From the Grove

Fall 2019

The Latest News from the California Avocado Industry

SECRETARY OF AGRICULTURE VISITS AVOCADO GROVE

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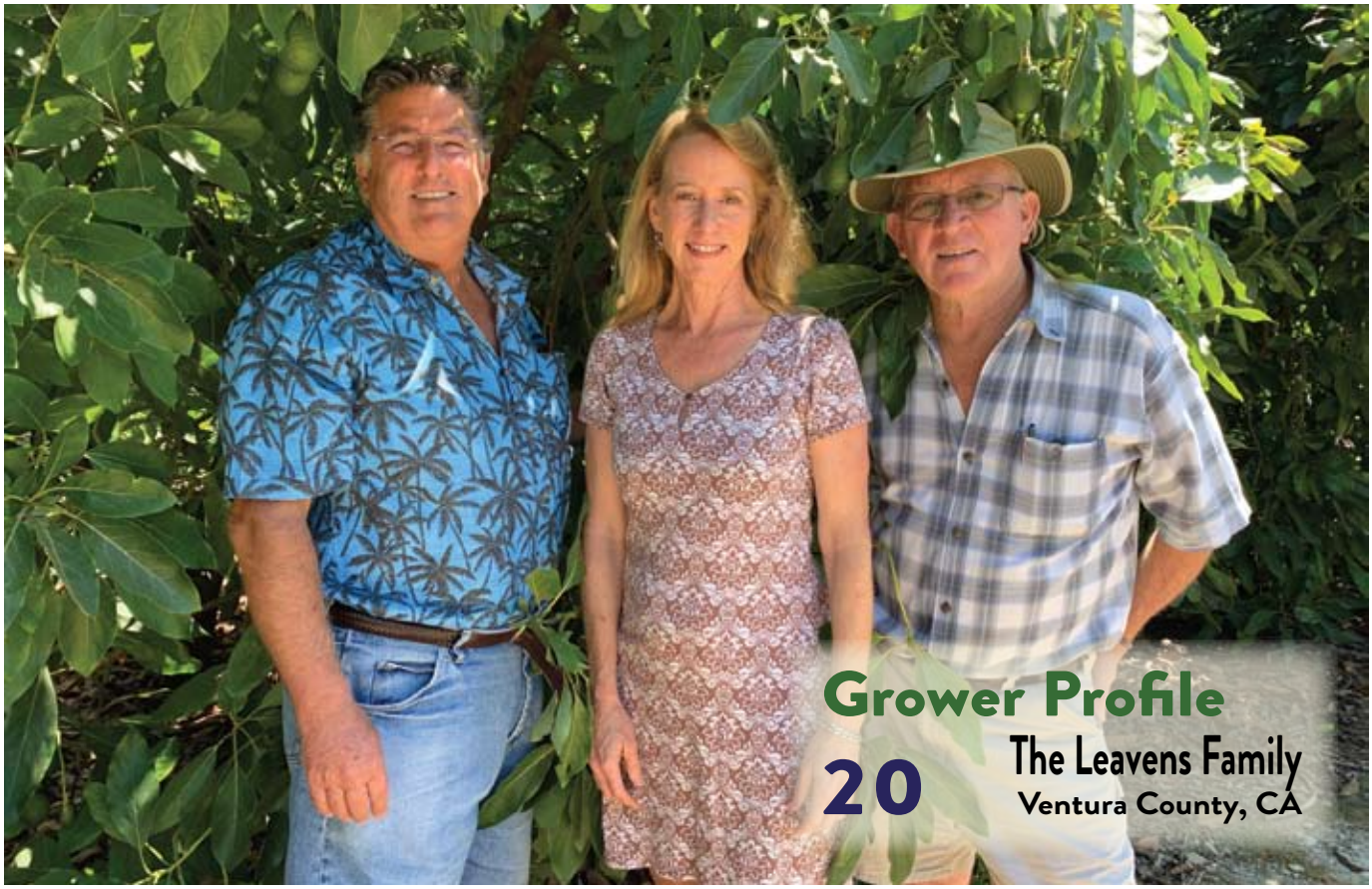

From the **Grove**

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Message from the President

Believe

Tom Bellamore

The 2019 season has all but concluded and what a year it has been. The crop — which some thought wouldn't amount to more than 160 million pounds — provided fruit from April to September, ending around 210 million pounds. The price it commanded averaged over $1.70 per pound across the season, setting a record. That price stands as a beacon, reminding us of what is possible. I believe that this new milestone has significance that is difficult to ignore. It strongly argues that consumers do not think of avocados as a commodity (even if some within our industry do), that avocados are not all the same, and it speaks to the power of the California Avocado brand. Believe — and we will all cross that threshold together and realize a future where California's place in the market is assured.

Some cling to archaic notions that supply and demand alone, dictate what happens in the U.S. avocado market. This season is yet another anomaly, they would claim, one shaped entirely by short supplies and burgeoning demand. In such a year, the fruit sells itself, they would say — it's automatic. If this were true, the f.o.b. price of California avocados would not differ from that of imported fruit, but it does. If the inherent value of California avocados was the same as fruit from Peru or Mexico, top-tier retailers would not make any extra effort to align their social media programs with the California Avocado Commission's programs, but they do. Their customers expect it, and they are savvy enough to deliver what their customers want.

Of course, this year shattered the ceiling for everyone, and some retailers decided to lower margins to keep the price point palatable for their consumers. Fewer promotions occurred, but demand continued strong. Not every consumer may have been willing to pay a premium for California avocados, but that's okay. The Commission's strategy is to target those with a propensity to pay and the retailers they frequent. The idea is to receive the highest value for each of the 450 million or so individual California avocados produced this year, and to keep as many of our target consumers as brand loyal as we can. Simply put, not everyone has to like California avocados, although we would prefer that they did. After all, that bumper crop year is always lurking just around the corner.

The avocado industry stands apart in the produce world, and economists often comment on how it defies predictive modeling. In the years prior to the entry of Mexican avocados into the United States, the U.S. Department of Agriculture's Economic Research Service (ERS) did some modeling on what might transpire as imported avocado volumes increased. They missed it by a mile. The market responded vigorously to what ultimately became a year-round supply, and dire, negative price impacts on domestic producers failed to materialize. Credit consumers' bottomless appetite for avocados and their uncanny understanding that "local" means "fresh," hence not all avocados are equal.

Economists at the University of California-Davis have attempted to account for the major variables that govern avocado market dynamics. One such study by Dr. Hoy Carman and R. Kim Craft noted "along with quantity, the key factors explaining demand include prices of related goods [of which, few, if any, exist], the purchasing power of potential customers, the size of the market in terms of number of consumers and consumer tastes and preferences." The Commission places great stock in that final factor because it is where we can make a difference. Dr. Carman goes on to emphasize that "advertising is the final factor posited to explain consumer demand for avocados. Industry advertising efforts are expected to increase demand through providing information and changing preference patterns."

The Commission has done precisely that, and while the factors noted by Dr. Carman are immutable when it comes to explaining avocado market dynamics, no single one, by itself, will determine the California avocado industry's future. In the face of a 3 billion-pound U.S. avocado market in 2020, it's a mistake, I'd say, to assign definitive weight to any one of the market-influencing factors Dr. Carman enumerates. Just when you think you understand it, or can out-guess it, you'll be wrong. The best approach, this writer maintains, is to look at that $1.70 average price-per-pound, and believe. Believe in the consumer who is proudly wearing a pair of California avocado socks. Believe in the California Avocado brand and the loyalists who seek it out on social media. And most of all, believe in yourselves, because you are producing the finest piece of fruit on earth, and your fruit is certainly worth $1.70 per pound or more.

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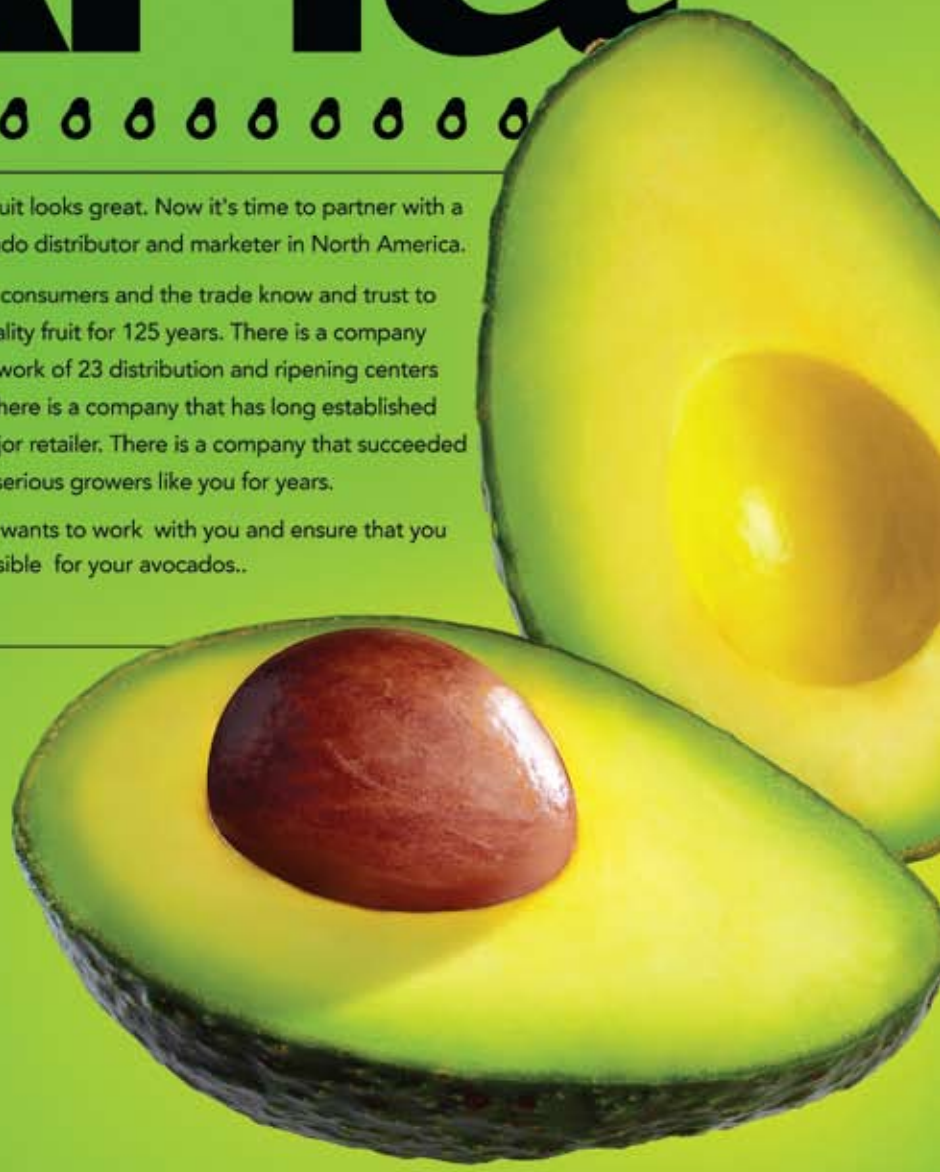

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Chairman's Report

John Lamb

It's Time to Review & Move Forward

As the 2019 California avocado season winds down, we take stock of the past year and look forward to next year. At the California Avocado Commission (CAC) that means reviewing our marketing programs and budget for last year and starting the process all over again for next year. For this year, we are seeing a larger crop than expected at the highest value per pound ever recorded by California growers. For those of us that had a decent crop this year, it will be a banner year. Not so much for those affected by last summer's heat wave.

