UC CE UNIVERSITY OF CALIFORNIA Agriculture and Natural Resources UC Cooperative Extension

WILL HIGH DENSITY AVOCADO PLANTING BE PROFITABLE IN HIGH WATER COST REGION OF CALIFORNIA?

Etaferahu Takele, Extension Economist, Area Advisor, University of California Cooperative Extension (UCCE)

ettakele@ucanr.edu

https://ucanr.edu/sites/Farm_Management/

Avocado Irrigation Workshop,

Oxnard, CA

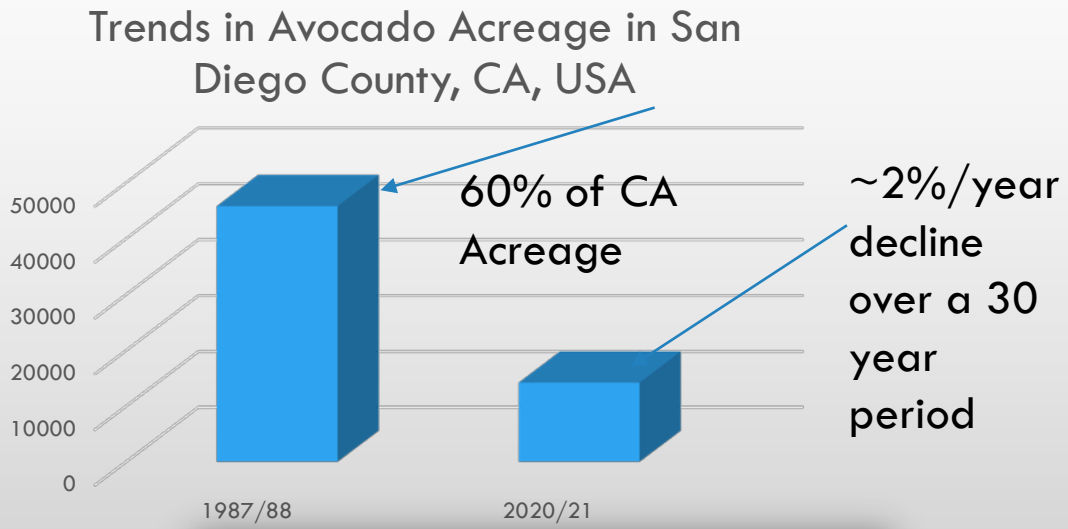
7-18-23

High Water Cost and Avocado Production, San Diego County

- Water prices in San Diego County approximate 3x above Ventura and Santa Barbara, 2x above Riverside and 6x above Santa Maria.
- In addition, the region realized a 5% per year increase for the past two decades for treated water reaching up to $1900/ac.ft. in some areas in 2020.

The high prices and increases due to:

- Limited water sources/supply, main source municipalities (not much suitable irrigation water from ground or reclaimed water, salinity issues).
- Water demand increases in the region due to growing urbanization and population.



Dr. Gary Bender visiting a grove with water cutoff in 2010

UC CE UNIVERSITY OF CALIFORNIA Agriculture and Natural Resources UC Cooperative Extension

Research and education to mitigate water cost

Irrigation management and efficiency methods:

- Drip irrigation and low volume mini sprinklers became most common systems;
- Monitoring and time sensitive irrigation applications (e.g. CIMIS) practices helped minimize waste and over irrigation;
- Remote and ground sensing technologies for timely and efficient irrigation application (such as work now in progress by Aliasghar Montazar, Farm Advisor, southern California); etc.

Production practices improvements:

- Pruning: methods and efficient time management for productivity and cost minimization;
- Irrigation and fertilization application efficiency
- Diversification:
  - Organic production in anticipation of high produce returns;
  - New variety (lamb hass) for tree management and possible productivity increase

Future Prospects:

- High Density Planting for increasing yield and water use efficiency.

