

Tree Fruit Research at the Intersection of Biology and Technology



Matthew Whiting

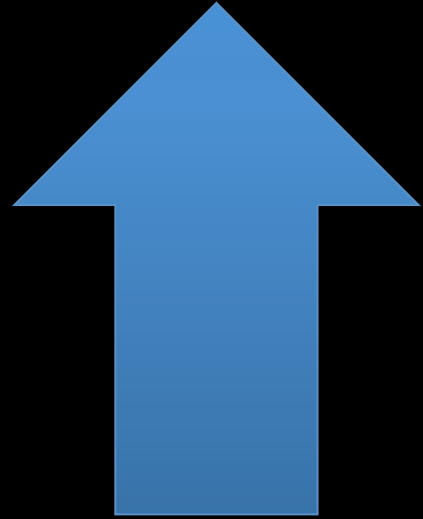
Washington State University

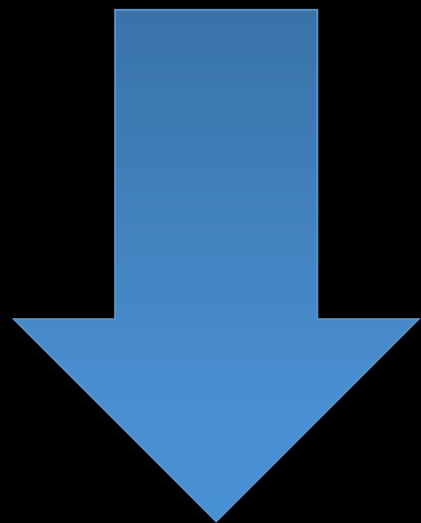
Necesitamos Ayuda

OLSEN BROS
SOLICITA PISCADORES PARA LA
CHERRY BLUEBERRIES
EN 65603 N. SHULER RD
LLAMAR AL 509 588 7645
APUNTATE YA!



Key Production Trends:







To remain competitive, the US sweet cherry industry must improve efficiency



Cherry orchard of the future

- Profitability
- Sustainability
- Right genetics
- Right location
- Right management

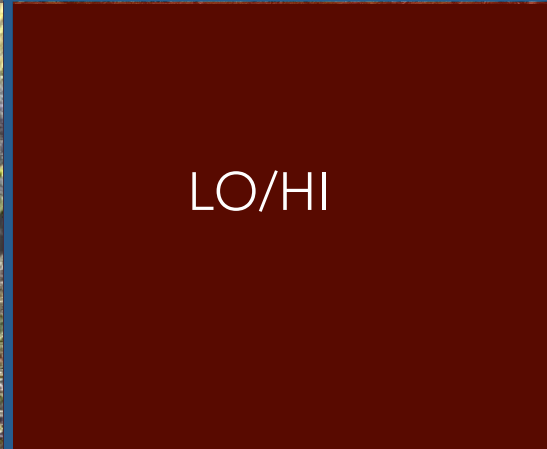
Efficient, consistent,
balanced
production



Output vs. Input:

Production systems

OUTPUT



INPUT



Is this the orchard of the future?



Is this the orchard of the future?







Is this the orchard of the future?



Is this the orchard of the future?



Is this the orchard of the future?

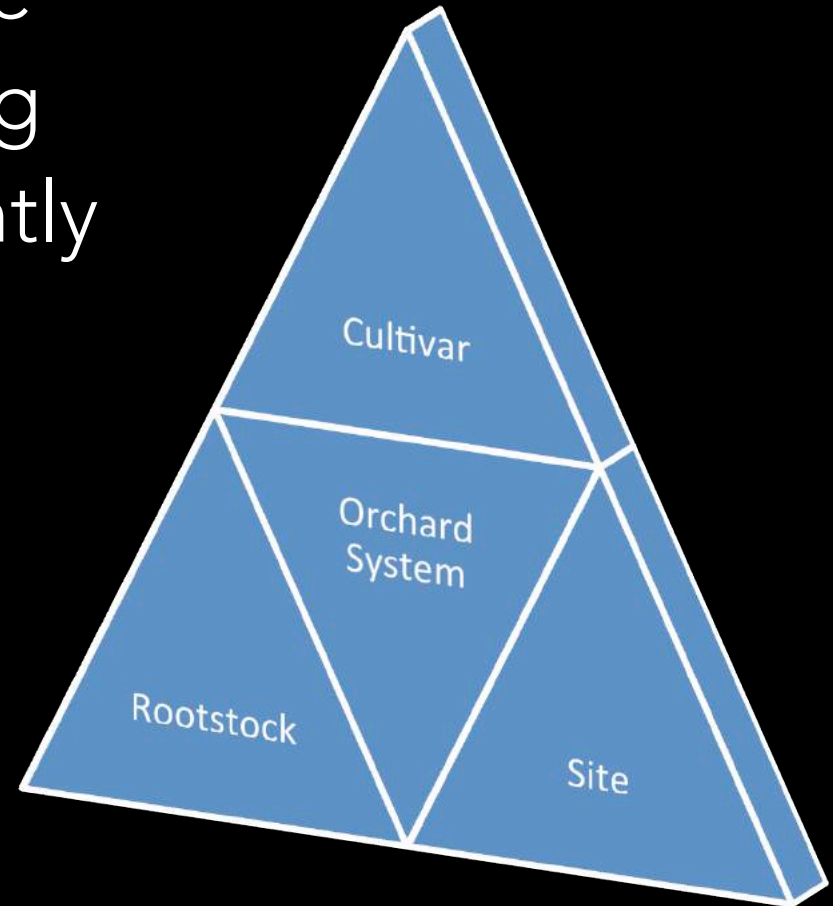




Keys to future orchards:

- Profitable + sustainable
- Simple pruning/training
- Precocious + consistently productive

- Ability to utilize automation/mechanization



Is this the orchard of the future?





