Cascade Consulting and Research, LLC

California Cherry Pollination Presentation 2015

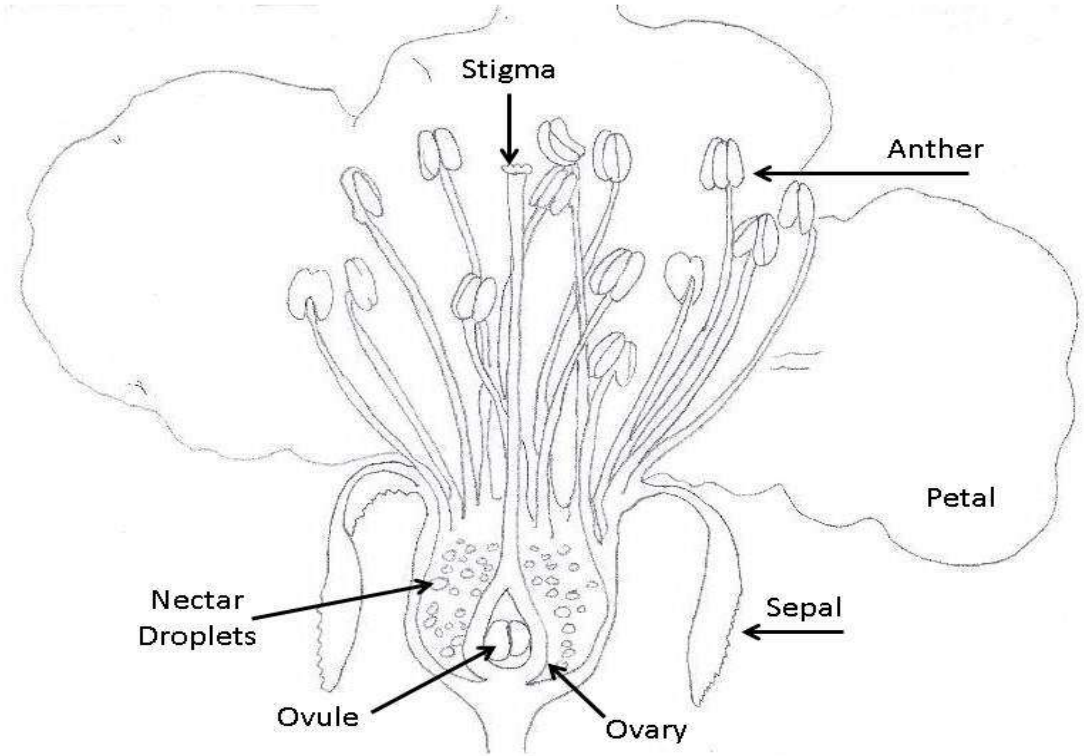
Cherry Pollination

- Pollination is a *Process*, not an *Event*
  - Turns a flower into a fruit
    - Transfer of pollen from an anther to a stigma
      - Stigma can be in the same flower or in a different flower
    - Pollen grain hydrates and germinates
    - Pollen tube grows down through the style
    - Pollen tube reaches the ovule
    - Fertilization of the egg cells in the ovary occurs





Cherry Pollination



Cherry Pollination

- Sweet Cherries Can Be:
  - Self-Sterile
    - Require cross-pollination from another compatible variety
  - Intra-Sterile
    - Have the same s-alleles as each other
  - Self Fertile
    - Are also universal pollen donors

Self-Sterile (Require Cross-Pollination)
Bing, Brooks, Tulare, Van, Early Robin, Regina, Cristalina, Coral Champagne, Attika, Rainier, Royal Rainier, Garnet, Chelan, Tieton
Self-Fertile (Also Universal Pollen Donors)
Lapins, Sweetheart, Index, Benton, Santina, Selah, Skeena, Sonata, Staccato





Cherry Pollination

- Pollinizer Selection
  - Purpose
    - Pollinate main variety or generate additional income?
    - Answer can influence rootstock and training system
  - Bloom Timing
    - Overlap with main variety?
      - Cherry flowers that have not been treated with ReTain® are normally receptive to pollen for only 12 – 48 hours after opening.
  - Pollen Compatibility
    - 22 different compatibility groups, plus universal donor group





