APPLE PHYSIOLOGY – BLOOM TO HARVEST USE OF PGR'S & OTHER TIPS

OR WHY DOES THIS HAPPEN?

Increasing Branching

- Several products
  - 6-BA (Maxcel, Exilis, RiteWay)
  - BA + GA (Promalin, Perlan, Typy)

- Two Timings
  - Dormant
  - Early shoot growth

5000 ppm MaxCel in latex paint

Branching

- Latex application
  - 5,000 ppm = 0.2 – 0.33 pint/pint latex paint
  - When buds begin to swell before shoots emerge
  - *Day after planting
- Foliar application
  - 250-500 ppm = 16 fl. oz./10 gallon
  - 3-4 applications @ 28-30 inches of growth, 2-3 x

Pollination & Crop Regulation

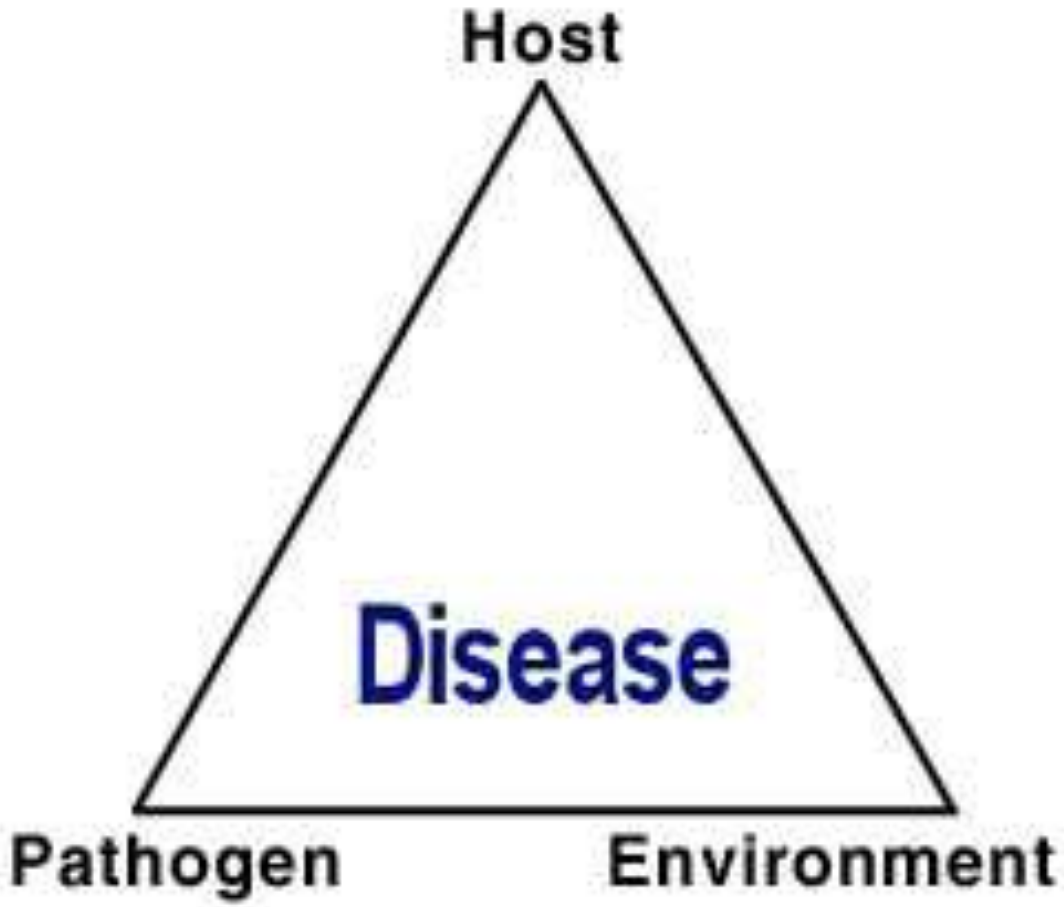
Pollination by flower type

- **King flowers**: open earlier with high stigmatic receptivity but shorter length (speed skater)
- **Lateral flowers**: Open later but have longer stigmatic receptivity (cross country skier)

