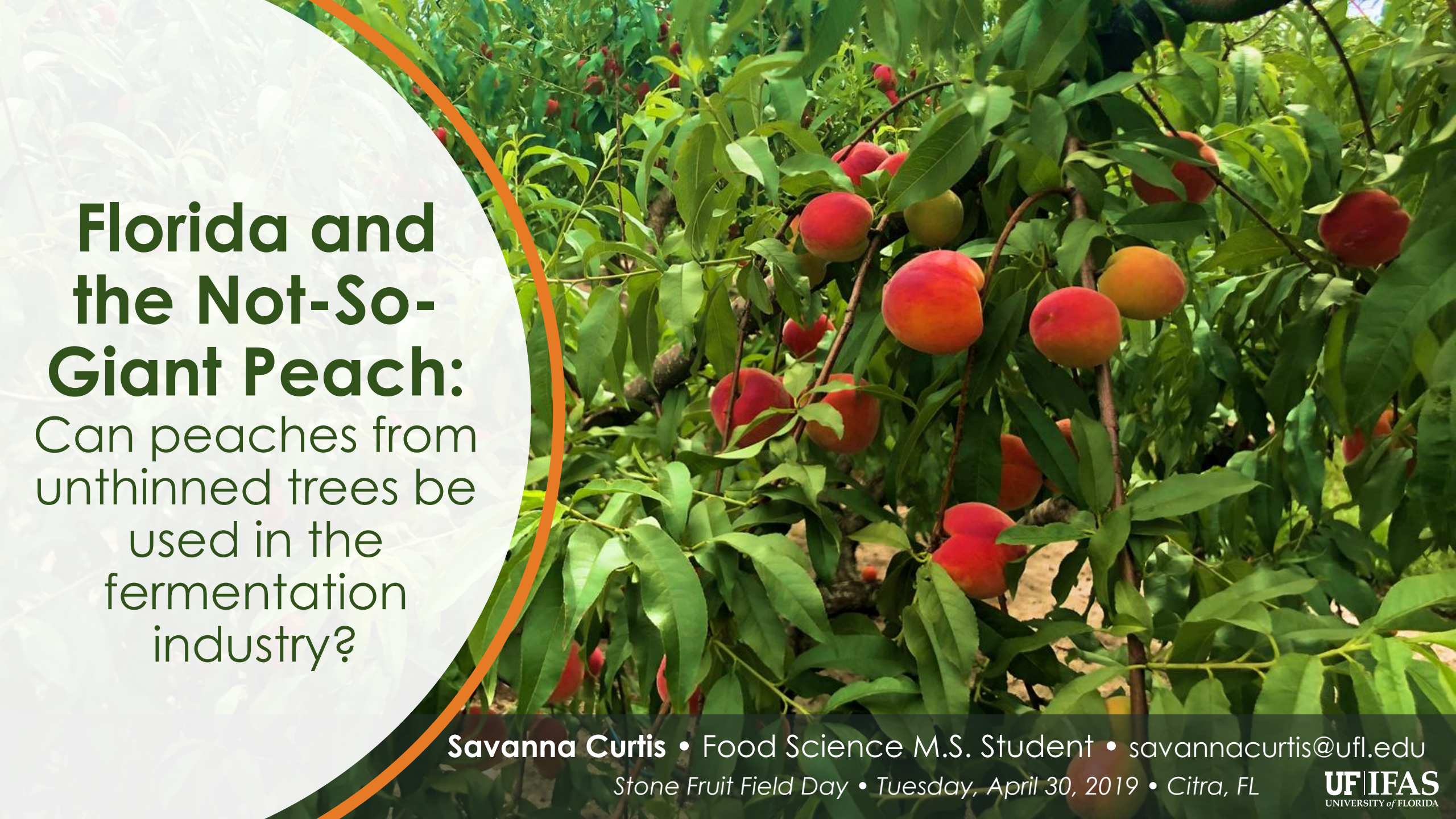
Florida and the Not-So-Giant Peach:

Can peaches from unthinned trees be used in the fermentation industry?



Savanna Curtis • Food Science M.S. Student • savannacurtis@ufl.edu

Stone Fruit Field Day • Tuesday, April 30, 2019 • Citra, FL

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Outline

- **Background**
  - Florida Peaches
  - Tree Care
  - Fermentation
- **Research**
  - Objectives
  - Methods
    - Processing
    - Fermentation
  - Results
- **Theoretical Cost Analysis**
- **Conclusions**
- **Questions**

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Florida Peaches

- Rising interest in the Florida peach industry and its effect on Florida agriculture
  - Orange crop decline
  - Grower desire for other profit sources
- Success with University of Florida developed low chill cultivars
  - UFSun – primary cultivar grown for research
    - Early harvest
    - Two month head start on market sales

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Fruit Size & Market Value

- Larger fruit = high grade
  - 2" – 2.5" diameter
- Small fruit <2" = low grade
- UFSun peaches are typically smaller than mid to high chill peaches
  - Shorter growing period in Florida's subtropical climate
- Tree thinning
  - Encourages larger fruit size, but smaller quantities
  - Expensive (~$1500 per acre)

Unthinned (top) and thinned (bottom) UFSun Peaches (Sarkhosh Lab, 2018)

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Thinning vs. Not Thinning

Thinned Peach Trees

- Thinning promotes larger fruit growth
- High probability that fruit will be acceptable for fresh market
- Highest grade
- Expensive

Unthinned Peach Trees

- 2x the fruit mass of a thinned tree
- Smaller fruit
- Less sugar
- Not acceptable for fresh market sale
- Low grade

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Fermentation

- Proven to enhance food products in:
  - Nutritional value
  - Functionality
  - Organoleptic properties
  - Uniqueness
  - Economic value
- Fermented products are currently trending on the market for 2019

