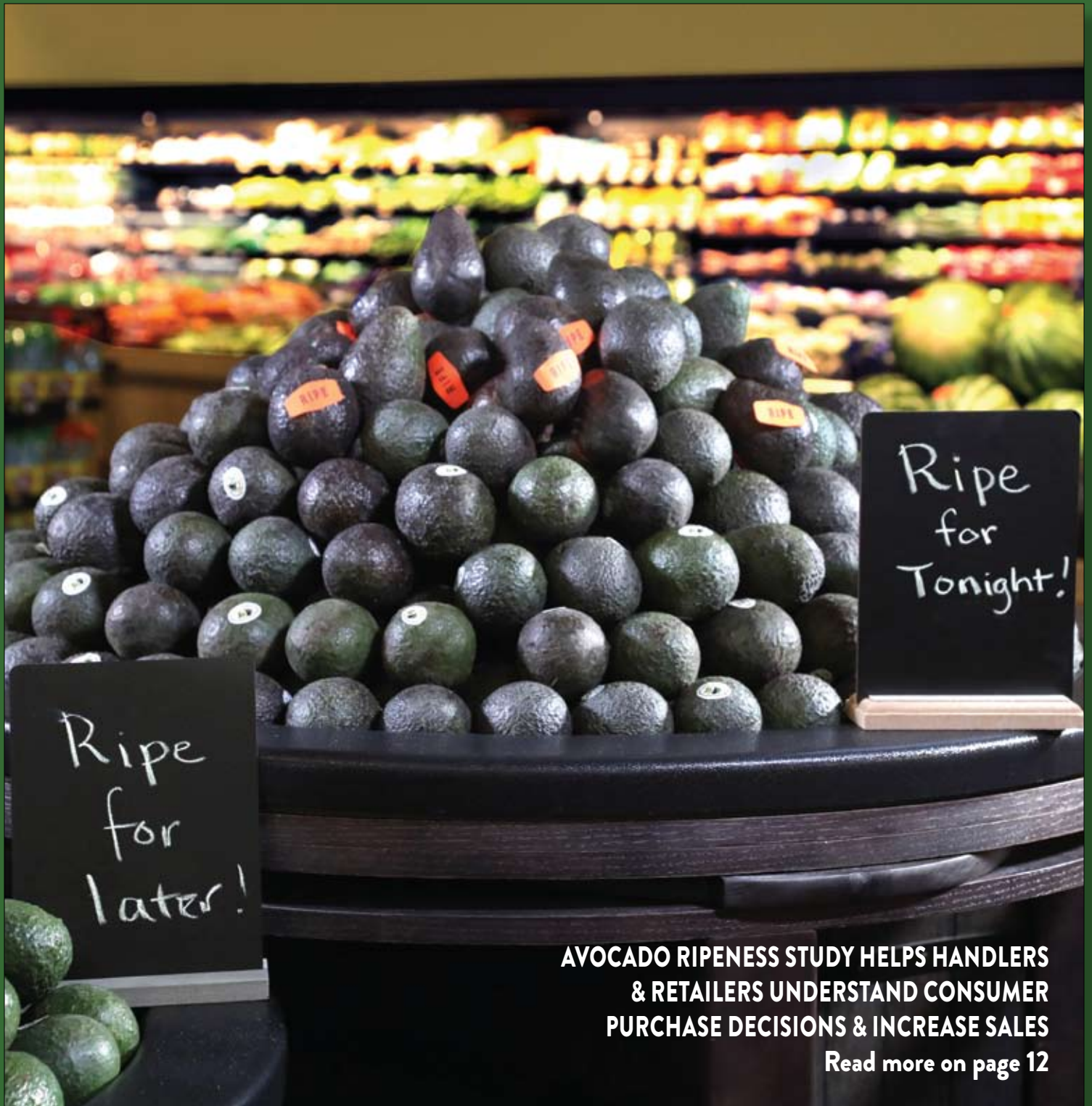


From the **Grove**

Winter 2021

The Latest News from the California Avocado Industry



**AVOCADO RIPENESS STUDY HELPS HANDLERS
& RETAILERS UNDERSTAND CONSUMER
PURCHASE DECISIONS & INCREASE SALES**

Read more on page 12

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10

Tom Bellamore Rides into the Sunset After an Impressive Career



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From the Grove

Volume 11, Number 4

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CA Avocado Commission

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The articles, opinions and advertisements presented in this magazine are designed to offer information and provoke thought. Inclusion in this publication does not presume an endorsement or recommendation by the California Avocado Commission for any particular product or cultural practice.

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New Country

By now, the news is quite widespread that I shall be resigning my post as President of the California Avocado Commission in early 2022, and as you read this the Commission will have already named my successor. As such, this amounts to being my last column in *From the Grove*, the industry magazine birthed during my tenure.

This last column is purposefully brief, since there is only one thing left for me to say, and that is a heartfelt thank you, for allowing me to serve the California avocado industry for over 27 years. The days ahead will be occupied not with thoughts of avocados, but instead with territory heretofore unknown.

As Augustus McCrae of Lonesome Dove aptly said: *“There is nothing better than riding a fine horse through new country.”* With four fine horses in my stable, I am more than ready to ride for my own brand across new country. And that’s where you will – or more likely, not – find me. 🍌



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Chairman's Report



Rob Grether

'Tis the season to be grateful and the season to be hopeful. Certainly, we should strive to have a guacamole-bowl-half-full kind of outlook all year, but when the crop doesn't set or the rain doesn't fall or the wind blows too hard...or maybe you run out of chips, it can be easy to forget how blessed we are to be California avocado growers, packers and marketers. I know there are

easier professions, less complex industries, and investments that carry lower risk, but conversely there are few products as long-loved but also on-trend as avocados, and it's our California avocados topping the charts.

I am grateful for our product's market position, and grateful to everyone who has worked to build and protect our industry and worked to de-

velop and sustain our premium brand. Among the many individuals who work hardest for our success, this season I am particularly grateful to the California Avocado Commission's President and CEO, Tom Bellamore.

As many of you know, Tom has announced his plan to retire in early 2022. In November, the CAC Board engaged the executive search firm, Boy-





Board of Directors

District 1

Member/Jessica Hunter-**Secretary**
Member/Michael Perricone
Alternate/Ryan Rochefort

District 2

Member/John Cornell
Member/Ohannes Karaoghlianian
Alternate/Charley Wolk

District 3

Member/John Lloyd-Butler
Member/Robert Grether-**Chair**
Alternate/Maureen Cottingham

District 4

Member/Rachael Laenen-**Vice Chair**
Member/Jason Cole-**Treasurer**
Alternate/Catherine Keeling

District 5

Member/Andrew Prechtl
Member/Daryn Miller
Alternate/Will Carleton

Handlers

Member/Gary Caloroso
Member/Peter Shore
Alternate/Connor Huser

Public Member

Daniella Malfitano

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

den, to help it identify and recruit Tom's successor. The search process is under way and will really pick up steam after the holidays. While I hope the search is completed in a timely manner, it is not urgent as Tom will stay with us until his successor can start. As many of you know, Tom is humble and lowkey. As such, he doesn't want to be celebrated and probably isn't thrilled that I am calling attention to him now. He may feel like he has just been doing his job and doesn't deserve special recognition, but I think it is important for us all to recognize that our industry and our brand wouldn't be what they are today if not for Tom's leadership at CAC.

Tom joined the Commission in 1994 and has been its President since 2009. I had little exposure to the Commission prior to 2011 and so I have only really known the Commission as an organization run by Tom. I can distinctly remember the grower meeting in Santa Paula, the staff's focused presentation, and Tom's deft and thoughtful responses to challenging questions from growers. I approached Art Bliss in the parking lot about becoming an alternate and then somehow a decade passed. But I am so grateful that through those years, I had the opportunity to work with Tom first as an alternate, then as a director, on numerous committees and finally as Chairperson. Over the past decade—and presumably before—Tom led the Commission through numerous challenges without faltering, through significant growth in the global avocado industry, and through *huge* changes in marketing without falling behind or being too precariously out in front.

The President of the California Avocado Commission is responsible for developing the overarching strategy to support our industry's sustainability and prosperity. Tom has consistently delivered. Certainly, some years are challenging for many growers, and

many years are challenging for some growers, but over the long run, the strategies Tom helped develop and execute with his team, the Board, and other industry stakeholders have, but for a few exceptions, been highly successful. Per capita consumption of fresh avocados has skyrocketed during Tom's tenure as President. There were many factors that contributed to this growth, but I want to recognize that CAC's marketing was out ahead of foreign efforts and that even as California's market share shrunk, brand preference grew and the price premium held.

Despite Tom's enormous contribution to the organization, all will be fine when he finally hangs up his hat. CAC's staff is stable and professional, and Tom has successfully developed his Vice Presidents into exceptionally capable leaders who can continue to lead this organization. Most of California's growers and California's handlers are bullish about the future of the California avocado industry and are confident in CAC's ability to support this industry and serve their interests. In large part, this confidence is built on the leadership Tom has demonstrated during his tenure as CAC's President. I am hopeful for our future and know that while we will face new challenges, we will be able to do so from a strong foundation, with an outstanding team, with a valuable brand, and with enduring gratitude for Tom Bellamore. 🥑

By April Aymami
Industry Affairs Director

CAC 2021 General & Board Officer Election Results

On November 18, 2021, the California Department of Food and Agriculture announced the results of the California Avocado Commission's recently concluded 2021 General Election and seated the new board members for commencement of the 2021-22 CAC fiscal year. The CAC Board consists of 19 members and alternates, of which 15 are producers representing the five growing districts throughout California (10 members and five alternates), three are handlers representing operations that handle at least 1% of the California crop (two

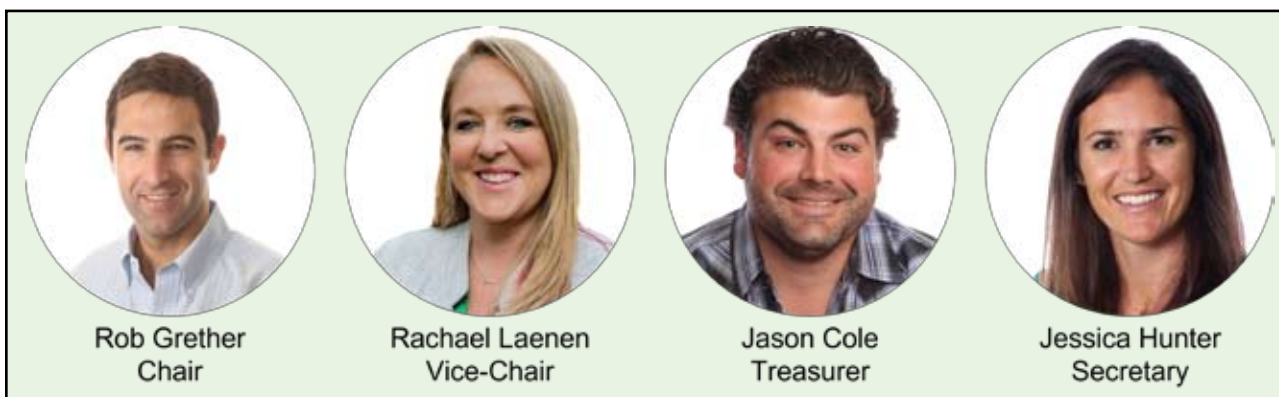
members and one alternate), and one public member who is appointed by the CDEA. Board members and alternates are elected for two-year terms, with half of the producer and handler member seats up for election annually. In odd years, as was the case in 2021, alternate producer and alternate handler member seats also are elected.

For the 2021 General Election, one producer member and one producer alternate member were elected to each of the five districts, as well as one handler member and one handler alternate member. Below is a summary

of the results of the 2021 CAC General Election. The following members shall serve a two-year term (November 1, 2021 through October 31, 2023). A listing of the full Board of Directors can be found on Page 6. Please take note of who the current Commissioners are who represent your district. If you are unsure of which district your grove resides in, please contact the Commission or locate your city/zip code on the following chart: CaliforniaAvocadoGrowers.com/commission/district-map

Affiliation	Member	Alternate
District 1	Michael Perricone	Ryan Rochefort
District 2	Ohannes Karaoghlanian	Charley Wolk
District 3	Rob Grether	Maureen Cottingham
District 4	Jason Cole	Catherine Keeling
District 5	Daryn Miller	Will Carleton
Handler	Peter Shore	Connor Huser

In addition to CAC's annual election, each November the newly seated board conducts an election among their producer members to fill the seats of the Commission's Executive Committee. The following individuals have been elected to serve as the Commission's Executive Committee for the term ending October 31, 2022. 🍌





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Tom Bellamore Rides into the Sunset After an Impressive Career

By Tim Linden

When Tom Bellamore joined the staff of the California Avocado Commission in the early 1990s, he was perfectly positioned to utilize the education, the experience, and skill sets he had developed through education, work and life experiences.

He was hired as vice president of government affairs and more than 27 years later is retiring after leading the Commission as its president since 2009. Bellamore has been materially involved in what has been a very eventful three decades of change for California avocado growers, and he needed all his experiences and talents to navigate the landscape.

Charley Wolk, who has been a board member of the Commission for many different terms during its 40+ years of existence, noted that he has served each of the Commission's four presidents during that period and knew them all well. He believes Bellamore did an excellent job during his CAC career and points to his personality as perhaps the key attribute that informed his success during his tenure. "One of his traits that served him well was his desire to run away from the limelight. His M.O., his leadership style... was not to jump up and make a point before he was ready. He wanted to consider every issue and give guidance where he could. He has a very humble attitude."

Wolk said this was far different from previous CAC presidents, but it clearly worked for Bellamore and helped him get through some very thorny situations over the years. "His work ethic was unmatched. He had a thoroughness to everything he did. He certainly didn't shoot from the hip. He had the skill and ability to bring people together."

While Wolk is very appreciative of Bellamore's style, he did say tooting your own horn is sometimes necessary too, but the retiring president wouldn't do it. "Sometimes you do have to let the growers know what has been accomplished. I remember a grower once saying how lucky the industry was to get so much good press in magazines like *Good Housekeeping*. I'd shake my head," Wolk recalls. "That didn't just happen. Tom and his staff did that."

That comment reminded Wolk of another enduring trait that Bellamore has. "Tom's concern for his employees was so sincere. I mean really sincere."

Ron Campbell, who represents Mexico's avocado growers (APEAM) as well as the importers (MAHIA), was an adversary of Bellamore's in the early years and a collaborator after Mexico gained access to the market. "The California avocado growers never appreciated how difficult it was to keep Mexico out of the market. Tom was a formidable opponent to say the least. I don't think growers understood how hard he fought. It took us (Mexico) a long time to gain full access."

Like Wolk, Campbell said some of that lack of awareness by the growers is tied to Bellamore's personality of taking a back seat and avoiding the spotlight. But he said that was the perfect approach in dealing with the Mexican industry and officials. "Tom was a gentleman, smart, professional and humble. He always stayed humble and that is the approach that works very well with the Mexicans. They do not respond well to a lot of yelling and screaming."

Once Mexico did gain full access to the market, Campbell said the relationship between Mexico and U.S. producers shifted as the focus was on building the market. While there was tension, he said CAC under Bellamore and Mexico's promotional organization, along with the Hass Avocado Board, did work collaboratively to build the market and increase consumption. He noted that the farmgate value for California growers has grown over the years, proving in his estimation that a rising tide does lift all boats. "Each of the associations has done an excellent job including CAC. As Tom retires, he can hold his head up high. He did a great job representing his industry and he is leaving his industry in good shape. The value of research and promotion programs has been proven."

True to his nature, Bellamore would not be interviewed for this story. He believes he merely "did his job" for the past 27 years and others can determine how well he accomplished that.

Tom Bellamore grew up in New Jersey in the 1950s when it was more rural than what comes to mind today. He was at-

tracted to the open spaces, bugs and biology. He began his college career as a biology and pre-med student at Fairleigh Dickinson University in New Jersey, but soon joined a friend who was attending college in Alaska.

