Tree Fruit Research at the Intersection of Biology and Technology

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Key Production Trends:

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

Cherry orchard of the future

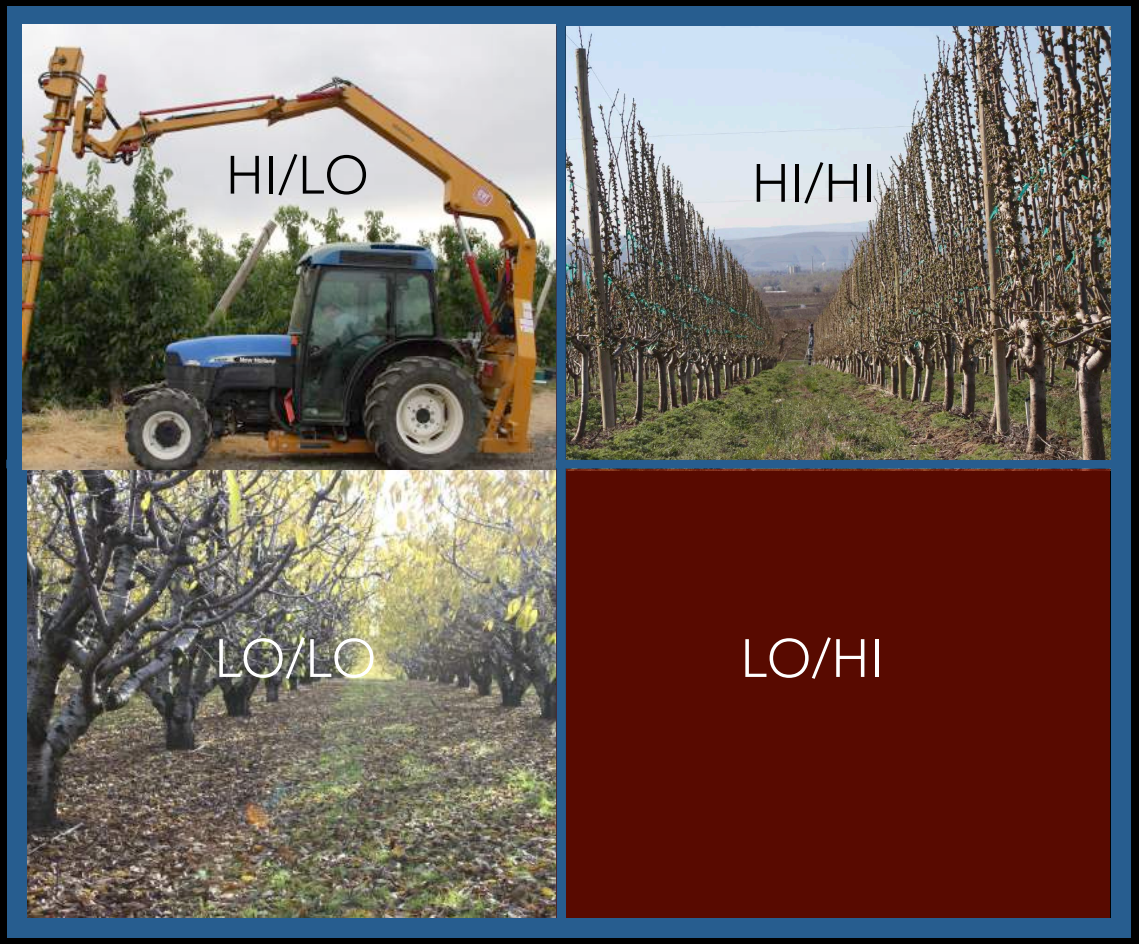
- Profitability
- Sustainability

- 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?

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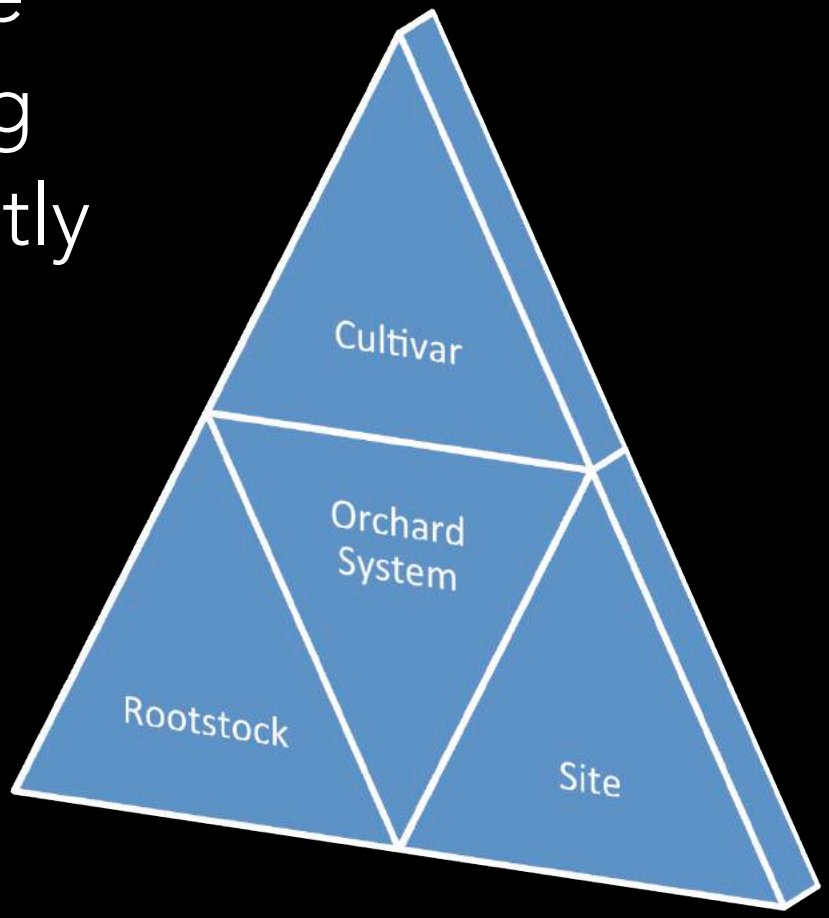
Is this the orchard of the future?