Environmental Influences

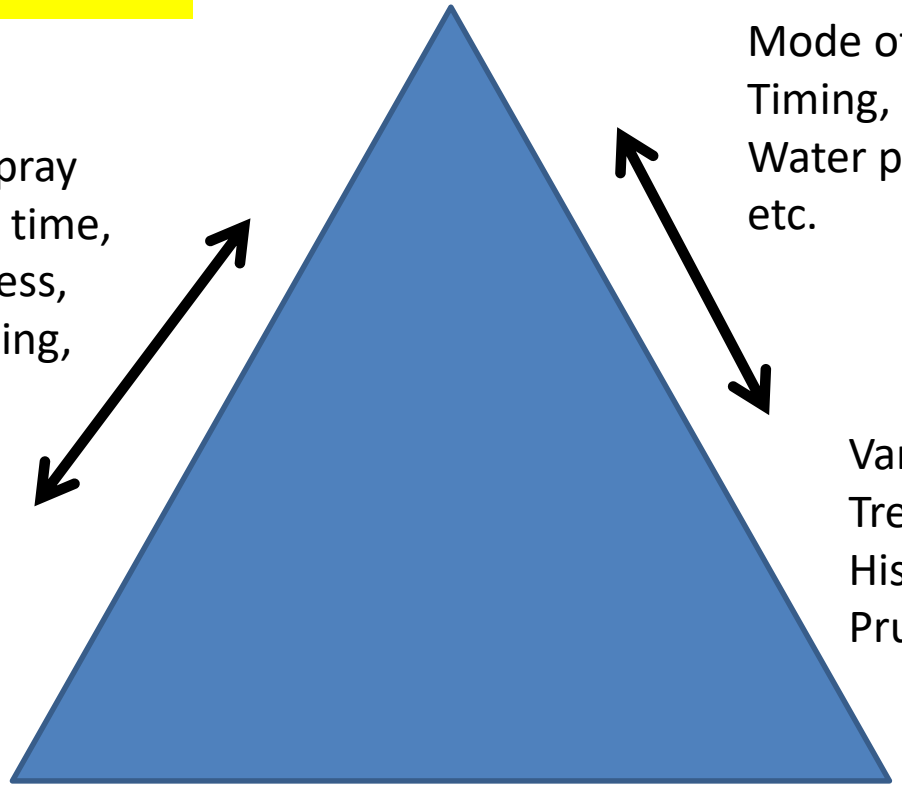
- Lower temperatures extend ovule longevity but result in slower pollen tube growth
- Warmer temperatures reduce stigma receptivity and increase ovule degeneration

The Disease Triangle



Equilateral Plant Disease Triangle with 3 necessary casual factors of disease

Another way to look at thinning?



Slide from J. R. Schupp

What causes russeting of fruit?

- Can be caused by
  - Fungi or yeasts on fruit surface
  - Insect feeding
  - Frost around bloom
  - High humidity & precipitation @ 15-20 DAFB
  - Crop protection materials