Glucose → carbon dioxide + ethanol + energy

$$C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH$$

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Research

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Research Objectives

- Assess the effect that tree care (thinning or not thinning) has on UFSun peach juice characteristics
  - Compare the characteristics of these juices based on:
    - Harvesting
    - Processing
    - Fermentation
- Create a theoretical economic analysis
  - Compare profitability and viability of using thinned versus unthinned tree-ripened fruit for bulk juice and fermented beverages

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Methods: Harvesting & Processing

Thinned and Unthinned tree-ripened peach fruit were harvested and processed by the same methods to allow for back to back comparison

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Methods: Harvesting & Processing

- 1 Metric Ton harvested in Citra, FL in May 2018
- Stored at 5°C/40°F at 80% RH until use

Harvesting → Sorting → Blanching → Pressing → Sterilization → Enzyme Addition → Storage

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- Removed bad spots (mold, brown rot, etc.)
- Cut pits from flesh
- Weighed peach flesh for total weight

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Methods: Harvesting & Processing

- 1 Metric Ton harvested in Citra, FL in May 2018
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- Cut peaches blanched with 10lb steam at 120°C for 8 minutes
- Rinsed with cooling water for 3 minutes

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- Blanched peaches pressed in hydraulic press up to 200bar
- Juice filtered into food grade buckets through strainer to catch pulp and fruit solids

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- Sterilized juice stored in 5gal plastic food grade buckets at -20°C until needed for experimentation

Harvesting → **Sorting** → **Blanching** → **Pressing** → **Sterilization** → **Enzyme Addition** → **Storage**

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Methods: Fermentation

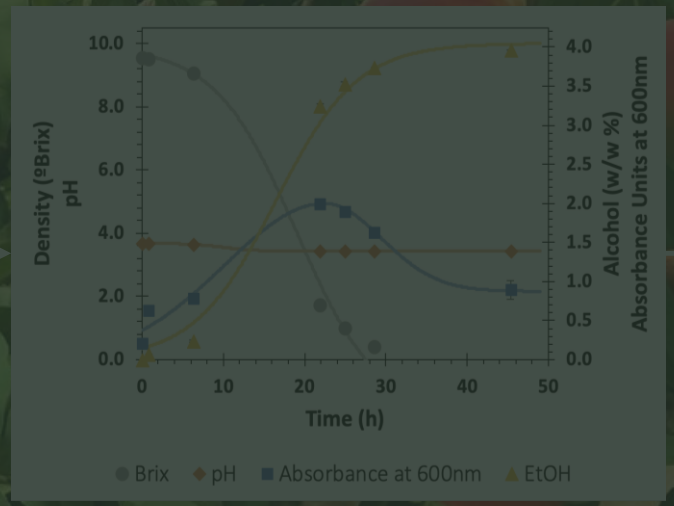
1: Rehydrated yeast

- Lallemand strain EC-1118 champagne yeast
- Rehydrated based on supplier instructions
- Yeast counted via hemocytometer method

2: Added yeast to juice

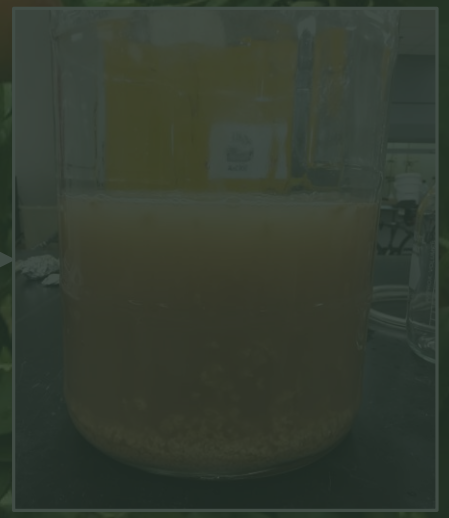
- 1.5 x 10^7 cells/mL pitched into juice volume
- Anaerobic environment created with a waterlock bung (to allow escape of CO_2)
- Three scales of fermentation done:
  - 15mL in duplicate
  - 250mL in triplicate
  - 11L (pictured) in duplicate

3: Sample fermentation parameters over time



- Samples taken over the course of fermentation analyzed for:
  - Ethanol content (%w/w)
  - Brix content
  - pH
  - Absorbance at 600nm (industry standard for measure of biomass in a liquid)

4: Cold crash final product



- At the end of fermentation, carboy placed into cold room (~5°C) to assist in yeast settling

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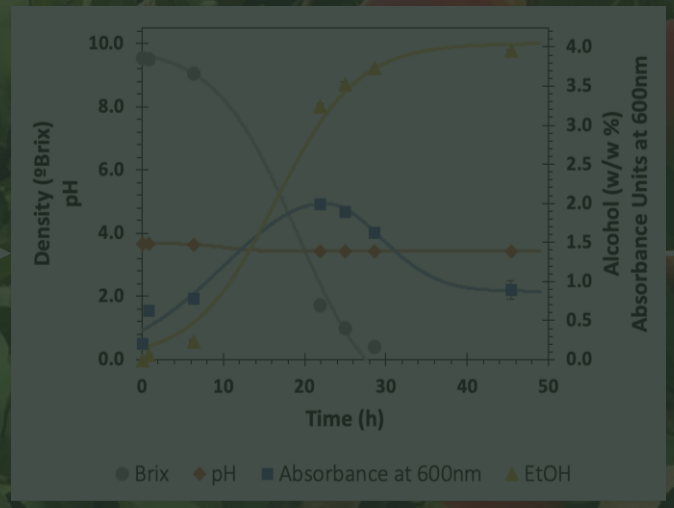

