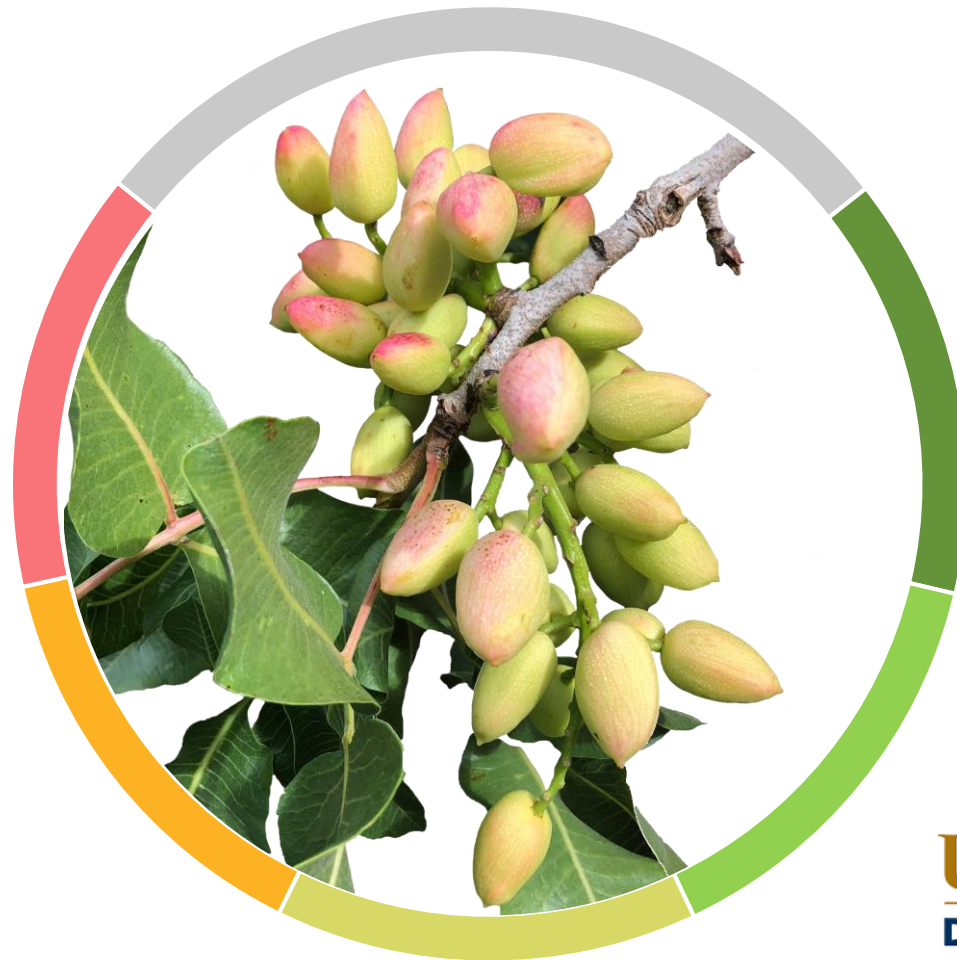


Update

Pistachio Hull Integrity and Nut Quality

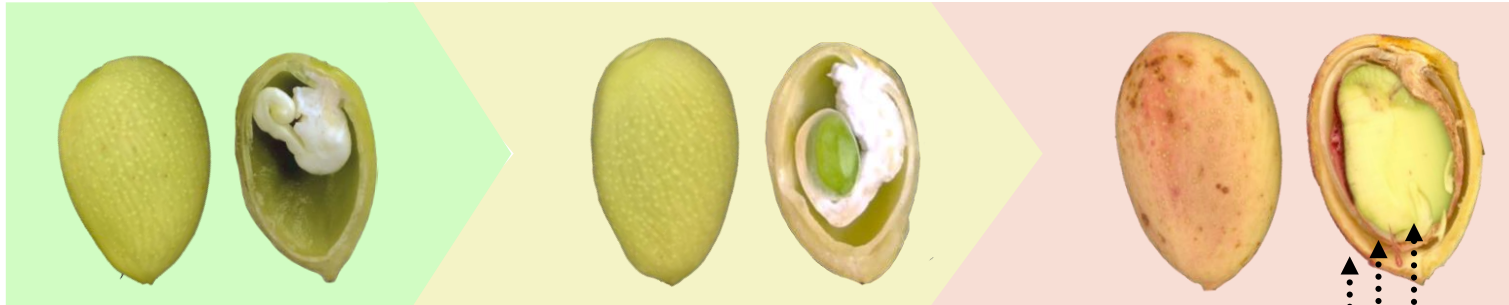


Barbara Blanco-Ulate
Associate Professor

Giulia Marino
CE Specialist

UC DAVIS
DEPARTMENT OF PLANT SCIENCES
College of Agricultural and Environmental Sciences

Pistachio Nut Growth and Development



mesocarp = **hull**
endocarp = **shell**
embryo = **kernel**

Management practices

Irrigation
Fertilization
Pest/Disease Control

Best time for harvest

Nut Quality at Harvest

✓ Shell split
✓ Kernel flavor

✗ Hull deterioration
✗ Shell stains
✗ Insect damages



Our research on nut growth and development

Nut growth parameters

- Dimensions (diameter and volume)
- Nut biomass

Nut visual and textural attributes

- Color and shape (hull, kernel)
- Incidence of shell split
- Insect oviposition or damage
- Firmness (hull, shell, kernel)

