Power in Partnership

BLUE DIAMOND GROWERS

almond facts

NEWS, VIEWS, AND INDUSTRY INSIGHT

MARCH – APRIL 2021

Celebrating 2021 Bloom

XTREME (Almonds) Heat

Meet Regional Manager Meggie Gilbert

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Turning Up the Heat! *Blue Diamond*'s newest innovation for almonds is a spicy success!

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Blue Diamond, the world's largest processor and marketer of almonds, exports to over 100 countries.

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PRESIDENT'S CORNER

Mark Jansen
President & CEO

It's difficult to believe that just over a year ago our world was turned upside down from a public health crisis that impacted nearly every facet of our daily lives. Fortunately, with the adoption of new public safety measures and the introduction of vaccines, we can all start to breathe a sigh of relief that light at the end of this pandemic tunnel finally is in view.

I'm encouraged that we were able to successfully secure a vaccine administrator and the COVID-19 vaccine doses needed to host on-site vaccine clinics for our team members at all three *Blue Diamond* facilities. This is just one more step we've taken to ensure the health and safety of our workforce.

I've shared with you before that I'm tremendously proud of how well our *Blue Diamond* team members pivoted over the last 12 months to ensure our facilities were able to continue receiving and processing the record-sized crop from our growers. Despite unexpected challenges to production demands, supply chain channels, and consumer behaviors we kept the manufacturing lines running and the shipments flowing.

Related to shipments, supply chain issues remain a global challenge, particularly at the Port of Oakland where agriculture products are stacked at the port with ships returning empty to Asia due to slow turnaround times. Our *Blue Diamond* team has been working overtime to reschedule and find new ways to get product to our global customers.

As a co-op we seize any opportunity we can to celebrate our grower-owners. For the fifth year in a row, The White House publicly recognized National Ag Day on March 23 in a well-deserved salute to the contributions of America's farmers, ranchers and agribusinesses. This year's proclamation recognized the role that the two million American farmers and ranchers played over the last unprecedented year in ensuring a safe and abundant food supply for families around the world.

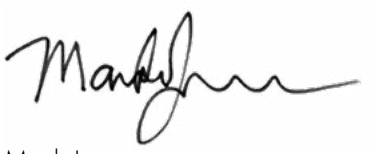
Through an extension of our co-op's efforts to recognize and celebrate the diversity we appreciate in our *Blue Diamond* workforce, we took the opportunity to combine recognition of March as Women's History Month with Ag Day in giving a shout out to our women almond growers. This was just one of several social media posts over the last two months as we increased our corporate social media engagement efforts to better connect our co-op and our growers to the communities we serve. You can read more about those efforts and other co-op news in the News in a Nutshell section of this issue.

We continue marketing though the record 2020 crop that is now estimated to top 3.1 billion pounds. I'm inspired by our relentless focus on innovation that delivers value to our growers through new uses of, and new markets for, their almonds. Our newest snack nut flavor family, XTREMES™, brings on the heat to reach a younger target market share than almonds have traditionally. Internationally, we also recently introduced *Almond Breeze*™ Almond Cooking Cream in Brazil, a cutting-edge non-dairy creamy base for dishes like beef stroganoff and alfredo pastas. You'll find more details about both of these innovative outside-the-box *Blue Diamond* products in the following pages.

With the 2021 bloom now complete, all eyes remain on the weather. After periods of March storms that included heavy rain, winds and even some hail, grower-owners might welcome springtime calm in the next growing phase as trees soak up the nutrients needed to grow the 2021 crop.

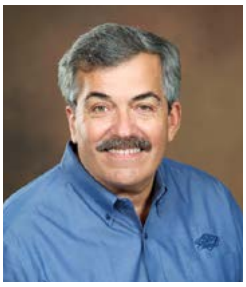
Although the March rain may have delayed irrigation in some regions, California has been officially declared to be in a drought situation due to the lackluster snowpack in the Sierra watershed. While obtaining ample supplies of water will certainly present challenges for growers, I'm aware many of you have been planning ahead, using valuable lessons learned from past dry years to most effectively manage your orchards.

I believe in the perseverance of our farmers and the strength of this *Blue Diamond* cooperative. This past year has clearly demonstrated that no matter what comes our way, by staying focused on partnership, quality and innovation, together we can ensure long-term success. ◆



Mark Jansen
President & CEO

Regional Managers



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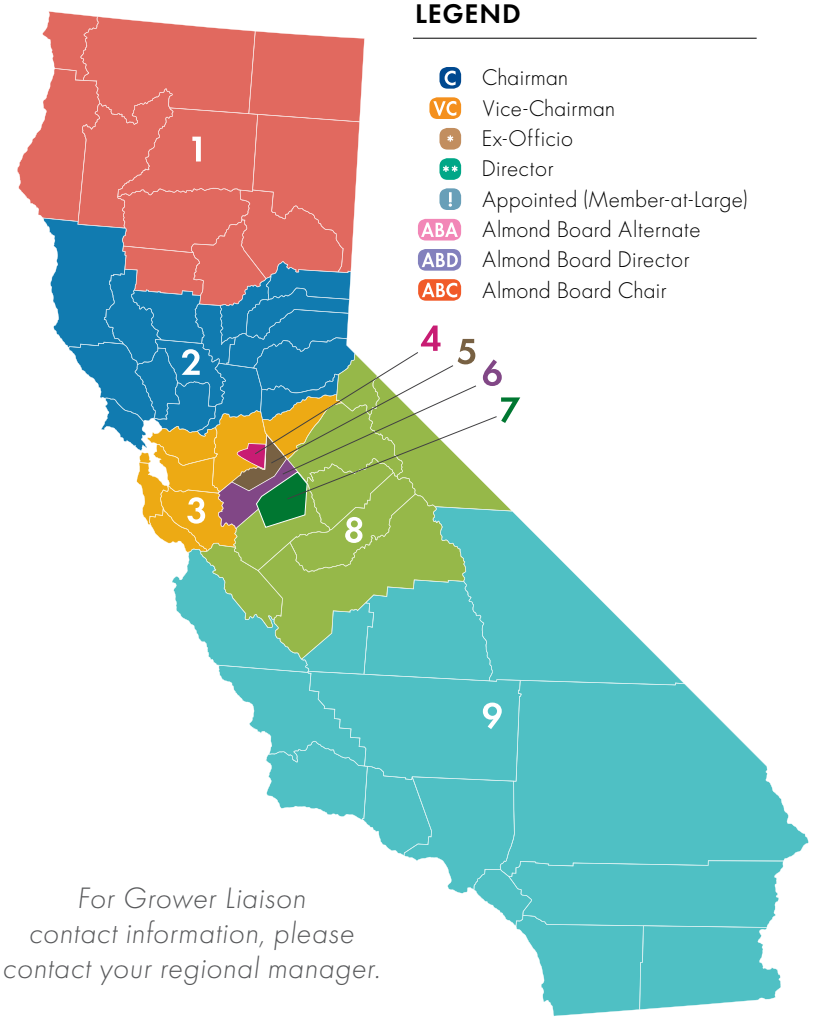

LEGEND

- (C) Chairman
- (VC) Vice-Chairman
- (*) Ex-Officio
- (**) Director
- (!) Appointed (Member-at-Large)
- (ABA) Almond Board Alternate
- (ABD) Almond Board Director
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Ray Van Beek (C)
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Clinton Shick (*)
Karamjit Jhandi (!)

Meet Your Newest Regional Manager, Meggie Gilbert

Almond Facts (AF): What attracted you to *Blue Diamond*?

Meggie (M): My father has been a *Blue Diamond* grower since the 1980s and his passion for the land, as well as growing the highest quality crop possible attracted me to work for *Blue Diamond*. Also, he had some incredible regional managers along the way that became a part of our family (Bob Ketcher, Mel Machado, and others) and I never forgot what an important role they played in advising my father on his crop each year.