Cherry Pollination

- Pollinizer Compatibility
  - Pollination genetically controlled by single gene with alternative forms (alleles) designated S_1, S_2, S_3, S_4, etc.
  - Each variety has 2 alleles
    - Each pollen grain will carry only one of the alleles
    - Pistil will have both alleles
    - If the allele in the pollen is the same as either allele in the pistil, the pollen is rejected.
  - Compatibility Groups
    - Varieties grouped according to their 2 alleles
    - Varieties in the same group will not cross-pollinate
      - Except for the Universal Donor Group (Group O)

Cherry Pollination

- Pollinizer Compatibility

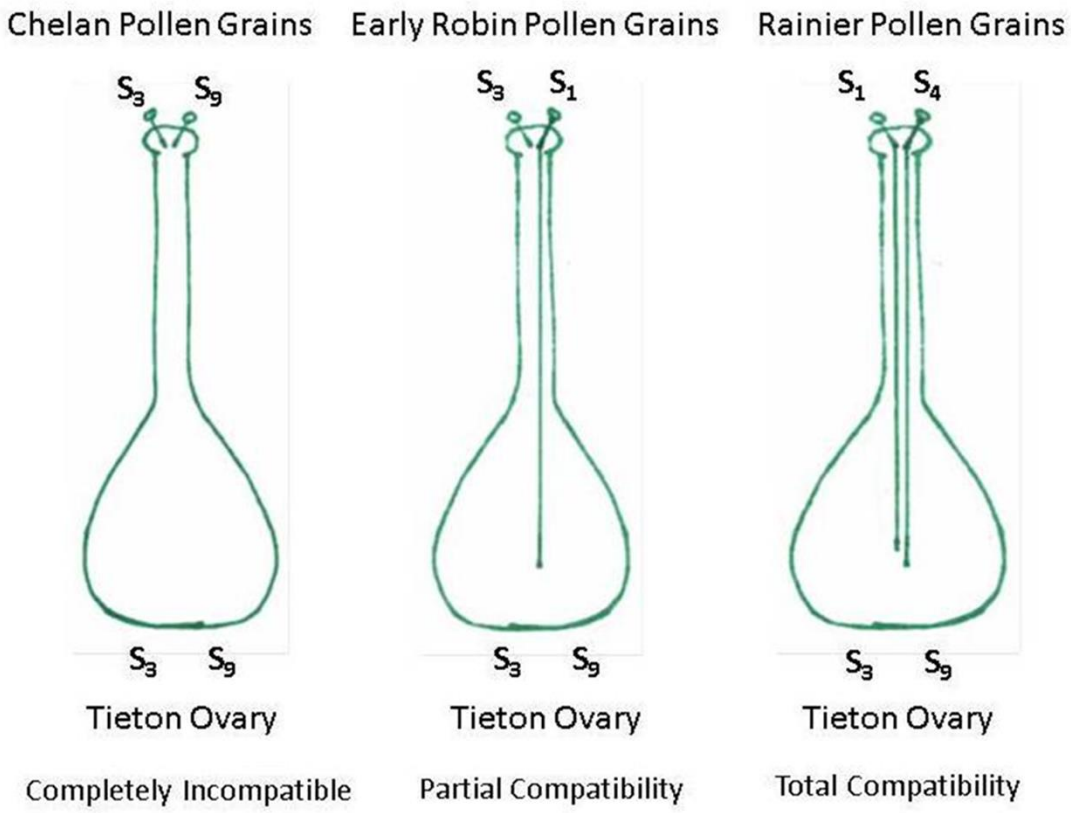
Allele Group	Varieties
Group 1 (S_1, S_2)	Tulare, Summit
Group 2 (S_1, S_3)	Van, Early Robin, Regina, Cristalina
Group 3 (S_3, S_4)	Bing, Lambert, Royal Anne
Group 6 (S_3, S_6)	Attika (Kordia)
Group 9 (S_1, S_4)	Black Republican, Rainier, Royal Rainier, Garnet, Chinook
Group 16 (S_3, S_9)	Chelan, Tieton, Burlat
Group 18 (S_1, S_9)	Brooks
Group O (with S_4') (Universal Donors)	Lapins, Sweetheart, Index, Benton, Santina, Skeena, Stella, Selah, Sonata, Staccato





