

Canopy Management Strategies



The Problem:

- Our avocado trees are too tall!
- We grow on mountains
- Picking is very slow because pickers are working from ladders that are 30 ft (9 m) high, using 10 ft picking poles to reach the fruit

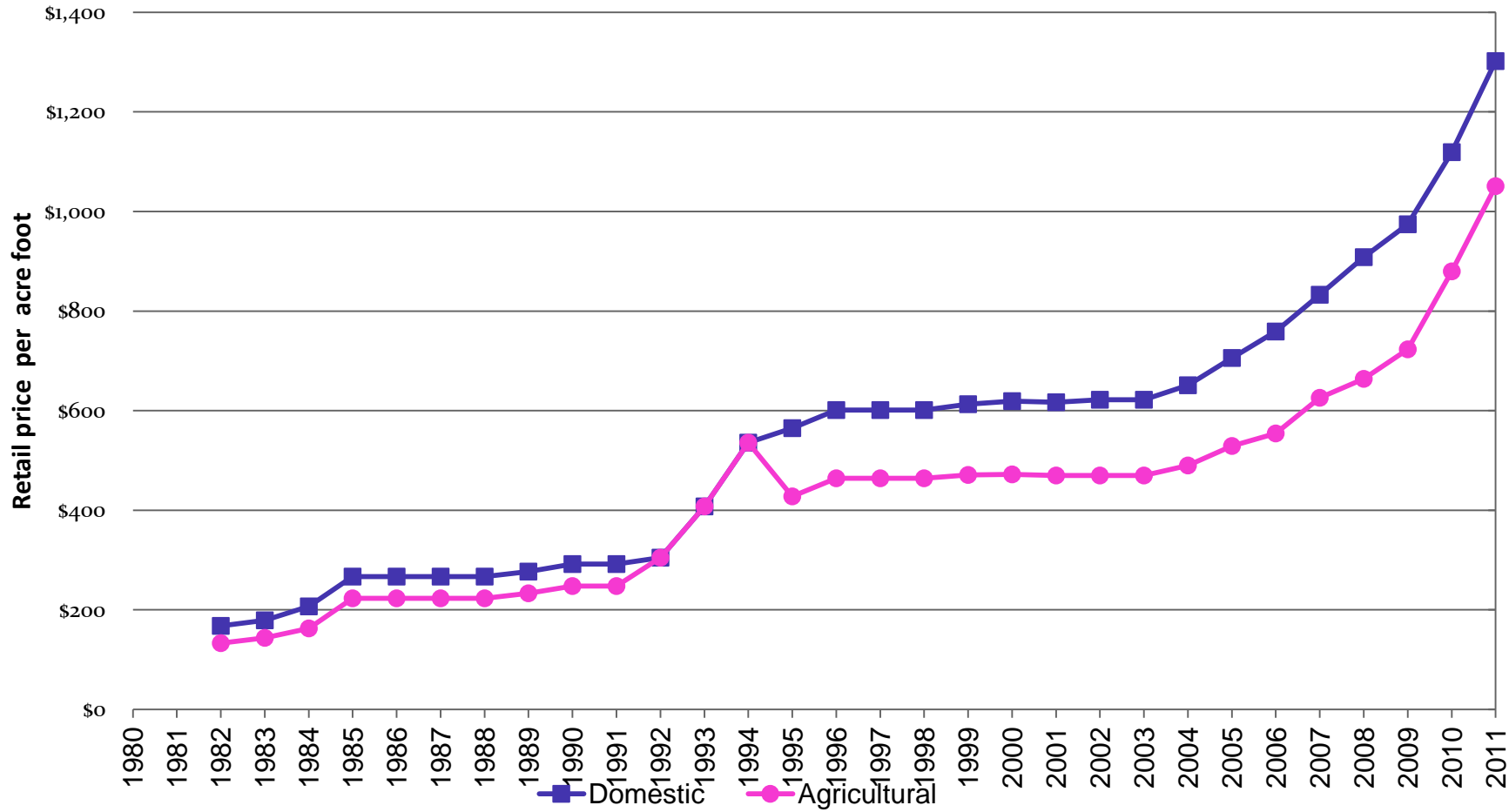


We have to worry about Costs.
What are **Operating** Costs?

