

Plantaciones en ladera y alta densidad









Planting systems on hillsides – a holistic approach



Planting Design

Ability to adapt planting system for hillsides

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Medium	Worst	Best

Trees per Hectare

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Least	Medium	Most
277	463	1,110

Planting Orientation

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Contour	North/South preferred	No specific orientation since trees are equidistant

Tree Height

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Highest	Medium	Lowest
Unpruned	Depends on distance between rows	Depends on distance between trees

Tree Dimension

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
4 sides plus top (until trees grow into a solid canopy)	2 sides plus top	4 sides plus top

A low density planting from CA



The external wall appears productive..... But walk inside and one sees empty non-productive space

Low density planting



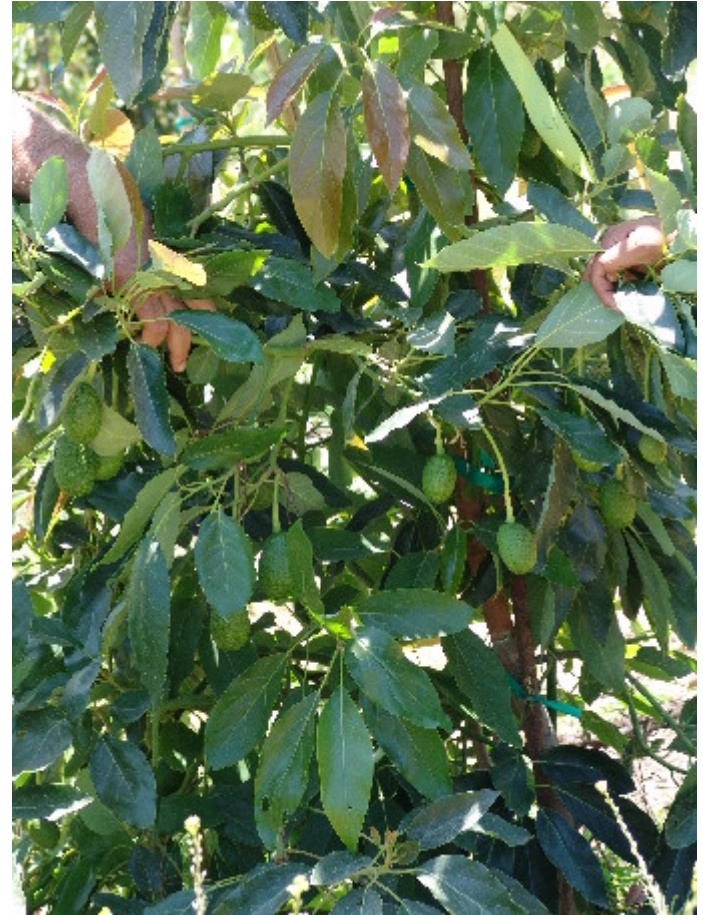
A California Hedgerow



California Hedgerow



High Density



High Density in California



Exposed canopy surface area

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Good only until trees touch; then only top of tree and sides of the block	Acceptable if N/S planting is achievable	Best since all sides exposed

Light penetration into the canopy

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Worst	Intermediate	Best

Half-tree contour of light penetration – Hedge Row

Extent of
effective light
penetration

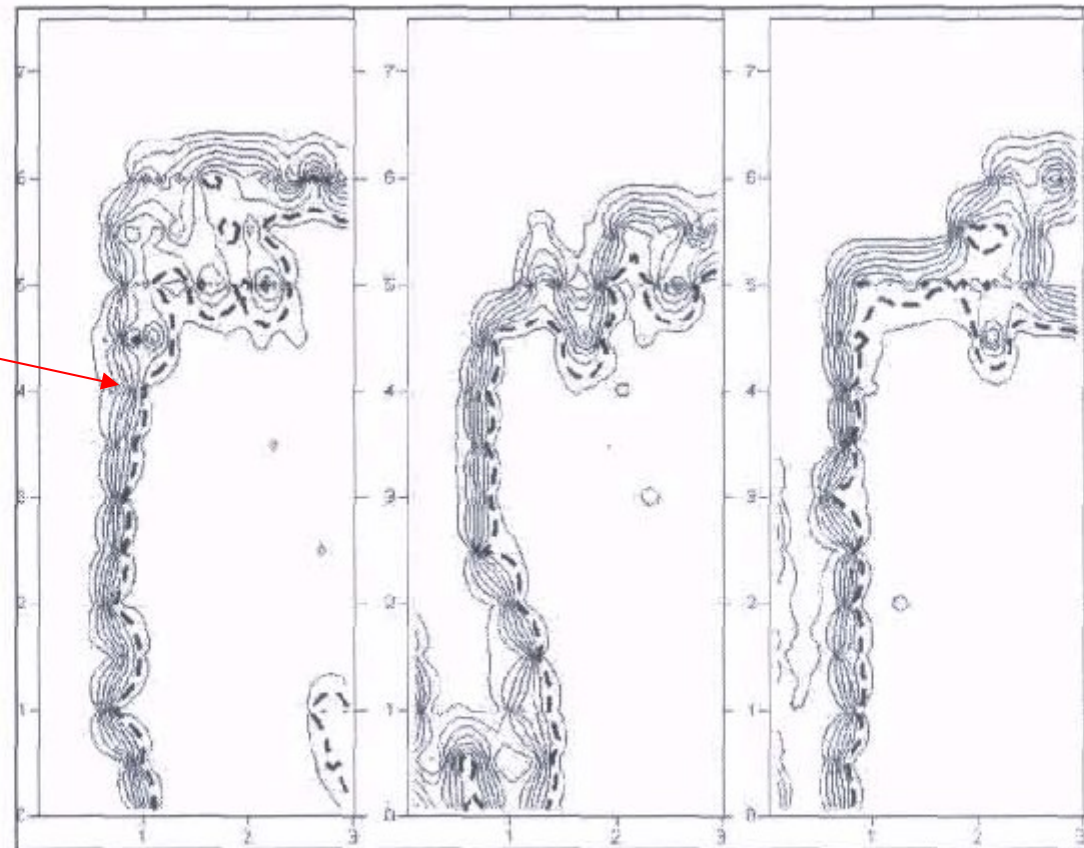


Figure 51– Contours of half-tree cross sections based on measurements done on the 7/9/2003 in 'Shomrat' orchard; CV. Hass; pruned hedgerow; three different cross sections from the same row.

