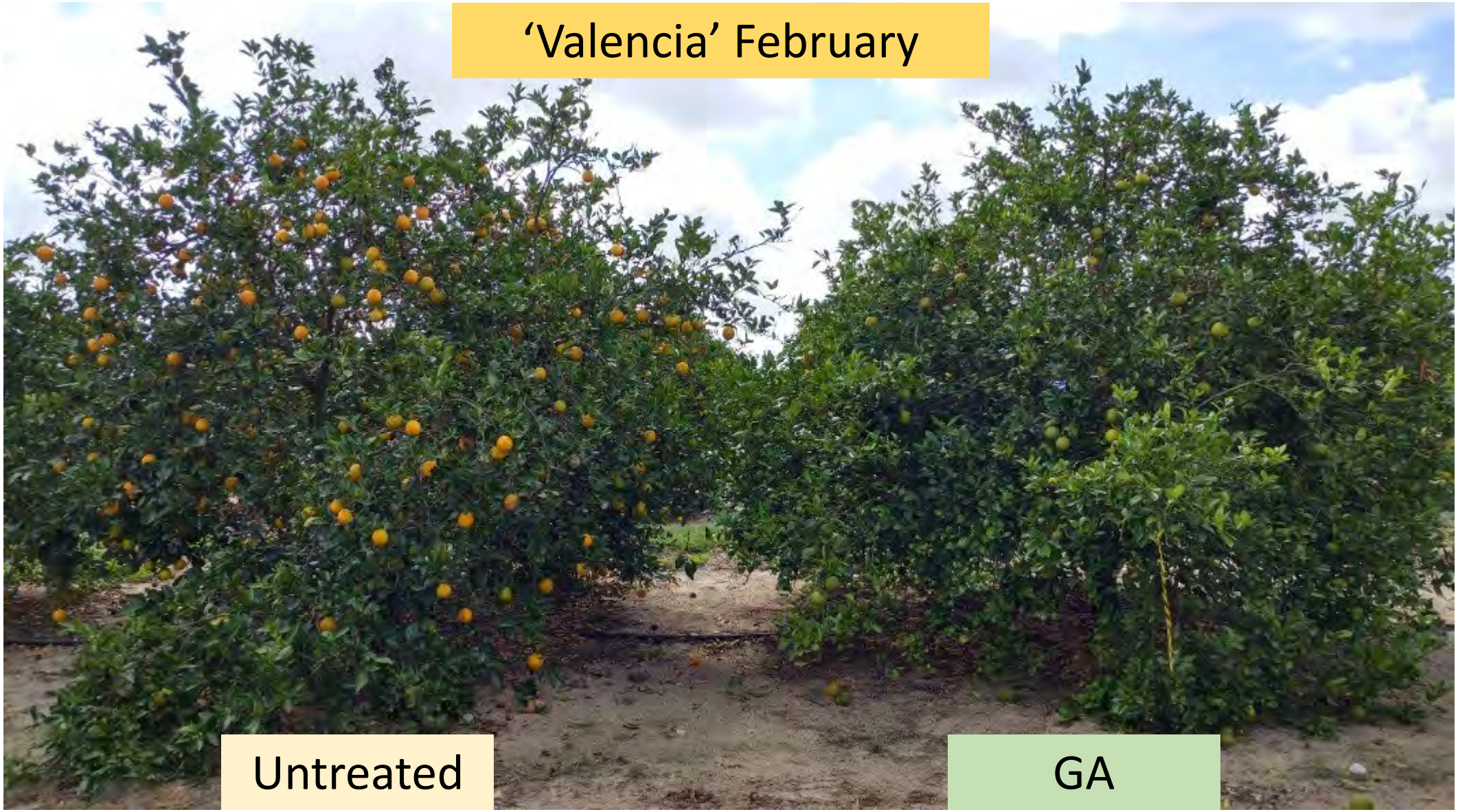

Pay attention to fruit color as well as canopy density

