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Agriculture and Natural Resources

Canopy Management Strategies

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Our Talk Today:

- A description of our problem in avocado production
- Early pruning trials with large trees
- A possible solution: high density plantings

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

- Low avocado prices due to competition
  - more efficient farming
  - 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.
- Smaller trees are probably the only ones that could be efficiently sprayed by ground rigs in hilly terrain.
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Notes from Z.R.Ernst and A.A.Ernst, High Density Cultivation, 2011

- Overgrown avocado trees
  - only produce on the canopy boundary
  - probably in the first meter or two from the edge of the canopy
- All of the volumetric capacity inside remains unused as only unproductive branches grow here
- Keeping trees smaller increases the entire volumetric production of the orchard
- Worker safety will be improved

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

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)
- Stehly Ranch in Valley Center

Pruning Treatments

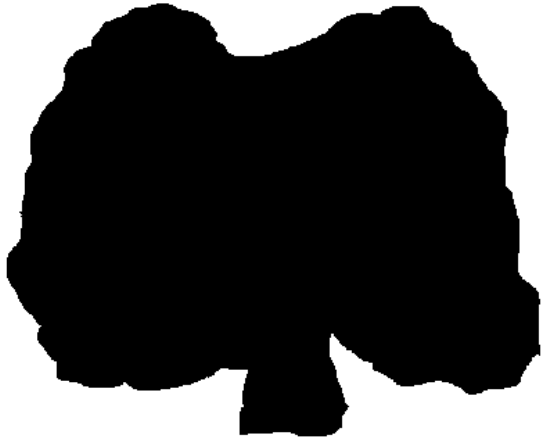
- Non-pruned control
- Cal Poly (Pomona) low stump (3 ft), vase shape
- Stump - Single Leader
- Stumped, no follow-up
- Thinned
- Australian 2-cut method
- Cal Poly high stump (8 ft), vase shape
- Israeli method

Stumping (no follow-up pruning)

- Normally done in California
- Trees are cut back to stumps about 3 ft high, 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 in height
- Center is opened like a vase shape
- Sides of canopy lightly pruned each year



Stumping - Single Leader

- Trees are kept at 13’ 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 trunk (~2 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 rejuvented
- But, cutting the center branch back is dangerous!, it fell back on us several times

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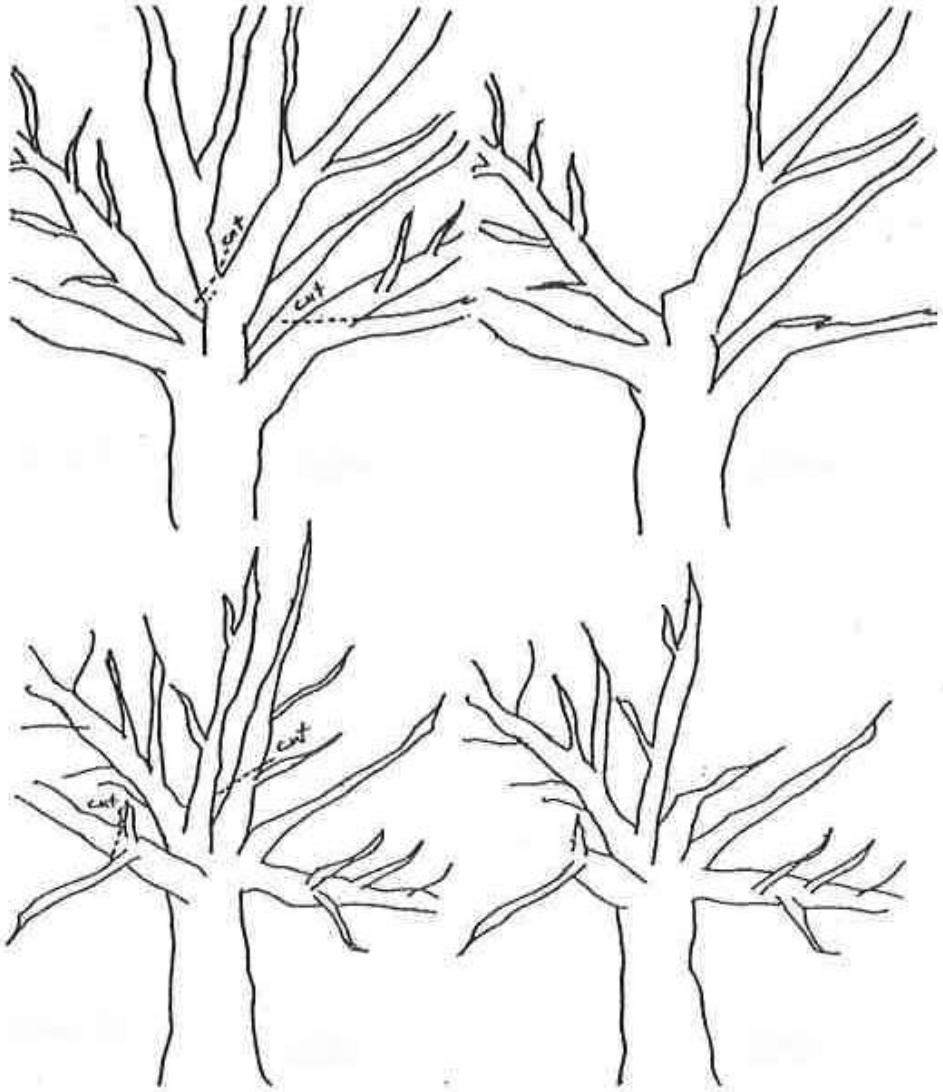
Australian 2 Cut