AF: What made you want to become a field supervisor?

M: The opportunity to work with growers daily, understand their concerns and issues, and help identify solutions to those daily challenges. In my previous roles at other companies, I was several layers removed from the grower and I missed the daily interactions with growers as well as watching the crop develop from start to finish.

AF: Have you always been interested in agriculture?

M: Yes, I was blessed to have parents that engaged me in 4-H at a young age. I enjoyed the friends I met, speaking competitions, and county fairs where my sisters and I showed with the 4-H program. My high school ag teachers helped continue the spark or my passion for agriculture as I was involved with FFA at the local, sectional, and regional level. Finally, in college, I took a Plant Pathology class which opened my eyes to the "Pathway to PCA Program" and helped steer me toward a career in the crop protection industry.

AF: What do you do in your free time?

M: I love coaching my kids' sports teams or playing golf with my husband, Mike. My kids are: Savannah (9), Mitchell (6), and Siena (4).

AF: What are you looking forward to the most as you begin your career as a field supervisor?

M: Meeting the *Blue Diamond* growers and learning about their family's history and agriculture roots. Every grower has a story to tell, and I am excited to listen, learn, and be a part of their future growing seasons.

AF: Do you have a favorite *Blue Diamond* product?

M: Yes, I love Vanilla *Almond Breeze*® with my protein shakes and the Wasabi & Soy Sauce Flavored Almonds.

AF: Anything else you would like to share with our growers?

M: I am very excited to be a part of the BDG family; and look forward to meeting with all of you. ◆

Mark Jansen Named "Most Admired CEO" Honoree

Blue Diamond Growers President and CEO Mark Jansen was recently announced as one of the most admired CEOs in the greater Sacramento region.

Sponsored by the *Sacramento Business Journal*, the annual recognition program honors top executives who've demonstrated strong leadership, integrity, forward-thinking vision and commitment to innovation in their fields. Nominees for the distinction of Most Admired CEO are solicited from the community and then voted on by their business peers.

A virtual award ceremony honoring Jansen and the other honorees was planned for April 6 and a special publication showcasing the Most Admired CEO honorees is scheduled for distribution in mid-April. A spotlight about Jansen's nomination appeared in the February 26 issue of the Business Journal.

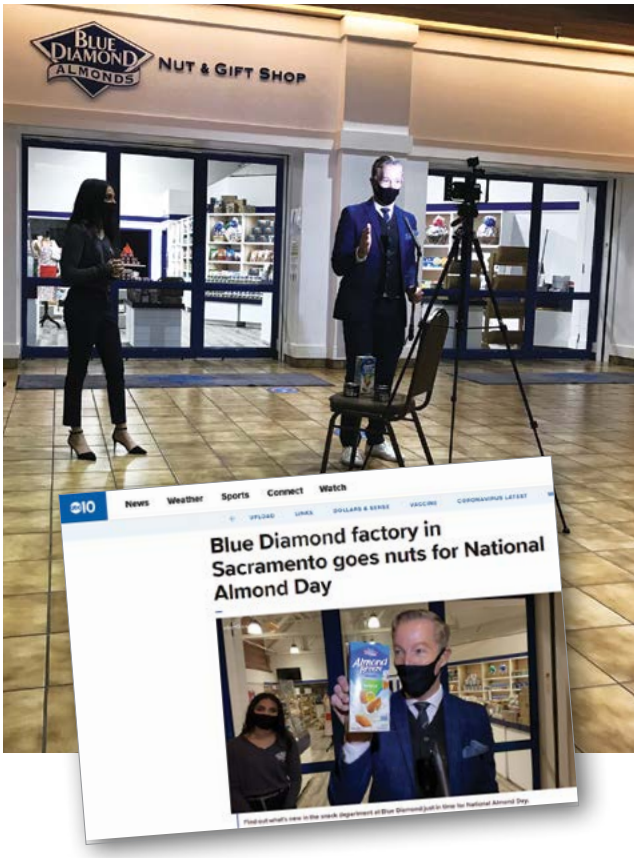
Jansen took over as President and CEO of *Blue Diamond Growers* in September 2010. ◆


SACRAMENTO BUSINESS JOURNAL

Get to know Mark Jansen, a Most Admired CEO honoree

Feb 26, 2021, 10:41am PST

In the News



Live with Kelly & Ryan Morning Talk Show

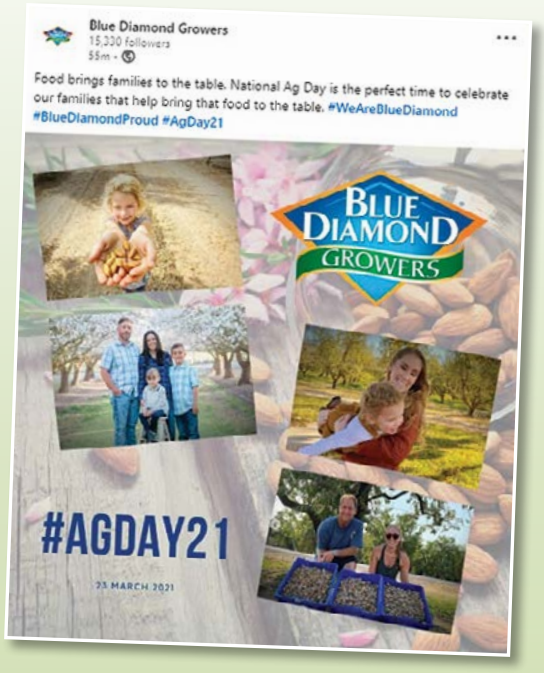
In February, Almond Breeze almondmilk was featured on NBC's Live with Kelly & Ryan as part of a healthy living segment with Nutritionist Keri Glassman.

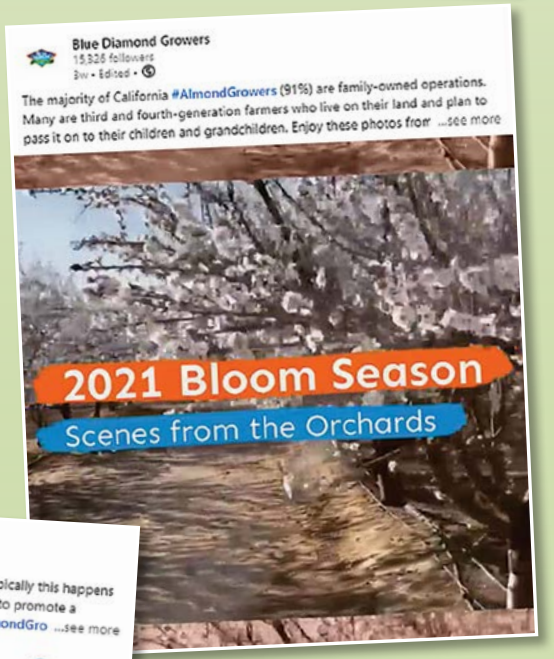
National Almond Day Media Promotion

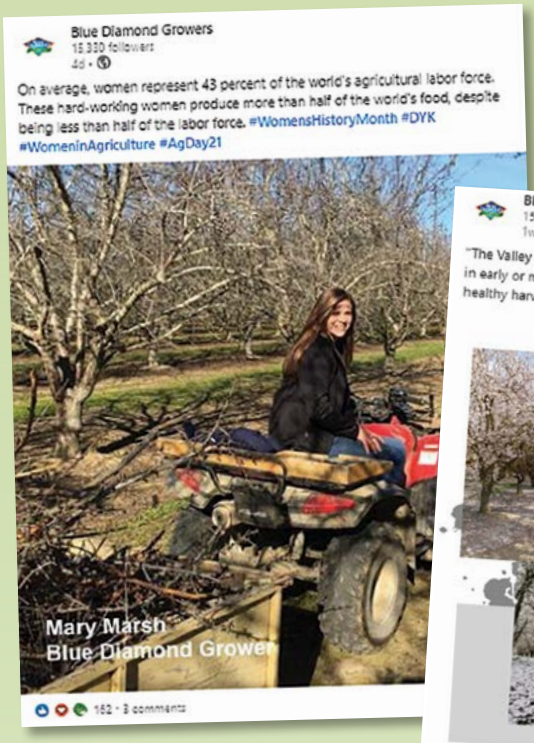
In celebration of National Almond Day on February 16, the Sacramento Blue Diamond campus hosted local ABC affiliate ABC10 television and well-known personality Mark S. Allen to help promote almonds.

