Developing and Optimizing Sweet Cherry Training Systems for Efficiency and High Quality Fruit –Part 1

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MICHIGAN STATE UNIVERSITY AgBioResearch

IFTA

Cherry Training Systems

Continuously evolving strategies to grow the best fruit, with high yields, most efficiently

Fruit tree growers have changed cherry trees from a naturally tall tree in the forest, to a moderated-sized pruned tree in the orchard, to a highly-structured fruiting wall that is easy to harvest and may allow partial mechanization

Sweet Cherry Trees in Nature

- A forest tree, tall with top vigor
- Slow to begin fruiting, 5-7 years

- The Cherry Revolution began in the 1990s with hybrid rootstocks to induce early fruiting and control tree size


Simplified canopy architectures and mechanized thinning
Photo Courtesy of Mark and Ines Hanrahan

Advantages and Drawbacks of High Density Sweet Cherry Systems

- Early bearing
- High yields
- Harvest efficiency and ease
- Tree efficiency (light and spray distribution)
- Easy to protect with covers

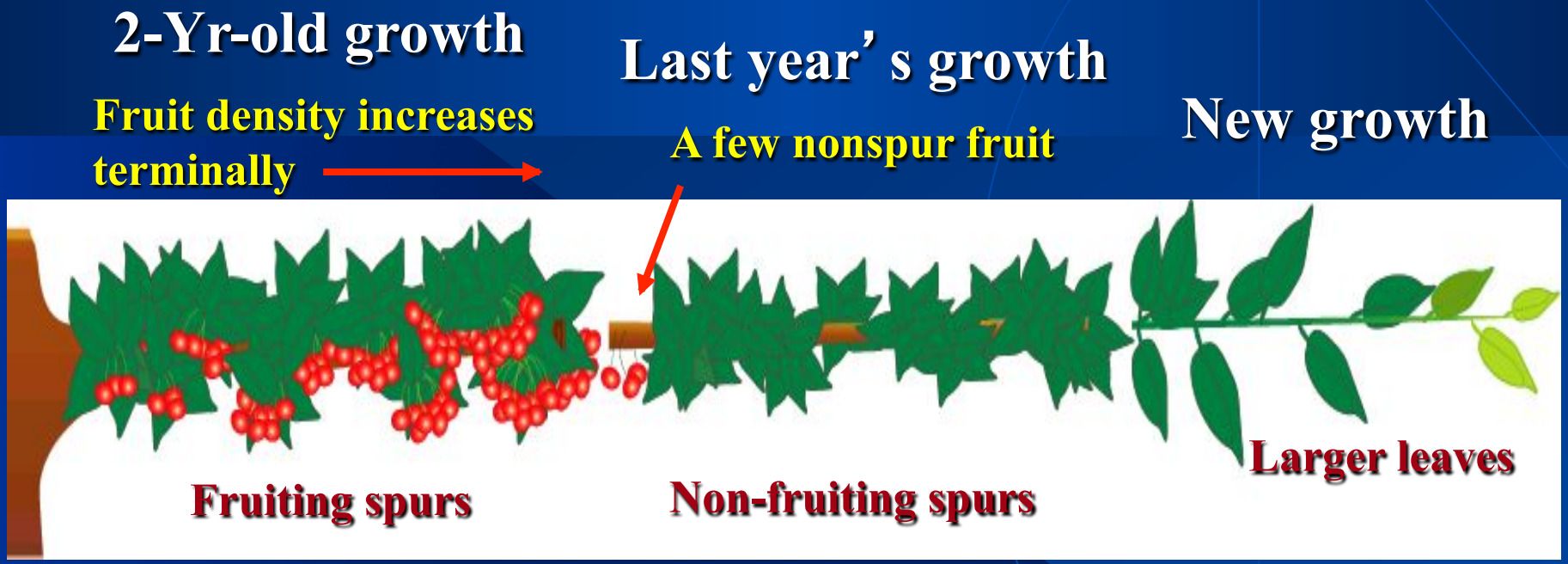
- Fruit quality?
- Early return on investment and breakeven cost?

- High establishment cost
- High level of inputs (training labor)
- High level of knowledge
- Must protect from frost since trees are smaller
- Short lifespan?

Slide by Musacchi and Lang


Narrow “Fruiting Wall” Canopies for Space Efficiency under Protective Structures
MSU High Tunnel Cherries for Early Ripening and Rain Protection

Cherry Systems Fundamentals: Growth and the Basic Fruiting Units



Understanding this basic set of leaf populations and fruiting sites is a fundamental key to all training systems