Keys to future orchards:

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

- Ability to utilize automation/ mechanization

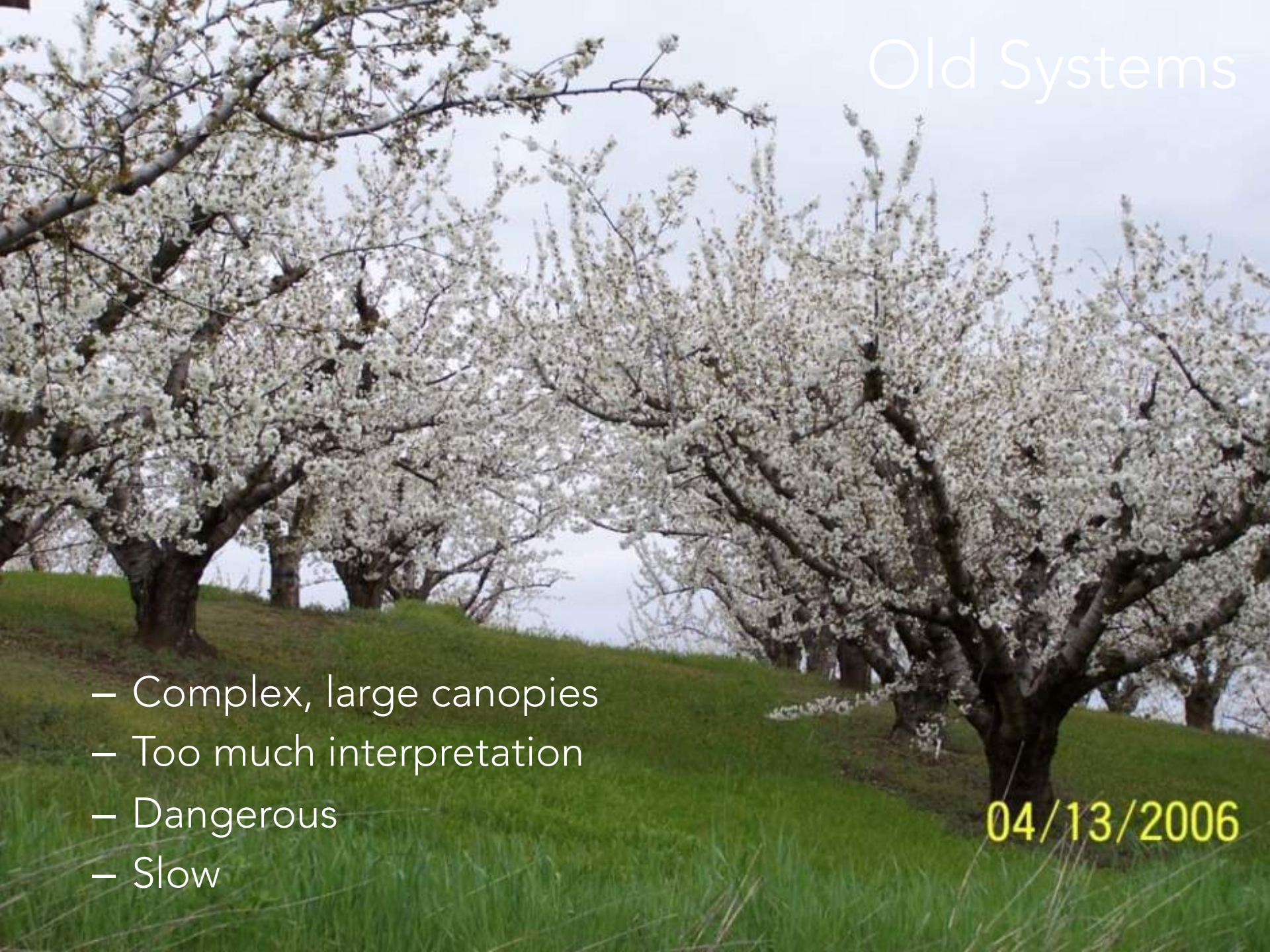


Is this the orchard of the future?


