

Research Project Indicates High Density Is a Viable Option in High Water Cost Regions

In 2011, it became clear to Dr. Gary S. Bender, University of California Cooperative Extension, San Diego, that California avocado growers in the county were facing increasing pressure due to rising water prices, periodic drought and California's dwindling share of water from the Colorado River. For the average California avocado grower in San Diego County producing 5,000 pounds per acre and applying four acre feet of water per year, the set up was fiscally unsustainable unless a substantial increase in yield per acre occurred.

In response, Dr. Bender proposed a research project designed to produce the maximum amount of fruit per acre on a sustained basis. Previous research had shown that a few high-density production growers would periodically produce 20,000–30,000 pounds per acre, but reported problems with pruning. Dr. Bender, along with Sonia Rios and Gary Tanizaki, established a goal of consistently producing a minimum of 11,000 pounds per acre in order for growers to break even. During the project, the researchers:

- Compared two styles of pruning
- Tracked hours of pruning labor to determine cost effectiveness
- Tracked irrigation amounts in order to compare water used by a 20' x 20' spaced grove

High Density Plantings Established

The research project was set up at the Nick Stehly Ranch in Valley Center, CA. Because Stehly Ranch had a history of avocado root rot, the experimental groves were established on a hillside that had never been planted and trees were grafted onto Dusa rootstock because it was the most root-rot tolerant rootstock at the time of planting.

In August and September 2012, a 10' x 10' high density Hass grove and a Lamb Hass grove were planted, with topping set at eight feet (later reduced to seven feet). To encourage a pyramidal shape, the top branch of each tree was tied to a metal stake. One B-flowered Zutano pollinizer tree was

surrounded by eight Hass (or Lamb Hass) trees in nine-tree units. Originally, spot spitters were used for irrigation, but were replaced by full circle micro-sprinklers in 2014.

Pruning Trial Results

Pruning avocado trees is difficult and often growers discontinue pruning out of frustration — with the end result being overcrowded groves. Although growers commonly agree that pruning is necessary, there is little agreement concerning how to prune. To that end, Dr. Bender's team compared two commonly used pruning styles.

Style 1 (Traditional). Harvest in early March and prune trees into a fat "Christmas tree" shape, topping at seven feet. Trees were also skirt-pruned to keep skirts one foot off the ground.

Style 2 (Alternate Side). Harvest in early March and prune alternate sides starting with the southwest side the first

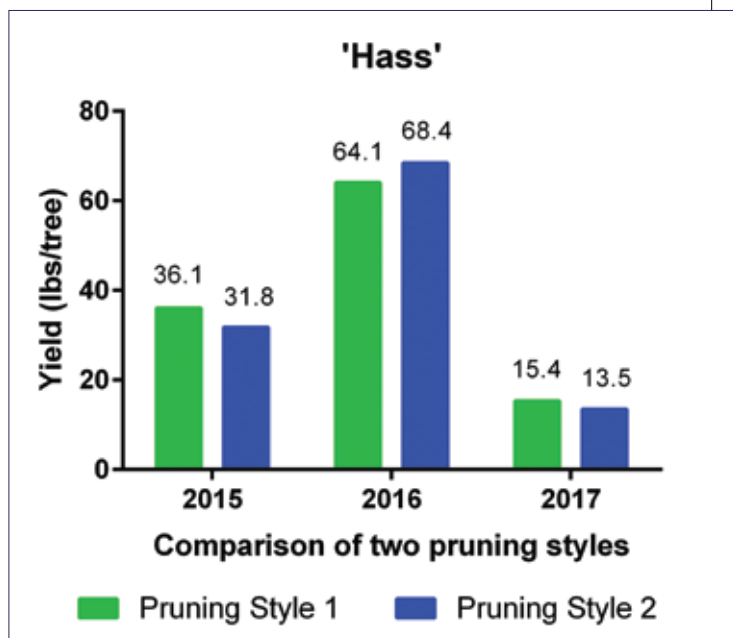


Figure 1. Comparison of 'Hass' high density planting yields for two different pruning styles for 2015 to 2017.