Light penetration into the tree

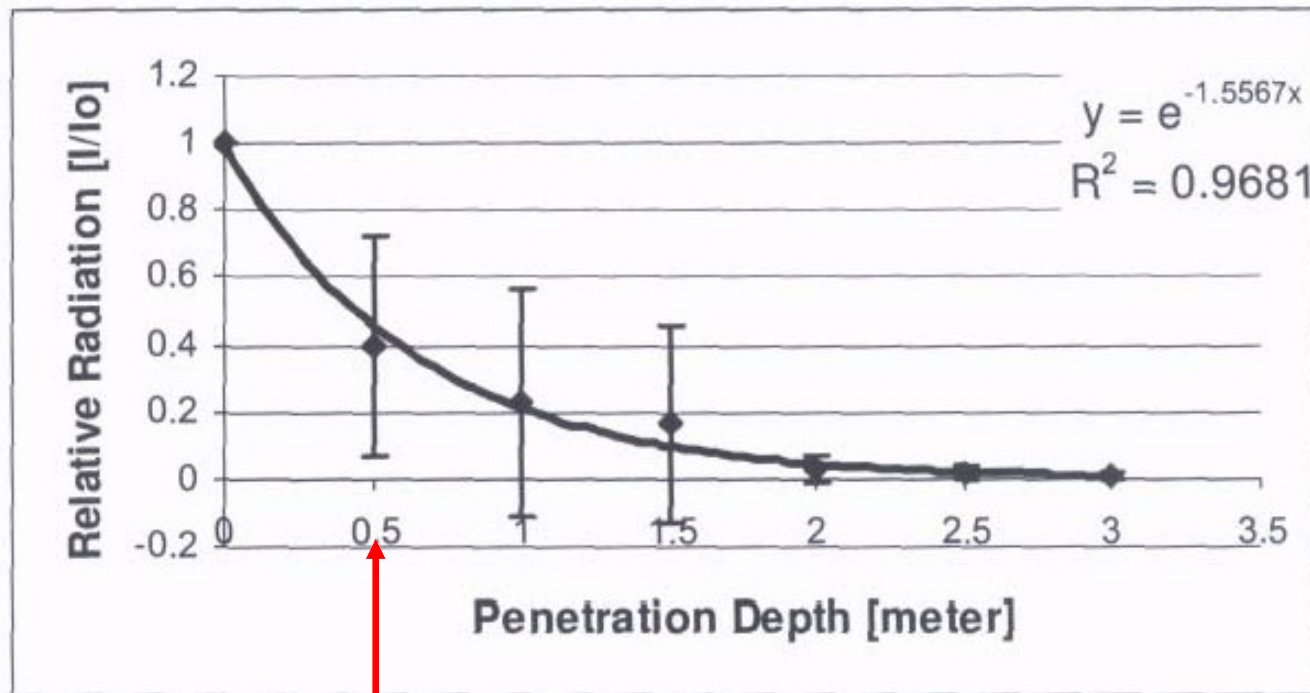


Figure 53- Relative irradiance in different depth of the canopy as measured on the 3/9/2003; “Shomrat orchard”, CV. ‘Hass’.

60% reduction of light penetration within 0.5 m (20 inches)