2
1

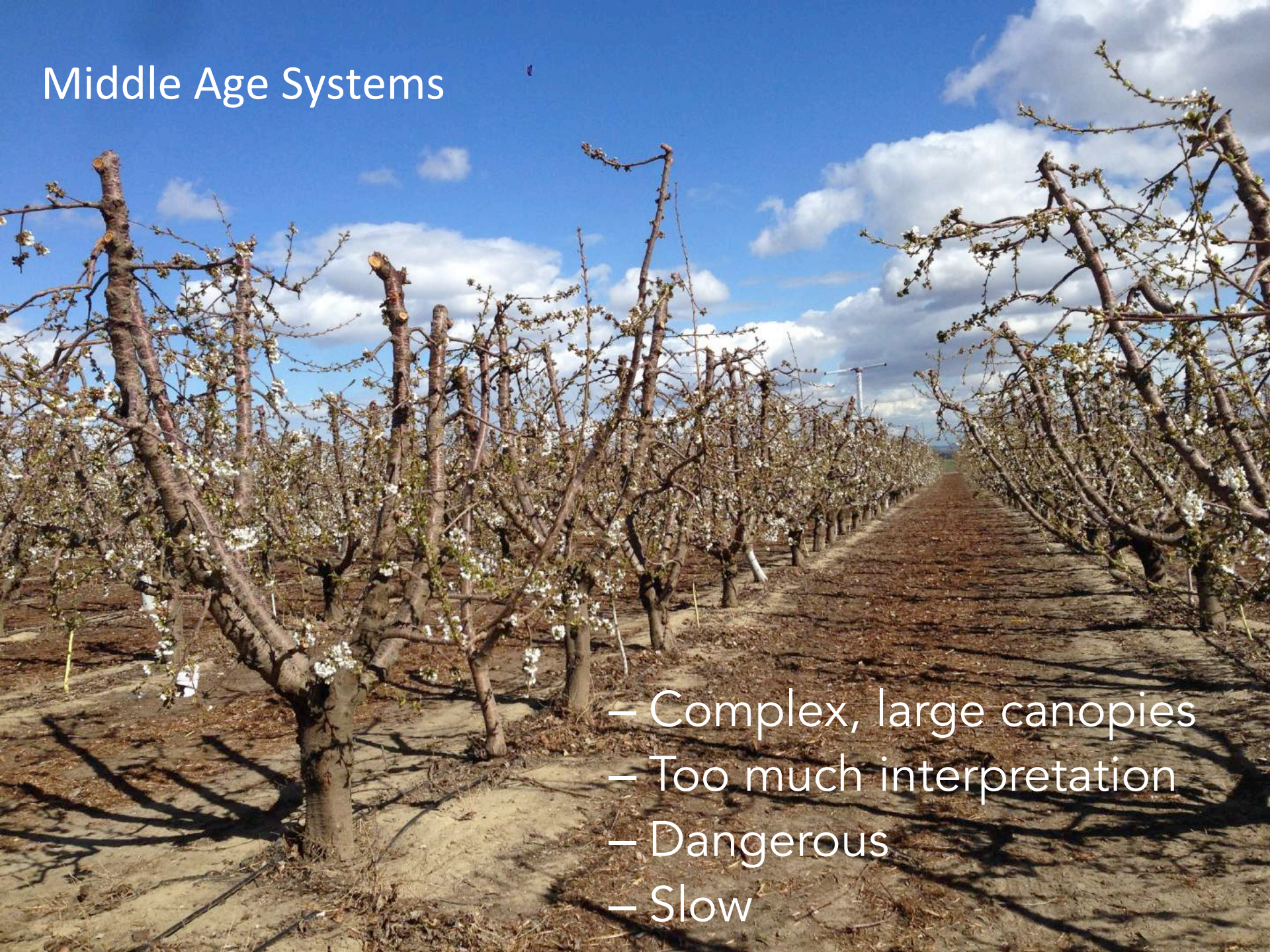

What is successful in other crops?
Jazz/M9 – 100+ tons/ha

Old Systems



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

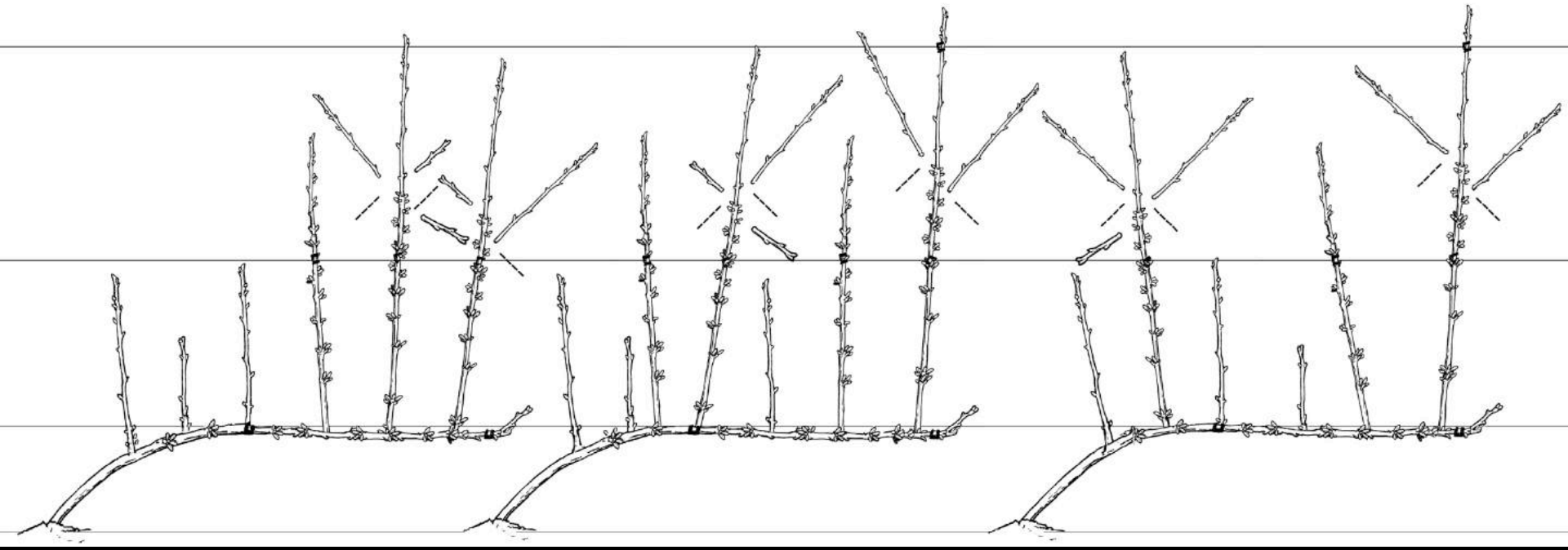
Middle Age Systems



- 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:

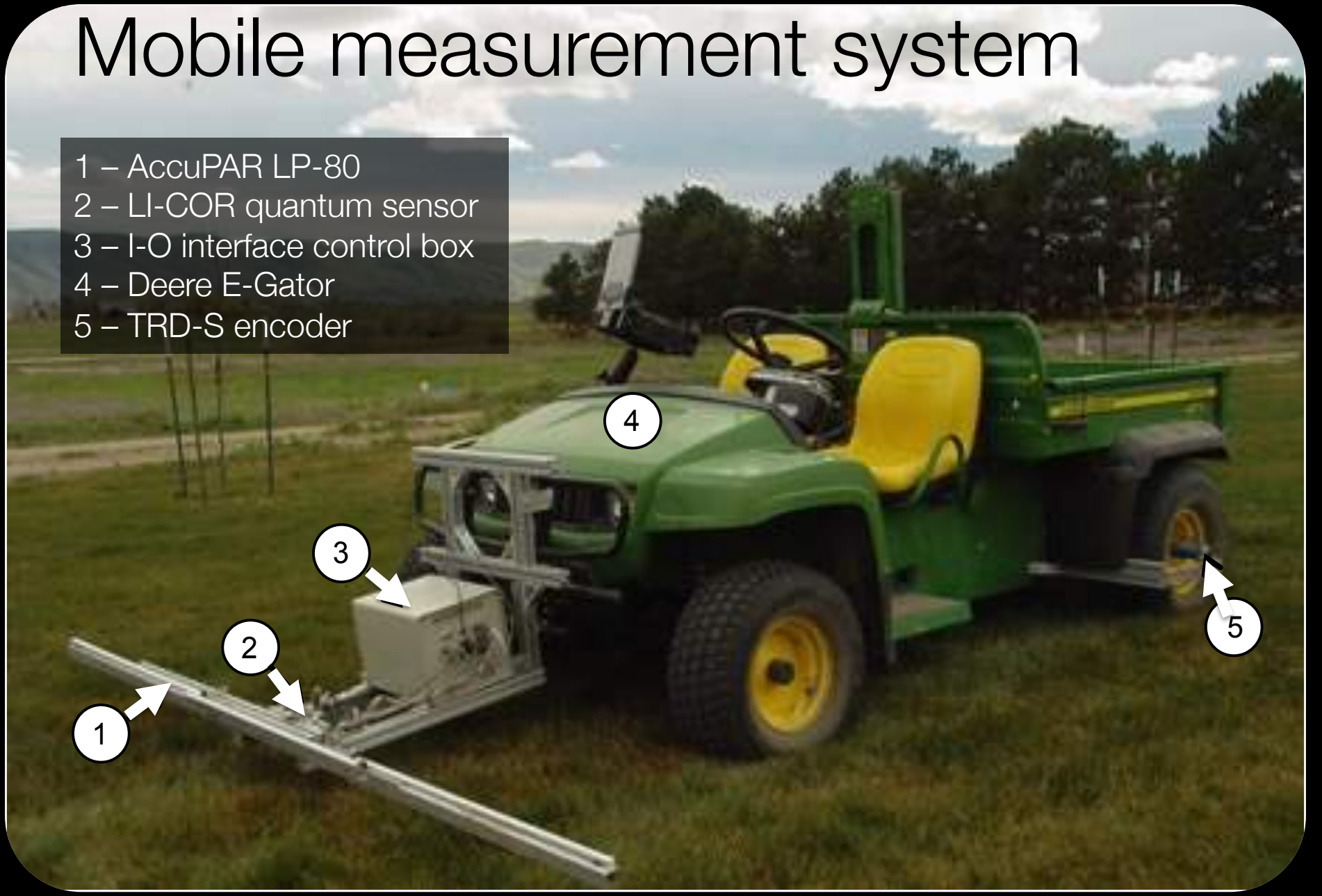
1. Remove all lateral wood (leave short stubs)
2. Renew vigorous uprights (leave renewal sites)