About high density (global interests, some examples)

- South Africa has a fairly long history of research into high density production systems (Kohne & Kremer-Kohne, 1990; Stassen, et al., 1995) but little uptake in the form of commercial plantings until just a few years ago; Maluma variety (known for its upright growing characteristic considered a partial solution to overcrowding);
- Chile, the majority of plantings range between 800 and 1,600 trees/ha which is still significantly higher than the majority of production systems globally, in some cases even up to 6,000 trees/ha (1.25m x 1.25m spacing)—mostly Hass variety;
- Israel is now planting high density, especially supported by availability of technology to desalinate sea water— Hass and other varieties.
- California of particular interest for high-density production are the semi dwarfing rootstock P35 (still in trial phase) and the GEM scion variety. Rob Brokaw (pers. Comm., 2018) of Brokaw nursery, the largest avocado nursery in California, cited that 20% of the orders for trees are now GEM and most of the plantings are going in at densities above traditional spacing.

UC CE | UNIVERSITY OF CALIFORNIA Agriculture and Natural Resources | UC Cooperative Extension

This Presentation will highlight:

1. The production results of high density avocado planting from a trial conducted in San Diego county: (2011-2018): discussion of yield, water use and pruning; *Gary Bender PI*
2. *Economic analysis: Eta Takele (2020): addressing h*ow the results from the field trial work together in the whole production system to demonstrate:
    - Investment prospects especially addressing at concerns/ perceptions of high costs of density planting (high cost of plants and labor);
    - Pruning cost impacts;
    - Profit prospects.

Avocado Production in San Diego County, CA

The high density field trial: Dr. Gary Bender-PI :

- Valley Center, San Diego, CA
- Two varieties: Hass and Lamb Hass with Zutano pollinizer
- 2011-2018 (6 years)

The interest in the field trial was to investigate the potential of high density in:

1. Productivity/Yield;
2. Irrigation water use;
3. Pruning hours: two methods of pruning compared for efficiency:
   - Whole grove pruning annually.
   - Half grove alternate pruning: one year one side and the other half the next year.
   - Tree height kept at 8’ for ease of harvesting and prevent overcrowding.

RESULTS:

1. Yield: High density trial, Hass and Lamb Hass
430 trees per acre

Yield Per Acre and Per Tree					
		Hass		Lamb Hass	
Year	Trial Year	lbs/.acre	lbs./tree	lbs./acre	lbs./tree
2012	Planting				
2013	Year 1				
2014	Year 2				
2015	Year 3	13,246	31	8,716	20
2016	Year 4	25,100	58	15,213	35
2017	Year 5	5,541	13	10,274	24
2018	Year 6	20,992	49	11,706	27
Average	Year 7+	16,220	38	11,477	27

Hass yield showed more alternate bearing than Lamb Hass but on the average Hass has~40% more yield than Lamb Hass

Comparing: Yield of High Density vs Traditional planting, Hass variety

Valley Center Field Trial 430 trees per acre				Traditional Planting 145 trees per acre		
Year	*Trial Year*	*Yield: lbs./acre*	*Yield: lbs./tree*	Interview *year*	*Yield: lbs./Acre*	*Yield: lbs./tree*
2012	Planting			2011		
2013	Year 1					
2014	Year 2					
2015	Year 3	13,246	31		700	5
2016	Year 4	25,100	58		2,900	20
2017	Year 5	5,541	13		4,300	30
2018	Year 6	20,992	49		5,300	37
Prod. Year (Avg.)	Year 7+	16,220	38		9,000	62

- *More yield per acre during the establishment years for high density;*
- On average ~80% more yield in high density than traditional planting.