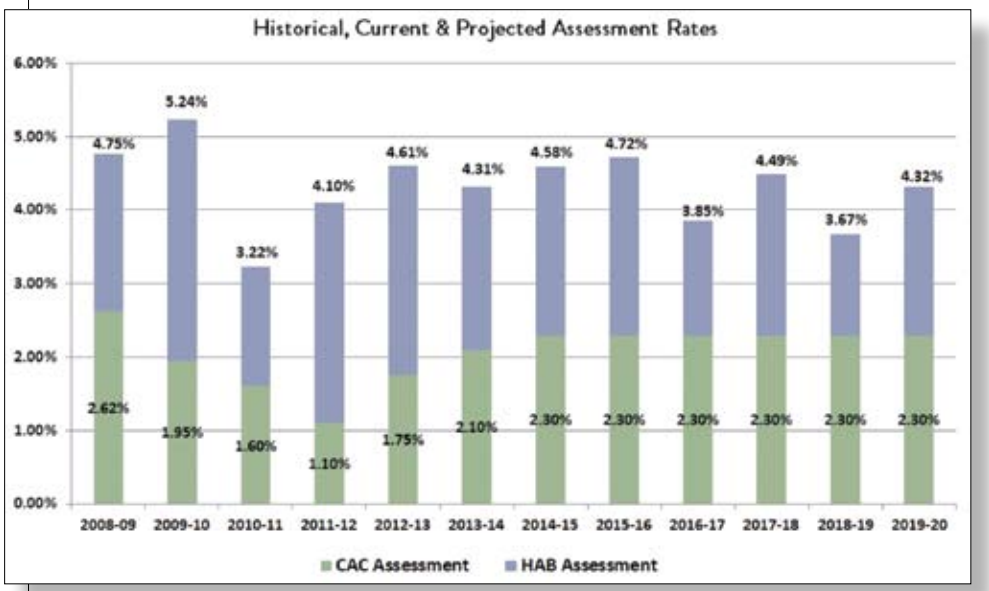
Because of the record value of the crop, CAC is in a very strong financial position going into next year. So, how do we evaluate the drivers of our budget going forward? There are three main components: crop size, average price and assessment rate. At our August board meeting every year we start the process of coming up with a crop size by talking to a lot of people. It is still very early in the game to try to figure out what is in any one of our orchards, let alone the entire industry. So we talk to people around the state – growers, packers, field men. We stick our heads into trees to compare this year's crop, and in my case I also talk to the foreman of our harvest crew. He has seen every tree on our ranch in detail and, frankly, I have not. We also look at long term trends to see historically how crop size is affected by prior years. As the year progresses we will do grower surveys and have meetings with packers to get their take on the crop. At this point we have heard that coastal areas seem to be lighter due to lower than normal temperatures this past spring and inland areas much higher after a smaller crop this year.

The next component is the most controversial, and that is average price. We have heard for years that we need to be more optimistic because somehow our estimate of the price is a starting point for the industry. That theory has

Year	Volume (lbs)	Total Budget	Total Marketing Budget	Total Marketing Budget ($/lb)
2010-11	302,500,000	$14,197,000	$9,025,000	$0.030
2011-12	462,300,000	$17,800,000	$11,811,000	$0.026
2012-13	500,200,000	$17,225,000	$11,500,000	$0.023
2013-14	297,500,000	$16,296,000	$10,700,000	$0.036
2014-15	279,000,000	$15,384,000	$9,750,000	$0.035
2015-16	401,400,000	$15,428,000	$9,882,000	$0.025
2016-17	215,900,000	$12,728,000	$7,710,000	$0.036
2017-18	337,800,000	$15,705,000	$10,500,000	$0.031
2018-19 (estimate)	200,000,000	$11,950,000	$6,970,000	$0.035
2019-20 (projection)	365,000,000	$16,000,000	$11,000,000	$0.030

been proven incorrect in both estimating too high a price and too low a price (as in this past year). The thing to remember is that we are trying to create a budget. I would hope most of us are pretty conservative when budgeting. While we had incredible prices this year I am not willing to budget that they will continue next year with a much larger California crop and an estimate of close to 3 billion pounds from all sources. As you can see from the tables, there are lessons to be learned from the past. While we want to be optimistic we also have to be realistic.

The last component is the assessment rate. As you can see from the table below, we have maintained an assessment rate at 2.3 percent for the past five years. We have tried to leave this alone so growers can count on consistency from the Commission from year to year. By not having wild swings in the assessment rate it lets us use our reserves in lean years and build reserves in good years. It also allows growers to plan on a consistent assessment that does not gouge a high producer in one area and then lower the rate the following year.



So how does this all compute for our planning for 2019/2020? At this moment we are estimating a crop of 365 million pounds at an average price of $1.15 per pound and leaving the assessment at 2.3 percent. In October, the board will consider this rate and either pass it or alter it as the discussion dictates. If passed, this will result in a total budget of $16 million. We anticipate a marketing spend of $11 million— that would be 68.8 percent of the total budget (3 cents per pound), which is the highest level ever.

Thank you for producing the world's finest avocados!

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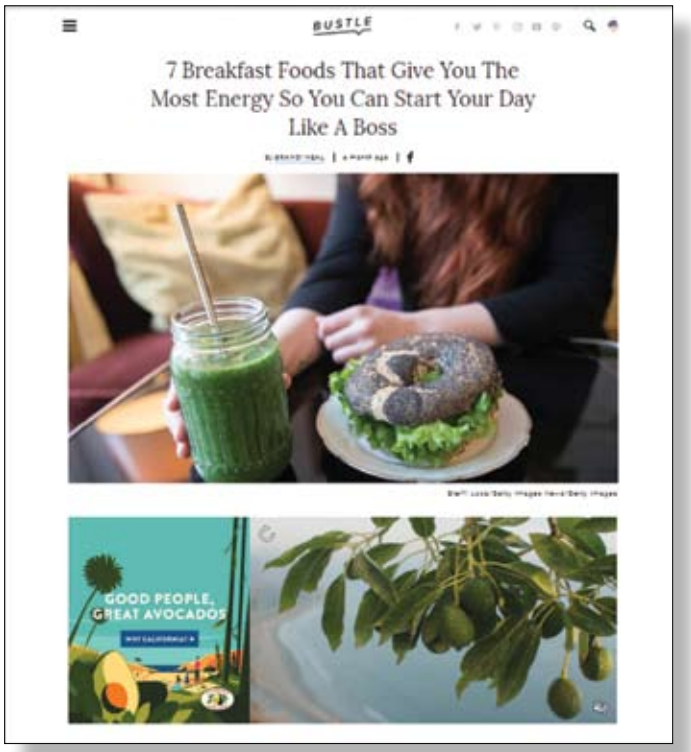
To contact a CAC representative, please visit: CaliforniaAvocadoGrowers.com/Commission/your-representatives

CAC Extends Media Buy To Support Late Season Volume

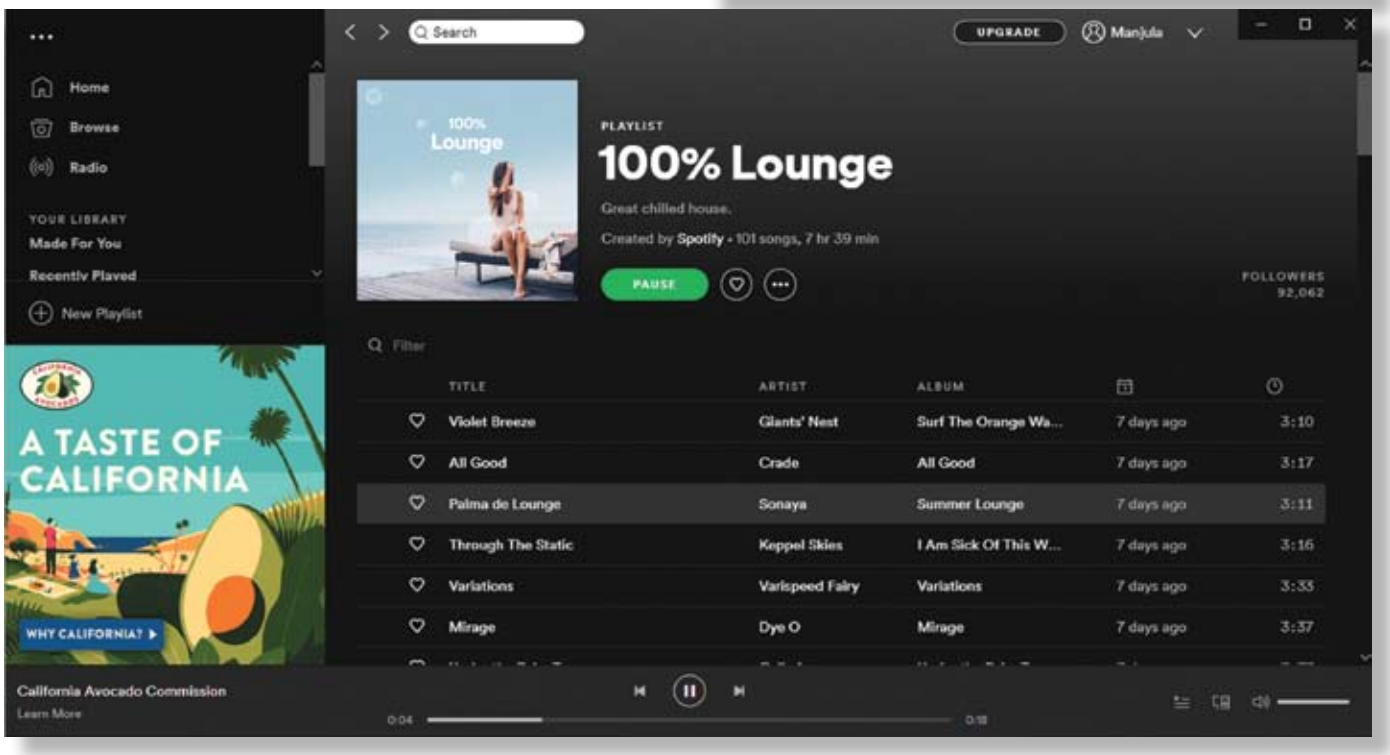
Throughout the summer, the California Avocado Commission (CAC) utilizes a variety of media platforms to engage with its "Premium Californians" target and encourage purchase of the fruit during the peak season. In midsummer, based on action from the Board, CAC added incremental support to the consumer media plan in response to crop volumes.

"The Committee monitors the timing of the crop and it became clear at our last meeting that we were going to continue to see a sizeable volume of California avocados well into August," said Bob Lucy, chairman of the CAC Marketing Committee. "In an effort to continue the Commission's marketing support to build demand and communicate where our fruit is available through August, the Committee recommended the Board consider extending media support requiring additional funding."

The additional budget approved by the board resulted in 141.4 million impressions targeted to "Premium Californians" for the year.



California avocado video banners on Bustle encouraged consumers to meet the growers who produce their favorite fruit.



The Commission targeted "Premium Californians" with display banners on the digital music platform, Spotify.

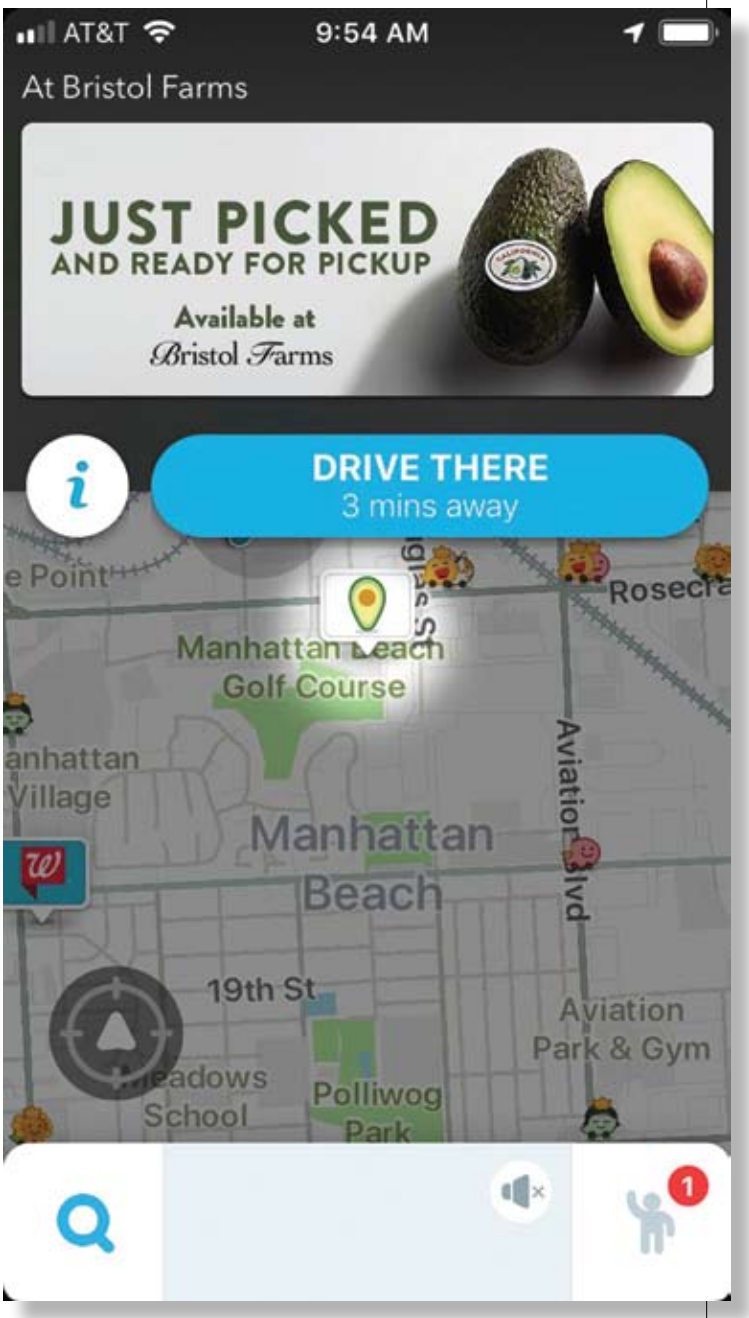
The additional consumer media support, which took place from July 8 through August 18, allowed the Commission to extend its successful digital and audio media partnerships with top partners, including Hulu, Tastemade, Spotify, Bustle and YouTube. Posts on Facebook and Twitter were included to boost retailer support.