Bellamore fell in love with the place, graduated from the University of Alaska and took a position as a biologist with the Naval Arctic Research Laboratory in the most northern section of Alaska. He stayed in Alaska for 13 years, also working for the Alaska Department of Fish & Game, and the Alaska Seafood Institute. His final stop in Alaska introduced him to commodity marketing, which remained a focus of his career for close to four decades.

In 1985, Bellamore moved to Seattle to take a position with the Seafood Marketing Institute, spending a lot of time working on export programs. He also had stints in programs representing cotton, and dry peas and lentils. That final position was in Idaho, which introduced him to his California-born wife, Melanie. It was her desire to get back to her home state that led Bellamore to pursue an opening at CAC.

It was his expertise in both commodity marketing and biology that made him a perfect fit for CAC in the mid-1990s. At that time, the Commission was very engaged in the effort to protect its industry and prevent the importation of avocados from Mexico because of the risk of pests. Bellamore spent countless hours discussing bugs and their impact on the industry and writing position papers on the subject.

Wolk said it was through the efforts of CAC that the industry was able to achieve a stair-step approach to the opening of the U.S. market to Mexican avocados. That deliberate approach allowed the pest impact to be measured, and also allowed the collective avocado industry to build demand as supplies increased.

While employed by CAC, Bellamore continued his education, earning a master's in business administration and a law degree. That advanced education served both Bellamore and CAC well as his duties expanded and he eventually became president of the Commission.

As the new president, Bellamore downsized the staff and greatly reduced expenses, which was the major point of contention with the previous administration. Today, CAC is a lean organization and the budgeting process is very transparent.



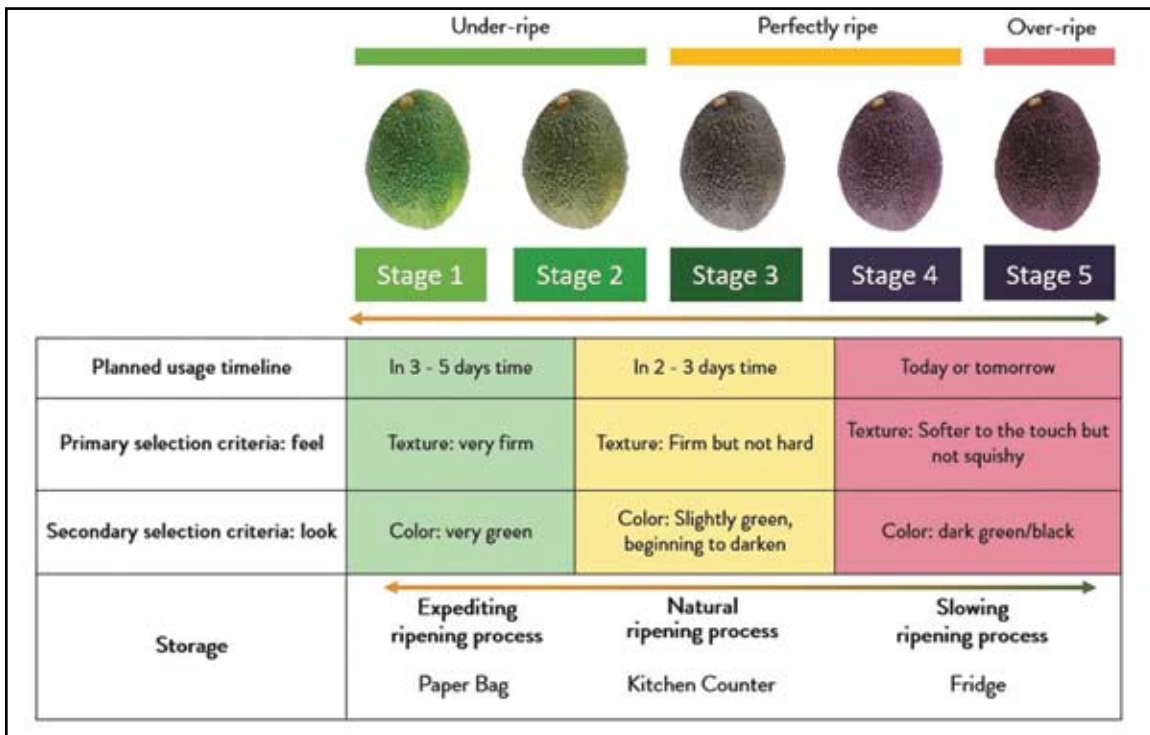
Under Bellamore's leadership, the California avocado industry has enjoyed some of its best years as the field price has been trending upward and California has successfully positioned itself as the premium avocado in the marketplace. Years ago, Bellamore realized, and told growers, that Mexico's production would continue to increase. At one annual meeting, he said a two-billion-pound U.S. market was not far off in the future. The United States is now consuming close to three billion pounds of avocados per year and California has become a niche player, but an important one. California continues to lead the nation in avocado consumption, and it is where most of the state's production is consumed...at a premium price.

California avocado growers approved a continuing marketing order referendum in 2021 ensuring that the Commission will exist for at least another five years. Wolk said Bellamore was adamant about seeing the industry through that referendum. "He took it very personally. If the referendum would have failed, he thought it would be because of him. He was fearful of that and wanted to see it through."

The referendum did pass and Wolk said Bellamore is leaving the industry in very good shape. The premium positioning and focusing on West Coast sales has proven to be prescient. Farmgate price has improved, and the California avocado industry has a bright future, according to Wolk. "I believe we are going to have some 500 to 600-million-pound crops in the not-so-distant future and we are going to be able to sell that."

Wolk also noted that he is on a two-year waiting list to buy more avocado trees to plant in California. "That wouldn't be happening, if it wasn't a strong industry." 🥑

Avocado Ripeness Study Helps Handlers and Retailers Understand Consumer Purchase Decisions and Increase Sales



As a leader in the industry, the California Avocado Commission is frequently asked for information to help handlers and retailers build demand for California avocados. A key component of increasing sales of the premium fruit is understanding the behaviors behind a shopper’s decision-making process — how often they shop, what motivates their purchases of avocados and why they select certain avocados over others. To that end, the Commission conducted an Avocado Ripeness Study during the 2021 California avocado season at Tier 1 retail account locations to provide insight into shoppers’ avocado ripeness level preferences and the role those preferences play in determining shoppers’ decisions to purchase avocados.

In 2002, a quantitative consumer study conducted by CAC discovered 77% of avocado consumers planned to eat their

avocados on the same or following day of purchase. However, the Commission’s 2021 Avocado Ripeness Study, qualitative research conducted in July 2021, suggests trends are changing. Findings from the survey indicate today’s consumers are looking to purchase avocados they can enjoy the day of purchase as well as later in the week, and that their ability to determine the ripeness of the fruit — and identify a good value — are deciding factors in their purchases.

Participants indicated they shop in-store on a weekly basis and although they don’t plan every meal for the week ahead, they do consider what they might make throughout the week when creating their shopping lists. This behavior is reflected in the purchase decisions they make concerning avocados. Many of the consumers surveyed reported they were looking for avocados for same day use as well as throughout the week. Further, they noted they rarely purchase avocados for



Retailers often merchandise the ripest avocados stacked on top of less ripe avocados to help shoppers easily find the most-ripe avocados and to protect them from potential damage. The Commission provides retailers with bins to encourage incremental displays during the California avocado season, and these can help customers showcase different ripeness levels.

same day use only. Most shoppers reported they purchase two to five avocados at a time and will purchase more if they are planning on using more avocados in a dish than usual or if there is a good sale. Ultimately, consumers select avocados based on how and when they plan on using them.

Confident in their ability to gauge avocado ripeness, shoppers prefer bulk avocados for same day use because they can easily assess an individual piece of fruit's ripeness based on its appearance, color and firmness. In fact, every participant mentioned they squeeze avocados and use the level of firmness to determine ripeness. Although shoppers generally viewed bulk avocados as the more expensive option, if they were looking for fruit they could consume the day of purchase they preferred bulk fruit whose ripeness they could easily determine.

As for incremental avocado purchases consumers make based on what they need for the next three to five days, shoppers indicated a preference for bagged avocados because of the perceived value they offer. Half of the participants reported they would occasionally purchase bagged avocados for the cost-effectiveness and convenience. When purchasing bagged avocados, participants indicated that, if available, they would prefer a variety of ripeness levels of avocados in the bag so they could use the avocados over time.

The study also helped the Commission determine if select retail accounts are meeting shopper preferences. While conducting this study, the Commission noted that select re-

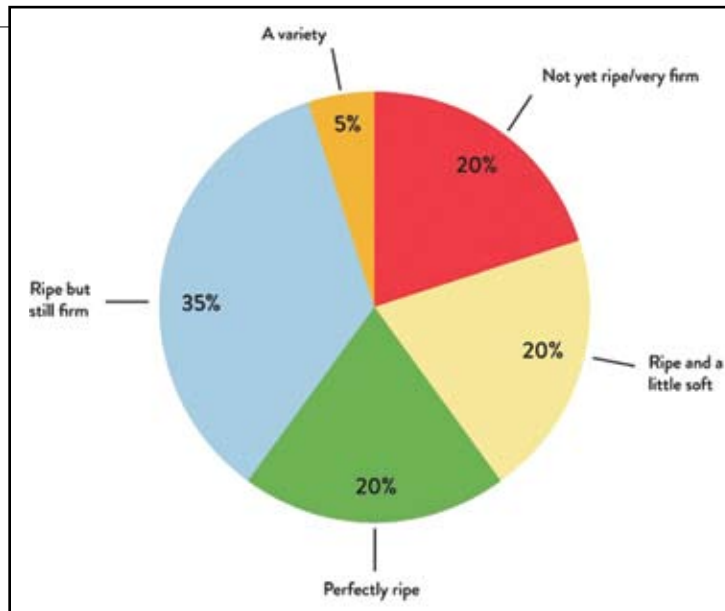


Some retailers merchandise ripe and less ripe avocados separately when available, which may encourage incremental purchases.

tailers are utilizing shoppers' preferences for ripeness when displaying avocados. Multiple retailers have avocado displays in their produce department that feature avocados that are "ripe now" in one section and avocados that will be "ripe in a few days" in an adjacent section. Many other retailers follow the merchandise practice of stacking the ripest avocados on top of firmer ones, helping shoppers select the ripest fruit while also protecting the softer fruit from damage.

Because consumers select avocado ripeness levels based on usage, serving occasions and the timeframe in which they will use them, the majority of respondents indicated they preferred avocados to be slightly underripe rather than overripe to ensure they have the flexibility to use the fruit over several days. This is a significant change from consumer preference in 2002. Consumers also have a strong awareness of how to adjust the ripening of avocados at home with all participants sharing similar methods for storing avocados. These methods included storing avocados in the refrigerator to slow the ripening process or expediting it by placing the fruit in a paper bag. Common reasons shoppers purchased fewer avocados than usual was if the fruit was too ripe, not ripe enough or too expensive.

Insights from this qualitative ripeness study can have an impact on sales. The Commission is sharing key findings from the study with handlers and retailers to help them better understand the important role ripeness plays in a shopper's decisions and insights concerning consumer demand for the fruit.



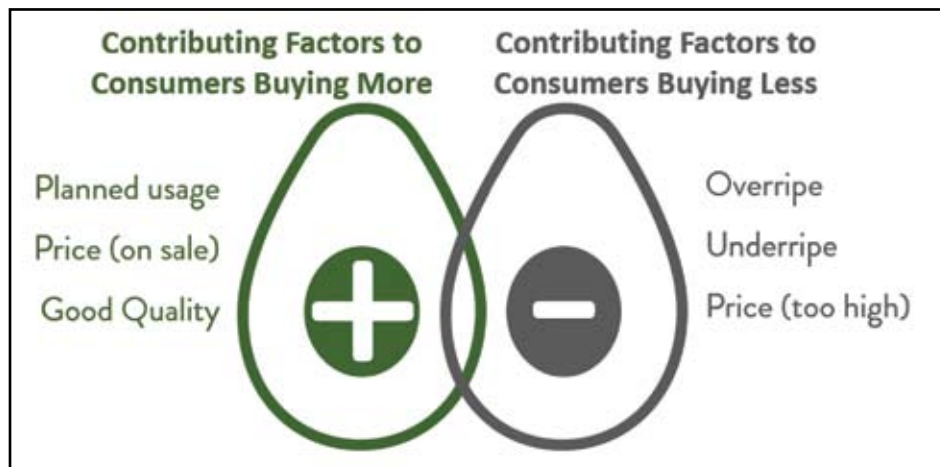
In the 2021 study shoppers indicated a range of preferences for avocado ripeness levels.

Based on the study’s findings, the Commission’s research and analytics teams made the following observations:

- Shoppers are looking for multiple levels of ripeness when selecting avocados. Retailers and marketers can benefit from this by providing a variety of ripeness levels of bulk California avocados and consider offering bagged avocados with multiple levels of ripeness per package.
- Shoppers indicated they consider country of origin and show preference for California avocados. One ripeness study participant noted, “Yes, my store usually has a good mix of both ripe and unripe, especially as they are grown and distributed in California.”
- Providing recipes and usage ideas for California avocados can help shoppers with meal planning. This tactic can

incentivize shoppers to take advantage of perfectly ripe and soon-to-be ripe avocados.

Armed with the knowledge that consumers take an active role in selecting their avocados based on ripeness — with price and value driving incremental sales — handlers can develop and enhance their ripeness programs around consumer preferences. Similarly, retailers can utilize this data to develop in-store displays that address consumers’ consideration of how, when and for what occasions they are serving avocados. Ultimately, this study strengthens the Commission’s position as a trusted partner who provides industry members with valuable information to increase demand for and awareness of California avocados. 🥑



These factors contribute to why consumers purchased more or less avocados when shopping.



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California Avocado 2021-22 Marketing Plan Overview

The California Avocado Commission has released its 2021-22 Marketing Plan, which is designed to increase California avocados' perceived value, preference and loyalty with key targets. Other key objectives of the comprehensive consumer and trade advertising, marketing and public relations plans are to help retain or increase the high awareness of the California growing region among the Commission's targets and to aspire to an average price per pound of \$1.35 or greater.

Marketing Plan activities will be focused in regions where California avocados are distributed, with consumer advertising and outreach programs targeted to "Premium Californians" and avocado super users (see 2020-21 Marketing Results article, pages 20-24). The Commission will provide support

for top tier retailers who merchandise California avocados in California, the West and regional divisions of national chains, as well as targeted foodservice chains that carry and promote the Golden State fruit. During the pre-season, the Commission focuses its efforts on working with potential customers to secure distribution and commitment to support California avocados in season. Within this same timeframe the Commission launches its trade marketing campaigns to generate excitement for the start of the California avocado season and creates a flexible consumer media plan that can easily be adjusted based on actual harvest timing. Prior to the start of the season, CAC also fleshes out the details of its consumer and trade marketing activities, which are outlined on page 18.



The Commission will capitalize on the popularity of its "The best avocados have California in them" campaign by updating existing assets for the 2021-22 season and adding some new creative executions. The examples above show select frames from two of the videos illustrating how the end frames will all include the tagline on a green background.