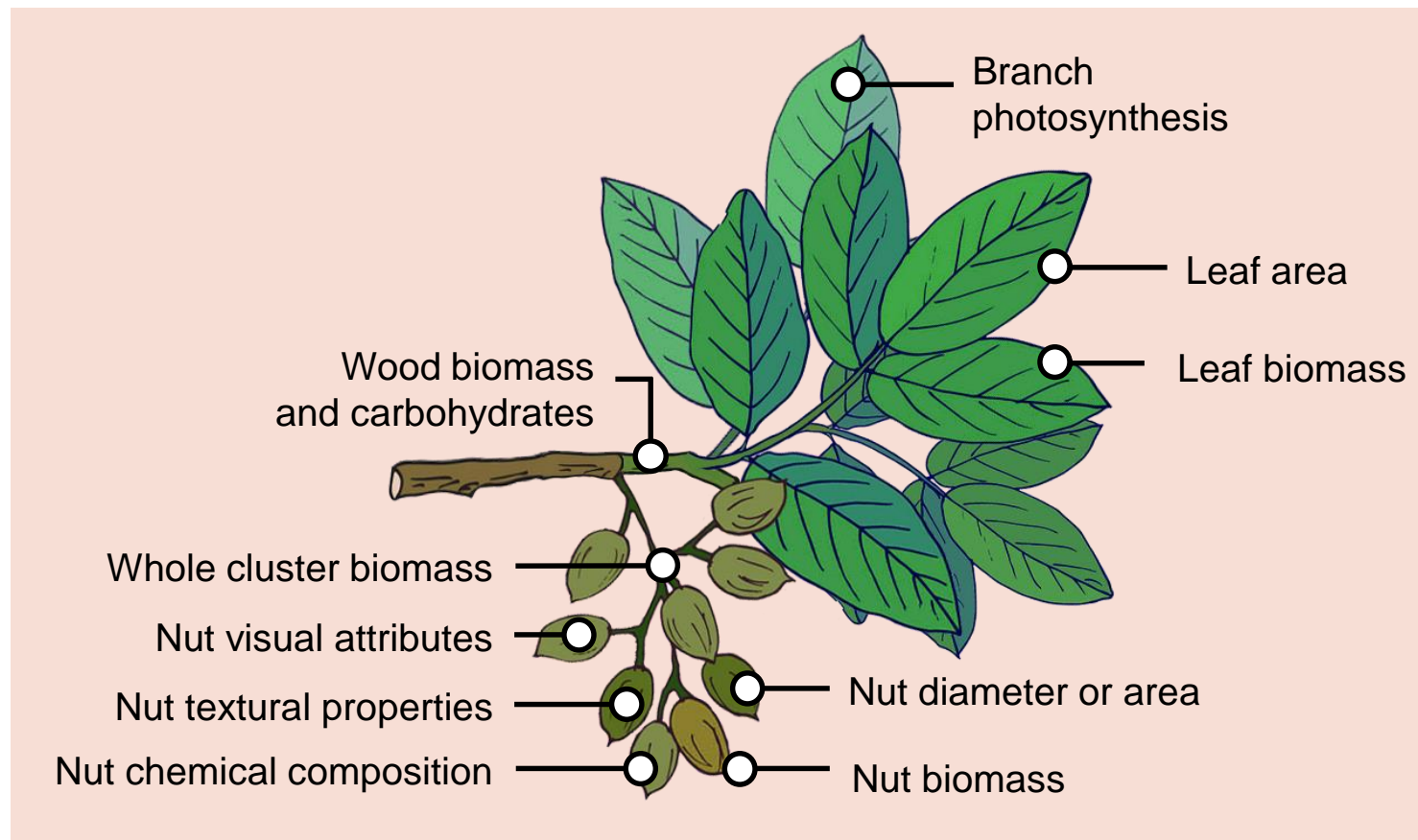
Nut chemical profiling

- Volatiles
- Fatty acids
- Phenolics

**Over 35,000
single nut data!**

**We created
large datasets**

Multi-year and multi-orchard research project

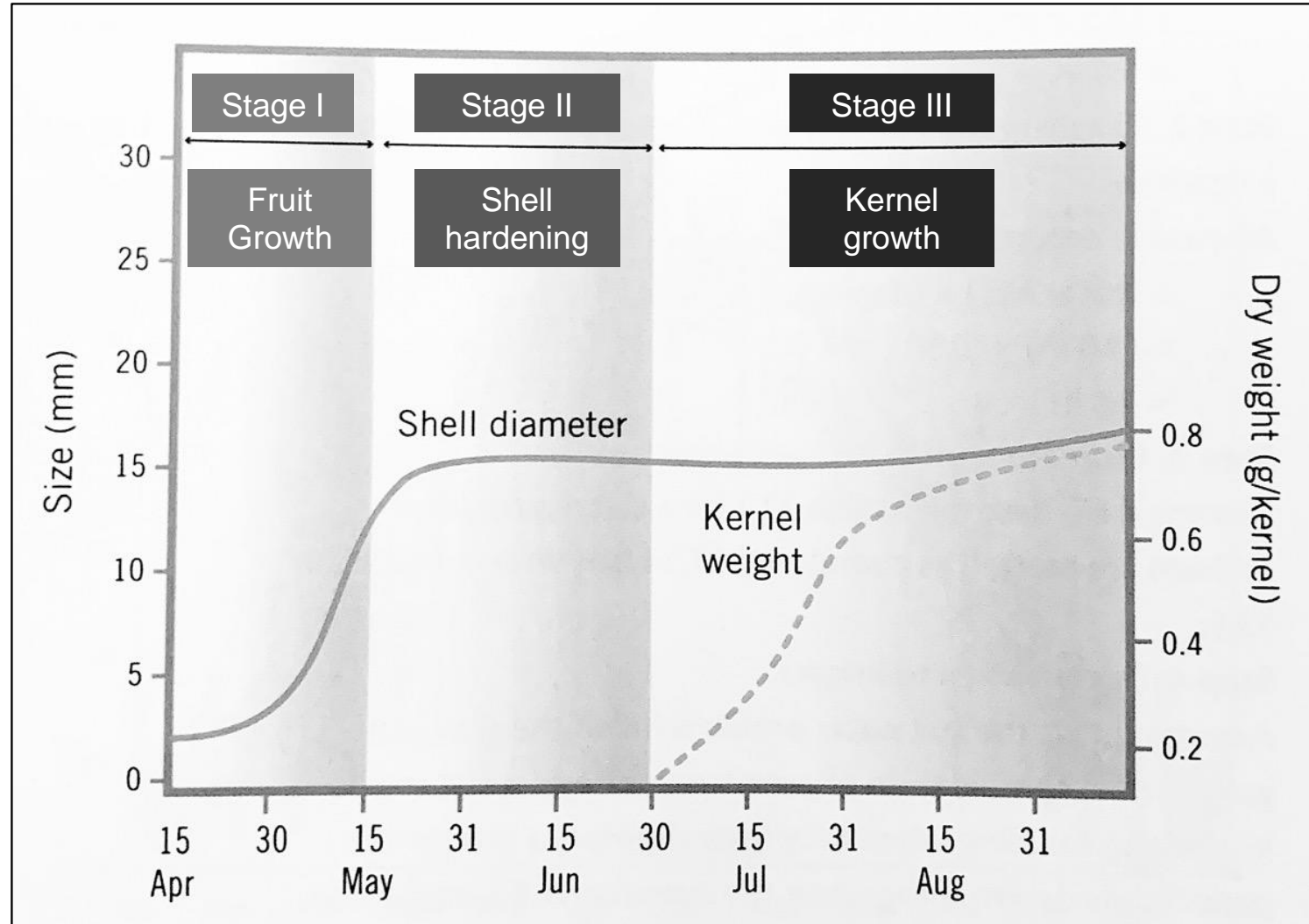


Lightbulb Finding #1

Rethinking the nut growth stages



Pistachio Nut Growth and Development



Goldhamer and Beede. "Irrigation Management". In Pistachio Production Manual (2016): 127-140

Hull & Shell Growth

Shell Hardening & Kernel Growth

Hull Ripening & Kernel Maturation

Late April

May

June

July

August

September

GDD

120

193

280

381

437

500

613

733

865

993

1,106

1,223

1,357

1,508

1,647

1,759

1,881

2,007

2,139

2,284

2,377

2,475

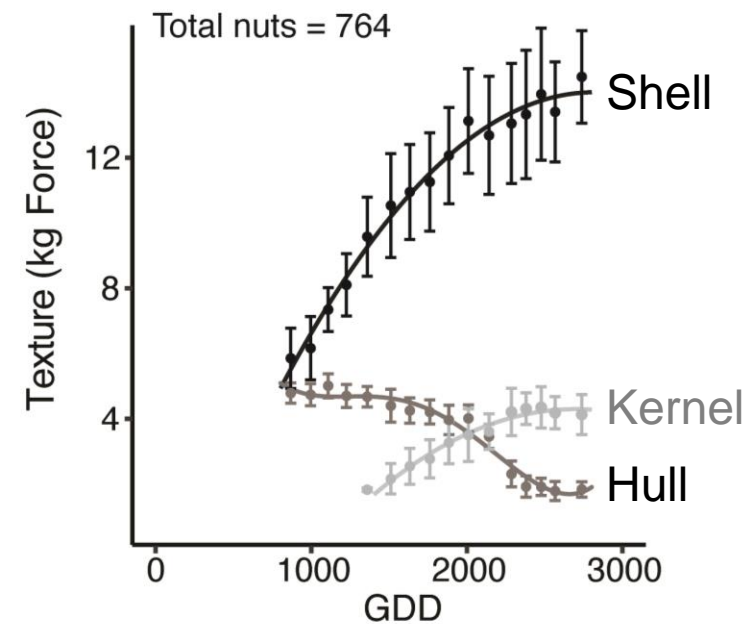
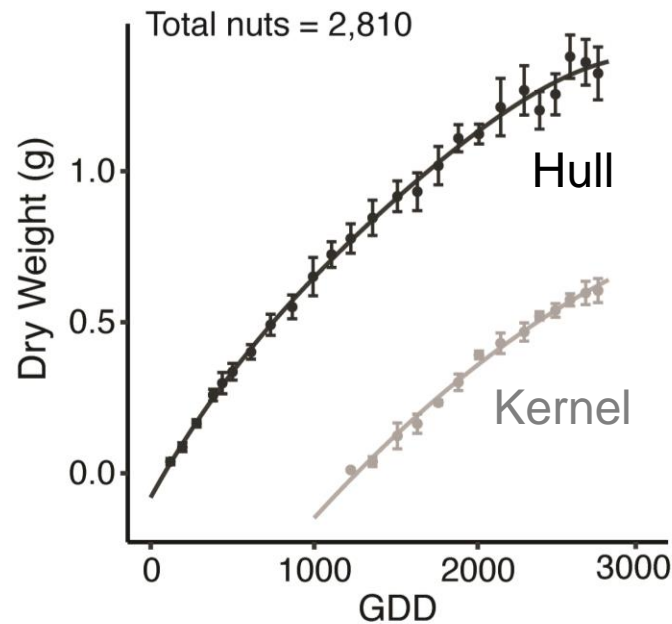
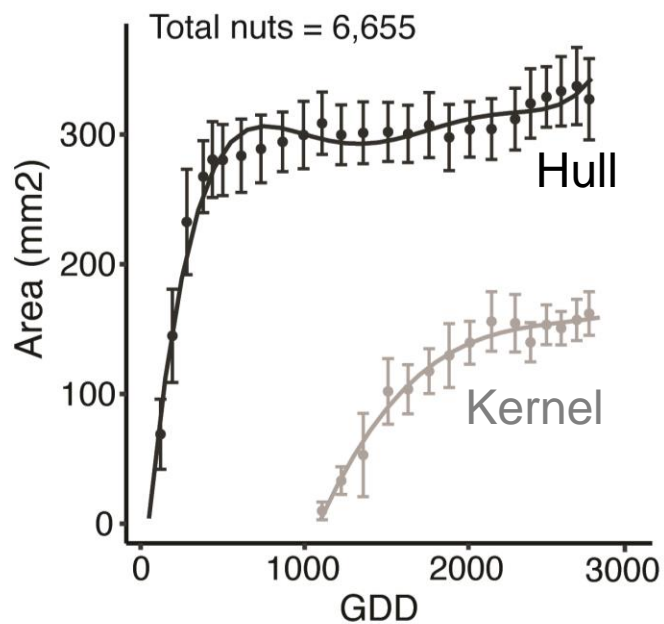
2,564