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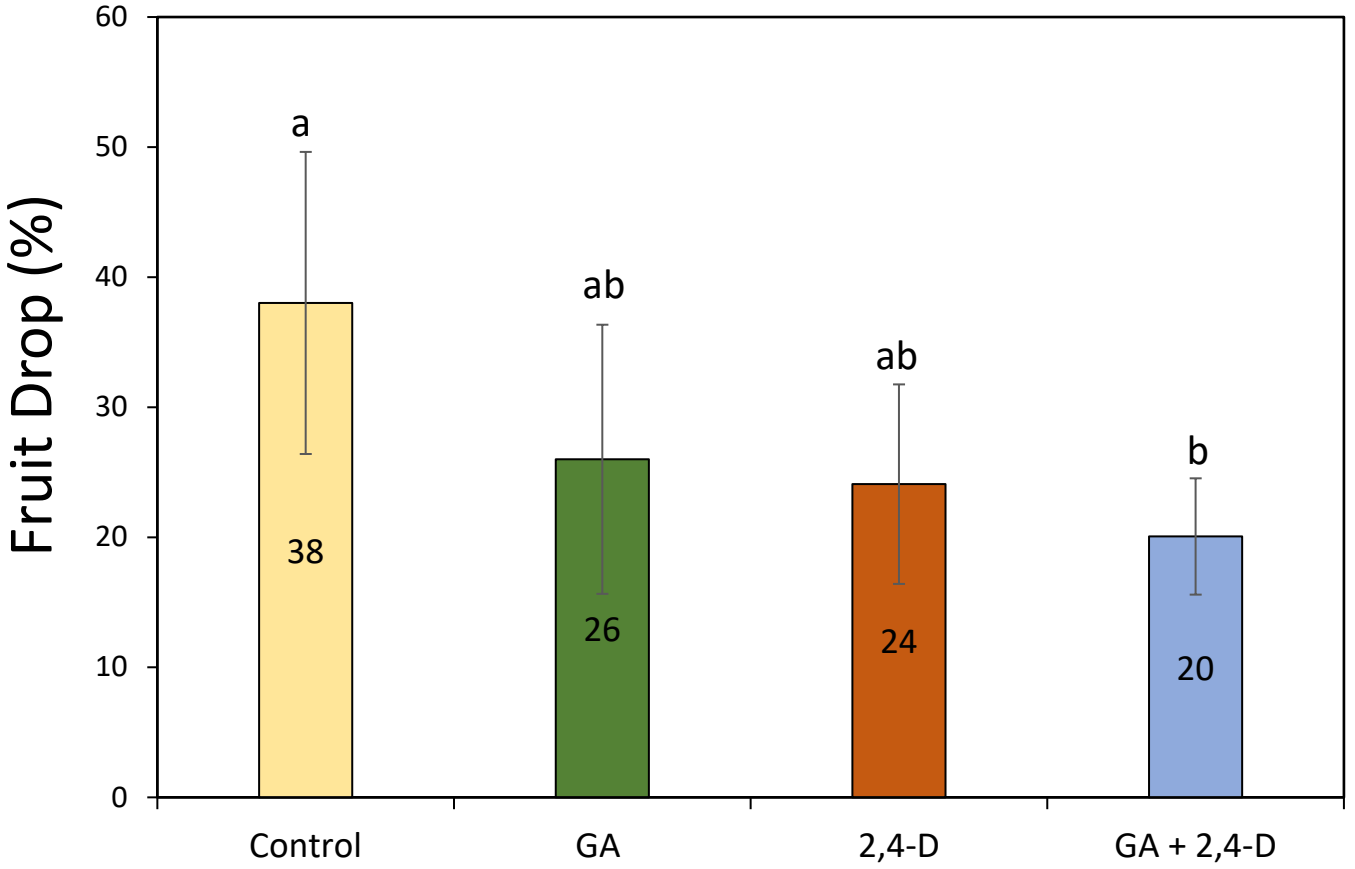
Year 1 results on GA and 2, 4 D trial