PAR interception of vertical and angled fruiting walls

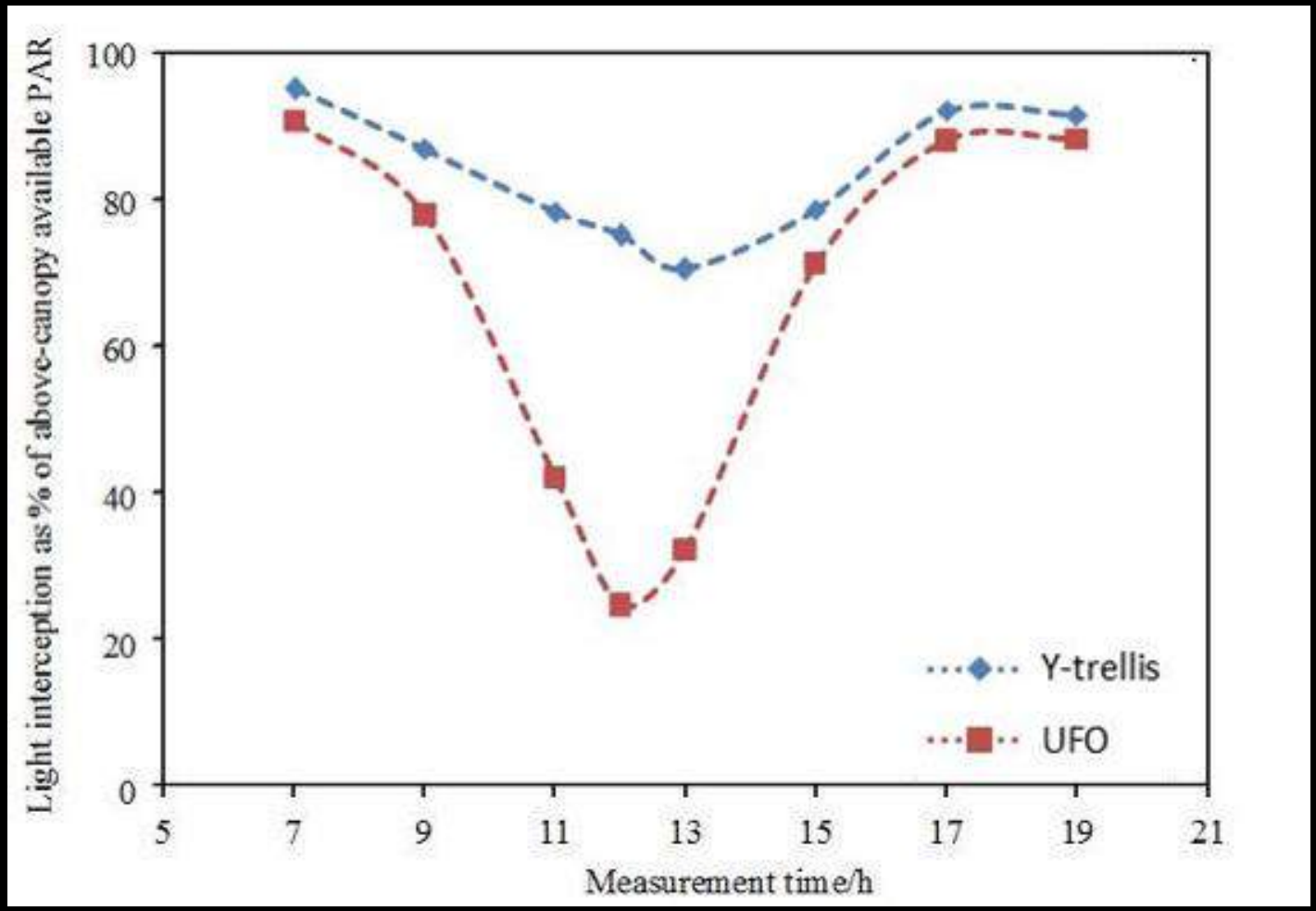
Vertical UFO

Y-trellised UFO

Mobile measurement system



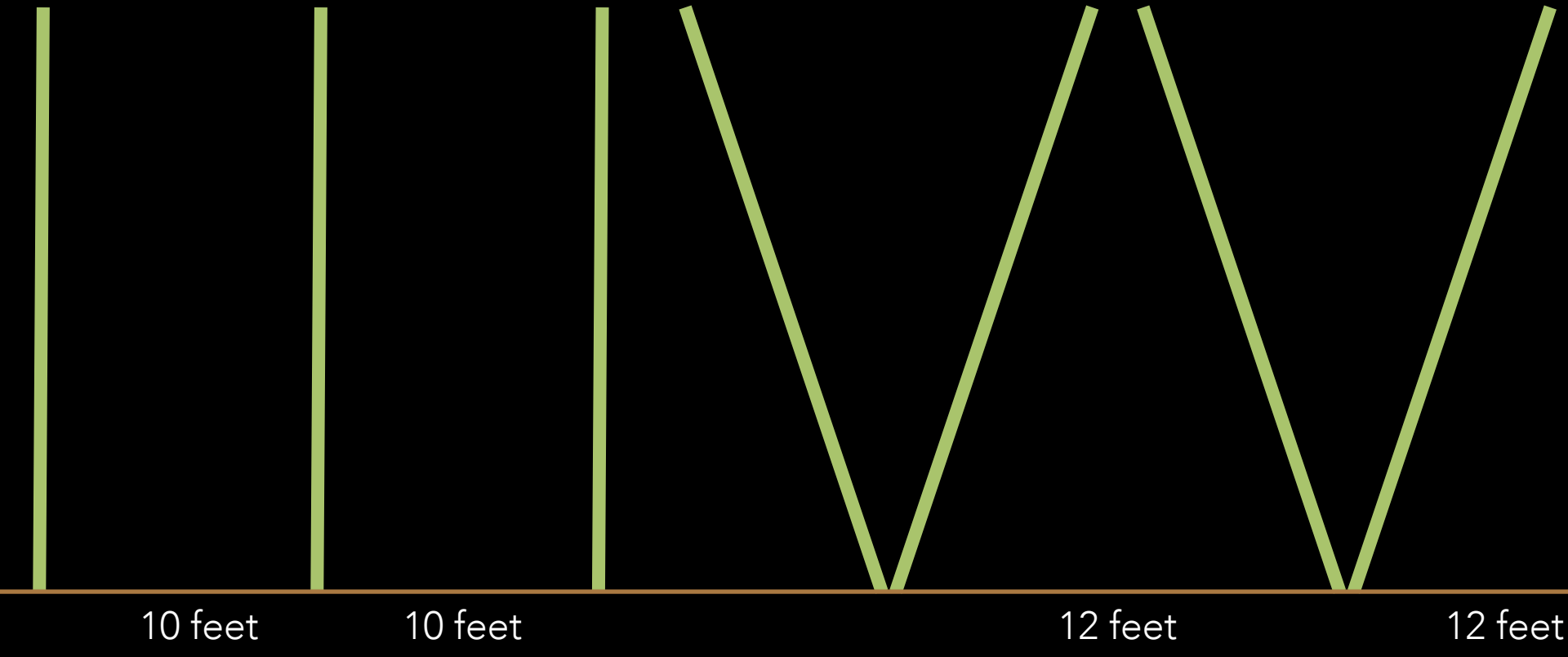
PAR interception of vertical and angled fruiting walls