2,660

Nut

Half

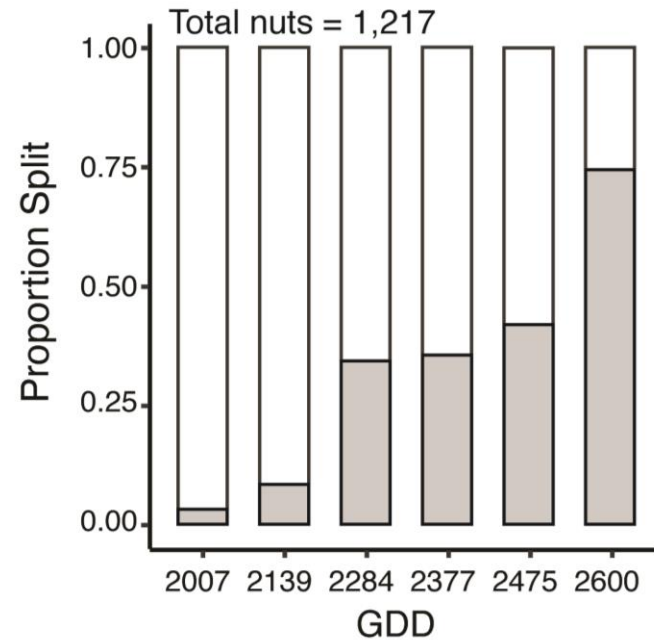
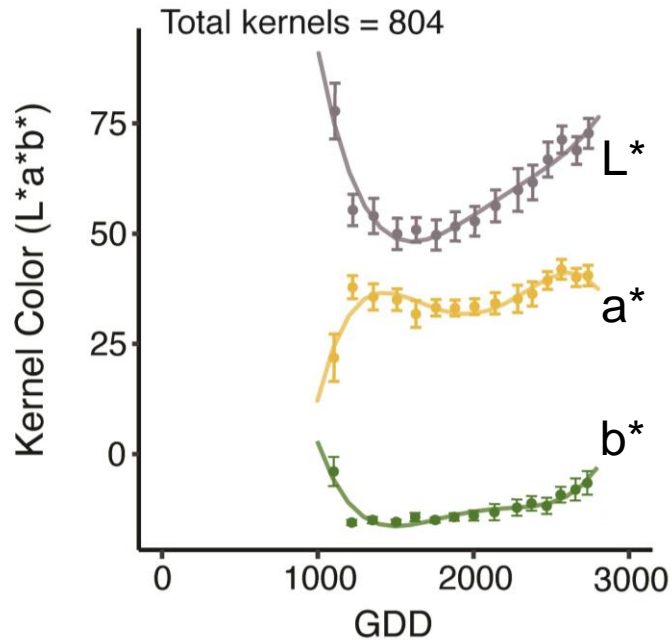
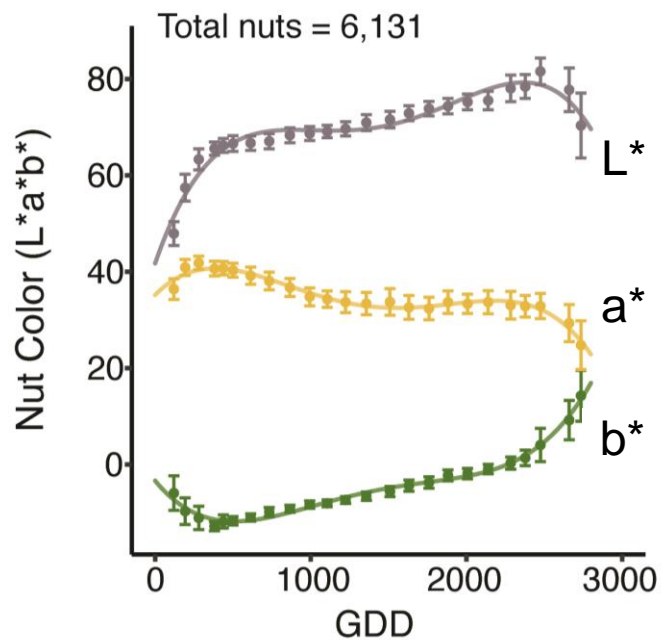
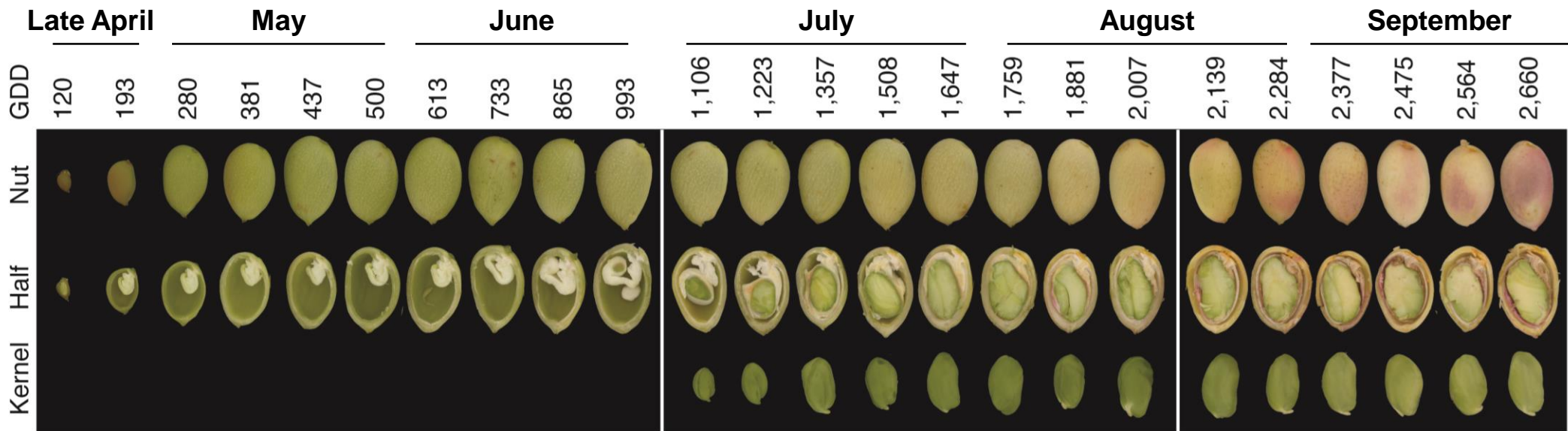
Kernel



Hull & Shell Growth

Shell Hardening & Kernel Growth

Hull Ripening & Kernel Maturation

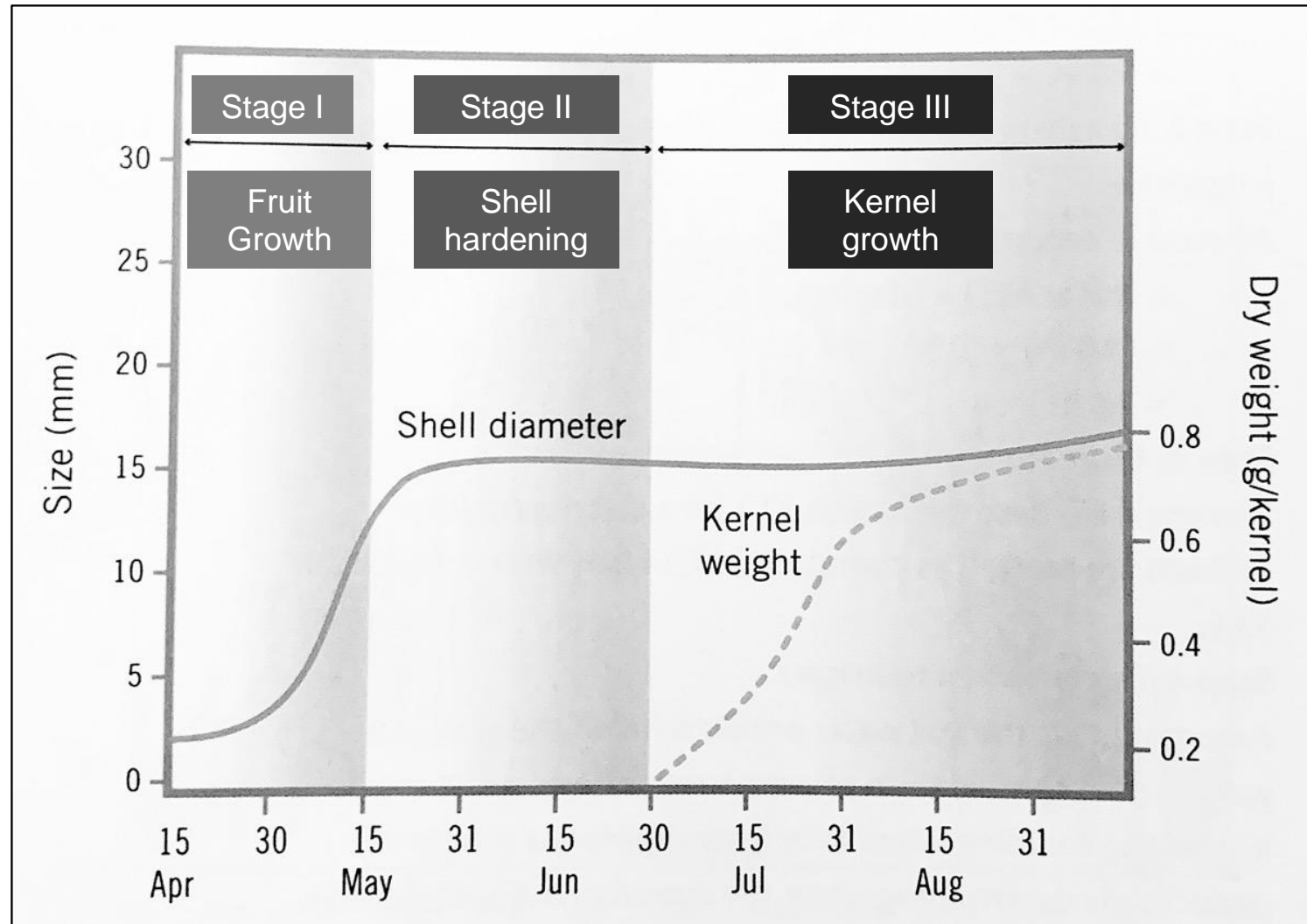


💡 Finding #1

Rethinking the nut growth stages

- **Shell hardening and kernel growth happen at the same time**
- Hull ripening and kernel maturation start once the kernel reached the maximum size
- There is a peak in volatiles that happen just before hull ripening