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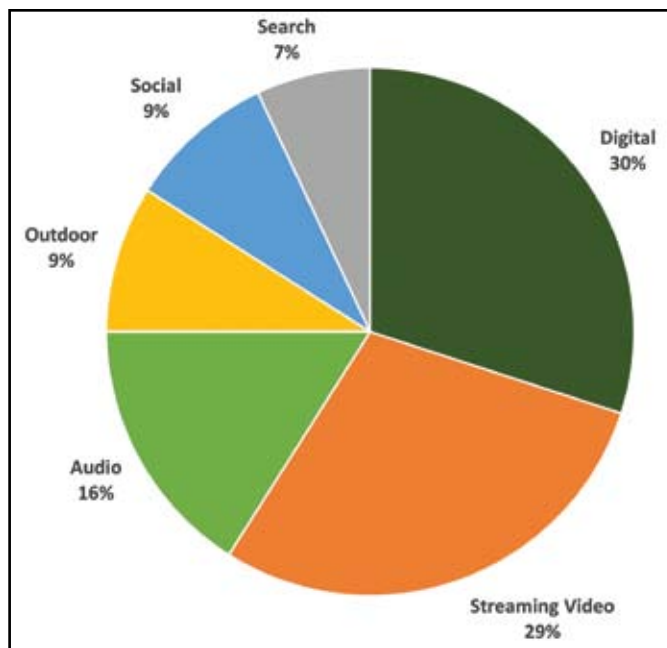
CAC will continue its award-winning “The best avocados have California in them” campaign, modifying already-developed assets to keep them fresh while saving on production costs. The media plan, which is based on what works effectively and efficiently to reach targeted consumers and is informed with key learnings from fiscal year 2020-21, will leverage promising new tactics while being mindful of the planned budget. Consumer-facing CaliforniaAvocado.com website enhancements will include optimizing unpaid search and improving overall site performance. In addition, eight email newsletters will be distributed to subscribers highlighting California avocados’ unique seasonal availability as well as recipes to increase usage of the fruit. Consumer research will be conducted to measure the effectiveness of the Commission’s advertising and marketing activity.

Social media

The Commission will continue engaging with California avocado consumers via its Facebook, Instagram and Twitter channels. To reach a younger range of the consumer advertising target market, CAC also will add TikTok to its collection of social media platforms. LinkedIn, which has been an effective means of connecting with business audiences, will remain part of the Commission’s social media program. Social posts across all platforms, as well as search engine advertising, will be used to drive traffic to the California avocado online merchandise shop where fans can purchase a range of newly released merchandise (see article pages 32-33 for new merch highlights).

Consumer public relations

Working from the success of last year’s virtual cooking class, the Commission will host another online season opener cooking class with an engaging chef who will prepare California avocado dishes for an audience of respected local publications and media channels, influencers, retailers and trade writers. In late May, CAC will play host to consumer and trade media, customers and influencers at a local California Avocado Grove



The 2022 California avocado media plan is built to reach targeted consumers effectively and efficiently.

Open House. Attendees will learn about the nutritional benefits of the fruit, its season, our growers and the benefits of buying local. This activity will kick off the 10th Annual California Avocado Month in June, which will be promoted via a press release and mat release featuring two chef recipes and highlighting peak availability of the California avocado crop. Throughout the season two paid influencers will provide digital and social support for California avocados with content they create for the consumer website and CAC’s social channels. Four registered dietitians who are respected health and well-

ness influencers — including one new advocate with a strong following among a younger demographic — will serve as Living Well Brand Advocates. In addition, the Commission will expand communications concerning California avocado growers’ sustainability practices.

Retail and foodservice promotions and communications

To generate awareness concerning California avocados and the promotional support CAC provides its industry partners, retail and foodservice trade advertising and public relations will take place throughout the season. CAC’s tiered account go-to-market strategy will continue to align Commission marketing strategies with California avocado distribution at key retail partners’ locations. This season, the Commission will place an emphasis on improving identification of California avocados at retail, including the use of display bins, and will target a minimum of 50 retail promotions with prominent identification of the Golden State fruit. CAC staff will actively partner with retail dietitians and cooking schools throughout the season and deliver menu presentations to targeted foodservice accounts. In addition, the marketing team will target promotions with 16 – 20 foodservice chains located in California and the western region of the U.S. with the goal of getting California avocados on the menu during the season. To round out its industry presence, CAC will exhibit at the first Global Fresh Produce and Floral Show (formerly the Produce Marketing Association Fresh Summit) in Orlando, Florida, October 27-29. The Commission also will demonstrate its leadership at multiple foodservice conferences throughout the year. 🥑



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California Avocado Marketing Performance:

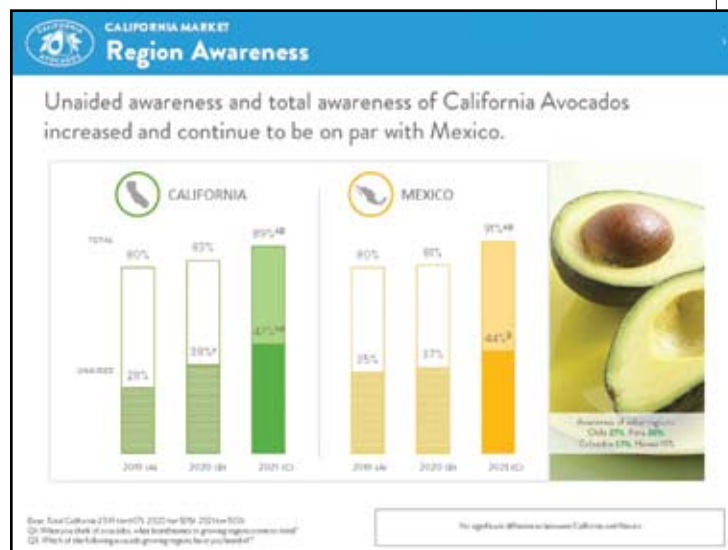
A Recap of Fiscal Year 2020-21

The California Avocado Commission provided its fiscal year 2020-21 marketing performance report, known as the Dashboard, to the Board of Directors in November. The report covers activity in the areas of consumer advertising, social media, consumer public relations, brand advocates, retail and foodservice programs, trade advertising and public relations as well as research highlights. A summary of that report follows.

California avocado marketing activity was developed to achieve CAC's business plan goals and objectives, in particular the marketing objective to increase California avocado perceived value, preference and loyalty with our targets. The consumer targets are "Premium Californians," defined as those having bought an avocado in the last 6 months, who pay more for high-quality items, seek out name brand products, and are environmentally conscious, because those are the consumers most likely to pay a premium for California avocados. In addition, the Commission targets avocado super users (the top 25% of avocado consumers who buy 75% of the volume).

Many of the key performance measures in the Dashboard report use "impressions," a marketing metric used to quantify the potential views of an advertisement, article or webpage, hearing a radio/audio ad or interacting with a brand or product. In fiscal year 2020-21, California avocado marketing activity garnered more than 1 billion impressions and helped achieve brand awareness of 89% in California.

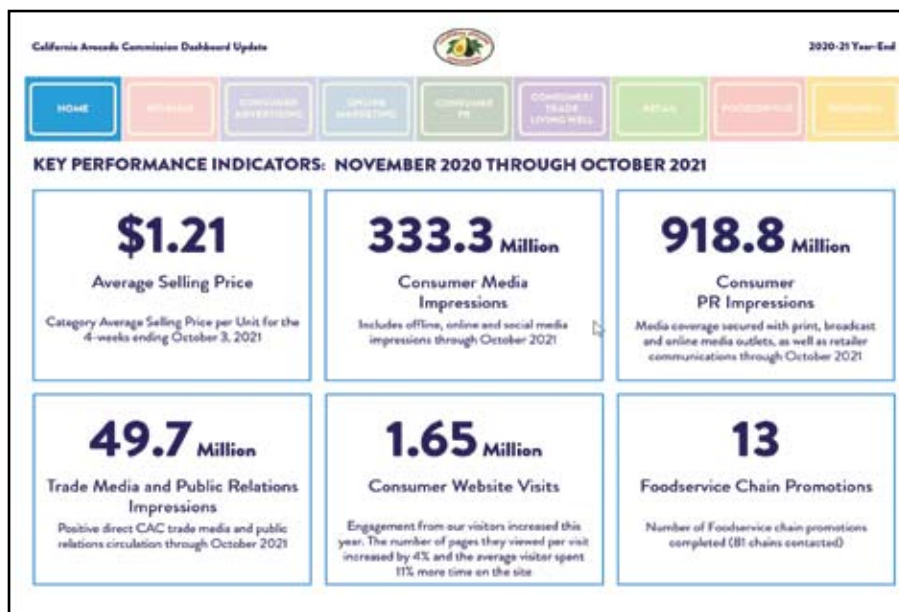
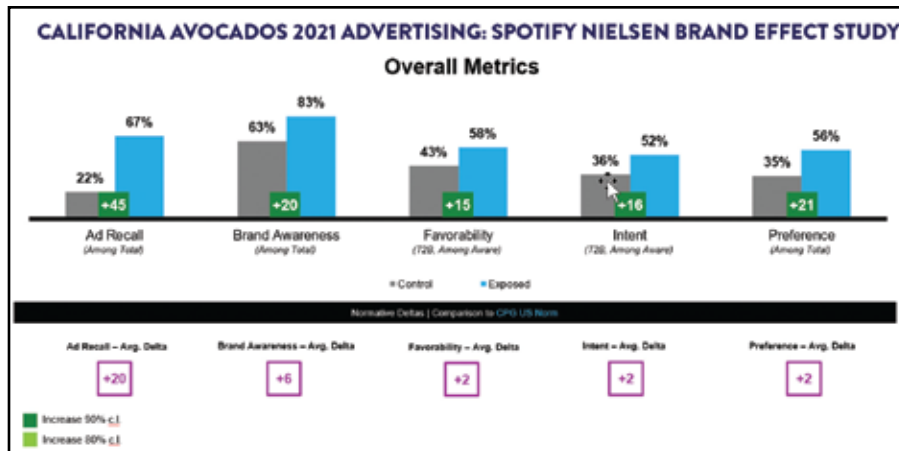
The consumer advertising campaign "the best avocados have California in them" continued and achieved more than 333 million impressions. These media impressions included nearly 172 million from digital brand ads plus about 12 million more that also promoted California avocado availability at local retailers, 40 million audio and nearly 70 million from outdoor advertising. Video advertising was a big part of the media plan, garnering more than 93 million views via digital streaming and 16 million video views on audio platforms.



A complimentary research study by audio provider Spotify analyzed how well California avocado ad units performed on its channel and found they exceeded benchmarks across the board. The chart shows that ad recall increased 45 points after ad exposure, compared to a benchmark norm of plus 20 points. Consumers' favorability ratings and purchase intent for California avocados increased 15 and 16 points respectively after ad exposure, and brand preference increased 21 points, all significantly better than their comparative 2-point benchmarks.

The California avocado social media program on Facebook, Instagram, Twitter and Pinterest delivered more than 27 million impressions and 2.6 million engagements, with an additional 2.8 million impressions for social posts that also promoted California avocado availability at participating retailers. Another social platform, LinkedIn, targeted a business audience with nearly 1,000 followers and garnered about 500,000 impressions with an active engagement rate of 4%. The California avocado merchandise shop had 15,000 unique shop visitors and 35,000 page views. It delivered \$15,000 in revenue, which helped offset the cost of delivering California avocado-branded merchandise to fans.

CAC's consumer public relations efforts yielded more than 918 million impressions from a variety of programs. At the launch of the California avocado season, the Commission hosted an online cooking class in partnership with celebrity chef Brian Malarkey. Participants for this exclusive event included local, regional and national consumer media, trade media, influencers and retail contacts. As part of this program, Malarkey developed two new and unique California avocado recipes. Coverage was secured in top-tier outlets, such as MSN, NBC Los Angeles, Patch California, Sunset Magazine and The San Diego Union-Tribune, resulting in more than 157 million impressions. In



addition to covering the campaign's new recipes, several outlets also highlighted other recipes from CaliforniaAvocado.com and directed consumers to visit the website for more inspiration.

To celebrate California Avocado Month, the Commission partnered with Modern Luxury's premium California magazines to host a crowdsourced California Avocado Recipe Contest, which leveraged the trend of cooking and enjoying meals at home. More than two dozen entries were received, with the winning recipe highlighted in a video featuring chef and wellness influencer Nikki Martin. The California Avocado Month Recipe Contest included cov-

erage in Patch California and Yahoo! as well as four Modern Luxury outlets: Angeleno, Riviera, San Diego and San Francisco Magazine, and garnered more than 514 million impressions.

California Avocado Month also was celebrated with a local drive-in event where media, influencers and consumers enjoyed the classic family film, Angels in the Outfield. More than 76 million impressions were garnered through local media coverage of the event and via inclusion of California avocado recipes developed for the event by chef E Dubble in a nationally distributed mat release.

This past year, CAC partnered with

various brand advocates to develop unique content promoting California avocados on social media and CaliforniaAvocado.com. Six brand advocates across different themes (health, wellness and lifestyle) amplified content throughout the entirety of the season on their own blog and social media channels (including Instagram and Pinterest). Two vloggers (video bloggers) and one recipe developer created Commission-owned content for the website and social channels. This brand advocate program secured more than 7 million blog post impressions as well as nearly 124 million social media impressions, totaling more than 131 million impressions during the span of the program. A website contributor program resulted in four new videos and 10 new recipes/article posts for the Commission to share on CaliforniaAvocado.com and social channels. Nearly 34 million additional million impressions resulted from ongoing reactive and proactive news bureau media consumer public relations activity.



Vlogger Dzung Lewis developed content for California avocado social channels and the consumer website.

HAPPY HOLIDAYS FROM
Del Rey Avocado



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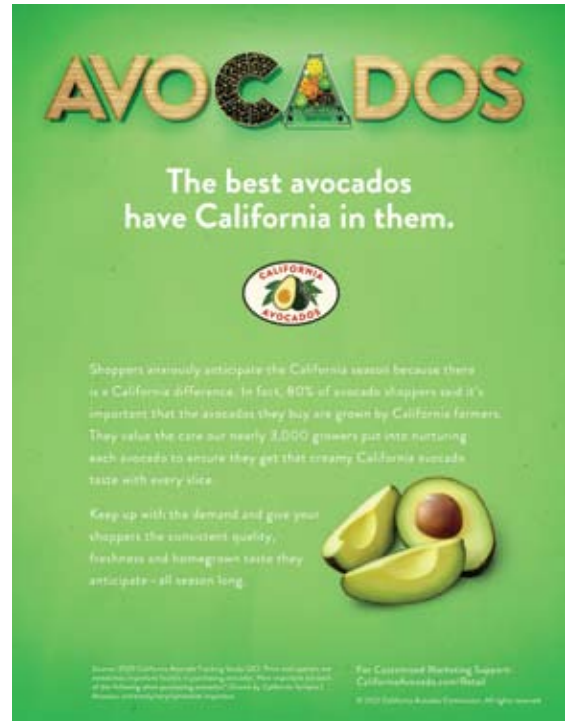
2022 CA AVOCADO SEASON IS AROUND THE CORNER. CONTACT ONE OF OUR TEAM MEMBERS TO LEARN MORE ABOUT DEL REY AND HOW WE MAKE CA GROWERS OUR #1 PRIORITY

Jessica Hunter, jessica@delreyavocado.com
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For GAP certification assistance please contact:
Hillary DeCarl, hillary@delreyavocado.com



Results from the Commission's consumer public relations campaign include this article in Sunset magazine that announced California avocado season.



The Commission used print and digital advertising to reach its retail trade targets, encouraging them to carry California avocados in season.



Highlights of CAC's export promotions included virtual and in-person cooking classes, an Instagram Live event and in-store verbal demos at 109 stores in South Korea.

CAC's Living Well Brand Advocates program worked with six health and wellness influencers including four registered dietitians. This program, which was detailed in the fall 2021 edition of *From the Grove* (pages 23-24), garnered 3 million digital and traditional media activations.

The Dashboard also reported on the California trade marketing activities covering retail, foodservice and export programs in detail. CAC continued its tiered account go-to-market strategy, aligning marketing activities with the distribution of California avocados to optimize brand identification and return value. The Commission's retail and foodservice trade advertising programs produced 39 paid print ads with more than 3 million impressions and 810 paid digital ads garnering nearly 32 million impressions. Combined trade advertising and public relations programs yielded nearly 50 million impressions. Highlights of the California avocado retail and foodservice promotions are covered in *From the Grove* magazine fall 2021 edition pages 39-41 and a sampling are shown here. 🥑



Thirteen foodservice chains with locations in the west promoted California avocados to their patrons.



This California avocado display at Bristol Farms is an example of a Commission-sponsored promotion requiring call outs of the California Avocados brand.