2

1



What is successful in other crops?

Jazz/M9 – 100+ tons/ha

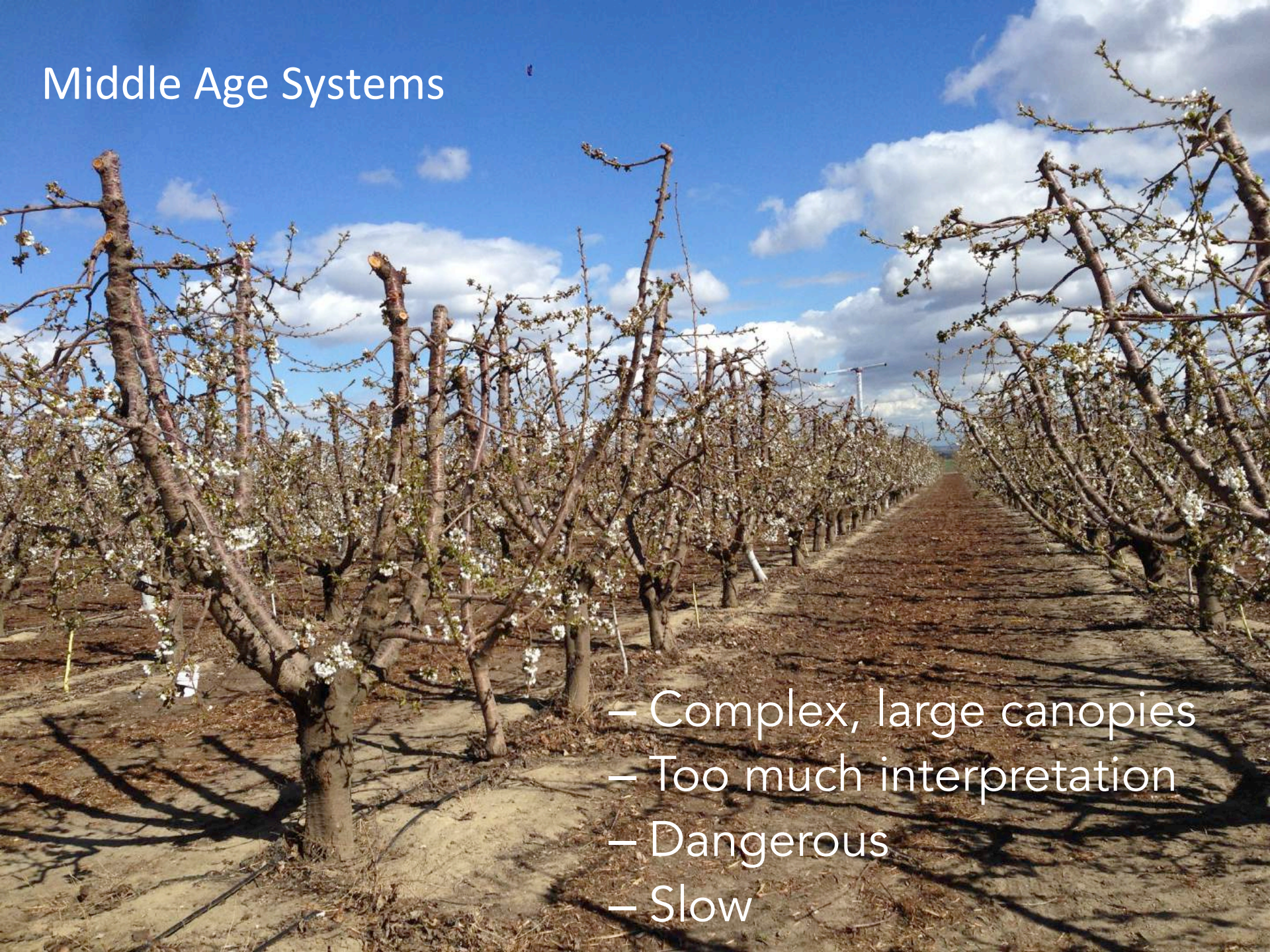


Old Systems

- Complex, large canopies
- Too much interpretation
- Dangerous
- Slow

04/13/2006

Middle Age Systems

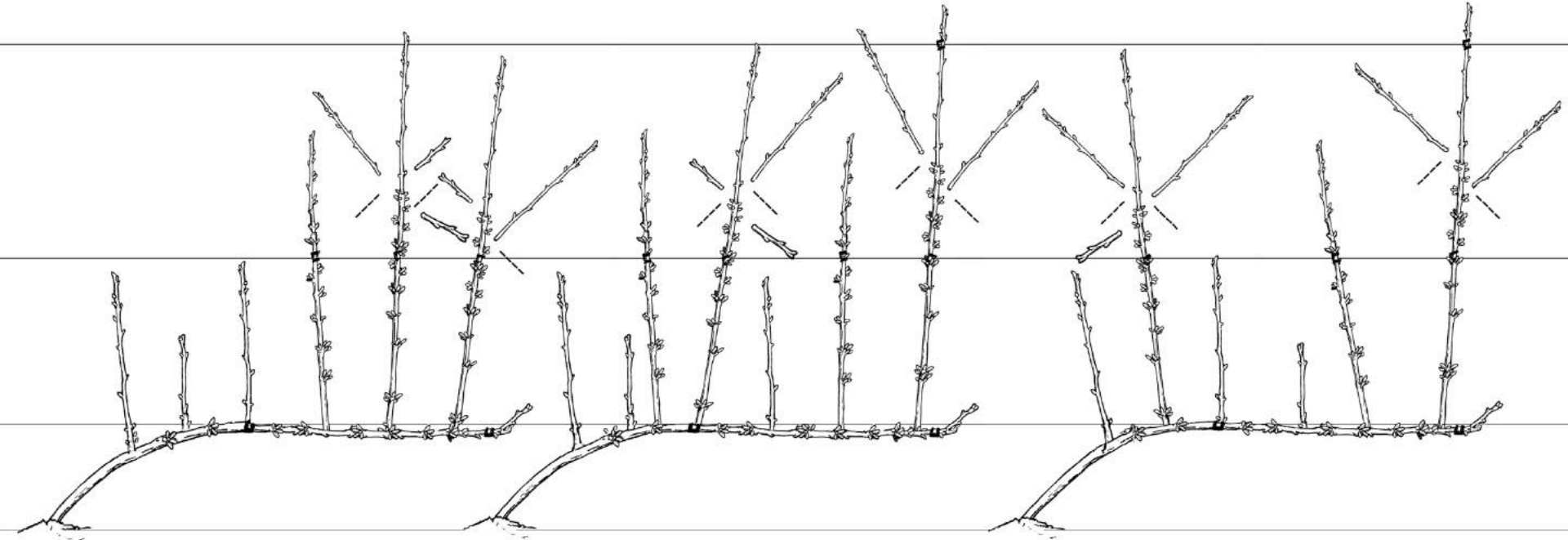


- Complex, large canopies
- Too much interpretation
- Dangerous
- Slow



- Compact, fruiting wall
- Repeated processes
- Efficient
- Suitable for mechanization/automation

Simplified Pruning of the UFO System:



Pruning rules:

1. Remove all lateral wood (leave short stubs)
2. Renew vigorous uprights (leave renewal sites)



PAR interception of vertical and angled fruiting walls



Vertical UFO



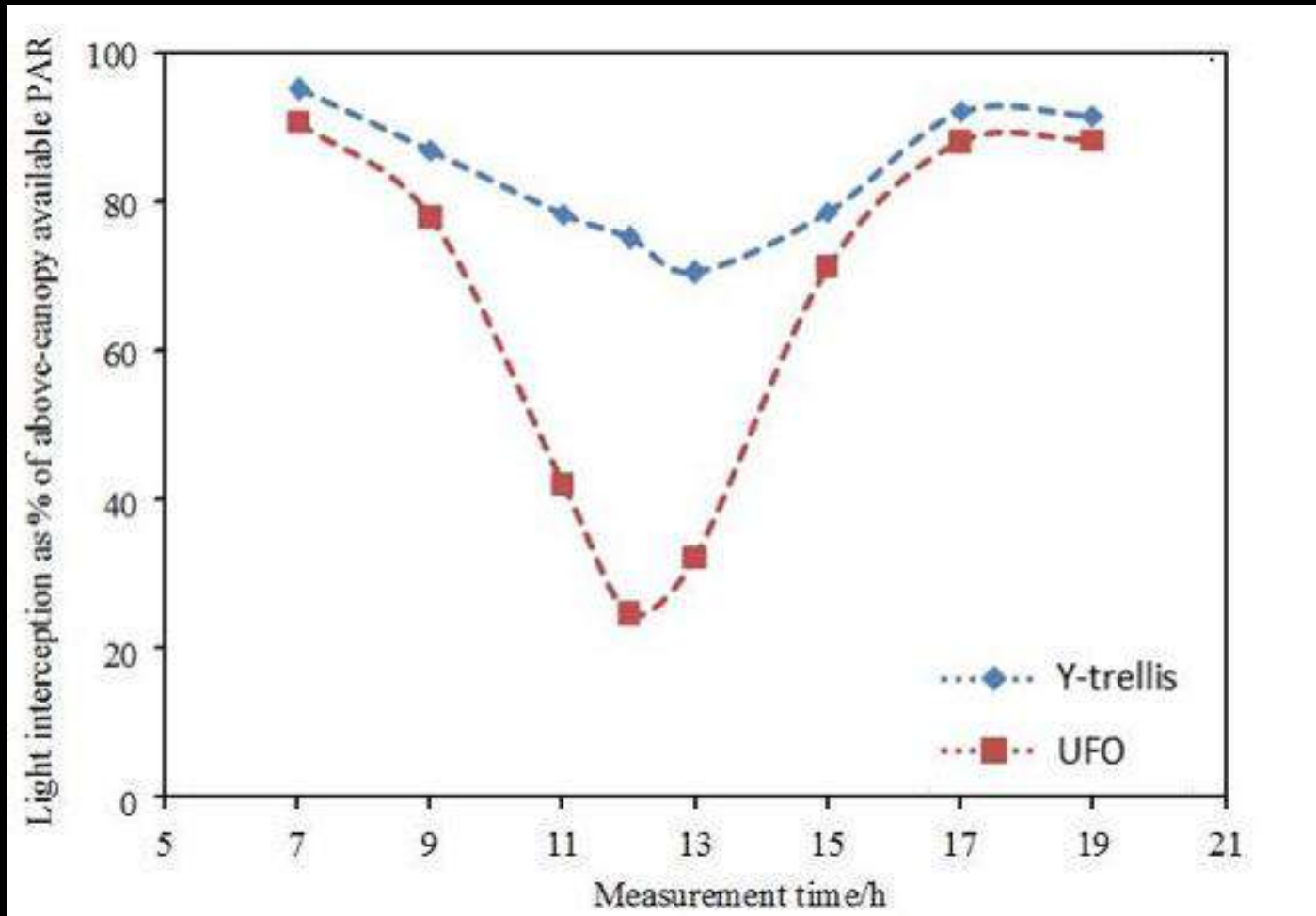
Y-trellised UFO