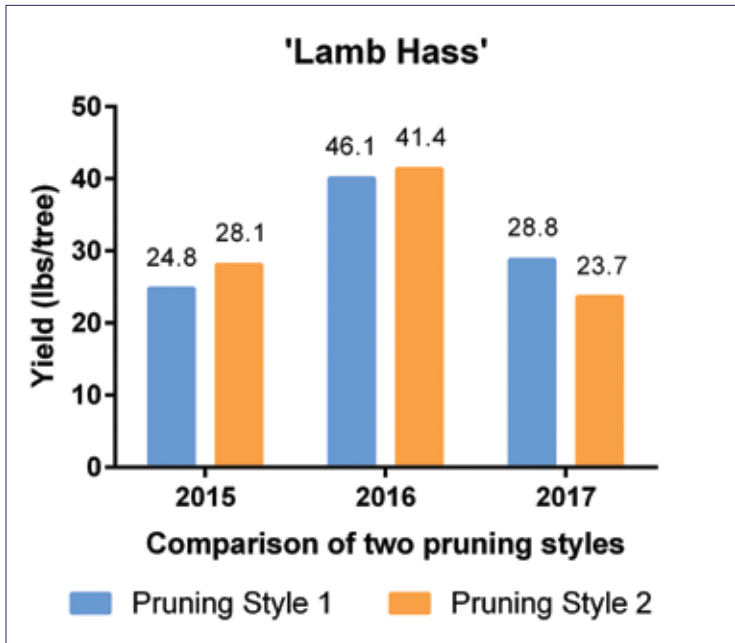


Figure 2. Comparison of 'Lamb Hass' high density planting yields for two different pruning styles for 2015 to 2017.

year. Heading pruning was done to create a 60-degree angle from the lowest branch up to seven feet; the non-pruned side was left alone. The next year, the northeast side was pruned in a similar fashion. Trees were also skirt pruned to one foot off the ground.

Thus far, there has been no significant difference in yield per tree or numbers of fruit per tree between the two pruning styles, thus indicating both are viable options (Figures 1 and 2).

High Density vs Average California Yield Per Acre

As seen in Figure 3, Hass avocado yield per acre for the

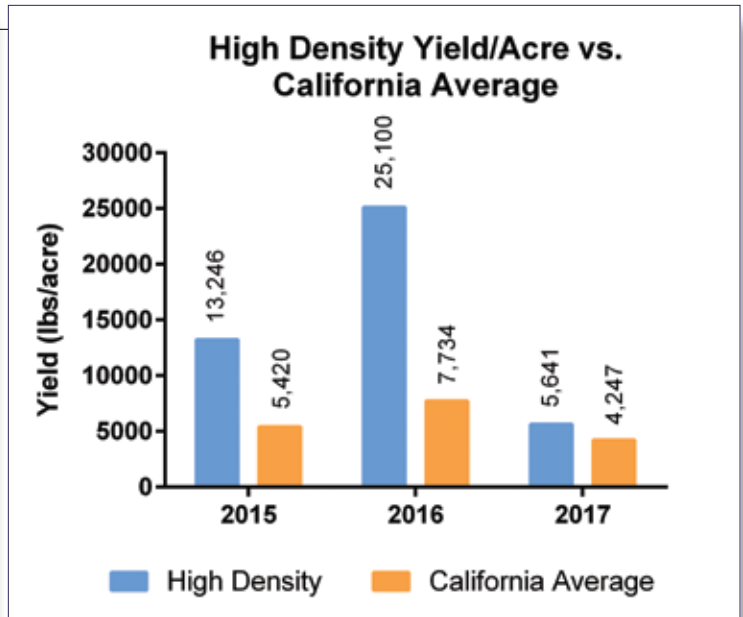


Figure 3. Comparison of the calculated yield per acre for 'Hass' grown at high density versus the California industry average. Industry average data are based on the published annual production volume divided by the bearing acres (Californiaavocadogrowers.com/industry/industry-statistical-data).

high density groves outpaced the average (20' x 20') California yield per acre. It is worth noting that the 2017 harvest was an off-year due to high temperatures in June 2016 and the fact that it was an alternate bearing year. Over a three-year period, an average of 14,662 pounds per acre were produced per year — well over the 11,000 pounds per acre goal set by the research team.

The Lamb Hass trial groves, although in a significant alternate bearing pattern, produced an average of 11,428 pounds per acre per year (Figure 4).