RESULTS

2. Water Use: High Density trial, 430 trees per acre

Year	Trial Year	Ac. In/acre
2012	Planting	
2013	Year 1	14.04
2014	Year 2	39.60
2015	Year 3	34.56
2016	Year 4	57.84
2017	Year 5	45.48
2018	Year 6	46.00
	Year 7+	46.00

~ 4 ac. ft at maturity

- High clay content soil:
- Irrigation monitored and documented using watermark soil irrigation monitors;
- Trees irrigated when the watermarks averaged 35-40 centibars (cb).
- Worked well for the 6 years, no tip-burn of trees; details https://www.californiaavocadogrowers.com/sites/default/files/documents/11-High-Density-Avocado-Production-Winter-18.pdf.

Comparing: Water use of High Density vs Traditional Planting, Hass Variety

Valley Center Field Trial 430 trees per acre				Traditional Planting 145 trees per acre
Year	*Trial Year*	*Water Ac. In/acre*	Interview *year*	*Water Ac. In/acre*
2012	Planting		2011	
2013	Year 1	14.04		6
2014	Year 2	39.60		11
2015	Year 3	34.56		16
2016	Year 4	57.84		21
2017	Year 5	45.48		26
2018	Year 6	~46.00		32
Prod. Year (Avg.)	Year 7+	~46.00		42

- Early age high density planted trees used significantly more water per acre than the traditional planting.
- By year 6, there was very little differences in water use between the high density and the traditional planting, despite the fact the number of trees ~tripled in high density.

RESULTS

3. Pruning: High Density trial
430 trees per acre

Using Alternate Side Pruning*

Year	*Trial Year*	Hours/ Acre
2012	Planting	
2013	Year 1	26.89
2014	Year 2	43.33
2015	Year 3	55.08
2016	Year 4	48.56
2017	Year 5	49.10
2018	Year 6	49.50
	Year 7+	49.30

Pruning approximated an average of ~4 hours per acre beginning year 4

- Trees kept at 8’ height with path for harvesting maintained.
- Comparing the two pruning methods: alternate side pruning showed to be cost effective as there was no significant yield differences between the two methods; which means alternate pruning would cost ~$950/acre less than the whole grove annual pruning.

Comparing: Pruning of High Density vs traditional, Hass Variety

Valley Center Field Trial 430 trees per acre			Traditional Planting 145 trees per acre	
Year	*Trial Year*	Hours/ Acre	Interview *year*	*Hours/ Acre*
2012	Planting		2011	
2013	Year 1	26.89		
2014	Year 2	43.33		
2015	Year 3	55.08		
2016	Year 4	48.56		14.50
2017	Year 5	49.10		16.86
2018	Year 6	49.50		21.71
	Year 7+	49.30		38.64

- Pruning in high density began as early as year 1 vs year 3 in traditional.
- Pruning approximated ~11 hours per acre more than the traditional as the trees age.

*E*conomic Analysis

Enterprise budget analyses: Enterprise Cost Return Analyses

1. *Development of Establishment Costs*

   $TC_{establishment} = \sum VC + \sum FC + \sum OC\text{-}GR$ *(Years 1-6)*

2. *Development of Production Costs*

   $TC_{production} = \sum VC + \sum FC + \sum OC;$

   $\sum FC$ *includes cumulative establishment costs amortized over 34 years of tree life using the rate of return to current assets in agriculture;*

3. *Profit Analyses*

   Gross margin $= GR - \sum VC - \sum OC$ *(returns to capital asset and management)*

   $\Pi = GR - TC$

TC = total cost (excluding management)
VC = variable cost
FC = fixed cost
OC = overhead cost
GR = gross returns
Π = profit

Data for the enterprise budget analyses:

- **The field trial** (yield, water use, pruning hours, and planting hours);
- **Grower interview** for all other production practices (nutrition, pest and disease management/control, etc.)
- ***2020 prices of inputs***: *Some values that might be of interest to mention*
    - Labor: > minimum wage including fringe benefits and overhead:
        - $26.70/hour for equipment operators
        - $19.28/hour for manual labor
    - Water: $1900/ac. ft
- **Price of avocados** (3 years average: 2018, 2019 and 2020): $1.39/lb.
- **Amortization rate** to calculate capital recovery: 5.50%; California's long-term rate of return on agricultural production assets from current income.