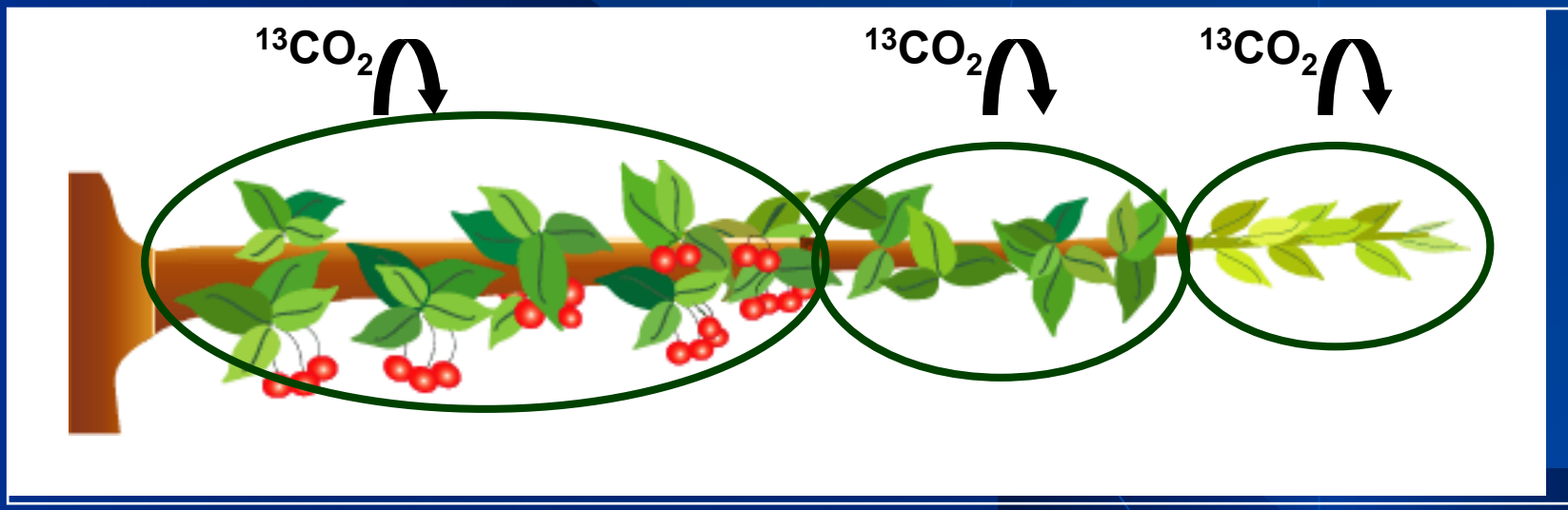
Ayala and Lang, 2004

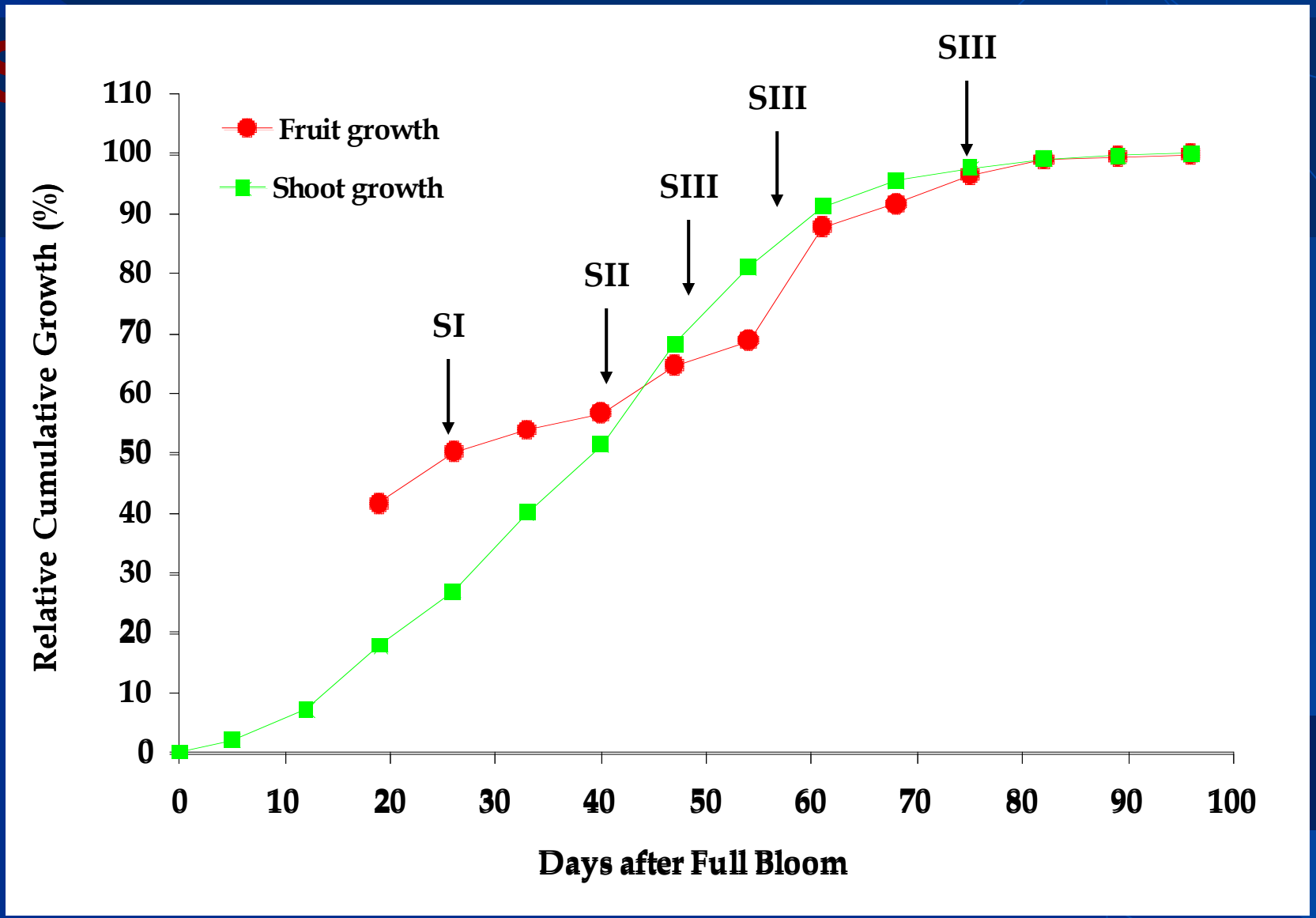
$^{13}CO_2$ Research

Marlene Ayala

Managing the Sugar Supply to Fruit

Year	2001	2002	2003
Leaf population	Fruiting spurs	Non-fruiting spurs	Current season shoot




Fruit growth
Shoot growth
SI
SII
SIII
SIII
SIII
Relative Cumulative Growth (%)
Days after Full Bloom
0
10
20
30
40
50
60
70
80
90
100
110

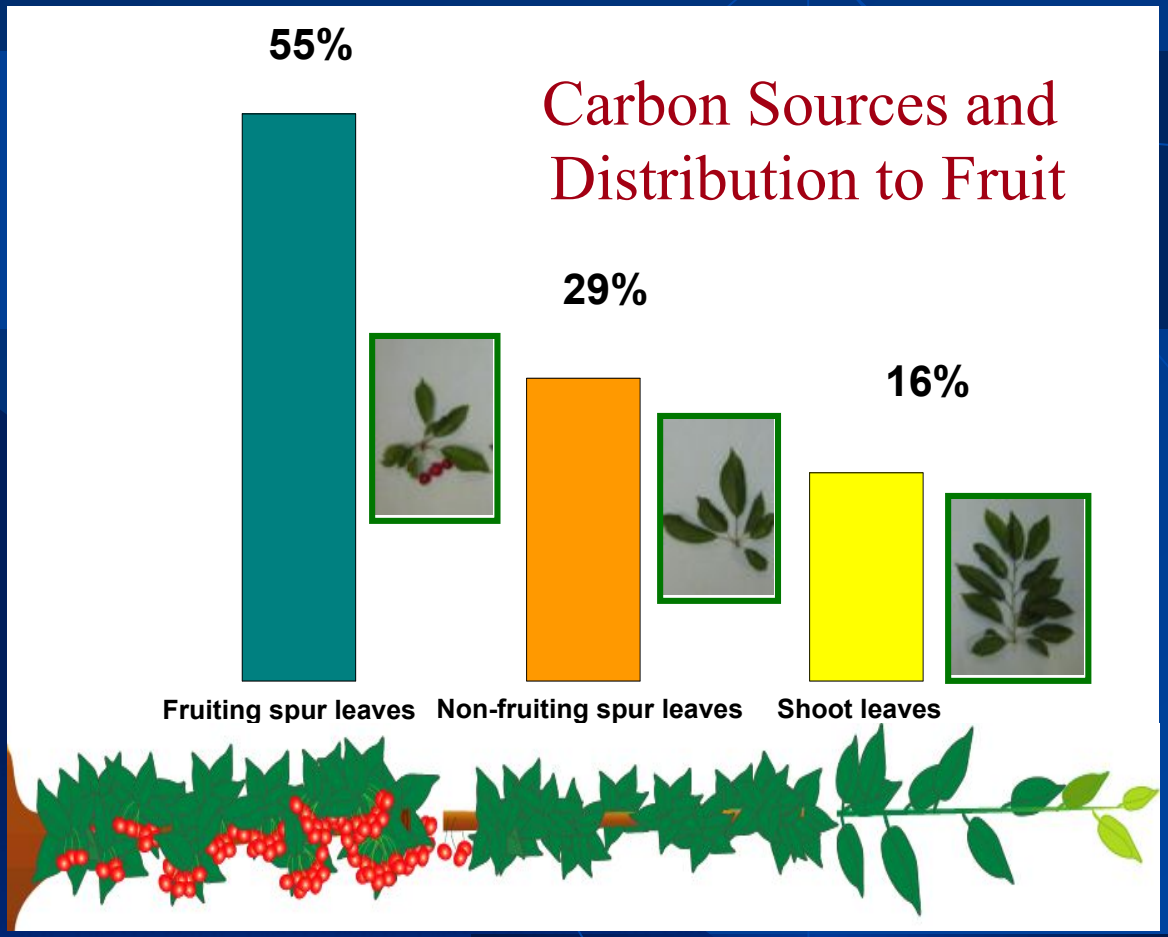
Leaf Area and Location

Beginning of Stage III
(44 days after full bloom)