- 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



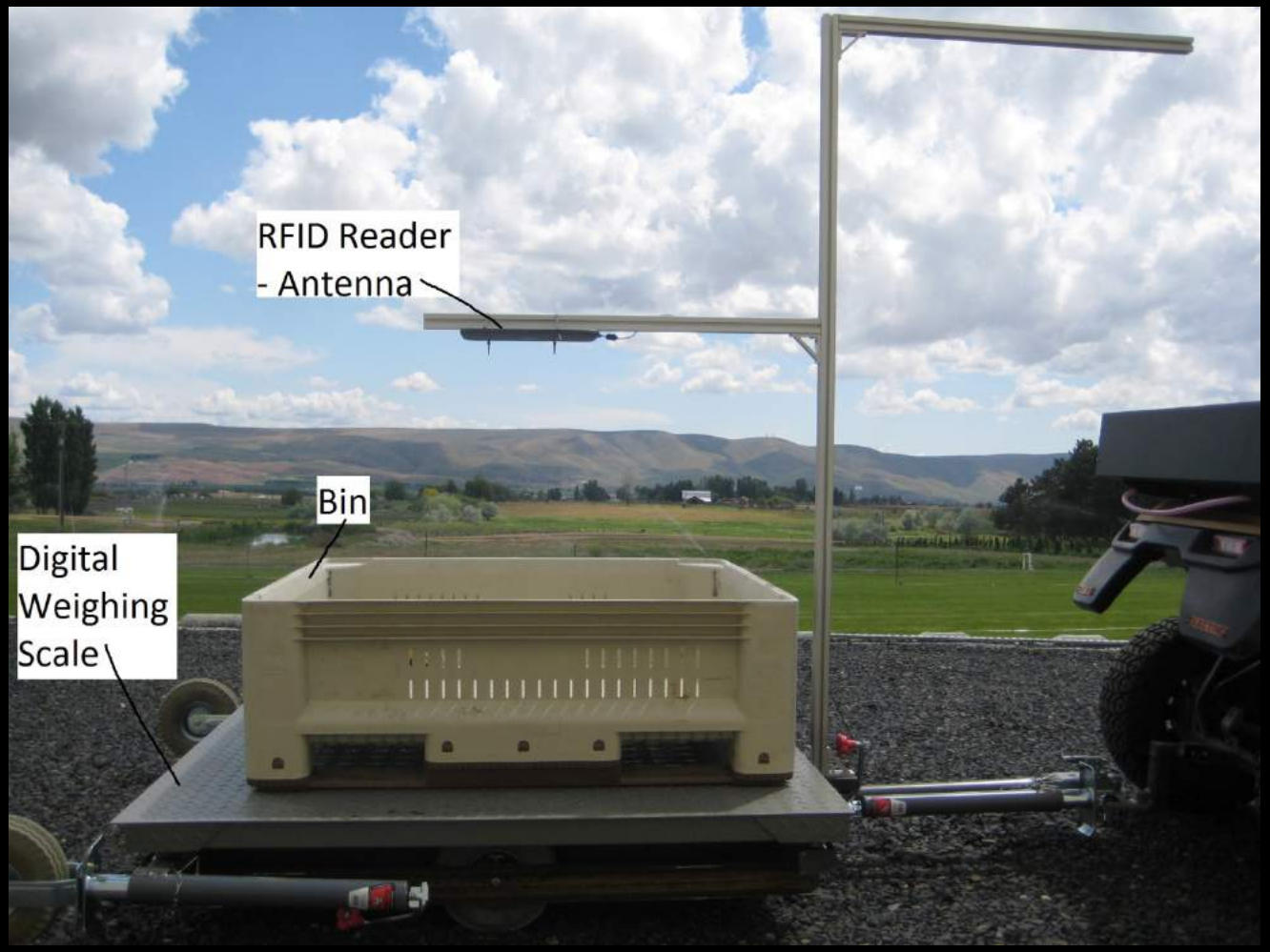
1 ‘wall’ per row

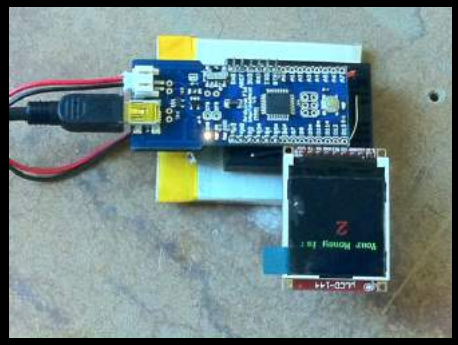
2 ‘walls’ per row

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%)***


OP-4

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