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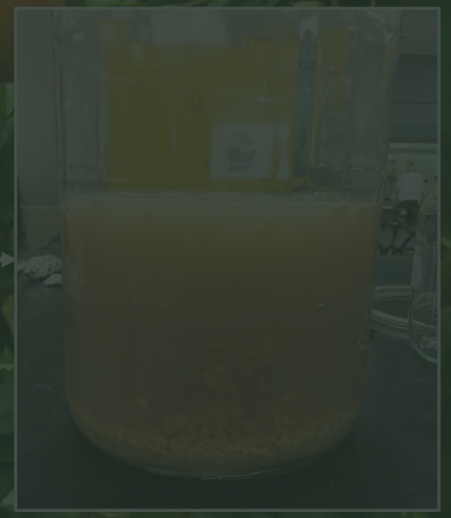

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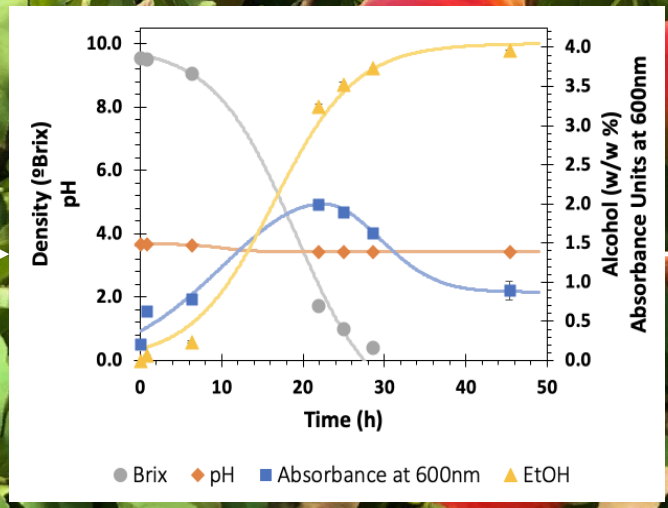

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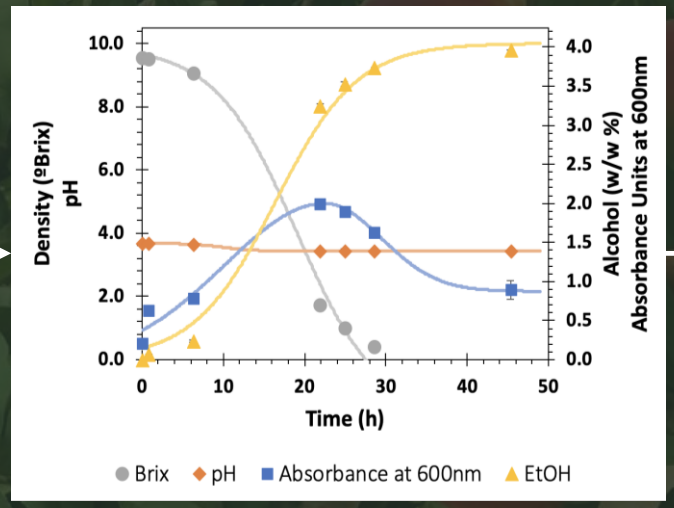

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-
-
-

duplicate

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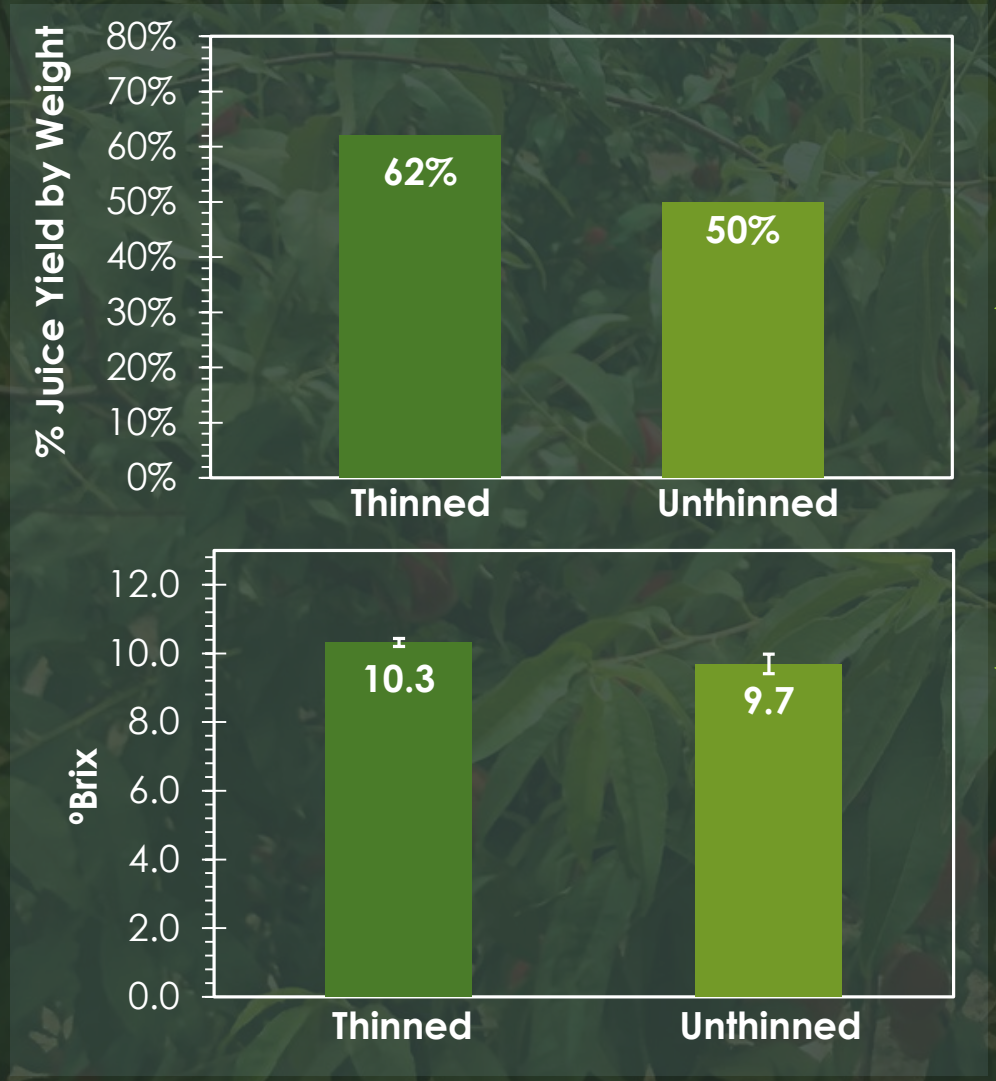
Results: Processing