- Valencia on Swingle, 15 year old trees
- Four treatments applied in October, November, December
  1. Untreated Control
  2. GA (Progibb 10 fl oz per acre+ surfactant)
  3. 2, 4 D (1.1 fl oz per acre+ surfactant)
  4. GA+ 2, 4 D
- Hand spray, 1 gallon per tree.
- 8 replicates per treatment, 2 buffer trees on both sides

GA+ 2, 4 D application reduced preharvest fruit drop by 18%



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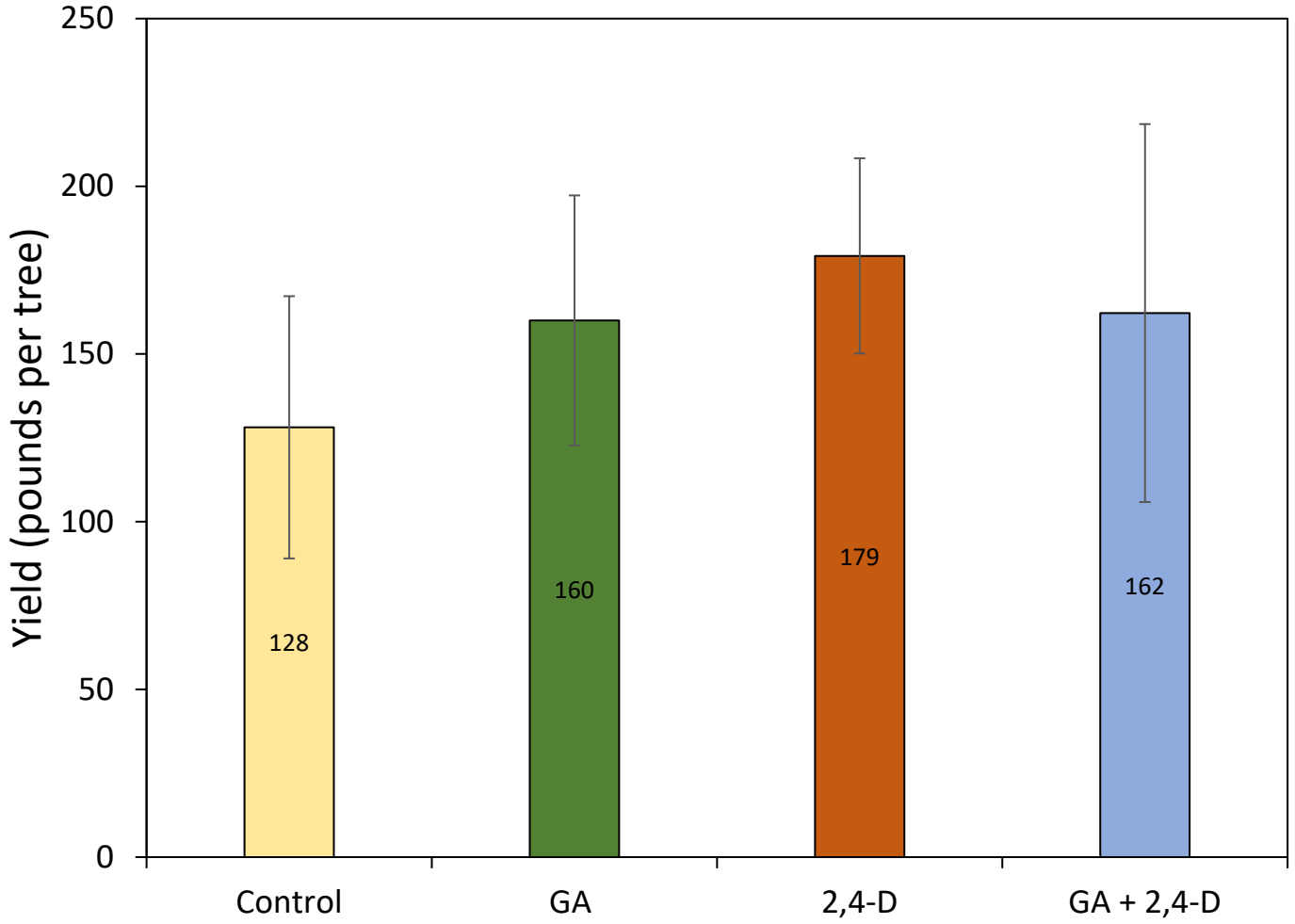
No statistical effect on yield