Pistachio Nut Growth and Development

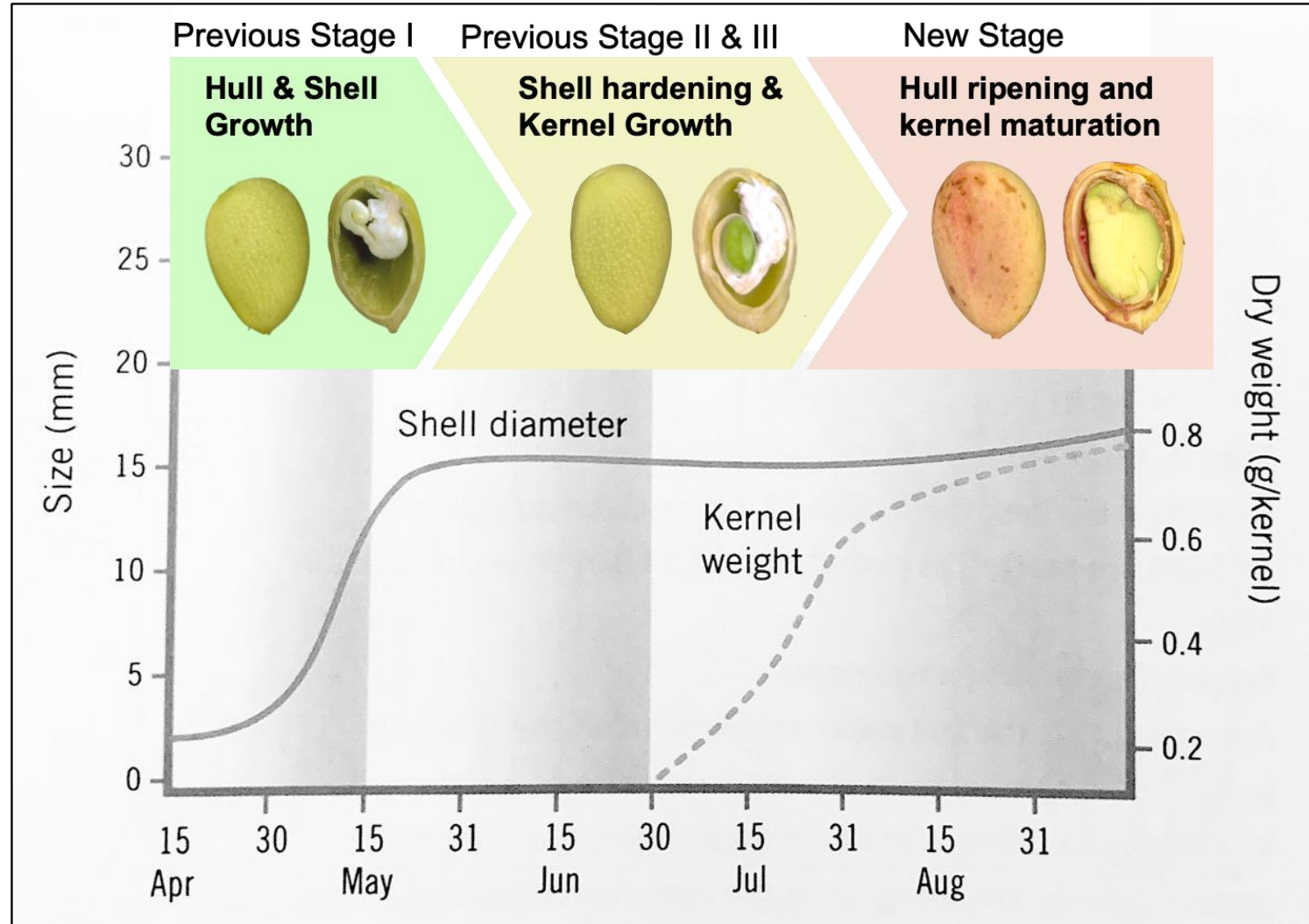


💡 Finding #1

Rethinking the nut growth stages

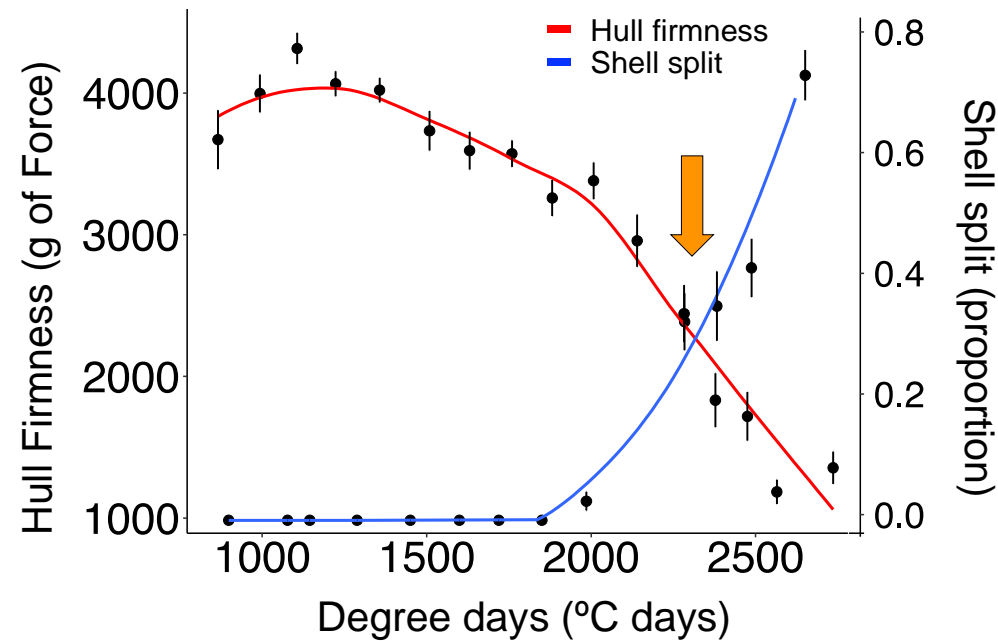
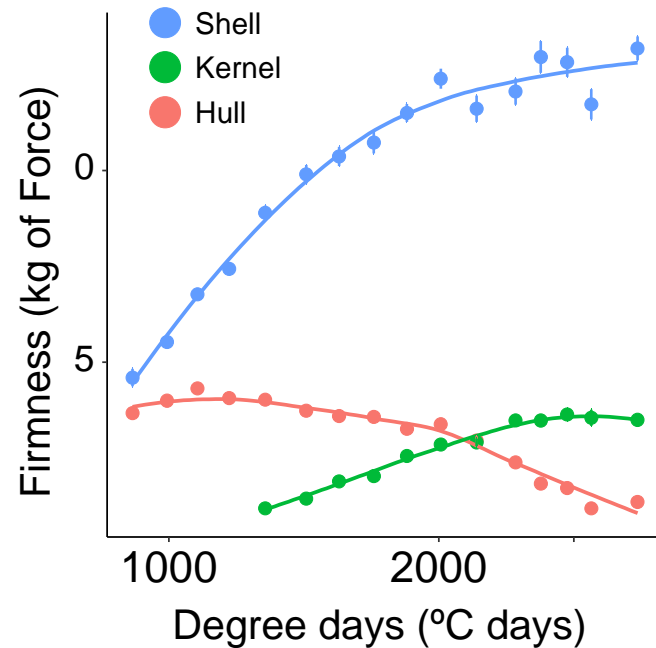
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Pistachio Nut Growth and Development

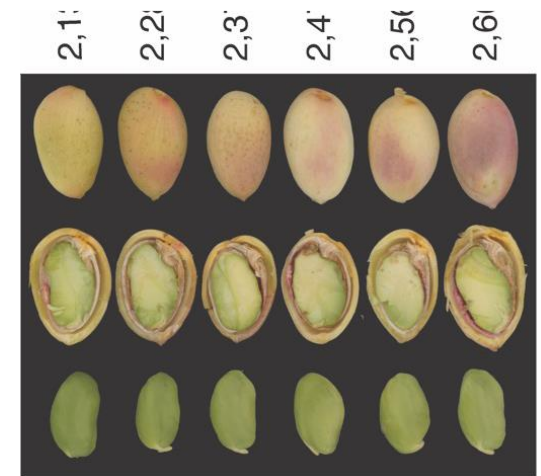


Hull Breakdown (at the end of nut development)

- **Hull softening and hull coloration to red** are reliable biomarkers of hull breakdown
- Shell split occurs in parallel with hull softening



Hull Ripening & Kernel Maturation

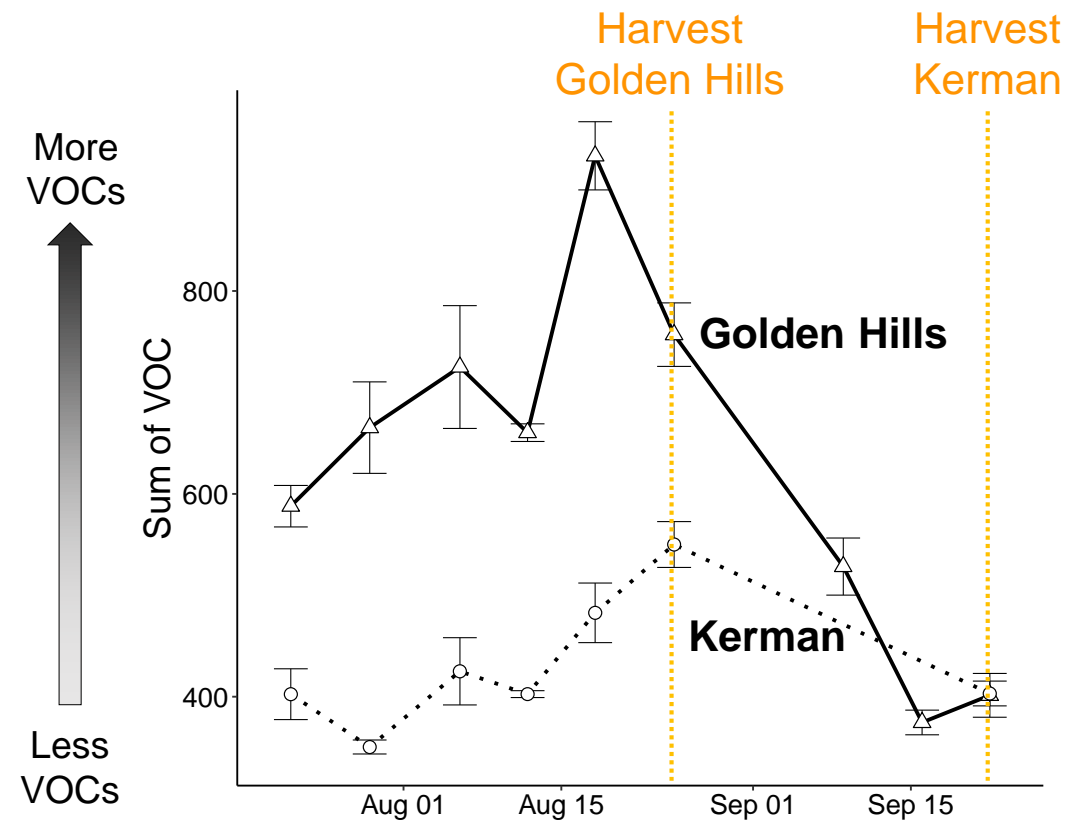
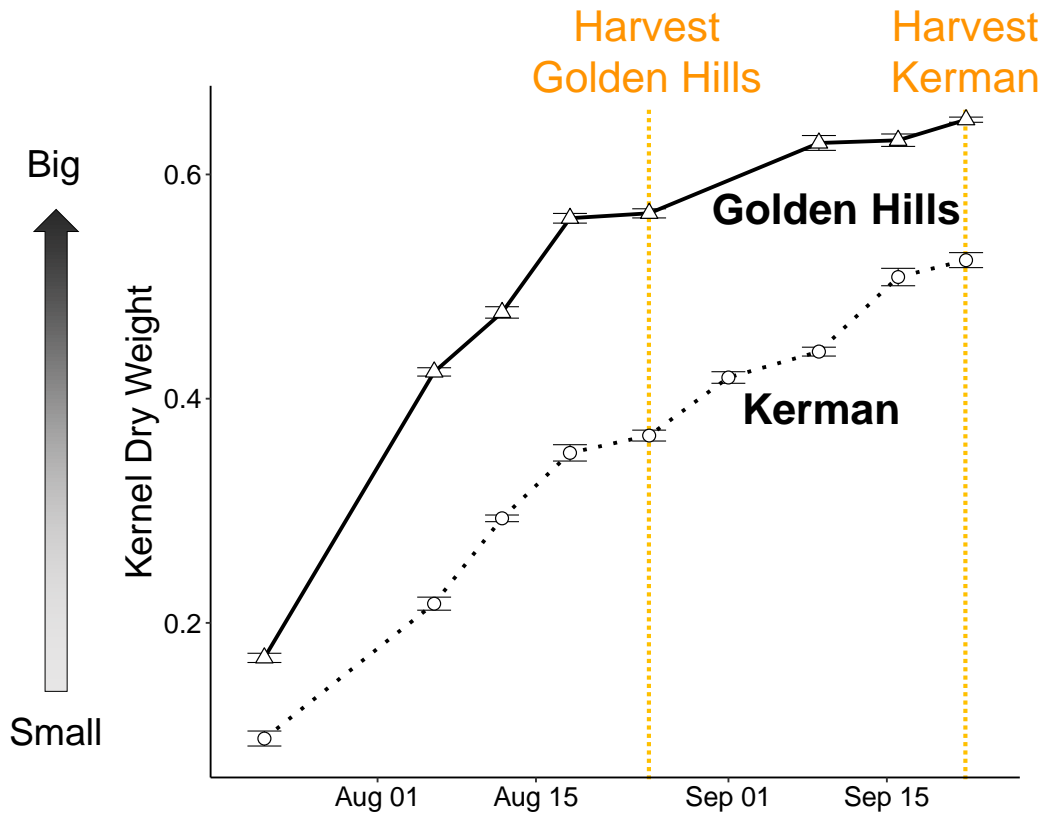