Fruit : 25% final size

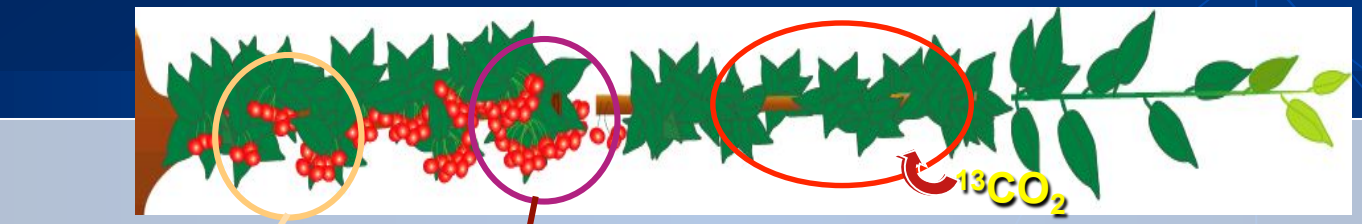
Shoot: 16 leaves

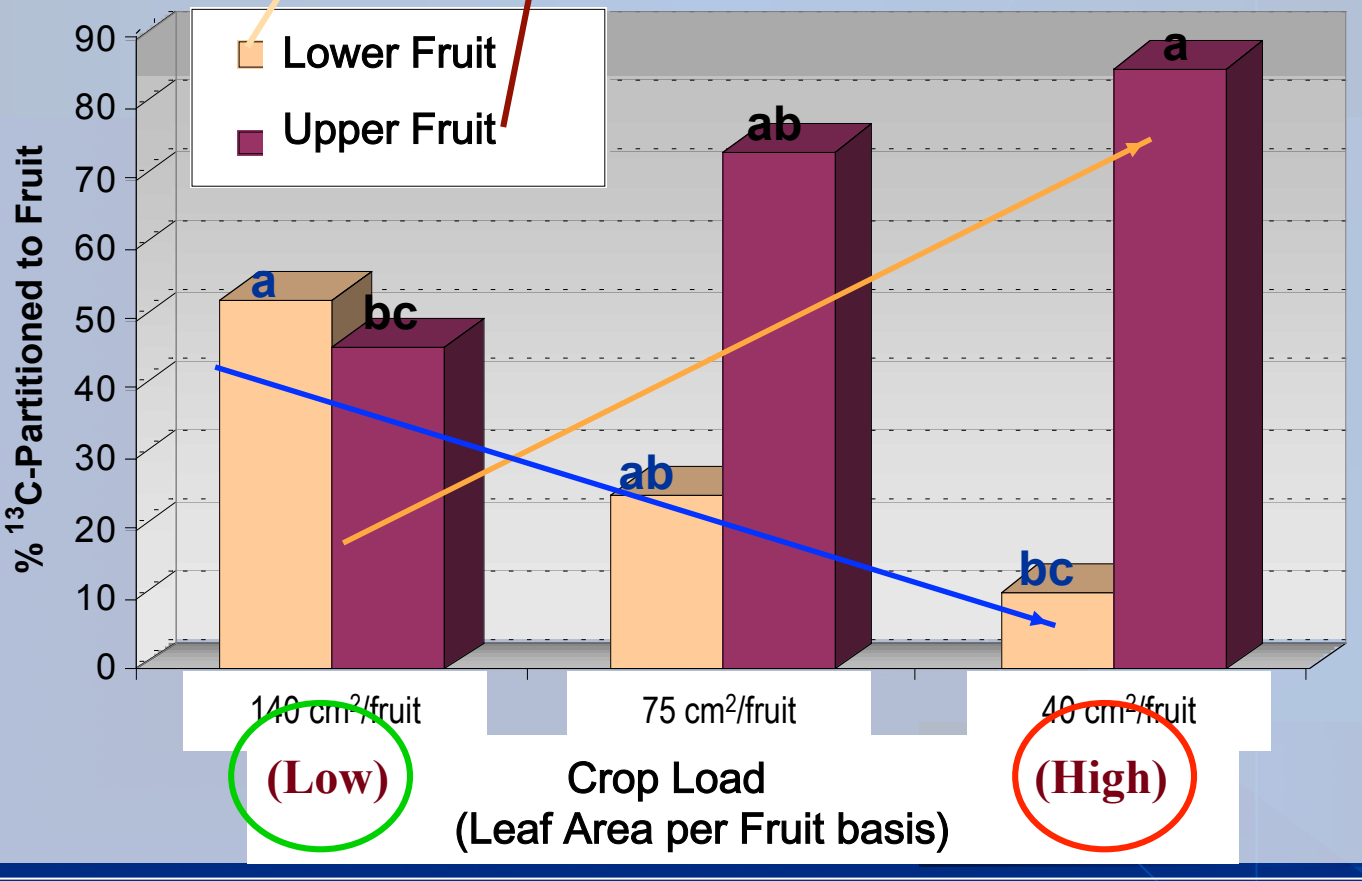
Ayala and Lang, 2004



Large leaf size, close to the fruiting clusters, is critical to achieve maximum fruit size, firmness, and sweetness

Crop Load Effects on ^{13}C Movement to Fruit





Balanced crop loads improve uniformity of quality fruit

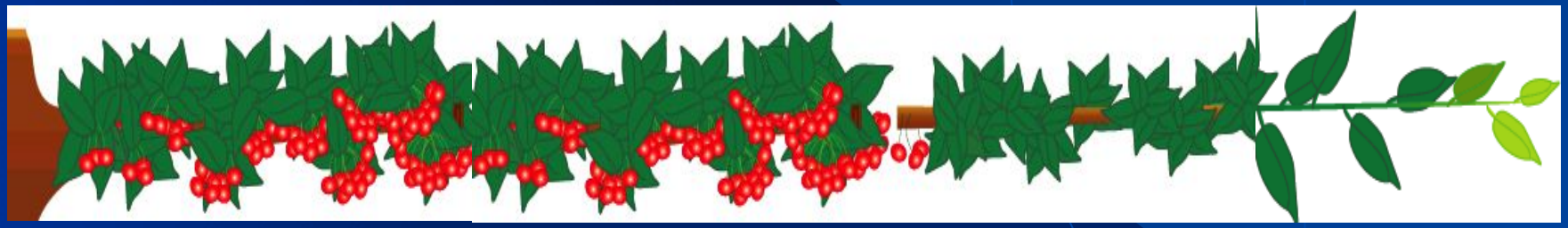
Basic Growth & Fruiting Units

Year 3:

Fruit populations: 1 spur (e.g., 75 total), 1 non-spur (e.g., 10 total)

Leaf populations: 2 spur (e.g., 120 total), 1 shoot (e.g., 10 x 2X)

Leaf-to-Fruit Ratio: 1.65



Year 4:

Fruit populations: 2 spur (e.g., 150 total), 1 non-spur (e.g., 10)

Leaf populations: 3 spur (e.g., 180 total), 1 shoot (e.g., 10 x 2X)

Leaf-to-Fruit Ratio: 1.25

Basic Growth & Fruiting Units

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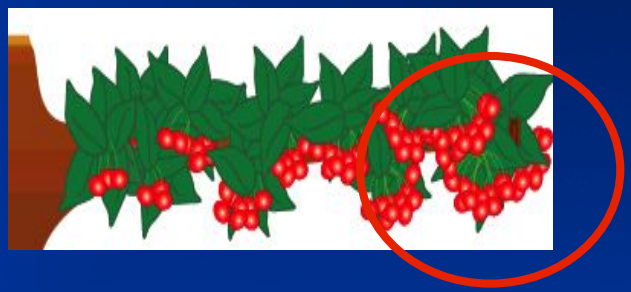

Anticipation of the future unbalanced cropping sites can help in pre-emptive management to better balance leaf-to-fruit ratios and improve performance

A dormant heading cut to remove:
15 to 30% of last year's shoot will remove
25 to 40% of the future spur density

Basic Growth & Fruiting Units

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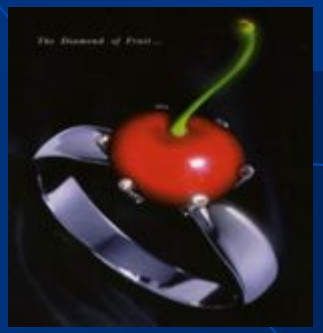
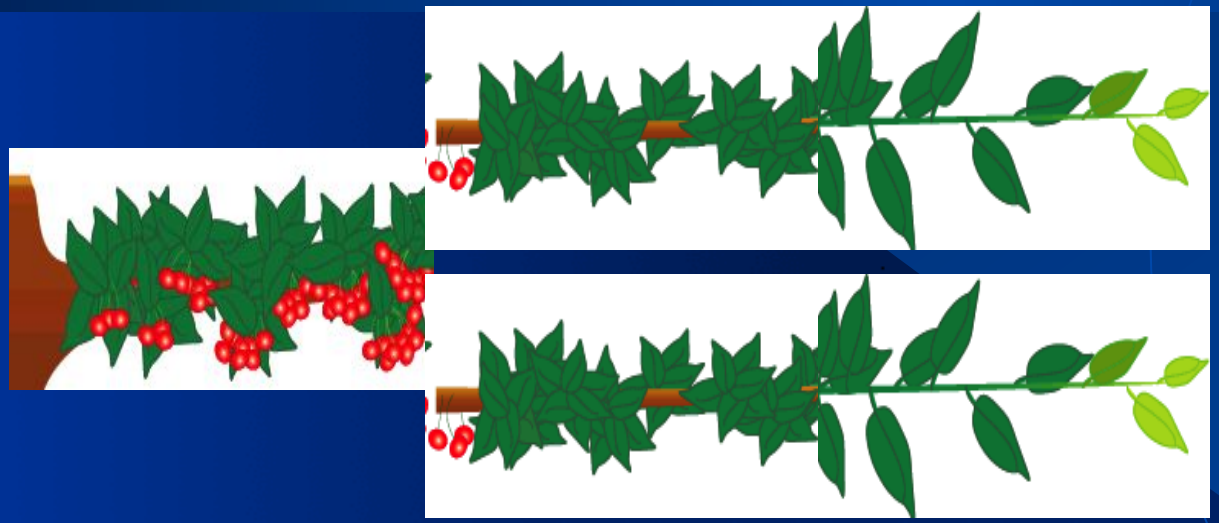




Heading cuts stimulate new shoot leaf populations and non-spur fruit populations, while reducing future spur fruit populations