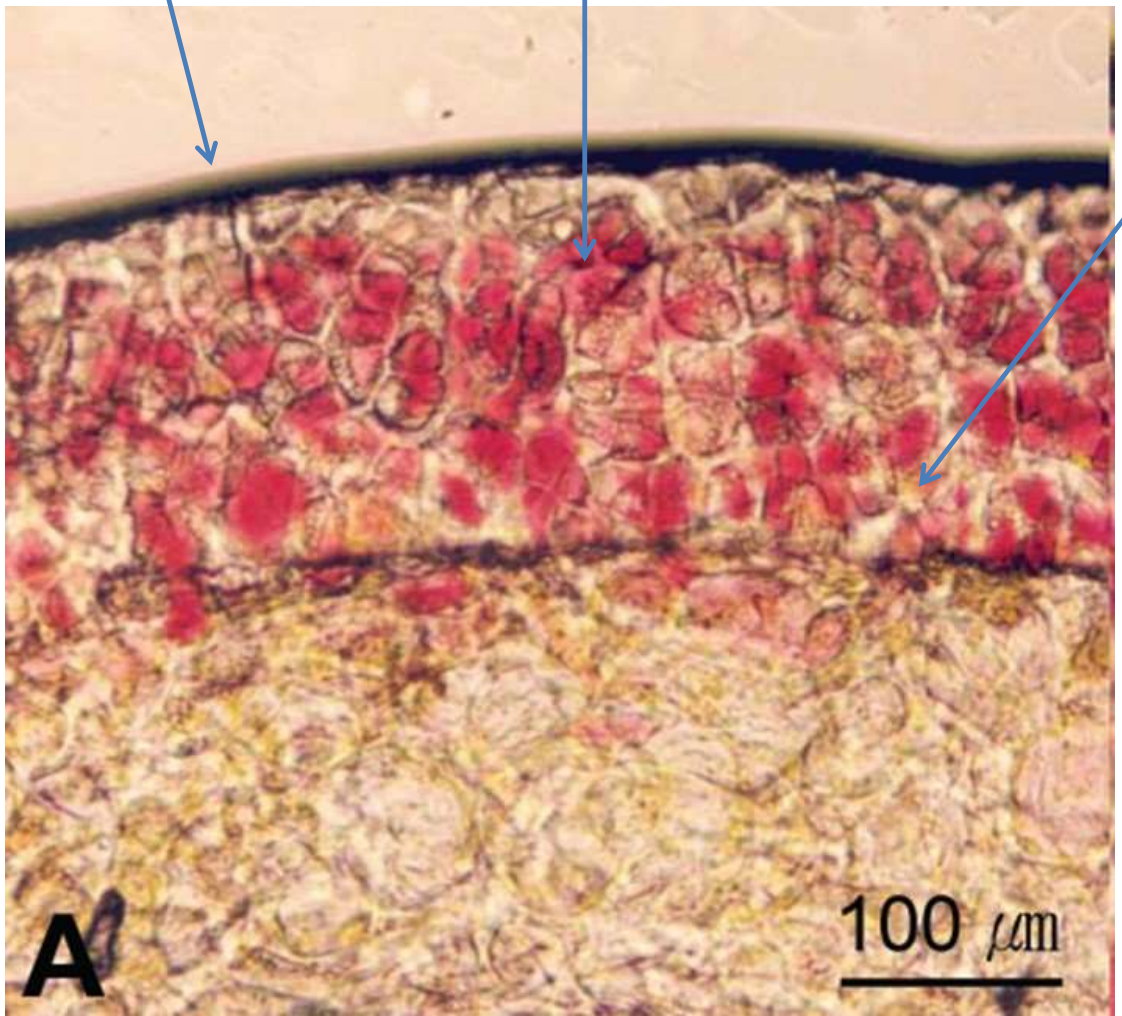
Cuticle

Epidermis

2 or 3 cell deep

Hypodermis

6 – 10 cells deep



Anatomical changes

- Abnormal development of waxy layer covering epidermal cells (known as cuticle)
- Weakness leads to micro-cracks in cuticle
- “Cracks” expand further with fruit enlargement
- Cells beneath “cracks” exposed to air forming corky tissue (cambial) to form
- Reference

