

Dormancy, Bloom, Fertilization and Set of Pistachio Nuts

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2015 Pistachio Production

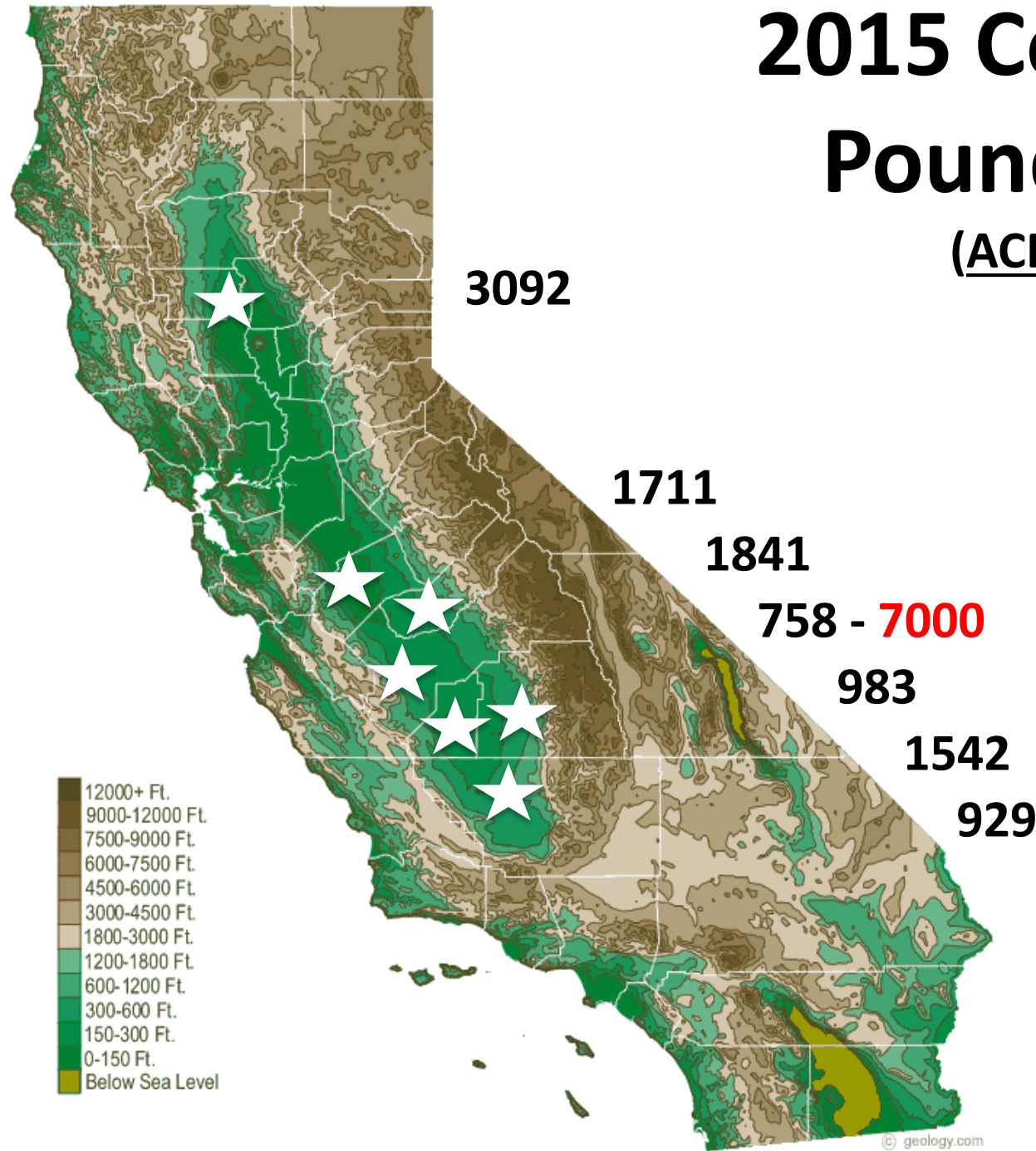
- **Administrative Committee for Pistachios:
November 13th 2015**

– Open Inshell	212,256,825	75.9%	
– Closed Shell	54,048,386	19.3%	(70%)
– <u>Shelling Stock</u>	<u>13,422,238</u>	<u>4.8%</u>	

- **Total New Crop: 279,747,449 pounds**

2015 County Yield Pounds per Acre

(ACPistachios.org, 2016)



April 4th 2015

Kerman

Peters





Reasons for Decreased Yields ?

