

# HOS 4341

## Seed Dormancy Chilling Requirement

# Dormancy

## Overview

- Perennials
- Seed dormancy

## Release of Dormancy

- Chilling requirement

## Mechanism of Onset and Release of Dormancy

- Hormonal
- Nutritional
- Gene expression

# Seed Dormancy

## Primary dormancy

### Seed coat

Prevention of water uptake  
Mechanical constraints  
Gas exchange

**Scarification**

### Chemical

Inhibitors or  
Inhibitor production

### Developmental

Immature embryo

### Physiological

Brief exposure to light, dehydration or  
chilling

### Deep dormancy

**Stratification**

### Double dormancy

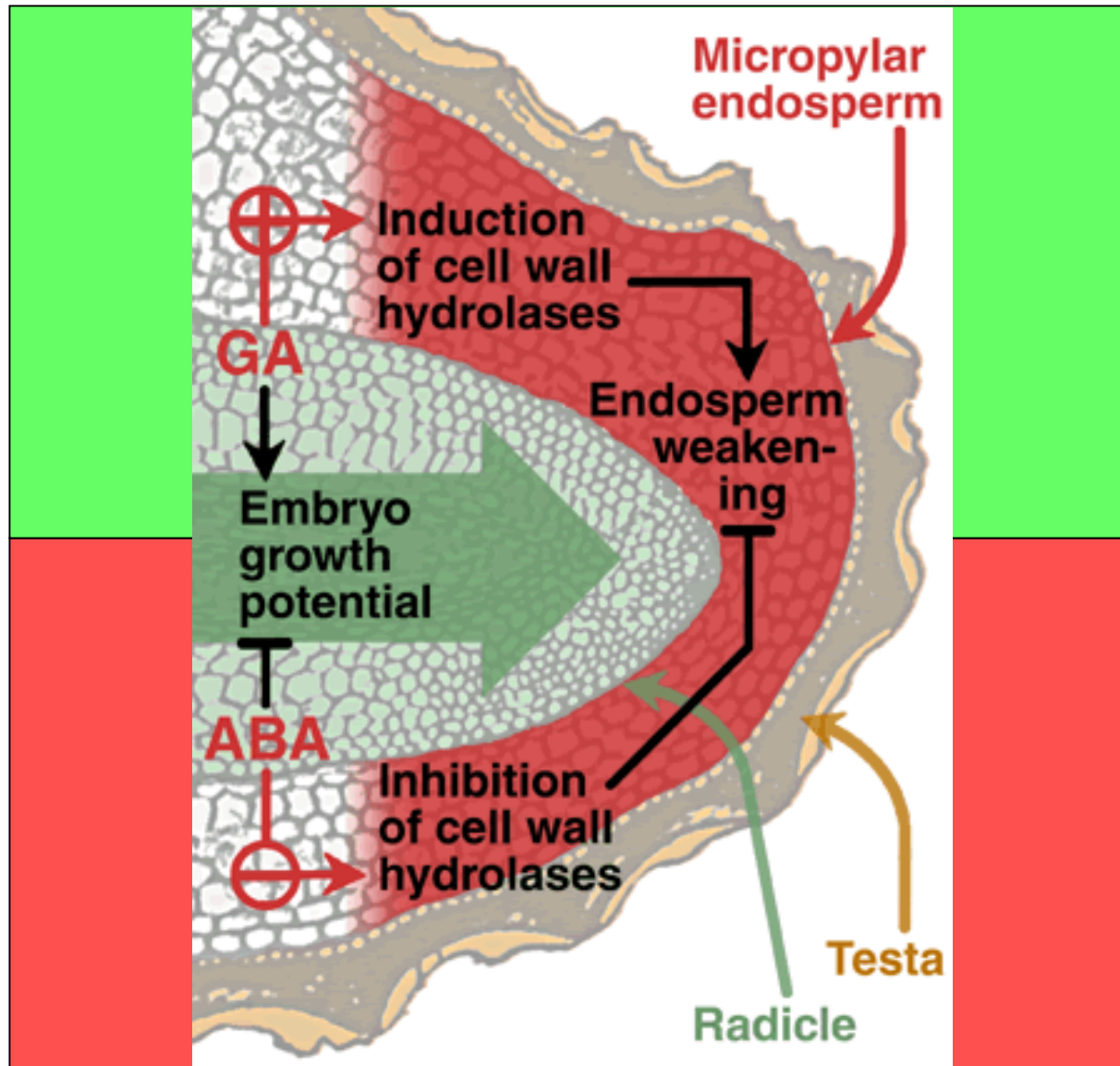
## Secondary dormancy

### Post-imbibition conditions

Water stress  
Prolonged dark or light  
Anoxia or hypoxia  
Drought

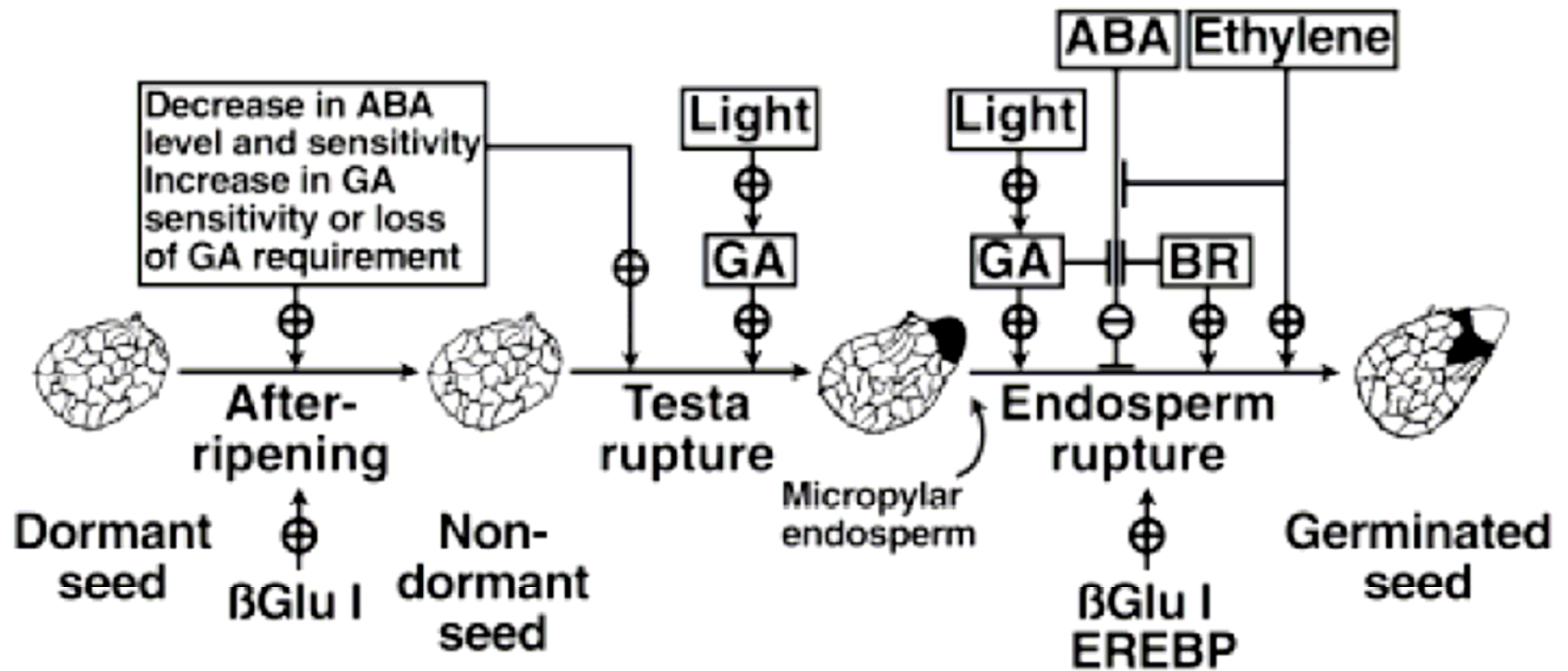
# Seed Dormancy

## Interplay of hormones



# Seed Dormancy

## Interplay of hormones





Untreated + gibberellin + abscisic acid

Figure 3: Light-induced germination of lettuce seeds

The seeds in the top row were placed in darkness, and the seeds in the bottom row were placed in light.