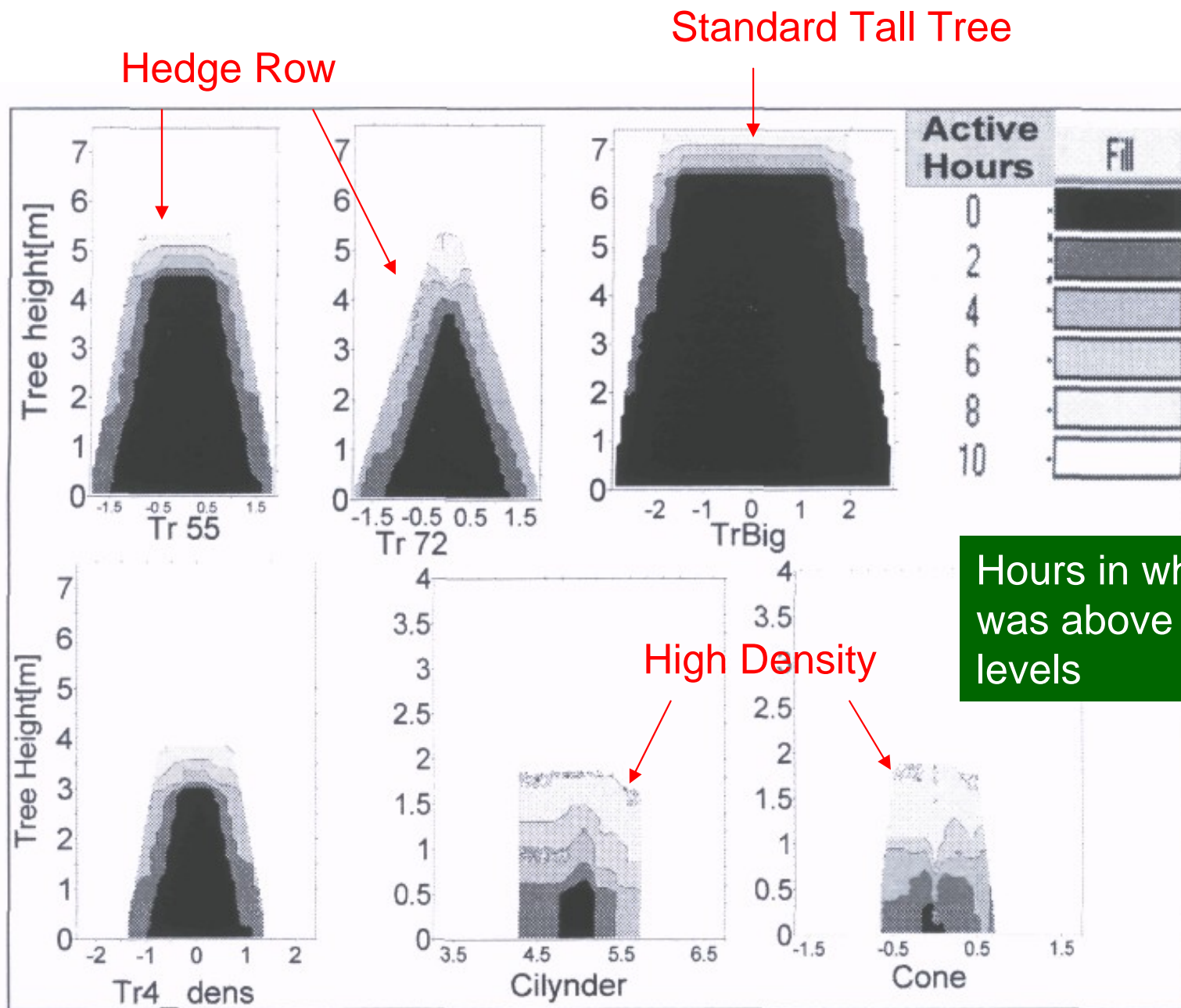


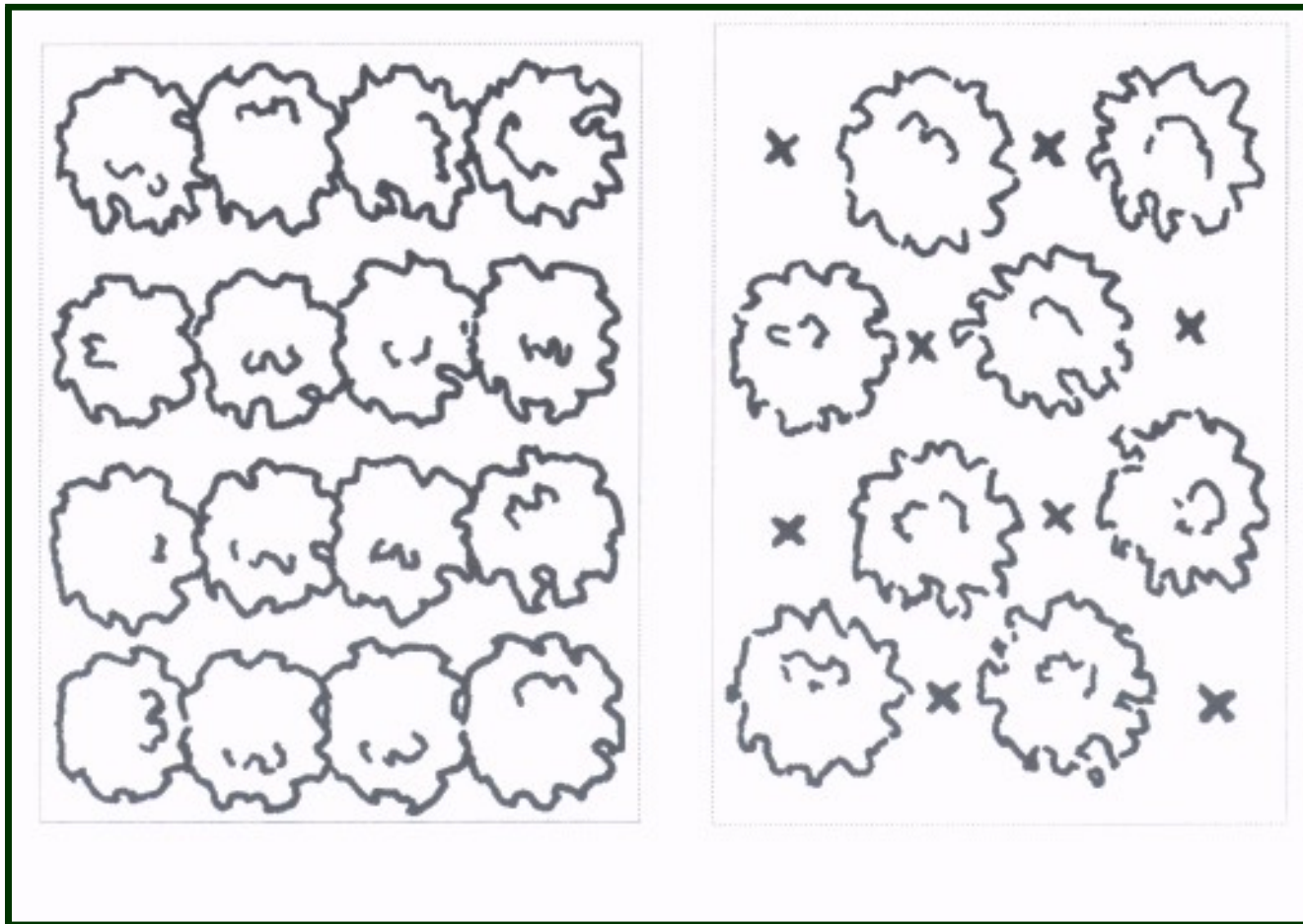
Figure 50 - Seasonal averaged daily exposure hours with PAR above the threshold level in selected models.

Management Strategies

Tree Removal

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Yes	No	No

Tree removal when crowded



Rejuvenation Strategy

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Stump trees; keep same trees forever	Side replacement every 3 years	Tree replacement every 10+ years

Rejuvenation of tall trees



Pruning Activity

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Least	Intermediate	Highest
Low branches only	Some annual pruning with aggressive pruning every 3 years	On going