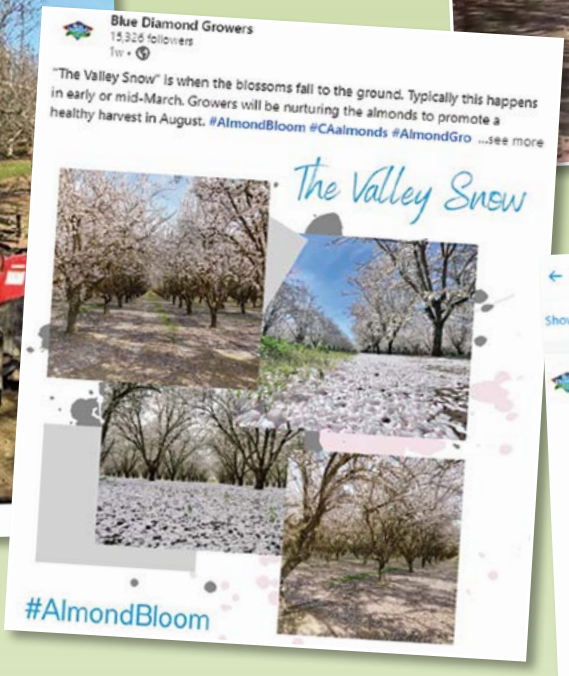
#WeAreBlueDiamond Social Media Activity

We celebrated the 2021 bloom with a one-month engagement campaign on *Blue Diamond*'s various co-op-focused social media platforms, all connected with **#almondbloom** and **#weareblue diamond**. Thank you to all who "liked" and shared the posts, as well as posted your own stories, to expand outreach and better connect our growers and co-op with the world!









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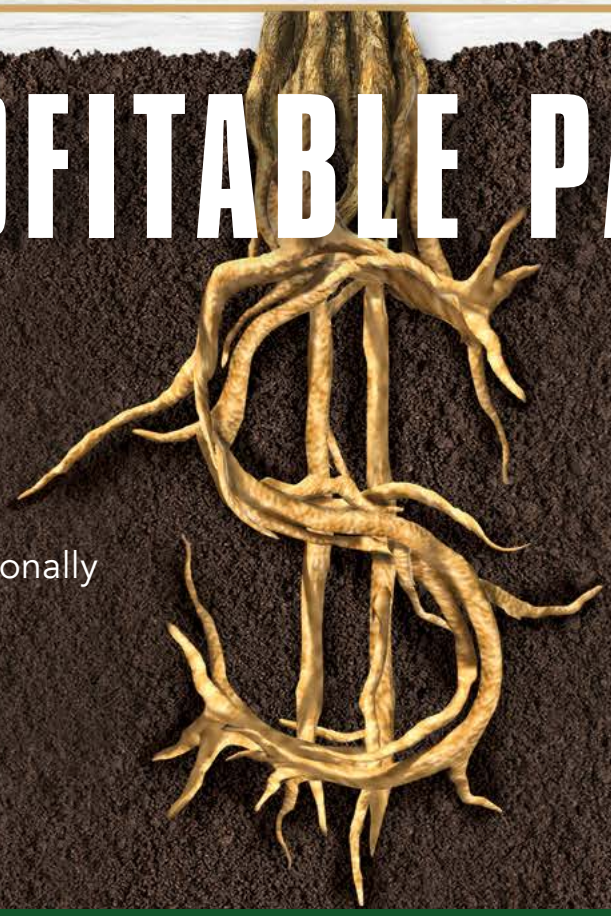

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Very Veggie Spring Green Breakfast Casserole

Cook Time: 90 minutes Difficulty: Medium Makes: 12 Servings
Courtesy of: Love and Lemons, loveandlemons.com

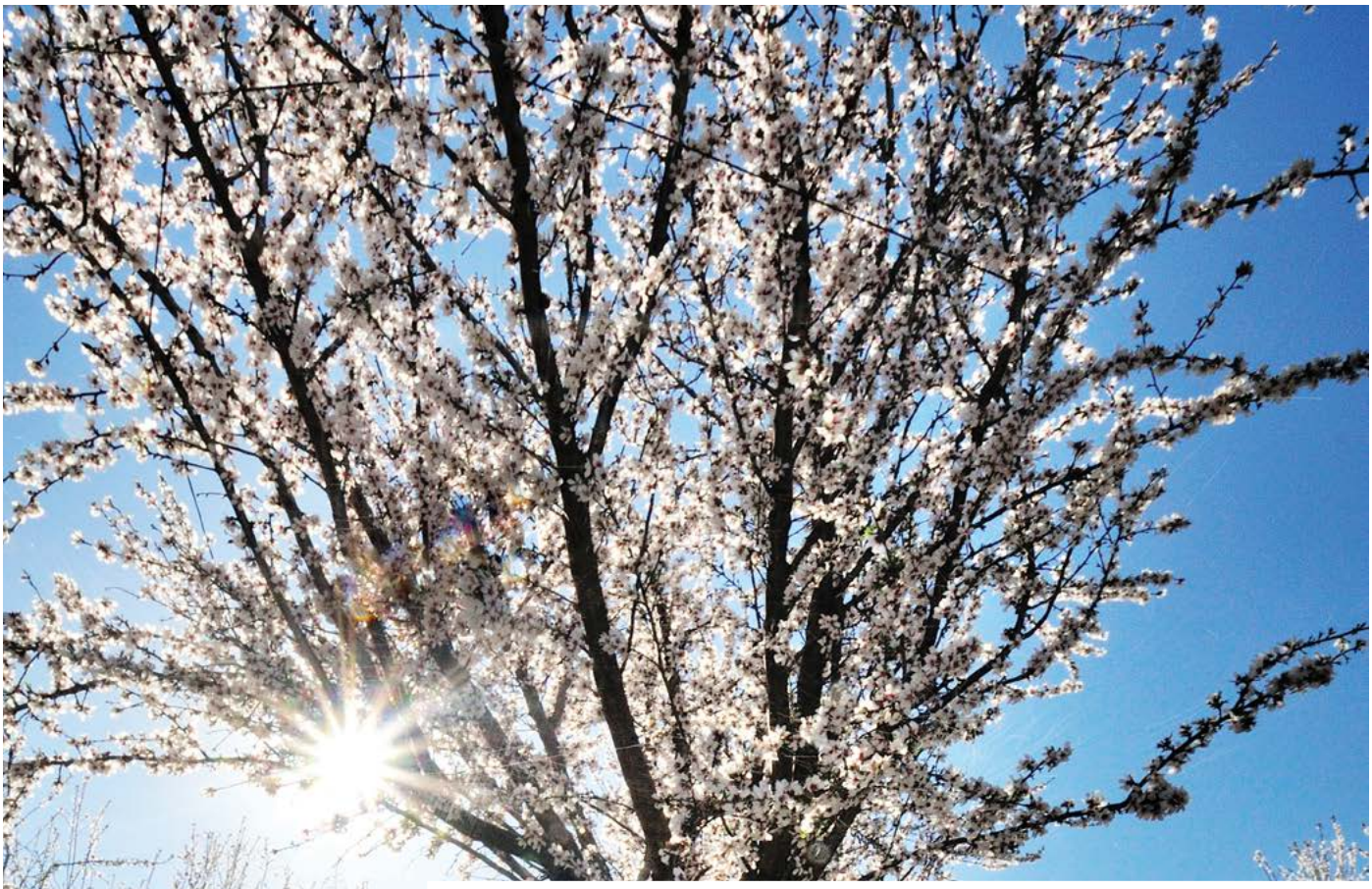
Ingredients

- 2 sweet potatoes cubed
- 10 to 12 ounces mixed mushrooms quartered
- 1 bunch asparagus tender parts chopped
- Extra-virgin olive oil for drizzling
- 12 large eggs
- ½ cup *Almond Breeze* Cashew Blend Unsweetened Original
- 1 garlic clove minced
- ½ to 1 teaspoon sea salt
- ½ teaspoon black pepper
- 4 ounces crumbled feta cheese
- 1 bunch scallions chopped
- 1 cup frozen peas thawed