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Fruit size improved with GA + 2, 4 D

	Size (mm)	Brix/Acid
Control	63b	11.6
GA	64ab	11.2
2, 4-D	65ab	13.1
GA + 2, 4-D	66a	12.1

Summary:

- GA + 2, 4 D application seems promising
- 3 sprays of GA show lower efficacy than 5 application

Latest research on role of other PGRs in managing HLB-affected trees

Understanding the cause of canopy dieback and what can we do about it?

- Trees with severe HLB symptoms show:
  - Significant canopy dieback
  - Significant fruit drop
  - Low yield
- Valencia and Hamlin trees were selected based on symptoms, monitored for :
  - Canopy density
  - Yield
  - Fruit drop
  - **Bud development**
  - Hormone analysis

Mild trees

Severe trees

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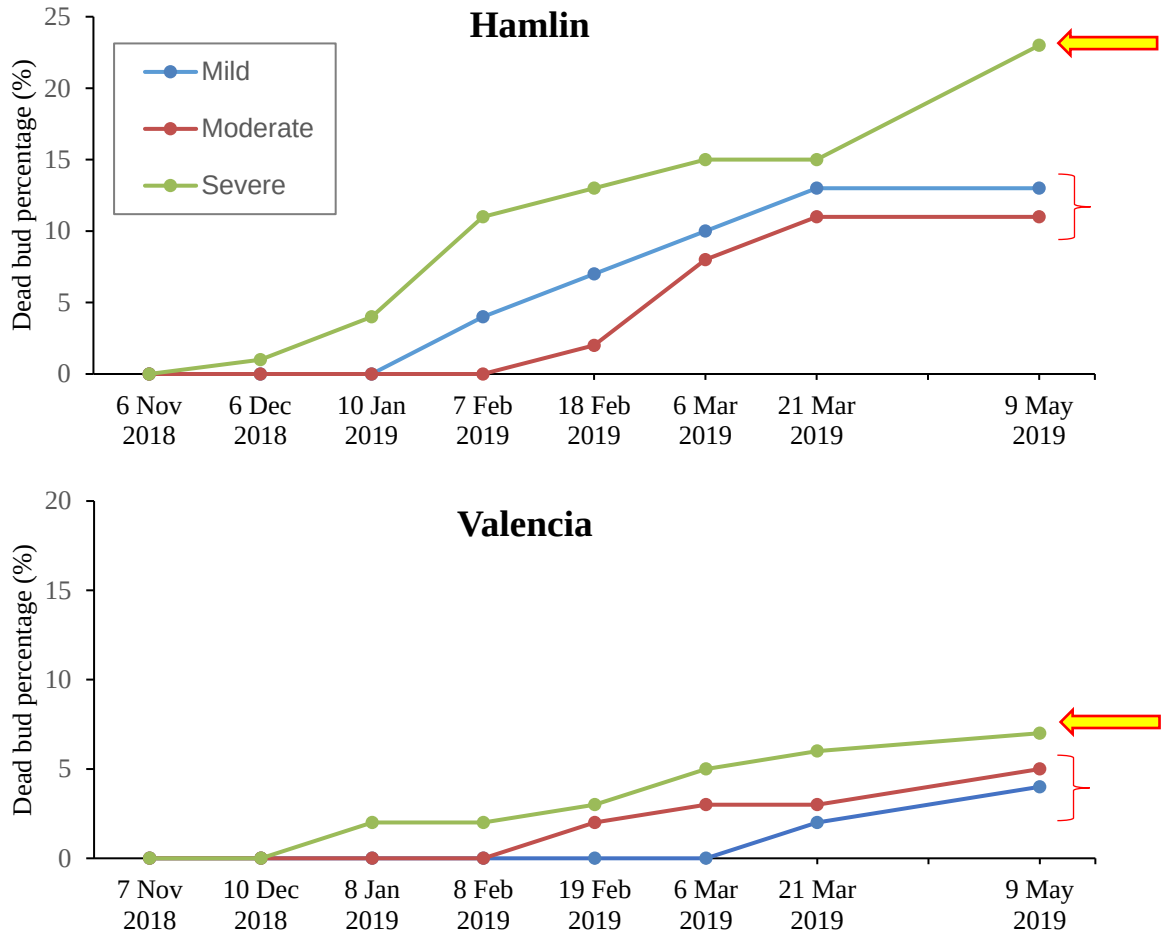
Significant bud dieback in severely symptomatic trees as compared to mild