Hedgerows require
severe pruning every 2 to
3 years

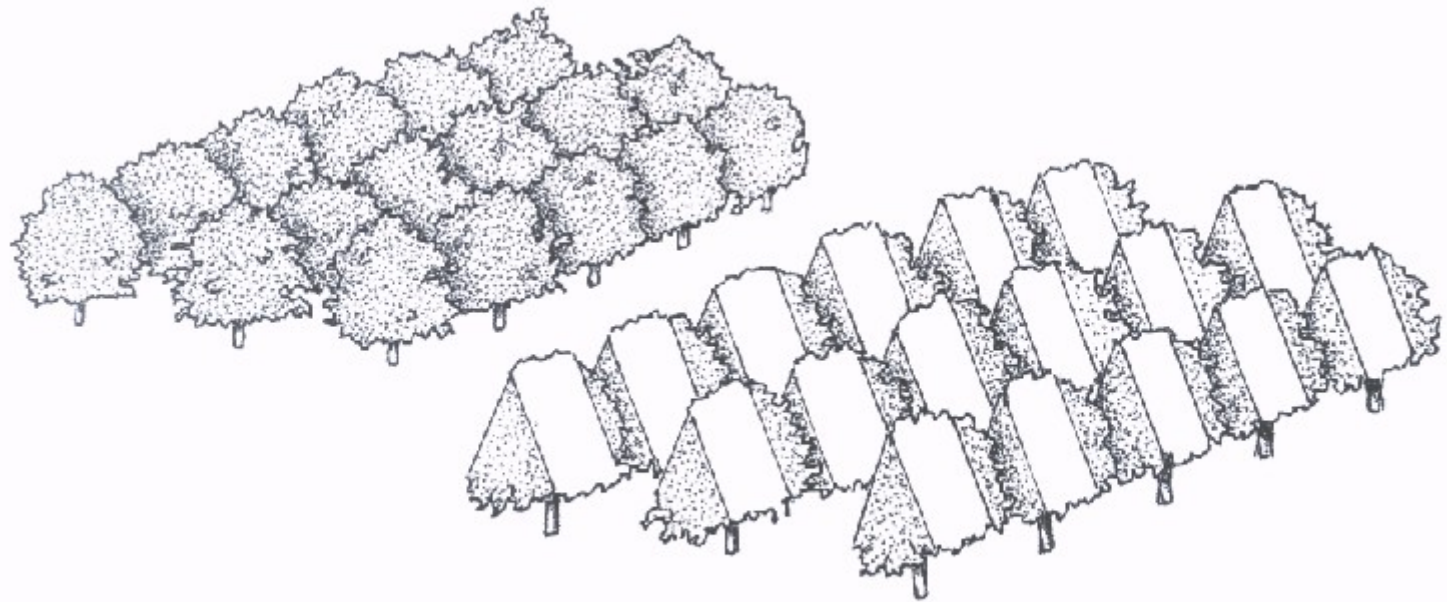


Figure 26. Desired result from hedgerow pruning. Upper: orchard before pruning. Lower: orchard after pruning

Mechanical Pruning of Hedgerows on Flat Ground



Mechanization is more complicated and costly on hillsides

High Density Maintenance

Light pruning 2 to 3 times/year



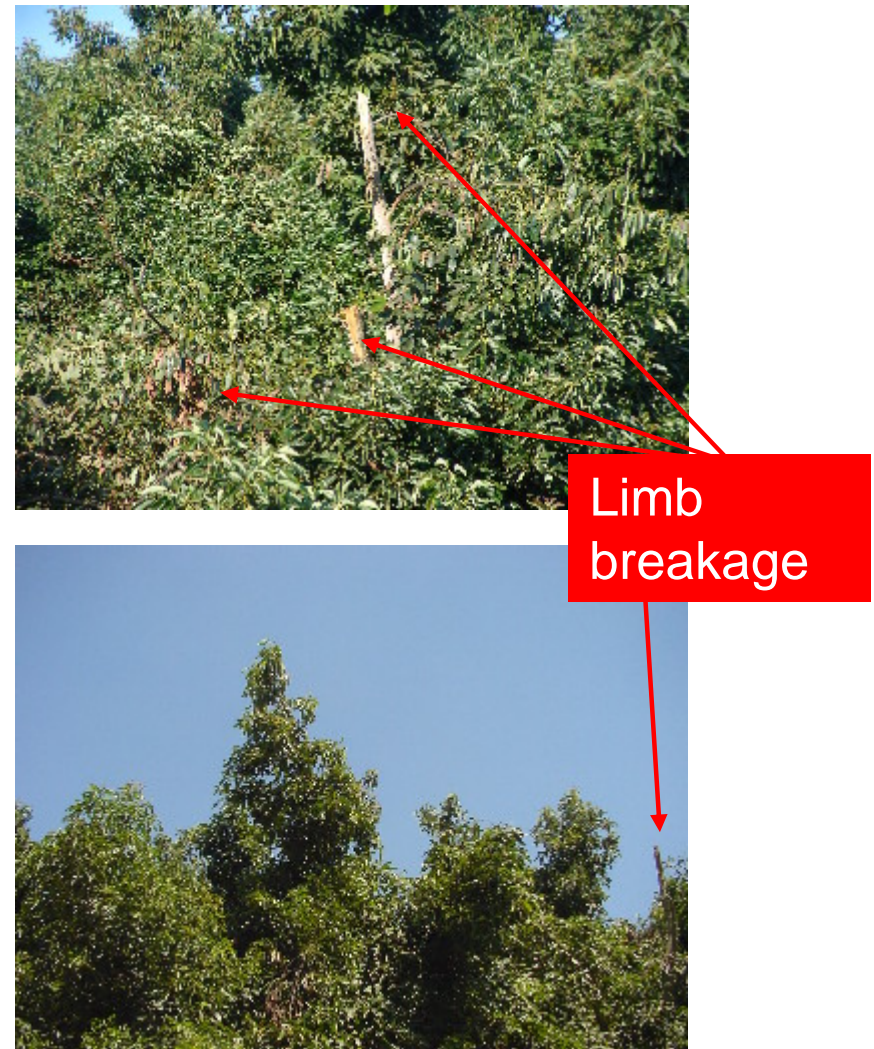
Branch support (staking) and probability of branch breakage

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
High	None	None

Staking and limb breakage



Limb breakage



Cost and ease of spraying for pests

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
High	Medium	Low
Requires helicopter in most cases when trees are mature	Helicopter and some ground application depending on slope and accessibility	Ground application feasible





Pathway for honeybees

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Good in early years	Medium	Always

Productivity considerations

Early production (on per hectare basis)

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Least	Medium	Most

Kilograms of fruit needed per tree to achieve production goal

Tree spacing (m)	Target Production (Kg/HA)		
	10,000	15,000	20,000
3 x 3	9.0	13.5	18.0
6 x 6	36.0	54.0	72.0

Productivity loss as trees mature and crowd

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Low until shading occurs	Loss occurs every 3 rd year when one side is severely pruned	Least

Harvesting considerations

Cost of harvesting

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Highest	Medium	Least

Size picking accuracy in mature trees

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Low	Medium	Best

Impact of planting density on ease of harvesting

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Good as long as trees are relatively small	Depends on orientation of hedge row relative to the slope	Always easier to pick

Harvest equipment required (ladders and picking poles)

Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Most	Medium	None

Worker environment

	Low Density (6 x 6)	Hedge Row (3.6 x 6)	High Density (3 x 3)
Worker Efficiency	Low	Medium	High
Worker Friendly	Least	Some	Most

Picking from the ground



Even the inexperienced can do this!