Directions

1. Preheat the oven to 400°F and line two baking sheets with parchment paper. On one baking sheet, spread the sweet potatoes, on the other baking sheet, spread the mushrooms and asparagus. Drizzle with olive oil and sprinkle with pinches of salt and pepper and toss to coat. Roast the sweet potatoes for 30 minutes, placing the baking sheet with the mushrooms and asparagus in the oven to roast during the final 10 minutes.
2. In a medium bowl, whisk together the eggs, milk, garlic, ½ to 1 teaspoon salt (use ½ teaspoon salt if using the feta cheese, use 1 teaspoon salt if skipping the feta cheese), and black pepper.
3. Reduce the oven temperature to 350°F. Lightly spray a 9 x 13-inch baking dish with non-stick spray. Place all the sweet potatoes evenly in the bottom of the baking dish. Add half of the remaining vegetables and spread out evenly. Sprinkle with ½ of the feta cheese. Add the eggs, the other half of vegetables, sprinkle with the remaining feta.
4. Bake for 40 to 45 minutes or until the eggs are set. Let the casserole sit for 10 minutes before slicing.

Note: the recipe fits into a standard 9 x 13-inch pan. If you use a smaller pan, you'll need to use multiple pans.



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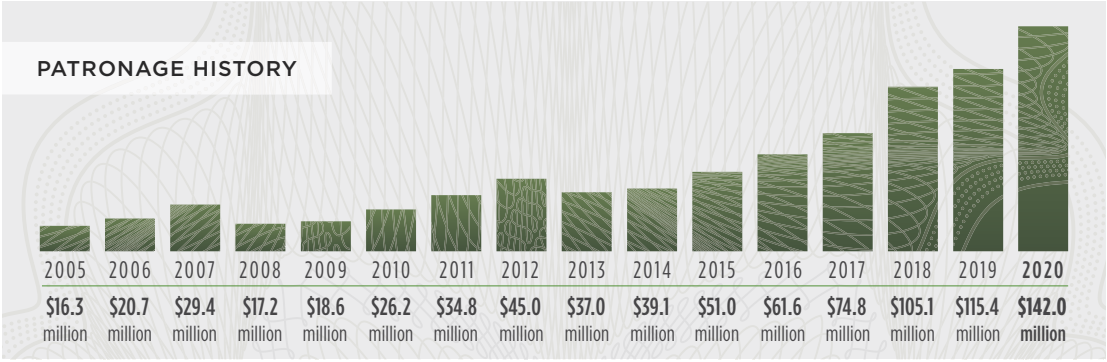

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Blue Diamond® Turns Up the Heat with Its New Line of XTREMES™ Almonds

Blue Diamond's Innovation and R&D team has successfully turned up the heat with a recent launch of the brand's first dedicated line of extra spicy almonds — *Blue Diamond* XTREMES™. Available in three super-hot flavors — Cayenne Pepper (Hot), Ghost Pepper (Hotter) and Carolina Reaper (Hottest) — these new almonds are made with real peppers and have a spicy flavor rush that takes snacking to the next level.

This new flavor family is geared toward a younger snacking demographic as on-trend spicy foods tend to attract Millennial and Gen Z audiences. Feedback coming in already through *Blue Diamond* social media and consumer inquiry platforms show the new level of spiciness is a tasty hit with consumers.

Blue Diamond XTREMES™ have the legendary, satisfying almond crunch with a mouth-blazing, fiery flavor rush, all on a superfood. A serving of XTREMES™ has 6g plant protein per serving and are an excellent source of antioxidant Vitamin E and a good source of magnesium. *Blue Diamond* XTREMES™ almonds are available now at *Blue Diamond* Nut & Gift shop locations and through Amazon and are beginning to roll out at grocery and convenience stores nationwide.

Almond Breeze™ Portfolio Expands in Brazil with First Almond Cooking Cream

An exciting new product hit store shelves in March in Brazil — *Almond Breeze*™ Almond Cooking Cream! The product was developed by *Blue Diamond Growers*, in partnership with Laticínios Bela Vista, which licenses the *Almond Breeze*™ brand in Brazil. Now stroganoffs, mousses, toppings, guava with cream and many other Brazilian recipes have new option of tasty and milk-free ingredient, in a 200g pack.

Naturally lactose-free and gluten-free, creamy *Almond Breeze*™ Almond Cooking Cream is an alternative to dairy milk cream, for both sweet and savory recipes, including preparations that need to be heated.

"In its formulation, there is no presence of peanuts, soy, milk or any other type of animal protein. Therefore, we present a product that is ideal for vegetarians, vegans or those lactose intolerants, and that makes a point of enjoying delicious preparations without compromise in result. The performance of this milk-less cooking cream in recipes is amazing!" explains *Blue Diamond Growers*' Global Consumer Business Director for Latin America, Edgar Fernandes. ◆

The End of Ag Burning in California — Breaking Down the Recent CARB Decision

The Issue

Since the passage of SB 705 (2003 Florez), the agricultural industry has worked with the San Joaquin Valley Air Pollution Control District (District) for the last 15 years to reduce agricultural burning by more than 80 percent. The remaining situations have remained exempted because either no alternative solutions have been developed (e.g. how can vines with wire be incorporated into the soil?) or the existing alternatives are cost prohibitive (e.g., small and disadvantaged farms). While alternatives to ag burning have been found for most situations through the development of solutions like whole orchard recycling for orchard removals, chipping of prunings, and chipped wood for bioenergy, further progress has been hampered by the pace of closures of biomass plants, and the inability to get alternative technologies (e.g. cellulosic ethanol, renewable diesel, biochar) off-the-ground to provide needed biomass solutions.

In December of 2020, the District staff presented their report and recommendations on agricultural burning to their board proposing further reductions in acreage and crop types that can be burned. The board adopted the report although further restrictions would be difficult to meet; the report was then transmitted to the California Air Resources Board (CARB). The Almond Alliance worked with other trade organizations impacted by the District's recommendations in preparation for the upcoming CARB meeting.

CARB Board Meeting

At the February 25th CARB meeting, several Almond Alliance members provided in-person testimony and submitted written comments on how eliminating all agriculture burning, without any exceptions or extensions was not realistic without making alternatives and options available to small growers. Many small growers explained how they are unable to secure the needed chipping and shredding services due to their size and limited acreage. Others

expressed that soil incorporation was not economically feasible given the size of their orchards. The grape and wine industry also articulated how alternatives to burning requires chipping, and there is so-far no-way to chip vines without first removing trellising wire. Despite the extensive public testimony from growers, the CARB board voted unanimously to phase-out agricultural burning in the San Joaquin Valley by January 1, 2025 with few exceptions.