Hamlin showed more dieback than Valencia

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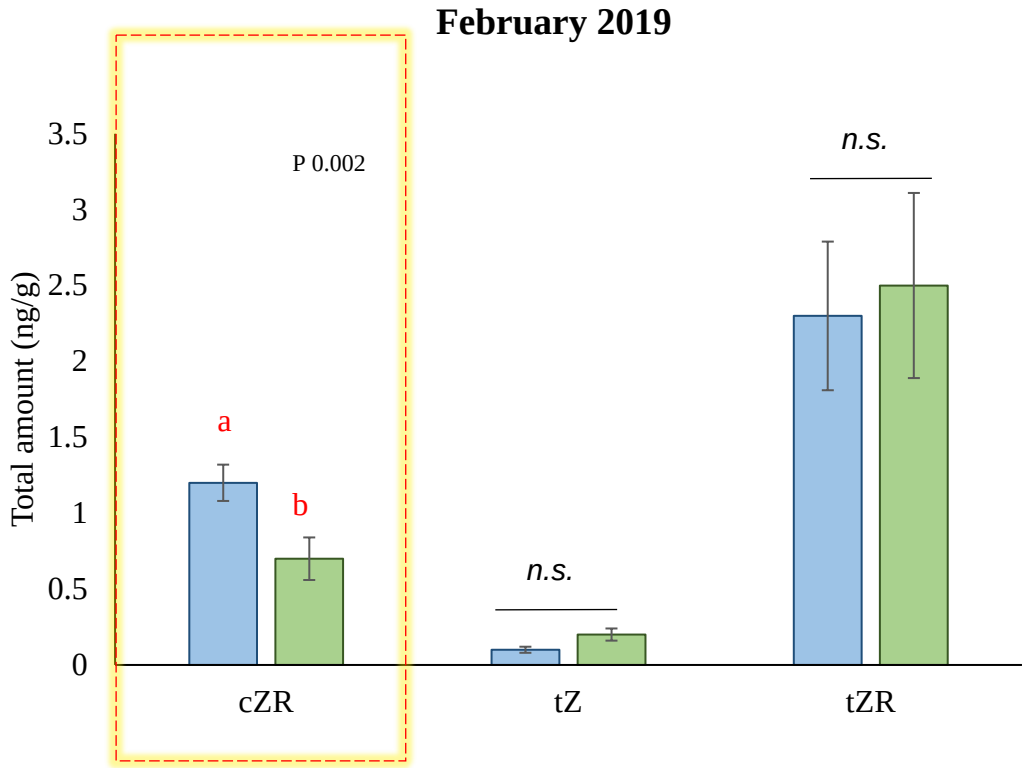
Severe trees show low levels of cytokinin in Spring!