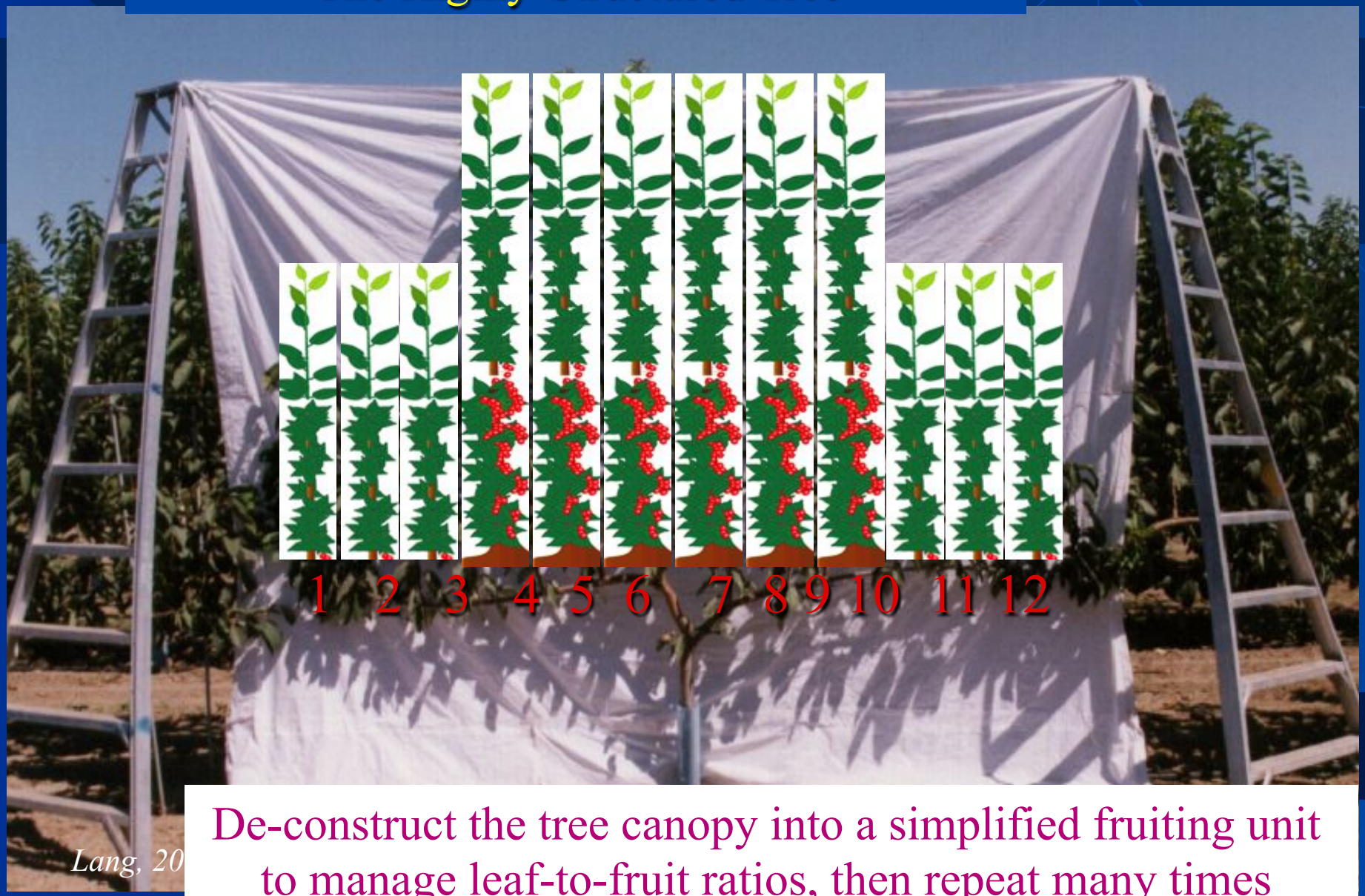
Year 3:

Fruit populations: 1 spur (e.g., 40 total), 2 non-spur (e.g., 20 total)

Leaf populations: 3 spur (e.g., 166 total), 2 shoot (e.g., 20 x 2X)

Leaf-to-Fruit Ratio: 2.75

Strategies to Optimize Precision Cropping: The Highly-Structured Tree



Lang, 20

De-construct the tree canopy into a simplified fruiting unit to manage leaf-to-fruit ratios, then repeat many times


High Performance Orchards:
Precisely-Structured Trees with
Simplified Fruiting Units
Lang 2001


2010 NC140 Sweet Cherry
Training Systems Trial Sites
(13 Planted, 9 Active in 2012)
Victoria
Seattle
Spokane
Vancouver
Portland
Oregon
Boise
Idaho
Twin Falls
Reno
Salt Lake City
Provo
Utah
Nevada
Cheyenne
Wyoming
Boulder
Denver
Colorado
San Francisco
Oakland
Las Vegas
California
Los Angeles
San Diego
Phoenix
Tucson
Mexicali
Santa Fe
New Mexico
Albuquerque
Arizona
Oklahoma City
Oklahoma
Dallas
Texas
Austin
San Antonio
Houston
Hermosillo
Chihuahua
MEXICO
Tropic of Cancer
La Paz
Culiacan
Monterrey
Durango
Ciudad Victoria
Zacatecas
San Luis Potosi
Tepic
Leon
Guadalajara
Queretaro
Merida
Edmonton
Red Deer
Calgary
Swift Current
Prince Albert
Saskatoon
Regina
Brandon
Winnipeg
L. Winnipeg
Flin Flon
Thompson
Williston
Grand Forks
North Dakota
Minnesota
Duluth
Helena
Montana
Butte
Bismarck
Missouri
South Dakota
Minneapolis
St. Paul
Wisconsin
Iowa
Scottsbluff
Nebraska
Omaha
Kansas City
Kansas
St. Louis
Missouri
U. S. A.
Chicago
Milwaukee
Lake Michigan
Lake Superior
Lake Huron
Lake Erie
Lake Ontario
Detroit
Michigan
Toronto
Buffalo
Cleveland
Pittsburgh
Pennsylvania
Indianapolis
Illinois
Indiana
Dayton
Ohio
Cincinnati
Louisville
Kentucky
Nashville
Tennessee
Memphis
Little Rock
Arkansas
Birmingham
Alabama
Mississippi
Jackson
Baton Rouge
Louisiana
New Orleans
Atlanta
Georgia
Tallahassee
Florida
Jacksonville
Orlando
Charlotte
North Carolina
Columbia
South Carolina
Richmond
Virginia
West Virginia
Norfolk
Washington D. C.
Baltimore
Philadelphia
New York
Boston
Massachusetts
Providence
Concord
New Hampshire
Augusta
Maine
Montreal
Ottawa
Quebec
Timmins
Amos
Moosonee
Ontario
Quebec
Labrador City
St. John's
Halifax
Nova Scotia
Fredericton
New Brunswick
Prince Edward Island
Charlottetown
Rio Grande
ATLANTIC
OCEAN


Fruiting Wall Cherries
- A narrow canopy improves light penetration & distribution, producing fruit with higher sugar, color, firmness, and uniformity
- improved spray coverage with reduced volume and drift

Harvest Labor and Productivity

Orchard Type	Picking Efficiency[1] (min/Tree)	Trees per Acre	Pickers Hours per Acre	Pickers Required per Season[2]
Traditional	52.80	136	119.68	124.69
Pedestrian	21.93	272	99.42	103.58
Mechanical	0.30	390	1.95	2.03

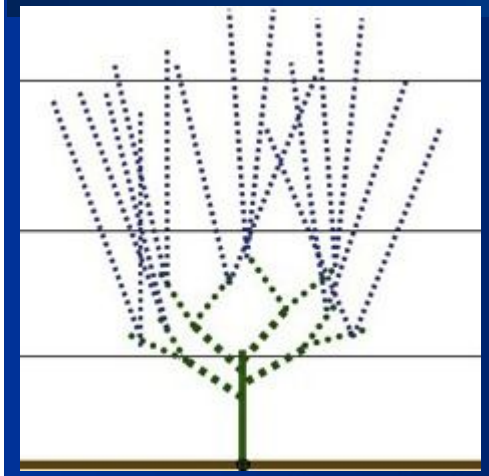
[1]Based on Assumed Yields

[2]Based on an 8-hr day for hand harvest and 16-hr day for machine; 33.34 acres to harvest in 4 days


California NC140
Cherry Systems Trial
Photo courtesy of Joe Grant

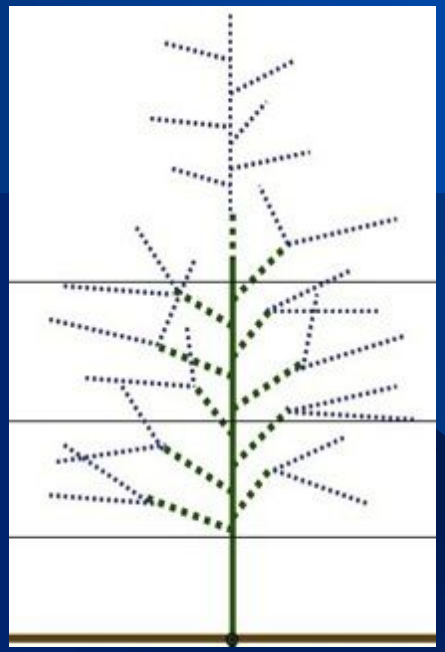
2010 NC140 Sweet Cherry Training Systems

KGB



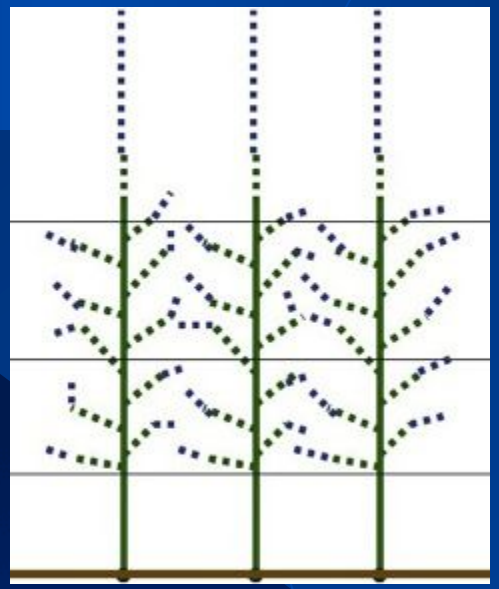
Kym Green Bush

TSA



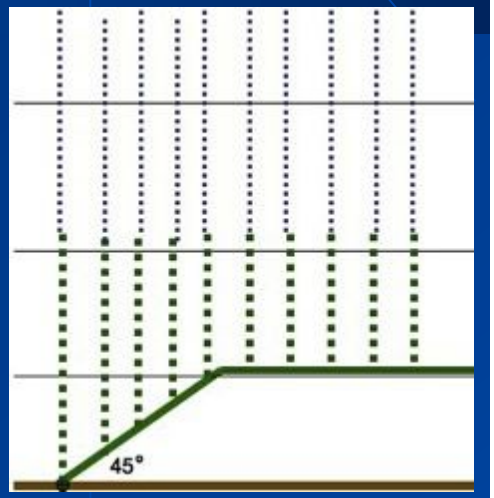
Tall Spindle Axe

SSA



Super Slender Axe

UFO



Upright Fruiting Offshoots

All have minimal permanent wood (solid green line) and simplified strategies for fruit wood renewal