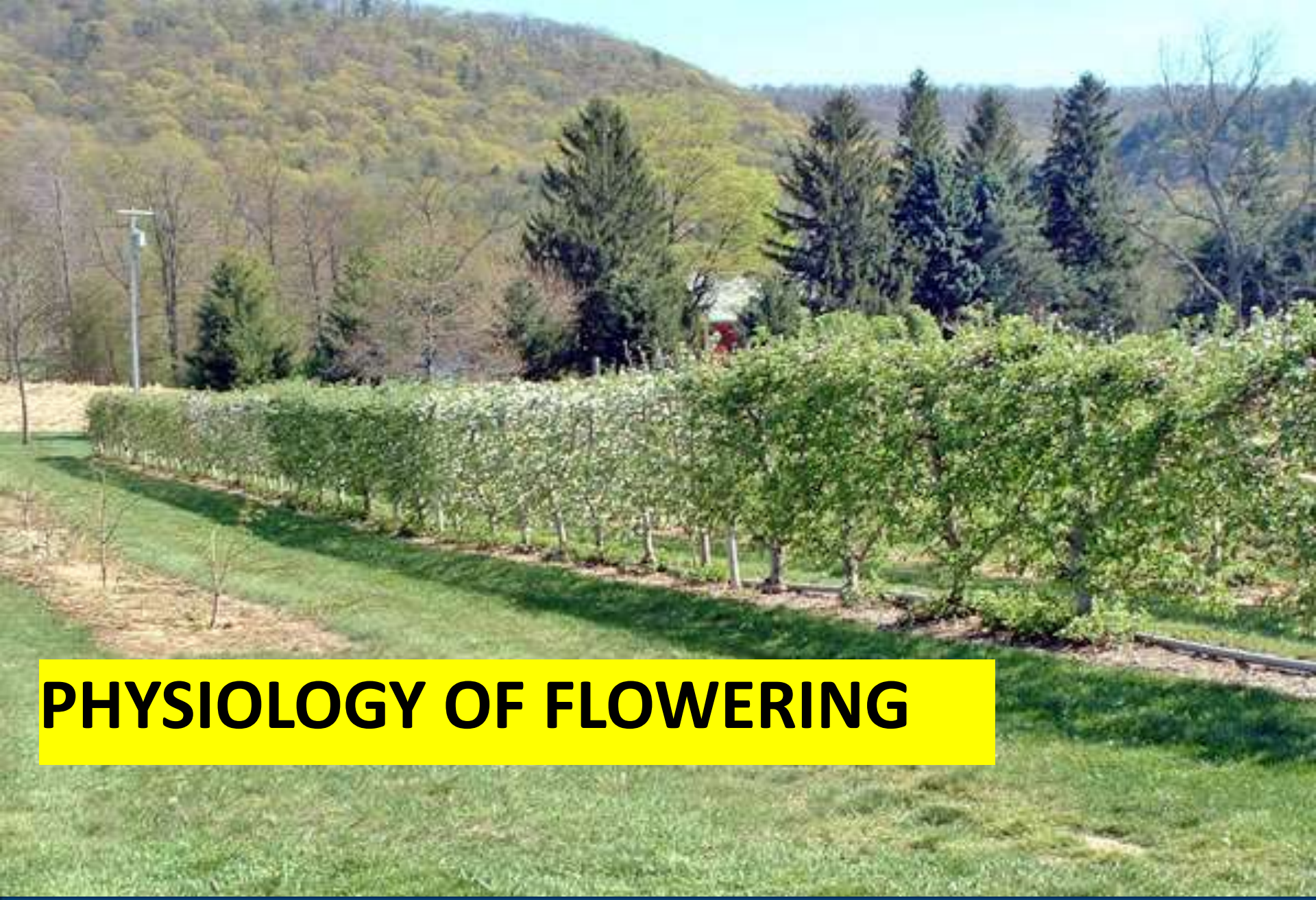
  http://www.tfrec.wsu.edu/pages/cpg/Leaf_Injury

Reducing russet

- Multiple sprays of GA products
  - Provide® - Gibberellins A_4A_7
  - Novagib 10L - Gibberellins A_4A_7