Funding Needed for the Agriculture Industry to End Agricultural Burning in the San Joaquin Valley

In preparation for a worse case CARB board decision and ultimate implementation of a total phase-out, the Almond Alliance and our agricultural association collaborators focused on increasing state funding for soil incorporation incentive programs, chipping, shredding equipment and air curtain burners as well as bio energy solutions.

While incorporating chipped woody biomass into ag lands can provide some soil and carbon sequestration benefits (at least for orchard removals), it takes time for those benefits to accrue economically to the grower. Thus, the "Alternative to Agricultural Burning" program facilitated by the District incentivizes growers to utilize alternatives to burning such as whole orchard recycling by covering the additional in-field costs of the alternative compared to burning or sending to a biomass plant if feasible. In the past, biomass plants would cover some of the in-field cost of chipping orchard removals prior to shipping to their facilities. The program has been utilized widely in the almond industry but needs to be expanded to other woody crops in order to phase-out ag burning in the San Joaquin Valley. The Almond Alliance and our agriculture trade partners have asked that the state increase their investment in this program so it can be expanded with additional incentives for smaller growers.

The utilization of chipping and shredding on small acreage is also challenged by the availability of equipment and the fact that small jobs are less profitable for custom chipping and shredding operators. In the meanwhile, while prunings lie on the orchard floor, other orchard activities such as integrated pest management activities (e.g. mummy nut removal and weed management cannot occur.) The Almond Alliance articulated that for whole orchard removals to be feasible on small orchards the primary issue is the availability of equipment that can function on small acreages.

In terms of reducing the hurdles to chipping/shredding because of costs, availability, right-sized equipment, we proposed forming a stakeholder group to make recommendations on how to catalyze chipping/shredding and orchard removal services that are economical and available to small growers. A primary goal is to motivate custom operators to make new equipment investments and grow their businesses to service small farms. We also requested funding incentives for chipping/shredding

companies to expand their fleets and increase availability for smaller orchards.

In addition to on-farm alternatives, we also need to increase the utilization of woody biomass as an input to bioenergy processes within the San Joaquin Valley through processes such as gasification, pyrolysis, and torrefaction which produce a variety of products including heat, power, syn-gas, bio-oils, and biochar. Bio-economy facilities are still more in the research and development phase but show promise that they can produce products that enhance quality of recycled plastic, pre-cursors inputs for bio-plastics, and other valuable chemical compounds.

Supporting development of a new agriculture based bio-economy and the bio-products developed and produced in Central Valley will show policy makers that agriculture is a key partner in reaching the State's greenhouse gas reduction goals by producing alternative fuels like syngas and contributing to new methods of green energy production. It also brings technical jobs to the San Joaquin Valley. Lastly, it adds value to ag co-products and processes them locally for jobs movement toward a bio-economy. Incentivizing early adopters with up-front investment helps to defray the costs of developing markets for the new types of ag produced bio-energy and bio-products.

While some of these solutions have been around for some time, they are not being built at a pace that would match potential needs due to a rapid phase-out of ag burning. Therefore, we believe it is necessary to develop a stakeholder group and a six month summit with CARB to review technologies and assess potential solutions and any barriers for wide implementation.

Meeting with State Leadership

Our coalition has also met several times with the Administration to express our concerns about ending agricultural burning without the availability of feasible alternatives. We have made an official request for additional funding to expand the "Alternative to Agricultural Burning" program, increase the availability of chipping and shredding equipment, the purchase of air curtain burners and investment in bio-energy research and solutions. We continue to request assistance for the companies and farmers that are seeking bio-energy and bio-economy solutions, but who also face hurdles such as lack of markets for products, necessary equipment, permitting and infrastructure.

For now, farming operations in the San Joaquin Valley within allowable acres may still apply for a permit to burn prunings. The number of operations actually receiving a permit, however, will be gradually reduced. Similarly, CARB's ruling will reduce the size of an operation that is allowed to apply to legally burn orchard removals.

The Almond Alliance in partnership with *Blue Diamond* will be participating in a discussion on this issue in early April. It is our hope to provide an update on resources available for smaller growers that face hurdles to implementing available alternatives to agricultural burning.

For more information on this issue, visit the San Joaquin Valley Air Pollution Control District website resources:

Main Page:
ww2.valleyair.org/agriculture/agricultural-burning

Compliance Assistance Bulletin:
ww2.valleyair.org/media/4uugbkb5/ag-burn-cabposted.pdf

Elaine Trevino, President, Almond Alliance of California

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[1] Profit increase based on 2017 almond price/lb. and average yield/bearing acres with 8.3% increase in yield versus untreated over three-year trial, per trial data of five locations with a single application of Velum One at 6.5 or 6.85 fl. oz./A.

[2] Velum One applied at 6.5 oz./A, spring 2017, via drip irrigation. Trees planted in January 2017. Increase in green canopy pixels based on an average of two rows of untreated trees compared to an average of two rows of Velum One-treated trees.

THE BEE BOX

Verifying Survey-Based Beekeeping Best Management Practices with Field Experiments

In the last "Bee Box" update from Bee Informed Partnership, we highlighted the recently published research conducted by BIP's Research Coordinator, Dr. Nathalie Steinhauer and colleagues, that examined four years of U.S. honey bee colony health, survival and management information collected through BIP's Annual Colony Loss and Management Survey (Steinhauer, Staeger & vanEngelsdorp 2021 *Science of the Total Environment* vol. 753). The goal of this work was to evaluate the association between beekeeper management practices and colony survival rates and to determine whether differences in management practices that are shown to be associated with lower colony mortality according to survey data analyses are confirmed with field experiments.

What management mattered most? Four beekeeping management actions had the greatest impact on colony survival rate in small-scale beekeeping operations (0–50 colonies): 1) Regularly replacing old comb; 2) action on deadouts — either rapidly reusing equipment from colonies that have died, or freezing equipment prior to reuse rather than storing and reusing without freezing (unless colonies died as a result of transmissible infectious diseases, such as American Foulbrood, in which case equipment must not be reused or sterilized with specific protocols); 3) implementing a *Varroa* management plan where *Varroa* are treated when they reach the critical threshold level of three *Varroa*/100 bees; and 4) creating new colonies by dividing existing colonies, rather than purchasing packages as a source of new colonies (*Table 1*).

Table 1. Average practices vs. BMPs to be tested in the field.

Management Practice	Average Practice	Best Management Practice
Action on Deadout	Store equipment for later use	Reuse equipment immediately by adding to living colonies or using for a split
Varroa control frequency	Apply miticides once in fall	Monitor monthly and apply miticides when above 3.0 mites/100 bees
Starting new colonies	Packages	Make splits when possible and buy nucs if splits impossible
Comb-culling technique	Do not treat old brood comb before reuse	Freeze old brood comb before reuse

Following up with field experiments – To determine whether beekeeping management practice recommendations drawn from survey data reported to improve honey bee colony survival rates could be experimentally-reproduced, Dr. Kelly Kulhanek at the University of Maryland and colleagues conducted a multi-year field study to compare

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colonies managed according to either best management practices (BMPs) or average practices ("Survey-derived best management practices for backyard beekeepers improve colony health and reduce mortality" PLOS 1, (2021) 16(1): e0245490).

In 2016 honey bee colonies to be used in this study were established from packages on bare foundation. This was done so that the colonies were as similar as possible at the outset of the experiment. Seven apiaries across the U.S. (seven apiaries x 20 colonies per apiary = 140 total colonies in the study) were assigned to one of two groups — BMPs or Average Practices — and treated according to corresponding management protocols (*Table 1*). Field experiments were conducted for three years, and honey bee colony health metrics were monitored monthly between the months of May to October. The health characteristics measured included: population size (measured as number of frames covered with adult bees), the amount and quality of developing bees (brood pattern), queen status, mortality, disease prevalence and load (*Varroa, Nosema*, viruses) and honey and new colony production.