- **Winter temperatures**
 - Effects on dormancy and yield
- **Spring temperatures**
 - Effects on bloom, pollination, fertilization, set growth and yield
- **Drought**



Insufficient Chill

**-> Less Viable Flower Buds -> Less Nuts
= Less Yield**

**Asynchronous,
delayed, erratic and
prolonged bloom....**



Dormancy

- **Period in an plant's life cycle when growth and development are temporarily stopped**
- **Thought to be a time of:**
 - **decreased metabolic activity**
 - **carbohydrate resources are conserved**
- **Closely associated with environmental conditions**

Endodormancy & Ecodormancy



**Chill
Requirement**

**Heat
Requirement**

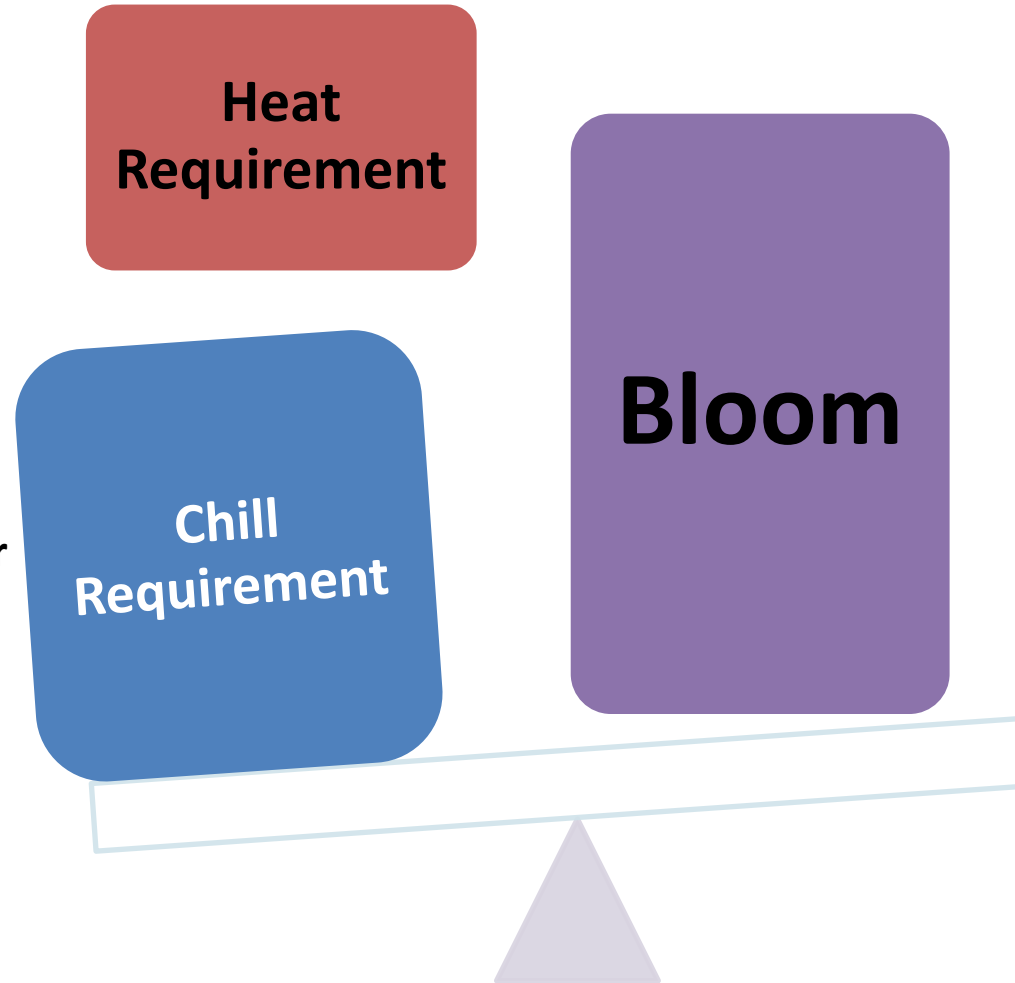
- **Endodormancy:**
 - does not grow due to internal factors
- **Ecodormancy:**
 - growth prevented due to environment: temperature