kudos® 27.5 WDG

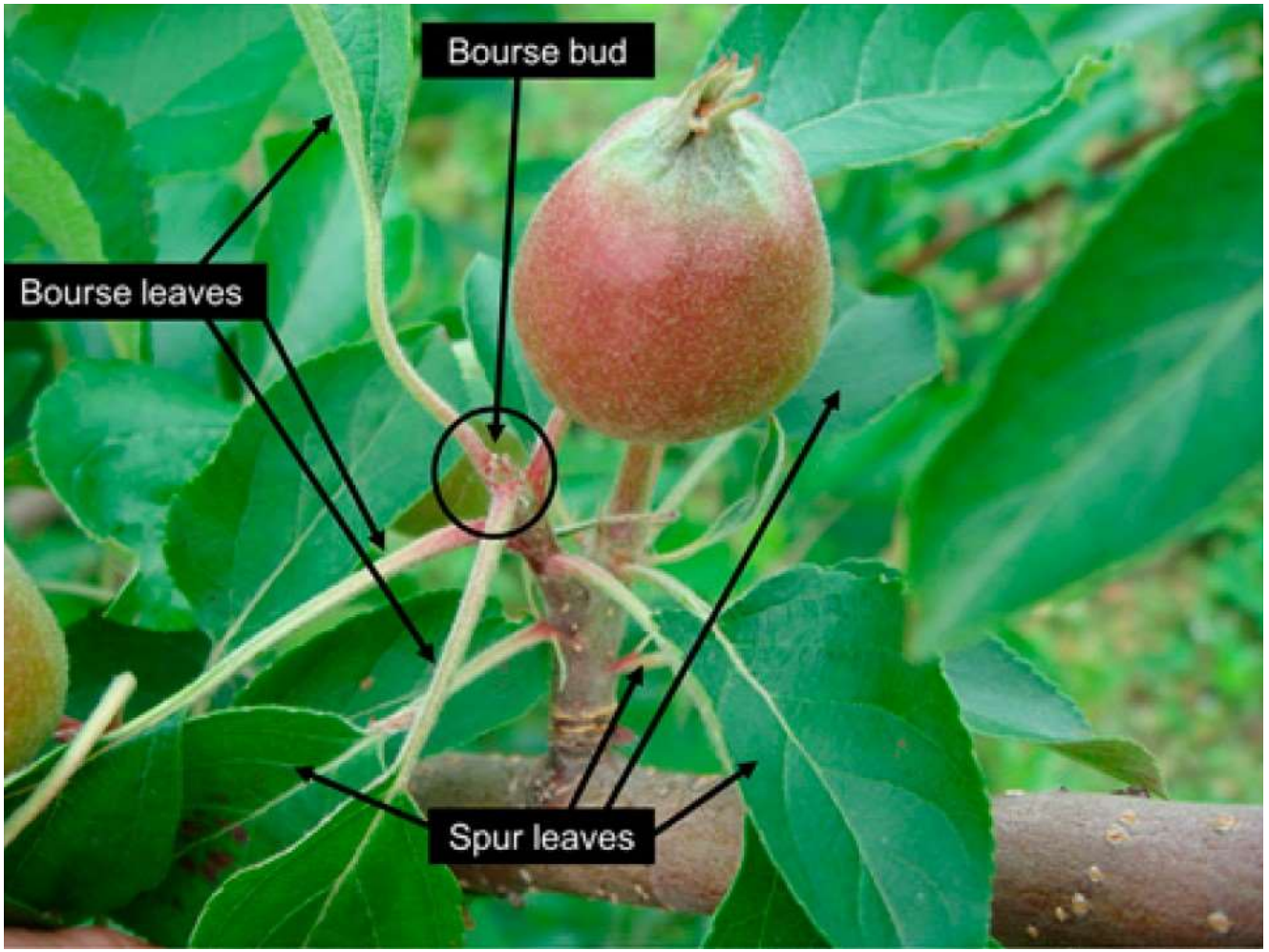
APOGEE



PHYSIOLOGY OF FLOWERING

Over cropping → Reduced Flowering

Individual apple fruiting spur

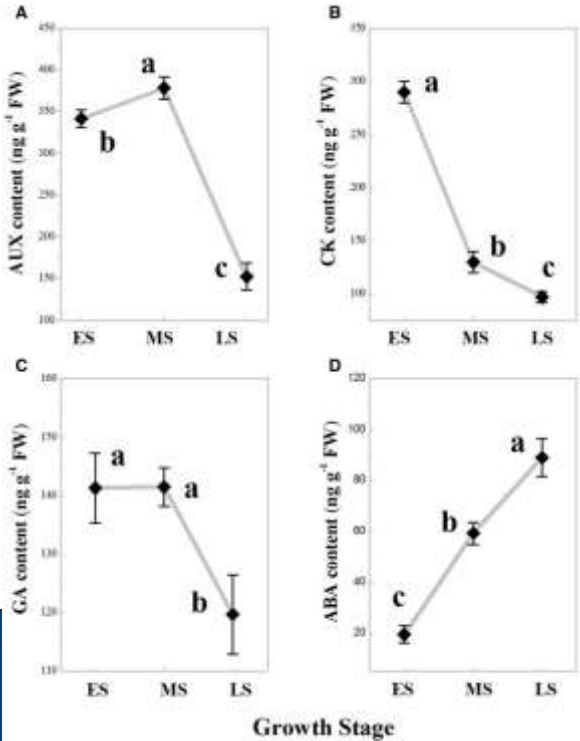


From Elsysy & Hirst HortScience 52:1229

Hormone level changes influencing flower formation

A Recent Study Found:

- Auxin content increased then decreased
- Cytokinin decreased thru season
- Gibberellin level then decreased
- Abscisic acid increased thru out season



Xing et al. 2015 Plant Cell Physiol 56:2052

Role of Spur Leaves, Bourse Leaves and Fruit on Flowering

- Honeycrisp vs. Gala
  - Biennial vs. Annual cropping
- Seeds vs. Leaves
  - Seeds as a source of GA's
  - Leaves provide flower promoting compounds
- Bourse shoot leaves (BL) vs. Spur leaves (SL)
  - BL are essential for flower formation
  - SL are not need for flower formation
- Whole tree effect
  - Overcome local inhibiting effects

Elsysy & Hirst HortSci 53:1229

Tips to Influence Flowering

- Prohexadione calcium to reduce growth
  - Apogee / Kudos
  - Better light
- NAA products
- Ethephon products