# Release of Dormancy - Chilling Requirement

A measurable period of cold temperatures (0-10 degC) required by plants to break out of endodormancy

## POINT TO NOTE

- Measured as bud break
- Different for different species
- Geographical distribution of plants based on chilling requirement
- Ecodormancy can override chilling requirement
- Intensity of dormancy proportional to chilling requirement

Table 6.1. Chilling requirements in hours below 7C of some deciduous fruit species

Species	Number of chill hours
Almonds	0-800
Peaches	100-1250
Japanese plums	100-800
Apples and pears	200-1400
European plums	800-1500
Cherries	800-1700

From: Saure, 1985. Hort. Rev. 7:239-299.

Doesn't cold temperature signal onset of dormancy?

# Modification of chilling requirement

1. Intermittent warm periods during chilling
2. Light
3. Presence of leaves

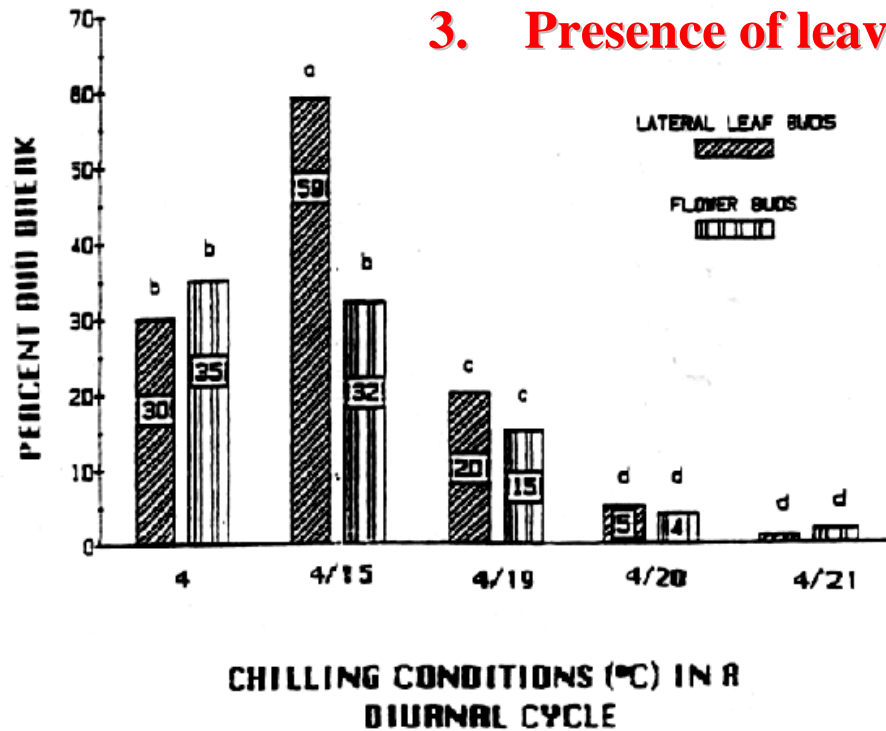


Fig. 1. The influence of diurnal temperature cycles on bud break in 'Redhaven' peach. (Exposure to 4°C in the cyclic treatments for 16 hr a day.) Mean Separation by Duncan's multiple range test, 0.05 level.