Results:

1. **Establishment/investment costs** per acre, Hass Variety, 2020

High density, Hass Variety						
(430 Trees Per Acre, 2020 Study)						
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**
Yield (pounds)			13,246	25,100	5,541	20,992
Establishment Costs (year 1-6) ($)	29,712	9,841	10,969	18,633	14,895	16,804
Returns ($)			17,187	29,191	9,810	27,069
Establishment cost after returns ($)	29,712	9,841	6,218	10,558	-5,085	-10,265
Cumulative Establishment Costs ($)	29,712	39,553	33,335	22,777	27,862	17,597

85% of the cumulative establishment cost offset by returns

Comparing: Establishment/Investment costs (2020)

High density, Hass variety

(430 Trees Per Acre)

	Year1	Year 2	Year 3	Year 4	Year 5	Year 6
Yield (pounds)			13,246	25,100	5,541	20,992
Establishment Costs (year 1-6) ($)	29,712	9,841	10,969	18,633	14,895	16,804
Returns ($)			17,187	29,191	9,810	27,069
Establishment cost after returns ($)	29,712	9,841	6,218	10,558	-5,085	-10,265
Cumulative Establishment Costs ($)	29,712	39,553	33,335	22,777	27,862	**17,597**

85% of the cumulative establishment cost offset by returns during establishment

Traditional Production (145 Trees per acre, 2011 study adjusted for inflation to 2020)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Yield (pounds)			700	2,900	4,300	5,800
Establishment Costs (year 1-6) ($)	15,006	6,556	8,505	9,323	11,063	12,525
Returns ($)			897	3,615	5,515	7,429
Establishment costs after returns ($)	15,006	6,556	7,608	5,608	5,615	5096
Cumulative Establishment Costs ($)	15,006	21,562	29,171	34,780	40,228	**45,324**

28% of the cumulative establishment cost offset by returns during establishment

High density establishment cost 3x lower than the traditional planting because: 85% of the cumulative establishment cost offset by returns during establishment whereas only 28% of the cumulative establishment cost in traditional planting offset by returns during establishment

Results.

2. **Production costs and returns** per acre, Hass Variety, 2020

High Density (430 Trees Per Acre)							
						$/Acre	Returns Margin %
Yield (pounds)						16,220	
Total production costs year 7+ ($)						16,233	
Gross Returns ($) (16,220 lbs. X $1.39/lb)						22,494	
Gross Margin(Retuns after paying variable costs)						9,857	43.82
Returns after paying toal costs/returns to management ($)						6,260	27.83

Before deducting long term asset costs

After deducting long term asset costs

Comparing: Production Costs and Returns, Hass Variety (2020)

High Density (430 Trees Per Acre)	$/Acre	Returns Margin %
Yield (pounds)	16,220	
Total production costs year 7+ ($)	16,233	
Gross Returns ($) (16,220 lbs. X $1.39/lb)	22,494	
Gross Margin(Retuns after paying variable costs)	9,857	43.82
Returns after paying toal costs/returns to management ($)	6,260	27.83

Traditional Planting: (145 Trees Per Acre)		
Yield (pounds)	9,000	
Total production costs year 7+ ($)	12,980	
Gross Returns ($) (16,220 lbs. X $1.39/lb)	12,510	
Gross Margin(Retuns after paying variable costs)	3,837	30.67
Returns after paying toal costs/returns to management ($)	-563	-4.50

Improvement attained by high density in gross margin and especially net profit (returns to management)

SUMMARY: High Density: Potential?