Lightbulb Finding #2

Faster hull breakdown in Golden Hills compared to Kerman

- Golden Hills nuts develop earlier than Kerman and have (generally) larger nuts

Examples of nuts at time of harvest

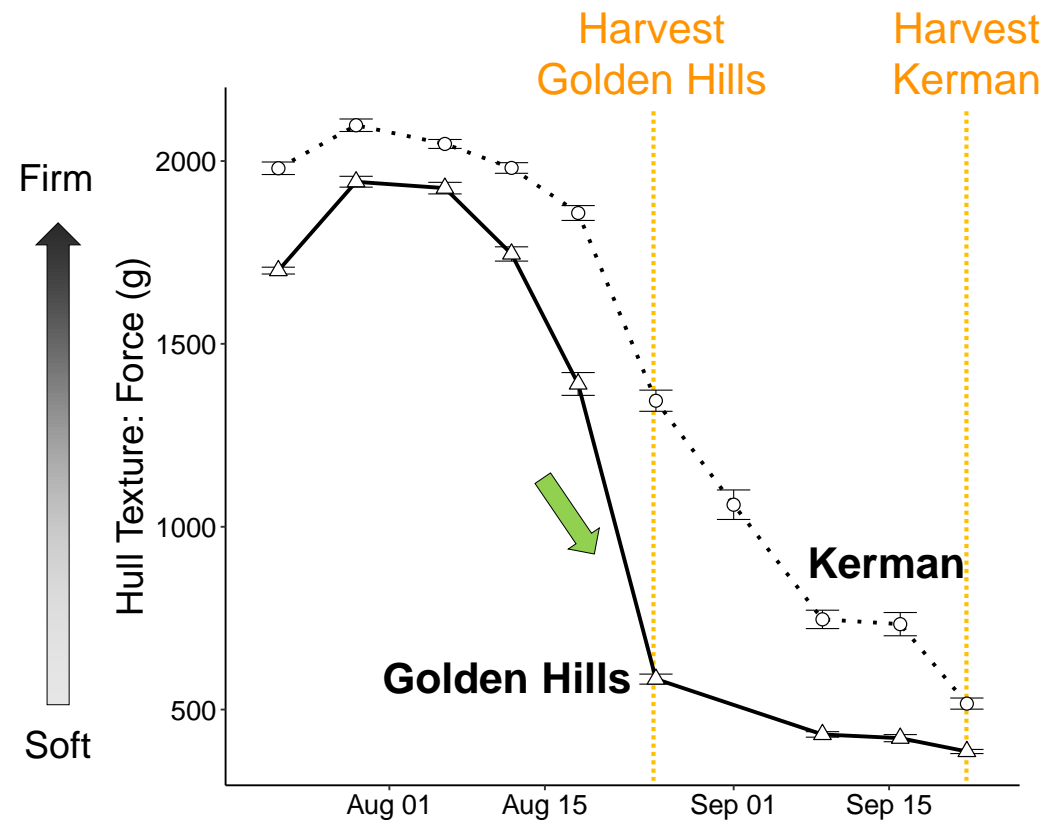
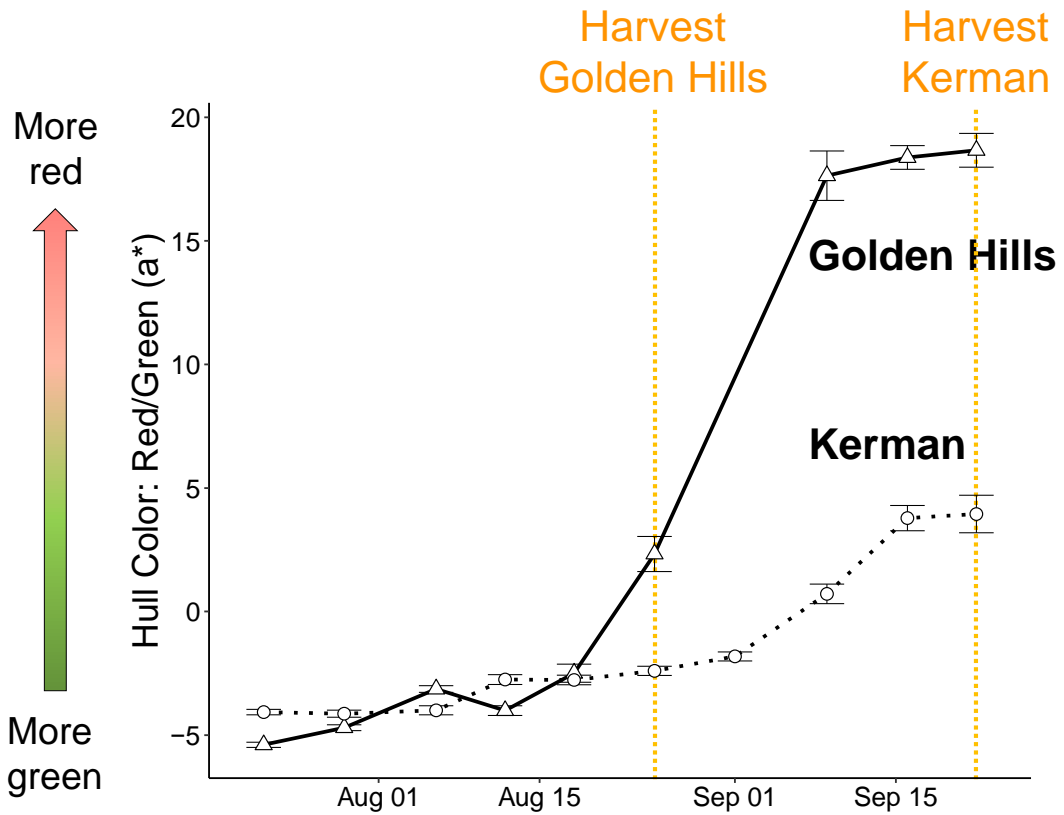


Lightbulb Finding #2

Faster hull breakdown in Golden Hills compared to Kerman

- Golden Hills rate of hull breakdown is faster (steeper) than in Kerman = **Harvest promptly!!**