- These are costs to actually farm the crop
- Herbicide, bee hive rental, road repair, harvesting, packing, CAC assessment, spraying for thrips, PCA, fertilizer, water, labor

- **Water is the big one, especially for San Diego**
- At four ac ft/acre, at \$1300 per acre ft, water cost is \$5200 per acre
- For ten acres this will be \$52,000!

Valley Center - Water Rate Schedule



As a Result – Avocado Acreage is Declining

- High water prices makes it impossible for growers to make money at the county average yield (5,000 lbs/acre), unless they get \$2/lb
- We need to increase yield/acre
- How do we do that?
- Or can growers even get water?

Notes from R. Hofshi, High Density Avocado Planting (not dated):

- Low avocado prices due to competition will require more efficient farming and a significant increase in productivity.
- Young trees are vigorous, produce large fruit early, have better canopy to root ratio and reach peak productivity approximately by 7 to 8 years.
- Smaller trees are easier and less expensive to harvest, particularly when size picking is done, and are very amenable to snap harvest.
- Spraying for different pests may become a way of life; smaller trees are probably the only ones that could be efficiently sprayed by ground rigs in hilly terrain.”
- Reduced alternate bearing

Notes from Z.R.Ernst and A.A.Ernst, High Density
Cultivation, 2011

- Overgrown avocado trees only produce on the canopy boundary and probably in the first meter or two from the edge of the canopy
- All of the volumetric capacity inside the above boundary remains unused as only unproductive branches grow here
- Keeping trees smaller increases the entire volumetric production of the orchard
- Also, worker safety will be improved as pickers no longer have to be up on cherry pickers (in South Africa), or, in our case, ladders on slopes

What about pruning?

- In the early 1990's there was a lot of talk about improving yield by pruning, but
 1. Growers didn't know how to prune
 2. Grove workers certainly didn't know how to prune
 3. At any rate, it had never been proven that yields could be improved by pruning
 4. Many theories on what to do!

Could we improve yield by pruning?

- To answer this question Bender and Faber designed a pruning trial in 1998 that would compare 8 different styles of canopy management.
- Our goal was to develop methods that could improve yield, and trees that could be picked from the ground



Original Pruning Trial (implemented in 1998)

- 3 groves in Ventura County
- 3 groves in San Diego County
- Each grove would have all 7 pruning methods and a non-pruned control block
- Each pruning method would have at least 16 trees in a block
- However, 2 groves suffered severe frost damage, and 2 growers backed out of the trial
- Left with 1 grove in Ventura and 1 in San Diego
- Data lost from the Ventura grove in 2003

At the completion of the trial

- The trial ended in 2005
- We had six years of individual tree harvest data (at least sixteen trees from each pruning method) from only one ranch, the Nick Stehly Ranch in Valley Center
- Due to the lack of replication in other ranches, we couldn't statistically analyze the data and publish in a journal
- However, we have some interesting data!
- (and we made some mistakes to learn by)

Styles of Canopy Management

- Non-pruned control
- Cal Poly low stump (1m or 3 ft), vase shape
- Stump - Single Leader
- Stumped, no follow-up
- Thinned
- Australian 2-cut method
- Cal Poly high stump (2.5 m or 8 ft), vase shape
- Israeli method

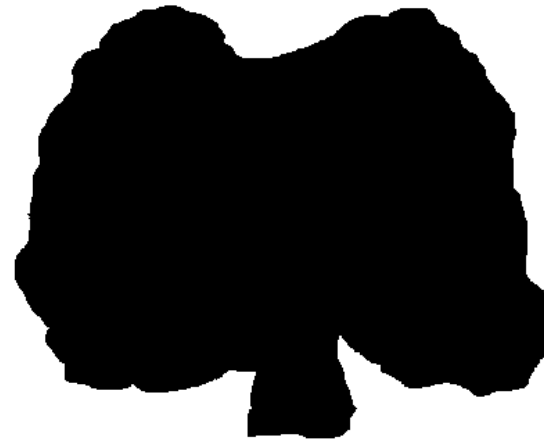
Stumping (no follow-up pruning)