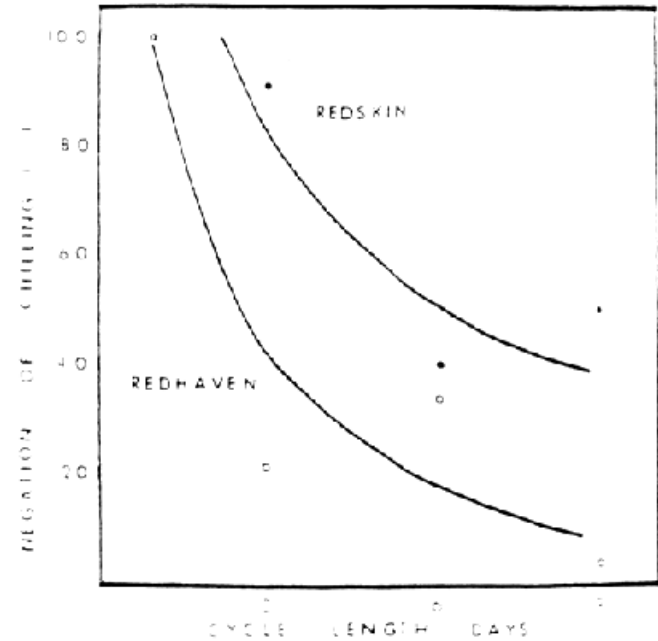


Fig. 2. The effect of cycle duration on chilling negation effect by high temperatures with 'Redhaven' and 'Redskin' peach lateral leaf buds. Data were taken after accumulation of 1200 weighted chilling hours for 'Redhaven' and 1150 for 'Redskin'. In all cycles 2/3 of cycle was maintained at low temperature and 1/3 at high temperature. % reversion of chilling was calculated from the formula:  $y = (100 - x \times 100/z)$  where  $x$  = the level of bud break observed and  $z$  the level of bud break in the corresponding continuous chilling.

**As time progresses chilling becomes irreversible**

# Presence of leaves inhibits bud break but not chilling accumulation

Trt	<u>Prechil</u>		<u>Postchil</u>		<u>Prechil</u>	<u>Postchil</u>
	D	G	D	G		
1A	+	-	-	-		
1B	-	-	-	-		
2A	+	-	-	-		
2B	-	+	-	-		
3A	+	-	-	-		
3B	-	-	-	+		
4A	+	-	-	-		
4B	-	-	+	-		
5A	+	-	-	-		
5B	-	+	+	-		

**D-Defoliated**  
**G-Girdled**

**Bud break inhibitor**  
**moves through the**  
**phloem**

# Chilling models

Predict status of dormancy cycle and/or completion of endodormancy

## 1. Chill hour model

Weinberger, 1950

No. of hrs between 0-7 degC

## 2. Chill unit model

Richardson et al., 1974

Chilling effectiveness units assigned to various temps.

1 CU = 1 hr at optimum Temp

Fractional CUs at non-optimum Temps

## 3. Mean Temperature Model

Uses mean winter (December and/or January) monthly temperatures to estimate accumulated chilling units (FL & GA)

Table 6.2 Chill units calculated by several authors

Chill unit values	Corresponding temperatures (C)		
	A	B	C
0	<1.4	-1.0	-1.1
0.5	1.5-2.4	1.8	1.6
1.0	2.5-9.1	8.0	7.2
0.5	9.2-12.4	14.0	13.0
0	12.5-15.9	17.0	16.5
-0.5	16.0-18.0	19.5	19.0
-1.0	>18	21.5	20.7
-1.5	—	—	22.1
-2.0	—	—	23.1

A- Richardson et al., 1974, high chilling peaches  
B-Gilreath and Buchanan, 1981, low chilling nectarine  
C-Shaltout and Unrath, 1983, high chilling apples

## **Limitations of the chilling models**

- Chill hour model does not account for chilling negation but Chill Unit model does**
- Neither model accounts for enhancing effect of moderate temps. Chill negation is subject to time constraints**
- Optimal temp varies from sps to sps**
- In general the optimal temp is higher and its range broader for low chill cultivars**
- The optimal temp varies with stage of dormancy. Neither of the model accouts for that**

## **Questions???**

- **What are the two major types of seed dormancy?**
  - **Which type of seed dormancy manifests itself after imbibation?**
  - **How can seed coat based dormancy be broken?**
  - **How can deep dormancy be overcome?**
  - **Relative amounts of what hormones determine dormancy of a seed?**
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- **What is the importance of chilling requirement?**
  - **What does the presence of leaves inhibit?**
  - **Bud break inhibitor moves through which conducting tissue?**
  - **Name the two models for chilling?**
  - **Do you think these models are applicable in present commercial production environments?**
  - **What do you suggest as an alternative?**