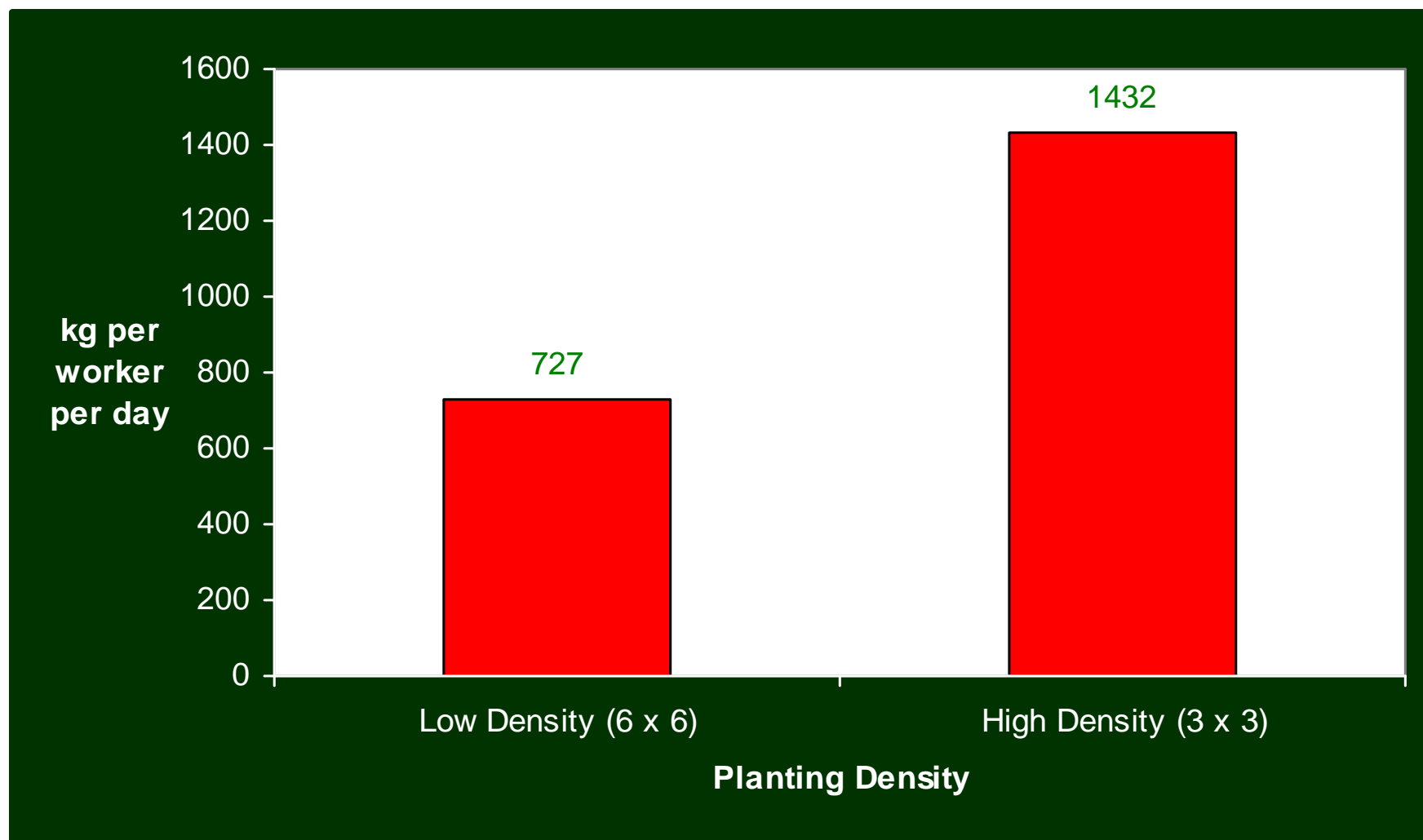
More experience is needed here to use the picking pole