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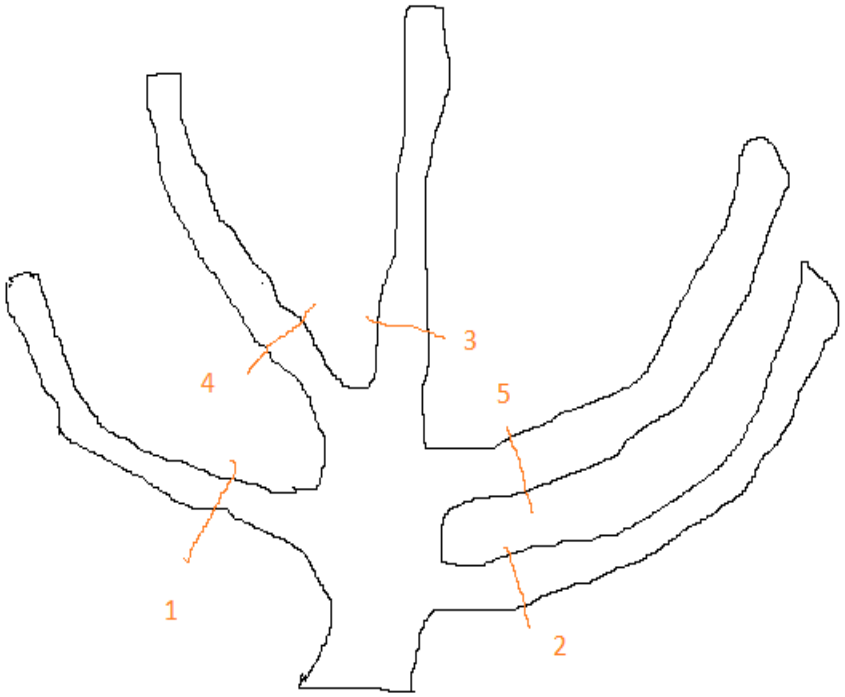
Israeli Method