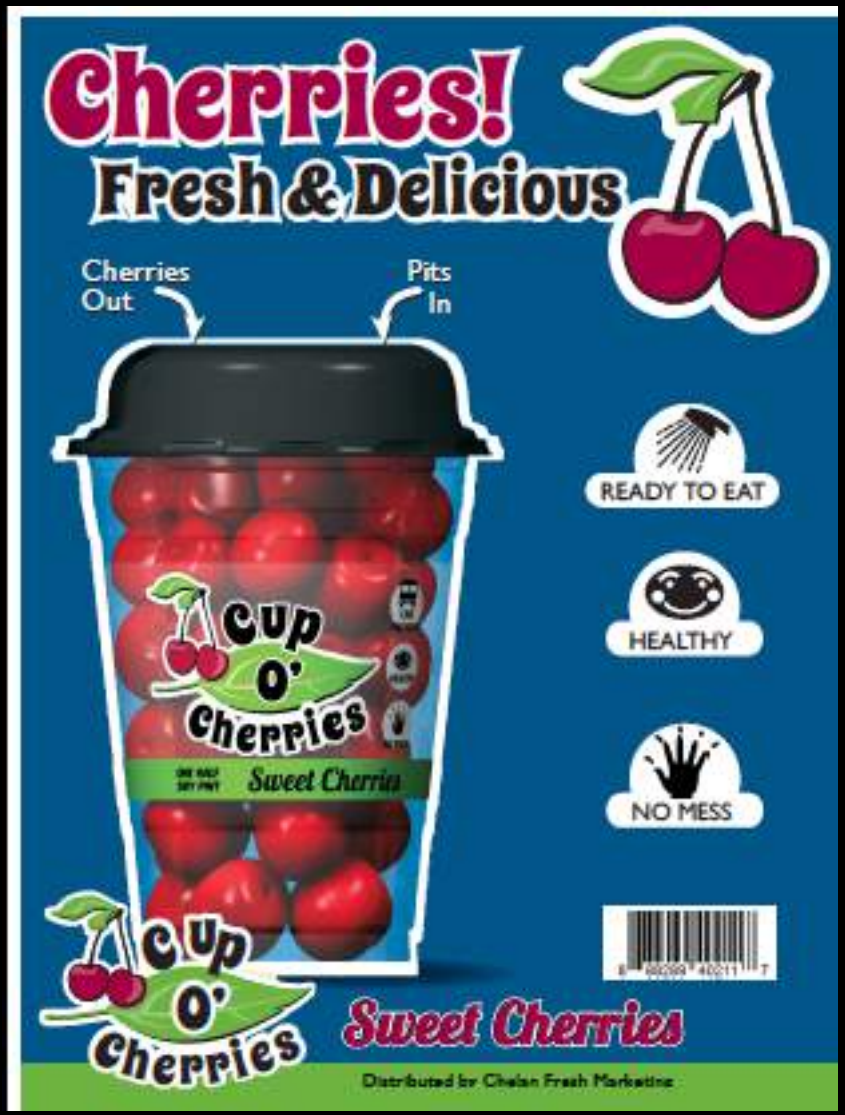
Shake-and-catch harvest testing

Chelan – high PFRF

Skeena – low PFRF

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

New packaging + marketing by Chelan Fresh



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

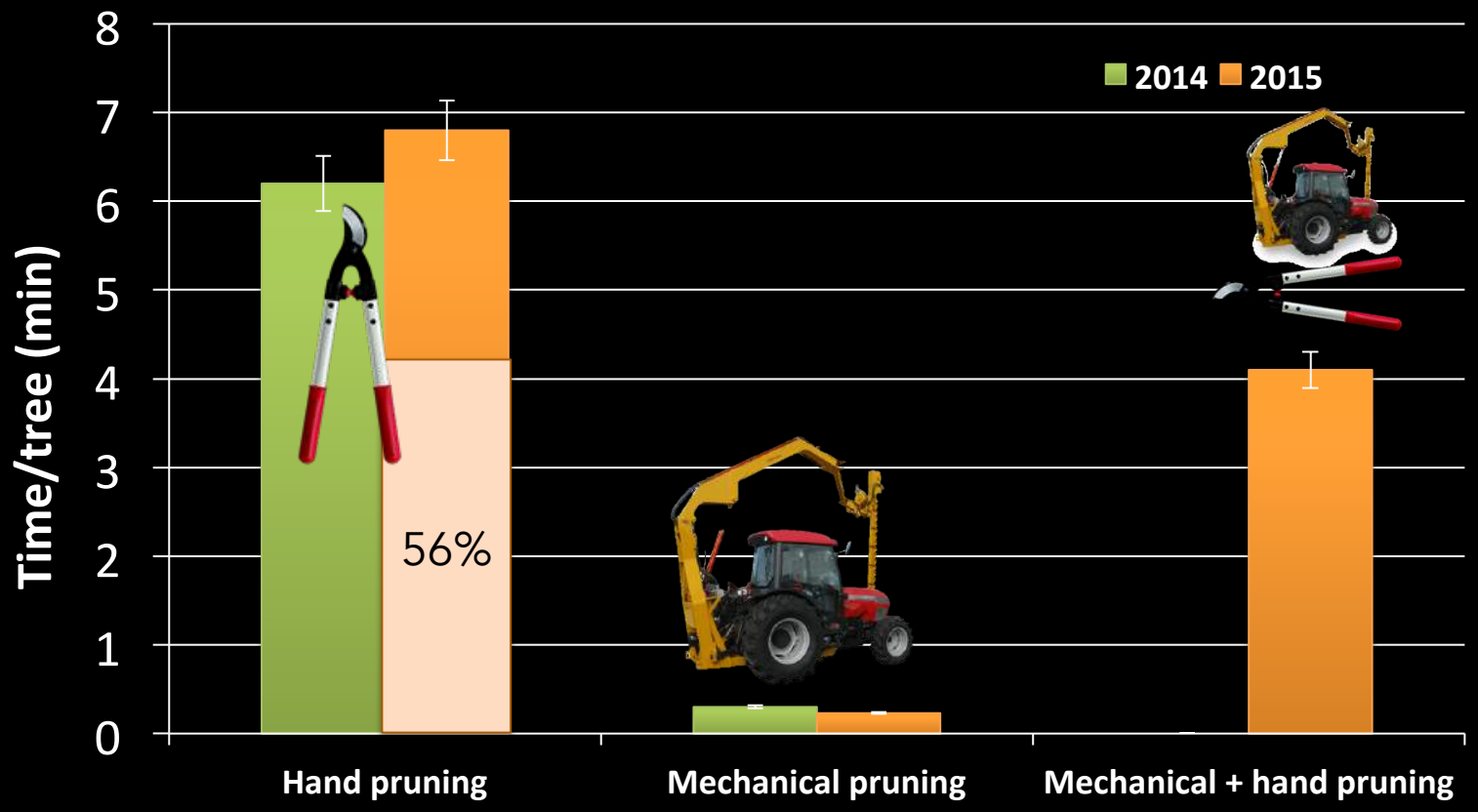
YEAR 1