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Commission's Grower Profitability Study Finalized

By Ken Melban
Vice President of Industry Affairs

As previously reported, the California Avocado Commission conducted a grower profitability study over the past few months. The objective of this study was to collect information concerning actual growers' costs and returns to provide a data-based assessment of the financial health of the industry. This information will provide the Commission with a better understanding of the operating characteristics and financial health of California avocado growers.

Based on Board direction, with oversight from the Production Research Committee, a survey was developed and mailed to all 1,743 commercial California avocado growers on August 2. The surveys included a postage paid envelope for direct return to Dr. Dennis Tootelian, the economist conducting the analysis, to maintain confidentiality. Returns were accepted through September 21, with a total of 174 responses received. This was a 10% grower response rate representing 10% of producing acres – impressive considering the level of detail asked for in the survey. The data requested was for 2018, 2019, and 2020.

The 77-page report includes detailed findings concerning:


- Farm acreage (bearing and non-bearing)
- Pounds harvested and crop values by district and acreage
- Overall farm income, expenses and net margin
- Farm income, expenses and net margin by district and acreage
- Water sources
- Overall irrigation costs
- Irrigation costs by water source, district and acreage
- Perceived threats to future profitability

In terms of the results, there were not many outlier responses, although the ranges in responses were quite wide for most questions. The analysis was focused on Commission districts and by acreage category (10 or less, 11 to 50, 51 or more).

As you will see in the following information, there are, in some instances, significant variations within districts, between districts, and among scale of operations. It is really a mixed bag. A copy of the full report may be found on the California Avocado Industry Impact and Status Reports webpage at: CaliforniaAvocadoGrowers.com/accountability-reports/impact-reports.

The Commission will now explore, based on the report, whether there are further efforts for CAC to consider that may help growers' profitability. Marketing remains the biggest component of the Commission's efforts for growers, along with communicating information on production and cultural practices. Without question, production costs, like water and labor, continue to increase for many growers. Yet, as the report established, many in the industry remain profitable.

The biggest factor to mitigate increasing costs is increasing yields. The Commission remains focused on providing information to help growers make educated and informed decisions on improving farming practices towards increased yields. We know, as evidenced by this report, that farming avocados in California can be profitable. As we move forward as an industry, it is critical that our businesses remain profitable, and the Commission will do its part in this partnership with growers to do everything possible to deliver improved profitability for all. 🥑



Respondent Characteristics

District	2020	2020	2019	2019	2018	2018
District 1	22	12.8%	22	12.9%	22	13.2%
District 2	56	32.6%	56	32.9%	56	33.5%
District 3	27	15.7%	27	15.9%	25	15.0%
District 4	31	18.0%	30	17.6%	29	17.4%
District 5	36	20.9%	35	20.6%	35	21.0%
Total	172	100.0%	170	100.0%	167	100.0%

Acreage	2020	2020	2019	2019	2018	2018
10 acres or less	73	42.9%	73	43.5%	75	45.5%
11 to 50 acres	73	42.9%	72	42.9%	68	41.2%
51 acres or more	24	14.1%	23	13.7%	22	13.3%
Total	170	100.0%	168	100.0%	165	100.0%

Operating Characteristics



	2020	2019	2018
Acres			
Total Bearing Acres	4,771	4,770	4,600
Total Non-Bearing Acres	1,233	1,046	968
Total Acres	6,004	5,816	5,568
% Bearing to Total Acres	79.5%	82.0%	82.6%
Pounds			
Total Pounds	37.1 million	23.8 million	33.9 million
Crop Value			
Total Crop Value	\$39.5 million	\$37.8 million	\$37.3 million

Average Operating Characteristics



	2020	2019	2018
Acres			
Avg. Bearing Acres	31.3	31.7	31.4
Avg. Non-Bearing Acres	7.8	6.7	6.2
Avg. Total Acres	39.1	38.4	37.6
Pounds			
Avg. Pounds per Bearing Acre	7,556	4,882	7,935
Crop Value			
Avg. Crop Value per Bearing Acre	\$8,072	\$7,752	\$7,949
Avg. Crop Value per Pound	\$1.09	\$1.59	\$1.03

Averages by District in 2020



	District 1	District 2	District 3	District 4	District 5
Acres					
Avg. Bearing Acres	41.9	14.8	40.1	27.2	32.6
Avg. Non-Bearing Acres	12.9	5.3	3.3	9.2	8.3
Avg. Total Acres	54.8	20.1	43.4	36.4	40.9
Pounds					
Avg. Pounds per Bearing Acre	6,109	5,098	6,126	8,090	12,359
Crop Value					
Avg. Crop Value per Bearing Acre	\$6,422	\$5,781	\$7,068	\$8,933	\$12,158
Avg. Crop Value per Pound	\$1.05	\$1.13	\$1.15	\$1.10	\$0.98

Income, Expenses, & Net Margins



	2020	2019	2018	Growth 2018-2020
Total Income, Expenses, & Net Margins				
Total Gross Income	\$42.1 million	\$40.3 million	\$38.7 million	4.4%
Total Expenses	\$40.6 million	\$36.8 million	\$36.1 million	6.1%
Total Net Margin	\$1.5 million	\$3.6 million	\$2.6 million	-24.0%
Expenses & Net Margin Ratios				
Total Expenses as % of Gross Income	96.5%	91.1%	93.4%	1.7%
Net Margin as % of Gross Income	3.5%	8.9%	6.6%	-27.2%

Average Income, Expenses, & Net Margins

	2020	2019	2018	Growth 2018-2020
Avg. per Bearing Acre				
Avg. Gross Income per Bearing Acre	\$9,260	\$8,923	\$8,794	2.6%
Avg. Total Expenses per Bearing Acre	\$8,934	\$8,133	\$8,211	4.3%
Avg. Net Margin per Bearing Acre	\$326	\$790	\$583	-25.3%
Avg. per Pound				
Avg. Gross Income per Pound	\$1.18	\$1.73	\$1.17	0.4%
Avg. Total Expenses per Pound	\$1.14	\$1.58	\$1.09	2.0%
Avg. Net Margin per Pound	\$0.04	\$0.15	\$0.08	-26.9%

Avg. Income, Expenses, Net Margin by District 2020

	District 1	District 2	District 3	District 4	District 5
Expenses & Net Margin Ratios					
Total Expenses as % of Gross Income	130.7%	106.1%	83.6%	114.8%	75.5%
Net Margin as % of Gross Income	-30.7%	-6.1%	16.4%	-14.8%	24.5%
Avg. per Bearing Acre					
Avg. Gross Income per Bearing Acre	\$6,333	\$6,423	\$7,327	\$10,549	\$13,791
Avg. Total Expenses per Bearing Acre	\$8,961	\$6,817	\$6,127	\$12,111	\$10,336
Avg. Net Margin per Bearing Acre	-\$2,648	-\$394	\$1,200	-\$1,563	\$3,456
Avg. per Pound					
Avg. Gross Income per Pound	\$1.05	\$1.23	\$1.12	\$1.34	\$1.08
Avg. Total Expenses per Pound	\$1.49	\$1.30	\$0.92	\$1.54	\$0.81
Avg. Net Margin per Pound	-\$0.44	-\$0.07	\$0.20	-\$0.20	\$0.27

Sources of Water

	2020	2019	2018
Wells and/or Surface Water on Property	25.0%	25.1%	25.3%
Mutual Water Company	23.2%	24.0%	24.1%
Water Agency	34.5%	34.1%	33.7%
Wells/Surface & Mutual Water Company	6.5%	6.0%	6.0%
Wells/Surface & Water Agency	10.1%	10.2%	10.2%
Wells/Surface, Mutual Water, & Water Agency	0.6%	0.6%	0.6%

Avg. Irrigation Costs by Water Source 2020

	Wells/ Surface	Mutual Water Co.	Water Agency	Wells/ Mutual	Wells/ Agency
Avg. Irrigation Costs per Acre	\$753	\$1,389	\$1,157	\$555	\$698
Avg. Irrigation Costs per Pound	\$0.08	\$0.19	\$0.21	\$0.07	\$0.14
Irrigation Costs as % of Total Crop Value	8.0%	17.9%	19.4%	7.0%	12.3%
Irrigation Costs as % of Gross Income	7.3%	18.3%	17.9%	6.8%	11.1%
Irrigation Costs as % of Total Expenses	9.0%	19.5%	17.3%	7.0%	11.5%

Sources of Water by District 2020



	District 1	District 2	District 3	District 4	District 5
Wells/Surface Water on Property	14.3%	9.3%	29.6%	23.3%	52.8%
Mutual Water Company	23.8%	25.9%	25.9%	40.0%	2.8%
Water Agency	47.6%	59.3%	22.2%	10.0%	19.4%
Wells/Surface & Mutual Water Co.	0.0%	0.0%	7.4%	16.7%	11.1%
Wells/Surface & Water Agency	14.3%	5.6%	14.8%	6.7%	13.9%
Wells/Surface, Mutual Water, & Water Agency	0.0%	0.0%	0.0%	3.3%	0.0%

Avg. Irrigation Cost by District 2020



	District 1	District 2	District 3	District 4	District 5
Avg. Irrigation Costs per Acre	\$1,776	\$1,996	\$606	\$777	\$570
Avg. Irrigation Costs per Pound	\$0.41	\$0.46	\$0.10	\$0.12	\$0.06
Irrigation Costs as % of Total Crop Value	32.9%	40.7%	8.5%	10.9%	6.0%
Irrigation Costs as % of Gross Income	33.7%	40.4%	8.1%	9.3%	5.3%
Irrigation Costs as % of Total Expenses	23.7%	39.1%	9.7%	8.2%	6.8%

Perceived Threats to Future Profitability

(Mean Rating: 5=Very Serious; 1=Not at all Serious)



	Very/Somewhat Serious	No Opinion	Not Very/Not at All Serious	Mean Rating
Cost Factors				
Water costs	93.4%	1.2%	5.4%	4.62
Cost of complying with govt. regulations	74.7%	14.2%	11.1%	4.02
Cost of labor	79.1%	9.2%	11.7%	4.00
Other Factors				
Availability of water	91.5%	3.7%	4.9%	4.57
Imported avocados	80.2%	12.3%	7.4%	4.23
Environmental regulations	79.2%	13.8%	6.9%	4.15

Perceived Threats by District

(5=Very Serious; 1=Not at all Serious)



	District 1	District 2	District 3	District 4	District 5
Cost Factors					
Cost of labor	4.50	4.00	3.92	3.90	3.83
Water costs	4.73	4.87	4.59	4.48	4.29
Cost of complying with govt. regulations	4.45	3.90	4.04	3.93	3.97
Other Factors					
Availability of water	4.77	4.59	4.70	4.31	4.51
Environmental regulations	4.45	4.12	3.84	4.21	4.18
Imported avocados	4.32	4.08	4.33	4.00	4.49

3-Year Average Operating Characteristics



	Total	District 1	District 2	District 3	District 4	District 5
Bearing Acres	28.2	41.6	14.9	40.4	28.1	32.2
Non-Bearing Acres	6.5	12.5	4.9	2.5	5.7	9.0
Total Acres	34.6	54.2	19.9	43.0	33.8	41.1
Pounds per Bearing Acre	6,707	\$6,486	\$4,775	\$6,776	\$5,649	\$9,079
Crop Value per Bearing Acre	\$8,098	\$8,107	\$6,006	\$8,526	\$6,656	\$10,355
Crop Value per Pound	\$1.21	\$1.25	\$1.26	\$1.26	\$1.18	\$1.14

3-Year Average Financial Characteristics



	Three Year Average
Total Expenses as % of Gross Income	93.7%
Net Margin as % of Gross Income	6.3%
Gross Income per Bearing Acre	\$8,564
Total Expenses per Bearing Acre	\$8,025
Net Margin per Bearing Acre	\$539
Gross Income per Pound	\$1.28
Total Expenses per Pound	\$1.20
Net Margin per Pound	\$0.08

3-Year Average Irrigation Costs



	Three Year Average
Total Irrigation Cost	\$44,821
Avg. Irrigation Cost per Acre	\$1,180
Avg. Irrigation Cost per Pound	\$0.22
Irrigation Cost as % of Total Crop Value	17.9%
Irrigation Costs as % of Gross Income	17.0%
Irrigation Costs as % of Total Expenses	18.1%

Final Thoughts



- **Acres**
 - Growth in acreage is mostly in non-bearing acres. Unknown whether these acres are being primed for bearing in future years. If not, acreage is holding steady.
 - Pounds per bearing acre is declining slightly, crop values are holding steady.
- **Revenues, Expenses, and Net Margins**
 - Revenues are growing, but expenses are growing faster. This puts pressure on net margin.
 - It appears the primary issue is expense management. This seems to be especially the case in District 1 and to a lesser extent in Districts 3, and 4. It also seems to be the case among farms with 10 acres or less or 51 acres or more.
- **Irrigation Costs**
 - Overall, irrigation costs declined on a cost-per-acre basis and as a percent of gross income. Irrigation costs per pound harvested and as a percent of crop value either declined or held steady.
 - The implication is that while irrigation costs are still very significant, they do not appear to be the only major cause of the increasing total expenses experienced by avocado farms.

Orondis® Fungicide Available for Use in California Avocado Groves

By Tim Spann, PhD
Spann Ag Research & Consulting

On November 24, Syngenta announced its product Orondis® Fungicide had been granted full registration for use against Phytophthora root rot in California avocado groves. Orondis® (Oxathiapiprolin) is an entirely new type of fungicide belonging to FRAC (Fungicide Resistance Action Committee) class 49. Orondis® works directly against the Phytophthora propagules in the soil, rather than against the pathogen in the tree, effectively eradicating the pathogen from treated soil for a period following application.

The labeled rate for Orondis® on avocados is 4.8 fl. oz./acre up to 9.6 fl. oz./acre. Syngenta recommends the 4.8 fl. oz./acre rate for maintenance programs utilizing a 6-month retreatment program, or the 9.6 fl. oz./acre rate for a 12-month retreatment program. For heavy/severe infections and/or to start off using a strong program before reverting to a maintenance program, Syngenta recommends considering using the higher end of the labeled rates on a six-month retreatment program for the first year. Importantly, Orondis® is limited to no more than two sequential applications before rotating to a fungicide with a different mode of action (non-FRAC class 49). In trials, Ridomil Gold® SL at 16 oz./acre was an effective product to use in rotation with Orondis®. Orondis® has a Restricted Entry Interval of 4 hours and a Preharvest Interval of 30 days.

Orondis® is approved for application through drip or microsprinkler irrigation only. The soil should be wetted prior to injecting Orondis®, and the product must be incorporated with 8-12 hours of irrigation. Dakota Camino, a Syngenta sales representative, states, “A minimum of 8 hours and maximum of 12 hours of water is often most efficient for incorporation; I would not advise using less than 6 hours of water to incorporate Orondis® and I would not advise using more than 12 hours of water to incorporate Orondis® in most systems.”

Growers need to be aware that existing stocks of product have labels that do NOT include avocados. Therefore, grow-



ers must have in their possession at the time of application the product's supplemental label that includes avocados, until new product with an updated label is available. A copy of the supplemental label is available on the California avocado growers website (CaliforniaAvocadoGrowers.com).