- 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 UC Extension Specialist

Every other tree is removed

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

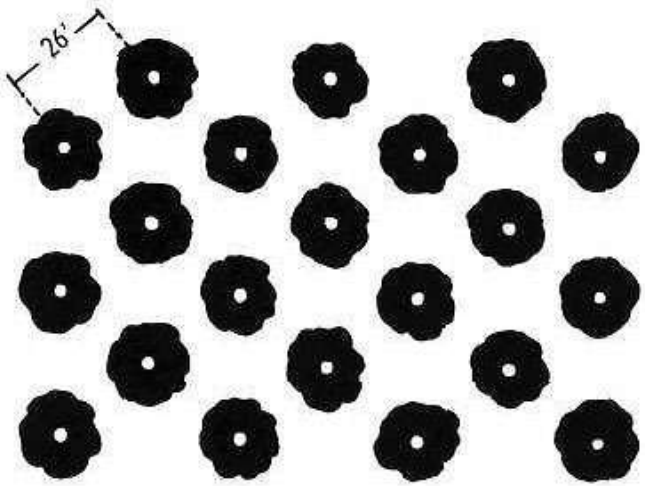
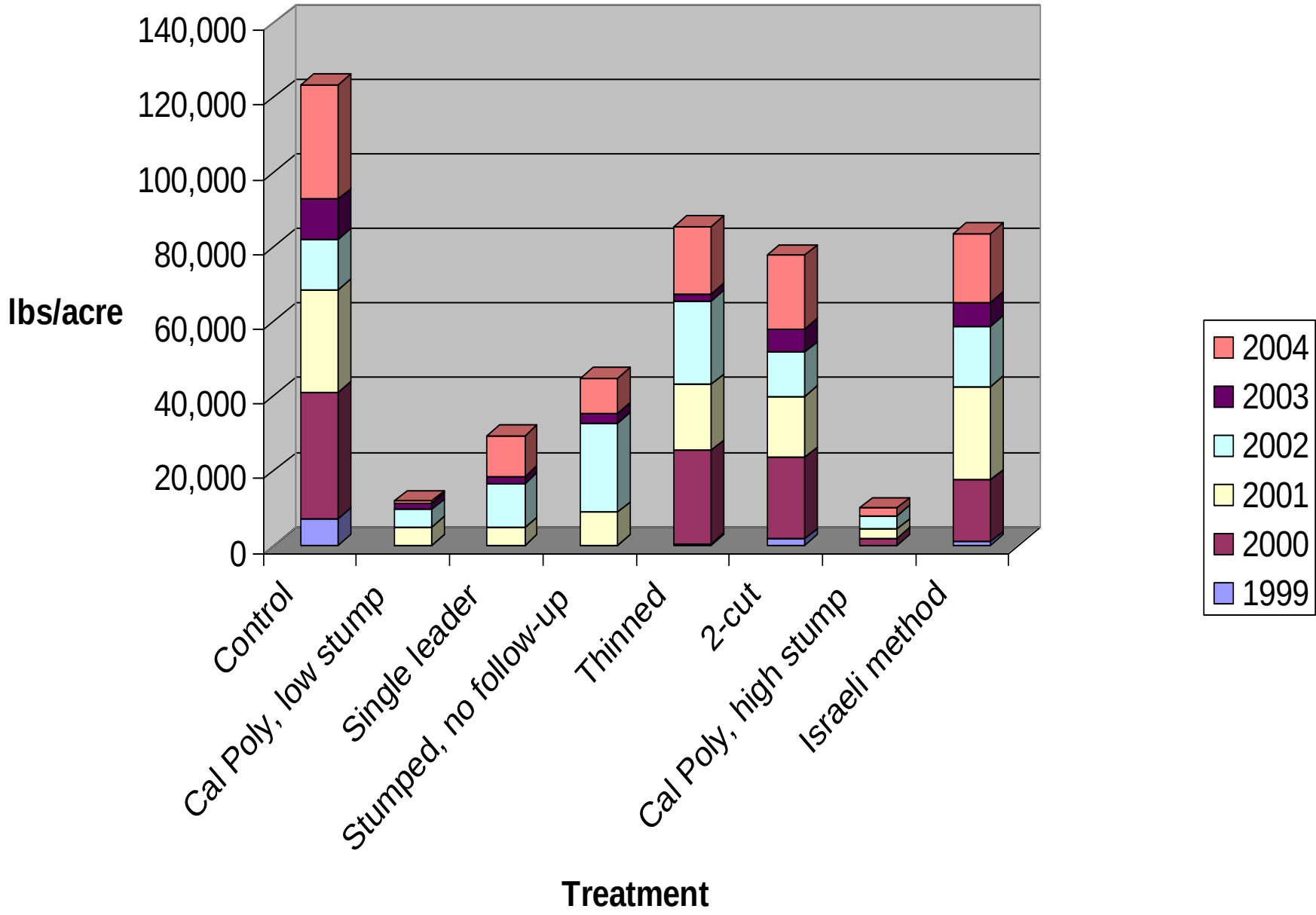