} For Growth Reduction

- Gibberellic Acid
  - To reduce flowering
  - ProGibb LV Plus
  - Stone fruits

} For Growth Enhancement

Enhancing Return Bloom

- Apply multiple sprays 7-10 days apart when fruit diameter is >30mm
- Materials
  - NAA
    - Fruitone L, Fruitone N, Pomaxa, Refine 3.5WSG
    - 5 ppm x 3 applications
  - Ethephon
    - Ethephon 2, Ethrel, Motivate
    - 8 oz/A
    - 2-3 applications

Increasing flower formation

- Ethephon
  - stronger material
  - avoid early ripening cultivars (≤ McIntosh)
  - non-being young trees can use a higher rate
  - do not apply during high temperatures >85F

Fruit Quality Physiology

Have You Seen This?

Preharvest Influences on Watercore

- Fruit maturity
  - Over mature
  - Late harvest
  - Cool growing season
- Calcium levels in fruit
- Exposure to high fruit temperature
- Light crop load

Watercore

Physiological disorder where cell walls break down and cell contents ‘leak’ into intercellular spaces

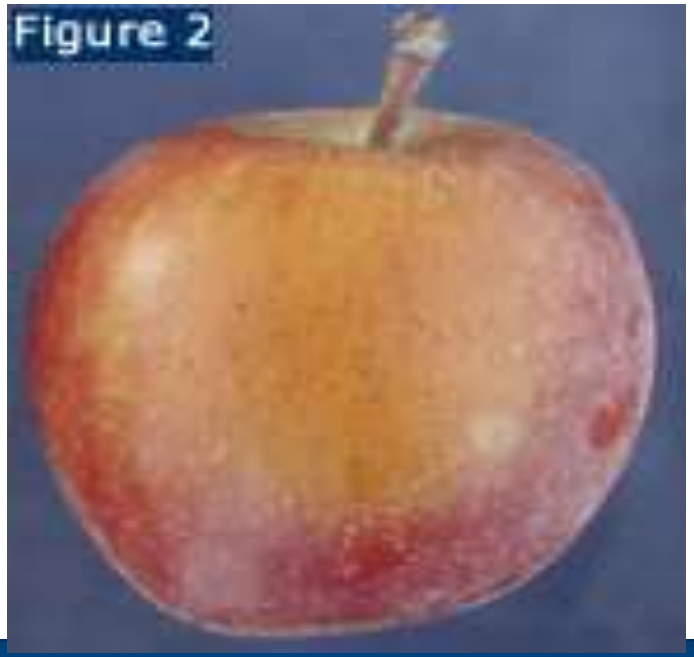
High Temperature

Over Maturity

Types of Sunburn Damage

- Sunburn browning – most common

as yellow, brown or dark tan; due to UV-B radiation and high temperature



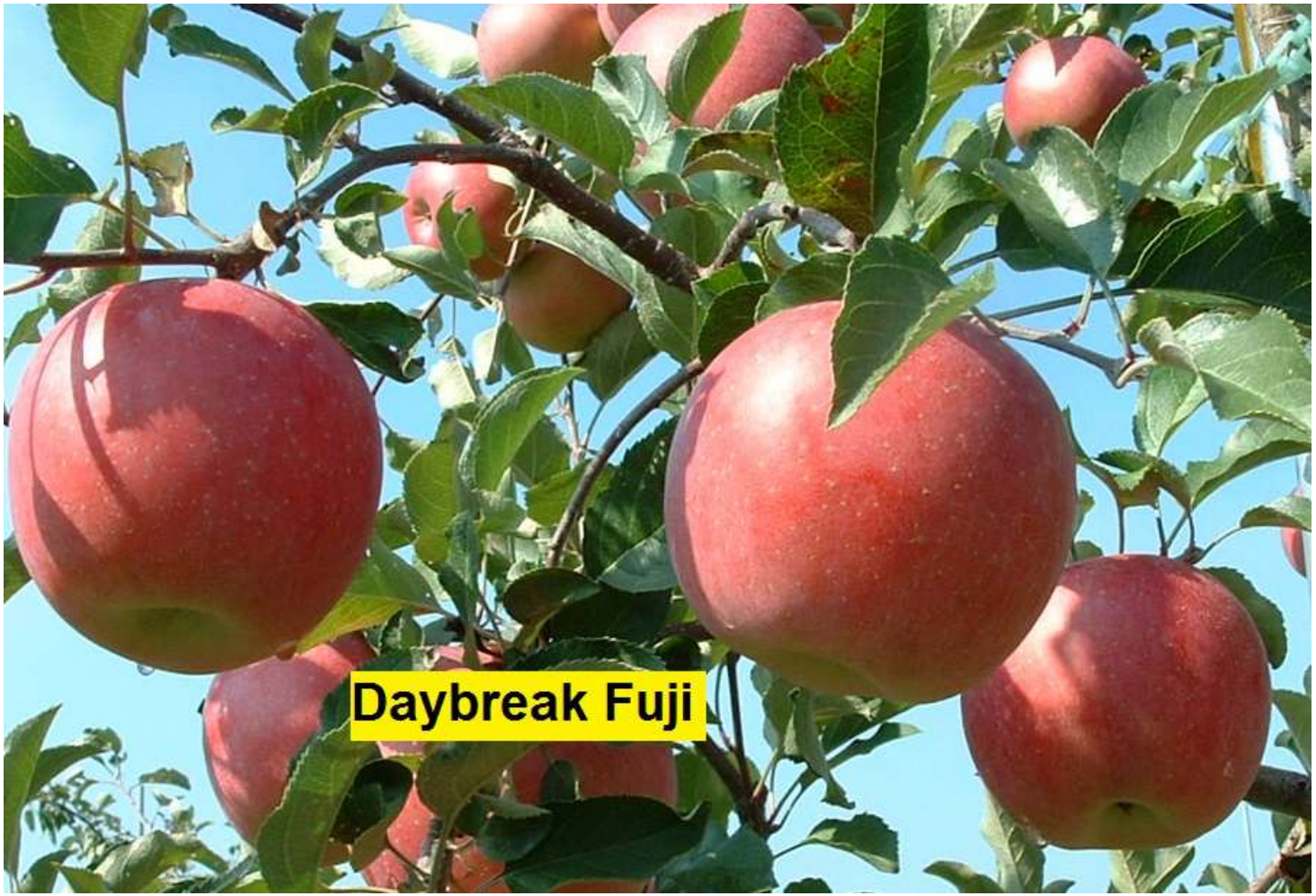
Types of Sunburn Damage