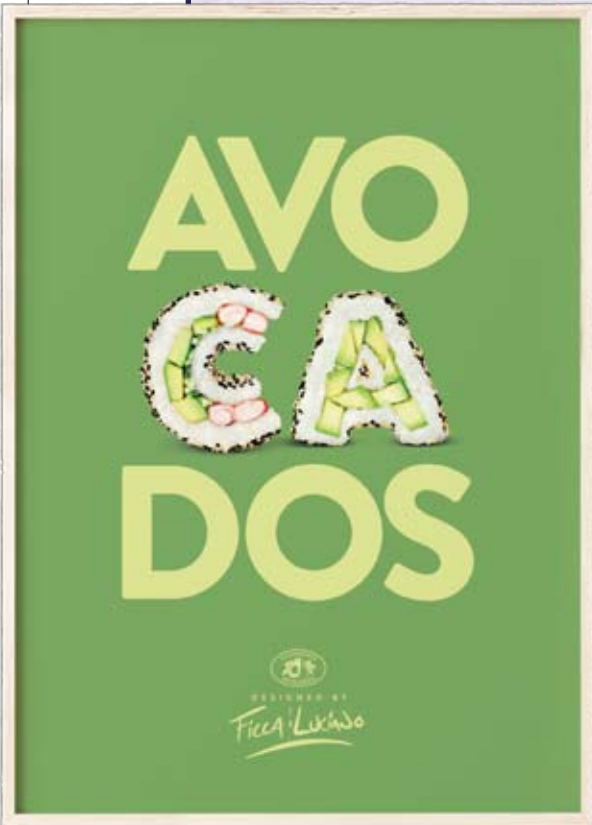
Also, it is important to know that nut crops in California were added to the label at the same time avocados were added. There are over 1 million acres of nut crops in California compared with about 50,000 acres of avocados. Syngenta is doing everything they can to ensure product is available to any grower wishing to apply Orondis® to avocados, but orders will be filled on a first-come-first-served basis. Growers should speak with their pest control advisor immediately to develop their treatment plan for 2022 and get their order in as soon as possible. 🍷

New Items Added to the California Avocado Merchandise Shop

The California Avocado Commission developed and introduced new products to the California avocado merchandise shop in fall 2021 in time for holiday shopping. The new merch includes a series of poster prints featuring the current California avocado advertising campaign, apparel, an apron and a beach towel displaying campaign ads, a new sticker pack and merchandise not previously offered in the shop. A coffee mug, a small pouch, a laptop sleeve, an “avo head” hat perfect for sporting events

and an avocado pit pillow that is great for expecting mothers round out the new product line up. All of the items are California avocado-branded and are available for purchase at Shop.CaliforniaAvocado.com. The shop helps extend the California avocado marketing campaign in the offseason, further the connection between California avocados and the California lifestyle and brings traffic to CaliforniaAvocado.com. When fans purchase these merch items and wear or use them publicly it helps build awareness of California avocados. 🥑



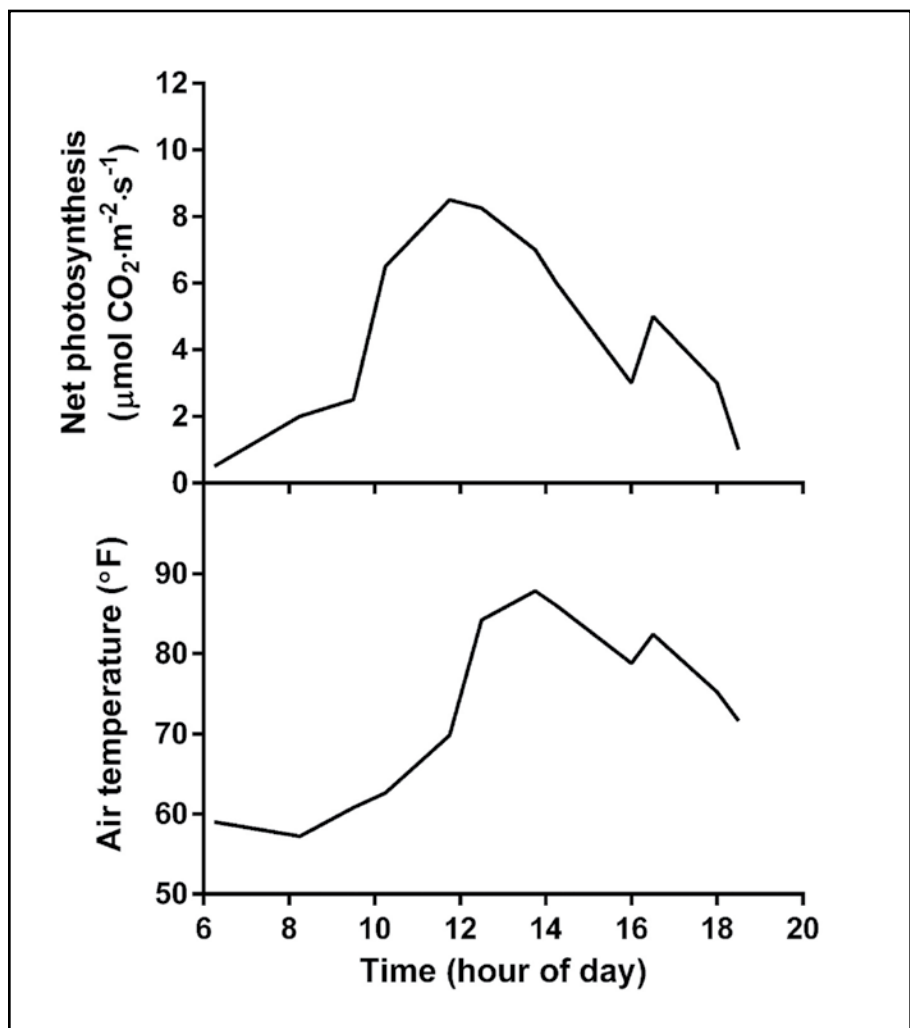


Potential for Heat Mitigation by Overhead Irrigation in Avocado Groves

It is undeniable that our climate is changing and as a result our weather is becoming more erratic. For California avocado growers this is resulting in more frequent, hotter, and longer duration heat waves. It is true that heat waves are nothing new to California avocado groves, but these events used to occur a few times per season with temperatures peaking over 100°F for a few hours in the afternoon. Recently, heat events have become more common, often lasting for several days in a row, and temperatures have been documented to reach 100°F and stay above that temperature for 8 hours or more in numerous groves. These events are unprecedented.

This has caused many growers

Figure 1. Air temperature (lower graph) over the course of a day at the South Coast Research and Extension Center, Irvine, CA, and corresponding net photosynthesis of 'Hass' avocado leaves. Redrawn from: Liu et al. 2002. Acta Horticulturae 575: 865-875.



to ask if it is possible to cool avocado groves using overhead irrigation. The short answer is yes. This technique is relatively common in deciduous fruit orchards in some of the hot dry areas of the northwestern U.S. as well as in other countries such as Spain and Australia. However, there is no research data available for implementing this technique in avocados in California; although, I have heard of a few growers installing some test systems.

In this article I want to review what happens to avocados when temperatures reach extreme levels, some things to consider if you want to try overhead irrigation for cooling your trees, and some potential risks to consider.

How Does Heat Affect Avocados?

To understand how avocados are affected by heat, it's important to remember where avocados originate. The avocado is native to the subtropical forests of southern Mexico, Central America, and northern South America where it lives primarily as an understory tree (growing in the shade of larger trees). In these areas temperatures rarely exceed 85°F, rainfall is abundant, and the trees are rarely exposed to intense sunlight — quite different from the environment they're grown in commercially.

As a result of evolving in these idyllic conditions, the avocado tree has little tolerance for high temperatures. This can be seen by looking at what happens to photosynthesis as the air temperature increases. The accompanying figure (**Figure 1** on page 34) shows air temperature data over the course of a day at South Coast Research and Extension Center in Irvine, California. These graphs clearly show how 'Hass' photosynthesis declines when afternoon temperatures exceed about 85°F.

The other accompanying figure

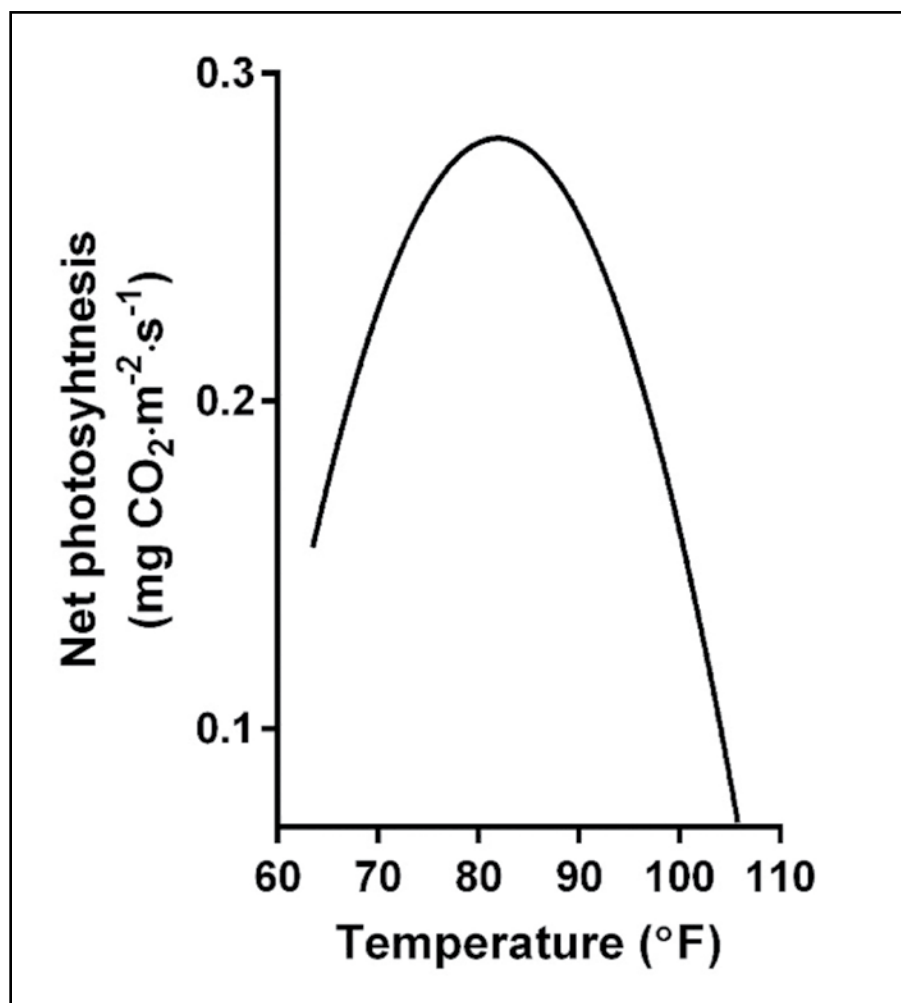


Figure 2. The relationship between air temperature and net photosynthesis of 'Fuerte' avocado in the Murray Valley, Victoria, Australia. Redrawn from: Scholefield et al. 1980. California Avocado Society Yearbook 64:93-106.

(**Figure 2**) is data from the Murray Valley in Victoria, Australia and shows how 'Fuerte' photosynthesis responds to temperature. Again, when temperature exceeds about 85°F photosynthesis declines and continues to decline to the point of fully stopping when temperatures exceed 100°F.

Why does photosynthesis decline at high temperatures? Photosynthesis and plant water usage are directly connected. There are pores in plant leaves called stomata. When plants take up water from the soil, that water moves through the plant and exits through the stomata. It is the difference in vapor pressure between the leaf and the atmosphere that actually drives water

movement through the plant. The inside of the leaf is essentially at 100% relative humidity and the atmosphere is usually at a lower relative humidity. Thus, the drier the air is, the greater the vapor pressure gradient, and the greater the flow of water is through the plant. Water vapor leaving leaves through the stomata reduces the leaf temperature through evaporative cooling. So, when stomata close, the leaf temperature begins to increase.

However, water is not the only thing that moves through the stomata. Carbon dioxide (CO₂) also enters the plant through the stomata to supply photosynthesis, which is the process of chemically combining CO₂ with water

(H₂O), using the energy of sunlight to produce carbohydrates (CH₂O) and oxygen (O₂). The carbohydrates (sugars) are the plant's energy source to grow.

When the vapor pressure difference between the plant's leaves and the air becomes too great (or available water becomes limited because the soil becomes too dry), the plant responds by closing its stomata to prevent excess water loss. This also cuts off the supply of carbon dioxide for photosynthesis. Thus, when air temperatures climb above a plant's threshold – approximately 85 °F for avocados – the stomata begin to close thereby reducing the rate of photosynthesis.

What happens next is a cascade

of events. Wilting will begin to occur, which is the plant's attempt to reduce the amount of sunlight being intercepted by the leaf, thus avoiding heating up. If the stress is not relieved, the leaf temperature will continue to climb until the leaf tissue cooks. This is seen later as scorching on the leaves. In addition, wilting allows sunlight to penetrate to normally shaded parts of the canopy leading to sunburn of the fruit and stems. If the high heat conditions continue long enough or occur on successive days, parts of the canopy can die back and young trees can be killed.

Using Water to Cool a Grove

There are three ways in which wa-

ter applied to a grove can result in cooling:

1. Convective cooling: when water evaporates in air (either under the tree or overhead) there is a temperature drop that results in air circulation (convection) within the grove.
2. Hydro-cooling: water applied directly to the leaves and fruit absorbs the sensible heat from the plant tissues and carries it away in "runoff".
3. Evaporative cooling: water applied directly to leaves and fruit removes sensible heat to latent heat transfer.

How much water is needed to cool a grove?

The following is excerpted from: *Evans, R. G. 1999.*

OVERTREE EVAPORATIVE COOLING SYSTEM DESIGN AND OPERATION FOR APPLES IN THE PNW. USDA-ARS

-Northern Plains Agricultural Research Laboratory, Sidney, MT.

"[The] heat "load" on fruit that is exposed to the sun has two principal components: 1) direct radiative heating from the sun; and, 2) advective heating from hot air originating from outside the block moving through the orchard. Taking a simple physical chemistry approach, we can make some calculations to give us the relative magnitude of the amount of water required for effective overtree evaporative cooling of exposed fruit. Assuming that we want to cool apples under conditions where the incoming solar radiation has an intensity of 800 W m⁻² and that we have an air temperature of 95°F (reasonable numbers for the middle of a summer day). To equal (neutralize) the energy from the incoming solar radiation would require the complete evaporation of about 21 US gal/min/ac above the tree canopy (assuming: 8.36 lb/US gallon of water, 1040 Btu/lb is the latent heat of vaporization, 8695 Btu to evaporate 1 US gallon of water, and 1 W/m² = 0.3170 Btu/hr/ft²). However, there is also an advective (wind) component that is typically at least equal to the solar radiative heating during periods of high air temperatures, low humidities and low wind speeds. This means that at least 40 gpm/ac [2,400 gallons per hour per acre] would have to be continuously applied over the tree during this period to just equal the incoming both radiative and advective heat energy and maintain the exposed fruit surface at ambient temperatures (in this case 95°F) under these assumed conditions. Cooling the exposed fruit below ambient temperature would require the application of additional water. These calculations are supported by field data measuring actual exposed fruit temperatures on hot summer days in south central Washington of cooled and uncooled fruit. Higher wind speeds and/or higher air temperatures would increase the amount of water required for effective evaporative cooling."

All applications of water in the grove will cool trees in one or more of these ways. Factors such as climatic conditions, water application rates, application uniformity, and system operation will dictate how much each mechanism contributes to cooling.

The evaporation of water requires large amounts of energy (910 BTU/lb water at 86°F). When cooling a grove using evaporative methods such as canopy irrigation, this energy (heat) comes either from solar radiation and/or from the surfaces (i.e., plant tissues) the water contacts. To prevent sunburn damage, it is best if this energy (heat) comes from the plant tissues of which one is trying to prevent sunburn.

In the Pacific Northwest where orchard cooling has been used in apple production, rates of overhead water application range from 8 gallons per minute per acre (gpm/ac) to over 80 gpm/ac. Typically the lower rates are used for continuous application and the higher rates are used in pulsing applications — 15 minutes on, 15 minutes off.

Risks of Evaporative Cooling in Avocado Groves

There are numerous potential risks to using overhead irrigation to cool your avocado grove. The first one is thinking you can use your existing irrigation system. Most growers' irrigation systems are not designed to deliver the volume of water needed for the durations needed to the entire grove in order to effectively cool the trees. Thus, a separate system will need to be engineered and installed to effectively cool the grove. To avoid excess water use, pulsing would probably be the most efficient method to use and appropriate controllers and valves are needed to make that happen.

A sufficient water supply is needed to supply both overhead cooling and irrigation needs. Remember, the water

being applied to cool the grove is evaporating; that is how it cools. You will also need to apply irrigation to maintain soil moisture, so the trees have water available for uptake. After all, the point of cooling is to keep temperatures down, allow photosynthesis to continue, and prevent tissue damage.