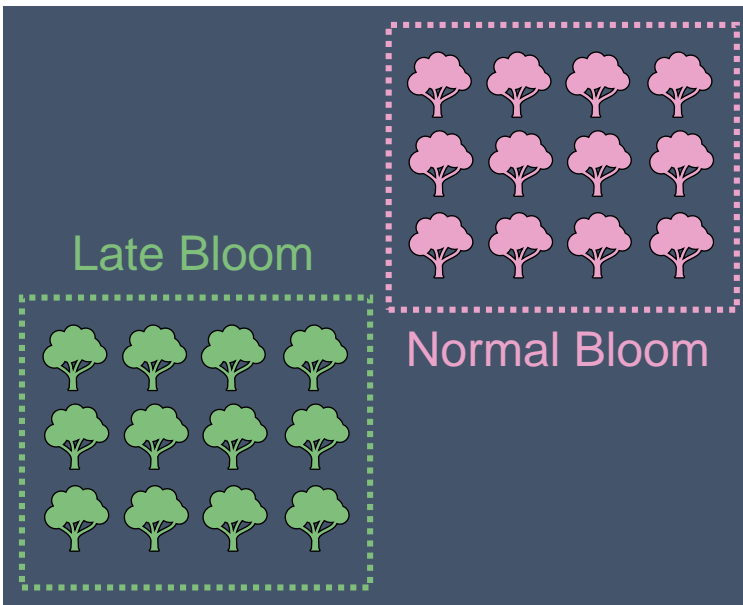
Examples of nuts at time of harvest



Lightbulb Finding #3

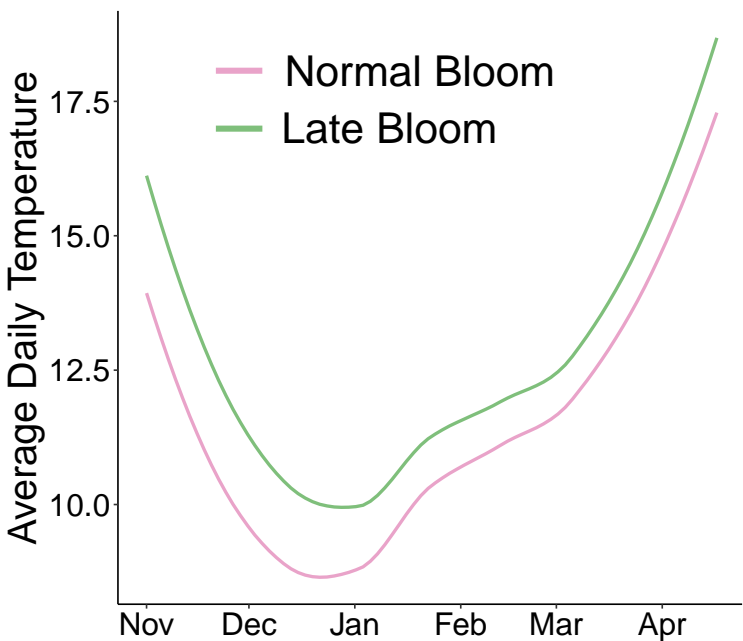
CPRB funded
2021- 2022

Bloom time and temperature during early nut growth impacts blanking and nut quality at harvest

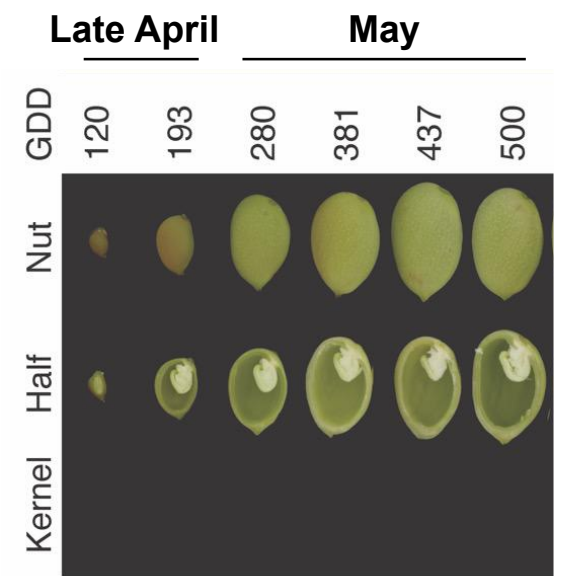


Commercial orchard with different bloom times due to higher temperatures in winter

Winter and Spring Temperatures

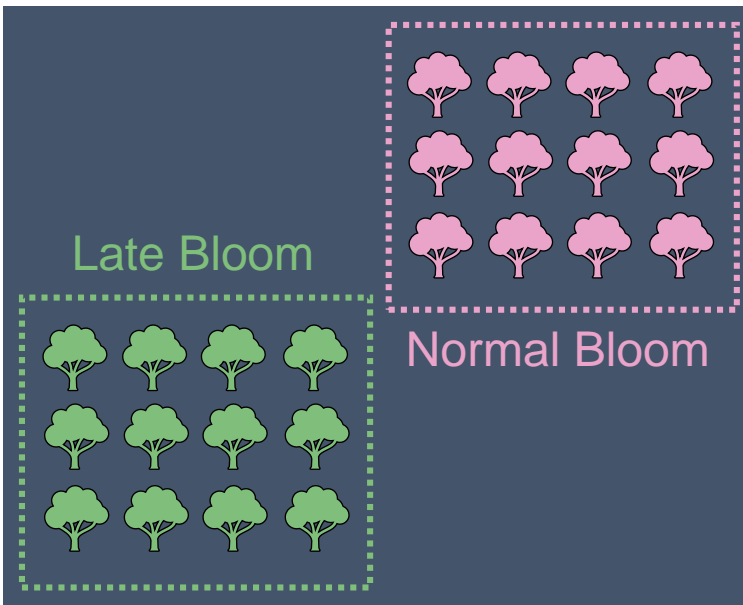


Hull & Shell Growth



Lightbulb Finding #3

Bloom time and temperature during early nut growth impacts blanking and nut quality at harvest

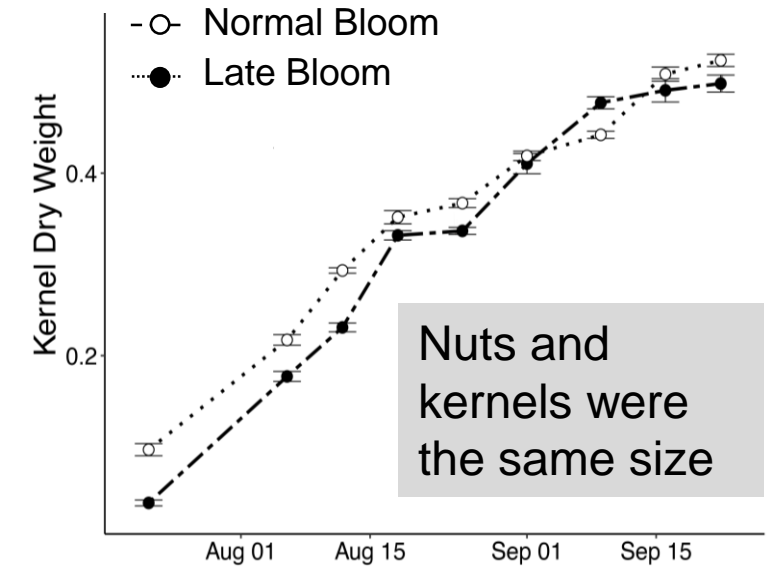


Commercial orchard with different bloom times due to higher temperatures in winter

Late bloom nuts have higher incidence of blanks and filled nuts without splits



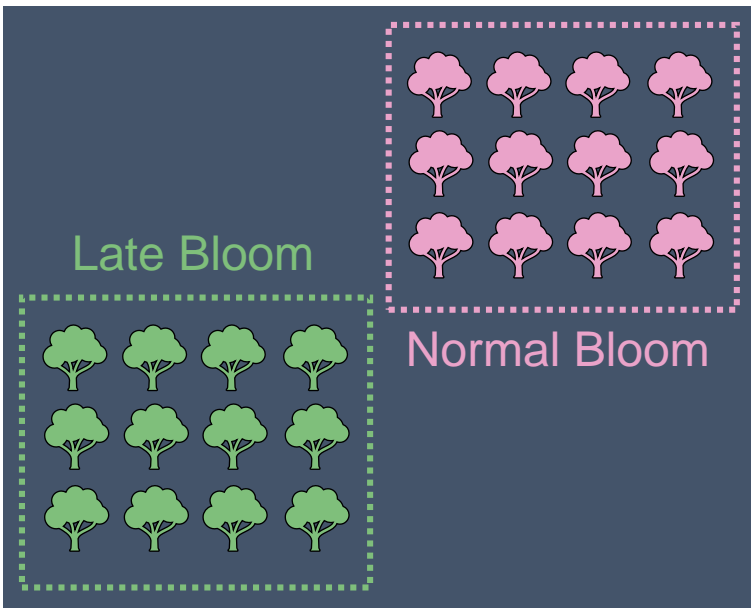
	Normal Bloom	Late Bloom
% Blanks	18%	37%
N	90	95
% With Shell Split	94%	55%
N	32	32



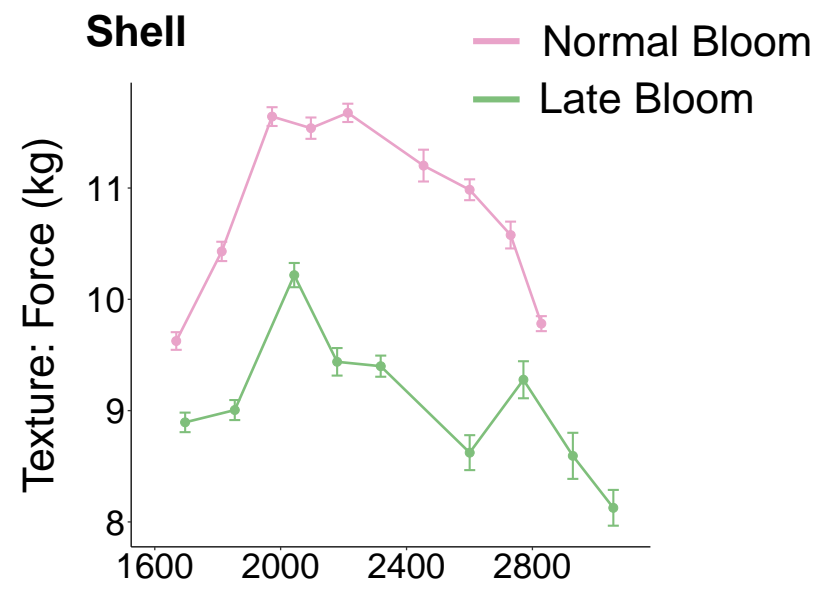
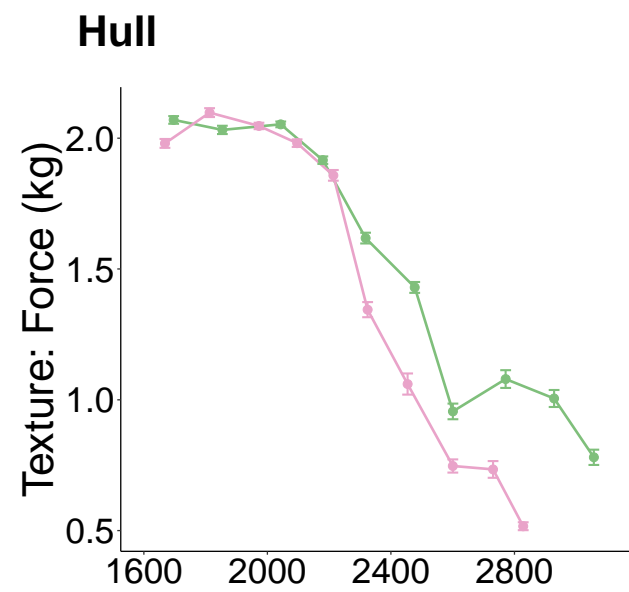
Lightbulb Finding #3