Cherry Pollination

- Pollinizer Compatibility



Cherry Pollination

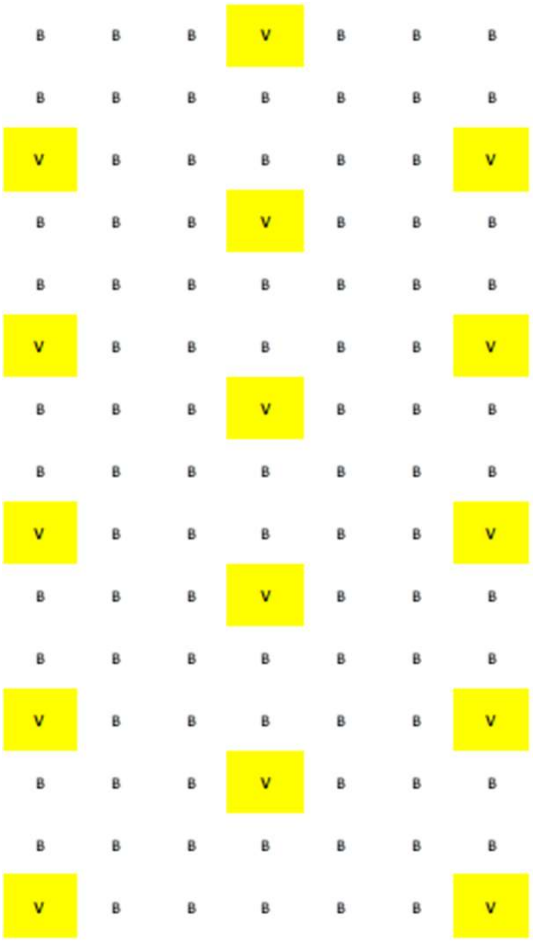
- Pollinizer Placement
  - Minimum of 10% pollinizers
    - Optimum every other tree in every row, but not practical
  - Honeybee Flight Patterns
    - ~82% of bee flight is up and down the row
      - Up to 98% in high-density plantings
  - Every 3rd Tree in Every 3rd Row
    - Common in older square or diamond plantings
    - No tree is farther than 2 trees away from a pollinizer
  - High Density Plantings
    - Every 10th tree in every row on a diamond
    - Solid rows if pollinizer is a commercial variety
    - Every other tree in every other row