- Thinned fruits yielded more juice by weight from flesh than unthinned fruits when pressed with a bladder press
  - Due to larger size of thinned fruits

- Thinned fruits produced juice with a higher sugar content compared to unthinned fruit
  - ANOVA shows this to be a statistically significant difference ($p>0.05$)

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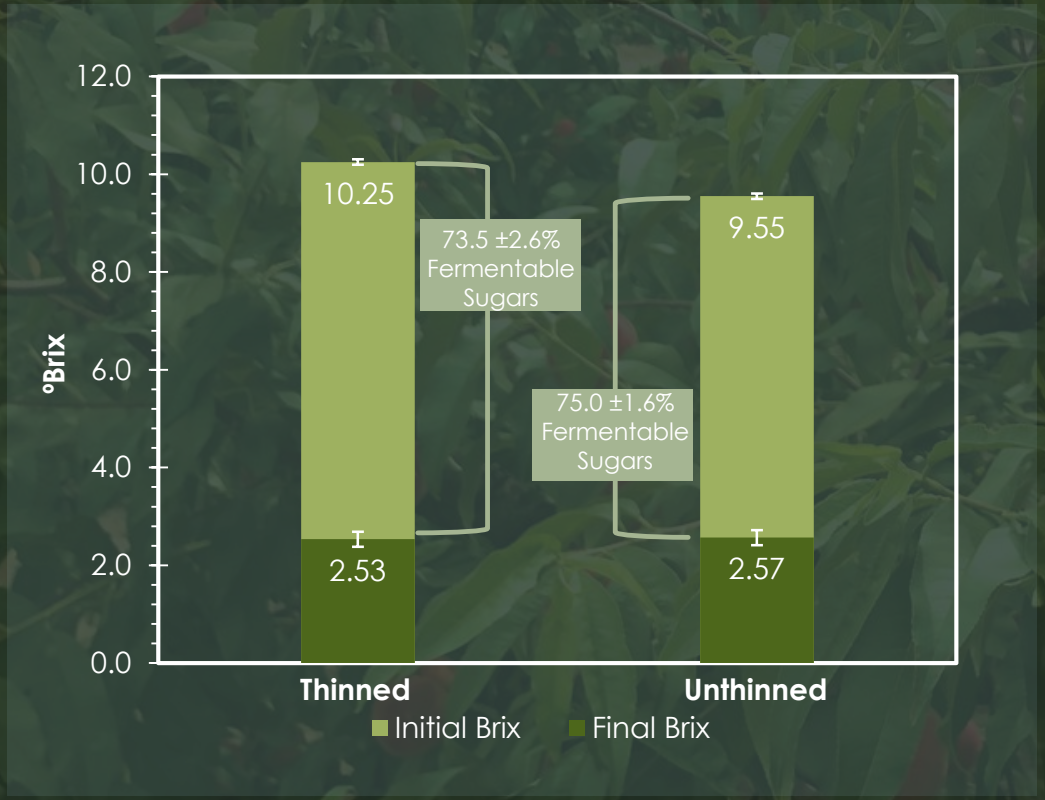
Results: Fermentable sugars



- 250mL fermentations followed a method by the American Society of Brewing Chemists (ASBC) for Yeast Fermentable Extract (YFE)
  - Tells us the amount of fermentable sugars in a fermentation medium
- Triplicate YFEs completed on thinned and unthinned juice
- Although thinned fruit has a higher brix than unthinned fruit, the amount of fermentable sugars in both juices are not significantly different ($p>0.05$)