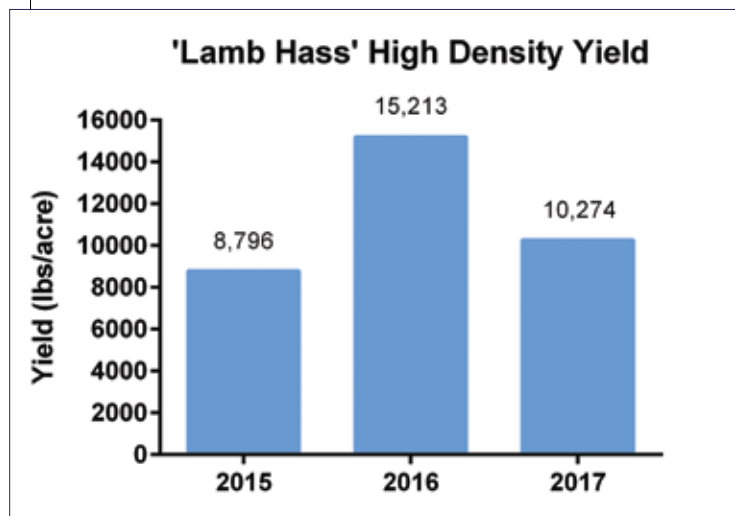


Figure 4. Calculated yield per acre for 'Lamb Hass' grown at high density.

Table 1. Water applied to the 162 trees in the trial was recorded monthly. Yearly summations are presented below. Gallons/acre and acre feet/acre are calculated based on 430 trees/ac planted on a 10' x 10' spacing.

Time period	Gallons applied per 162 trees	Gallons/acre	Acre feet/acre
2/15/2013-10/31/2013	14388	381926	1.17
11/1/2013-10/31/2014	405232	1075615	3.30
11/1/2014-10/31/2015	353610.5	938595	2.88
11/1/2015-10/31/2016	591991.7	1571336	4.82
11/1/2016-10/31/2017	46501.8	1234293.3	3.79

Table 2. Calculated pruning costs per acre for high density plantings based on the average number of hours to prune the trial plot. Per acre costs based on an average number of trees per acre: 48 Zutanos, 387 Hass or 387 Lamb Hass.

Year	Topping Zutanos	Alternate-side pruning-Hass	All sides pruned-Hass	Alternate side pruning-Lamb Hass	All sides pruned – Lamb Hass	Skirt pruning and aisle clearing both Hass and Lamb Hass
Average hours per year in the trial plot (last three years)	2	7.1 for 40 trees	8.1 for 32 trees	2.25 for 40 trees	5 for 32 trees	12.7 for 162 trees
Average per acre	5.3	68.7	98.0	21.8	60.5	30.3
Cost per acre @ \$15/hr	\$79.50	\$1,030.50	\$1,470.00	\$327.00	\$907.50	\$455.08

Irrigation and Pruning Labor Costs

Because the grove soil had a large clay content, trees were irrigated when the Watermarks averaged 35 – 40 cen-

Table 3. Average yield of Hass at standard spacing (20' x 20') and high density (10' x 10'), the increase in \$/ac based on average fruit prices in March for the past three years, and the net increase or decrease in \$/ac after pruning costs are accounted for.

Year	Hass yield/ac*	High density yield/ac	\$/lb*	Increase in \$/ac due to high density	Pruning costs/ac**	Net increase (decrease) in \$/ac
2015	5,240	13,246	\$1.12	\$8,967	\$2,004.58	\$6,962
2016	7,733	25,100	\$0.70	\$12,157	\$2,004.58	\$10,152
2017	4,801	5,641	\$1.53	\$1,285	\$2,004.58	(\$720)

*Based on historical data from www.CaliforniaAvocadoGrowers.com.
 **Calculated as total cost from Table 2 for Zutano pollinizer pruning, Hass all sides pruned and, and skirt pruning and aisle clearing.

tibar. This amount was deemed “perfect” and the trees never experienced tip burn. Table 1 illustrates the yearly irrigation summations. The higher water use in 2016 was due to two incidents in which water was mistakenly left on overnight.

Pruning labor costs included pruning, as well as skirt pruning and aisle clearing to ensure light reached the bottom branches of the trees. As Table 2 indicates, there is a significant cost associated with pruning the high density groves.

That said, due to the increased yield per acre in the Hass high density groves, in two of the last three years the test grove plots produced an increase in dollars earned per acre. With these results in hand, the researchers have determined (Table 3) that high density production “is a viable way to increase income per acre and can help the growers in high water-cost areas to stay in production.”

New Grower Education Courses

As part of the grant, the researchers also hosted new grower education courses each year. Based on new grower turnout (35 – 45 new growers each year), the researchers noted that interest in avocado growing in San Diego County remains strong.

The complete report, *Improvement of Yield Per Acre by Close Spacing, Pruning of Close-Spacing ‘Hass’ and ‘Lamb Hass’ Trees, Combined with New Grower Education Classes — Final Report*, is available at www.CaliforniaAvocadoGrowers.com.

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