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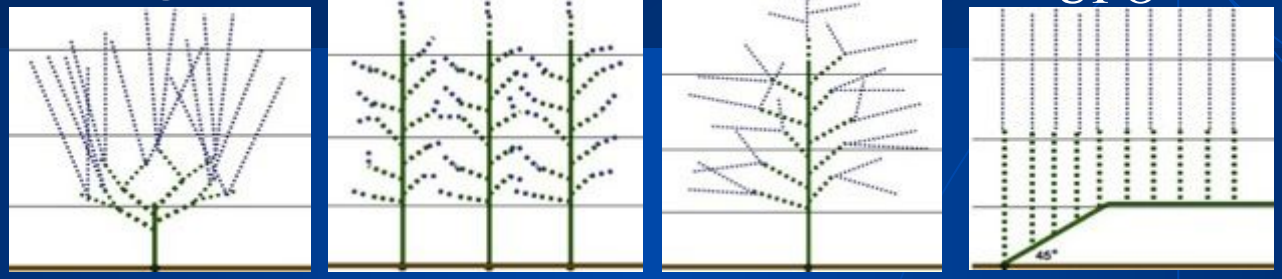
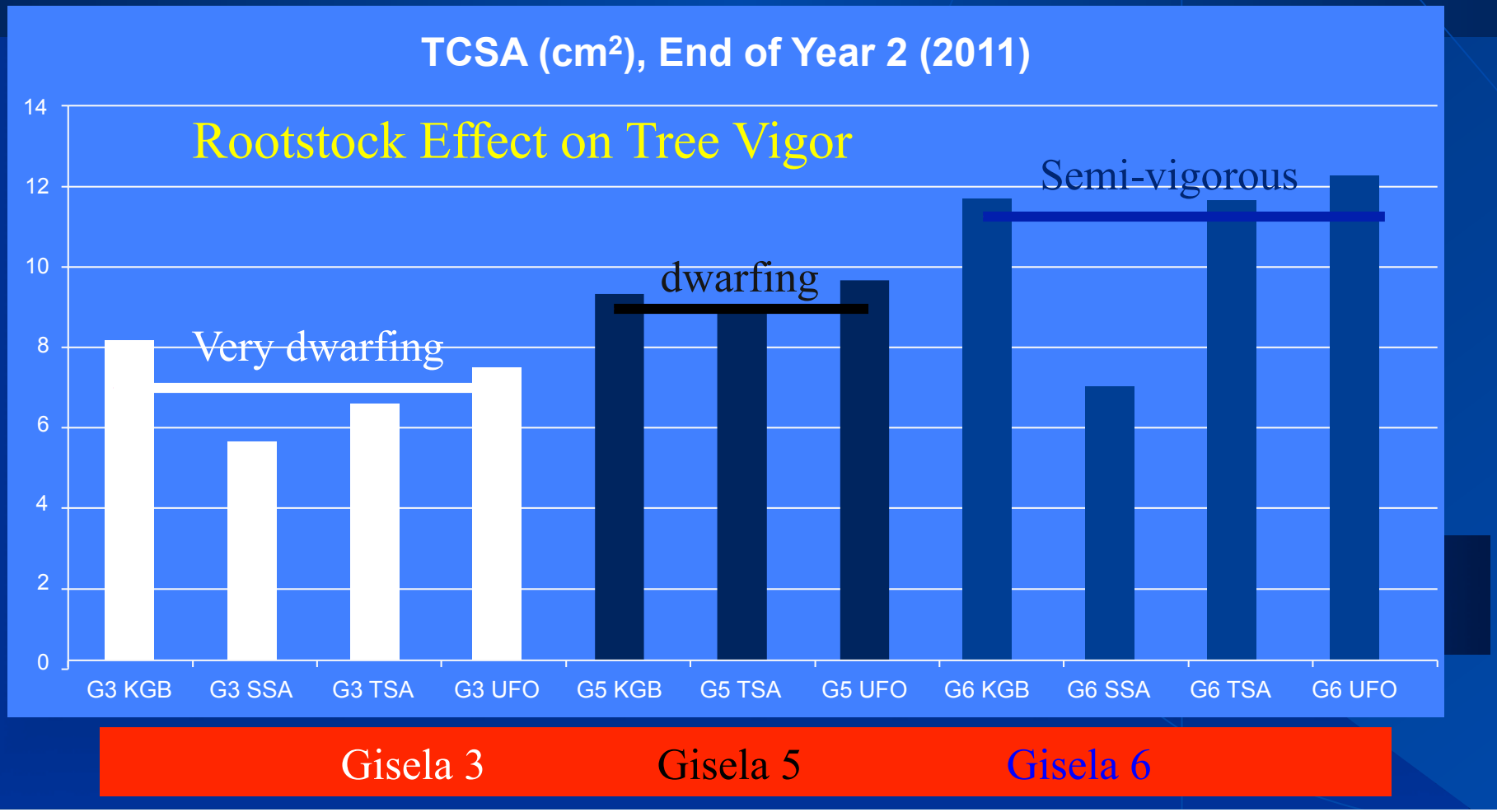
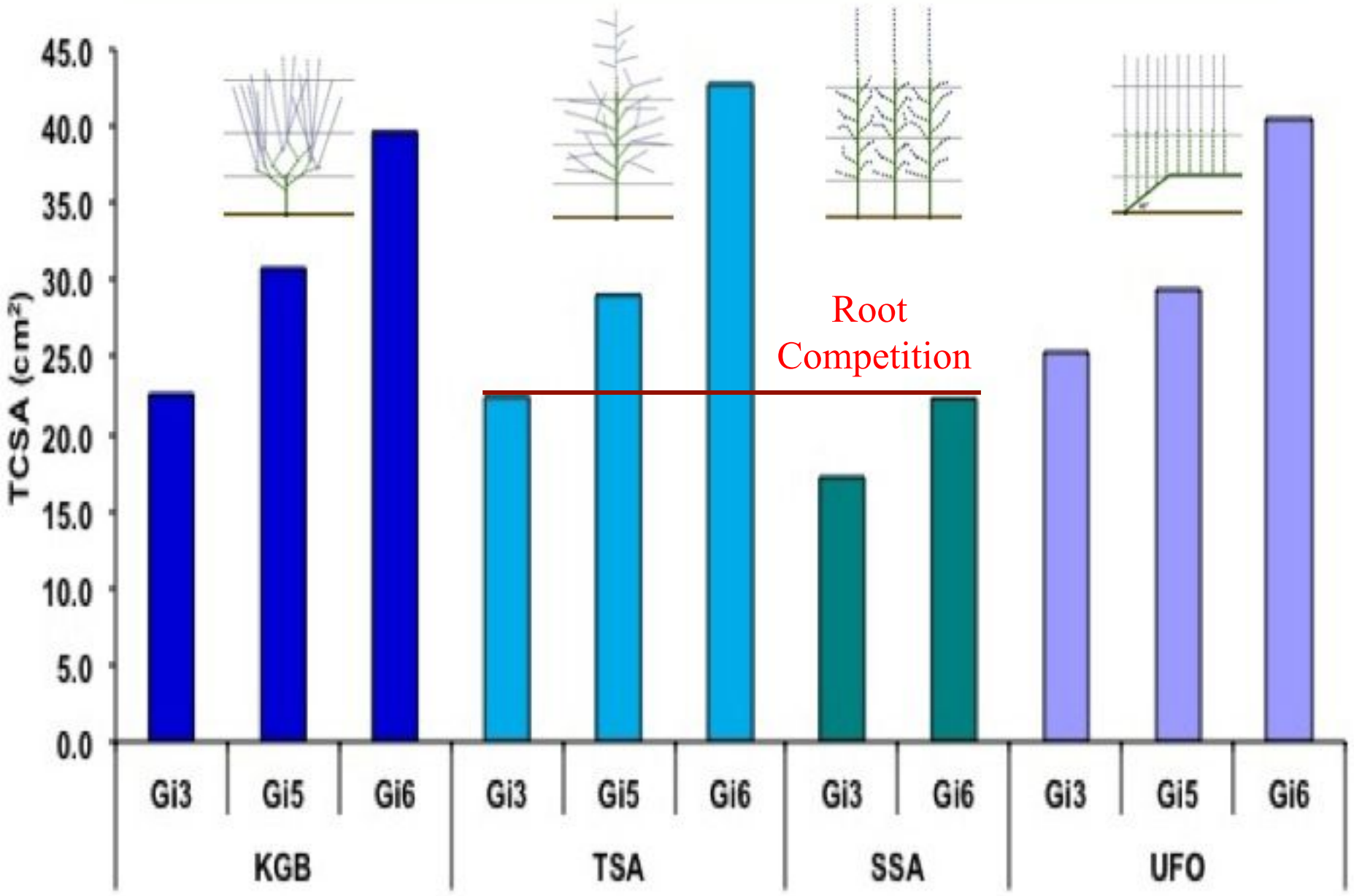