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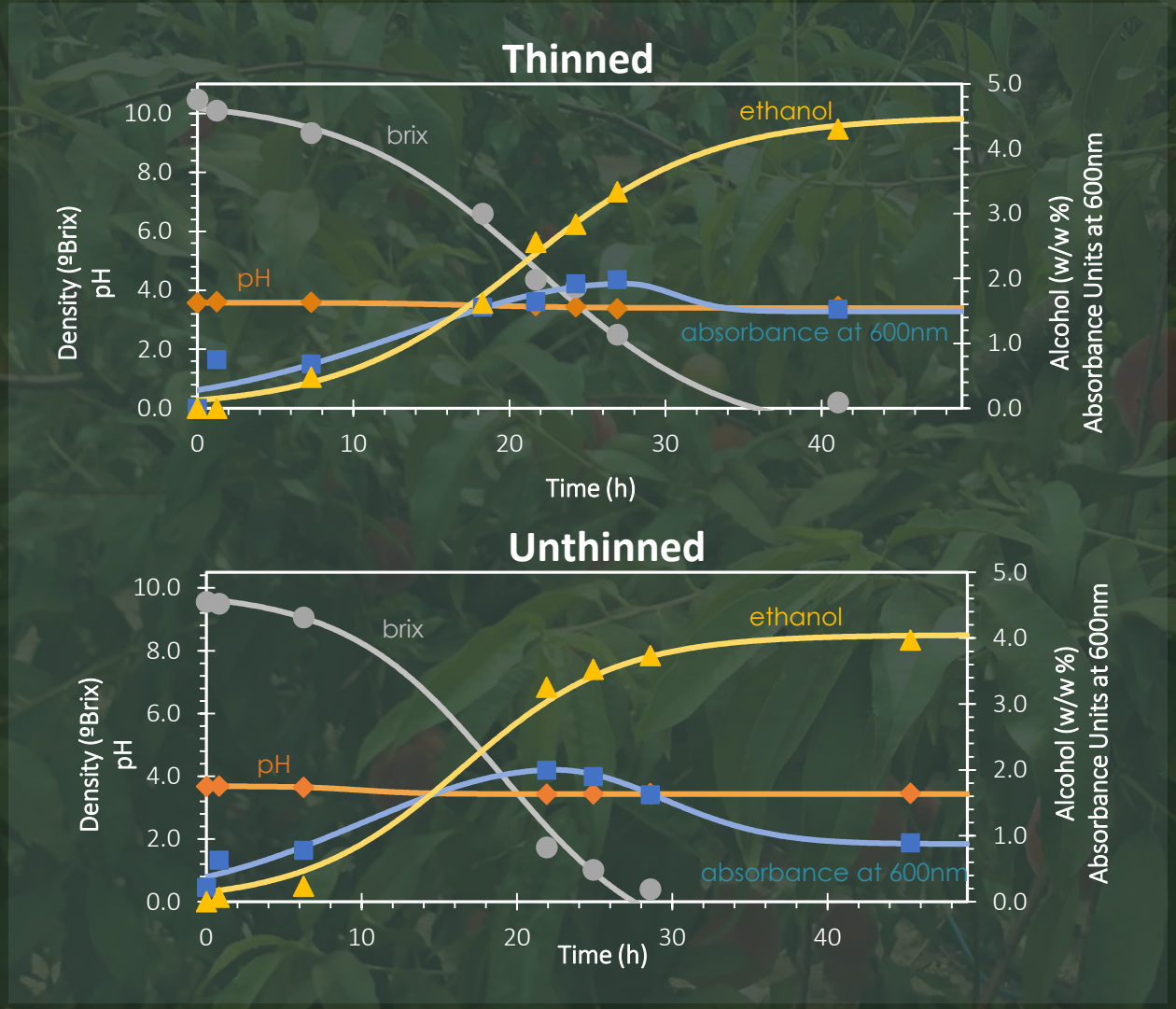
Results: Fermentation kinetics



- Fermentation kinetics for 15mL fermentations
- F-Test analysis completed on Prism software, $\alpha = 0.05$
- No significant kinetic differences between brix, ethanol, and pH
- Significant difference between the rates of fermentation
  - Absorbance at 600nm is analogous for yeast cells in suspension and showcases fermentation rate
  - The amount of cells in suspension will peak and then fall as yeast begin to flocculate and settle
  - Unthinned peach juice has a faster rate of fermentation than thinned peach juice

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Theoretical Cost Analysis: Thinned versus Unthinned UFSun

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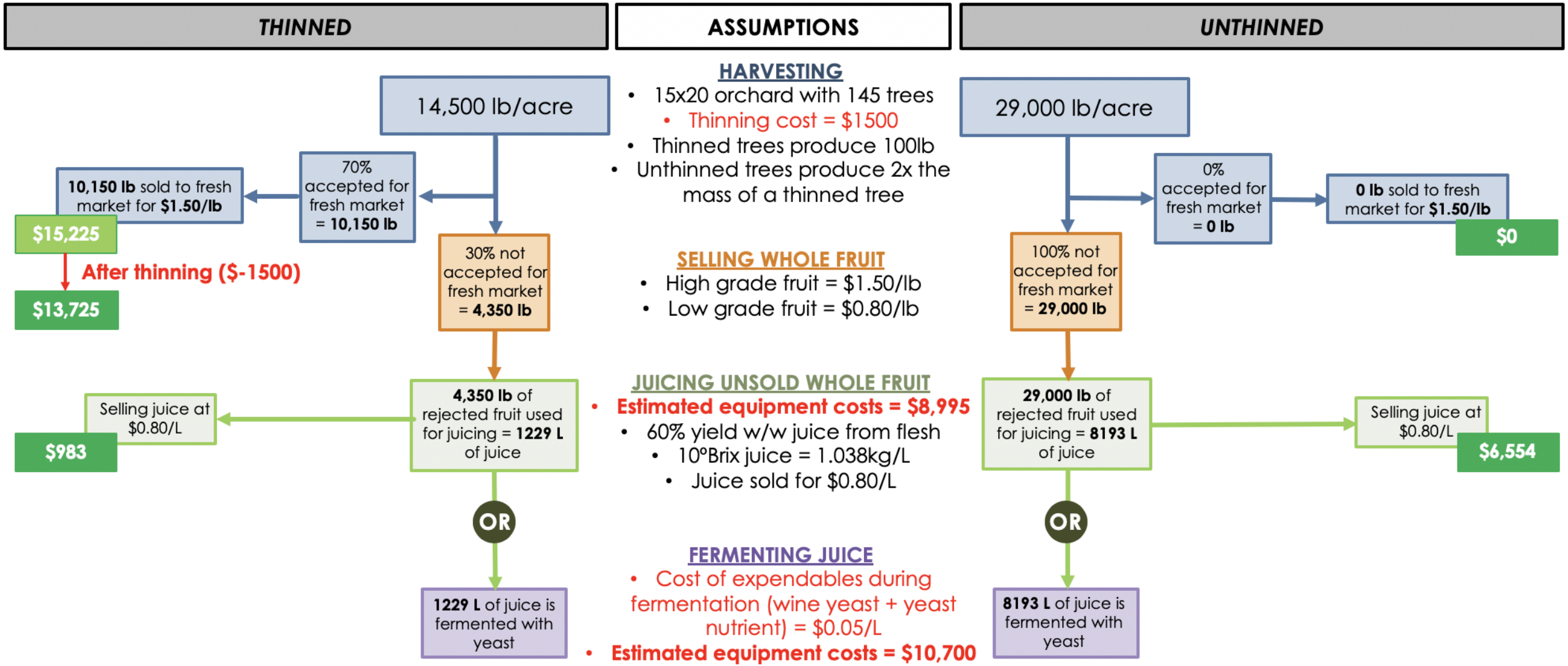
Theoretical Cost Analysis