Mobile measurement system

- 1 – AccuPAR LP-80
- 2 – LI-COR quantum sensor
- 3 – I-O interface control box
- 4 – Deere E-Gator
- 5 – TRD-S encoder



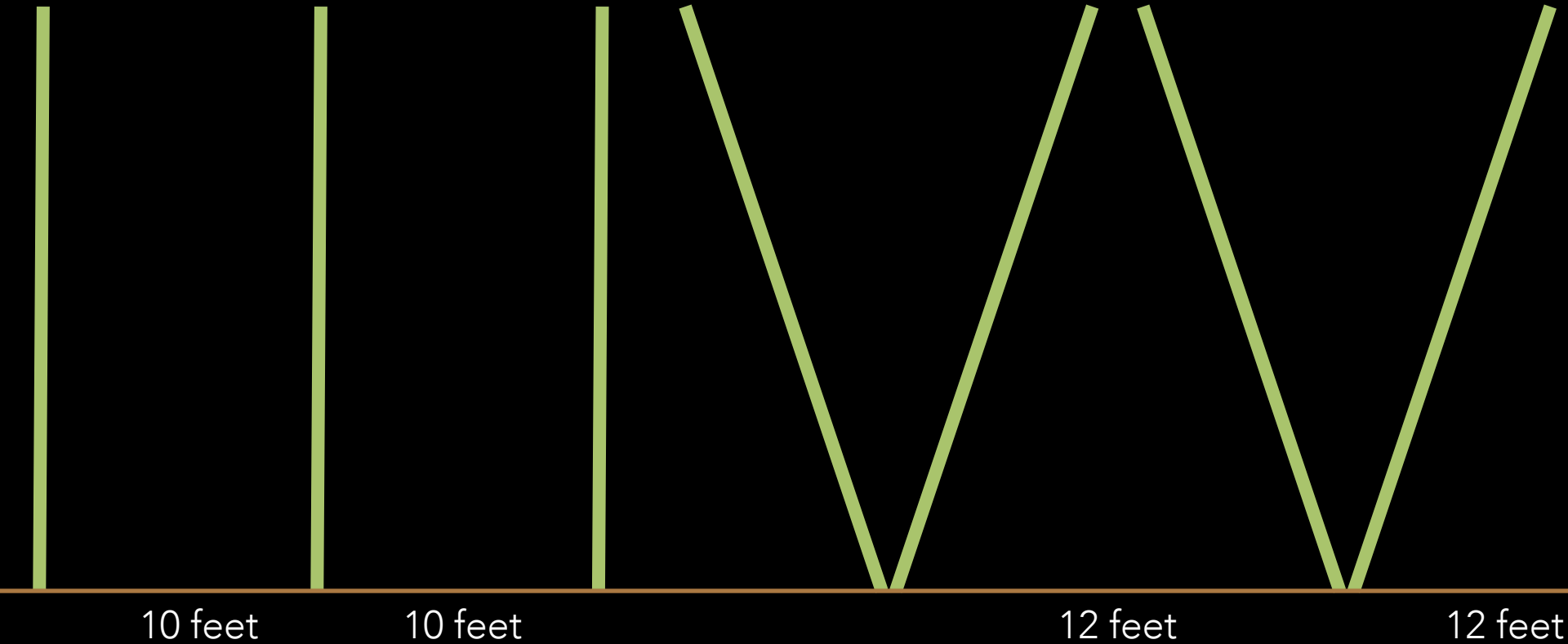
PAR interception of vertical and angled fruiting walls