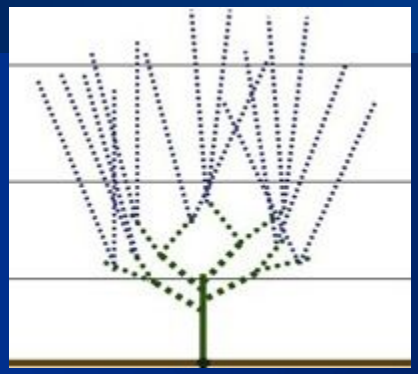


System x Rootstock Effect on Tree Vigor (TCSA), Fall 2012

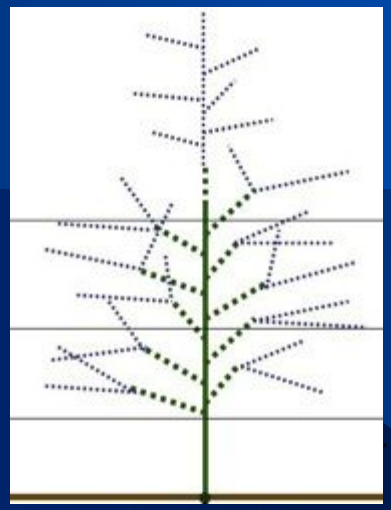


New Sweet Cherry Systems

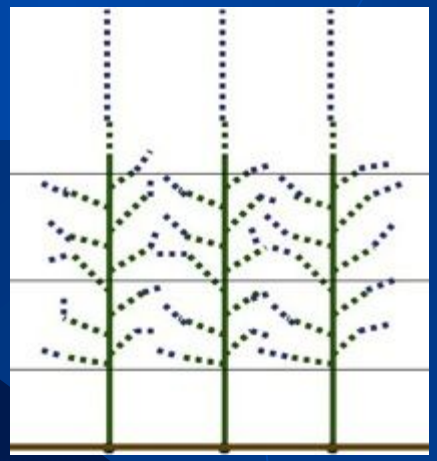
KGB



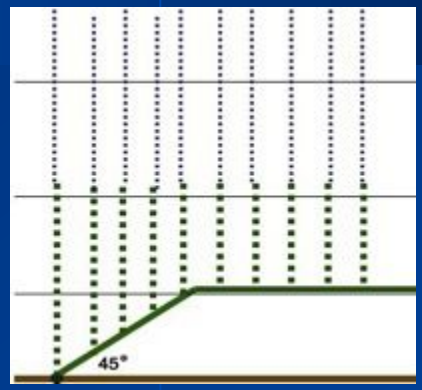
TSA



SSA



UFO



There is no single best system. Growers will be successful who understand the fundamental training rationale and fruiting units for each system, and how to adapt their system management for their specific needs: their orchard site, their variety characteristics, their markets, and their labor situation.

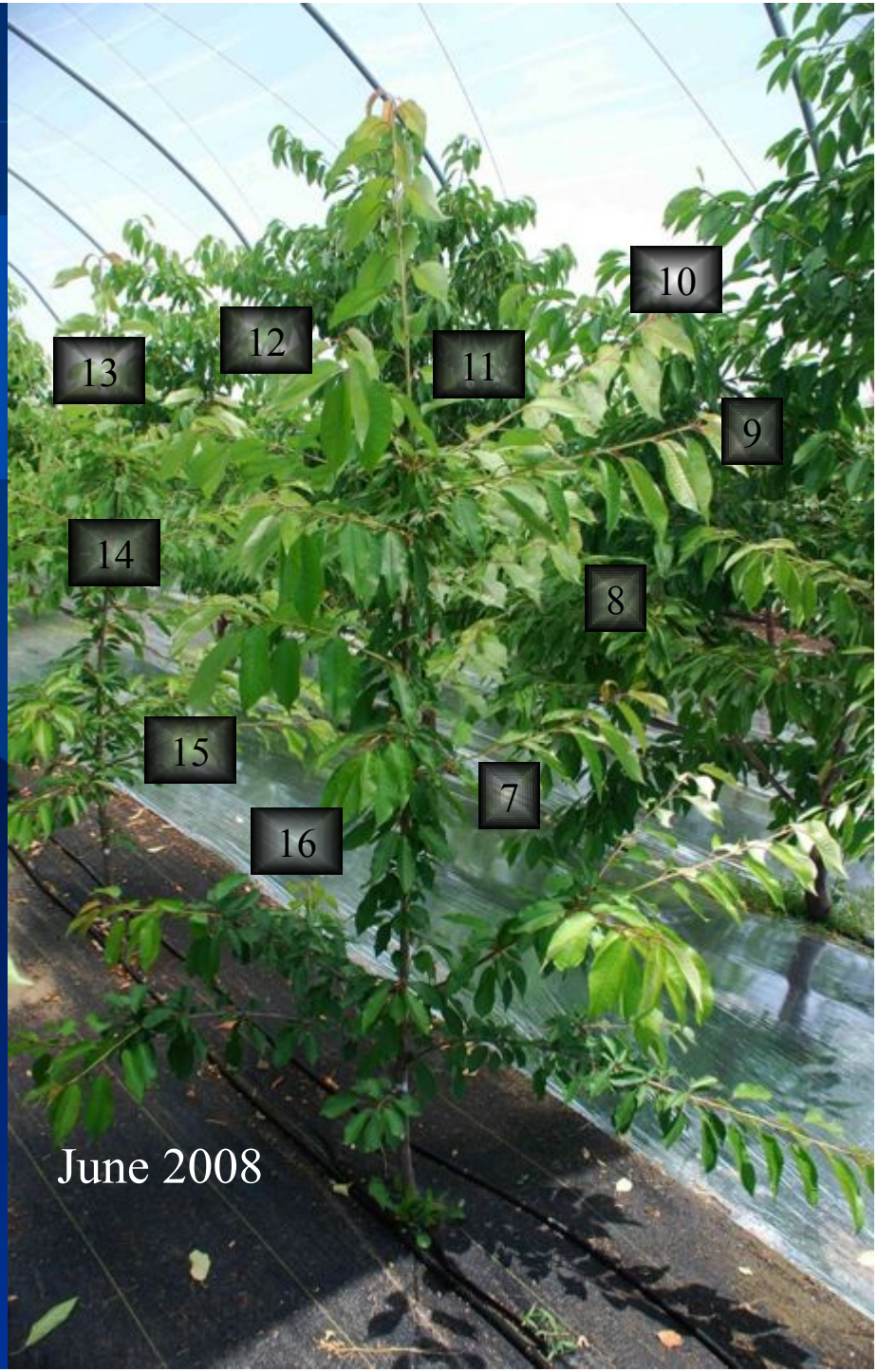
Precise Fruiting Unit Formation

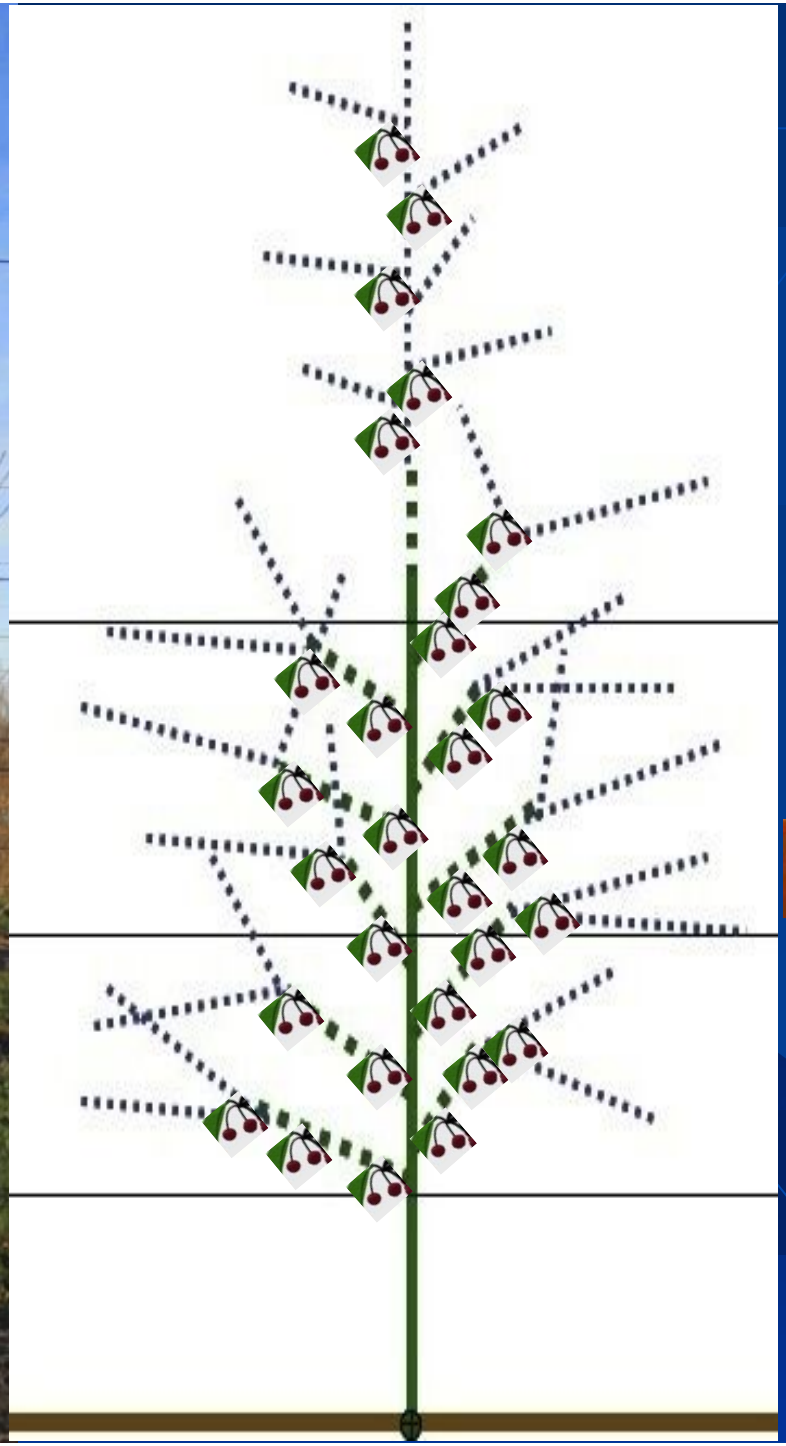
Year 1- 10 to 15 lateral or upright shoots (future fruiting units)