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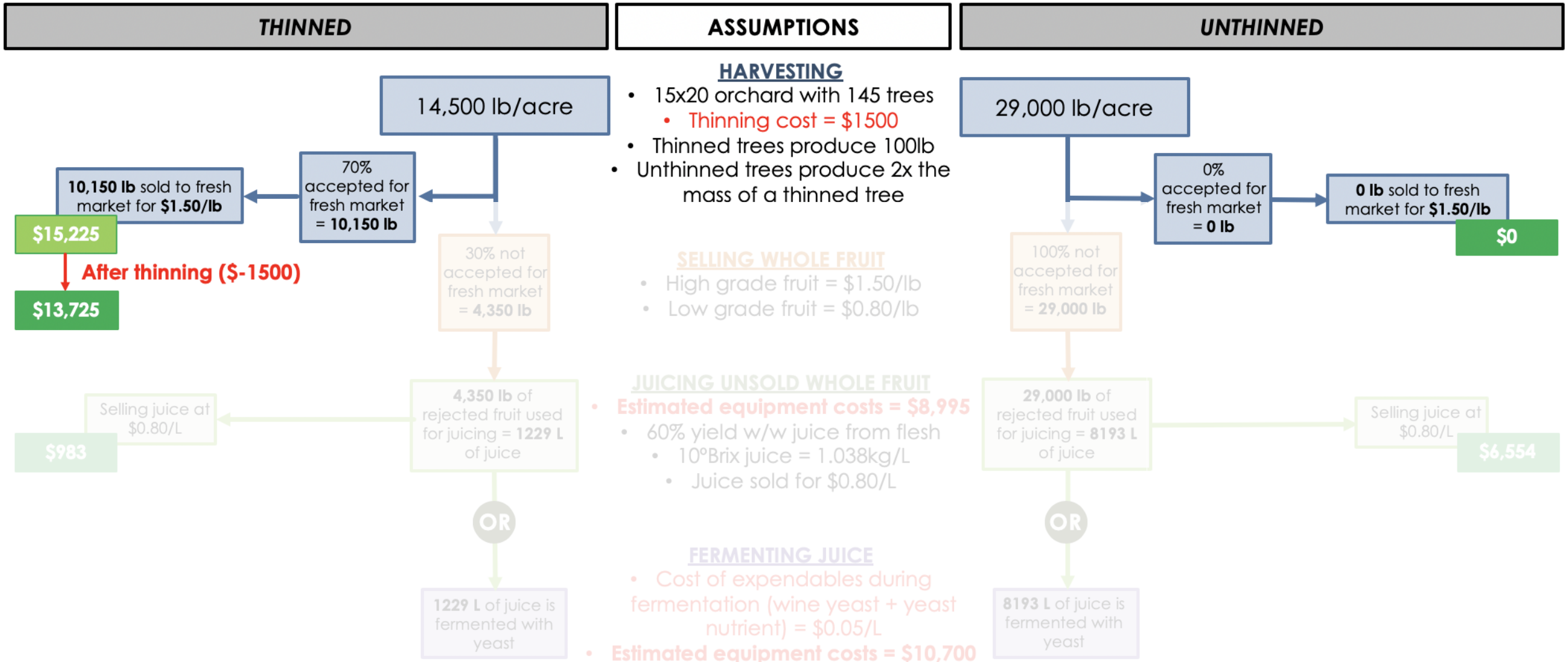