- Photo-oxidative sunburn – due to sudden exposure to sunlight after growing in the shade; due to limb repositioning, NOT due to UV-B or high temperatures; can also occur on fruit at top of bins.

To Reduce Sunburn

- Kaolin based sprays (Surround)
- *Pureshade*® (calcium carbonate)
- Raynox Plus®
- Shade netting
- Evaporative cooling

Fruit Color Development



Apple Skin Color Depends on Blends of Pigments

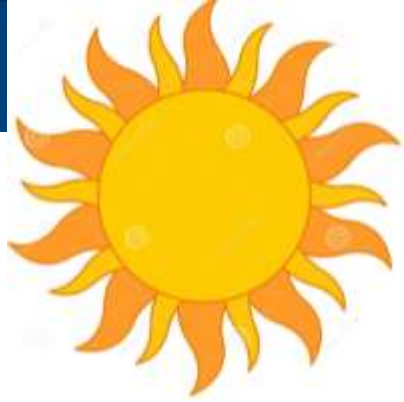
- Chlorophyll: in chloroplasts - green
- Carotenoids: in chloroplasts and chromoplasts - yellow, orange
- Anthocyanins: in vacuoles - red, purple, blue

As Apples Ripen

- Chlorophyll is degraded and carotenoids increase in chloroplasts
- Anthocyanins increase up to 5-fold

- Under non-conducive conditions for anthocyanin development, anthocyanin may be destroyed and precursors shunted to other pathways
- Chlorophyll may not degrade as rapidly

Light



- Triggers genes involved in anthocyanin accumulation
- Sugars needed to convert precursors to anthocyanin
- Depends on stage of development - Mature ‘McIntosh’ require longer exposure than early harvest
- Critical level depends on cultivar and stage of development
- Blue-violet and UV wavelengths are most important to color development

Can Fruit Lose Color?