The Commission also added Waze, a popular crowdsourcing navigation app, to the media buy. The app's users, who spend an average of 10.5 hours per month with Waze, align well with CAC's "Premium Californian" target. Eighty-four percent of users are between the ages of 25 and 54 and 46 percent have a household income of $100,000 or more.

When Waze users were in close proximity to a California avocado retailer, the app prompted users to drive there and purchase the fruit by highlighting the store with an avocado "pin" on the navigation map and showcasing drive-time messages that calibrated how quickly they could arrive. "The Waze program is a great example of communicating where California avocados are available to targeted consumers," added Lucy.

The late summer incremental consumer media campaign garnered very successful results with Waze, including more than 12.6 million impressions and nearly 84,000 clicks. In total, there were 32,628 Waze users who drove to retail locations after seeing the advertising.

In-image advertising showcasing the unique local appeal of California avocados ran across a variety of premium websites.



California avocado pins and mobile banners encouraged Waze users to visit nearby retailers to purchase the fruit during its peak season.

Secretary of Agriculture Perdue Visits California Avocado Grove

U.S. Secretary of Agriculture Sonny Perdue toured a California avocado grove on July 15, accompanied by California Avocado Commission (CAC) Chairman John Lamb, CAC President Tom Bellamore and other representatives of the Commission. The grove tour, which took place at Rancho Guejito Avocado Farm in Escondido, was conducted by grower Al Stehly.

"On behalf of California avocado growers, I'd like to thank Secretary Perdue for the time and interest he expressed about our industry during his visit," said Lamb. "We had a very productive meeting with the Secretary, who seemed very interested in helping with labor, water and other issues facing California growers."

Secretary Perdue.

Commission representatives informed the Secretary about California avocado industry modernization in progress, including high-density plantings, managed tree height, salt tolerant varieties and improved water efficiency.

"We expressed to Secretary Perdue the significant challenges growers are having with limited labor availability and let him know that the situation is getting worse with the aging of existing workers and enforcement concerns," said Bellamore. "California avocado harvest crews are well-compensated, averaging $18 per hour or greater piece rate,

Secretary Perdue had a sit down meeting with Commission representatives to discuss issues impacting the California avocado industry prior to the field tour.

but with agriculture labor availability approaching crisis levels, the industry needs a flexible guest worker program that allows the existing workforce to remain and one that provides access to new workers."

Water availability, quality and pricing remain significant concerns for California avocado farmers. Commission representatives emphasized the importance of increased statewide water storage capacity as well as easing Endangered Species Act restrictions to allow greater State Water Project deliveries. Industry representatives also covered trade issues with Secretary Perdue, such as the tremendous increase in avocado volumes coming from imports. Export opportunities were discussed, including the challenges in gaining access to some foreign markets. Bellamore called upon the Secretary to expedite access to China for California avocados.

Secretary Perdue gained a hands-on appreciation of the skill it takes to harvest avocados, using a picking pole to cut an avocado from a tree. After the tour, the Secretary was available for media questions from major networks and local San Diego press.

Rancho Guejito is the only remaining undivided Spanish land grant in California. Avocados have been grown on the property since 2010.

Showcasing CAC's Targeted Retail And Foodservice Programs

"Targeting" provided an important filter during a lighter than normal volume season, with a focus on retailers and foodservice operators in California and neighboring states who have demonstrated a preference for California avocados. The California Avocado Commission (CAC) marketing programs were designed to increase awareness of the availability of California avocados, as well as to encourage sales of California avocados at participating retailers and foodservice chains.

RETAIL PROGRAM HIGHLIGHTS

Southern California-based Gelson's Markets conducted a California Avocado Month display and sales contest that ran from June 3 through June 30. Gelson's 27 locations promoted California avocados in the stores, utilizing California avocado display bins and custom signage featuring the brand logo. The in-store program was supported with Gelson's social media and an ad feature.

Pavilions California Reed avocados program ran from late May through early June and featured California avocado display bins.

California avocado growers Chris Ambuul and Mike Sanders conducted a grove tour for an Albertsons-Vons-Pavilions influencer team to help with their "LOCAL" promotion.

CAC supported Southern California's Albertsons-Vons-Pavilions' LOCAL campaign, which highlighted locally grown summer fruits and vegetables in 352 locations. From June and throughout the California season, stores utilized California avocado display bins to add impulse displays in and around the produce department. These bins included custom decals featuring California avocado growers Chris Ambuul and Mike Sanders, who were featured on hanging banners at Albertsons locations. Pavilions displayed California Reed avocados as an additional California avocado variety in its 27 stores during California Avocado Month in June.

Ambuul and Sanders led a grove tour for an Albertsons-Vons-Pavilions influencer group in support of the LOCAL campaign. Brandon Matzek of www.KitchenKonfidence.com blogged about the event, which included social media support from the retailer.

This season's California avocado programs included in-store product demonstrations (demos) that gave shoppers

an opportunity to sample the outstanding quality of California avocados. On June 16 and 17, demos featuring California avocados were staged in 51 Sam's Club locations in California. Product demos with co-partner Tajin® seasoning took place in 41 California Walmart locations in the days leading up to the 4th of July, encouraging shoppers to include California avocados in their American summer holidays celebrations.

Targeted retailers in neighboring states also participated in California avocado season programs. In Portland, the Albertsons-Safeway division supported California growers during June with a full-month Big Book ad on two-pound bags of California avocados. They then created a fully integrated promotion by running a sales contest in conjunction with an ad on bulk and two-pound bags of avocados from June 19 to July 4.

In Phoenix, Albertsons-Safeway Southwest showcased California avocados with a social media campaign in June. CAC sponsored a California avocado recipe and post for Albertsons' and Safeway's Facebook outreach. The post ran and was boosted (paid for premium placement) from June 10 through June 23. This post had the highest impressions of any post the customer has run to date with the same level of funding. For a program covering the entire Southwest division, Albertsons-Safeway expects to see a reach of 300,000. The California avocado campaign reached more than 400,000, exceeding expectations by nearly 35 percent.

A representative from the Albertsons-Safeway marketing team said, "This campaign proved to drive customer interaction. The clicks, likes and shares for both banners are higher than I've ever seen on a campaign with a similar budget [and] run length."

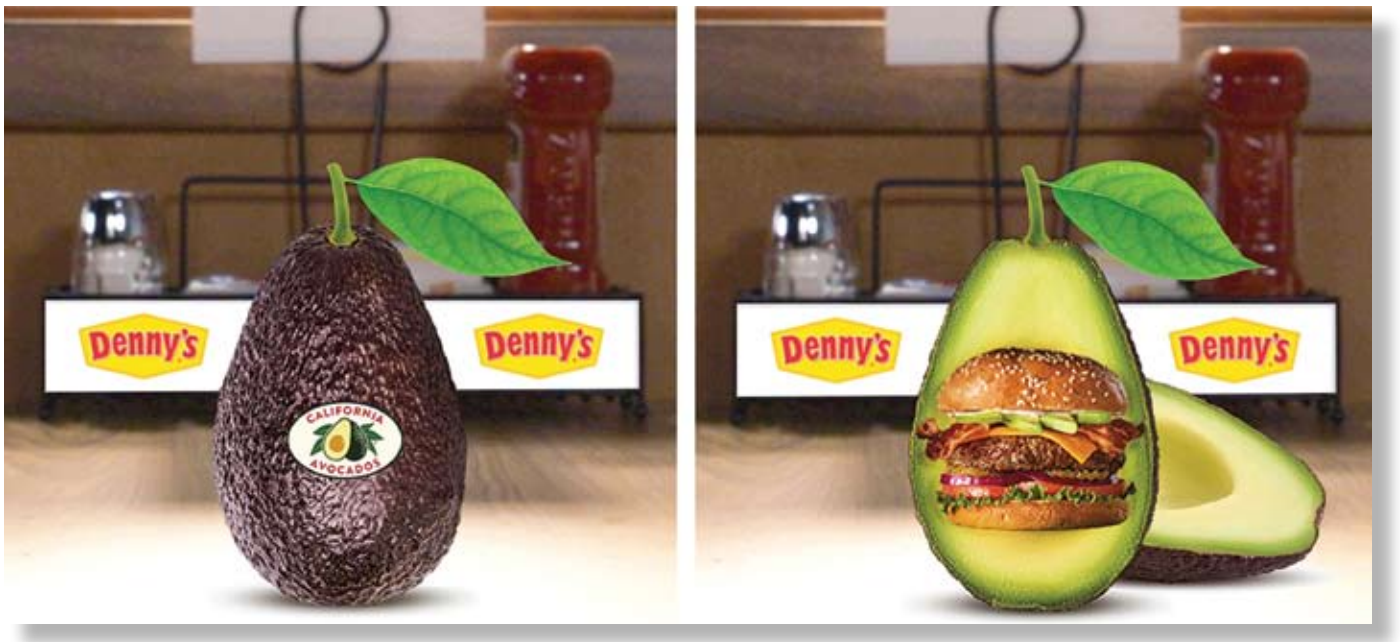
FOODSERVICE PROGRAM HIGHLIGHTS

Denny's, a family restaurant chain, featured fresh California avocados during peak California avocado season in 390 California units and 30 Nevada units, from April 8 through August 18. Leveraging the popular appeal of fresh California avocados, Denny's ran an "upsell promotion" to add avocado to any/all items on the menu, with a focus on the new Southwest Chorizo Burger. Server buttons were used to convey the upsell message and social media posts were used to promote avocados on burgers.

Baja Fresh launched a new menu item, *Honey Chipotle Chicken Salad*, featuring California avocados during a limited time offer. A similar dish had been recommended by the Commission during menu ideation and development work in a prior year. During the promotional period from April 22 through September 1, 62 Baja Fresh units in California used the California Avocado brand logo on their in-store point-of-purchase pieces, mailers and social media posts.

In 126 units located in Arizona, California, Colorado, Idaho, Montana, Nevada, Utah, Washington, Washington D.C. and Wyoming (Rock Springs), Café Rio Mexican Grill introduced new fajitas including freshly made guacamole. California avocado branding was featured from June 10 through September 1.

"It is important to support targeted customers who champion California avocados within California and in nearby markets, showing them the value of California avocado quality and commitment, even in challenging crop years," said Jan DeLyser, CAC vice president marketing. "We continue to see that putting California avocados in the spotlight for their premium quality and freshness encourages sales and premium pricing."



Denny's avocado burger promotion included signage with the California avocado label.

By Tim Spann, PhD
Research Program Director

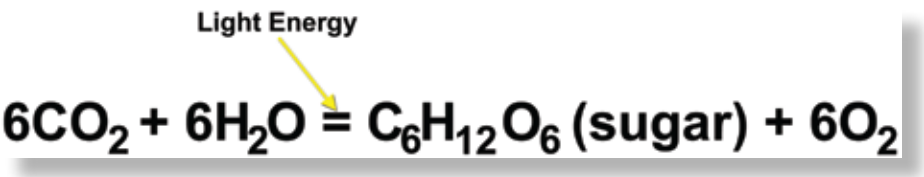
High Density Groves: Fact or Fiction?

