

# Plant growth regulators to rejuvenate health of HLBaffected trees

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### Take home message

- More leaves = more potential for fruit production
- HLB-affected trees lag in growth due to hormonal imbalance
- Timely PGR application is critical for the desired benefit
- Gibberellic acid can improve yield efficiency in Hamlin and Valencia
- Repeated GA applications needed
- 2, 4 D is showing promising results in reducing fruit drop
- Cytokinin can boost spring and summer growth



### Why fewer fruit on HLB-affected trees?

- A branch of healthy and HLB trees set the same amount of flower
- Flower to fruit set ratio is about the same
- Major reason for reduced fruit production is the unavailability of fruiting wood
- Higher dieback with an increase in disease severity



### Impact of HLB on leaf growth

HLB-affected trees show dieback but what else:

- 1. Delay in bud-break , higher bud-dieback
- 2. Fewer leaves per shoot
- Leaves are about 2 times smaller and 50% lighter
- 4. Reduced tree height, small shoots
- 5. Higher leaf drop(8% vs 0.6%)



HLY

**HLB** 

HLB



### Why HLB-affected trees lag in growth?





Buds (T1 & T2)







Expanded leaves (<u>T4</u>)



Fully mature leaves (<u>**T5**</u>)

Class	Associated Function(s)
Auxins	Cell differentiation
Gibberellins	Elongation
Cytokinins	Cell division
Ethylene	Ripening, abscission, and senescence
Abscisic acid	Seed maturation, dormancy
Jasmonates	Plant defense
Salicylic acid	Systemic Acquired Resistance (SAR)



HLY



## **Exogenous PGR application**

- We know there is hormonal imbalance due to HLB
- HLB trees lag in growth
- Auxin, GA, and cytokinin are growth promoting hormones
- Strategies to improve growth should improve yield (may take a year or two)



### Valencia Orange Field Study (2016-2022)

Trees treated with multiple GA applications (20 g ai, Sep-Jan) produced more fruit

5 year average pounds/tree p value **Boxes per tree** 1.9 Control 172 b 0.05 2.4 GA 220 a Extrapolation (150 trees/acre) Boxes per acre Control 287 367 GA



#### Field Study 2, <u>3, 4, 5</u>

## GA Grower Trials

- Data from 4 sites for two consecutive years
  - 1 Valencia
  - 3 Hamlin
- Grower sprayed half block with GA (10 fl oz per acre with adjuvant) and left other half untreated
- Ten trees were selected in on each side. Same trees from year 1 to 2 were monitored for yield and canopy
- Site 1 and 2: Central Florida
  - 2021-Oct, Nov
  - 2022-Aug, Sep, Nov (Hamlin) and Sep, Nov (Valencia)
- Site 3: Charlotte county (Ona)
  - 2021-Sep, Oct, Nov
  - 2022-Aug, Sep, Nov



ension

### **GA Grower Trials**

• Grower sprayed GA (+adjuvant) in Fall using air blast sprayer



Valencia (Central Florida)



The reduction in yield from year 1 to 2 in both sites is possibly due to hurricane Ian ~~ ~~

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#### Field Study <u>3, 4</u>

![](_page_10_Figure_1.jpeg)

Yield efficiency is an important parameter as it accounts for difference in canopy volume (fruit bearing area) that may exist in trees before the start of experiment (A bigger tree has more bearing volume to produce fruit).

![](_page_10_Picture_3.jpeg)

#### Field Study <u>5</u>

### Site 3 (Hamlin)

- GA application
  - 2021: Aug, Sep, Nov
  - 2022: Aug, Sep, Nov (extensive hurricane damage)
    - 2, 4-D application at 3 oz per acre, one week after the hurricane

	2021	2022	2021	2022	
	Yield (lbs/tree)	Yield (lbs/tree)	FDF (December)	FDF (August)	FDF (November)
Control	316 b	34.7 b	5.49 b	6.0 b	5.26 b
GA	380 a	52 ab	7.05 a	6.74a	5.54 b
GA + 2,4 D (post hurricane treatment)		68.03 a			7.07 a

Observation: 1-2 months after the hurricane, very few fruit were seen on untreated trees whereas GA retained more fruit

Trees harvested in January

![](_page_11_Picture_9.jpeg)

# GA and 2,4 D (2021-2022)

- 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 (1.2 fl oz per acre+ surfactant)
  - 4. GA+ 2, 4 D
- Rationale-GA can improve tree growth and slow peel senescence and 2,4-D can suppress fruit drop signal

![](_page_12_Picture_9.jpeg)

#### Field Study <u>6</u>

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

# No statistical effect on yield

![](_page_13_Figure_3.jpeg)

![](_page_13_Figure_4.jpeg)