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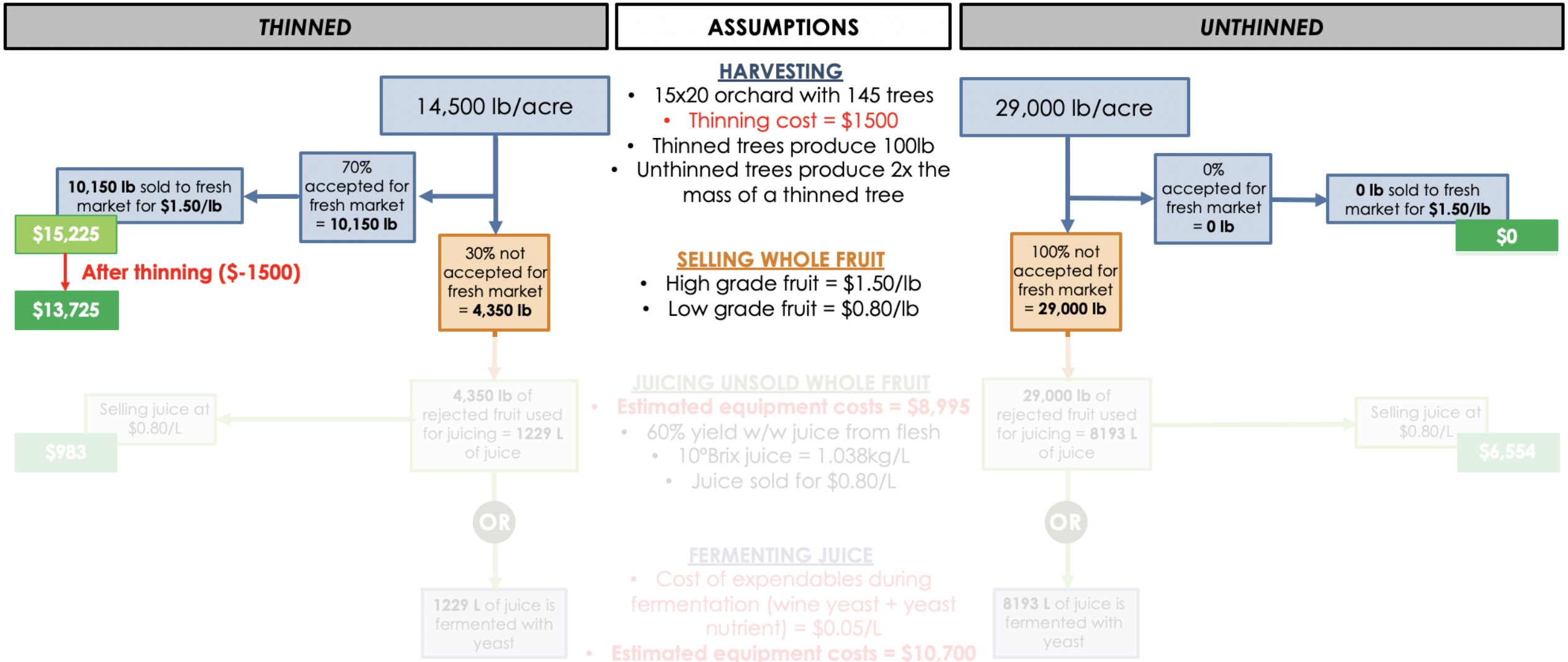

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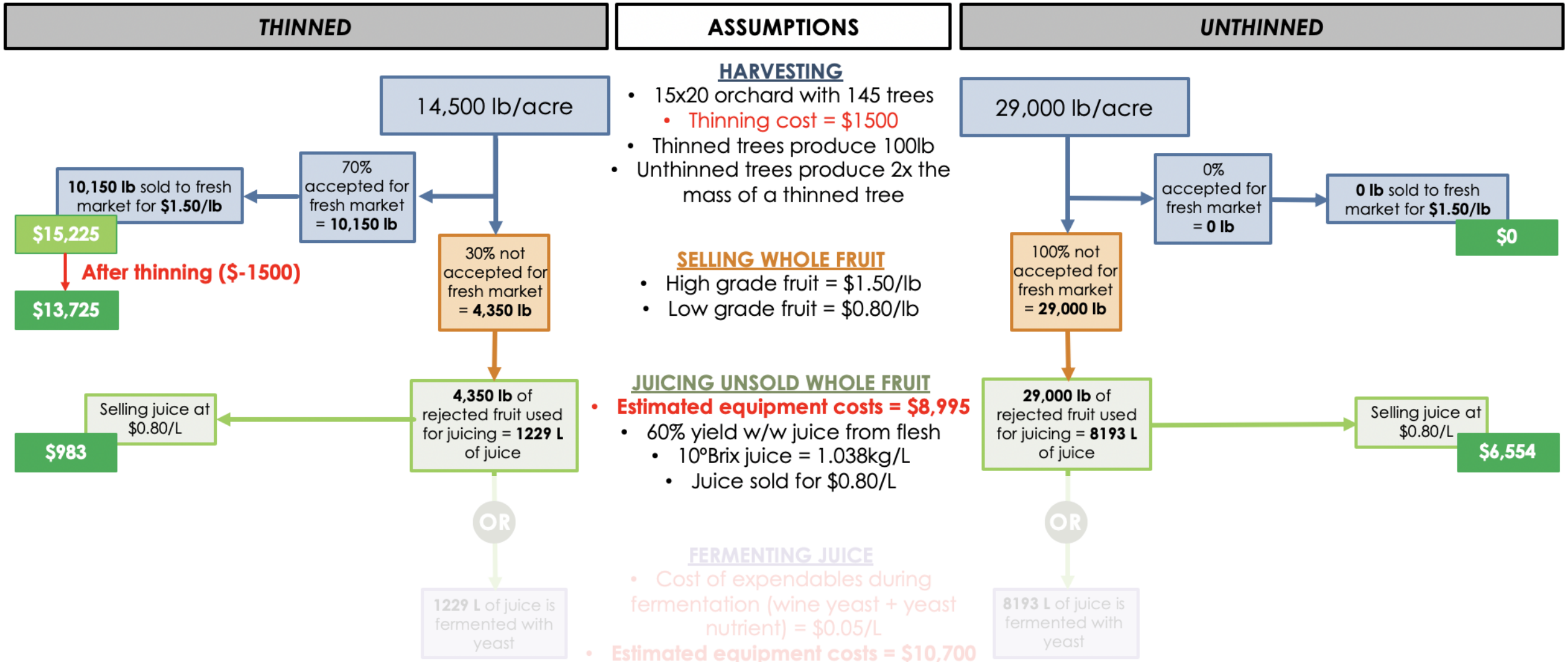