Compared to colonies with average practices, BMP colonies exhibited: 1) lower average monthly *Varroa* loads May-September and spent fewer months above threshold levels (3 *Varroa*/100 bees) (*Figure 1*); 2) lower fall loads of Acute Bee Paralysis Virus and Deformed Wing Virus (DWVA and DWVB); 3) greater new colony production; and 4) lower mortality (*Figure 2*). Furthermore, the gap in mortality rates widened between groups each year.

Although beekeepers cannot control all factors that influence colony health and keeping in mind these BMPs focus on small-scale beekeeper management data, these results highlight practical strategies that beekeepers can incorporate into their management strategy to improve colony health, survival and productivity.

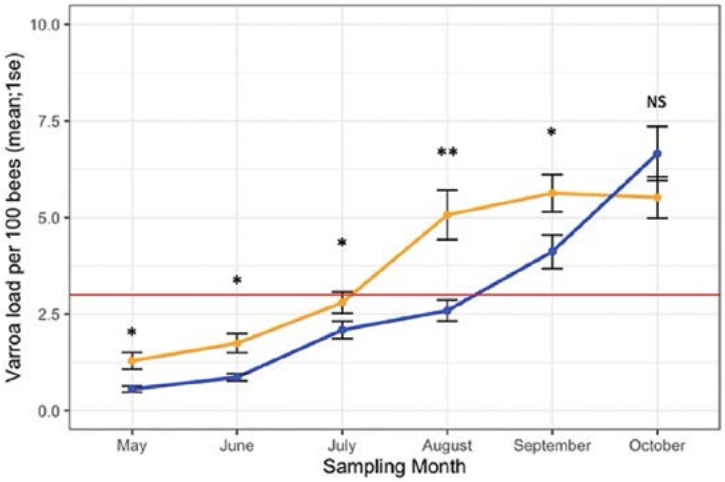

Figure 1. Monthly mean (+/- standard error) Varroa load per 100 bees.

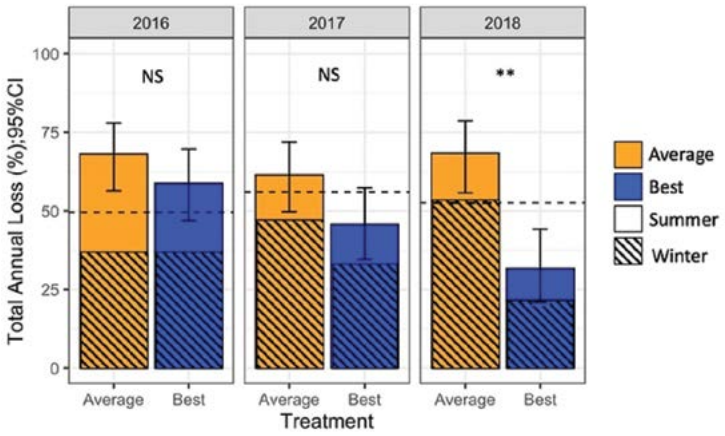

Figure 2. 2016-2018 % Total (+/- 95% Confidence Interval) summer, winter and total losses. Blue bars = BMP apiaries; orange bars = average apiaries.

Jeri Parrent,
The Bee Informed Partnership
Grants Coordinator

THE ALMOND BOARD

Want Better Yields? Get Personal with Your Trees

Managing orchards is a bit like marriage: It's a long-term relationship. A mistake today could stay with you for a while, but care and attention to detail can pay benefits year after year.

That's the message Sebastian Saa, associate director of Agricultural Research at the Almond Board of California (ABC), wants to share with growers.

"Everybody wants to have good yields, and that's important," Saa said. "But understanding how to read the tree, how to interact with the tree, is what leads to sustainable yields year after year."

That means paying attention to what the tree is telling you at each stage of growth, understanding what certain changes or circumstances mean and reacting appropriately. Reading your trees' signals is particularly important under challenging conditions, as signals can help a grower determine if they need to adjust certain practices. Missing a signal from the trees — or misinterpreting it — could lead to the wrong decision when it comes to fertilization, irrigation or foliar sprays, Saa said.

Misinterpreting your trees' signals could also mean you'll miss an opportunity for quality yields — not only this year but next year — because while the tree is currently producing this year's crop, it's also getting ready for next year. In each tree, branches' fruit-bearing spurs are constantly changing — new ones being born, others bearing fruit, still others dying off. Identifying the different population of spurs in your tree, and what other key parts of the tree are up to, provides a wealth of important information to the grower, Saa said.

In that regard, understanding and calculating your yield is a simple equation: the number of flowers by the percentage of fruit set multiplied by kernel weight:

Yield potential = No. of flowers % of fruit set kernel weight

But don't let the simplicity of this formula fool you — the importance of your final count is hardly trivial.

"The formula may be straight forward, but it's implications are significant, especially if you can figure out how to manipulate the variables," Saa said.

In this article, we will focus specifically on kernel weight. For more information on the other two main factors, please visit almonds.com/industrynews or type "Optimal Yield Series" in the search bar at almonds.com.

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Filling Up the Balloon

"The hull is like a balloon," said Saa. "You want large balloons on your tree and then the process of filling up those balloons with kernels begins."

By the first full week of May, growers are starting to see those hull balloons reach full size. Management decisions related to water and nutrients from then until July will largely determine the success — and size — of kernel development inside the hull. Saa notes that growers have access to ABC tools and resources, such as the Nitrogen Calculator [1] and Almond Irrigation Improvement Continuum,[2] to help quantify and meet tree nutrient and evapotranspiration demands.

"Inflating the balloon is relatively cheap for the tree, but essential. However, it's an expensive proposition, as trees require a lot of energy, i.e. carbohydrates, to develop good quality kernels," Saa said.

Through photosynthesis, sunlight is harvested to produce carbohydrates, which provides energy to grow the kernel. Referencing research [3] conducted at UC Davis, Saa likens carbohydrates to currency: The tree has to buy the food necessary to fill the hull balloon.

So how do growers ensure their trees will have enough carbohydrate dollars during the summer months to feed kernel growth?

"Since carbohydrates are produced by the leaves intercepting light, we want to have a canopy that covers 80 percent of the orchard floor in midsummer. An ABC-funded study shows that about 80 percent canopy coverage in the summer is needed to maximize carbohydrate production, so good canopy cover and healthy leaves are essential," Saa said.

He also notes that ABC is currently funding a study — conducted by Dr. Zwieniecki and Dr. Anna Davidson — on carbohydrates to gain further insight into the importance, balance and timing of this critical food source and its relationship to kernel development. When complete, this study will provide growers with more scientifically vetted information to help them make management decisions.

As with most aspects of farming, present-day success relies on good decision making in the past. Reaching the desired 80 percent canopy size in midsummer depends on management decisions made during the spring following petal fall and leading up to early fruit growth. All aspects of the tree are growing during this period — the roots, leaves and fruit — and each part wants to come out on top; they are all competing for resources. Satisfying tree nutrient and water demand, therefore, not only increases the percentage of fruit set, it also leads to the growth of healthy and abundant leaves, which will ultimately harvest sunlight to feed kernel growth during the summer.

"It's all management that defines the potential for the tree to capture water, light and nutrients. The final kernel will be the direct reflection of those three factors," Saa said.

Have questions about how to optimize yield? Email Saa at ssaa@almondboard.com.