Cytokinin is essential for cell division and growth

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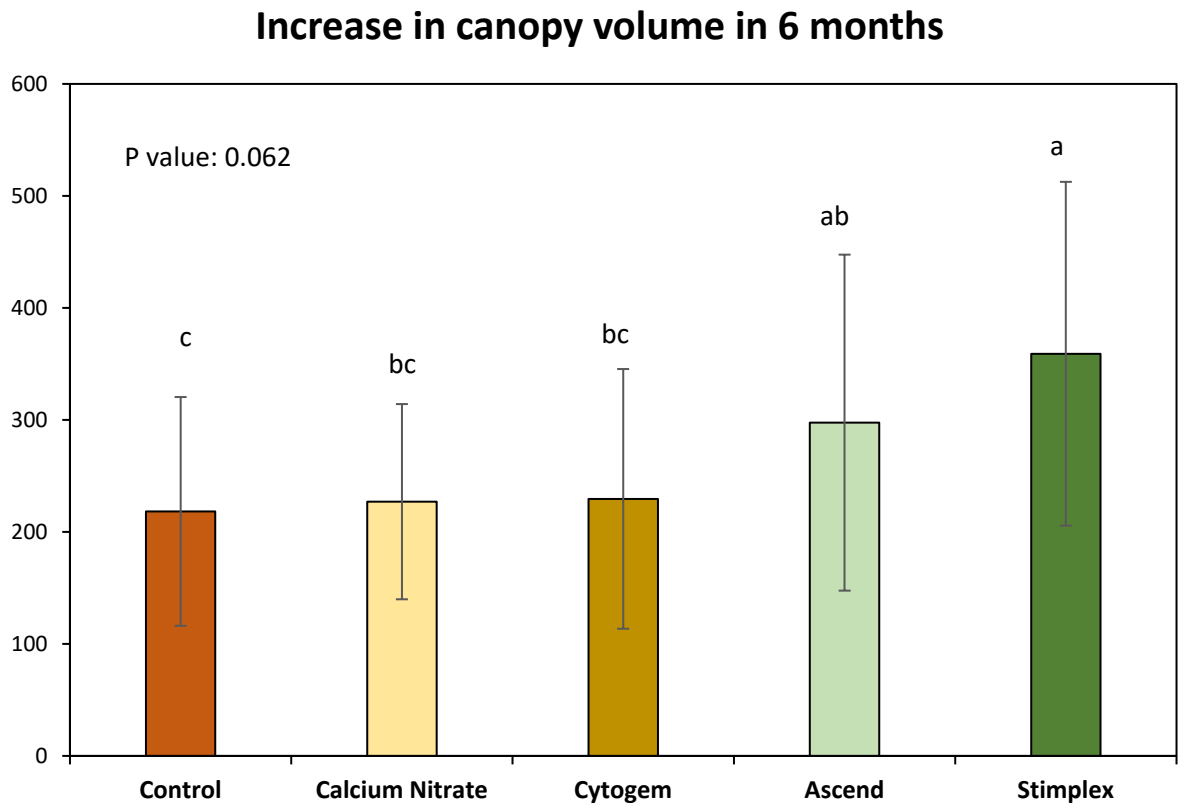
Study 1 : Hamlin Reset Study

- Two PGRs showed improvement in growth, when applied every 45 days for 6 months, slight improvement in SPAD (leaf chlorophyll was also observed)

SPAD value	
Control	95 b
Calcium Nitrate	90 b
Cytogem	95 b
Ascend	100 ab
Stimplex	106 a



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Control

Stimplex

Ascend

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Conclusion

- GA affects multiple processes in a tree, vegetative growth to fruit drop
  - The effect of tree is gradual…
  - Building a strong foundation
- Multiple 2,4-D application, low rate but repeated seem to be promising in reducing drop
- GA+2,4-D can possibly be advantageous
- Other PGRs such as cytokinin product may help with boosting growth, especially of young trees