Year 2 – 20 to 35 total future fruiting units

The greater the number of new shoots created in Years 1 and 2, the greater the diffusion of vigor.

This diffusion, and removal of any overly vigorous or weak shoots, results in more balanced and uniform fruiting units.





TSA Spacing:

5 x 11 ft

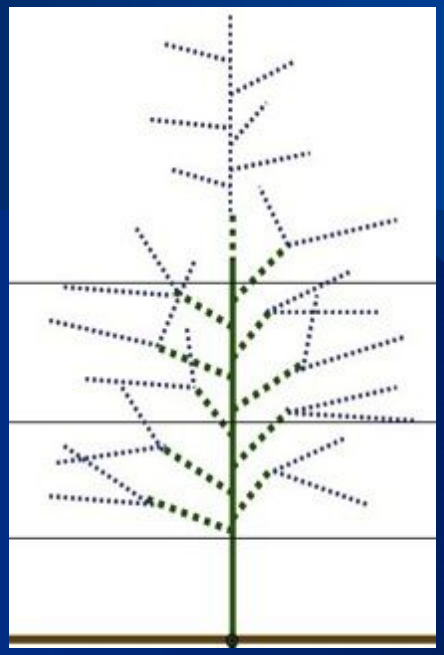
Heading of lateral shoots to balance crop load with leaf area.

Fruiting sites:

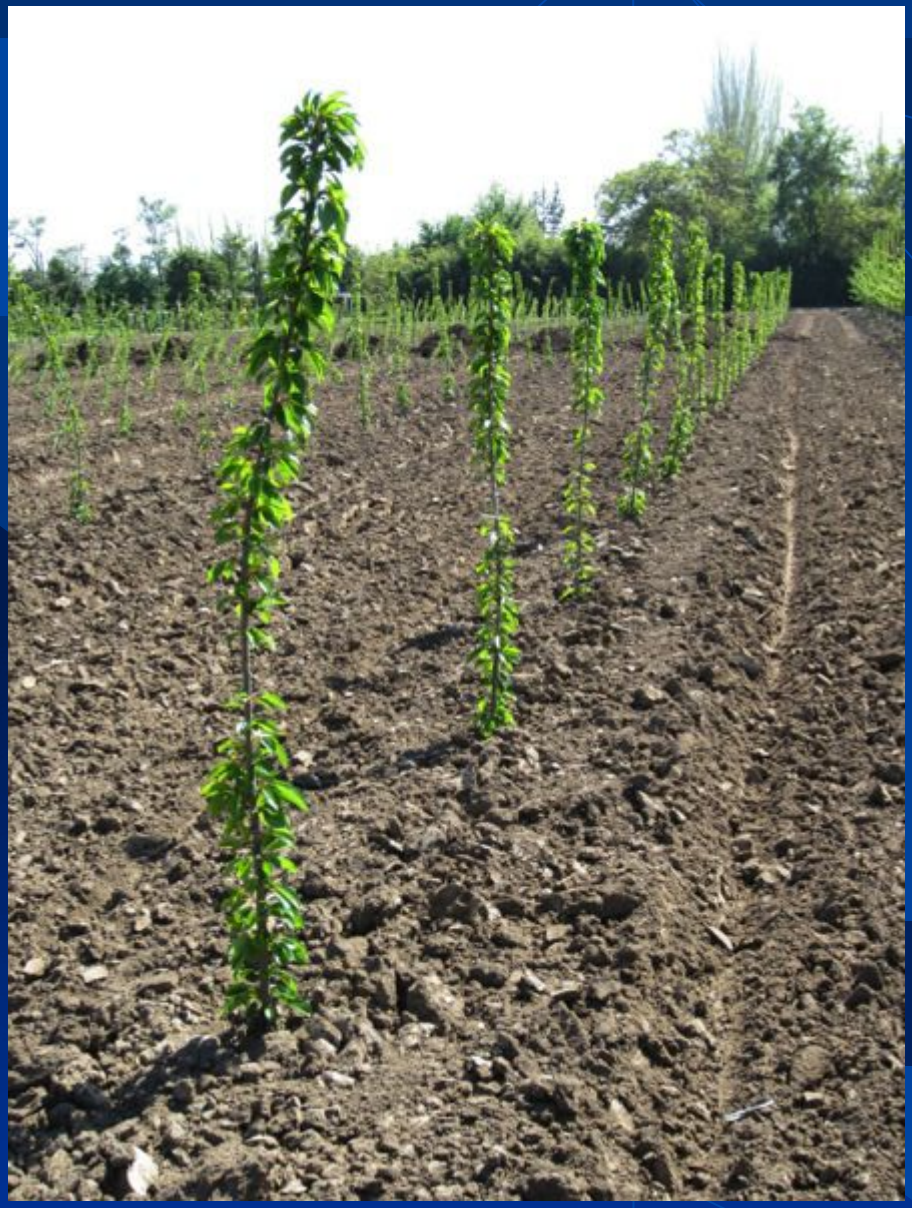
both spur and non-spur

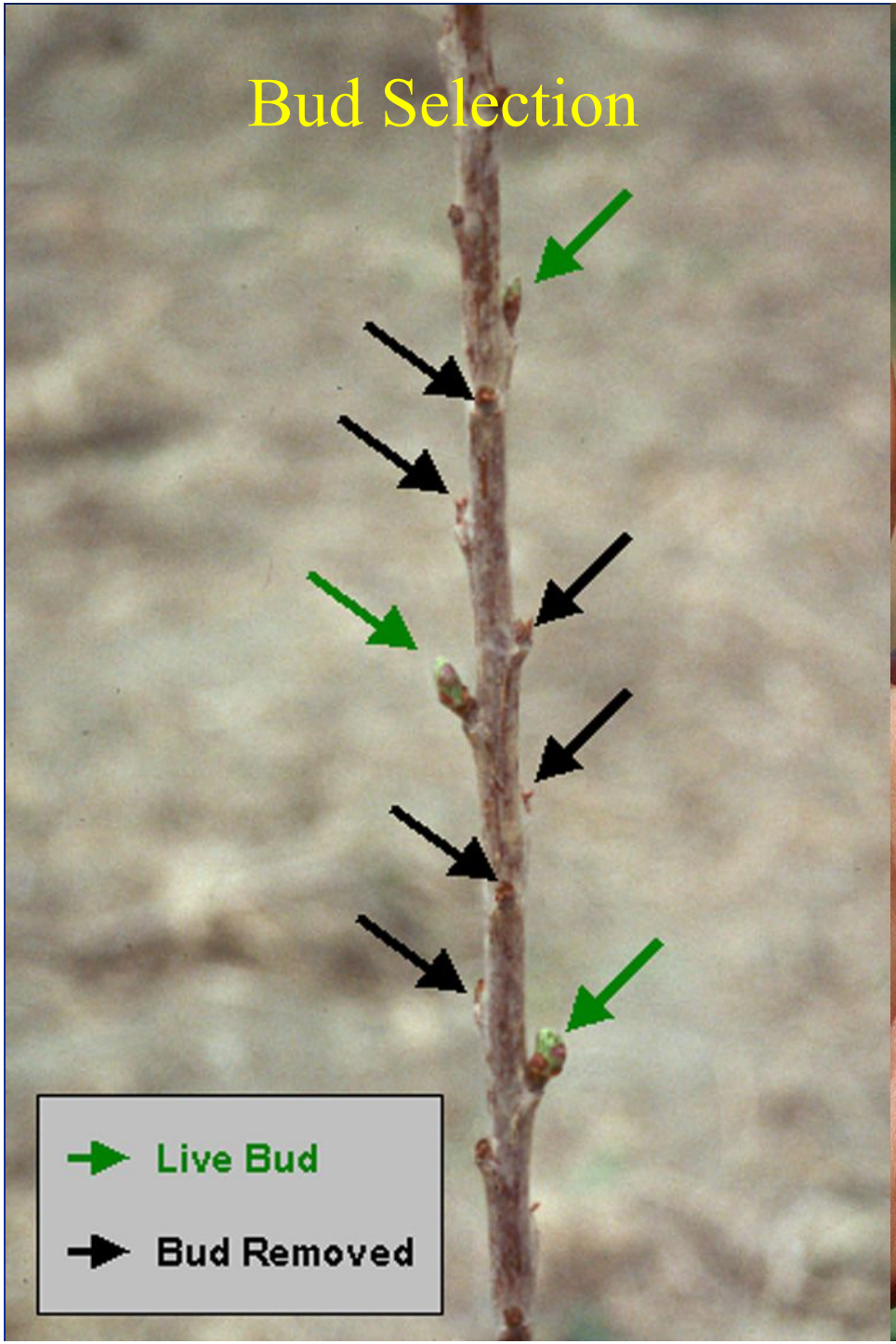
Establishing the TSA Orchard: Nursery Trees