- Diurnal trend was nearly symmetric around solar noon
- *Yield potential* on angled canopies is greater than planar canopies
 - 5 year-old 'Santina'/Gisela12 – 35 tons/ha (Y-trellis UFO)
 - 4 year-old 27 tons/ha

Vertical system

Angled system



10 feet

10 feet

12 feet

12 feet

1 'wall' per row

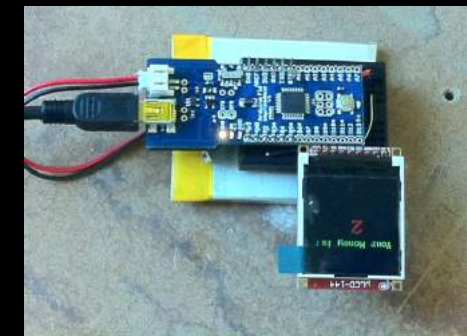
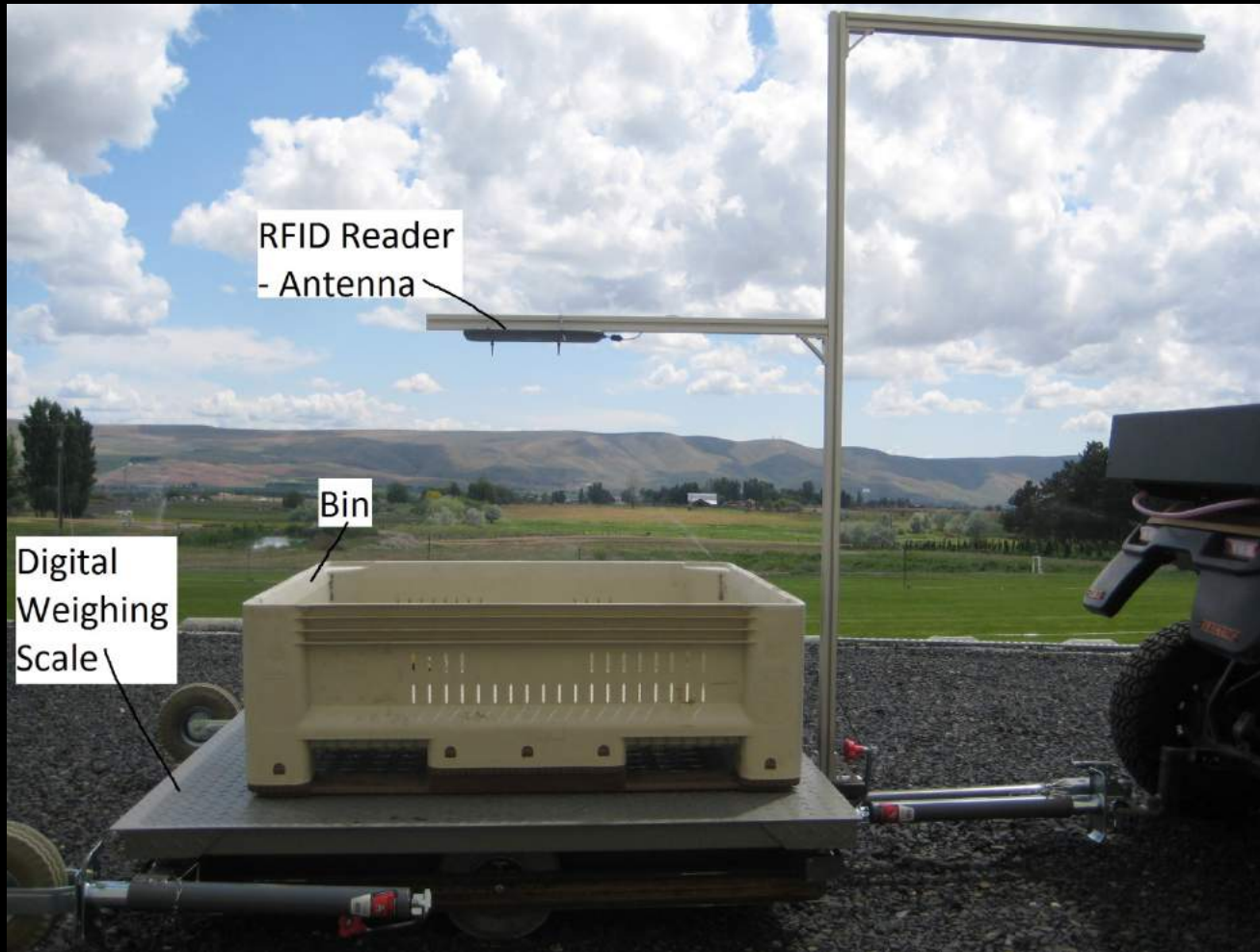
2 'walls' per row

What difference does training system make?