- Not Really
- Environment and Light Trigger;
  - Increase in chlorophyll production
  - Reduced production of anthocyanins
  - Increased respiration leads to lower production

Other Factors

Orchard Nutrition

- Late-season high N inhibits anthocyanin accumulation , also increases shade
- High N causes precursors of anthocyanin to be converted to proteins rather than phenylalanine
- Deficient K inhibits anthocyanin accumulation, applications may partially compensate for high N
- Effect of other elements are inconsistent

High Leaf Nitrogen = Poor color


1.5%

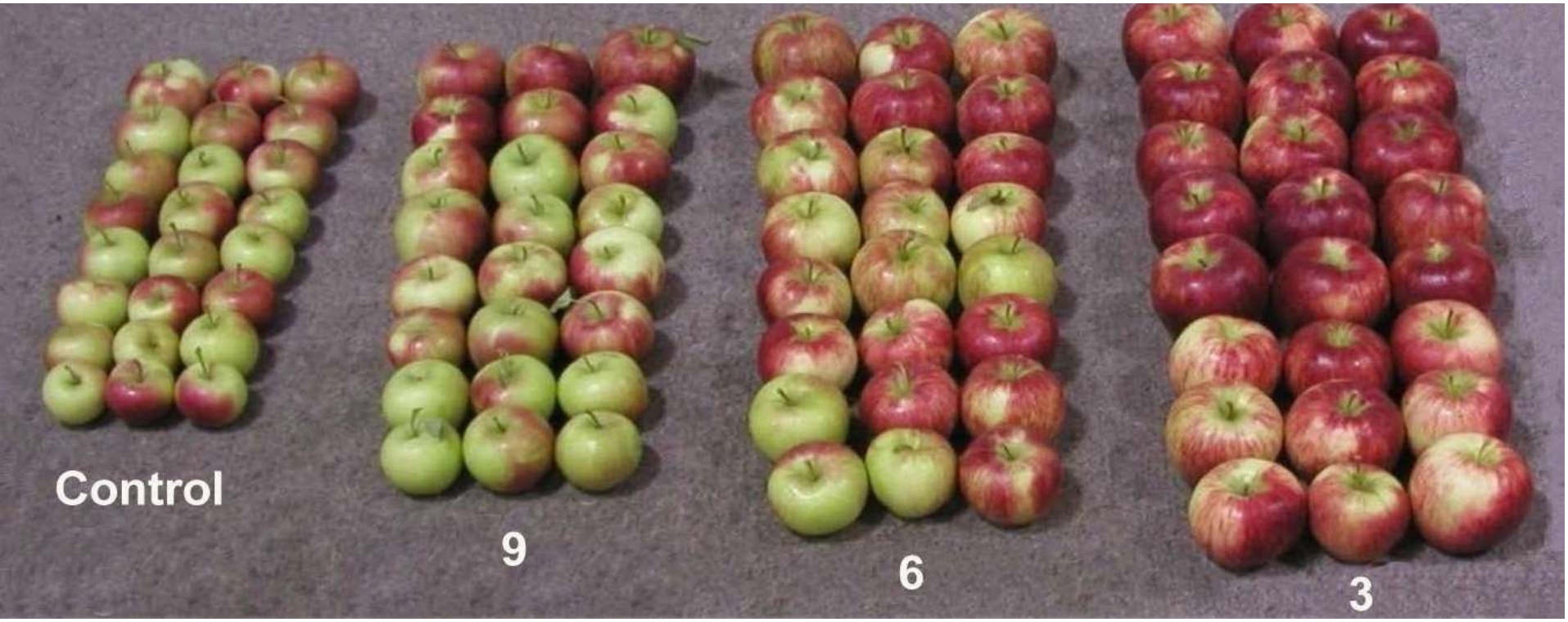

2.4%


2.6%


3.0%

Lailiang Cheng

Crop Load – Watkins, Cornell Univ.



Fruit/ cm trunk cross sectional area

Other Factors

- Water stressed trees develop poor color due to low sugars, high temperatures
- Wounding **increases** color due to ethylene
- Detached fruit color better than on tree
- Some evidence that fruit on dwarf rootstocks color better but it is not totally due to light

Enhancing Light

- Summer prune about 2 weeks before harvest
- Reflective mulch

Altering Physiology of Fruit Drop

MCP

- SmartFresh or Harvista
- Inhibits ethylene action
- Binds irreversibly to ethylene receptors making fruit unable to respond to ethylene
- May also
  - delay red color,
  - starch degradation,
  - delay watercore development

SmartFresh

ReTain

- AVG (aminoethoxyvinylglycine)
- "look-alike" for precursor to ethylene and binds irreversibly with that precursor & prevents production of ethylene
- Natural ripening process is slowed including:
  - stem loosening
  - fruit softening
  - starch disappearance
  - red color formation

Questions are guaranteed in life; Answers aren't.