Water quality can become a major issue in applying overhead irrigation. When the applied water evaporates, the dissolved salts will be left behind. This can result in salt buildup on fruit and leaves and potentially lead to severe burn from the salt accumulation.

Lastly, the potential for disease outbreaks must be considered. We are fortunate in California that we have very

few issues with foliar and fruit disease issues. However, this is because of our dry climate and not because the pathogens aren't present. The application of water directly to foliage and fruit, and the increased humidity resulting from that application — particularly during a multiday heat event — could cause disease issues such as fruit rot.

This article is not meant to discourage anyone from testing overhead cooling systems for avocados, but hopefully it gives you pause to consider some of the risks involved and what would be required to implement such a system. If you decide to test overhead cooling in your grove I would be very interested in hearing about your experiences. 🍯

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Prevalence, Impact, and Significance of *Botryosphaeria* Fungi in Avocado Nurseries and New Plantings in California

Propagating, planting, and growing disease-free avocado (*Persea americana* Mill.) materials are crucial for expanding avocado production areas in California while preventing economic losses. Avocado Branch Canker (ABC) and anthracnose blight, caused by *Botryosphaeria* and *Colletotrichum* species, respectively, are two diseases threatening avocado health and productivity worldwide. Although California anthracnose of avocados—as a disease affecting fruit on the tree, leaves, and twigs—is unusual, ABC is increasingly being recognized as a major issue for avocado production in California. Symptoms worldwide include death of graft union, dieback, and canker. More recently, avocado growers have reported frequent failed graft plants possibly dying due to graft union failure in California avocado nurseries. In addition, cases of initially healthy-looking young avocado trees, dying in the year or a few years after planted, were reported. In some instances, loss can reach 10%.

Past surveys of mature avocado orchards in California have confirmed

the widespread occurrence of ABC and that several species in the *Botryosphaeriaceae* family are the primary causal agents of this disease. These fungi are generally considered to be wound parasites, infecting young and mature trees through pruning and grafting wounds. In addition, other causes such as drought and bark sunburn injuries in commercial orchards can provide optimum conditions for successful fungal infections.

Little information is presently available on the disease etiology and epidemiology of the fungi involved in the decline of grafted avocado plants in nursery and young trees in new plantings. Although the causal fungi may spread from nearby, old, infected tree orchards, circumstantial evidence suggests the potential causal pathogens (*Botryosphaeria* spp.) might have means of spread other than by external inoculum and be present as latent infections (without symptom development) in nursery stocks. Injuries occurring during grafting might provide entry points for initial infections leading to

graft union failure in nursery while in newly established orchards, young trees sold by nurseries potentially carrying inocula remain symptomless. These early latent infections would only develop cankers years after planting when the plants undergo abiotic stress, such as drought or sunburn, which provide conditions for successful infections. These reports are consistent with ABC epidemiology in avocado productions in Israel, where a spate of canker outbreaks in young avocado orchards was found to be caused by *Botryosphaeria* species and originated from nurseries.

Following meetings with avocado nursery managers, consultants, and representatives from the California Avocado Commission, our plant pathology group at the University of California, Kearney Agricultural Research and Extension center (UC, KARE, Parlier, CA), received funding from the Commission to assess the phytosanitary status of avocados in California propagation nurseries and newly established groves. The overall goal was to gain insights about the modes and times of

infection, sources and movement of pathogen inocula in nurseries, potential significance of nursery inoculum in ABC epidemiology in young orchards, factors triggering symptom initiation and expression in the field, and eventually develop appropriate integrated management practices that must be initiated at the nursery level. The lack of products registered for use against ABC in avocado nursery and orchards is a serious concern for California avocado farmers and nurserymen. Hence, preventative measures are critically needed to optimize the production of disease-free plants in nurseries and orchards, and ideally Integrated Pest Management (IPM) practices should include chemical control for grafting and pruning wound protections.

The specific objectives of this project, supported by the California Avocado Commission, were to survey avocado nurseries and newly established orchards and: 1) investigate the occurrence and extent of ABC and anthracnose problems during propagation in nurseries and young orchards; 2) determine whether or not latent infections occur in young asymptomatic plants and the potential sources of inoculum in nurseries and young groves; 3) identify the causal agent(s) in diseased materials in nurseries and infected tissues in young trees in orchards and assess the diversity and genetic relatedness of the recovered fungal species; 4) test the susceptibility of avocado scions and rootstocks to selected species of *Botry-*

osphaeria present in orchards and nurseries; 5) assess the impact of heat and water stresses as contributing factors in ABC disease expression; and 6) conduct laboratory, lathhouse, and field trials to test the efficacy of chemical and physical control products to protect wounds against pathogens causing ABC in nurseries and trees against sunburn injury in the field, respectively.

Phytopathological Status of Avocado Propagation and Planting Materials from Nursery.

A preliminary survey of avocado nurseries was initiated to determine the possible stages of initiation and extent of ABC and anthracnose infections in symptomatic avocado materials used during the propagation process in nurseries, and whether or not latent infections occur in avocado asymptomatic propagation materials that eventually

can serve as sources of inoculum for infections in grafted plants and young trees. Healthy and diseased seeds and grafted plants were collected from nurseries and sanitary analysis was performed to determine the associated fungi. Nursery graft samples were classified based on visual symptoms into a severity scale (Table 1; Figure 1). Healthy liners of various scions (Hass and GEM) and rootstocks (Toro canyon, Duck 7 and Dusa), budwoods from avocado mother trees (Hass, GEM, Toro Canyon, Duck 7, and Dusa), and two-year-old potted avocado trees (Hass and GEM on Toro canyon, Duck 7, or Dusa) were provided by cooperating nurseries. Wood pieces or sections from asymptomatic tissues and a margin of active necrosis of the above seeds, grafted plants, liners, and graft union of potted trees were superficially disinfected using 10% commercial bleach and plated on acidified

Table 1. Symptom's severity scale of asymptomatic and symptomatic avocado graft plants.

Necrosis location	Description
1	Healthy. Control.
2	Necrosis progressing from the scion. Sharp margin. Healthy scion proximal end, graft and rootstock.
3	Necrosed scion. Healthy graft and rootstock.
4	Necrosed graft.
5	Complete necrosis. Graft + scion + rootstock.



Fig. 1. Avocado necrotic symptoms severity scale. A: 1 in the severity scale, B: 2, C: 3, D: 4 and E: 5.



Fig. 2. Isolation of *Botryosphaeria* fungi by plating sections of infected avocado wood tissues on acidified agar medium.

potato dextrose agar plates (Figure 2). Sanitary analysis was performed to determine if any/which pathogen(s) were present in the above asymptomatic and symptomatic avocado tissues. Growing fungi were identified by genus three to seven days after incubation at 25°C and their incidence in the surveyed materials subsequently calculated.

Sanitary analyses of seeds and grafted plants showed that *Fusarium* sp., *Alternaria* sp. and *Colletotrichum*

theobromae) that easily develop on mature avocado fruit. Interestingly, we did not recover any *Colletotrichum* sp. from seeds.

Sanitary analyses of healthy and diseased avocado liners showed that *Botryosphaeria* sp. and *Fusarium* sp. can exist as latent infections in asymptomatic samples. Both *Botryosphaeria* sp. and *Fusarium* sp. also were the fungi mostly isolated from symptomatic twigs (Table 2).

sp. were the most frequently isolated fungal genera in levels 2, 3 and 4 of the severity scale, while *Botryosphaeria* sp. were most prevalent in grafts of severity scale 2 (Figure 3). Although the main pathogen recovered from decayed seeds was *Geotrichum candidum*, it seems that seeds also can be contaminated by *Botryosphaeriaceae* fungi (*B. dothidea* or *L.*

Plating of wood pieces collected from healthy budwood of avocado scion and rootstock mother plants showed that no *Botryosphaeria* sp. were recovered from most batches of budwood, except a low incidence observed on GEM (Table 3). In contrast, *Colletotrichum* sp. were consistently isolated from all batches of budwood, but at low incidences (Table 3). The healthy-looking budwoods used for grafting underwent a bleach-sterilization step, as a routine procedure performed in the nursery, and explained the low levels of budwood contamination by *Botryosphaeria* and *Colletotrichum* fungi. Although we did not visit these orchards, sources of inoculum in mature mother trees are likely present consisting of fruiting structures of *Botryosphaeria* that can produce spores contributing to the aerial inoculum present in orchards.

Among 37 wood pieces gathered from the graft union region (Figures 4A, B) of potted avocado trees (Hass-Duke7 combination), 43.2%, and 5.4% of samples from the scion (Hass) part yielded *Botryosphaeria* and *Phomopsis* fungi, respectively. Whereas from 20 pieces of Duke7 rootstock tissue *Botryosphaeria*, *Phomopsis*, and *Fusarium* sp. were recovered from 25%, 5%, and 5% of pieces, respectively. This showed the

Avocado Liners	Material/ Organ	Symptom	#Pieces	# Pieces yielding specified fungi				
				<i>Botryosphaeria</i>	<i>Colletotrichum</i>	<i>Phomopsis</i>	<i>Fusarium</i>	<i>Alternaria</i>
Hass on Dusa (Cheravo seed)	Scion/Twig	Diseased	10	0	0	0	8	2
		Healthy	30	0	0	0	0	1
Hass on Toro canyon (Criollo seed)	Scion/Twig	Diseased	10	0	2	1	2	0
		Healthy	30	0	1	0	0	0
GEM on Toro canyon (Criollo seed)	Scion/Twig	Diseased	10	8	0	0	0	1
		Healthy	20	3	0	0	0	0
	Rootstock/ Twig	Healthy	30	1	0	0	0	0
Ungrafted clonal Dusa on Standard (Criollo)	Scion/Twig	Healthy	40	0	0	0	0	0
Ungrafted clonal Toro Canyon on Standard (Criollo)	Scion/Twig	Healthy	50	1	0	0	7	0

Table 3. Incidence of fungi recovered from avocado budwood collected from mother trees of different scions and rootstocks.

Cultivar / Rootstock *	Total tissues with colonies	Pathogen Incidence (%)								
		Botryosphaeria	Colletotrichum	Phomopsis	Fusarium	Alternaria	Cladosporium / Penicillium	Neurospora	Aspergillus	Epicoccum
Hass	272	0	2.6	0	0	69.5	15.4	0.4	0	1.5
Duke7	283	0	3.9	0	1.1	70.3	15.5	0.4	0.4	0.4
Dusa	256	0	3.9	0	0	78.9	9.4	0	0.4	0.4
GEM	330	0.3	3.9	0	0	62.7	20.0	1.2	0	3.6
Toro Canyon	314	0	4.1	0	0.3	54.8	25.8	0.3	0	1.9

*budwood was sterilized in bleach as a standard procedure by the nursery.

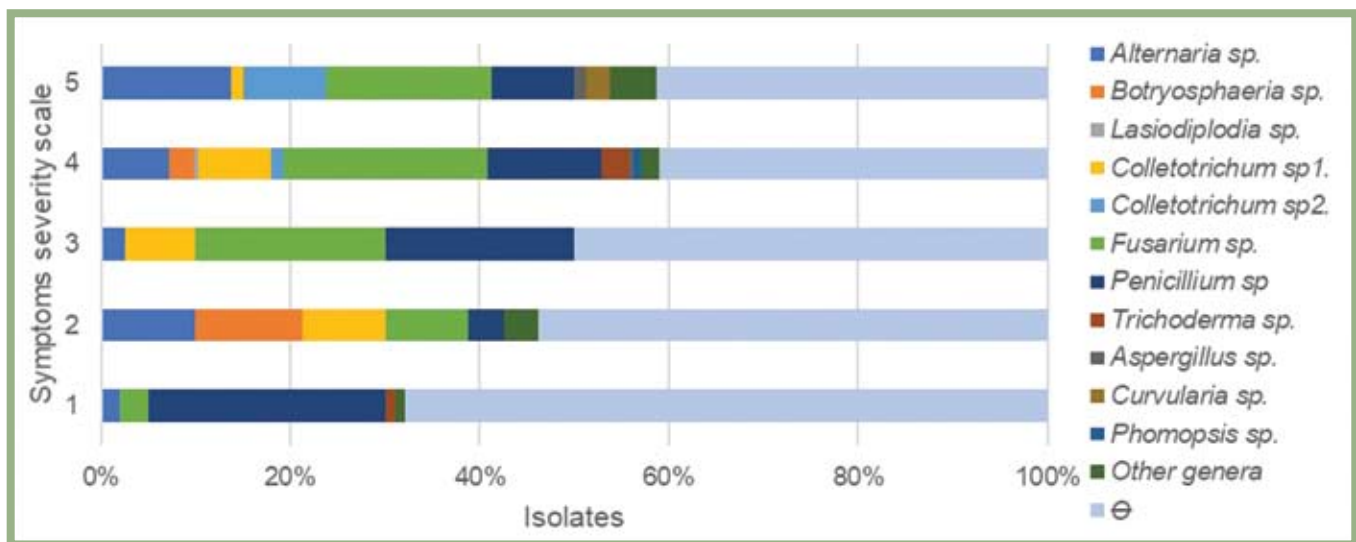


Fig. 3. Isolated genera grafted avocado plants in relation to the necrosis symptoms severity scale.

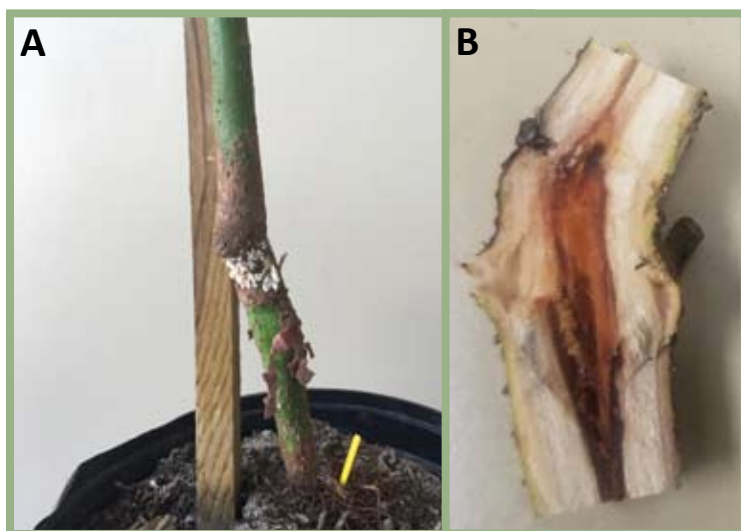


Fig. 4. Problems of infection of the graft union by inoculum contaminating the clonal part of the graft or the edible variety (budwood) (A) and vascular lesion (B).

plants can be infected at the graft union, which probably occurs through the wound created during grafting.

Prevalence of Botryosphaeria and Other Fungi in Newly Established Avocado Orchards in Major Growing Regions of California.

To determine the prevalence of *Botryosphaeria* and *Colletotrichum* in young avocado orchards, infected and symptomless avocado tissues (twigs, grafting union, scion, rootstock, and dead trees with or without sunburn damage) were collected from several young orchards located in San Diego, Riverside, Ventura, and San Luis Obispo Counties

Table 4. Characteristics of the sampled young avocado orchards in major California counties of production.

County	Location/City	Orchard			
		Code/location	Years on the ground	Date of sample collection	Cultivar
San Diego	Fallbrook	BAL-F	~ 1	3/10/2020	GEM
			~ 3		Hass
			~ 3		Bacon
	Escondido	JOH-B	8		Hass (high density)
			7		Hass on Dusa (high density)
	Valley Center	Red Mountain Mesa Drive	3		Hass
			8 months		Hass
	Pauma Valley	Starbeam	< 3		10/30/2019
Old Cole Grade Rd			< 3	Hass	
Fallbrook	AC-FW	~ 3	Hass		
Ventura	Santa Paula	Block D, Butler	3	1/15/2020	Hass
		Dom-G	1		GEM on Dusa
Riverside	Rancho	Deluz, Hen-A	2	3/10/2020	Hass on Dusa
		Deluz, Hen-A	5-6		Hass
San Luis Obispo	Morro Bay	POP	1	6/12/2020	Hass



Fig. 5. Young ‘Hass’ avocado tree with typical branch canker and dieback symptoms in newly established planting.