Labor Monitoring System, LMS

Research tool 2011



Harvest efficiency

Preliminary tests in sweet cherries and apples show a clear role of training system in harvest efficiency/costs.

| Cultivar | | Training System | Mean Harvest Rate (kg/min) |
|----------------|----------------------|--|----------------------------|
| Sweet Cherries | Bing/'Mazzard' | Traditional open center | 0.47 ± 0.12 |
| | Chelan/'Mazzard' | steep leader (4-5 upright leaders) | 0.53 ± 0.13 (+13%) |
| | Tieton/'Gi5' | Central leader | 0.64 ± 0.19 (+36%) |
| | Sweetheart/'Mazzard' | KGB | 0.72 ± 0.17 (+53%) |
| | Cowiche | UFO | 0.81 ± 0.18 (+72%) |
| Apple | Fuji (Apple) | moderate density (7 x 13) central leader | 3.58 |
| | Braeburn (Apple) | high density tall spindle | 5.61 (+60%) |



Mechanical harvest

- Harvest costs are $>50\%$ of all
- Labor cost increasing
- Labor availability decreasing



Mechanical harvest

- Taking short- and long-term look using total systems approach
 - Mechanical assist (shake-and-catch)
 - Fully mechanical harvest



Goal: Improve labor efficiency & safety with mechanical or mech-assist technologies



- 3-4 fold improvement in harvest efficiency with shake-and-catch system
- Worked with 10 growers in 2013/2014 to test/demonstrate the system
- Sold stem-free and stem-on cherries (same price, package, orchard)

Efficient harvest technologies



Shake-and-catch harvest testing



Chelan – high PFRF



Skeena – low PFRF



In domestic and export markets, stem-free cherries are accepted/preferred

New packaging + marketing by Chelan Fresh

Cherries!
Fresh & Delicious

Cherries Out
Pits In

Cup O' Cherries
SWEET SWEET SWEET
Sweet Cherries

Cup O' Cherries
Sweet Cherries

READY TO EAT

HEALTHY

NO MESS

Cup O' Cherries
Sweet Cherries

Distributed by Chelan Fresh Marketing

Barcode: 8 00200 40011 7

The image shows a clear plastic cup filled with red cherries. The cup has a black lid with a dual-compartment design. The lid is labeled 'Cherries Out' and 'Pits In'. The cup features the 'Cup O' Cherries' logo, which includes a green leaf and two cherries. Below the logo, it says 'SWEET SWEET SWEET Sweet Cherries'. To the right of the cup are three circular icons: a hand holding a cherry, a smiley face, and a hand with a cherry, each with a corresponding benefit: 'READY TO EAT', 'HEALTHY', and 'NO MESS'. At the bottom left is another 'Cup O' Cherries' logo, and at the bottom right is a barcode with the number 8 00200 40011 7. The background is blue with a green border at the top and bottom.

Cherries!
Fresh & Delicious

15 cups per box.
8oz. of fruit per cup
Approximately 8 lbs. of fruit

Box dimensions:
16" wide x 24" length x 6.75" high

5Tie x 13 High, 65 cases to a pallet

Pallet weight is 1035 lbs.

Dual compartment lid holds discarded pits

READY TO EAT

HEALTHY

NO MESS

Distributed by Chelan Fresh Marketing
Phone: 509-682-4252

Cup O' Cherries

The image shows a blue cardboard box containing several clear plastic cups of cherries. The box has a large 'Cup O' Cherries' logo on the front. To the right of the box are three circular icons: a hand holding a cherry, a smiley face, and a hand with a cherry, each with a corresponding benefit: 'READY TO EAT', 'HEALTHY', and 'NO MESS'. Below the icons is the text 'Distributed by Chelan Fresh Marketing Phone: 509-682-4252'. At the bottom right is a large 'Cup O' Cherries' logo. The background is blue with a green border at the top and bottom.

Utilizing platforms:

- Limb tying
- Thinning
- Pruning
- Harvest

- Work at night



Mechanical pruning

- Simplified planar systems – simplify pruning
- Investigated potential for mechanical pruning in UFO since 2010



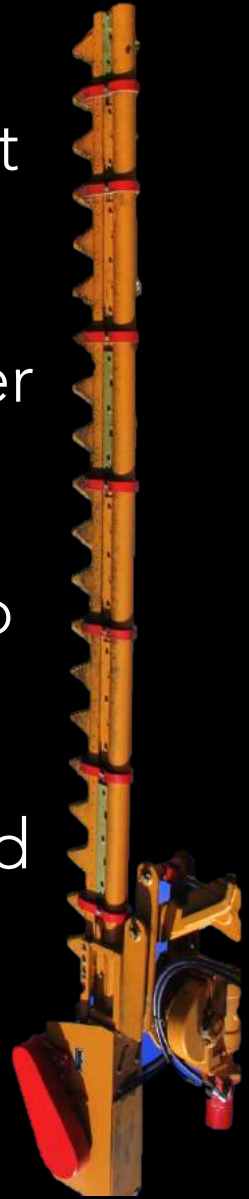
Objective

Determine best management practices for pruning sweet cherry and apple mechanically, by understanding equipment and orchard requirements.