Sebastian Saa, Associate Director of Agricultural Research at the Almond Board of California (ABD)

1 More information: sustainablealmondgrowing.org/home/toolsbenefits/tabid/220/default.aspx
2 More information: almonds.com/sites/default/files/almond-irrigation-improvement-continuum.pdf
3 More information: almonds.com/almond-industry/industry-news/just-people-almond-trees-need-carbs-thrive

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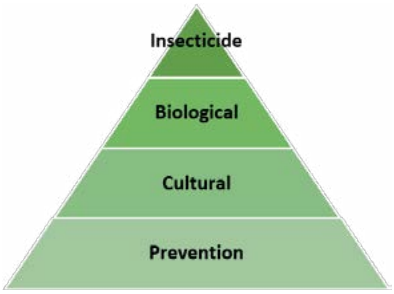
PCAs and growers know that prevention is the foundation of the "IPM Pyramid" for any pest. While a reactive tactic that also functions as a preventative measure may seem counterintuitive,



applying sprayable pheromone at any point during the season effectively prevents a significant portion of the next generation from ever existing. Preventatively reducing NOW population density also maximizes the impacts of other in-season inputs like insecticides simply because there are fewer larvae to kill.

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TIME TO CONSIDER

With spring comes a shift from helping the trees set a crop to growing/protecting what has set. Disease control can be less of an issue and insect/mite control moves into the spotlight along with delivering nutrients at the right rate, timing, and location. A drought year means adding extra emphasis on irrigation management to the list of practices to consider in March and April for many growers and PCA/CCAs.

Irrigation: The overall water picture is not good. Initial surface water allocation numbers are small to zero, and major reservoir levels are well below historical averages (see reservoir levels at: cdec.water.ca.gov/resapp/rescondmain). Even though it can be impossible to know how wells will perform in a year like this, early season irrigation planning should consider available resources for the entire season. Research results show season-long limited irrigation delivers better results than, for example, full water early followed by limited/no irrigation later in the season. Consider differences in rootstock, variety, orchard age and yield potential when determining the short- and long-term value of an orchard.

When planning the irrigation season for each orchard with your CCA, the following research based information may be helpful.

Resources/Tools: A very useful resource for irrigation planning in a drought year is the publication "Drought Management for California Almonds". Download it, free, at anrcatalog.ucanr.edu/pdf/8515.pdf.

Stem water potential (SWP), measured by a pressure chamber device (sources include: pmsinstrument.com/, soilmoisture.com/pwsc/), is the current, proven, gold standard for monitoring orchard water status. Even if not used regularly to schedule irrigation, the pressure chamber is the best tool for spot-checking other irrigation monitoring methods/technologies. Also, SWP is a more accurate measure of tree water status under saline conditions compared to soil moisture or estimating crop water use (using ET). This is a critical point in a drought year, especially where only low quality (saline) irrigation water is available. See ucanr.edu/datastorefiles/391-761.pdf for a free, detailed publication on using the pressure chamber for irrigation in almonds (and walnuts and prunes).

Research findings: One year of severe orchard water stress results in two years of major yield reduction (see table), *even if full irrigation is applied the second year.* This is because flower bud differentiation for next year's bloom occurs around harvest, and fewer flower buds differentiate under severe tree water stress. Crop loss in drought hit blocks will mostly be in lower kernel weight in the drought year, but will be due to significantly fewer nuts the next year compared to trees with good water status in both years.

Nonpareil yield per acre and kernel size count from a single year of imposed drought treatments (2009) followed by full irrigation on all treatments the following year (2010). Yields were not significantly different in Year 3 of the trial (2011). Research by Dr. Ken Shackel, UC Davis Plant Sciences Department, John Edstrom UCCE Colusa County (retired), Dr. Bruce Lampinen, UC Davis Plant Sciences Department, and Larry Schwankl, UC Extension Specialist (retired) and supported by the Almond Board of CA and Nickels Soil Lab (Colusa County).

Irrigation treatment acre-inches* in 2009	2009 Yield (lbs/acre)	2009 Kernel size (#/oz)	2010 Yield (lbs./acre)
30.8"	**2440**	24	**2260**
7.2"	**1890**	28	**1350**
3.6"	**2020**	29	**1010**
0"	**1030**	40	**320**

* Does not include 7–9" additional water from winter storage (in soil) + rainfall in-season

Almond trees are very resilient and have survived an entire season with just eight acre-inches of available water in an entire season. However, as discussed above, returning to full production will take two years after 100 percent ET available following a year of extreme drought stress.

Irrigate in the cooler hours (evening and night). This saves water vs irrigating through the day. Evaporation losses of 10–20 percent of applied water have been measured in UC research conducted in August in the Sacramento Valley. Short irrigation sets (less than six hr) lose more water by evaporation as a percent of water applied than longer sets.

Consider limiting/eliminating water use of non-crop plants. This is particularly true for sprinkler or flood irrigated orchards where irrigation water reaches orchard middles. Growing those weeds doesn't help your trees, although it may help reduce runoff and orchard access after rain or irrigation. Consult with your PCA about weed control options in row middles in micro-sprinkler irrigated orchards. For example, in a three year study, late April application of a low rate (1 qt/a) of surflan, incorporated with sprinkler irrigation, controlled summer weeds through harvest but allowed winter vegetation to grow, helping reduce winter rainfall runoff and fall equipment access. Removing vegetation in drip irrigated blocks may not provide significant water savings as drip hose (and irrigation water) usually stays in the herbicide strip away from vegetation in the row middles.

Steady water stress is better than a "feast or famine" approach. There is no "most critical time" for full water availability when water is short and so no benefit to providing more water to the orchard at any one time of the year. In a three year study testing crop yield and tree health under different irrigation strategies with good quality water, the best yields came from uniform reduction in percent applied water throughout the season. Using these results, if 60 percent of annual irrigation water budget is available, the orchard should get 60 percent of normally applied water in each set through the season. If a 100 percent water year irrigation set is 24 hours,

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then the set run time would be just over 14 hours under a strategy of 60 percent water application.

Wait, a little, before starting the irrigation season. This is especially true if water availability is limited and the goal is regular stress through the season. Current suggestions are to wait for a SWP of -1 to -2 bars below baseline before irrigating. If using soil moisture sensors to schedule irrigation, wait until the sensors show enough soil water depletion so that all water applied in the first set stays in the soil without saturating the root zone. Small, short irrigations to deliver fertilizer, especially in a drought year where the rootzone isn't saturated with spring rain, are a different story from first full irrigation.

Watch your salt(s). Limited irrigation and/or moderate to poor water quality can lead to increased root zone salinity and eventually decreased yield. The threshold for salinity yield impact in almonds is 1.5 dS/m in the rootzone (0–5'). With each 1.0 dS/m increase in salinity beyond 1.5 dS/m, yield is reduced roughly 20 percent. When needed, additional irrigation water should be added (where available) to reduce root zone salinity. Consult with your CCA about leaching requirement for a particular orchard based on irrigation water quality, soil salinity and target yield.

When planning irrigation this season, consider the long term consequences on soil and orchard health of using very poor quality irrigation water. It is possible that applying more (cheaper), poor quality irrigation water this season will cost more in yield loss and reclamation costs over time than smaller amounts of better quality water. It could also reduce land value.

To check root zone soil salinity, soil samples should be taken at one foot intervals to a depth of five feet, analyzed separately (not lumped) and the resulting salinity values averaged across the five depths to determine "root zone salinity". Consult with an experienced CCA regarding sampling sites and timings through the season.

Good salinity management can inadvertently result in poor nitrate management; see information about efficient nitrogen application in the next section.

Rootstocks differ in their tolerance for chloride, the major toxic element in saline ground water up and down the state. (Boron is a major issue on the west side, but generally not on the east side of the Central Valley.) Lovel, Nemaguard, and Krymsk 86 showed the lowest cumulative yield (4th–7th leaf) in a replicated trial assessing Nonpareil performance with different rootstocks using poor quality irrigation water (high levels of everything bad, including chloride) in western Stanislaus County. This trial was set up and is being conducted by Roger Duncan, UCCE Orchard Advisor.

Groundwater and surface water quality can change from year to year and within a year. Regular irrigation water sampling and lab analyses help inform irrigation management through the season. Including nitrate in the analysis helps with nutrient management.