The Ladder

Dangerous and inefficient

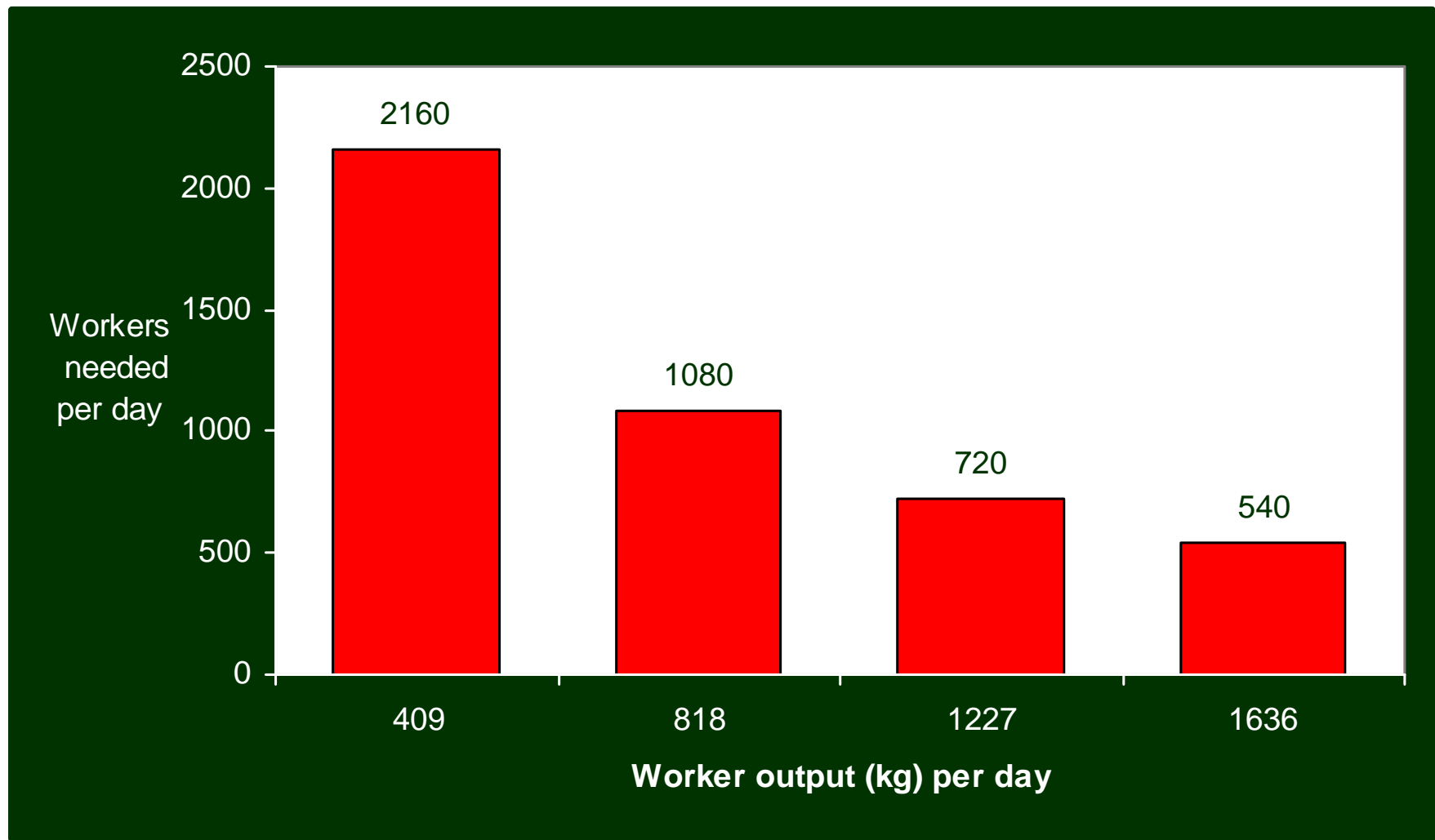


Average worker output per day vs. planting system



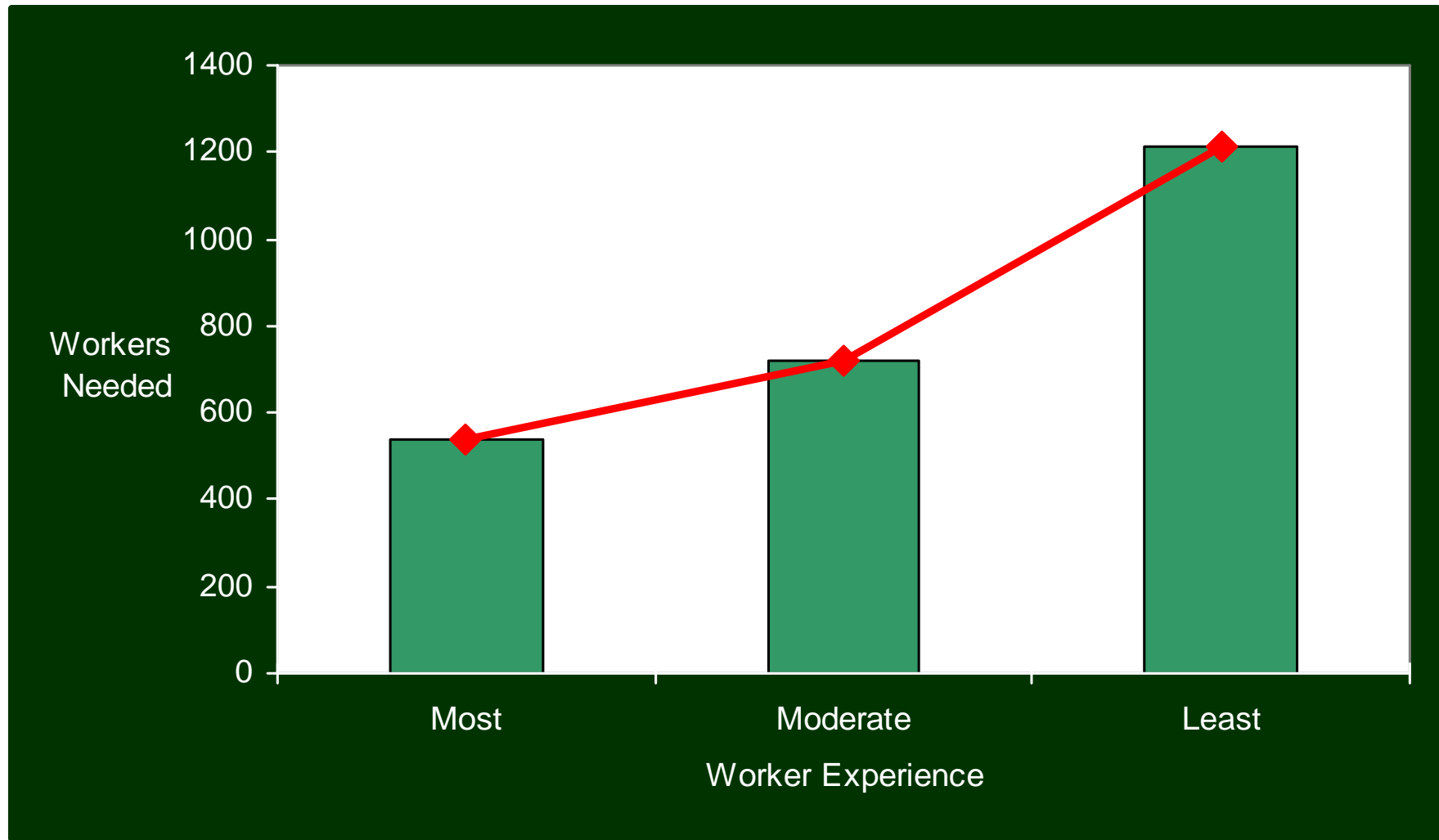
159,091 MT crop; 180 day picking season

Workers needed per day for CA industry vs. worker output per day



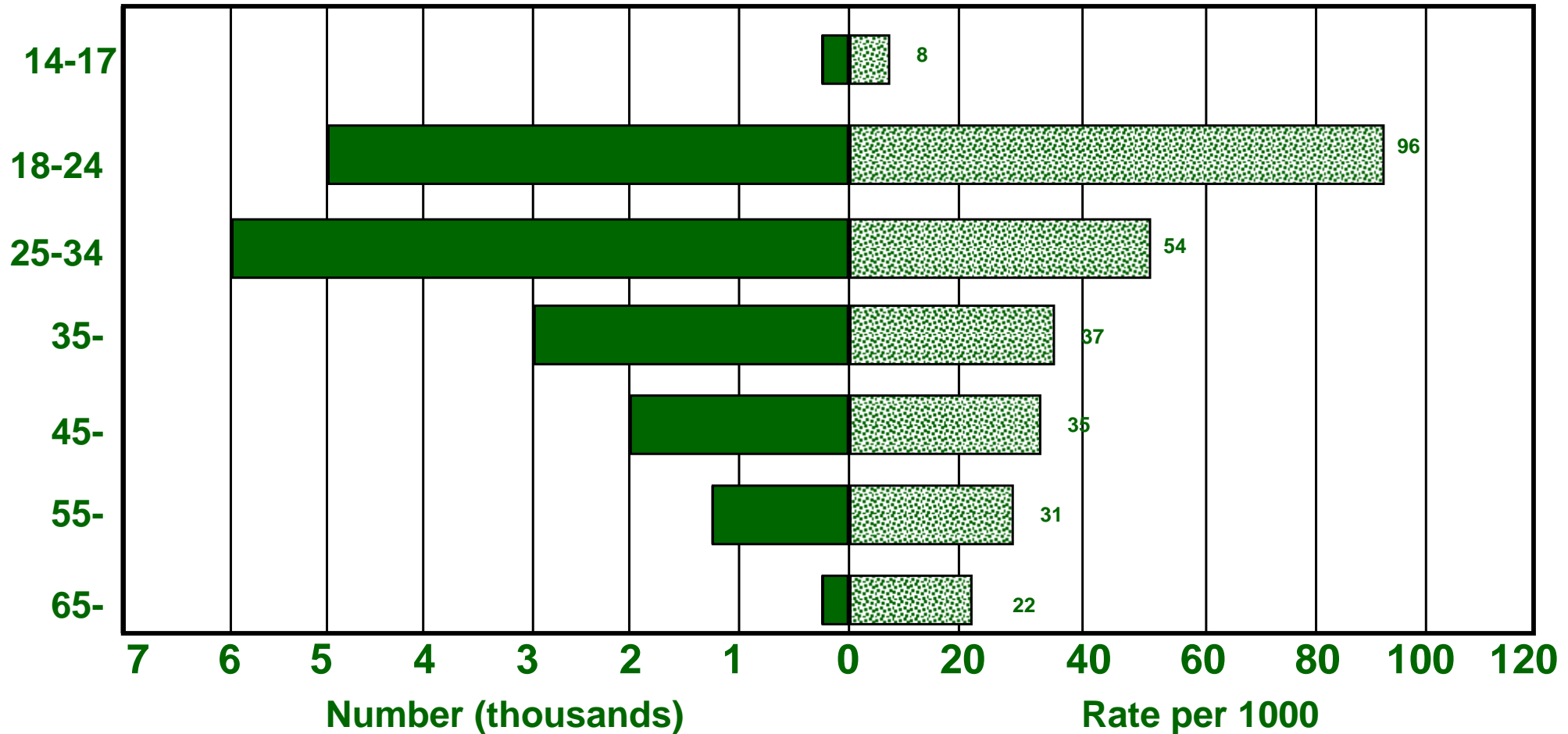
159,091 MT crop; 180 day picking season

Workers needed per day vs. worker experience



Age Specific Injury Rates

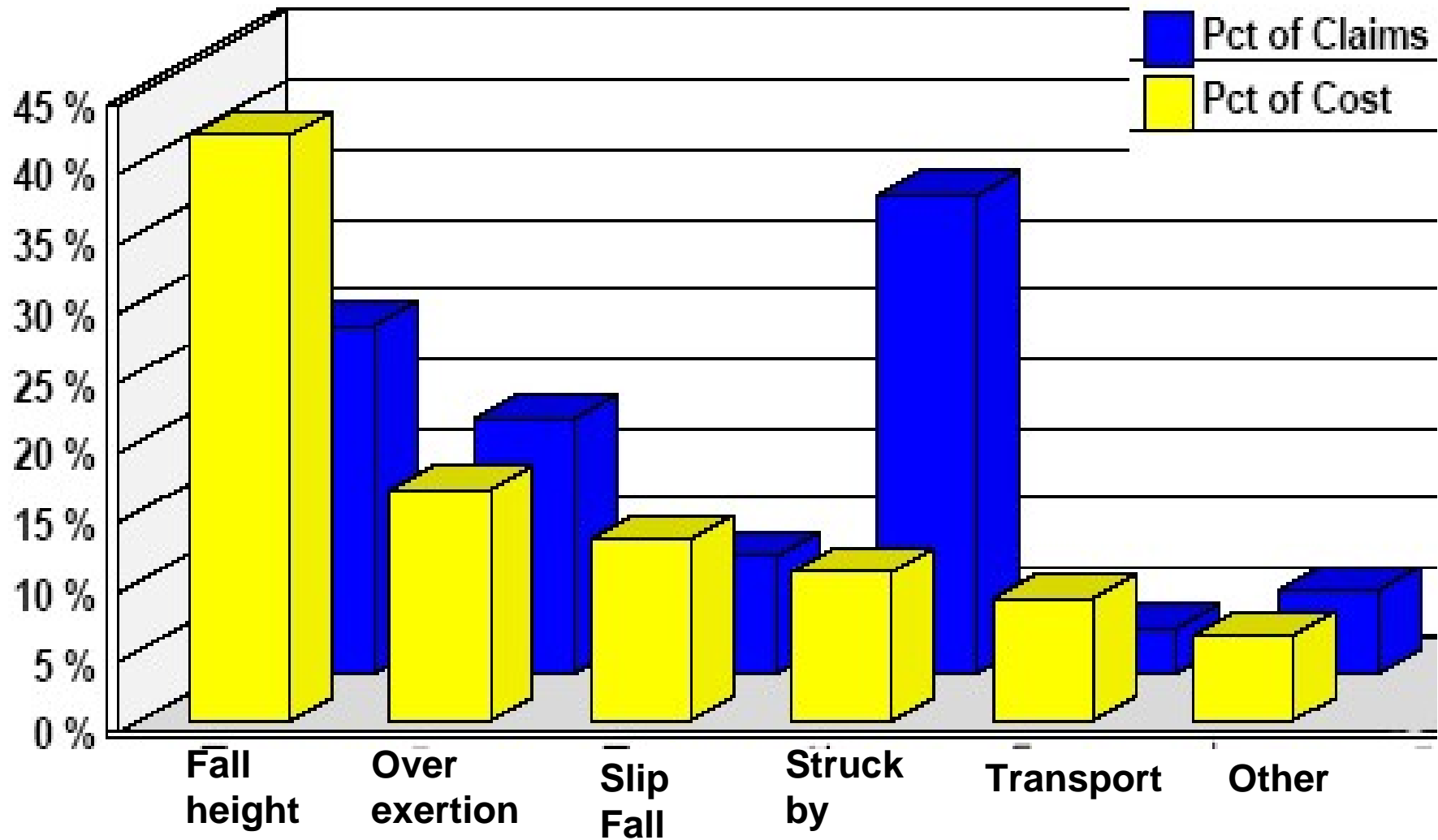
AGE GROUP



Worker safety