TSA



Can use whip nursery trees; feathered nursery trees best if available




Bud Selection
Live Bud
Bud Removed

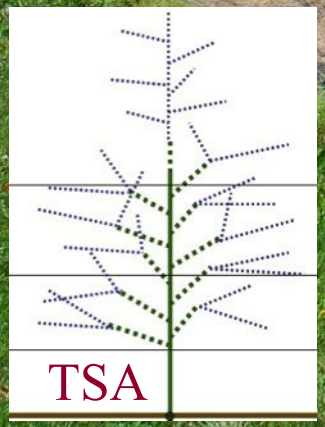

Promalin

Shoot Promotion

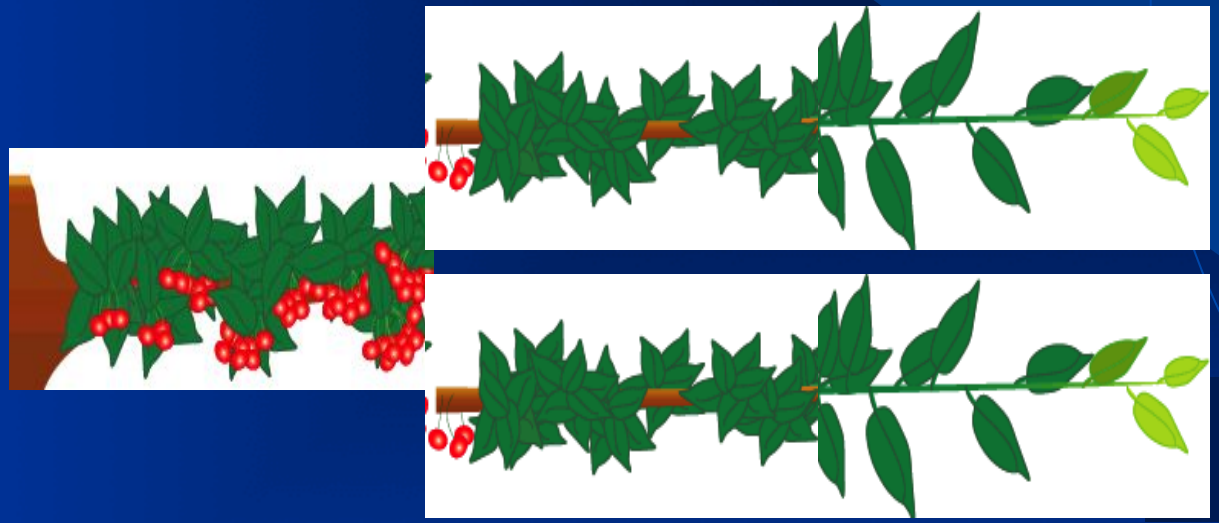
The goal in forming shoots in Years 1-2 should be to establish fruiting units for Years 2-4:

- Heading (not desirable)
- Promalin (sensitive to climate)
- Bud selection
- Bud notching/scoring (susceptible to bacterial canker)

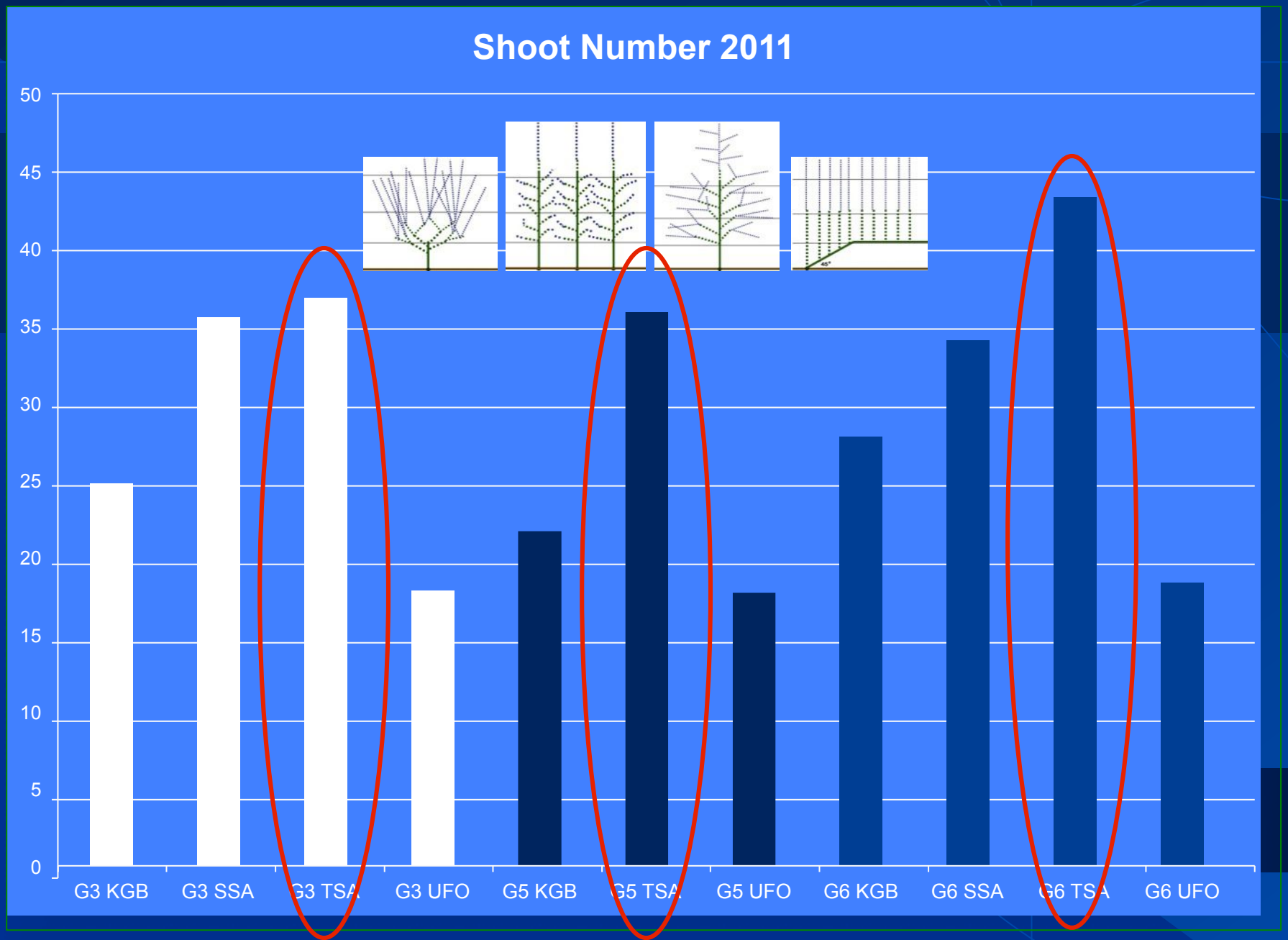
MSU-Clarksville TSA System Cherries



TSA Fruiting Unit Development

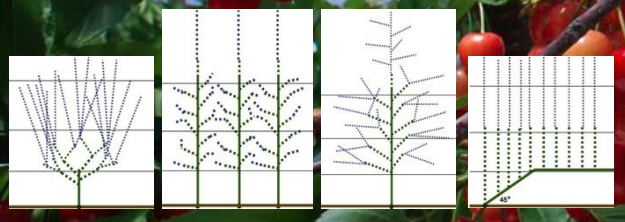


Heading cuts stimulate new shoot leaf populations and non-spur fruit populations, while reducing future spur fruit populations



Lillrose and Lang, 2011 (preliminary data, not analyzed for publication)

MSU Tree Fruit Research (End Part 1)



Training video clips at:
www.giselacherry.com

www.cherries.msu.edu