Bloom time and temperature during early nut growth impacts blanking and nut quality at harvest

Late bloom nuts have significantly harder hulls and softer shells



Commercial orchard with different bloom times due to higher temperatures in winter



Lightbulb Finding #3

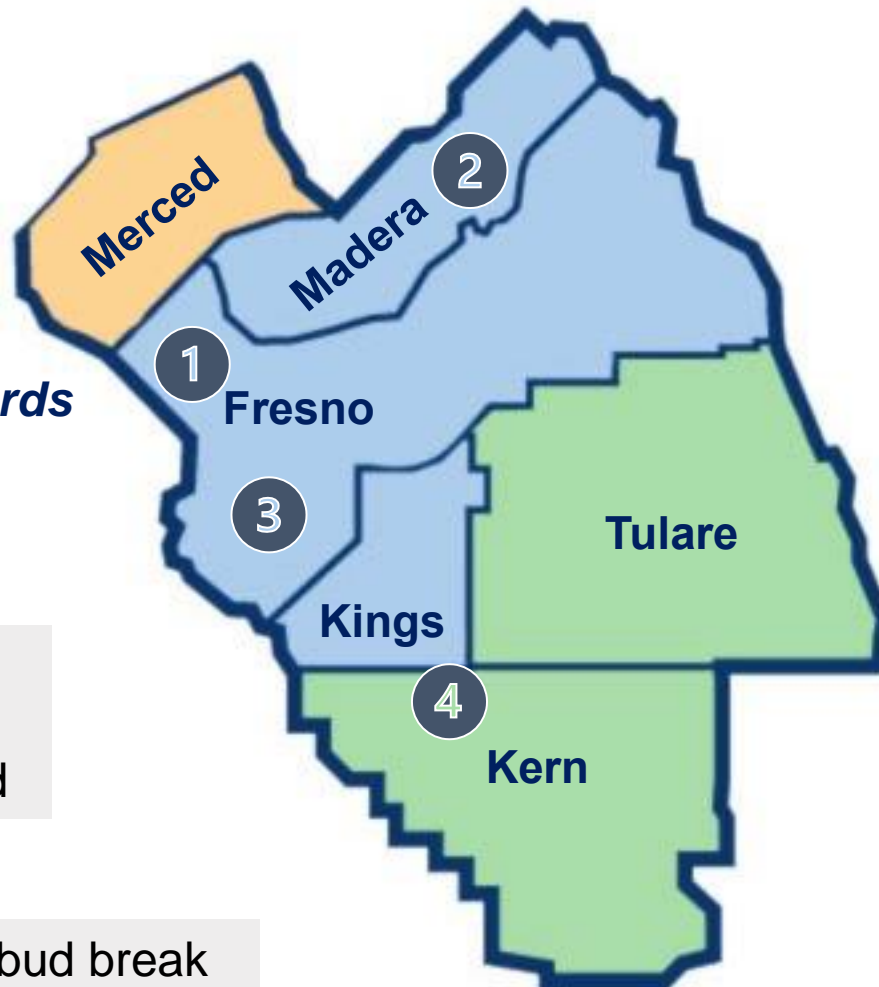
2022 Season Experimental Plan

4 locations and 9 orchards were selected

Commercial orchards across the Valley

Environmental temperature and bloom time monitored

Dormex® to promote bud break and determine the effect of anticipating bloom time

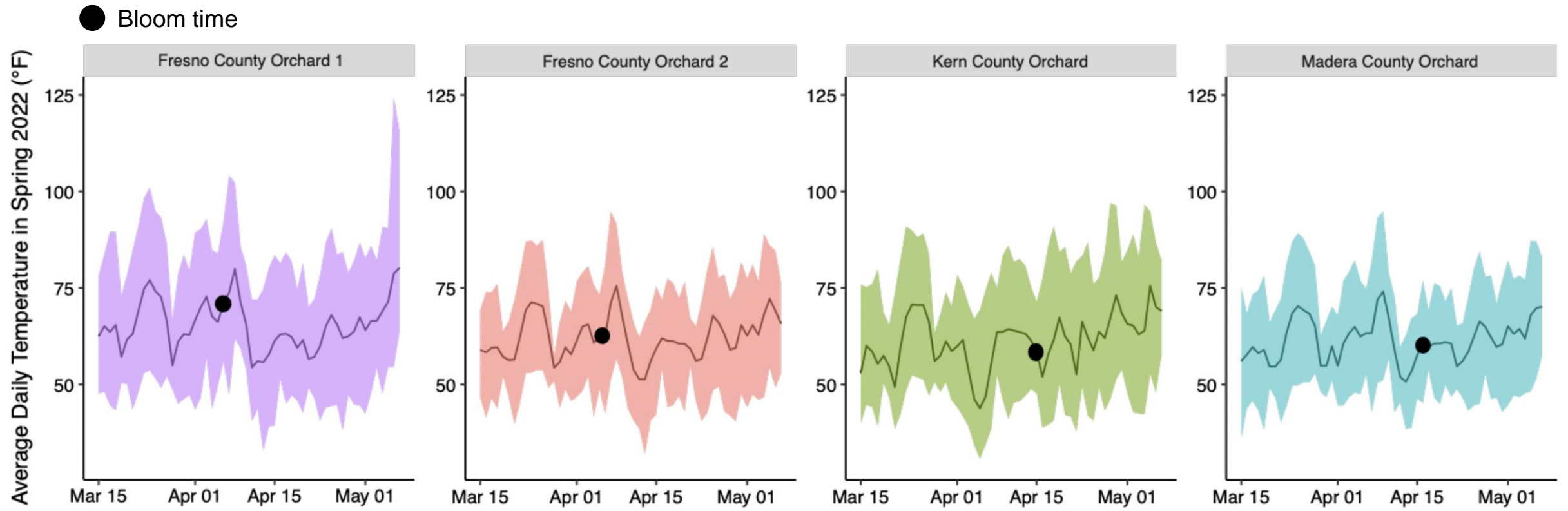


- 1 Three Rocks Orchards** (c.v. Kerman)
 - (1) Late Bloom
 - Dormex
 - No treatment
 - (2) Normal Bloom
 - Dormex
 - No treatment
- (3) **Three Rocks Orchard** (c.v. Golden Hills)
- 2 Madera Orchards = High chill** (cv. Kerman)
 - (4) On year
 - (5) Off year
- 3 Coalinga Orchards = Low chill** (cv. Kerman)
 - (6) Dormex
 - (7) Oil-treated
- 4 Kern Orchards** (cv. Kerman)
 - (8) High salinity
 - (9) Normal salinity

Lightbulb Finding #3

Bloom time and temperature during early nut growth impacts blanking and nut quality at harvest

Temperatures in Spring 2022 were unusual across the Valley

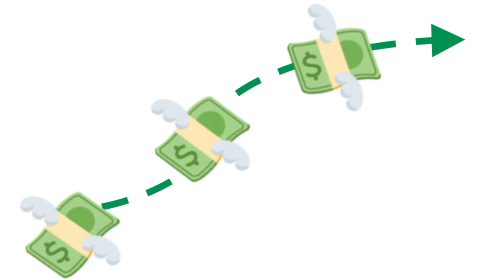


💡 Finding #3

Bloom time and temperature during early nut growth impacts blanking and nut quality at harvest

Nut defects observed in orchards in 2022

- High proportion of **BLANKS**
- Low harvestability (altered hull integrity)
- Low shell split of filled nuts