"High density groves have a greater yield potential than standard density groves." Many people believe this statement to be true. And you can find many growers who will tell you that their high density blocks yield more than their standard density blocks. So, it was met with great dismay when I said at a recent California Avocado Society seminar that it doesn't matter how many trees you have per acre, because trees per acre is not what determines yield potential. What? How can that be? Let's do a little investigation.

Light Interception

In the Spring 2019 issue of *From the Grove* I wrote an article titled, "Optimize Productivity by Pruning for Maximum Light." The takeaway from that article was that fruiting branches will only grow where there is light. We've all seen this in the form of old trees, 25 or 30 feet tall, with the first branch starting at 15 feet. There's no production in the tree's interior because there's no light.

A tree's leaves are energy factories. They take in carbon dioxide from the air and combine it with water taken up by roots to produce carbohydrates and oxygen using the power of sunlight. This is called photosynthesis and looks like the accompanying graphic.



Thus, in any orchard of any fruit crop, the name of the game is maximizing sunlight interception.

Generally, you should always be able to see spots of dappled sunlight hitting the orchard floor, even in the densest of canopies. But why would you want to see light hitting the orchard floor? Shouldn't it all be captured by the leaves? Light hitting the orchard floor is wasted, right? Not exactly.

Consider the leaves in a tree's canopy as layers. Each layer captures sunlight. If the first layer captures all of the light, there's nothing left for the second layer. By ensuring that a small amount of sunlight is reaching the orchard floor, you are ensuring there is light penetrating all the way through the canopy and each layer of leaves has light to capture. In turn, those leaves can support fruit production throughout the tree's canopy and not just on the outside.

More Trees = More Sunlight Captured

The common belief is that by planting trees at higher densities more sunlight will be captured, thus more efficiently utilizing the sunlight falling on a given acre. But does this pencil out? Let's see.

> ***"... it doesn't matter how many trees you have per acre, because trees per acre is not what determines yield potential."***

First, a couple of assumptions:

1. The height of trees, no matter their density, does not exceed 80 percent of row spacing. This ensures that the shadow cast by one row does not prevent light from reaching the lowest leaves of the trees in the next row.

2. Within the tree row, the trees are allowed to grow together. That is, if the trees are 20 feet apart, adjacent trees grow to fill that 20-foot gap.

3. We will assume a six-feet-wide open space between rows for picking access. Although we will look at what affect narrowing that gap has in some instances.

4. For simplicity of calculations, we will assume all tree canopies are cubes. That is, the volume of the canopy can be calculated as: (tree height) x (tree width in the row) x (tree width across the row).

Traditional Spacing: 20 x 20 feet = 109 trees per acre (tpa)

- Each tree is allocated 400 square feet in the grove
- Trees are kept to 16 feet tall (assumption 1)
- Trees are 20 feet wide within the row (assumption 2)
- Trees are 14 feet wide across the row (assumption 3)
- Thus, each tree actually occupies 280 square feet (20 x 14)
  - 280 square feet x 109 tpa = 30,520 square feet or 70 percent of an acre
- Each tree's volume is 4,480 cubic feet (16 x 20 x 14)
  - 4,480 cubic feet x 109 tpa = 488,320 cubic feet of canopy per acre

Modern Spacing: 15 x 15 feet = 194 tpa

- Each tree is allocated 225 square feet in the grove
- Trees are kept to 12 feet tall
- Trees are 15 feet wide within the row
- Trees are 9 feet wide across the row
- Thus, each tree actually occupies 135 square feet
  - 135 square feet x 194 tpa = 26,190 square feet or 60 percent of an acre
- Each tree's volume is 1,620 cubic feet
  - 1,620 cubic feet x 194 tpa = 314,280 cubic feet of canopy per acre

High Density #1: 12 x 14 feet = 260 tpa

- Each tree is allocated 168 square feet in the grove
- Trees are kept to 11 feet tall
- Trees are 12 feet wide within the row
- Trees are 8 feet wide across the row
- Thus, each tree actually occupies 96 square feet
  - 96 square feet x 260 tpa = 24,960 square feet or 57 percent of an acre
- Each tree's volume is 1,320 cubic feet
  - 1,056 cubic feet x 260 tpa = 274,560 cubic feet of canopy per acre

High Density #2: 10 x 10 feet = 436 tpa

- Each tree is allocated 100 square feet in the grove
- Trees are kept to 8 feet tall
- Trees are 10 feet wide within the row
- Trees are 4 feet wide across the row

- Thus, each tree actually occupies 40 square feet
  - 40 square feet x 436 tpa = 17,440 square feet or 40 percent of an acre
- Each tree's volume is 640 cubic feet
  - 320 cubic feet x 436 tpa = 139,520 cubic feet of canopy per acre

Ok, I know what you are saying to yourself. You wouldn't leave six feet between every row in a high density planting. You'll allow the rows to grow more to fill in the space between rows and keep maybe every fifth row wide as a drive row to place bins and accommodate harvesting. So for simplicity, let's say that there's only four feet of open space on average between rows in a high density planting. Let's see what that does to the numbers.

High Density #1: 12 x 14 feet = 260 tpa with 4 feet open between rows

- Each tree is allocated 168 square feet in the grove
- Trees are kept to 11 feet tall
- Trees are 12 feet wide within the row
- Trees are 10 feet wide across the row
- Thus, each tree actually occupies 120 square feet
  - 120 square feet x 260 tpa = 31,200 square feet or 72 percent of an acre
- Each tree's volume is 1,320 cubic feet
  - 1,320 cubic feet x 260 tpa = 343,200 cubic feet of canopy per acre

High Density #2: 10 x 10 feet = 436 tpa with 4 feet open between rows

- Each tree is allocated 100 square feet in the grove
- Trees are kept to 8 feet tall
- Trees are 10 feet wide within the row
- Trees are 6 feet wide across the row
- Thus, each tree actually occupies 60 square feet
  - 60 square feet x 436 tpa = 26,160 square feet or 60 percent of an acre
- Each tree's volume is 640 cubic feet
  - 480 cubic feet x 436 tpa = 209,280 cubic feet of canopy per acre

In this scenario, a 12 x 14 planting, with four feet open between rows, just barely edges out a traditional spacing of 20 x 20 concerning the ground area covered by tree canopy, but the traditional spacing still has a larger total canopy volume per acre. And thus, a greater yield potential!

Why Then Do People See Higher Yields on High Density Plantings?

The answer to this question lies in an assumption that I didn't state. In all this number crunching, I assumed that all things were equal in terms of grove management. The same fertilizer regime, the same pruning regime, etc. However, this is rarely the case.

The first major change that often occurs when moving to high density plantings is the variety. Most growers would agree that 'Hass' trees at a 10 x 10 spacing is not manageable. It's a pruning nightmare. Instead they'll plant 'Lamb Hass', 'Gem', 'Reed' or another variety with a more narrow, upright growth habit that lends itself to planting at higher densities.

Second, high density plantings force you into a routine pruning regime. This is because a high density planting that isn't pruned will quickly become too dense (maybe even as soon as the fourth year), the interior canopy will be lost and the yield will plummet. Recovery from this scenario requires drastic pruning that will take the trees one to two years to recover from. Just the opposite is true for a standard density planting. Many growers do not follow a routine pruning regime, the trees become tall, the canopy becomes a big umbrella, the interior and lower branches are lost and all the production moves to the top of the canopy. These trees will probably cost you more to harvest, but as anyone who has seen an old grove with 25 trees per acre knows, these trees can still produce, albeit not at optimal levels.

Lastly, many growers make other improvements to their overall management program along with increasing planting density. Some growers will implement a program of girdling limbs to stimulate production. Others will move to a more intensive fertility program to support the higher yields they see being produced. After all, it costs a lot of money to plant 260 or 436 trees per acre, and that is a huge psychological motivator to manage that investment properly.

What About Other Tree Fruits?

Given how the numbers appear to work, why do we hear about other fruit crops, like apples and cherries, with ridiculous planting densities on the order of 1,200 trees per acre? The crops that can plant at those densities have one key advantage that we don't have in avocados — size controlling rootstocks.

Apples for example have a range of rootstocks that control tree height to very specific degrees. If you want an apple tree 15 feet tall you plant a tree on one rootstock. If you want an apple tree that is only 5 feet tall you choose another rootstock. Thus, the pruning that needs to be done on apples is primarily to generate fruit wood and not to control height.

These systems also plant the trees on trellises so that the canopy of the tree may only be one foot wide. Trees one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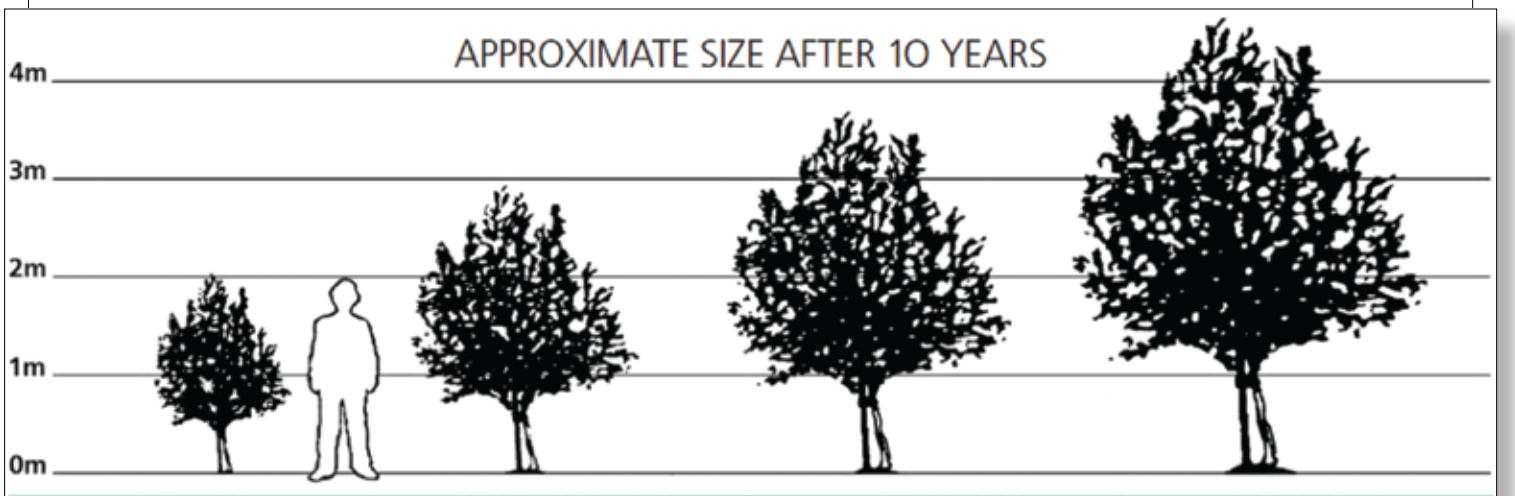

DWARF		SEMI DWARF		MODERATE		VIGOROUS	
FRUIT	ROOTSTOCK	FRUIT	ROOTSTOCK	FRUIT	ROOTSTOCK	FRUIT	ROOTSTOCK
APPLE	M9	APPLE	M26	APPLE	MM106	APPLE	M25
PEAR	QUINCE 'C'	PLUM	PIXY	PEAR	QUINCE 'A'	PLUM	BROMPTON
CHERRY	GISELA 5	PEAR	QUINCE 'C'	PLUM	ST JULIEN 'A'	CHERRY	CHERRY F.12.1
		CHERRY	GISELA 5	DAMSON	ST JULIEN 'A'	PEAR	WILD PEAR
				CRAB APPLE	MM106		
				QUINCE	QUINCE 'A'		

A cartoon showing the relative size of various fruit trees grown on different size controlling rootstocks. Image from Walcot Organic Nursery https://walcotnursery.co.uk/.

foot wide and only six feet tall can be planted in rows less than five feet apart and still achieve maximum productivity, while allowing all work to be done easily from the ground.

Why Plant High Density?

At this point you may be asking yourself, "Why bother planting avocado trees at high density?" First, it's the only planting system that makes sense for certain varieties. The Gem variety for example, will never grow large enough to fill its allocated space in a grove if planted at 20 x 20 feet; there will simply be too much open ground when the trees mature to be viable.