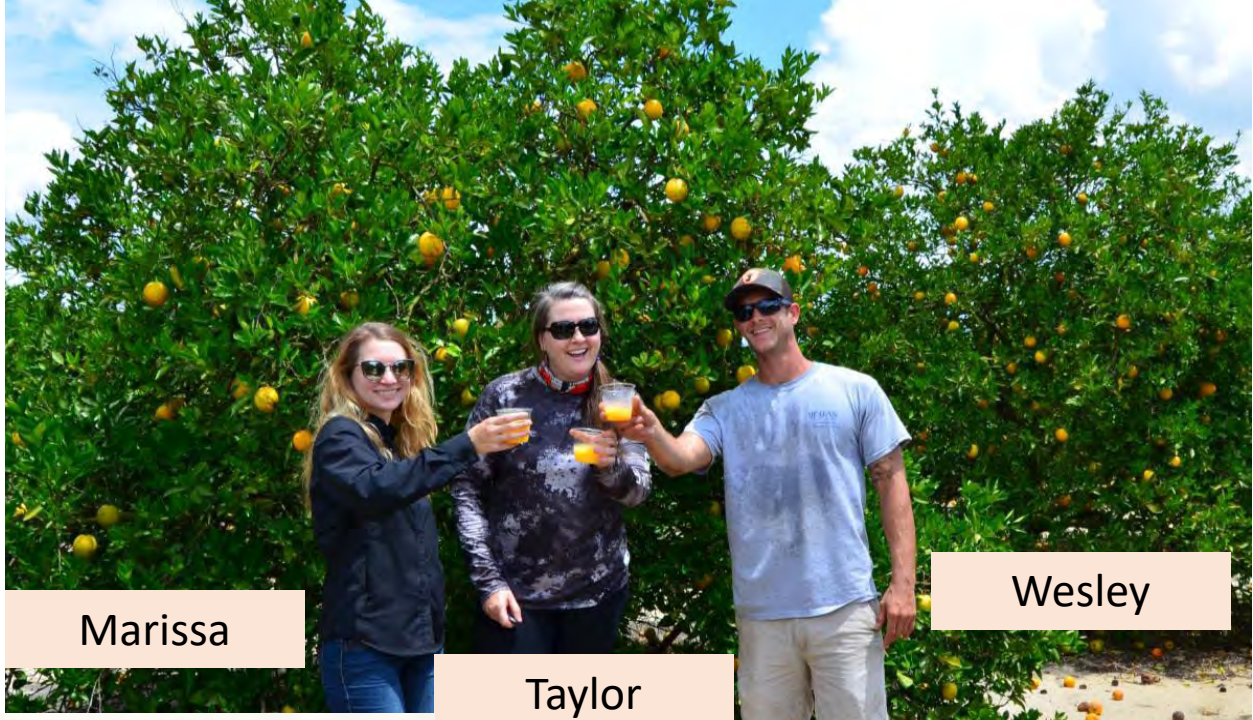
Number of PGRs are available for Florida use

- Comprehensive list of PGRs available for Florida use can be found in citrus production guide
- Read label carefully
- Example:

	Progibb	Ascend	Radiate	Cytoplex	Home	Receptor	Stimplex
IBA (Auxin) (%)	0	0.045	0.85	0.005	0.005	0.0042	0
GA (%)	5.7	0.03	0	0.004	0.005	0.0026	0
Cytokinin (%)	0	0.09	0.15	0.01	0.01	0.0084	0.01
oz per acre	10	6	13	32	32	32	56
no. of application	4	3	2	12	12	12	5

Thank you!

- Citrus Initiative
- CRDF
- Dr. Ariel Singerman
- Peace River Packing
- Alico
- Valent Biosciences
- Dr. Lisa Tang
- Sukhdeep Singh
- Mary Sutton



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