- Normally done in California
- Trees are cut back to stumps about 3 ft high (1 m), no pruning
- Stump is painted with white water-based paint to prevent sunburn



Stumping - Cal Poly Style

- Suggested by a professor at California Poly College, Pomona
- Trees are kept at 13 ft (4 m) in height
- Center is opened like a vase shape
- Sides of canopy lightly pruned each year



Stumping - Single Leader

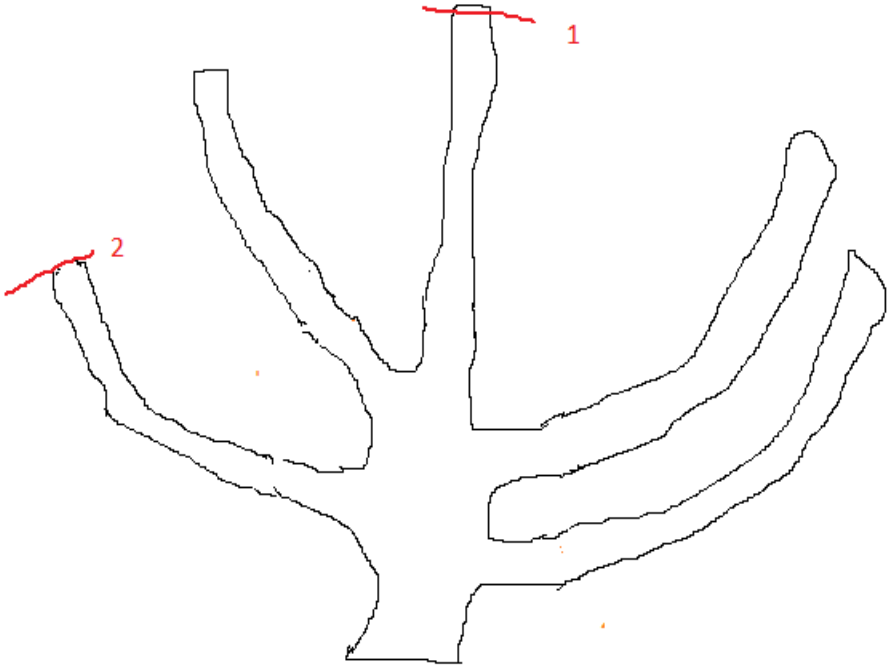
- Trees are kept at 13' (4 m) in height
- A strong branch growing upright in the center is kept as the leader
- Others are nipped back soon after fruit set each year, leaving enough leaf cover to shade fruit



Australian 2 Cut

- Suggested by a grower who returned from Australia
- Each year the highest branch is cut back to 20' (6 m) in height
- And the most vigorous branch growing into the adjacent tree is cut back
- Only two cuts are made each year
- This slowly brings the tree down and back into its proper place
- This keeps the tree in production while it is being rejuvenated
- But, cutting the center branch back is **dangerous!, it fell back on us several times**