Another benefit of high density plantings is higher production early in the life of the grove. My prior calculations have been based on mature trees. However, in the early years of a grove, before trees fill their allocated space, having more trees is beneficial. For example, a grove planted at 109 tpa may see its first commercial harvest in year 3 and you might expect to pick 4-5 pounds of fruit per tree (436-545 pounds per acre). Now imagine that the tree density is 260 tpa. Those trees will probably still not have filled their space in year 3, but your yield has increased to 1,040-1,300 pounds per acre. Thus, although a high density grove costs more to plant, it generates more yield and income sooner than a wider spaced grove and can result in positive cash flow years before a traditionally spaced grove.

High density plantings definitely have their advantages, especially with certain varieties and to generate early income from a new grove. When managed properly — the right variety, a good pruning program started early in the life of the grove — high density plantings can achieve almost unbelievable yields. However, those yields are not, strictly speaking, the result of simply having "more stems per acre." They are the result of a grove management system that is well planned and well executed.

A poorly managed grove — one without a good pruning program and well-managed irrigation and fertilization program — will be a poorly producing grove regardless of how many trees are planted per acre.

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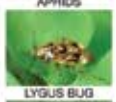
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Grower Profile

Beach House Serves as Touchstone for a Family Farming Operation

By Tim Linden

With a farming history that dates back more than 100 years and about a half a century of avocado production, it might seem odd that a beach house in Ventura County is the glue that holds Leavens Ranches LLC together. But separate interviews with the trio of leaders that currently run the 1200-acre operation clearly indicate that the once-a-year summer meeting at the beach house with all the family shareholder members is an extremely important element of the firm's success as a family-owned and operated agricultural entity. It is the touchstone where unit members are updated, expansion plans are discussed and the Leavens family members, who live all across the country, reconnect with each other, their roots and the company.

"Sell the ranch if you must but don't ever sell the beach house," President/CEO Link Leavens quipped is a common refrain joked about during every family in-person meeting.

The family story dates back to 1902 when Joseph G. Leavens came to Ventura County and established himself as a dry goods merchant in Santa Paula. Joe and his brother began farming together between Santa Paula and Fillmore in 1912, and the family is still farming that ranch today. In the 1940s after World War II, Joe's son Paul, a career Navy man, and his wife Anne, and their family moved to a ranch west of Santa Paula. This property, "The Home Ranch," still serves as company headquarters.

Leavens Ranches was established as an official entity and Paul and Anne's four children – Mary, Dorothy, Paul Jr., and Sarah – became partners (unit holders as they are now called) in Leavens Ranches. That partnership endures today as Leavens Ranches LLC, but now there are 27 unit holders, each of whom draws a direct bloodline to the original Joseph Leavens. Of those 27 unit holders, only three – Link Leavens, his sister Leslie and his cousin David Schwabauer – have a hands-on involvement in running the organization, but the company's corporate structure makes sure that all the unit holders and their families are involved and informed. Hence, there is a second quarter in-person meeting when the family gathers at the beach house in July, as well as an annual meeting in February, and three additional conference calls when further updating occurs.

Leslie Leavens, who is the company's chief financial officer, explained that Paul Sr. had four children, and each of those four G2 (generation 2) branches owns approximately 25 percent of the business. Of the G2s, only Dave's mom, Mary Leavens Schwabauer, the matriarch of the family, is still living at 92. G3, which includes the three aforementioned hands-on employees, has nine members. There are 17 members of G4, ages 18 to 45, and nine members of G5...so far. The board consists of seven people – one G3 board member from each of the four families plus three non-family board members who bring specific expertise to the management of the organization.

It was under Paul Jr.'s leadership that the company grew and expanded three farming areas: the Santa Clara Valley, including the Home Ranch in Santa Paula, the larger ranch in Moorpark and a third ranch in Monterey County. Over the years, the company has grown a variety of different crops,

As they do every year, many members of the Leavens Family gathered at their beach house in July to discuss the family business.

but avocados and lemons are their mainstays, as Paul Jr. focused on those crops in the 1950s as he was developing the ranches.

Link said today's split leans a little bit heavier toward lemons but Leavens Ranches has more than 450 acres of avocados. The company's three leaders each have their own story, which led to their current spot atop the organizational chart of the family farm.

Link and David took similar routes as both of their fathers worked in the company and they followed suit. Link, who is in his mid-60s, has been employed by the company for 45 years. After graduating from high school, he went to Cal Poly Pomona and studied fruit production with the intention of coming to the family business. "As a kid I always knew this is what I wanted to do," he says.

In 1973, after graduating, he joined the firm and has been there ever since. Of course, he has carved his own path but he also has proudly followed in his father's footsteps. For example, in 1987, Paul Jr. relinquished his position on the Calavo board to Link who has served the avocado company in that same position ever since. In fact, he is quite proud of helping Calavo go from a co-op status to publicly-owned with a value approaching $2 billion.

Along the way he has added to his skill set by earning an MBA from Cal Lutheran and has lent his expertise to many different associations and organizations. Industry service is a common thread among the Leavens Ranches management team. Besides being president and CEO, Link oversees the Santa Paula and Monterey operations.

Dave also received an agricultural degree from Cal Poly Pomona and an MBA from Cal Lutheran. His father, Charles Schwabauer, married Mary Leavens, and soon found himself working at the ranch. "My dad was always very mechanically inclined," said David. "He was very valuable to the ranch as he kept everything running. He used to say that everything was held together with bailing wire and bubble gum."

David wasn't certain he would follow in his father's footsteps but he said his dad asked him to so he did. "I have no regrets. There are always thoughts about the road not taken, but I know I have lived a rich, full life because of the road I did take."

Like his two other management partners, he is active in the industry, especially on several water boards. He runs the Moorpark ranch.

Leslie, however, did not contemplate a career in ag business. Not while she was in college studying fine arts...nor even when she was first working in agriculture for Brokaw Nursery. "I completely fell into it by chance or accident," she said, remembering that she grew up in a male-dominated culture in which a woman running the family ag business was never part of the discussion.

After graduating from UCLA in the late 1970s, Leslie pursued a few other options for several years including owning a Sacramento business that provided and serviced indoor plants

in office buildings. But in 1981, she moved back home and needed a job. She had grown up with the Brokaw family and was well acquainted with the owners of that well-known nursery. She secured a job as a dispatcher in charge of shipping nursery stock to the company's customers. It was a summer job that morphed into a seven-year run.

"It was a very valuable experience," she said, especially considering that she eventually would move into management in her family operation. "It gave me a lot of insight on being a non-family employee in a family business."

She also got to know many of the farmers in the county and developed strong relationships with many fellow farmers. "These are folks I am still interacting with on a regular basis."

But after leaving Brokaw, Leslie still didn't jump into the family business. "It was very gradual," she said. "I first went to work for the Ventura County Arts Alliance and then my dad hired me part-time."

Leslie helped out with accounts payable and some of the financial work, but she didn't even have a computer. Eventually, however, it did move into a full-time position and she and her dad did discuss her role in the company as well as in the industry. He thought she could play an active role in industry organizations, and, in fact, she has, serving on several water boards as well as local farm organizations including the Saticoy Lemon Association board and the Farm Bureau.

Her dad, she said, ran the company like a "benevolent dictator." Leslie clearly has a different style. She loves the role she plays for Leavens Ranch as its chief financial officer. One important aspect of the job is working with the other members on the board and management committee, especially the chairman of the board. "It is profoundly satisfying to be able to work for one's own family business," she said. "I get to work with not only my brother and cousin but also with the chairman on an individual basis."

She noted that cousin Andy Gilmour has played this role for the last few years and called him an "extraordinary visionary."

Discussing the company operation itself, Link is proud of the work he and fellow leaders have accomplished. He said diversification is one thing they have strived for as a risk diffuser. Farming in three geographical areas, the company is physically diversified. With two major crops, it is diversified by commodity. And within those two crops, the company has planted several different varieties, which again adds to its ability to withstand unforeseen problems.

It is currently evolving its planting density strategy. Most of the groves are planted on 22-foot centers, but Link said they have experimented with density as high as only eight to nine foot centers. "We are trying to learn from other perspectives," he said. "More units per acre means more production and that makes sense."

Link marvels about how far the avocado has come in his four-plus decades of involvement. "It's unbelievable. The elasticity of the avocado is the envy of all the produce industry," noting the premium prices consumers have been paid this year even though weekly supplies are at a very high level.

And he is very bullish on California's future as an avocado producer. He said the advantage of location cannot be overestimated. "CAC (California Avocado Commission) has done a great job of promoting."

As the three managing partners survey their future, they each look at it a little differently. Though Link is the oldest, he is the least certain about retirement and doesn't have a fixed date on the horizon. He noted that his father retired at age 70 and that might be a retirement age that interests him. Leslie, on the other hand, is going to retire from her day-to-day activities at Leavens Ranch in the spring of 2020. But she plans to continue her involvement with industry boards and associations. Dave, at 58, the youngest of the three, is also eyeing the end of the work road, but he hasn't picked a date yet. However, he wants it to be sooner rather than later because he does want to explore some of those roads still untraveled. He said art has always interested him and he has been an active member of the Santa Paula Art Museum. He expects to devote more time to that interest in a philanthropic way when he has more time on his hands.

Of course, the question is who will take over the management of the company. At this point, no members of G4 are involved in the day-to-day operations. And Leslie said the bylaws require family members to have appropriate schooling and experience before they can move into a management role in the family organization. "We have always been a family-owned and operated business, but it appears we will become family owned but not family operated," Leslie said.

David said that does appear to be the case. He observed that most of the unit holders do not live in California and have not pursued agriculture in either education nor in their work lives. He does have a daughter who works for the farm bureau where she lives in Oklahoma, but she is very happy with Midwest life and has expressed no interest in moving back to California.

Link said the company and its family-run board does recognize the situation and in fact, this year did hire a non-family member in a management position for the first time ever. And since his departure is not yet imminent, there will be at least several more gatherings at the family beach house, allowing for strategic planning and renewed connection to the family business before new leaders take over. That also will give an opportunity for more members of the family to come together and celebrate the rich agricultural history that is part of the Leavens legacy. "Who knows, maybe we will skip a generation and then the next one will come back and run the company," said Leslie.

By Tim Linden

Field Price, Extra Volume Takes Sting Out of Short Crop

A record average field price for the 2019 California avocado crop combined with 15 percent more volume than anticipated turned the season into a positive one. At least that was the view of several handlers who commented on another California avocado season unlike any other.

"Growers weren't happy with the volume drop caused by last year's July heat wave," said Ross Wileman, senior vice president of sales and marketing for Mission Produce Inc., Oxnard, CA, "but at least they were able to maximize their returns with good field prices and a little more fruit than they expected."

He said the market ended up very strong and while it is impossible to make up the dollars lost by only producing half a crop, the average field price of over $1.70 per pound took a big dent out of the potential financial shortfall.

Rob Wedin, vice president of fresh sales and marketing for Calavo Growers Inc., Santa Paula, CA, made a similar point. "The field price was significantly higher this year…at least in June and July when we shipped most of our California fruit. Growers that waited came out pretty well."

While the average price shows that growers did well with regard to the price, he noted that there were a sizable number of growers that had a tough season – especially growers hit the hardest by the extreme July heat wave of 2018. With a crop that was half the size of normal (or even less), some of those growers picked early to set up their trees for a strong 2020 crop. In those cases, not only did they have low yields but also low field prices. He said that in March the field price was less than $1 per pound.

Bob Lucy, president of Del Rey Avocado Co, Fallbrook, CA, said some growers had a "great year." Yield issues almost always strike unevenly and some producers were able to take advantage of very strong field pricing with pounds per acre above the average. Talking in late August, Lucy noted that the San Luis Obispo producers were still packing their Morro Bay avocados and finding excellent sales with some California retailers. "We still have a couple more weeks to go (with California fruit)," he said on August 28, after most other packers no longer had any California fruit left.

With the crop almost completely harvested, the handlers turned their attention toward 2020. While each said that any crop size predictions this early in the ball game are subject to change, they all agreed that there is a much

bigger crop on the trees than a year ago. No one quarreled with the preliminary California Avocado Commission estimate of around 365 million pounds. The early estimate is made for budgeting purposes and is typically on the conservative side. The handlers seem to agree with the consensus being that the 365 million pounds is probably on the low end of the expected range.