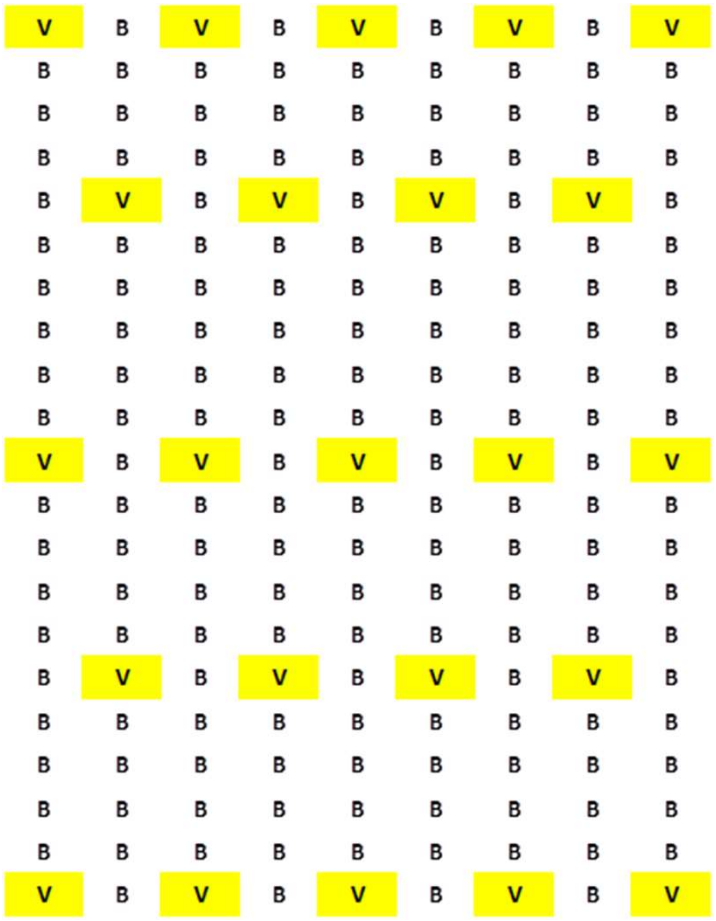
Cherry Pollination

- Pollinizer Placement
  - Every 3rd tree in every 3rd row; diamond pattern
  - No tree more than 2 trees away from pollinizer
  - Pollinizer trees should be distinct and/or marked to avoid confusion by harvest crew.



Cherry Pollination

- Pollinizer Placement
  - Every 10th tree in every row; diamond pattern
  - More trees between pollinizers down the row (5), but similar distance with tighter planting
  - Trees should be within 100 feet of a pollinizer
  - Pollinizer trees should be distinct and/or marked





Cherry Pollination

- Pollinizer Placement
  - Every other tree in every other row
  - Maximum cross pollination – every tree is adjacent to a pollinizer.
  - 25% Pollinizers is not economically practical unless the pollinizer is being grown as a second commercial variety.
  - Great for pollination, but a management nightmare. This pattern is NOT recommended

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Cherry Pollination

- Pollinizer Placement
  - Solid Rows
  - 25% Pollinizers
  - Pollinizer is also being grown as a commercial variety
  - Middle row of the 3-row set has lighter crop load than outer 2 rows

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Cherry Pollination

- Pollinizer Placement
  - Existing blocks with inadequate pollinizer density
    - Pollinizer grafts
      - Can graft at any density desired, even into every tree
      - Need to be managed as pollinizers
        - Easily distinguishable from main variety by picking & pruning crews
    - Bouquets
      - Cut from pollinizer varieties managed for bouquets (no dormant pruning)
      - Can be placed near hives and/or strategic locations down the row
      - Treated with *ReTain* for longer flower life
      - Maintain adequate water levels in drums to prevent desiccation





Cherry Pollination

- Pollinators
  - Cherries require insect pollination
  - Feral bees, bumblebees, mason bees, other insects generally inadequate
    - Insufficient numbers in early spring when cherries bloom
  - Managed colonies of Honeybees
    - Most important pollinator of cherries
    - Can be placed how, when, and where needed

Cherry Pollination

- Honeybee Pollination Management
  - Density
    - 2 hives / acre
    - More in high-density plantings
  - Placement
    - Elevated position in a warm, sunny area
      - Early morning sun = 50% more morning flight activity
      - Off the ground (place colonies on a bin or pallet)
      - On a knoll rather than in a frost pocket
      - Not under a tree
    - Protected from the wind
    - Groups of 4 – 12 hives at 100-yard intervals
    - Within ¼ mile of water or provide water





Cherry Pollination

- Honeybee Pollination Management

  - Timing
    - Not too early
      - Bees will go to other flowers for nectar, and stay with them
    - Not too late
      - Flowers only receptive to pollen ~ 12 – 48 hours
      - Unless treated with *ReTain*
      - Weather and variety dependent
      - Flowers are most receptive to pollination just as they open
    - ~5% Bloom





Cherry Pollination

- Honeybee Pollination Management
  - Weather Impacts on Honeybee Activity
    - Wind reduces flying speed and number of flights per day
    - Rainfall stops flight activity
      - Bees will fly between showers, but only short distances
    - Low temperatures reduce foraging

Temperature	Percent Foraging
65° F	100%
63° F	62%
54° F	21%
51° F	6%

Source: ***Dan Mayer, WSU • Bee Pollination of Tree Fruits • PNW 0282***





Cherry Pollination

- Honeybee Pollination Management
  - Competition
    - Cherry nectar has very high sugar concentrations, so cherry flowers are highly attractive to bees – BUT –
    - Once a bee starts foraging on a particular flower, they will stay with that species
      - Bees placed in orchard too early
      - Blooming cover crops / weed strips
        - Especially clovers , lavender, dandelions