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

YEAR 2

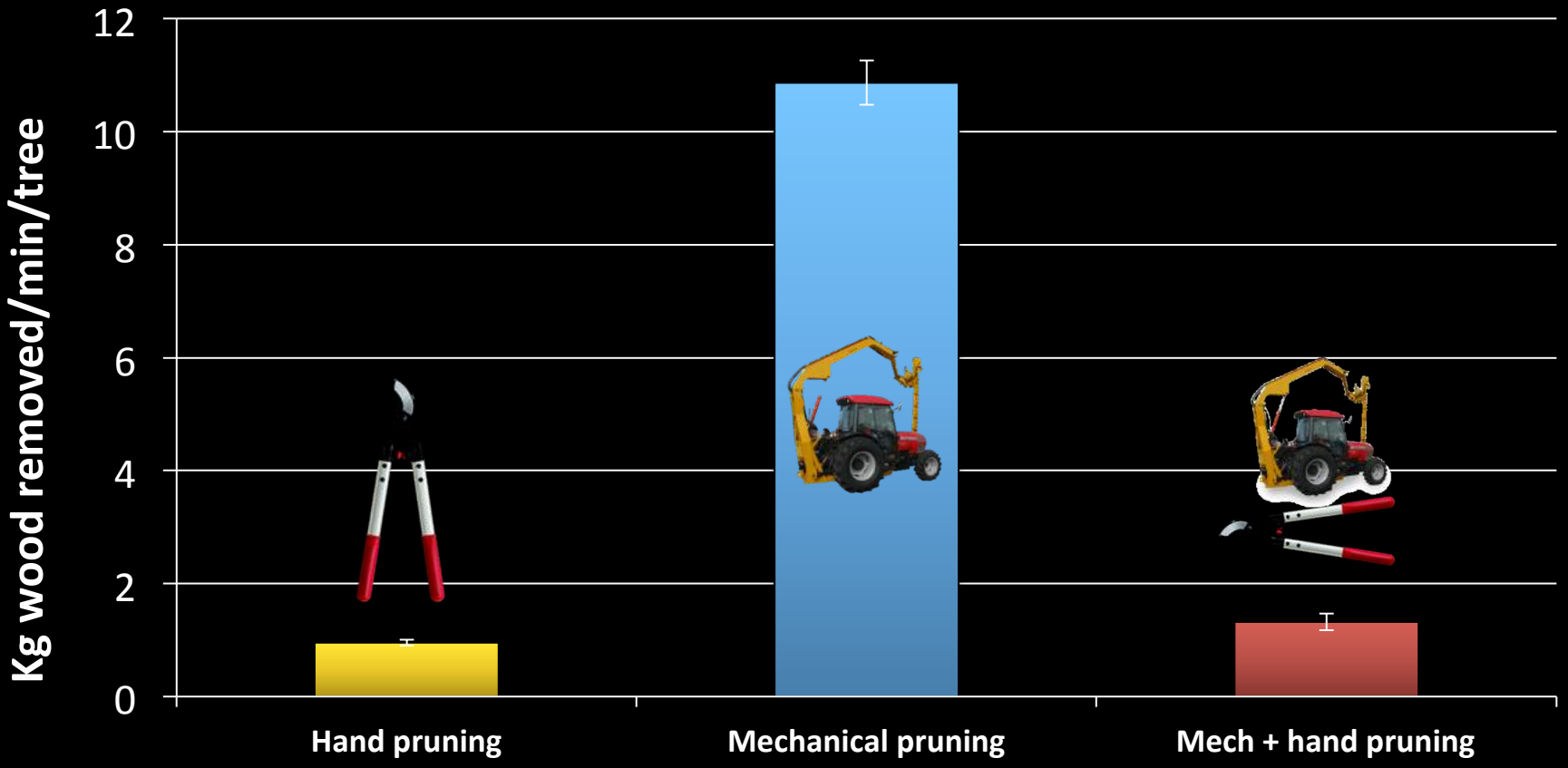
1. Hand pruning
2. Mechanical pruning
3. Mechanical pruning + Hand pruning

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 (α= 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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