But as Wedin of Calavo said: "We don't start getting serious about the estimate until February 15." He said by November 15, it is possible to make a fairly accurate estimate but there is still three months of winter that the crop has to navigate until it comes to fruition. He said when the trees were in bloom during the spring there was a lot of excitement as there was an excellent bloom. While the set appears to be fairly good, he said a sizable percentage of those blooms didn't produce a piece of fruit.

Lucy made a similar point that the making of a crop is a process with many stages. He noted that the amount of rain in the November/December time frame typically determines how large the individual fruit will grow. And that's key to determining the overall weight of the crop. A crop with large fruit (say 40s to 48s) obviously produces more pounds for the season than a crop that peaks on 60 size fruit. Lucy said the trees do appear to have set a fairly good crop. The winter will determine how large the fruit grows.

Each of the handlers expressed a level of excitement and anticipation in being able to market the certainly-larger 2020 California crop. Wileman said there does appear to be a "new normal" with regard to the avocado market. He said this year both the market and the field price stayed very strong even as combined weekly volume from all sources rose. During July, 50 million pounds of fruit were being marketed in the United States each week while the field price approached $2 per pound.

Some are predicting that 3 billion pounds of fresh avocados will be sold in the United States in 2020. That would represent a close to 20 percent increase. What price will growers be able to get for their fruit when the weekly average is 60 million pounds? "That's the million dollar question," said Wileman. "We don't know. Selling that much fruit is doable but at what price?"

He said every year is different and every year requires its own strategy.

Wedin said a deep dive into the numbers paints a promising picture, and reveals a lot of loyalty among retailers for California fruit. He said that during the May through July time period, the U.S. market consumed about the same amount of fruit in 2019 as it did in 2018 (more than 615 million pounds each year) yet the market price was $24 more per carton for California fruit and $20 more for all fruit. The average f.o.b. price in that time frame was in the mid-$50s in 2019 compared to the low to mid-$30s the year before. He said that proves demand continues to grow.

The relative scarcity of California fruit appears to also have played a very important role in driving the market upward. While total volume was similar, California growers sent about 12.5 percent fewer avocados to market during that time frame this year than they did a year ago. That gap could be credited with playing a big role in driving the price up for all avocados.

In looking at 2020, Wedin said that he has tracked the increase in demand at about 15 percent per year during the past decade. Is a 20 percent increase on a higher base going to occur without growing pains? Past history shows that the market has been able to remain steady even during short periods of very strong volume. But is that sustainable over many months? Time will tell.

All three handlers agreed that a California crop approaching 400 million pounds will have to be marketed over a longer time frame. But Lucy said the California industry's most loyal retailers are excited about that. "If the size is there, we will be marketing some fruit in January," he said. "There are retailers who will write California avocado Super Bowl ads. We think we will get going (with California fruit) around January 15."

Of course, he did offer his early caveat about good winter weather being the key to producing both an early and a large crop.

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To address the popular and trending topic of avocado ripeness, The Scoop Blog's Mythbuster explained how to ripen an avocado faster through a variety of techniques.

Busting Avocado Myths To Build Brand Loyalty

The California Avocado Commission (CAC) continuously develops content for its online channels to help educate, inspire and influence consumers to purchase California avocados when they are available. One such channel, The Scoop Blog, has become the go-to resource for California avocado consumers seeking to ask questions or gain an informed perspective about their favorite fruit. A great example of The Scoop Blog's unique content includes its Mythbuster program, which offers the best practices and techniques for handling California avocados.

Throughout the 2018 and 2019 seasons, CAC worked with well-known blogger and recipe development partner Dzung Lewis of Honeysuckle, who served as Mythbuster in a series of California avocado videos. CAC and Lewis tackled a variety of popular avocado topics, questions and misconceptions to provide solutions, resources and techniques. A few themes included *How to Prevent an Avocado from Browning*, *How to Ripen an Avocado Faster,* and *How to Cut an Avocado Safely.*

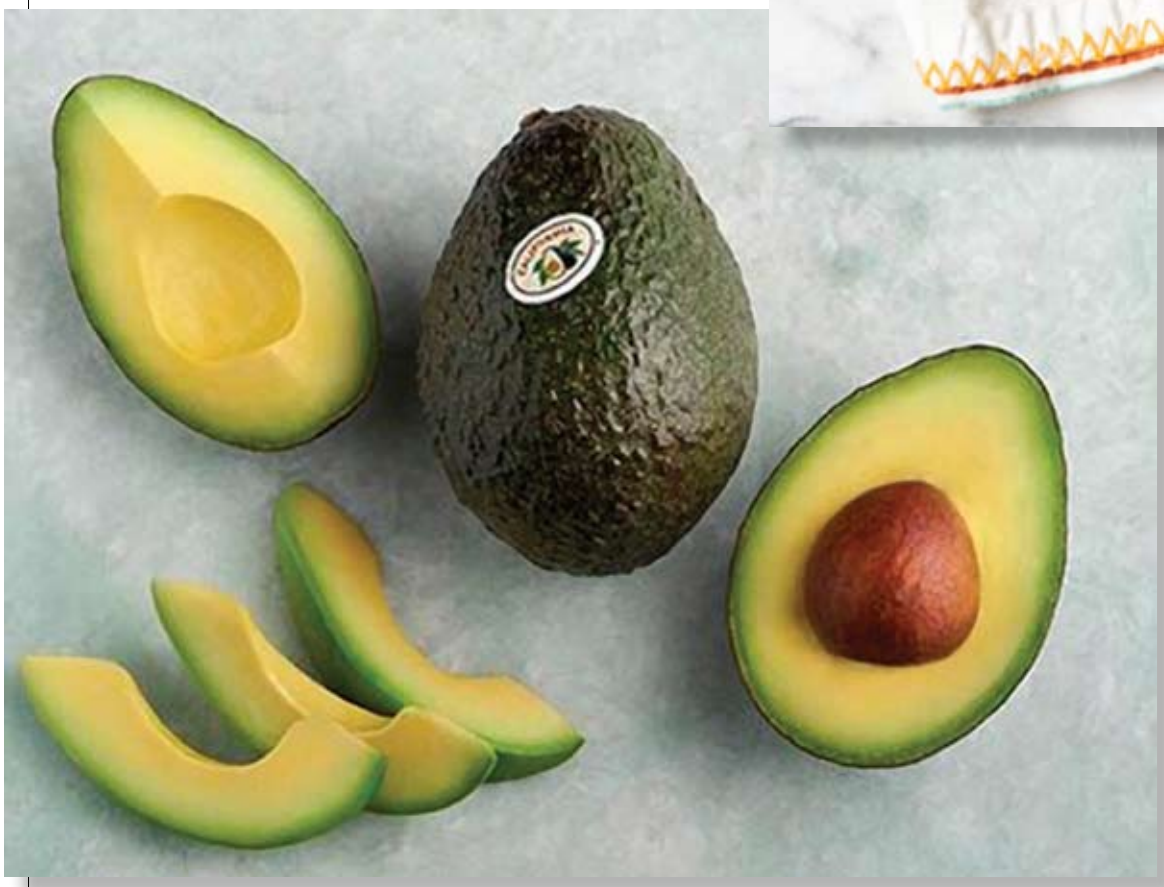
By debunking myths in a fun and informative manner, CAC's Mythbuster engages and educates consumers while keeping the brand top of mind. Additionally, because mainstream

Popular blogger and recipe developer Dzung Lewis of Honeysuckle has served as the California Avocado Commission Mythbuster since 2018.

media and consumers are often looking for experts to address trending topics or popular events, CAC's Mythbuster content offers the Commission an opportunity to join or lead these conversations. For example, when "avocado hand" (an injury caused by improperly cutting an avocado) became a popular topic on social media, CAC was able to leverage its Mythbuster video content to demonstrate how to safely cut and handle an avocado, while strengthening the brand's position as an industry expert.

CAC's Mythbuster content has garnered **more than 1.8 million social media impressions** with users spending an average time of 2:26 on The Scoop Blog – about **22 percent more time spent here** than anywhere else on the consumer website. Furthermore, the top Mythbuster article, "Is an avocado a fruit or a vegetable" has become the **third most popular page** on the entire CaliforniaAvocado.com website. As long as consumers have questions about the Golden State's official fruit, CAC's Mythbuster content will be there to provide answers and inspire local, seasonal eating.

Instead of traditional dicing or slicing, The Scoop Blog's Mythbuster offers another beautiful and unique way of cutting and styling avocados through fanning the fruit over a salad.



Since many consumers do not know how to safely cut an avocado, a Mythbuster video on The Scoop Blog showcased step-by-step instructions on how to properly cut a California avocado.

Xerces South Coast Pollinator Mix.

Panel Explores Avocado Cover Crops

By Alli Rowe
UC Cooperative Extension Ventura County

Cover crops in avocados? How do you select species? When do you seed? Do they even work? What benefits do you notice? What are the management issues? These were all questions addressed at an Avocado Nutrition and Cover Crop Usage field day seminar at Pine Tree Ranch in Santa Paula. Hosted by the California Avocado Commission and presented by Ben Faber and Alli Rowe from University of California (UC) Cooperative Extension, the cover crop portion of the seminar culminated in a grower panel of three cover crop veterans. On the panel was Carl Stucky, a seasoned avocado grower in Carpinteria; Mike Sullivan, an orchard manager who dabbles in both organic and conventional systems; and Chris Sayer, owner of Petty Ranch in Saticoy. So, what did we learn?

Cover Cropping History

All three of the growers on the panel had been cover cropping for more than 20 years. As Stucky put it, "Cover cropping is not new. People have been cover cropping for thousands of years." But how and why you cover crop is completely unique. Sayer started cover cropping to alleviate soil compaction issues that were killing lemon trees. Sullivan was introduced to cover cropping by way of Valencia orange trees suffering from poor soil health and water infiltration. Stucky started cover cropping on a property that suffered from severe soil erosion and loss.

Species selection

Different cover crops can address different issues. Initially, Sayer focused on deep-rooted crops such as sugar beets and daikon radish to break up soil compaction. Recently, he has been using grasses, such as triticale, to build biomass and increase soil organic carbon. Stucky aims for a variety of rooting types and diversity of plants to keep beneficial insects around. "I look for a range of responses and benefits; it is all cumulative," he stated. All growers mentioned mixing it up, aiming for rotating diversity and using selective covers to address specific needs. Agricultural crop rotation provides benefits such as soil fertility, nutrient cycling and erosion control. A permanent tree orchard can't be rotated, yet diversity in cover crop selection allows growers to gain the benefits of crop rotation.

Benefits

Cover crops provide a multitude of benefits based on species selected. Growing cover crops can increase soil organic matter, improve soil structure, enhance nutrient cycling, aid in weed suppression, provide habitat for beneficial insects and pollinators, and build on-farm resiliency to climatic changes.

For growers in Ventura County, improving water infiltration is a noticeable benefit that everyone can relate to. All growers reported issues of runoff prior to cover cropping and have seen dramatic improvements in retaining water in the soil. For a drought prone area and sensitive avocado trees, this could be the difference in surviving a July with a 120-degree heat wave. Pack out comparisons offer subjective records of yield increases on cover cropped blocks. And notable improvement of soil structure offers a compelling case for cover cropping benefits. Using soil map data, Sayer estimates his orchard was around 2 percent organic matter prior to cover cropping. After decades of dedicated cover crops, he now brings soil samples in with

Triticale and Lamb Hass.

Clover Medic Mix

organic matter topping 5.7 percent. That is almost unheard of in Ventura County. All of that organic matter improves soil structure, tilth, water infiltration and microbial communities to support healthy trees.

Another thing to love about cover crops is their role in nutrient management. Nitrate leaching is a problem of excess fertilizer making its way below the root zone and into water systems. Grasses and brassicas are excellent nitrogen scavengers, helping prevent nitrate leaching to groundwater. Covers of grasses and brassicas take up nitrogen and then slowly decompose, releasing that nitrogen back to the soil as a biologically available form for the cash crops to utilize. Legumes, on the other hand, work in an entirely different way to impact nitrogen. Utilizing nitrogen-fixing nodules in their root systems, legumes fix atmospheric nitrogen and exude it as biologically available nitrogen for other plants to use. With a greater level of soil nitrogen available, less added nitrogen is required for optimal crop growth.