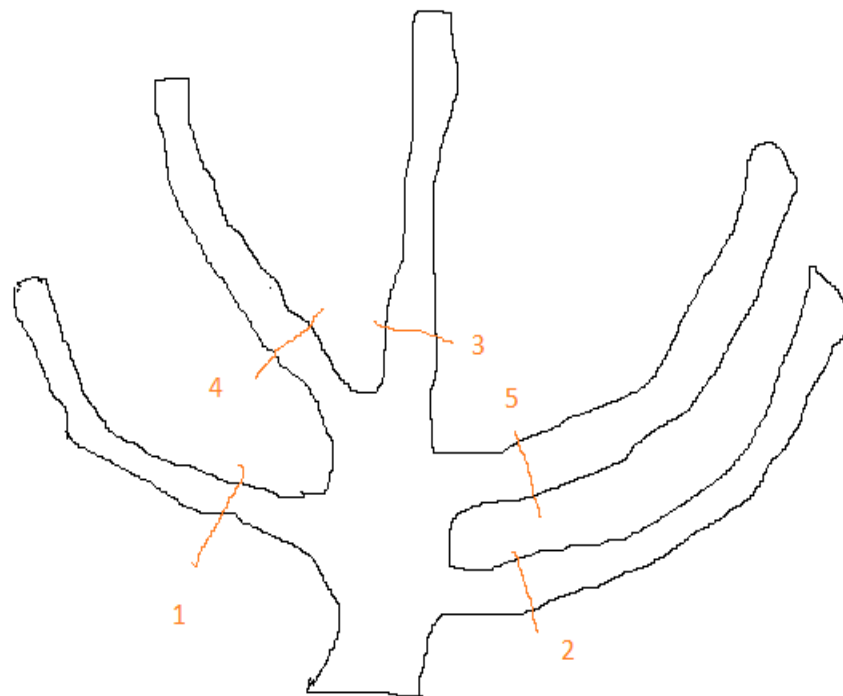
Australian 2 Cut



Israeli Method

- Suggested by two Israeli farm advisors
- Tree is divided into five main branches
- Start this year cutting back the branch aimed toward the afternoon sun.
- Each year cut one more branch
- This keeps the tree in good production and by the fifth year the tree is completely rejuvenated
- All cutting is done from the ground
- Simple and easy for grove workers

Israeli Method



Thinning

Suggested by Bob Platt, former Specialist

Every other tree is removed

Old research from the 1970's showed removing ½ of the Fuerte trees increase production per acre



Thinning

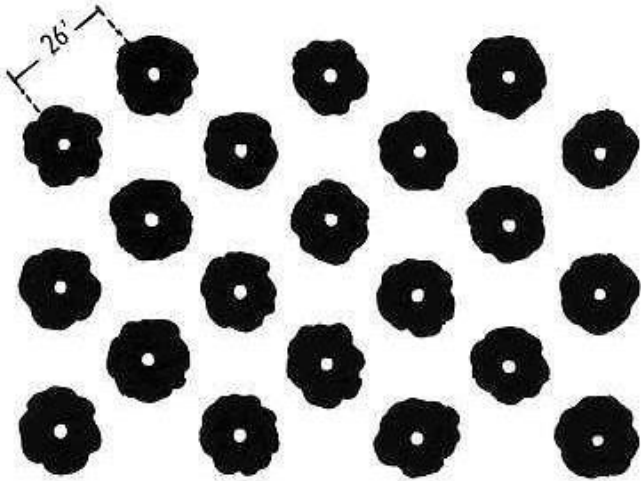
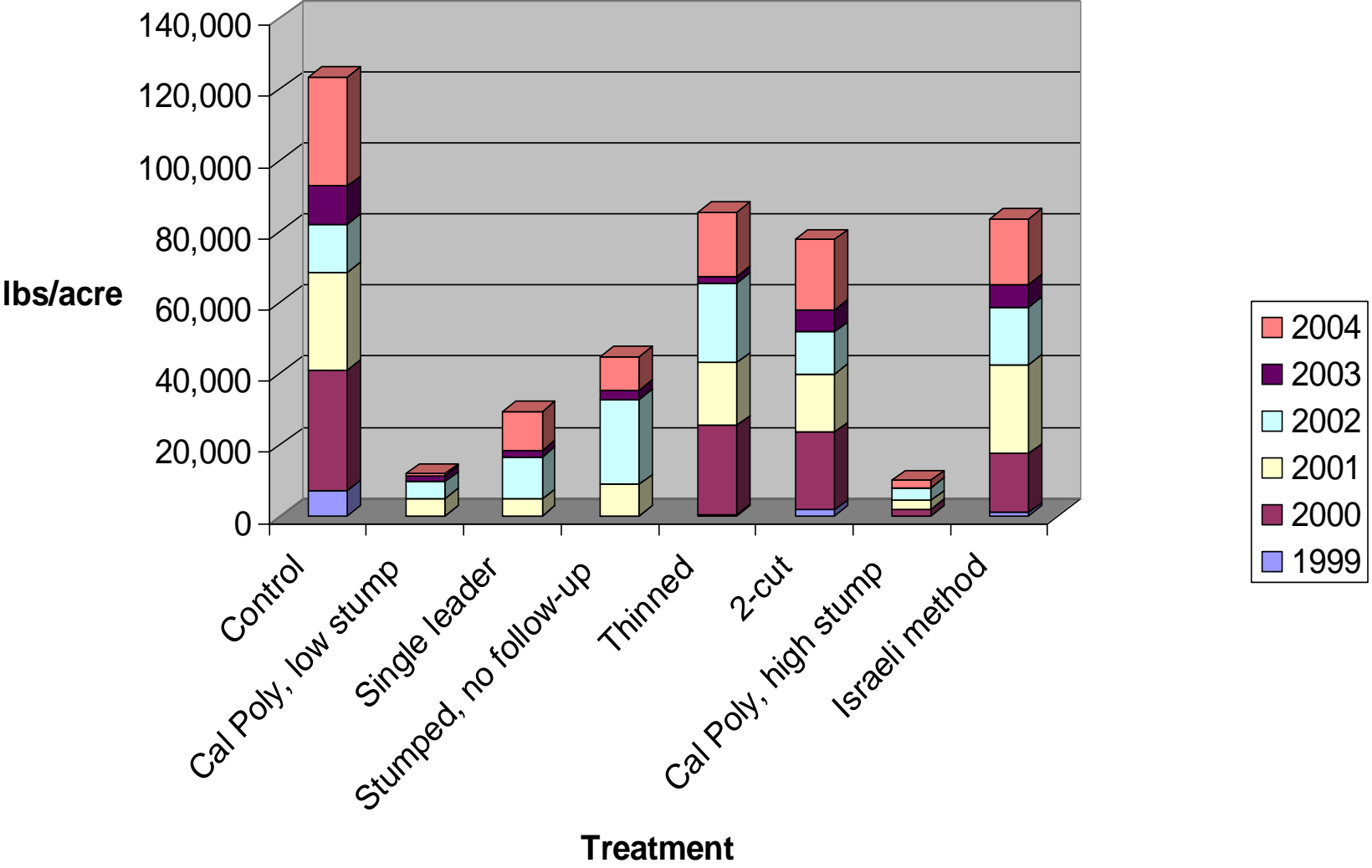