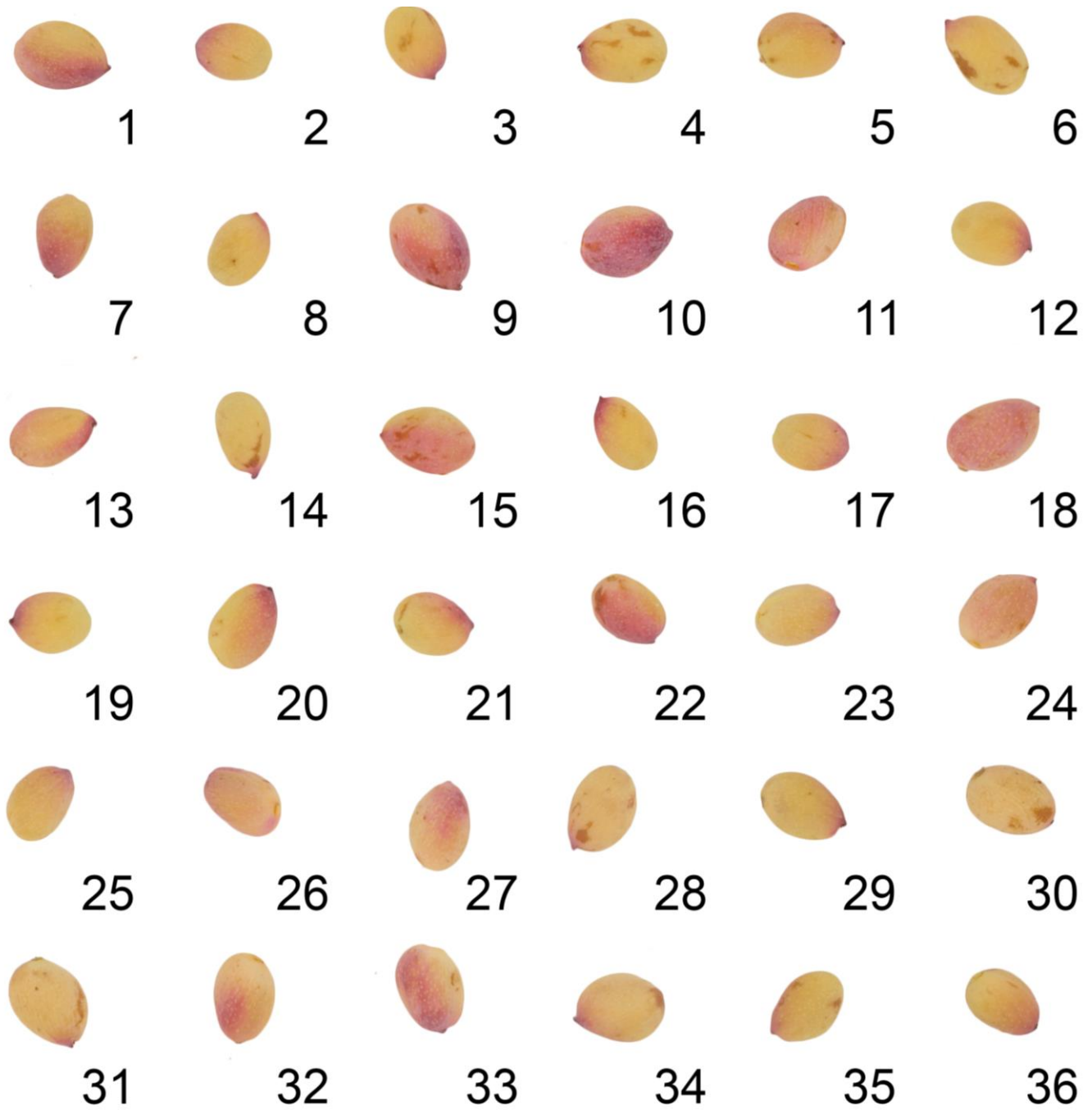
Other environmental factors made things worse in some orchards

Location	Treatment	% Blank	% Split	Avg. Kernel DW (g)
Kern	Heavy soil	53.90%	52.8%	0.40
	Sandy soil	60.19%	54.6%	0.47
Coalinga	Low Chill- Dormex®	46.78%	51.49%	0.55
	Low Chill- Oil	42.19%	33.40%	0.55
Madera	High Chill On-year	36.88%	49.09%	0.35
	High Chill Off-year	27.47%	56.14%	0.39

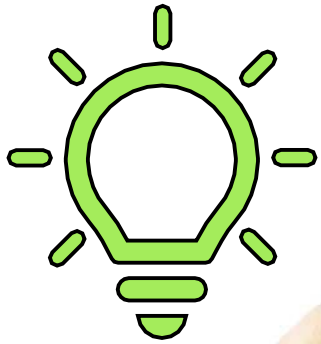


Spot the Filled Pistachios!

Use your skills to identify the filled nuts (not blank)



Wrap-up: Research Findings

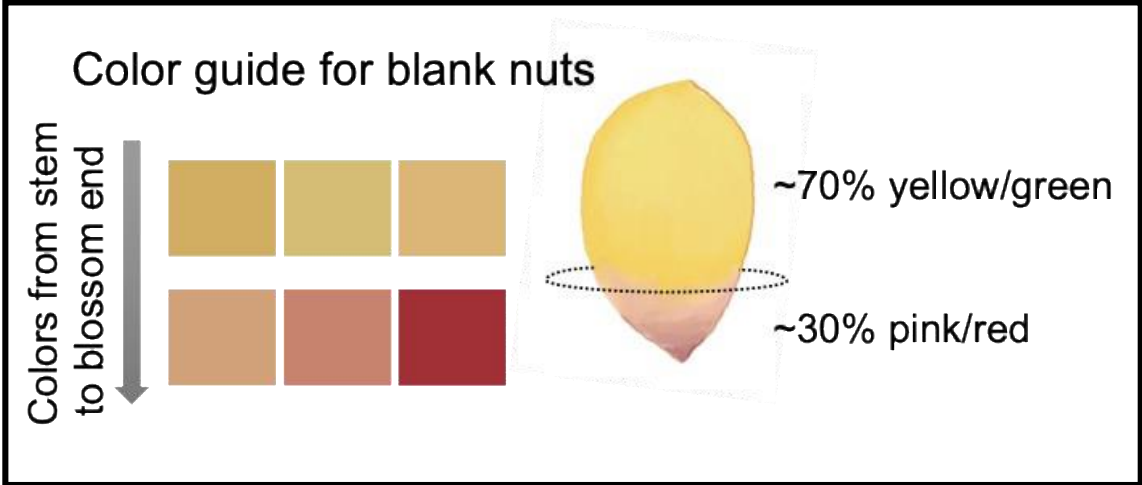


1. Rethinking the nut growth stages
2. Golden Hills nuts deteriorate at a faster rate
3. Trees that bloom late when spring temperatures are high yield nuts with multiple defects at harvest

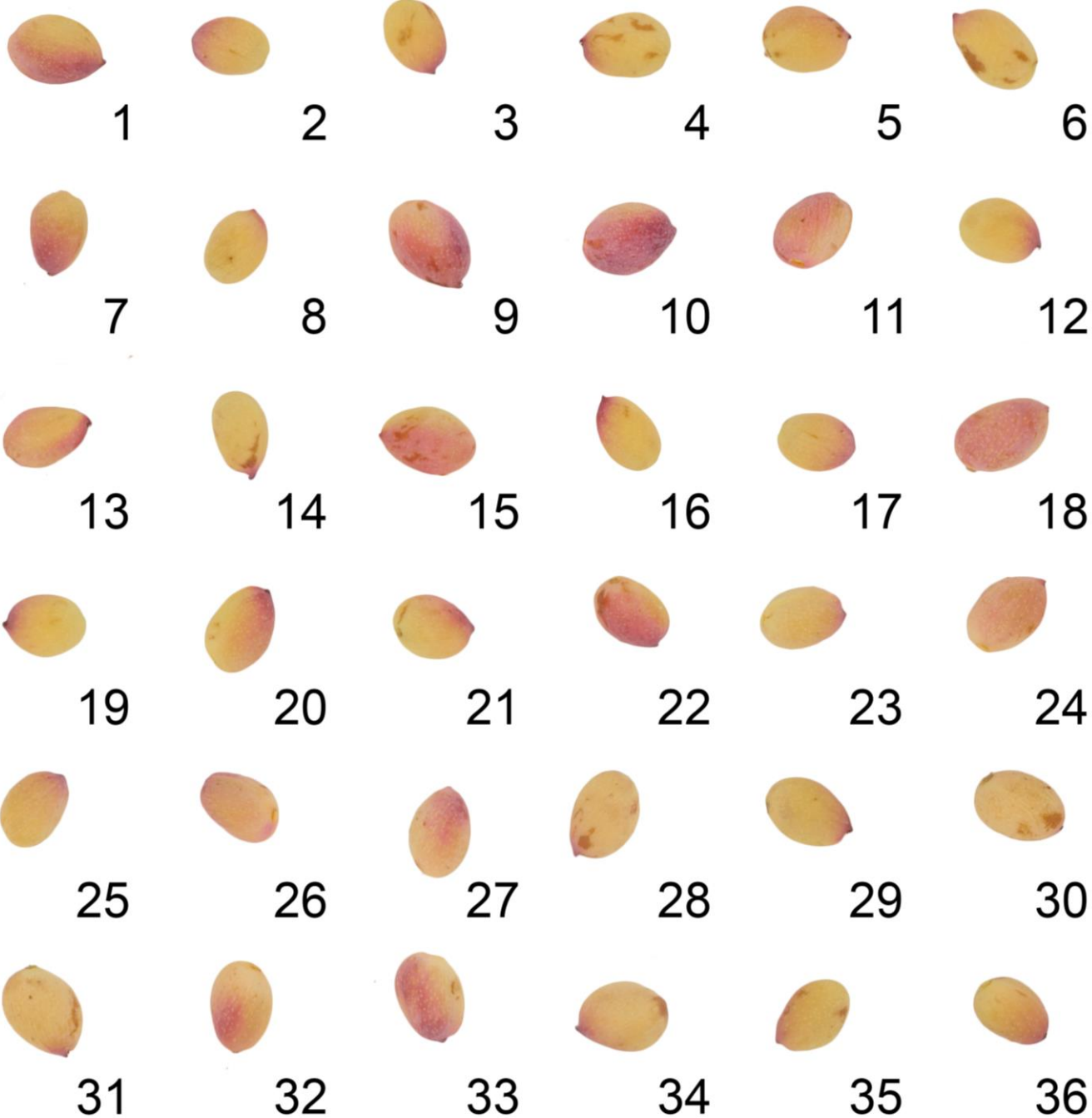
Spot the Filled Pistachios!

Use this guide to find the filled nuts (not blank)

Color guide for blank nuts



The color guide shows a vertical gradient of colors for blank pistachios. A vertical arrow on the left points downwards, labeled "Colors from stem to blossom end". The top row consists of three color swatches: light yellow, pale green, and light tan. The bottom row consists of three color swatches: light pink, medium pink, and dark red. To the right of the swatches is a diagram of a pistachio nut with a horizontal dashed line across its middle. The top portion of the nut is labeled "~70% yellow/green" and the bottom portion is labeled "~30% pink/red".



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Phoebe Gordon (Merced County)

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Georgia Drakakaki (UC Davis)
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Charles Burks (USDA-ARS)

Spot the Filled Pistachios!

Let's check the cut nuts!