What doesn't work to reduce drought stress and water use? Removing crop or heavy pruning (scaffold removal to reduce leaf area and water use) has not reduced water use in UC studies. Crop removal and heavy pruning can increase shoot growth and leaf area and so increase water use.

Nutrition: The primary nutrient concerns in almond production, especially bearing orchards, are nitrogen (N) and potassium (K), in that order. The primary goal of a fertility program is to deliver the amount of nutrient needed for the growth of crop (and the tree) as it is needed by the crop through the year. This limits waste and cost. A new best management guidelines for nitrogen in almonds was published this past winter and can be found at: almonds.com/almond-industry/orchard-management/soil-health-and-nutrients/nutrient-management.

Potassium: Most of the potassium in the trees is found in the nuts, so only limited amounts of K are needed before 3rd leaf. However, once a good crop is set early in the life of the orchard, potassium deficiency symptoms can appear (see photo) quickly if soil K is low.

Nitrogen: Orchards with at least adequate leaf N levels in summer, 2020 (greater than 2.5 percent leaf N) should

have 30 days of stored N "on board" to support bloom and early leaf out. Once 70 percent of spur leaf out has occurred, additional N inputs should begin. The exact amount applied with the first N application should be determined by application plan (how many applications will be applied?) and annual N budget (see table in this column). Roughly half of the total N demand of the orchard should be meet by the end of April. Small, frequent fertigation events ("shots") provide the most efficient N application and can be used with leaching fraction calculations to minimize N loss from the root zone. Almond trees can absorb very low levels of nitrogen from the soil solution and so can efficiently access lower concentrations of nitrate delivered in frequent, low N application rates.

The following table is presented as an example of the pattern of orchard nitrogen demand (not recommended N fertilizer rate) through the life of a representative orchard, based on 14' x 22' tree spacing, good growing conditions and Nonpareil trees. Almond orchard yield potential varies with location, rootstock, planting density and management. Please use yield data that reflects your actual orchard conditions when looking at this table and developing your own annual nitrogen budget. Data used in this table are taken from Table 2 (pg 8) of the Almond Board of California's Nitrogen BMPs (see link in this column).

Regular irrigation water quality sample analysis should include nitrate. Nitrate-nitrogen (nitrate-N) in the irrigation water is plant available. Every acre-inch of water with 1 ppm nitrate concentration contains 0.05 lb N. Water samples testing at 1 ppm nitrate-N contain 0.2 lb N in an acre-inch. The difference in N content between the two reports with the same numerical value is that nitrate is 23 percent N by weight, while nitrate-N is 100 percent N. Adjust fertilizer rates down, where practical, based on irrigation water nitrate levels. For example, in a mature 50 acre orchard, fertigation to deliver 35 lbs N/acre requires about 500 gallons of UN32 (3.54 lbs N/gal).

Orchard nitrogen (N) demand through the life of the orchard based on tree and crop demand (using 14' x 22' spacing; 145 trees/acre)

Orchard Age (year)	Total Non-yield N demand (leaves + wood)	Representative range of good yield for Nonpareil (kernel lbs/acre)	Representative crop (hull, shell & kernel) N demand based on kernel lbs/acre (lbs N/acre); crop is 6.8% N)	Representative total N demand (adding across the shaded columns) lb N/acre
1	30	0	0	30 (3 oz N/tree)
2	55	0	0	55 (4 oz N/tree)
3	65	750	51	116
4	55	1750	119	174
5	45	2750	187	232
6	40	2900	197	237
7–15	40	2500–3100	170–211	210–255
16–25	30	1800–2800	122–190	152–220

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If an acre-inch of water containing 10 ppm nitrate-N will be used in the fertigation set, then 32 gallons less UN32 can be applied. The N in the irrigation water makes up the difference. However, if there is only 1 ppm nitrate in the irrigation water, that works out to a savings of less than a gallon of UN32 and that reduction is hard to measure when setting out 500 gallons of UN32.

Reduce N and K inputs if you have reduced water availability as yield should be reduced. Excess nitrogen increases hull rot damage and the potential for nitrate leaching. When nitrate leaches, valuable cations (calcium, potassium, magnesium) go with it.

Pest Management: By March 1, mummies should be shredded using a flail mower at slow ground speed. If mummies are not broken up by the mower, navel orangeworm (NOW) may survive, increasing the population of that damaging pest in your orchard. A second pass is a good idea if some mummy nuts are intact after the first pass.

Monitoring traps for NOW (for moths and/or eggs) and peach twig borer (PTB) should be up by March 15. Given the warm weather for much of this winter and spring, early pest activity is a good bet. Check traps several times per week until biofix (first consistent trap catch) occurs and then shift to once a week monitoring. In areas with low NOW populations, Dr. Frank Zalom, UC Davis Department of Entomology, suggests using the first egg "catch" date as biofix, even if the weather cools off and the trap activity stops for a week or more. Experience suggests the first egg catch date is a better indication of the start of NOW activity than later dates. Consult with your PCA regarding NOW control strategies for the remainder of the season.

Look for leaf footed bug (LFB), early, as alternative hosts may dry up sooner than usual in a low water year. Information o monitoring and control practices for leaf footed bugs are available at: ipm.ucanr.edu/agriculture/almond/leaffooted-bug/.

If trees are water stressed, look for webspinning mites before the usual May start for scouting for this regular pest. Check for beneficial insects and mites at the same time. The up and down temperatures of spring time can help six-spotted thrips and/or predacious mites keep spider mite populations under control heading into summer. Mite scouting information and data sheets are available at: www2.ipm.ucanr.edu/agriculture/almond/webspinning-spider-mites/.

If you haven't already, consider marking your calendar to work on ant monitoring/control starting in June (and/or call your PCA to talk about ant control ahead of harvest). Ant damage at harvest can be costly, especially when slow drying conditions extend the time between shaking and pickup. Different ant baits deliver different control patterns over time. Use of a quick knockdown bait maybe the best approach for a one-harvest, self-fertile block, while a Nonpareil/Monterey orchard might benefit from a long acting product such Clinch® or Esteem®. Check with your PCA regarding strategies, materials and timing for ant management.

Wild fires and valley smoke may again be an issue this summer, increasing the need to pay attention to pests (rust, scab, anthracnose, alternaria, and mites) that can increase leaf drop at harvest and further slow nut drying. Spraying before it rains gives much better disease control compared to after a rain. Consult with your PCA regarding material selection and rates.

Vertebrate Control: Regular attention to rodent pests such as gophers, voles and ground squirrels is needed to effectively manage these damaging pests. Fumigation with phosphide gas (a restricted use material) is effective on gophers and ground squirrels in the spring. Once the soil begins to crack, the fumigant will "leak" out of the tunnels and control will be reduced or lost. Keep weeds controlled in the tree rows of young orchards to reduce vole habitat and damage. More information on gopher control is available at: ipm.ucanr.edu/pmg/r105600211.html and for ground squirrel control see: groundsquirrelbmp.com/biology.html.

Weed Control: Controlling weeds saves water. This is especially true in young blocks where plenty of sunlight reaches the orchard floor. Preemergent herbicides, applied to bare soil, can help reduce the number of herbicide applications needed in young blocks. See information on young orchard weed management at: ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=39245. Visit ipm.ucanr.edu/agriculture/almond/susceptibility-of-weeds-in-almond-to-herbicide-control/ for tables showing weed susceptibility to herbicides labeled in almond tables. Note: Paint does not protect trunks of young trees from herbicide damage, so preemergent herbicides applied ahead of carton removal delivers long lasting weed control without damaging trunks.

Final Thoughts: As I write this, there is valley rain in the forecast and travel advisories for snow in the mountains. Perhaps the water situation will improve, even just a little.

Franz Niederholzer, UCCE Farm Advisor, Colusa and Sutter/Yuba Counties

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