FIGURE 5. Orchard after first thinning—68 trees per acre.

Thinning

Accumulated Yield per Acre, 1999-2004



Cost Analysis (per acre)

Income to grower/acre 1999-2004 @ $1.00/lb

Treatment	Gross return 1998-2004	(minus pruning costs and extra management costs)	(minus picking costs) See next page for costs	Net return per acre over 6 years
Non-pruned control	123,496	(0)	(19,759)	103,737
Cal Poly low stump	11,918	(2,575.13)	(953)	8,390
Single leader	29,430	(2,697.75)	(2,354)	24,379
Stumped, no follow up	44,718	(1,437.44)	(3,577)	41,844
Thinning	85,509	(1,058.80)	(8,550)	75,901
2-cut	77,767	(2,111.90)	(12,442)	63,214
Cal Poly high stump	10,074	(2,656.93)	(806)	6,612
Israeli method	83,515	(1,430.70)	(8,351)	73,734

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Picking costs

- Assumes costs measured in 2002 as the costs for life of the research project:
  - control ($0.16/lb)
  - Cal Poly low stump ($0.08/lb)
  - Single leader ($0.08/lb)
  - Stumped, no follow up ($0.08/lb)
  - Thinned ($0.10/lb)
  - 2-cut ($0.16/lb)
  - Cal Poly high stump ($0.08/lb)
  - Israeli ($0.10/lb)

What Did We Learn?

- With the Stumped Trees:
- The 80% rule - Pete Stassen
  - tree on a 20’ x 20’ spacing should not be higher than 16’
  - to maintain production in the lower canopy
  - to maintain a tree at 16’, the tree should be pruned at 14’
- Keeping a tree at this height takes about 10 minutes per tree, twice a year.

What Did We Learn?

- Pruning after the summer flush reduces yield
- Prune before June to preserve the spring flush for flower production.
  - Explains low production with the Cal Poly method

What Did We Learn?

- 'Stumping with no follow up pruning' seems to stimulate production (until they start to crowd).
  - crowded in the fifth-sixth year
  - leaves are falling off lower branches in the shade

- Picking costs are very low in stumped, low-height trees, and very high in non-pruned, high trees

Other Considerations

- Labor supply and skill in harvesting is a major issue
  - need to develop methods to prune trees
  - maintain trees at a low height
  - with minimal removal of fruiting wood.

One Big Mistake in the Trial!

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

Also

- We didn't pay attention of On-Cycle trees and Off-Cycle trees. Trees were pruned the same each year.

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	Pruned all sides & top
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 crowding

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

H	H	H	H	H	H	H	H	H	
H	Z	H	H	Z	H	H	Z	H	bees
H	H	H	H	H	H	H	H	H	
H	H	H	H	H	H	H	H	H	bees
H	Z	H	H	Z	H	H	Z	H	
H	H	H	H	H	H	H	H	H	bees
H	H	H	H	H	H	H	H	H	
H	Z	H	H	Z	H	H	Z	H	bees
H	H	H	H	H	H	H	H	H	

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

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One year after planting

August, 2013 -Top two rows of the plot

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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

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

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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

Terminology

- In Chile, “Off-cycle”
  - Current year: poor flowering, high yield
  - Current year: large fruit, increased spring shoots, high vigor of summer shoots
  - Next year: increased intensity of flowering
  - Next year: low yield
- 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 reduce 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, gets rid of 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!

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Gracias

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