Mechanical pruning

- Gillison's GVF Center Mount Topper and Hedger
- Side shift ca. 1.2 m on either side of the tractor
- Height adjustment of 1 m to 6.5 m
- 360° rotation of cutting head
- \$24,000 USD



YEAR 1

1. Hand pruning
2. Mechanical pruning (1)
3. Mechanical pruning (2)

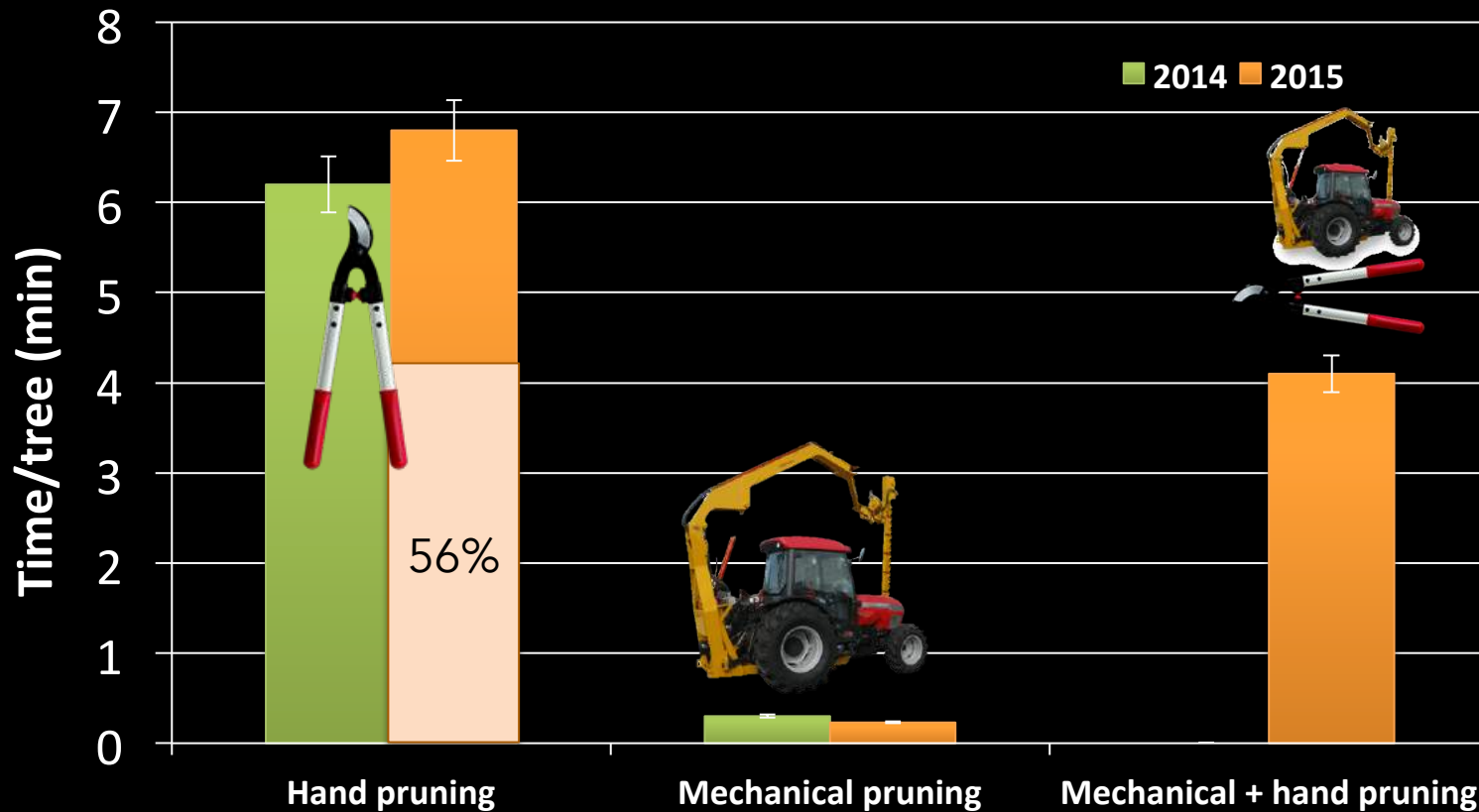


YEAR 2

1. Hand pruning
2. Mechanical pruning
3. Mechanical pruning + Hand pruning



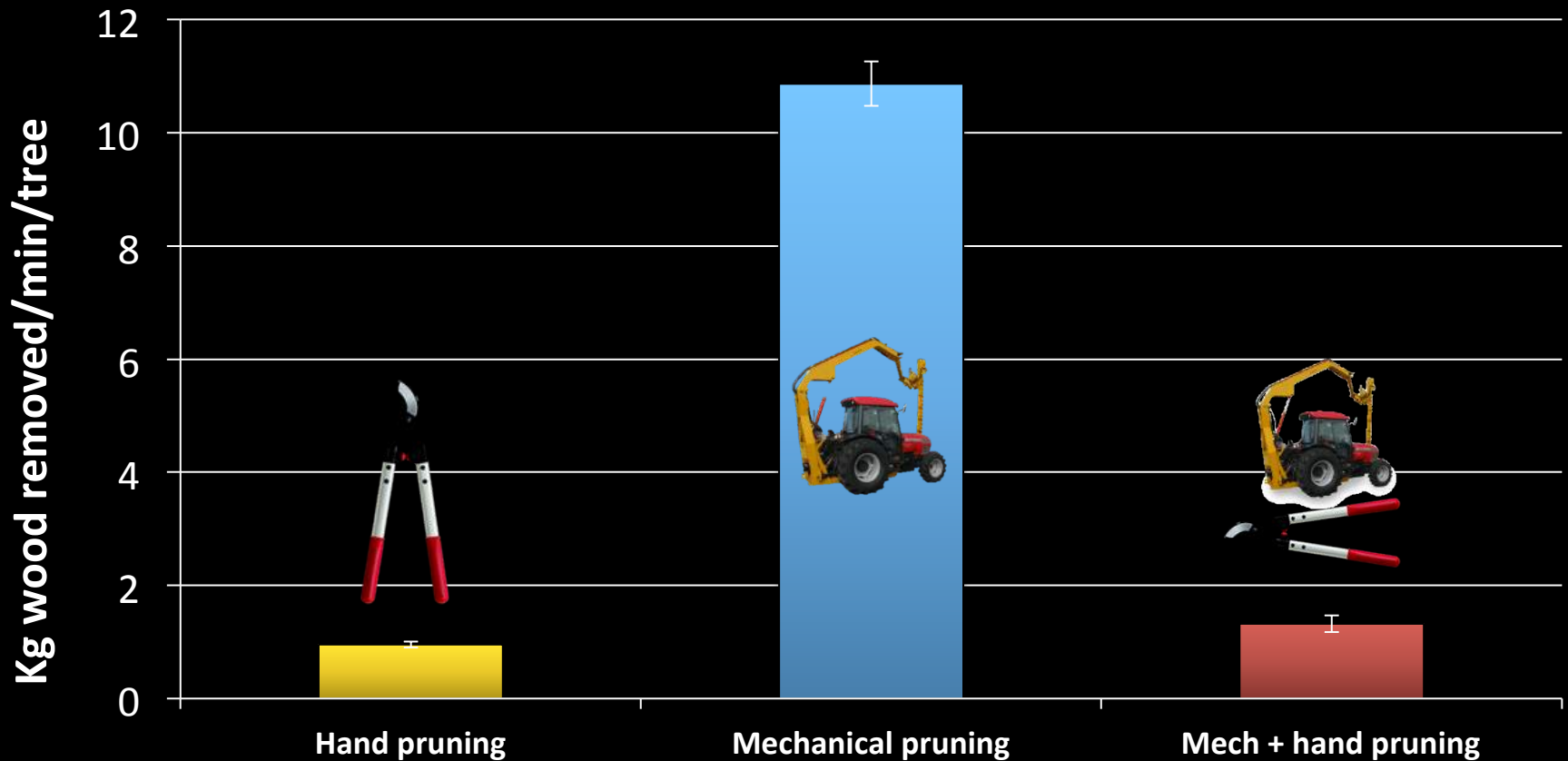
Results: Time



- Mech pruning 23 and 29 times faster than hand pruning (hedging and topping) in 2014 and 2015
- Combination of manual and mech. pruning was twice as fast as hand pruning (ca. 2.0 km/h)



Results: Efficiency 2015



- Mech + hand pruning was 66% more efficient than hand pruning alone
- Mech pruning was 11 times more efficient than hand pruning



Results: Yield and fruit quality 2015

| Treatment | Weight (g) | Firmness (g/mm) | SS (%) | Diameter (mm) | Row size |
|----------------------------|---------------|--------------------|-----------|------------------|----------|
| Hand pruning | 12.1 a | 313 | 16.1 | 29.2 a | 9 |
| Mechanical pruning 1 | 11.3 b | 302 | 15.7 | 28.3 b | 9 |
| Mechanical pruning 2 | 11.6 b | 310 | 16.0 | 28.5 b | 9 |