FIGURE 5. Orchard after first thinning--68 trees per acre.

Accumulated Yield per Acre, 1999-2004



Reduced yield is often found in pruning studies, but the more important result is reduced alternate bearing. Lack of timely pruning, also impacts yield. Allowing trees to carry fruit when they are flowering reduced energy available to support both flower and fruit.

One Big Mistake in the Trial!

- The beehives were set next to the control trees by the beekeeper. This created a design flaw in the trial: we saw the bees really working the control trees.

What Did We Learn?

- With the Stumped Trees:
- The 80% rule proposed by Pete Stassen in South Africa seems to be about right. Therefore a tree on a 20' (6 m) x 20' (6 m) spacing should not be higher than 16' (4.8 m) in order to maintain production in the lower canopy. To maintain a tree at 16' (4.8), the tree should be pruned at 14' (4.5 m)
- Keeping a tree at this height takes about 10 minutes per tree, twice a year.

Pruning after the summer flush reduces yield, all pruning should be done before August to preserve the summer flush for flower production. This is why the **Cal Poly** methods had low production.

Stumping with no follow-up pruning' becomes very crowded in the fifth-sixth year. Leaves are falling off lower branches in the shade

Don't prune sick trees, regrowth occurs at the expense of root health

Pruning overgrown mature trees (renovation) is different from guiding young trees.

Light is needed on all sides to cause flowering lower down in the canopy

Head back water sprouts lower in the canopy and remove those higher.

Prune at least 3-4 feet lower than you want the height of the tree.

Cut branches first on the south side of the tree.

Harvesting two vertical branches and pruning those is easy and the other branches can be left to size fruit.

The higher the cut, the sooner the production

Don't prune alternate trees in a block,
prune a whole block at the same time

Prune as an irrigation block.