Chill & Heat Requirements

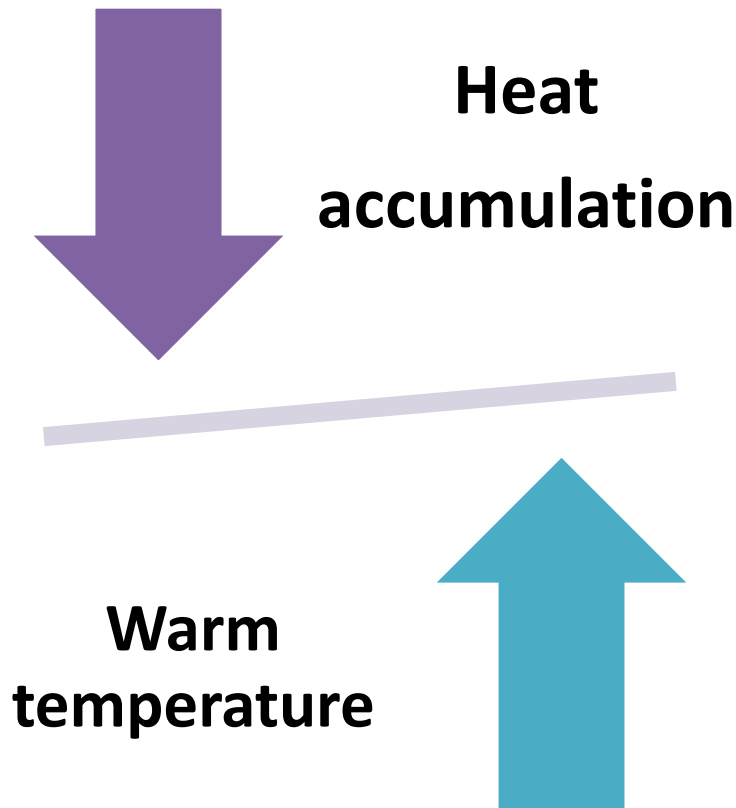
Interdependence between chill and heat

- Mutual regulation mechanism
- Excess chill accumulated in the winter -> reduction of heat requirement
- Spring heat accumulation compensates slightly for winter chill deficiency

(Alonso et al., 2005
Albuquerque et al., 2008).



Balance of Heat Accumulation and Temperature



Warm pre-bloom temperature:

- Hasten flower development
- Reduce flower weight
- Cause pre-mature senescence of pollen and ovaries
- Influence flower quality
- Reduce fertilization rate in tree fruits

(Browning and Miller, 1992
Beppu et al., 1997
Rodrigo and Herrero, 2002)

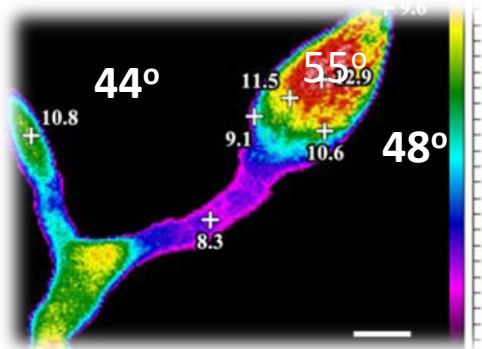
Need Better Chill and Heat Accumulation Methods

Account for chill and heat accumulation:

- What: chill or heat**
- How: high or low**
- When: sustained or interrupted**

Need Better Measuring Methods

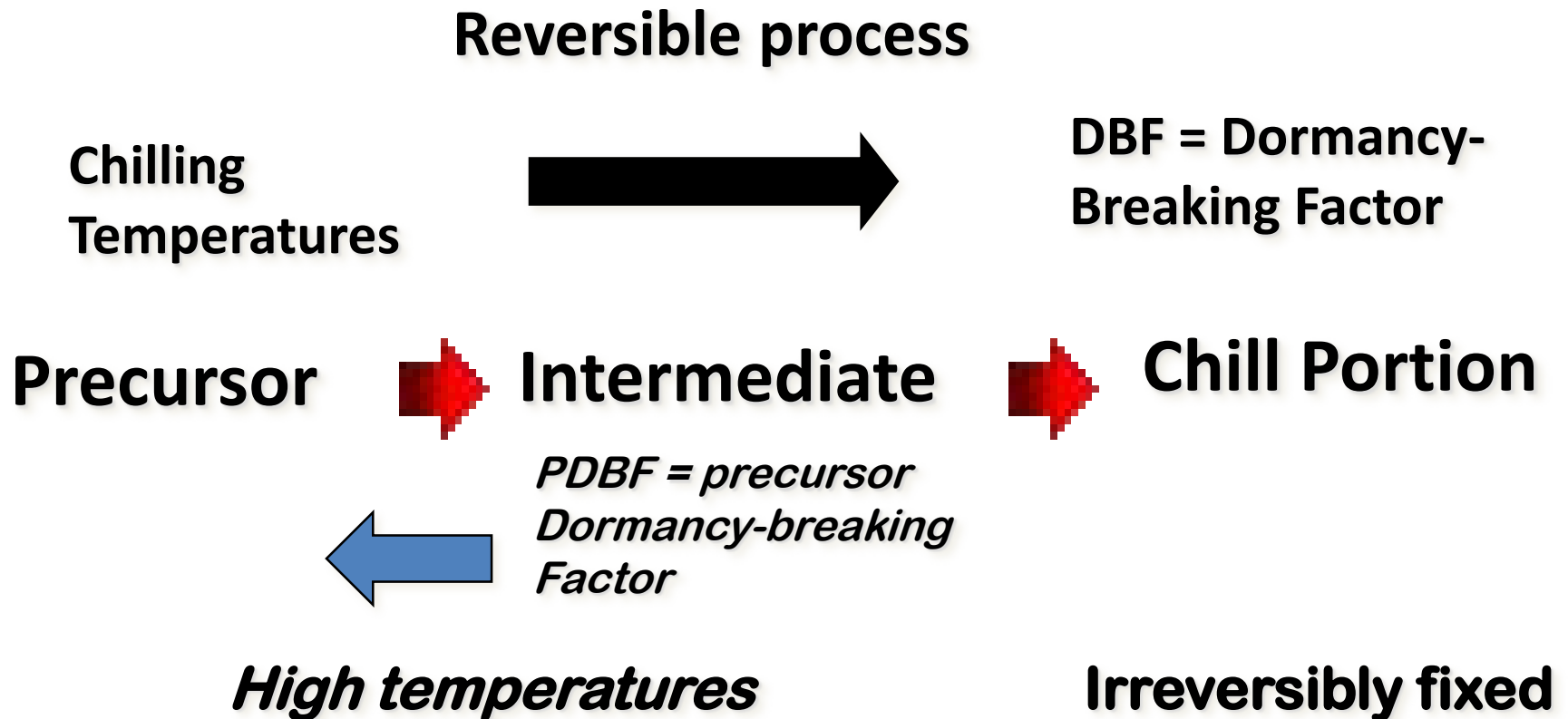
- Measuring ambient air temperature may be inaccurate: not reflect what tree experiences..
 - decreased fog
 - decreased evaporative chilling
 - Increased sun hours
 - warm the dark tree parts