| p-value ($\alpha= 0.05$) | 0.042 | 0.223 | 0.503 | 0.006 | |

- Hand pruning: 7.6 tons/acre
- Mechanical pruning 1: 9.1 tons/acre
- Mechanical pruning 2: 8.5 tons/acre



Before



After



Economic assessment

ASSUMPTIONS:

- 1 acre of UFO 'Tieton'/'Gisela5'
- Full canopy
- 1350 trees/ha

1 person

8 hours work/day

\$12/h

UFO pruning rules

- Hand pruning is 4x machine costs
- 2x over 2 years
- 23 ha to cover machine cost in 1 yr



Estimated pruning costs

| | |
|---|-------|
|  | \$741 |
|  | \$168 |
|  | \$590 |



Trial 3: 'Rainier'/'Gisela®5' 2016

- 5 reps of 10 trees
- Stihl® manual hedger

Treatments:

- Control (unpruned)
 - Hand-pruned
 - 20 days before harvest
 - 10 days before harvest
-
- Yield, quality, timing, return bloom, vegetative regrowth



Results:

- Mech-assist pruning was 7 times faster than hand
- Slight improvement (+12%) in color with both timings
- Slight reduction (-9%) in soluble solids at 20 dbh
- Return bloom, regrowth TBD



Conclusion

- Adoption of innovation has been slow in cherry industry
- Market pressures will continue to force innovation
- Plan orchards to account for these challenges
- Planar, vertical or angled systems
 - Not about now, but what is next.....





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