(Table 4). The orchards varied in age and consisted mainly of Hass, but also GEM or Lamb Hass cultivars (Table 4). Asymptomatic and infected tissues (with or without sunburn damage) (Figure 5) were sampled between October 2019 and June 2020. Laboratory analyses of healthy and symptomatic branches and twigs were carried out by plating twig or branch sections on acidified PDA plates. Infections were detected by direct isolation of fungi growing out of the symptomless and infected plant organs. Fungal identity was determined to genus through cultural and morphological characteristics.

Examination of the morphology of the growing fungi isolated from necrotic and cankered branches/twigs and dead trees sampled from the young orchards showed that Botryosphaeriaceae were the fungal pathogens predominantly associated with these symptoms on Hass and GEM across all counties (Table 5; Figures 6 and 7). Other fungi, including species of *Colletotrichum*, *Fusarium*, and

Table 5. Prevalence of fungi recovered from cankered tissues collected from a newly established avocado orchard in Red Mountain, San Diego County.

Pathogen genus	Samples with infection /disease (%)	Orchard #1	
		Plant age group	Year in the ground
Botryosphaeria	97.6	Young	3
Colletotrichum	31.0		
Fusarium	38.1		
Phomopsis	14.3		
Alternaria	95.2		

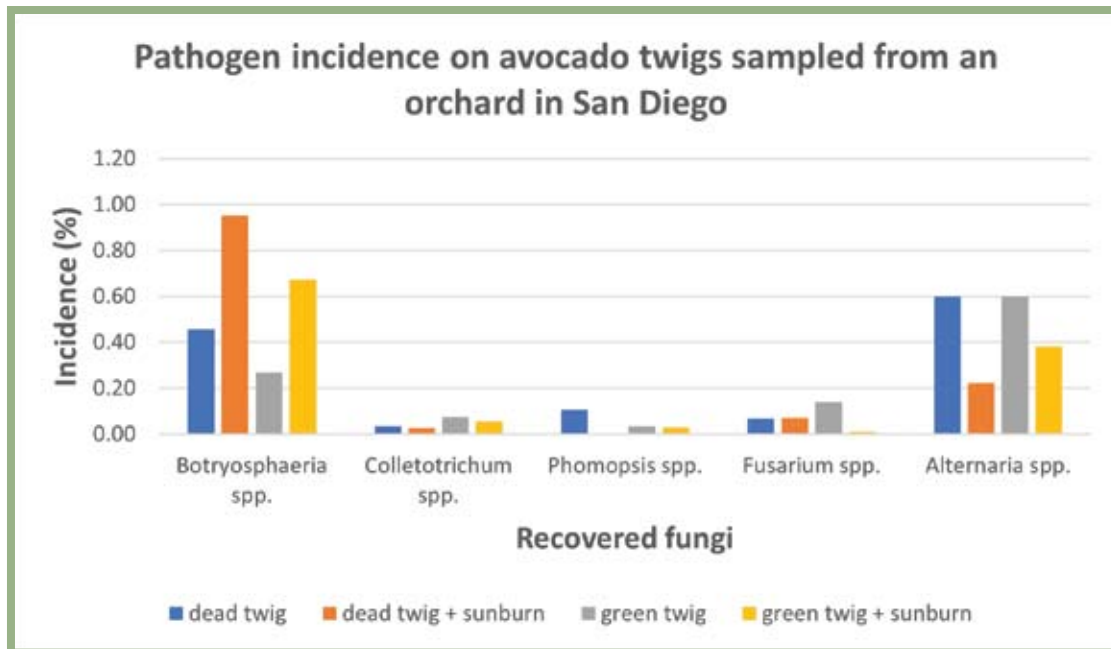


Fig. 6. Incidences of *Botryosphaeria*, *Colletotrichum* and other fungi in infected twigs (with or without sunburn damage) collected from a young avocado orchard in San Diego County.

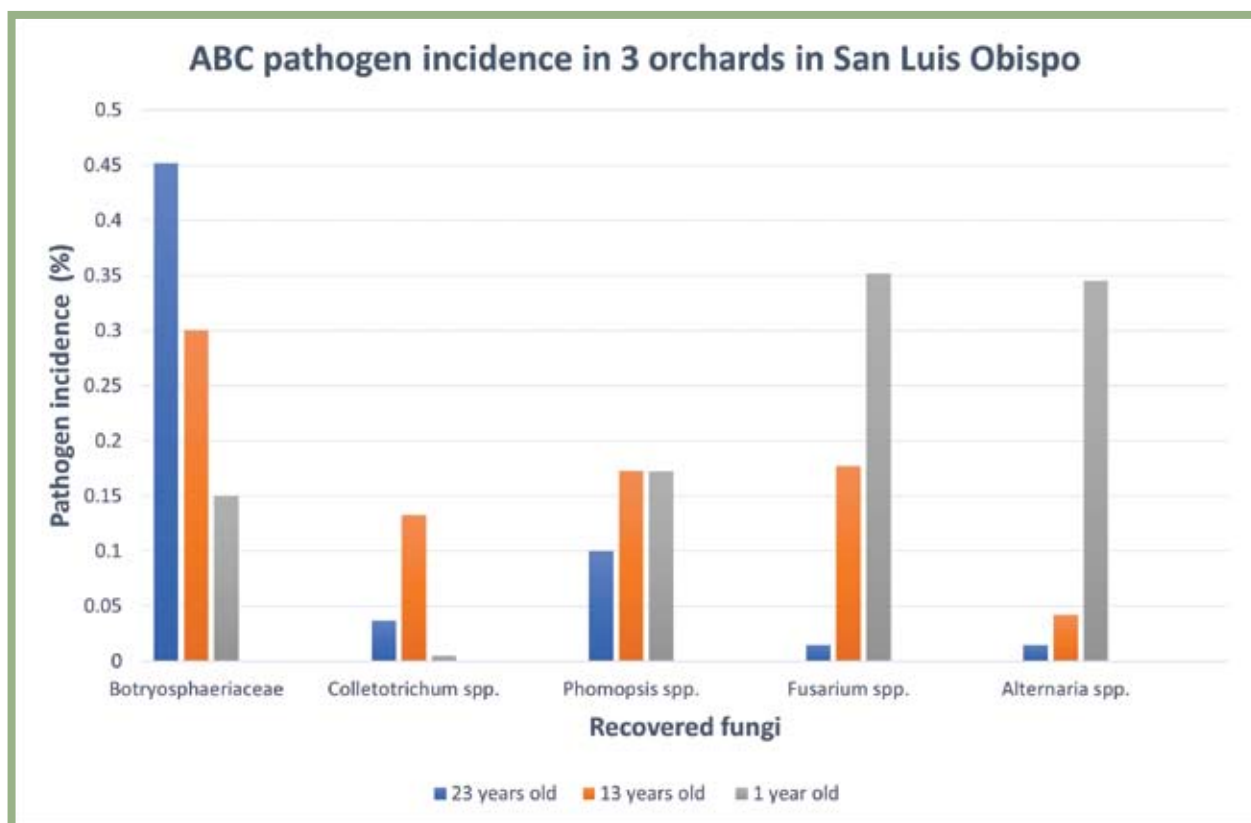


Fig. 7. Incidences of *Botryosphaeria*, *Colletotrichum* and other fungi in infected twigs (with or without sunburn damage) collected from a young avocado orchard in San Diego County.

Phomopsis also were isolated from the samples, but at lower proportions. *Botryosphaeria* species were recovered at high frequencies from infected twigs or dead tissues affected or not by sunburn damage, indicating that sunburn injury can trigger *Botryosphaeria* latent infections on the tissues to develop disease symptoms, but it is not required for infections to occur (Figures 6 and 7). Several saprophytic fungi, mainly *Alternaria* spp., also were encountered (Table 5; Figure 6).

Species Identity, Diversity, and Genetic Relatedness Among Recovered Fungal Pathogens in Nurseries and Orchards.

Morphological observations of *Botryosphaeria* and *Colletotrichum* isolates recovered from the survey suggest the occurrence of several species. Molecular methods were used to classify the fungal isolates at the species level, analyze their diversity and compare genetic relatedness among the pathogen species recovered from both nursery and orchard settings. Representative isolates of the identified genera were selected for maintenance and mycelia used for DNA extractions. Species identification of *Colletotrichum* and *Botryosphaeria* isolates was determined by sequencing

of partial regions of specific genomic regions followed by comparison with established databases.

Molecular identification of the recovered fungi confirmed that several species of *Botryosphaeria* are involved in ABC in both commercial avocado nurseries and orchards throughout California. These species include *Lasio-diplodia theobromae*, *Botryosphaeria dothidea*, and *Neofusicoccum* species (*N. luteum*, *N. parvum*, *N. australe*), the latter group being the most common species throughout the surveyed areas. The molecular techniques revealed the same species were recovered from nursery and young orchards, an additional indication that inoculum in new orchards can originate from the nursery as symptomless infection on

young trees, although spread from adjacent cankered old orchards cannot be excluded depending on the site.

Impact of Pathogen on Avocado Scions and Rootstocks.

Pathogenicity experiments, using a mycelium plug inoculation method, were performed in laboratory on excised avocado budwood shoots and in greenhouse conditions on potted (Hass and GEM) avocado trees, providing more informative results on the aggressiveness of selected isolates on the main avocado cultivars and rootstocks. Healthy budwoods originating from mother tree blocks (scions: Hass and GEM; and rootstocks (Toro Canyon and Dusa) were tested for their susceptibility after inoculations with isolates

Table 6. Incidence of fungi recovered from healthy and infected avocado tissues of potted avocado trees.

Avocado plants	Symptoms/tissues*	Pieces (#)	Number yielding specified fungi							
			<i>Botryosphaeria</i>	<i>Colletotrichum</i>	<i>Phomopsis</i>	<i>Fusarium</i>	<i>Alternaria</i>	<i>Cladosporium</i>	<i>Aspergillus</i>	<i>Penicillium</i>
Hass on Toro Canyon	Infected twigs	100	17	5	6	0	13	0	1	0
	Healthy twigs	170	8	0	5	7	10	0	6	0
Hass on Dusa	Healthy twigs	150	2	0	1	7	10	0	6	1
	Infected twigs	310	46	29	10	6	28	2	10	1
GEM on Dusa	Healthy twigs	100	0	0	1	1	33	0	1	0
	Fruit mummy	10	0	1	0	0	0	0	0	0
	Infected twigs	180	52	27	5	0	17	1	11	0
	Graft union of dead tree	30	12	0	0	2	6	0	0	0
GEM on Toro Canyon	Healthy twigs	120	25	1	0	1	25		0	2
	Infected twigs	60	44	16	0	0	4	0	0	0

* Infected avocado twigs were recovered from potted avocado trees subjected to water stress.

of *Neofusicoccum nonquaesitum* and *Lasiodiplodia theobromae*. The same *L. theobromae* isolate was used to assess its virulence on potted trees (Hass, GEM) in the greenhouse. Canker lesion lengths on twigs were recorded two weeks or one month after inoculations.

Pathogenicity, conducted on healthy avocado budwoods originating from mother tree blocks (scions: Hass and GEM) and rootstocks (Toro Canyon and Dusa), showed that two weeks after inoculations with mycelial plugs, all cultivars and rootstocks were susceptible to infections by *Neofusicoccum nonquaesitum* and *L. theobromae*. Inoculations of wounded shoots of potted Hass and GEM avocado trees showed they all appeared to be susceptible to infection by *L. theobromae* following Koch's postulates confirmation.

Effects of Abiotic Stress Factor on Disease Initiation and Expression.

Botryosphaeriaceae fungi can live, grow, and develop asymptotically as endophytes within the plant tissues, prior to symptom expression. To assess the influence of water stress factor on ABC disease initiation and development, we analyzed its effect in lathhouse experiments. Initially healthy looking young potted avocado trees (GEM and Hass on Dusa or Toro Canyon combinations) were placed near the greenhouse at Kearney Center. A set of trees was continually irrigated for about five weeks while the other set was not. Non-irrigated healthy young potted avocado plants (GEM or Hass on Dusa or Toro Canyon) developed canker and die-back symptoms after the applied water stress event while the irrigated plants did not develop any symptoms. Subsequently, pieces of symptomatic and asymptomatic twigs were plated on acidified Potato Dextrose Agar (PDA) plates followed by isolations of the associated fungi.

Isolations from pieces of asymptomatic twigs revealed that *Botryosphaeria* fungi could be recovered among other pathogens, indicating that they can exist latently in twig tissues prior to exposure to water stress. Infections could be detected by direct isolation in twig or branch tissues collected from trees subjected to water stress, which therefore can induce the disease (Table 6). These results indicate that detection of latent infections is very important in order to define the risk of the disease before the expression of symptoms and thus take the proper actions to alleviate the expression of the disease.

Effects of Selected Fungicides on the Incidence of Botryosphaeria Pathogens.

No fungicides are currently registered for use against ABC pathogens. Different active ingredients found in fungicides target different groups of fungi; so, testing and knowing the ones that are effective against *Botryosphaeria* can guide the selection and development of an efficient chemical control program. Selected fungicides were assessed for their efficacy and utility in protecting grafting and pruning wounds against infection by *Botryosphaeria* and other fungi in nursery and in the field. We first used *in vitro* tests to evaluate the inhibitory activity of selected fungicides belonging to two important chemical groups (Topsin, FRAC# 1; Switch, FRAC# 9 and 12; Rhyme, FRAC#3; and Scholar, FRAC#12) against the mycelial growth of target pathogens using a discriminatory fungicide concentration of 10 ppm. Representative isolates of the identified genera/species (*Botryosphaeria*, *Colletotrichum*, *Phomopsis*, and *Fusarium* species) were selected and used in this preliminary study. PDA plates amended with no fungicides were used as controls. The percentages of mycelial growth inhibition relative to the control were calculated and isolates were then classified as resistant (R) or sensitive (S) to the fungicide. We also performed *in vitro* mycelial growth test on agar media using various concentrations of fungicides belonging to two important chemical groups (i.e., FRAC codes 7 and 11). Furthermore, *in vivo* fungicide tests were conducted on potted avocado (Hass on Duck7) trees in the lathhouse at Kearney Center (Parlier, Calif.) and on Hass on Toro Canyon trees located at an experimental orchard (Pine Tree Ranch) in Santa Paula, Calif. Solo fungicide products or fungicide mixtures belonging to key chemical groups (i.e., FRAC codes (FRAC#1 = Benzimidazoles; FRAC#3 = DMI; FRAC#7 = SDHI; FRAC#9 = Anilinopyrimidines; FRAC#11 = QoI; and FRAC#12 = Phenylpyrroles) were tested (Table 1). Attached shoots on potted and planted trees were wounded artificially and fungicides were then applied at maximum label rates as used for *Botryosphaeria* shoot blight control on pistachio. Wounded shoots were inoculated with *Lasiodiplodia* spore suspension 24 h after fungicide sprays. Positive control consisted of wounded shoot inoculated with *Lasiodiplodia* spore suspension while negative control shoots were sprayed with sterile water. Inoculated and non-inoculated shoots were collected after six weeks and three months in lathhouse and field experiments, respectively. Fungicide efficacy was then

Fungicide trade name	Active ingredient/	FRAC group	Used in Lathhouse (L) or field (F) experiments
Water (negative control)	-		L and F
Merivon	Pyraclostrobin+Fluxapyroxad	11/7	L and F
Aprovia	Benzovindiflupyr	7	L and F
Topsin M	Thiophanate-methyl	1	L and F
Approach	Cyproconazole+Picoxystrobin	3/11	L and F
Flint	Trifloxystrobin	11	L and F
Rhyme	Flutriafol	3	L
Switch	Fludioxonil+Cyprodinil	12/9	L
Fontelis	Penthiopyrad	7	L
Scholar	Fludioxonil	12	L
Luna Experience	Fluopyram + Tebuconazole	7/3	L
Luna Privilege	Fluopyram	7	L
Surround® WP	Kaolin	-	L

measured by recording lesion lengths or percent of recovery of the pathogen. Eleven and five fungicide products were tested in lathhouse and field experiments, respectively (Table 7).