WCI CLAIMS



James M Meyers

School of Public Health, University of California, Berkeley, CA 94720

WCI CLAIMS - FALLS

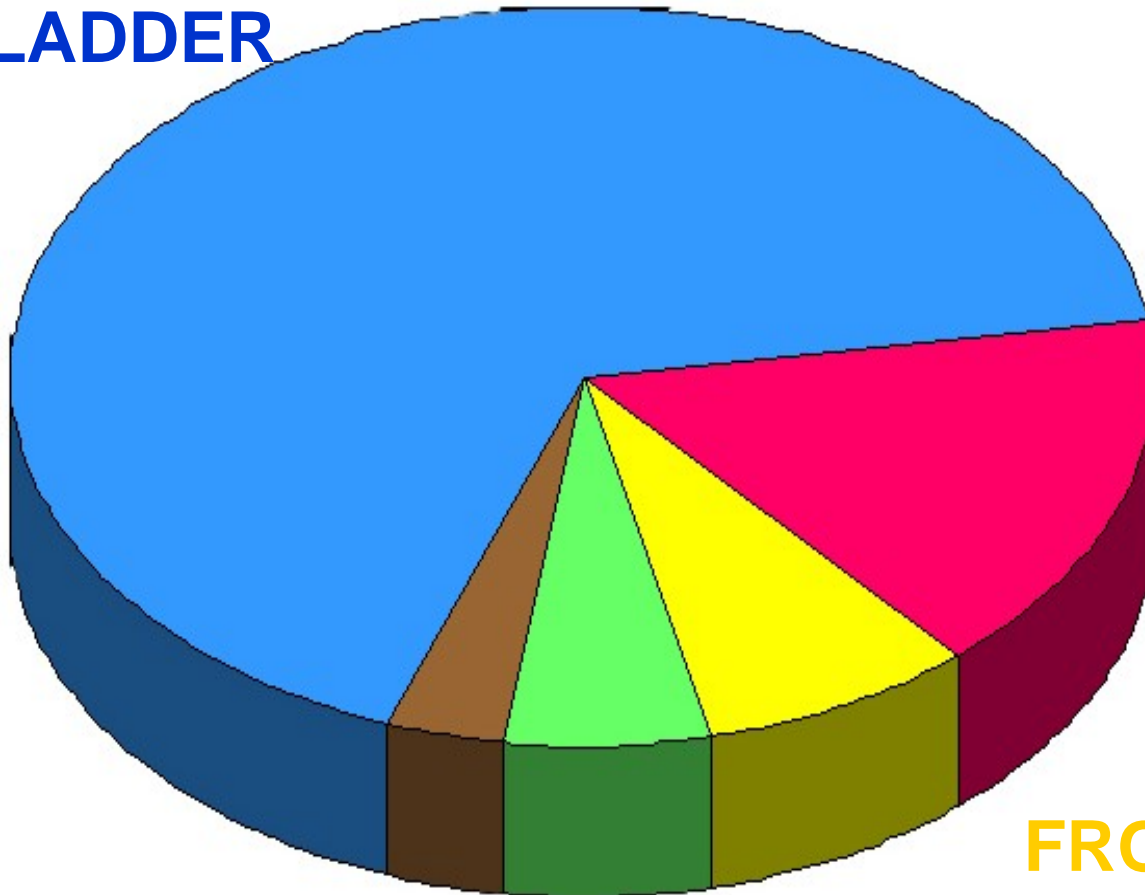
FROM LADDER
67%

SLIP/NO FALL
3%

SAME LEVEL
6%

SLIP/TRIP
16%

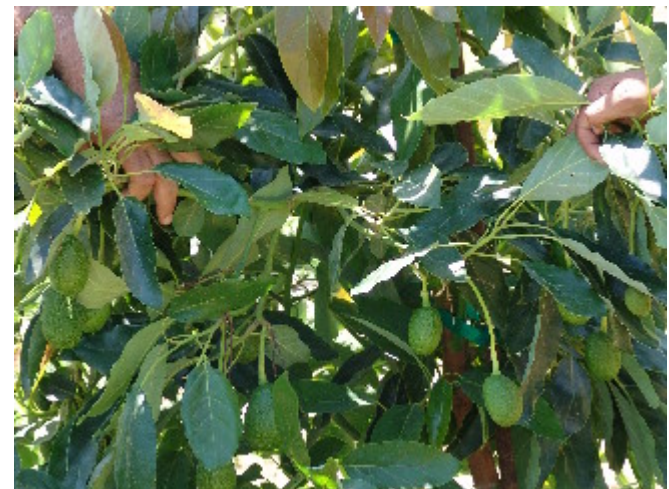
FROM ELEVATION
8%



High-density plantings achieves these goals:

Efficient production through
integrated management of
the orchard system and its
component parts

Produce avocados of high
quality, with a satisfied
workforce and lower
production costs and
higher returns





In conclusion

High density plantings on hillsides is **achievable**

Will require more attention to detailed management

Keys to success:

- Holistic approach
- Minimize alternate bearing
- Manage nutrition for fruit rather than growth
- Rootstocks???

For more information visit

www.avocadosource.com

the avocado world at your fingertips



The information on this website is free and includes downloadable information from around the world on all aspects of avocado production.