For a long-term investment in cover crops, it can be tricky to specifically cite one benefit over the other. Sullivan spoke to the challenge of putting a line item on a spreadsheet relating to cover crops saying, "How do you measure change in yield? Well, that is not necessarily why you cover crop. You cover crop because it makes sense."

Management

The word of the day is management. As with anything, if you don't manage appropriately, issues will arise. In the case of avocado groves, some of these problems can come in the form of irrigation entanglement from greedy cover crops, fat gophers snacking on your greens, thirsty cover crops sucking your water supplies, or providing a nice place for weeds you don't like to grow. These are all considerations and managing cover crops efficiently plays into how prevalent these problems are. As with any system, it is all about trial and error and using a curious mind to manage well.

An interesting management topic is timing of seeding. Some orchards are located in frost-prone areas. Planting tall cover crops that come to maturity during the coldest days of the year can put the orchard at greater risk for frost. Carl Stucky minimized this risk by seeding low stature cover crops in January. The winter rains assist in keeping growth minimal

during those frost-prone days of February. Come March and April, a fully established cover crop provides erosion control and increased infiltration to keep rain onsite. Voila! Management problem solved.

Take Home Message

Cover cropping is a fine balance of art and science. There are guides, resources and research to inform decision making about what to cover crop and when, but there is no hard and fast answer. The success lies in choosing the right cover crops to address specific issues and managing them as they work within a unique system. Cover crops are successful when the grower is interested in feedback, experimentation and learning. This could mean manipulating seeding dates based on weather, terminating cover crops based on tree needs, or getting creative with seed mixtures that fit the orchard. At the end of the day, it is all about finding creative practices to improve the overall functioning of the orchard and being adaptable to the future ahead.

Interested in learning more about cover crops or other soil health practices? California's Climate Smart Agriculture Programs support practices that increase soil carbon sequestration, reduce greenhouse gas emissions, improve yields and efficiencies, and promote climate resilience. Nine specialists throughout the state provide technical assistance and information on how to implement best climate smart practices. Find and locate a UC Cooperative Extension climate smart agriculture specialist near you by visiting http://ciwr.ucanr.edu/Programs/ClimateSmartAg/.

(Alli Rowe is a community education specialist for the Climate Smart Agriculture Program of UC Cooperative Extension in Ventura County.)

Subterranean clover

Photo credits.

Triticale: Chris Sayer
Subterranean clover: Kamprath Seeds
Clover Medic Mix: Kamprath Seeds
Xerces South Coast Pollinator mix: S&S Seeds

By Tim Spann
Research Program Director

Avocado Fertilization:

The Macronutrients

In the Summer 2019 issue of *From the Grove* I reviewed the basics of plant mineral nutrition, covering the concepts of essential nutrients, macro and micronutrients, and nutrient uptake. In this article, I'll dive deeper into understanding the macronutrient fertilization of avocados.

A comparison of recommended avocado leaf macronutrient optimum ranges for California and Mexico.[1]

Nutrient	California	Mexico
Nitrogen %	2.2-2.4	2.2-2.6
Phosphorus %	0.08-0.44	0.08-0.25
Potassium %	1.0-3.0	0.71-2.0
Calcium %	1.0-4.5	1.0-3.0
Magnesium %	0.25-1.0	0.25-0.8
Sulfur %	0.2-0.6	0.2-0.6

[1] Data from www.avocadosource.com.

Macronutrients

As a reminder, the macronutrients are nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S). These six nutrients can be further divided into primary (N, P and K) and secondary (Ca, Mg and S) macronutrients. Because of their relatively large abundance in plants, macronutrients are always reported as percent of dry matter or dry weight in a plant tissue analysis.

While various "optimum range" guidelines for macronutrients in avocado leaves are available, these ranges vary based on the source of the information and from region to region. Ideally, you should have tissue nutrient analyses performed on your leaf samples sometime between mid-August and mid-October every year. Over time you will develop a data set for your trees, and will be able to track their nutrient status and judge those levels relative to yield and the overall performance of your trees.

Nitrogen

Nitrogen is required in greater quantities by avocados than any other nutrient except K. Avocados take up N primarily as nitrate (NO_3^-) but also can take up some ammonium (NH_4^+).

Nitrate is highly soluble, which means it easily can be leached below the root zone, where it can potentially contaminate ground water supplies. Ammonium is held by soil particles and is therefore retained in the soil for a longer period until it is converted to nitrate by soil bacteria through nitrification. Nitrification is temperature dependent and can occur in as little as 1 to 2 weeks in warm soils (75°F) or up to 2 to 3 months in cold soils (50°F). The use of ammonium fertilizer will acidify soil over time as a result of the hydrogen released during the nitrification process. Urea [$CO(NH_2)_2$] is a commonly used form of N because it is relatively cheap. Urea moves into the soil with the irrigation water and is rapidly converted to ammonium, which then undergoes nitrification.

The decomposition or mineralization of organic matter also can serve as a source of N. Most avocado soils in California are naturally low in organic matter so mineralization is not a major source of N, unless organic amendments are routinely used.

Nitrogen is mobile within the plant — the plant can take N from an existing tissue and reuse that N elsewhere. As a result, N deficiency symptoms will first appear on old leaves since the plant can take the N from the old leaves to support new growth when there is insufficient N available in the soil. Nitrogen deficiency appears as a general yellowing or chlorosis of old leaves and reduced tree vigor.

Phosphorus

Phosphorus is taken up by plants in the form of phosphate (HPO_4^{2-} in alkaline soils; $H_2PO_4^-$ in acid soils). Most soils contain ample amounts of P, but it is often tied up in only slightly soluble compounds. Phosphorus is maximally available at a soil pH of 6.5 to 7.5, but

Macronutrients essential for 'Hass' avocado production and their primary functions in the tree's physiological processes.

Nutrient	Symbol	Uptake Form	Primary Functions
Nitrogen	N	NH_4^+, NH_3^-	Synthesis of amino acids (proteins), DNA and RNA, hormones
Phosphorus	P	HPO_4^{2-}, $H_2PO_4^-$	Synthesis of ATP, DNA and RNA; cell membrane integrity
Potassium	K	K^+	Ionic balance of cells, opening and closing of stomates
Calcium	Ca	Ca^{2+}	Cell wall and membrane structure
Magnesium	Mg	Mg^{2+}	Chlorophyll formation
Sulfur	S	SO_4^{2-}	Amino acid synthesis

Adapted from: Datnoff, Elmer and Huber (2007) and Taiz and Zeiger (2010).

the available P may be only one percent of the total P present in a soil.

There are many different P fertilizers available, including superphosphate and various forms of ammonium phosphate. In the U.S., the P content in fertilizers is given as percent phosphorus pentoxide (P_2O_5). To convert phosphorus pentoxide content of a fertilizer to elemental P content, the phosphorus pentoxide content is multiplied by 0.44. For example, a fertilizer with an analysis of 0-46-0 contains 0 percent N, 46 percent P_2O_5, and 0 percent K_2O, which equates to 46 x 0.44 = 20 percent P.

It should be noted that phosphite (PO_3^{3-}) and phosphorous acid (H_3PO_3) products used in the control of pathogens such as phytophthora root rot are not converted to phosphate in the plant and cannot serve as replacements for phosphate fertilization. There are soil bacteria capable of converting these products into phosphate, but the rate of this conversion is too slow to be of any practical benefit. There are no known plant enzymes that can carry out this conversion.

Symptoms of P deficiency are somewhat non-descript and include slowed growth and poor fruit development. Random, necrotic spots may appear on leaves of severely deficient avocado trees.

Potassium

Potassium is unique among the essential plant nutrients in that it does not become part of complex organic molecules. Rather, K remains in ionic form within the plant and acts as a regulator in many essential processes, including the opening and closing of stomates, regulating enzymes and controlling cellular pH.

Potassium is taken up by plants as potassium ions (K^+) dissolved in the soil solution. Avocados have higher K levels than almost any other fruit, and require K in amounts equal to or greater than N.

Common fertilizer sources include potassium nitrate (KNO_3), potassium sulfate (K_2SO_4) and potassium thiosulfate (KTS; $K_2S_2O_3$). In the U.S., the K in K fertilizers is reported as percent potash (K_2O), even though the fertilizers don't contain K_2O. This can cause confusion since K fertilizer recommendations may be based on actual pounds of elemental K needed. To convert fertilizer K_2O to elemental K, multiply a fertilizer's K_2O content by 0.83. For example, potassium nitrate has an analysis of 13-0-44 — 13 percent N, 0 percent P_2O_5 and 44 percent K_2O. In elemental terms it contains 44 x 0.83 = 36.5 percent K.

Potassium is highly mobile within plants; thus, deficiency symptoms appear first on older leaves. However, K deficiency can be difficult to diagnose in avocados since it is manifested as tip and marginal chlorosis and necrosis on older leaves, which is often masked by tip burn caused by chloride toxicity. Other symptoms of K deficiency are slow growth, weak stems and small fruit.

Calcium

Calcium exists in the soil and is taken up by plants as the calcium ion (Ca^{2+}). Calcium is a critical structural element in plants, being a component of cell walls and membranes. Once Ca is taken up and integrated into the plant it

is immobile and cannot move to other parts of the plant. Thus, there must be a continuous supply of Ca available in the soil for plants to support new growth.

Deficiency of Ca appears first in new tissues and symptoms include death of growing points, including shoot and root tips.

Despite most soils having relatively high levels of Ca, it may be necessary to provide supplemental Ca fertilizer, especially on alkaline soils where Ca availability is reduced. Common fertilizer sources include calcium nitrate, calcium ammonium nitrate (CAN17) and calcium thiosulfate (CaTS).

Magnesium

Magnesium is taken up as the magnesium ion (Mg^{2+}). Magnesium is a critical component of the chlorophyll molecule, which is essential for photosynthesis, and acts as an activator of numerous plant enzymes important for normal plant growth.

Magnesium is mobile within plants; thus, deficiency symptoms appear first on older leaves. Magnesium deficiency appears as interveinal chlorosis (yellowing between the leaf veins) on older leaves. As symptoms progress, the edges of leaves may become completely yellow leaving green veins down the middle of the leaf appearing as a "Christmas tree."

Magnesium is generally abundant in California soils, and may be too high in certain locations. This can lead to competition with Ca. There is no good way to manage high Mg levels other than to ensure sufficient availability of Ca in the soil.

Sulfur

Sulfur is taken up from the soil in the form of sulfate (SO_4^{2-}). Sulfur is a component of amino acids and is therefore necessary for protein synthesis.

Like NO_3^-, SO_4^{2-} is leachable from soils and deficiencies can occur on most soil types. However, in low rainfall areas like California, SO_4^{2-} can form precipitates in soil as gypsum (calcium sulfate; $CaSO_4$).

Sulfur is immobile in the plant and deficiency symptoms appear on new leaves first. Symptoms of S deficiency include slow growth and pale green to yellow new leaves.

When to Fertilize

We are fortunate that Dr. Carol Lovatt, retired professor of plant physiology at UC Riverside, spent many years looking at optimum timing of fertilizer application. To fully appreciate her research, it is important to remember a few key points:

1. Fertilizer should be applied to correspond with plant uptake.
2. Fertilizer should be applied in a quantity sufficient to replace what is lost due to crop removal.
3. You are fertilizing for three crops at any given time.

Let's look at each of these in more detail.