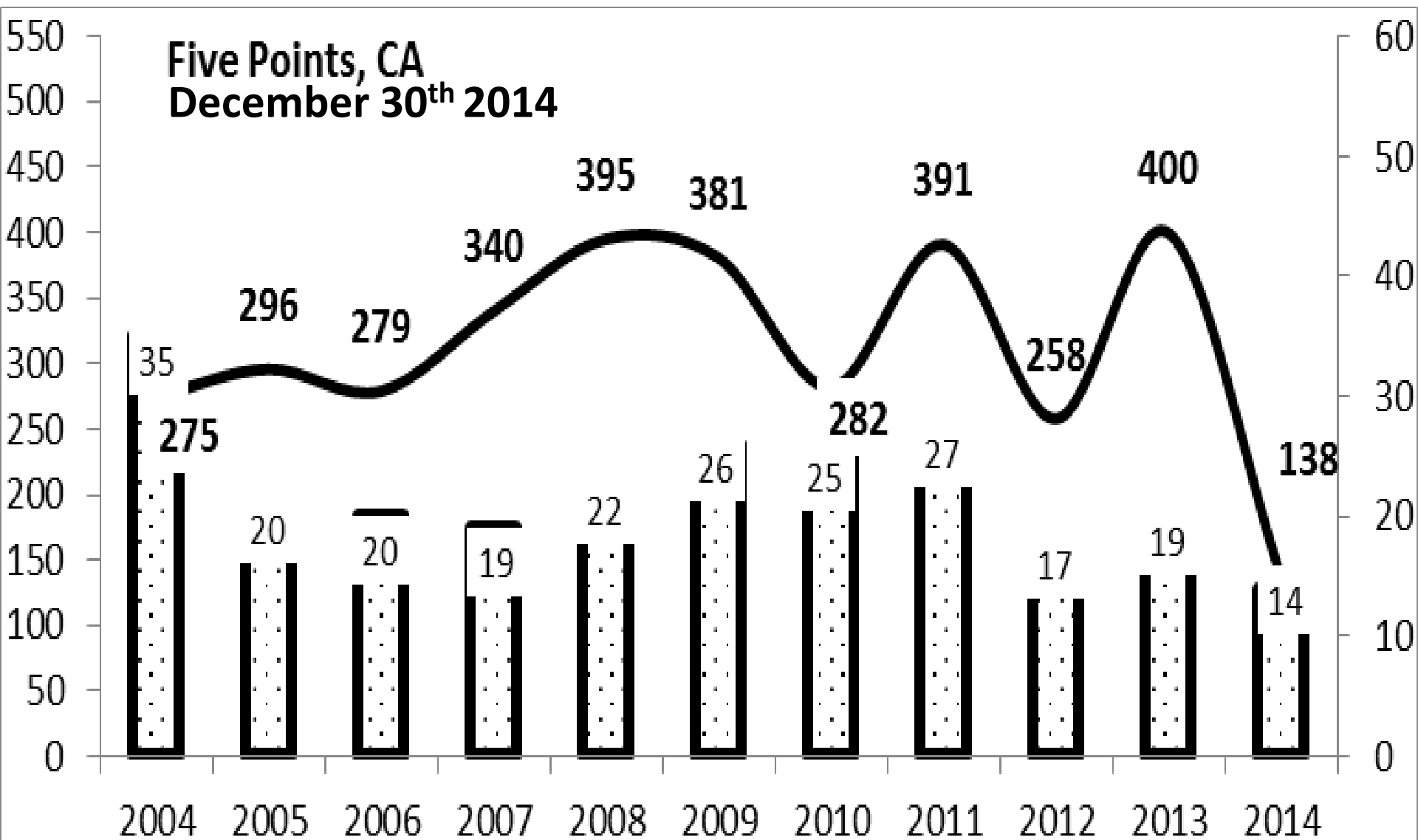
Current Chill Accumulation Methods

- **Hourly Accumulation Method: chill hours**
 - **> 45°F**
 - **November 1st – February 28/9th**
 - **Requirement is met by accumulated hours below 45°F**
- **Weighted Methods: chill portions**
 - **33 – 55°F**
 - **November 1st – February 28/9th**
 - **Intermittent warm temperatures reverse chill accumulation**
 - **Builds toward irreversible point if chill is sufficient**

Weighted Accumulation Methods



Hourly and Weighted Methods Differ



Pistachio Chill Requirements

Beede, 2005: hourly accumulation method

Kerman: 850 hours < 45°F

Peters: 900 hours < 45°F

Pope, 2014: weighted accumulation method

Kerman: 54-58 chill portions

Peters: 58-65 chill portions

Theoretical and not verified in California

Sirora (Australia): 60 chill portions

(Zhang and Taylor, 2011)

Pistachio Chill Requirements and Yield

“Nut crop yield records show that bud break based chilling requirements may not reflect yield....”

Pope et al., 2014

Suggests that potential yield cannot be based on bud break and % bloom... that physiological processes after bud break, also affected by temperature ...must be considered.....