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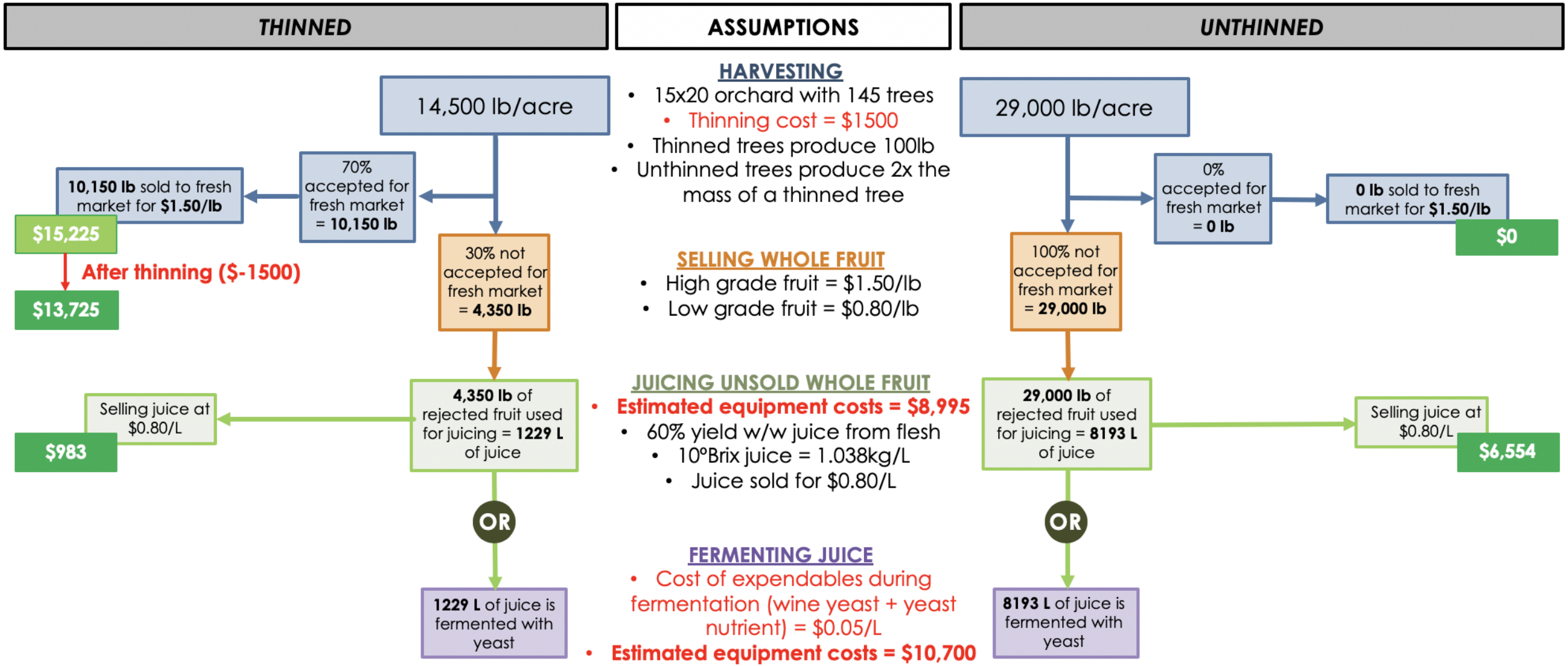

Equipment Costs

Piston Hydraulic Basket Press

- 90 gallon capacity
- Up to 4000 psi for pressing
- 304 Stainless Steel food safe plating
- High efficiency in juice yield

Source: https://www.gwkent.com/piston-hydraulic-press-stainless-steel-basket.html

JUICING UNSOLD WHOLE FRUIT

- **Estimated equipment costs = $8,995**
- 10°Brix juice = 1.038kg/L
- Juice sold for $0.80/L

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- 80% yield w/w juice from flesh
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FERMENTING JUICE

- Cost of expendables during fermentation (wine yeast + yeast nutrient) = $0.05/L

- **Estimated equipment costs = $10,700**

Large Batch Fermenter

- 20BBL = ~2400L batch capacity
- Cylindroconical = good for yeast settling/flocculation
- Cooling jacket for temperature controlled fermentation
- NEED utilities (cooling water source)

Source: https://www.apexbrewingsupply.com/products/20bbl-fermenter-unitank?variant=22017305607&gclid=EAIaIQobChMIx-2l8cL24QIVyl6GCh2jAgNtEAQYByABEgKKZ_D_BwE

Conclusions

- **Processing**
  - Thinned juice has a higher Brix than unthinned juice
- **Fermentation**
  - Thinned and unthinned juices have the same amount of fermentable sugars
  - There are no differences in the fermentation kinetics of thinned and unthinned juices, EXCEPT that unthinned juice ferments at a faster rate than thinned juice
- **Theoretical Cost Analysis**
  - Not thinning trees can potentially lead to higher profit under the assumptions made
  - Plenty of affordable equipment is available for purchase for growers who would like to host their own processing operations
  - It is also feasible to sell juice and non-marketable fruit to breweries and wineries for alcoholic beverage making
- **FUTURE: Sensory Analysis**
  - Peach wheat beer sensory panels this summer at UF!

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Questions?

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Thank you!

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References

- The Fermentation Association. "Fermented Food & Drink Top 2019 Food Trend Lists." *The Fermentation Association*, 28 Nov. 2018, fermentationassociation.org/1437-2/.
- Hutkins, Robert W. *Microbiology and Technology of Fermented Foods*. John Wiley & Sons, Inc., 2006.
- Petruzzi, Leonardo, et al. "Thermal Treatments for Fruit and Vegetable Juices and Beverages: A Literature Overview." *Comprehensive Reviews in Food Science and Food Safety*, John Wiley & Sons, Ltd (10.1111), 30 May 2017, onlinelibrary.wiley.com/doi/abs/10.1111/1541-4337.12270.

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