Timing of Plant Uptake

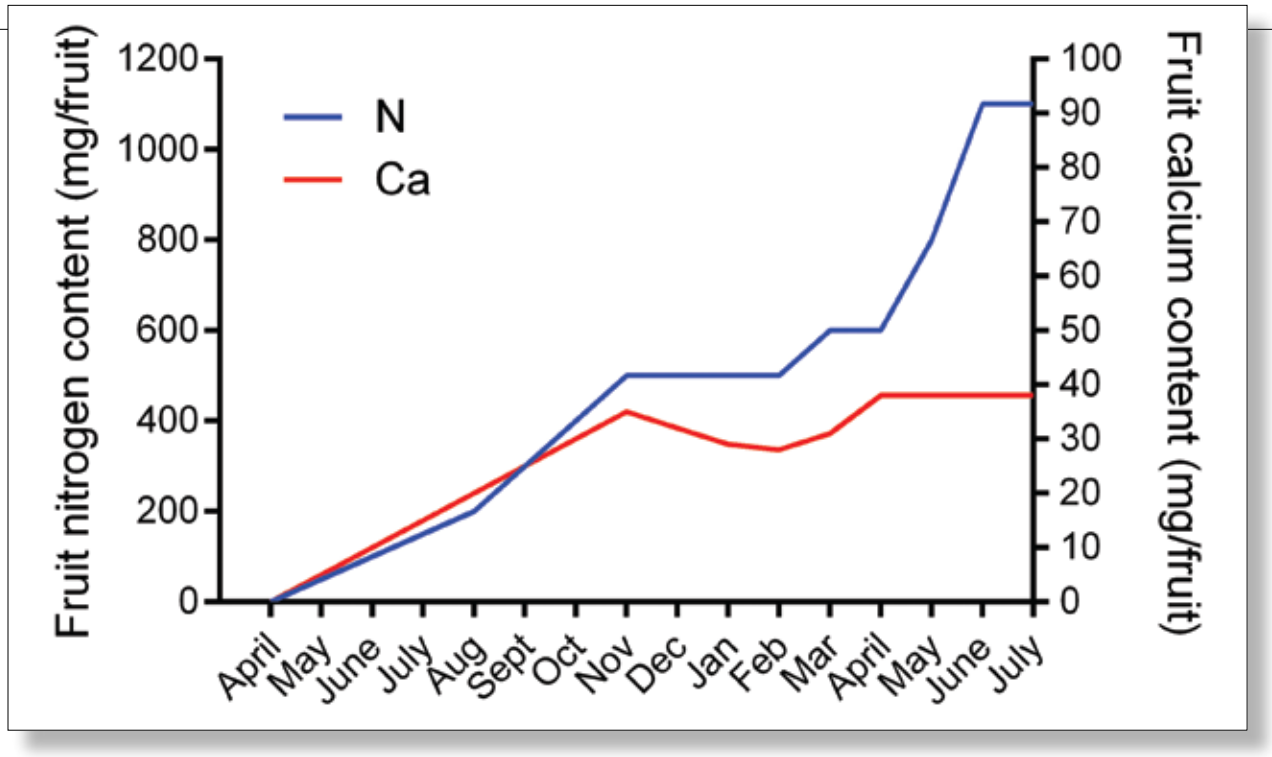
The primary goal in fertilizing avocado trees is to support fruit growth and development. Avocados grow in what is called a double sigmoid or "S" curve. That is, the fruit grow relatively slowly for an initial period, followed by a period of rapid growth, followed by another period of slow growth, and finally another period of rapid growth. In California, these periods of growth generally correspond to periods of bloom through July, August through October, November through February, and March through harvest.

To maximize yield, it is important to have nutrients available to support

Nutrients removed by an avocado crop based on a yield of 7,500 pounds per acre.

Macronutrient	lb/ac	Micronutrient	oz/ac
Nitrogen	16.5	Boron	2.3
Phosphorus	3.0	Iron	0.5
Potassium	22.5	Zinc	0.8
Calcium	0.8	Manganese	0.15
Magnesium	2.3	Copper	0.3
Sulfur	3.8		

Calculations based on data from Rosecrance, Faber and Lovatt. 2012. Better Crops Vol. 96, No.1.



Accumulation of nitrogen (N) and calcium (Ca) in 'Hass' avocado fruit. Redrawn from Rosecrance, Faber and Lovatt. 2012. Better Crops Vol. 96, No. 1.

the periods of rapid fruit growth. However, not all nutrients are taken up in the same pattern. Approximately half the required N, P, Mg and S are accumulated during both periods of rapid fruit growth. Thus, these nutrients need to be applied in spring and following bloom, so they are in the plant and available to support rapid fruit growth as well as the development of recently set fruit.

Potassium is more rapidly taken up during the second season of fruit development. Thus, depending on the crop load of the tree more K may be required to support fruit development in one year compared with another.

Calcium is the opposite of K, with most uptake occurring during the first season of fruit development. Therefore, Ca must be readily available during early fruit development each spring.

Replace What is Lost to Crop Removal

Nutrients that are in leaves or stems of the tree will eventually be returned to the grove as leaf litter decomposes and wood from pruning is chipped or shredded on the grove floor. However, the nutrients in fruit are exported from the grove when the crop is harvested. These are the nutrients that must be replaced on an ongoing basis.

Estimates of how much of each nutrient are removed from the grove based on fruit nutrient analysis are surprisingly low. A 7,500 pound-per-acre crop of 'Hass' avocados, which is the California industry average production, removes just 16.5 pounds of N.

Fertilizing for Three Crops

This last point can be a bit tricky to understand. Let's look at January of a given year as an example. At that point the crop hanging on the tree is getting ready to enter a period of rapid growth that will continue until harvest and those nutrient demands must be met. The tree also is getting ready to bloom. Flowering is a period of high nutrient demand — it is common to see trees turn yellow during bloom as they mobilize nutrients from around the tree to support the flowers — and adequate nutrition needs to be supplied to support bloom and early fruit set. As the bloom progresses, a spring flush of vegetative growth will appear from the terminal of indeterminate inflorescences. This growth will help to support the new setting crop, protect it from sunburn and contribute some inflorescences to next year's bloom. Thus, inadequate nutrition at any given time can potentially impact three different crop years.

How much fertilizer your grove needs depends on the specifics of your situation and should be based, in part, on annual leaf and soil analyses. If you are unsure how to develop a fertilizer program for your grove you should consult with your testing lab, a Cooperative Extension Farm Advisor, grove manager or other crop consultant to develop a program tailored to meet your grove's needs and your production goals. Just remember, your trees are eating for three and must be fed accordingly.

By Tim Linden

Opportunities Available for Spanish Avocados

Spain has a commercial avocado industry that has achieved success but one industry researcher believes opportunities are being missed in the European Union, which could lead to a much more robust program.

Iñaki Hormaza is a research professor at the IHSM la Mayora, a public research institute that belongs to the Spanish Council for Scientific Research (CSIC) and the University of Malaga. In an email interview with *From the Grove*, Mr. Hormaza gave an overview of the industry and the marketing potential that could lead to year-round production and sales to others members of the European community.

In Spain, he said about 80 percent of the avocado production is devoted to the Hass, with approximately 15,000 hectares (37,000 acres) of avocados in the ground. Of those, about 1,500 hectares are grown in the Canary Islands, a Spanish archipelago, and the rest are in continental Spain. The vast majority of Spain's acreage (12,500 hectares) are in the Andalucia region, which is in the south central to south east corridor. The area largely consists of the provinces of Malaga and Granada.

There are new plantings, including about 1,000 hectares in southern Portugal that are about one year old, and another 1,000 hectares in eastern Spain near Valencia (interestingly a high percentage of Lamb Hass) and western Andalucia (provinces of Cádiz and Huelva).

Hormaza said most of the new plantings are from new growers getting into the avocado business (mostly replacing old citrus orchards). They typically use the existing packers for marketing the fruit.

"Interestingly, all the big avocado packinghouses import Hass avocados from other countries – mainly Peru and Chile and, lately, also Colombia – to re-export to other European countries," he said. "So the avocados reach Spain by boat, are packed in southern Spain and shipped to the rest of Europe. The result of this is that the European customers do not really know when it's avocado harvesting season in Spain."

This is a practice which the Spanish researcher sees as a missed opportunity for the Spanish avocado grower. "I'm convinced that Spanish avocados could reach a much higher price in the European market taking into account sustainability of the production and lower carbon footprint. In fact, I believe that either we do that or the Spanish avocado industry will not be competitive in the medium term."

Hormaza argues that there are four or five avocado varieties that Spanish growers could plant resulting in year-round production and premium pricing. "We can produce avocados in Spain all year round but the big marketing companies are only interested in Hass. However, our window is narrowing since Peru is entering the European market as early as March, so most growers harvest Hass in Spain from December to March and from March the

packing companies import Hass from other countries, pack them here and send them to Europe. The problem is that those companies are not so interested in promoting Spanish avocados but only their labels."

He said the cartons include the name of the Spanish packer and wording showing that they were packed in Spain. Country of origin, he says is in small letters if included at all.

Hormaza has been working with some smaller companies in an attempt to highlight different varieties and the advantage of buying local avocados grown in Spain. "For example, we are getting good prices on our Reed avocados in July-August; no big companies would buy Reed in those months since they are selling Hass from overseas," he said.

Spain is a small player in the European market as its home-grown volume represent less than 10 percent of the European market, according to the university researcher. "In my opinion there is a clear niche to sell high quality avocados produced locally in Europe at a higher price than those imported from other countries."

While the Lamb Hass variety is finding some growers that like it, Hormaza is not convinced of its viability. "The problem with Lamb Hass is that it is not sold differently," he said. "It is sold as Hass and it is harvested too early, before Peruvian Hass avocados arrive to Europe."

As a result he said the Lamb Hass tends to be marketed in Europe with no distinction from the Hass. "The consumer usually does not distinguish visually between both but surely they notice that something weird is going on when they eat the fruit."

He reiterated that with few exceptions, "European consumers only have access to Hass and, in some cases, to Fuerte."

Not dissimilar from California, Hormaza said the main limitation to increasing avocado acreage in Spain is water availability. "With additional water, either from desalination plants or bringing water from elsewhere, we could easily double the acreage but I do not see that happening in the near future," he said.

Some groves in Portugal are already in production but most are still new plantings in the first years of production. Most of that fruit is marketed by Spanish companies.

As far as the Canary Islands are concerned, Hormaza said most of that fruit is marketed within the confines of those islands as that region is not allowed to import any (sub)tropical fruits from outside the islands. "Consequently, all the avocados consumed in the islands are produced locally. The excess is exported mostly to mainland Spain and, in some cases, also directly to the rest of Europe," he said. "They are trying to develop a specific label for the Canarian avocados, similarly to what they have for Canarian bananas."

According to Hormaza, avocado consumption in Spain is increasing but slowly. He said it is currently at about 1 kg per person (2.2 pounds) so most of the production is exported to other European countries, mainly the Netherlands, Germany, France, the United Kingdom and Belgium.

Meeting with targeted retailers is an important component of CAC's PMA Fresh Summit experience. Shown here from 2018 are Jessica Hunter, CAC Board secretary; Shanan Cox, Sam's Club; Jan DeLyser, CAC vice president marketing and Dave Anderson, CAC retail marketing director.

A Preview of the 2019 PMA Fresh Summit

At the 2019 Produce Marketing Association (PMA) Fresh Summit, the California Avocado Commission (CAC) will wrap up the celebration of its 40-year anniversary and kick off its next 40 years of groundbreaking avocado marketing, showcasing innovation, creativity and focused customer service. The Commission's key objectives for the event include building awareness of California avocados' competitive advantages and increasing retailers' knowledge about 2020 California avocado season expectations and marketing support.

CAC's Vice President Marketing Jan DeLyser is honored to serve as moderator of Saturday's session featuring Queen Latifah.

**Note, "EXPO only" registrations include entrance to the Exposition area on Friday and Saturday only. All other program activities listed above require an additional fee or badge/ticket. For more information, please visit https://www.pma.com/events/freshsummit.*

Key information about the upcoming event:
Location: The Anaheim Convention Center, Anaheim, CA
CAC booth number: 3937

PMA Fresh Summit 2019 Schedule of Key Activities:

Wed. Oct 16
12:30 p.m. – 4:00 p.m. Retail Produce Tour

Thurs. Oct 17
9:00 a.m. – 3:30 p.m. Educational sessions, including:
10:30 a.m. – 12:15 p.m. Forum for the Future – State of the Industry featuring PMA CEO Cathy Burns
1:45 p.m. – 3:30 p.m. Forum for the Future featuring Entrepreneur and Leading Shark on ABC's Shark Tank Robert Herjavek
4:00 p.m. – 5:00 p.m. VIP Invitation Reception
5:00 p.m. – 7:00 p.m. Welcoming Reception

Fri. Oct 18
7:00 a.m. – 8:45 a.m. PMA Foundation 5K Race for Talent
8:15 a.m. – 9:45 a.m. Forum for the Future featuring NBA Hall of Fame member and Entrepreneur Earvin "Magic" Johnson
*10:00 a.m. – 5:00 p.m. Exposition**

Sat. Oct 19
8:00 a.m. – 9:45 a.m. Women's Leadership Breakfast featuring Musician, Actress, Author & Entrepreneur Queen Latifah
*10:00 a.m. – 5:00 p.m. Exposition**

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