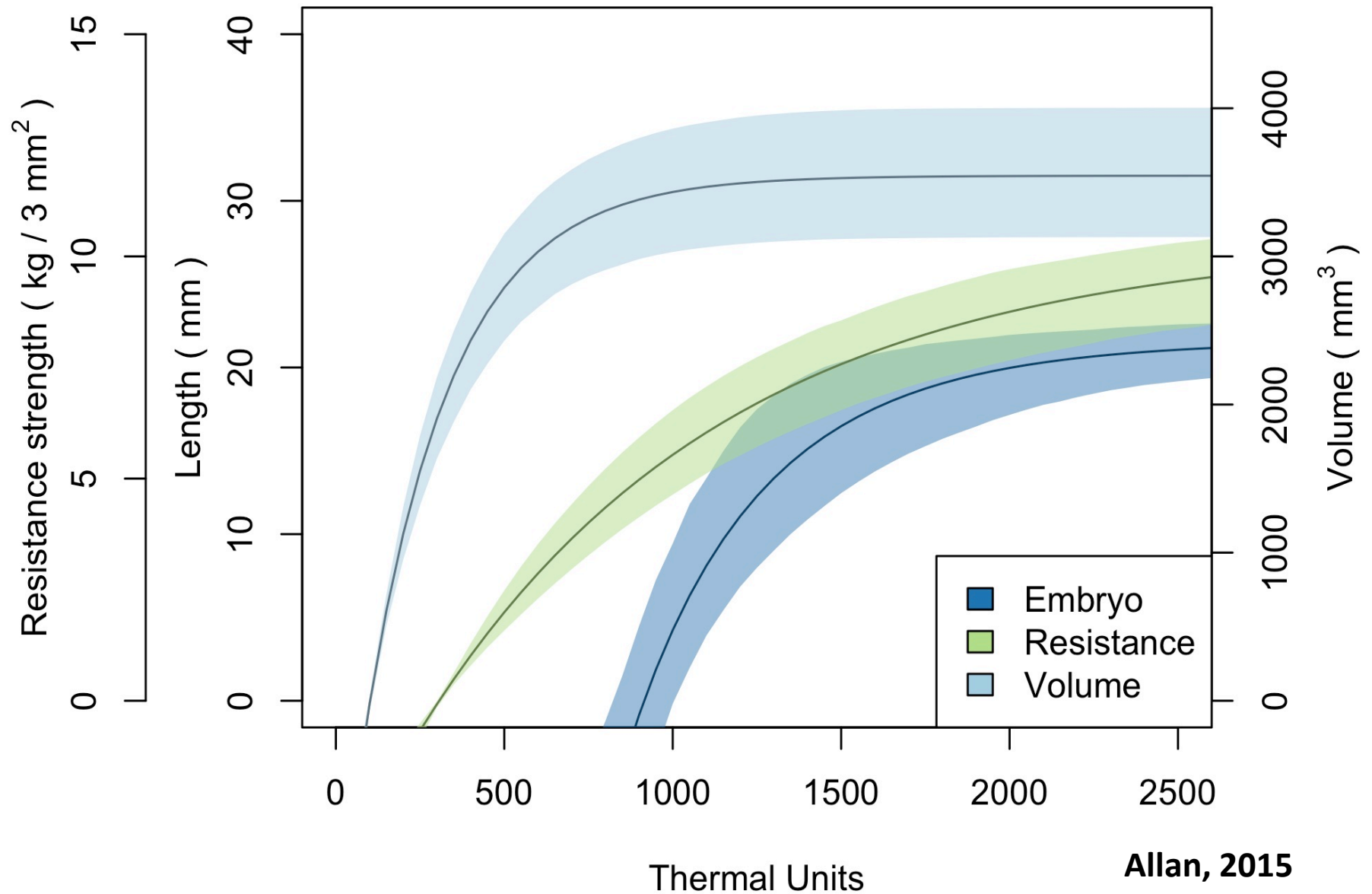




Temperature Related Factors in Yield Decrease

- **Lack of or poor quality, dessicated pollen**
- **Poor germination**
- **Poor pollen tube growth**
- **Parthenocarpy**
- **Abortion of fertilized embryo**
- **Poor shell enlargement**
- **Source-sink competition at nut fill**
- **Failure to split shell**

Development of the Pistachio Fruit as a Function of Heat



Understanding Temperature's Effects on Yield

Synergistic effects of chill and heat on nut size...
(Zhang and Joyce, 2012)

**Good winter chill + higher temperatures
at hull enlargement ----->**



**Poor winter chill + lower temperatures
At hull enlargement ----->**



Conclusions...

- Little true knowledge of how fall, winter, spring temperatures affect bloom much less how later temperatures affect the multiple factors that result in final yield....
- Need improved methods for measuring temperature accumulation...
- Perhaps need to develop, as in irrigation, plant based measurements....

What is UC doing?