Compared to traditional planting and given assumptions in the Study :

- Yield: on average~80% more;
- Establishment investment costs:
  - 3x lower,
  - Replanting/investing potential increased!
  - Advantage: high yield (returns) during year 3-6;
- Irrigation efficiency:
  - Can grow high density with ~same amount of water;
  - Water cost: $0.45/lb. in high density (33% of the returns goes to cover water cost) vs $0.81/lb. in traditional planting (60% of the returns goes to cover water cost).
- Positive profit potential: 44% gross margin and 24% net return (returns to management).

Potential of high density in other regions or lower water price scenarios

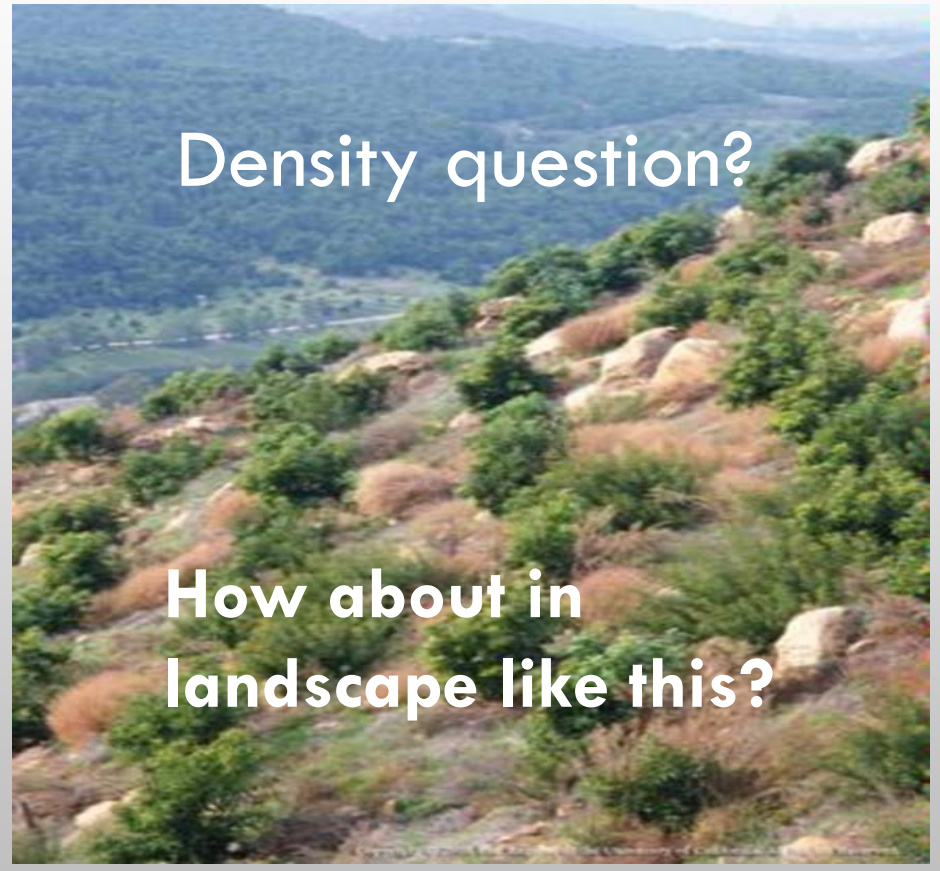
- Given the trial result showing high density's potential for profitability in the high water cost area, we can assume that the profit potential would be even higher in lower water cost areas.
- A rough calculation under the same assumption of high density planting and growing conditions, with water cost in Ventura ~650/ac. ft:

Establishment and Production Costs and Returns Per Acre Estimates in Ventura County (adjustment for water cost made)

	Year1	Year 2	Year 3	Year 4	Year 5	Year 6	Production	Margin %
Yield (pounds)			13,246	25,100	5,541	20,992	16,220	
Establishment Costs (year 1-6) ($)	27,840	4,561	6,362	10,921	8,831	10,671		
Returns ($)			15,233	28,865	6,372	24,141	18,565	
Establishment cost after returns ($)	27,840	4,561	-8,870	-17,944	2,459	-13,470		
Cumulative Establishment Costs ($)	27,840	32,401	23,531	5,587	8,046	-5,424		
Production cost ($)							8,145	
Gross Margin							11,961	64.43
Net returns							10,420	56.13

- Establishment cost fully offset by returns in the establishment period;
- Gross margin and profit margins ~64.43% and 56.13%, respectively.