Other Considerations

- Labor supply and skill in harvesting is a major issue in the avocado industry and will be more so in the future
 - If this assumption is true, then we need to develop methods to prune trees and maintain trees at a low height, but with minimal removal of fruiting wood.

Also

- We didn't pay attention to On-Cycle trees and Off-Cycle trees. Trees were pruned the same each year.
- In "on" year, winter pruning can be lighter and usually no summer pruning, in "off" year, need to tip vigorous shoots to contain growth and force laterals that will flower

The Modern Avocado Grove

- Trees maintained low with pruning
- Pollinizers planted so each Hass 'sees' a pollinizer tree (maybe!, but not sure)
- Plenty of bees (3-4 hives per acre)
- Bloom sprays and mulching
- No water stress, leaching salts periodically
- Active scouting and spot treatment for insects and diseases
- But, how do we prune??

High Density Grove (10 x 10) in Temecula

	Yield lbs/acre
2004 planted	0
2005	0
2006	2,727 (est)
2007	3,636 (est.)
2008	2,727 (est.)
2009	4,545
2010	32,727
2011	
2012	

High Density Grove (10 x 10) – Escondido

	Yield in lbs/acre
2006 planted	0
2007	0
2008	0
2009	5,080
2010	7,656
2011	24,195
2012	15,144
2013	8,147

A New Research Project

- High Density Trial 10' x 10' (3m x 3m) spacing
- Each Hass tree facing a Zutano for pollination
- 3-4 hives of bees per acre
- Irrigation and fertilization carefully managed
- Hass and Lamb Hass on Dusa rootstocks
- Goal: Maximize yield per acre

This will be a Pruning Trial with 2 Treatments on
High Density Hass and Lamb Hass

1. All sides pruned and topped each year (1/2 of the trees), compared to:

2. Southwest side pruned in first year, Northeast side pruned in second year, Trees topped in third year

- Three year rotation
- There will always be fruiting wood on the tree
- This is easy for grove workers

One year after planting
August, 2013 -Top two rows of the plot



How will we prune?

- We will follow the suggestion by Gardiazabal and Mena (CAS Yearbook 2011)
 1. Prune in first year to establish central leader
 2. Prune vigorous upright shoots in the subsequent years that compete with the central leader
 3. Prune weak branches to create small holes in the canopy for light penetration

Vigorous side shoots competing with the central leader, these will be tipped



4. In later years prune vigorous side branches to maintain the central leader shape
5. Perhaps use growth regulator NAA to reduce regrowth

How tall should the trees be?

- 80% of 10' (3m) should be about 8' (2.4m)

As for On-Cycle trees vs. Off-Cycle trees

- Recently Claudio Hernandez and Felipe Brunet gave an excellent talk in California on pruning high density trees
- In Chile, “On-cycle” have: heavy flowering, high yield the following year, small fruit size, limited development of spring shoots, sun damage, poor growth in summer, low flowering in the next year
- These can be pruned in the early spring to reduce some of the flowers

- In Chile, “Off-cycle” trees have poor flowering, high yield this year, but low yield (for the following year), with large fruit, increased spring shoots, high vigor of summer shoots, increased intensity of flowering in the following year
- It is good to summer prune these trees to reduce the intensity of flowering in the following year

Summary of Chilean Pruning

- High flowering year, prune out some flowers to create less fruit set, but larger size 48 fruit
- Low flowering year, prune out some summer flush to reduce the flowering in the following spring
- This will stabilize the crop with larger fruit size every year, reduces the on-crop, off-crop cycle

High density: grower must be convinced

1. Pruning should be done every year
2. Grower must accept loss of some fruit to contribute good fruit quality
3. Prune early in On-cycle year (early spring)
4. Prune late in Off-cycle year (summer prune)
5. Height control
6. Do not reduce canopy more than 30%

Hernandez and Brunet

Questions to be answered

- Can you afford the cost of the trees initially?
- What is the cost of the labor for pruning?
- Is the labor available?

If you don't keep up on the pruning,
your trees will look like this!



Gracias