Repeated GA+ 2, 4 D application is promising

![](_page_13_Picture_6.jpeg)

#### Field Study <u>7, 8</u>

# GA and 2,4 D (3 year trial, 2022-)

- Hamlin and Valencia
- Started in July 2022, applied every 45 days from July-November
- Four treatments
  - 1. Untreated Control
  - 2. GA (Progibb 10 fl oz per acre+ surfactant)
  - 3. 2, 4 D (1.2 fl oz per acre+ surfactant)
  - 4. GA+ 2, 4 D

![](_page_14_Figure_9.jpeg)

#### Field Study <u>8</u>

tension

#### Valencia

![](_page_15_Figure_2.jpeg)

GA+2,4-D reduced fruit drop significantly. The combination of 2 has the best results

# Cytokinin??

- Hamlin reset study (prelimnary)-goal was to improve growth
- Two PGRs showed improvement in growth, when applied every 45 days for 6 months, slight improvement in SPAD (leaf chlorophyll was also observed)
  - Stimplex (a seaweed extract, contains cytokinin)

![](_page_16_Figure_4.jpeg)

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

![](_page_16_Picture_6.jpeg)

Increase in canopy volume in 6 months

![](_page_17_Picture_0.jpeg)

![](_page_17_Picture_1.jpeg)

#### Field Study <u>9</u>

### PGR study to rejuvenate severe trees

- Started in Spring 2022
- Severely sick trees (uniform)
- Treatments are applied every 45 days
  - 1. Untreated
  - 2. GA
  - 3. Ascend (contains Auxin, GA, cytokinin)
  - 4. Stimplex (Seaweed extract, cytokinin)
- GA and Stimplex seems promising in improving Stir growth
- Reduction in starch accumulation

<b>Canopy Density</b>					
	%DIF in canopy in 5				
	months of application				
Control		0%			
SA		3%			
Ascend		-1.68%			
Stimplex		9.02%			

![](_page_18_Picture_12.jpeg)

#### Field Study <u>9</u> Stimplex-treated trees had significantly higher yield than control, ascend, and GA

![](_page_19_Figure_1.jpeg)

Spring application of GA is not as beneficial, possibly higher fruit set than what tree can support.

### **PGR combination trial**

- Mature Hamlin trees (about 25 yeas old)
- Moderately HLB-symptomatic
- 4 treatments applied, starting spring
  - Validate Cytokinin
  - Progibb-GA
  - Auxin-2,4-D

Untreated Control	U
Cytokinin 12oz Apr/May	С
Cytokinin 12oz Apr/May + Progibb Jul/Sep/Nov	C+GA
Cytokinin 12oz Apr/May + (Progibb + 2,4-D Jul/Sep/Nov)	C+GA+A

![](_page_20_Picture_9.jpeg)

# Use of Cytokinin (Spring) and GA (Summer) increased yield by approximately 90 lb/tree

![](_page_21_Figure_2.jpeg)

C+GA
C+GA+A

U

С

# According to first-year data, use of PGRs as per tree phenology seems promising

	Brix	Acid	Size	FDF
Untreated Control	10.9	0.68	61.1 b	6.9 b
Cytokinin 12oz Apr/May	10.3	0.73	63.1 a	7.6 a
Cytokinin 12oz Apr/May + Progibb				
Jul/Sep/Nov	10.4	0.69	63.3 a	7.3 ab
Cytokinin 12oz Apr/May + (Progibb + 2,4-D				
Jul/Sep/Nov)	10.1	0.64	62.7 ab	7.1 b

![](_page_22_Picture_3.jpeg)

### 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 for concentration and rate of recommended use
- 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

![](_page_23_Picture_5.jpeg)

### Avoid GA application January to May

- GA application during flush cycles can induce more vegetative growth
- GA application in spring during time of flowering can enhance fruit set
  - For healthy trees, higher fruit set was desirable but not for HLB-affected trees
  - Spring GA application negates the response of flower suppression applications
  - <u>A higher flower or fruit set does not mean higher yield</u>
  - <u>By reducing number of flower we are conserving resources for better tree</u> <u>and fruit growth</u>

![](_page_24_Picture_7.jpeg)

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- Tank mixing of GA with nutritionals and some insecticides is compatible
- Efficacy of day and night application is the same

![](_page_25_Picture_10.jpeg)

# Thank you!

- Citrus Initiative
- CRDF
- Peace River
- Alico
- James Shinn
- Valent

![](_page_26_Picture_7.jpeg)

![](_page_26_Picture_8.jpeg)

![](_page_26_Picture_9.jpeg)

#### CITRUS INITIATIVE

FUNDED BY THE FLORIDA LEGISLATURE

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