Variety	Percent Sugar in Nectar
Bing	43%
Rainier	32%
Van	44%



Cherry Pollination

- Honeybee Pollination Management
  - Colony Strength
    - Regulated by Dept. of Ag or County Ag Commissioner
    - Recommend minimum 20,000 bees per 2-story hive
      - Colonies grow to 50,000 – 60,000 bees / hive by mid-summer
    - Minimum 75 bees / minute entering hive under warm (>65° F), sunny conditions
    - Field force
      - Should be able to count an average of 25 – 35 bees on a single (full size) cherry tree in 1 minute if no wind and temps >65° F
    - Overwintering colonies better than spring starts





Cherry Pollination

- Honeybee Pollination Management
  - Foraging Behavior
    - ~ 30% of the bees in a hive are foraging at any given time
      - ~6000 foragers in a 20,000 bee colony
    - Foragers collect either pollen or nectar
      - Pollen collectors are more efficient pollinators
      - About 80% of foragers in sweet cherry are pollen collectors
      - Pollen collectors average 5 flower visits per minute
      - Nectar collectors average 8 ½ flower visits per minute
    - Foragers will visit 50 – 100 flowers on 2 – 3 trees per flight
      - 1500 – 2100 flower visits per day per forager
      - Not all visits result in pollination





Cherry Pollination

- Cultural Practices Affecting Flower Quality & Pollination
  - Nutrition
    - Nitrogen
      - Bud strength, bud size, and ovule longevity
      - Post-harvest urea sprays
        - Remobilization within 3 days
    - Boron
      - Increases pollen germination, longer pollen viability, better pollen tube growth
      - Post-harvest spray (tank-mixed with the urea)
        - Provided you don't have excessive B levels naturally
    - Zinc
      - Deficiency reduces fruit set
      - Bark better storage organ than foliage
      - Dormant sprays of zinc sulfate





Cherry Pollination

- Supplemental Pollen
  - Bouquets
    - Treat with *ReTain*
  - Pollen Inserts
    - Bees walk through supplemental pollen as they exit the hive
    - Harwood-Antles Dispenser
    - Ferarri Insert
    - Bee Booster® Pollen Dispenser

Cherry Pollination

- Supplemental Pollen
  - Mechanical Pollination
    - Hand Brush – effective, but too labor intensive
    - Hand Dusters
    - Aerial Application
    - Shotgun shell
    - Airblast sprayer

    } Ineffective / Inconsistent

    - ATV Blower



Cherry Pollination

- Mechanical Pollination
  - WSU Studies
    - Collect Pollen
    - Suspend pollen in liquid
    - Apply suspension via electrostatic sprayer
      - Stigmas are positively charged

Cherry Pollination

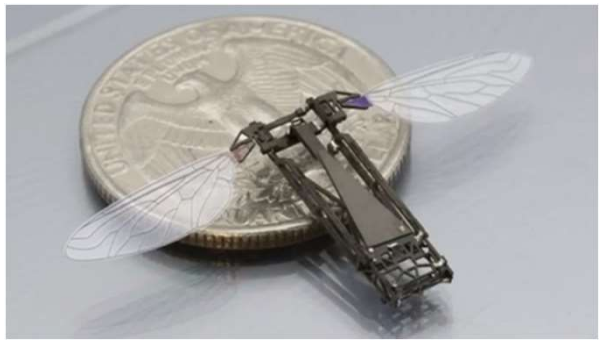
- Mechanical Pollination
  - WSU Studies
    - Challenges
      - Pollen doesn't stay viable in water very long
      - Stigmas are a very small target
    - Proof of Concept Studies
      - Tieton x Gisela 5, 8 years old, UFO training System
      - 1 application at 50% bloom (Supplemental pollination)
        - Improved Fruit Set by 15% compared to bees alone
        - Increased pollen grain deposition on stigmas
      - 2 applications at 50% & 90% bloom (Replacement pollination)
        - Sprayed through bee exclusion netting
        - Yield similar to open-pollinated trees