Questions still remain?



- Production related:
  - Would it be feasible to assume the same density in all situations?
  - Would planting a lower density be profitable?
  - Would location and production practices affect productivity and costs?
- Cost Related:
  - Would the cost of pruning be high in steeper slopes?
  - Would overcrowding happen as the trees age; needing more pruning? pulling out trees? Etc.
  - Would increasing labor wages and overtime payments be affordable?
  - Would labor be available?

REFERENCES

For details of the experiment and economic/cost analyses

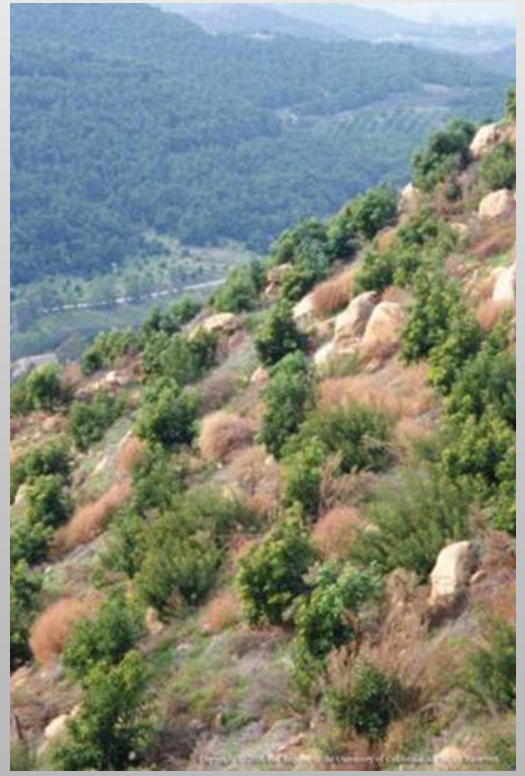
- Better growing: *Gary Bender,* farm advisor emeritus, UC cooperative extension, San Diego County, High density avocado production, A method to improve yield per acre, winter 2018 /f rom the grove / 35,

  HTTPS://WWW.CALIFORNIAAVOCADOGROWERS.COM/SITES/DEFAULT/FILES/DOCUMENTS/11-HIGH-DENSITY-AVOCADO-PRODUCTION-WINTER-18.PDF.

- Takele Etaferahu, Donald Stewart and Daniel A. Sumner, 2021.2020 Avocado Establishment And Production Costs And Profitability Analysis In High Density Planting, University Of California Agricultural And Natural Resources Cooperative Extension, Agricultural Issues Center, UC Davis Department Of Agricultural And Resources Economic *HTTPS://COSTSTUDYFILES.UCDAVIS.EDU/UPLOADS/CS_PUBLIC/B4/3D/B43D58D9-1E91-4A3E-80F9-A2EDB14958B0/2020AVOCADOHIGHDENSITYSANDIEGOCOUNTY.PDF*

- *Takele, Etaferahu, G. Bender, M. Vue, 2011.* Avocado Sample Establishment And Production Costs And Profitability Analysis For San Diego And Riverside Counties, 201, Conventional Production Practice *https://COSTSTUDYFILES.UCDAVIS.EDU/UPLOADS/CS_PUBLIC/5A/87/5A87BB11-59B3-4056-A2D6-A6E14507DD84/AVOCADOCONVENTIONALSDR2011.PDF*

Acknowledgements: Cooperators and Reviewers: Daniel Sumner and Don Stewart Of Agricultural Economics Dept. Davis, AND Gary Bender, UCCE farm advisor emeritus for San Diego County



Thank you