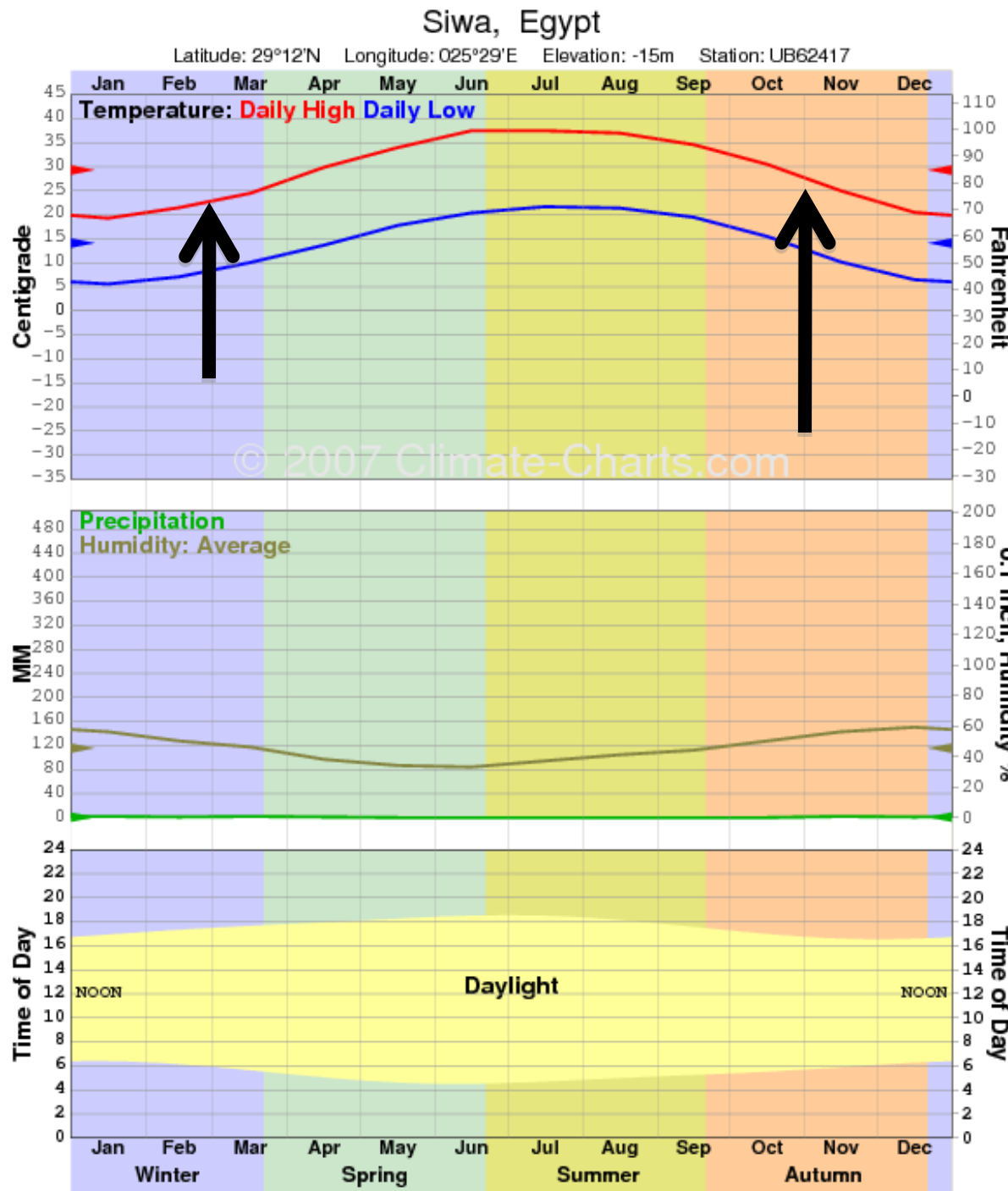
- Maciej Zwieniecki: long term objective
 - physiology of yield
- Lu Zhang: medium term objectives
 - Verifying chill/heat accumulation methods on bloom and yield
 - Evaluating accumulation methods for accuracy
 - Characterizing floral development in pistachios
- David Doll: short term goal
 - Evaluate oil and kaolin dormancy breaking treatments

What Can You Do Now?

- **Install a data logger temperature, RH**
- **Log 50% bloom date**
 - **Males**
 - **Females**
- **Log strength of bloom and pollen**
- **Log harvest date, yield, % blanks, splits and nut sizes**

**Develop
Historical
Climate
Data:
- that can be
correlated
with yield
and quality**

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