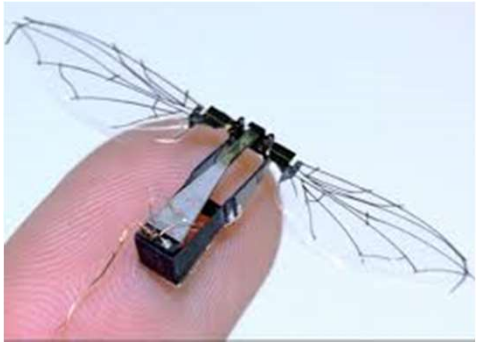


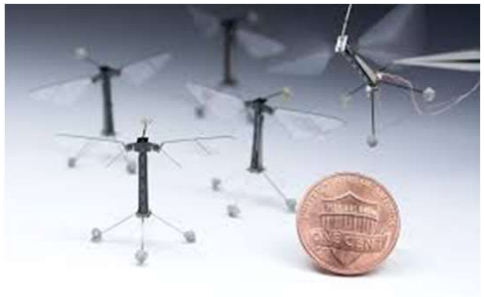


Cherry Pollination

- Mechanical Pollination
  - Robotic Bees?
    - Harvard School of Engineering and Applied Sciences







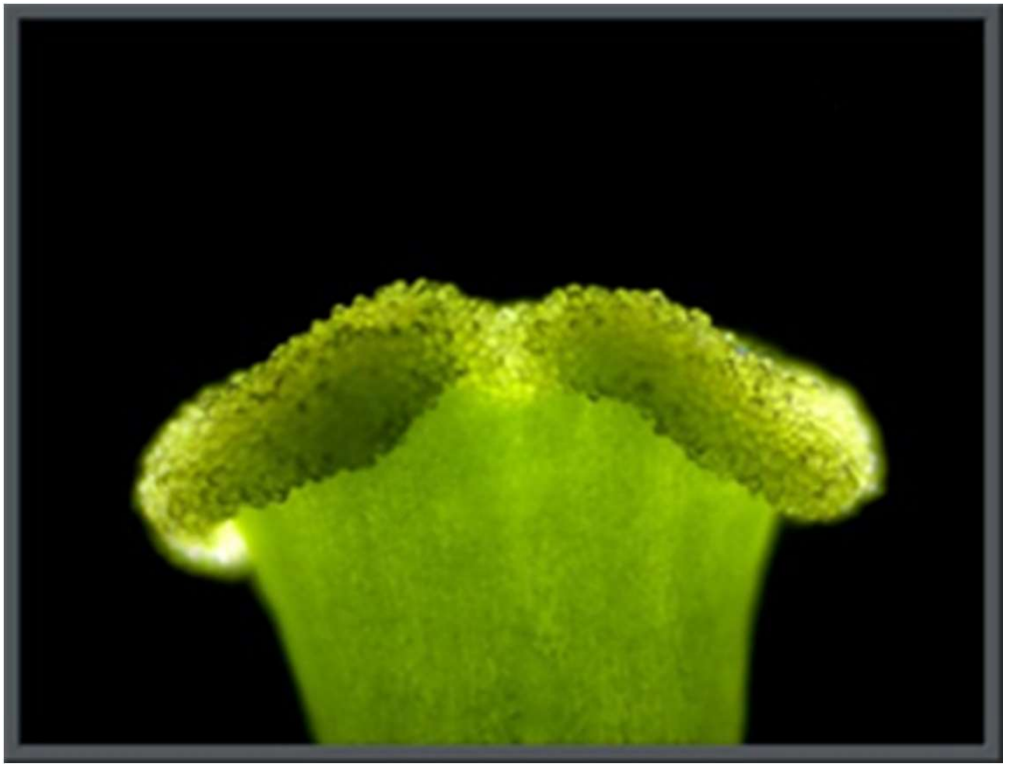
Cherry Pollination

- Bee Attractants
  - Nectar
    - Cherry flowers have very small amounts of nectar, < 1µl / flower
    - Sweet cherry nectar has high sugar concentration
  - BeeScent™
    - Pheromone that stimulates bee foraging behavior
  - Vericet
    - Blend of “plant constituents, metabolic accelerators, balanced minerals, and other factors”
    - Enhances pollen tube growth and stimulates bee activity (?)
  - Sugar
  - Boron
  - Witches Brews





Thank You



Pollen grains on a cherry anther (left) and receptive cherry stigma (right) photos by Brian Johnston, used with permission