Our results from mycelial growth assays using a single discriminatory concentration showed that the four fungicides tested (Topsin, FRAC# 1; Switch, FRAC# 9 and 12; Rhyme, FRAC#3; and Scholar, FRAC#12) were effective against *Botryosphaeria*, *Colletotrichum*, and *Phomopsis* species, but overall, they were ineffective against *Fusarium* species. Results from *in-vitro* mycelial growth at various concentrations of fungicides showed that new SDHI fungicide Aprovia (a.i. benzovindiflupyr; FRAC#7) provides better inhibition of the mycelial growth of *Botryosphaeria* fungi while Luna Privilege (a.i. fluopyram; FRAC#7) seems ineffective. Flint (a.i. trifloxystrobin; FRAC#11) was effective against *Colletotrichum* species.

Our Pine Tree Ranch trial results

showed that Topsin M was the most effective fungicide protecting wounds against infection by *Lasiodiplodia* and that it sustained good activity during the duration of the trial. It was followed by Merivon; Flint, Aprovia, and Approach did not perform well in comparison to the control treatment after the trial period. Our lathhouse trial results showed that Topsin M provided the best efficacy, followed by Merivon, Fontelis, and then Flint and Luna Privilege. The remaining products, including Rhyme, Approach, Switch, and Aprovia appeared ineffective, or lost activity with time.

Effect of Kaolin Against Sunburn Injury.

Bark sunburn damage or injuries caused by high temperature and direct solar radiation in tree orchards are known to provide optimal conditions for successful fungal infections. To prevent these heat injury-related infections avocado growers use white paint (Fig-

ure 5), which efficacy has yet to be proven; it may be phytotoxic to the avocado plant and with time weather and the pathogen may penetrate through unhealed wounds. Safe and anti-sunburn products such as kaolin clay, which is a natural mineral, have successfully been applied in different tree fruit orchards to prevent sunburn damage. We tested the efficacy of 95% kaolin clay particles (Surround® WP, Engelhard Corporation; applied at 4% concentration) treatments in protecting young avocado trees against sunburn injury (Table 7). Eighteen two-year-old potted avocado (Hass on Duck 7) trees were randomly placed near our greenhouse at KARE center during the summer of 2021 (June to July 2021) in a completely randomized design. Nine random trees were treated with Surround WP at a standard rate of 0.4 kg product to 10 L water while the remaining trees served as untreated controls. Measurements of sunburn damage severity on each tree

were determined after five weeks according to a one to four sunburn injury scale.

Our results showed that the preventive application of Surround reduced sunburn damage severity in Surround-treated trees while untreated trees sustained about 50% more damage.

Conclusions and Recommendations.

This study shows that:

1. *Botryosphaeria* (ABC pathogens) and *Colletotrichum* (anthracnose pathogens) can infect avocado plant materials during the propagation process in nurseries. As illustrated in **Figure 8**, latent infections of these pathogens also can take place during the propagation process and potentially serve as a source of inoculum in newly established orchards.
2. ABC pathogens exist in a phase

of latency early on in the budwood from mother trees and enter the plants through wounds during the grafting process, which can lead to canker lesions or graft-union failures.

3. These early infections also may stay latent up to several years after the trees are transplanted in the orchard, until the young plantings undergo abiotic stress such as drought and sunburn, which trigger latent infections to become active infections leading to symptom expressions, including the potential killing of the young trees.
4. Surveys of young orchards showed the occurrence and predominance of *Botryosphaeria* species across all sampled counties.
5. Molecular method showed that same fungal species were found in nursery and young planting

settings. Thus, nursery inocula can play an important role in avocado canker epidemiology in young orchards.

6. Development of best disease management strategies in nursery and young plantings should include the use of effective fungicides as adequate paints for protecting grafting/pruning wounds against ABC pathogen infection and trees against sunburn injuries.
7. All varieties and rootstocks appear susceptible to ABC after wounding.
8. Our fungicide efficacy trials on attached shoots in lathhouse and field conditions identified Topsin as an effective fungicide for protecting pruning and/or grafting wounds, but activity can be reduced or lost with time. It also will depend on the initial pathogen inoculum dose.

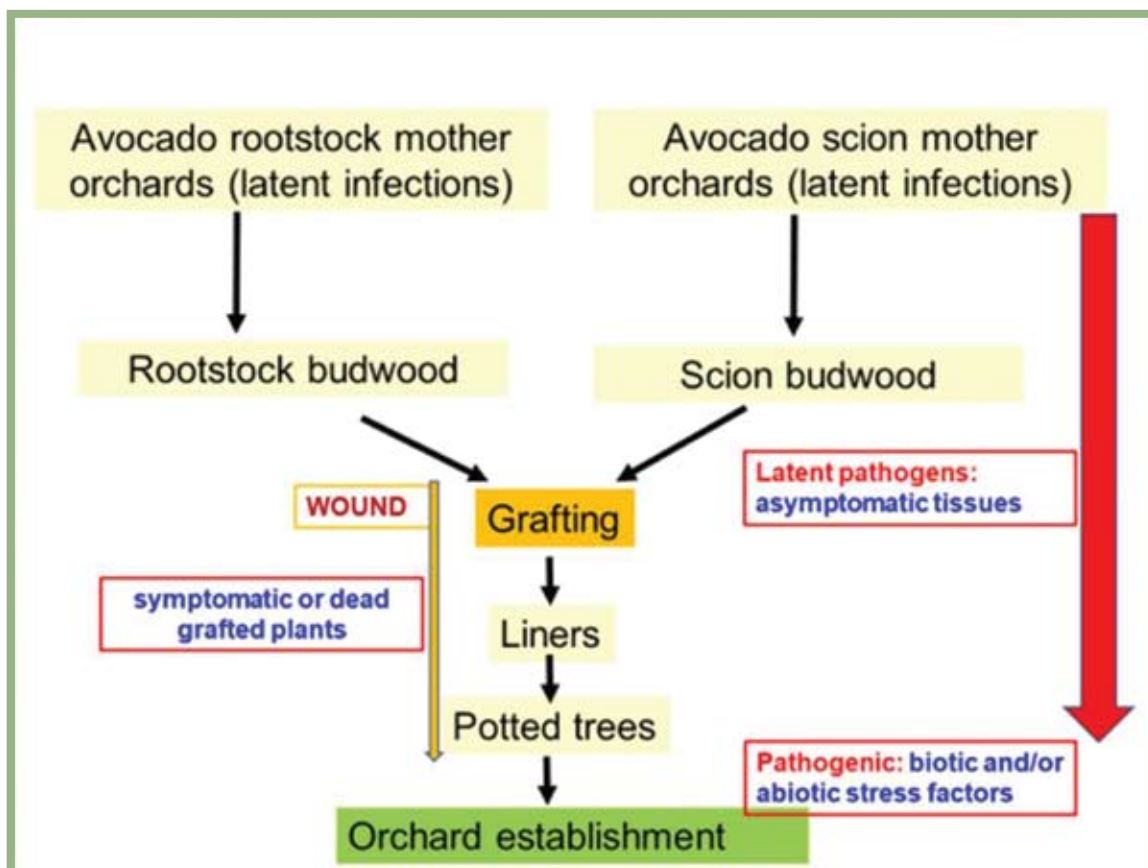


Fig. 8. Avocado nursery production process and potential sources of inoculum and point of infections.

9. Surround (Kaolin) is effective in reducing tree sunburn damage.

10. This study provides the groundwork for future chemical registrations/recommendations for managing ABC pathogens, propagating, and growing disease-free avocado materials. Future studies also will test and validate molecular diagnostic procedure for early detection of the latent, asymptomatic stage in avocado plant material and young trees.

11. Adherence to recommended best management practices for the management of ABC pathogens in avocado nurseries and groves should also be followed and include the following:

a. collect budwood from properly managed mother tree orchards (i.e., avoid pruning during or im-

mediately after rain, dew or heavy fog; properly prune dense canopies to increase air flow and reduce humidity);

b. propagate avocado materials under high nursery sanitary conditions;

c. sanitize grafting equipment;

d. treat budwood prior and during propagation with effective fungicides when available, but especially wounds created during grafting;

e. reduce tree stress and maintain trees in good condition through proper irrigation and fertilization practices;

f. make every effort to source good quality water and manage rootzone salinity, especially for new plantings;

g. reduce planting stress of new trees by ensuring new trees are

properly planted and irrigated;

h. avoid planting during periods that will cause tree stress — heat-waves, Santa Ana winds, etc.

i. use tree sunburn protectant product like kaolin potentially in combination with an effective fungicide that helps to reduce the incidence of ABC fungi.

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By Tim Linden

Optimism Abounds for 2022 California Crop



The stars appear to be aligning for the 2022 California avocado season with a manageable crop size, some rain, a very good December market, and an extra week of Super Bowl selling leaving handlers to express a good deal of optimism for the upcoming season.

Many avocado groves received three inches or more of rain by the middle of December with another storm in the forecast. In the first couple of weeks of the month, the f.o.b. price on smaller fruit jumped significantly along with good volume pointing to strong demand.

"There is expected to be a slight increase in California's volume in 2022," said Gary Caloroso, regional business development director for The Giumarra Companies, on December 13. He added

that the next month would be critical in the development of the crop and noted that a storm was expected to deliver much needed rain to all of the California avocado districts the following day. "We've had very little rain so far and we need some," he said.

Two days later, Gary Clevenger, managing member of Freska Produce International, reported that many growers measured at least three inches of rain in their groves in the previous 24 hours, which was a welcome sight. Clevenger echoed the comments of Caloroso stating there is expected to be a slight increase in California's volume in 2022. Early estimates peg the crop at about 305 million pounds. "It's a little bit larger than last year," Clevenger said. "Most growers are reporting a good set with minimal wind damage so far.

We have to get through January but it's looking very good."

The Freska executive surmised that some California fruit might be harvested in January to take advantage of a strong market and the later date for the Super Bowl. This year the Super Bowl will be held on February 13, the latest date ever. That extra week will give California fruit another week to size and also could create extra sales because the run-up to the event will be longer.

Clevenger pointed out that both December and January should offer plenty of opportunities for avocado promotions and sales. "There will be a lot of college bowl games, as well as an extra week of NFL (National Football League) games and the playoffs leading up to the Super Bowl. We'll have to see how the market holds up, but it is very

strong right now.”

He revealed that in the first couple of weeks in December, the f.o.b. price on 60s jumped almost \$20 per carton to near \$50. The always-popular 48s were returning \$55. “We’ll have to see how it plays out,” he said, “but right now there is a shortage of small fruit.”

He added that only 48s and larger fruit have been released for sale from California groves, but the release of 60s should happen by mid-January. It would have to be a size pick in January, but he believes some California growers will make that choice if the strong market persists.

Caloroso agreed that some California growers will pick early, and the later Super Bowl date will factor into the decision-making process. For the most part, he expects California’s crop to start being harvested in a meaningful way in March with the vast majority of the crop sold from April through July.

Rob Wedin, executive vice president of fresh sales for Calavo Growers Inc., had a very similar take on the size and marketing of the 2022 California crop. He expects Calavo to have about 10-15% more California fruit than it had in 2021 and believes that slight increase should allow growers to have a good season with solid pricing.

Another topic top of mind for Wedin is the reported opening of Jalisco for shipment of avocados to the United States. Calavo has a state-of-the-art packing facility in that Mexican state and has been marketing fruit from Jalisco to markets elsewhere in the world for many years. He said the timing of the Jalisco crop is a bit different than Michoacán as the “normal” crop typically matures one to two months earlier. “Jalisco has two seasons,” he said. “The first one runs from April through July and the second starts in July and takes them to the holidays before they usually

run out of fruit.”

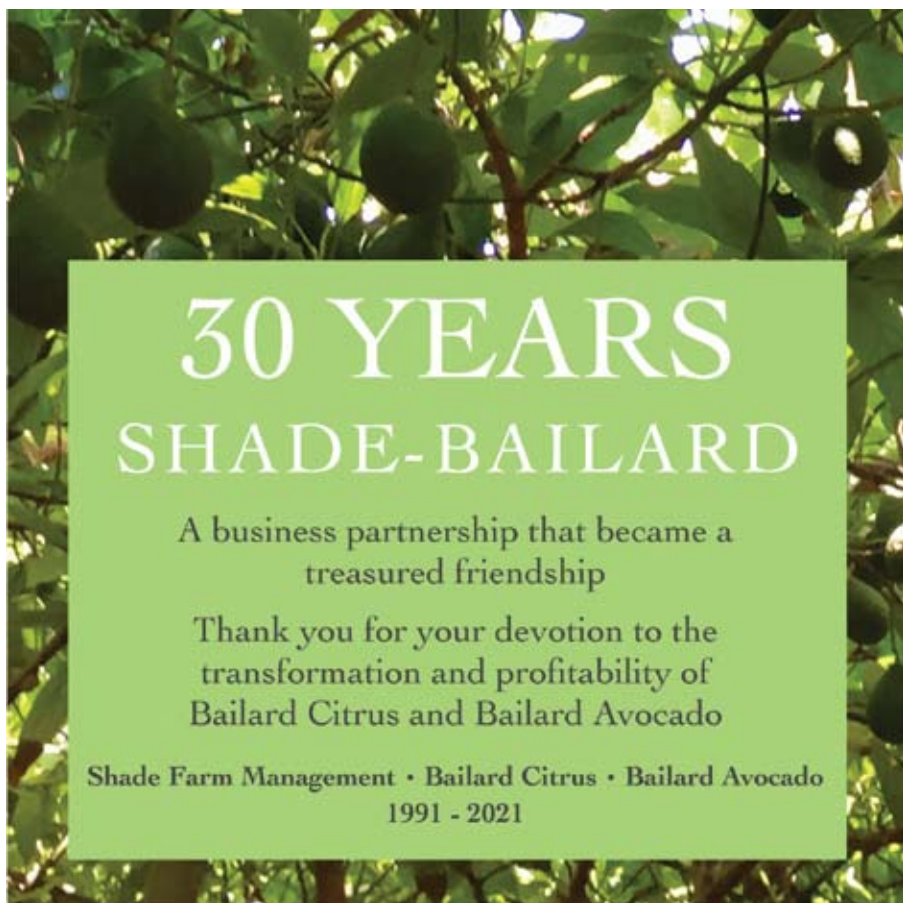
That could put Jalisco in the business of selling avocados to the U.S. market as California’s season is ramping up in the spring. It also pits Jalisco against Peru as summer arrives.

But Wedin does not expect that there will be an oversupply of fruit in the U.S. market just because Jalisco has been granted access, which is expected to commence in April. In the first place, the Jalisco fruit is already being sold in the world market to loyal customers in Canada, Asia and elsewhere. That fruit is not going to automatically be diverted to U.S. buyers. “It’s not new fruit. Its bigger impact might be in shifting which fruit goes where,” Wedin said, adding that Jalisco fruit will most likely be phased into the U.S. market over time.

The groves and packing sheds most likely have to be recertified before they can ship into the United States and that will take time.

Clevenger also said he does not expect the Jalisco fruit to adversely affect the market. “Demand keeps going up, both in the United States and worldwide. We need more fruit to fill that demand,” he said. “I’ve heard Michoacán growers are complaining about Jalisco gaining access, but it’s a big market.”

He reminded us that since Mexico first gained access to the U.S. market, the f.o.b. price has climbed even as volume has doubled and tripled, despite fears that the opposite would happen. He noted that Chile is increasing its sales to the United States this winter by a reported 50% and Colombian avocado imports should also be on the rise in the spring. Clevenger noted that consumption continues to increase. He quipped that avocado toast should again see a big boost in January when New Year’s resolutions take center stage. “I think there is a spot for everyone in the market,” he said. 🥑





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