Topics in Subtropics Newsletter

University of California Cooperative Extension

Fresno, Kern, Madera, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara,Tulare,&Ventura Counties

News from the Subtropical Tree Crop Farm Advisors in California

Volume 17, Fall 2018

TOPICS IN THIS ISSUE

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- Dr. Philippe E. Rolshausen, UCCE Specialist, University of California, Riverside
- Dr. Mary Lu Arpaia, UCCE Specialist, University of California, Riverside
- Dr. Ben Faber, UCCE Advisor, Ventura County
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California Citrus Network: an online forum to facilitate communication and information exchange regarding California citrus

Dr. Greg W. Douhan, UCCE Area Citrus Advisor, Tulare, Fresno & Madera Counties

The University of California Cooperative Extension office in Tulare County, is launching a new website to facilitate exchange of information among individuals involved in citrus production in California, from growers to academics. The ideology within this forum is to allow people within the field to exchange information in real time. It has been my personal observation, for example, that many PCA's have their own small network of individuals that they rely on for information regarding specific issues or problems encountered in the field and often only talk amongst themselves. It is my belief that having an internet-based forum would allow individuals to broaden this 'in house group' to all individuals involved in the industry to better communicate ideas, information, and concerns regarding various aspects of citrus production. The forum site is set up to deal with the various citrus regions; SJV, Desert, Coastal, Southern Interior, and Sacramento Valley. The specific areas set up thus far are; Pests, Diseases, Irrigation, Fertility, Weeds, Harvesting Issues, and Post-Harvest Issues (**Fig. 1**). Two additional sections have also been set up for discussions: a general citrus area, and a posting area dealing with all issues related to ACP/HLB. Users will also be able to upload pictures taken from the field when posting a question (**Fig. 2**).

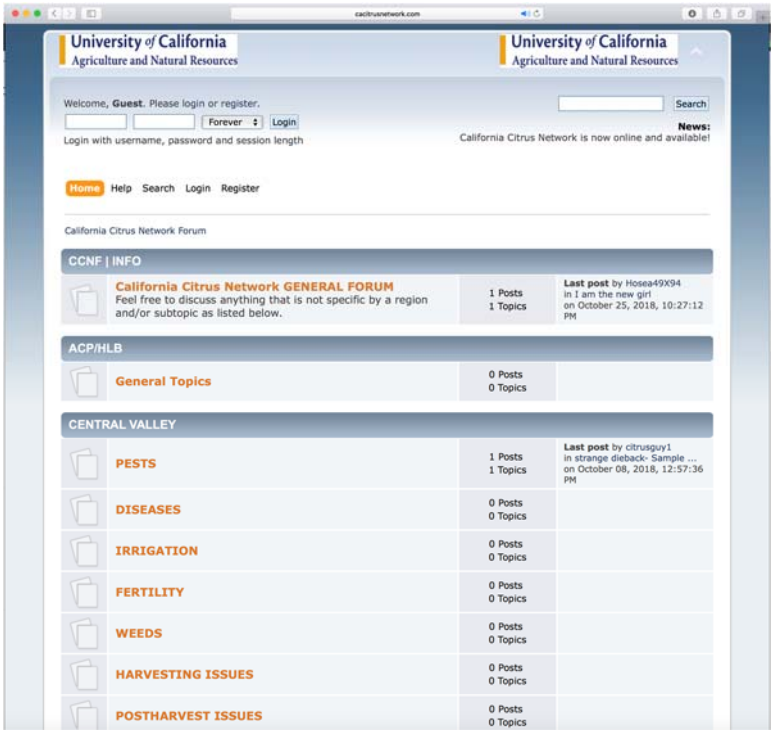

Figure 1. Screen shot of the main forum page on the http://cacitrusnetwork.com/ website. In this simple example, citrusguy1 is asking a question (expanded in Fig 2) regarding something he is seeing in the field within the central valley growing region. Note, if the user scrolls further down the page, each additional citrus growing region is also represented with the same subcategories for potential forum discussions.

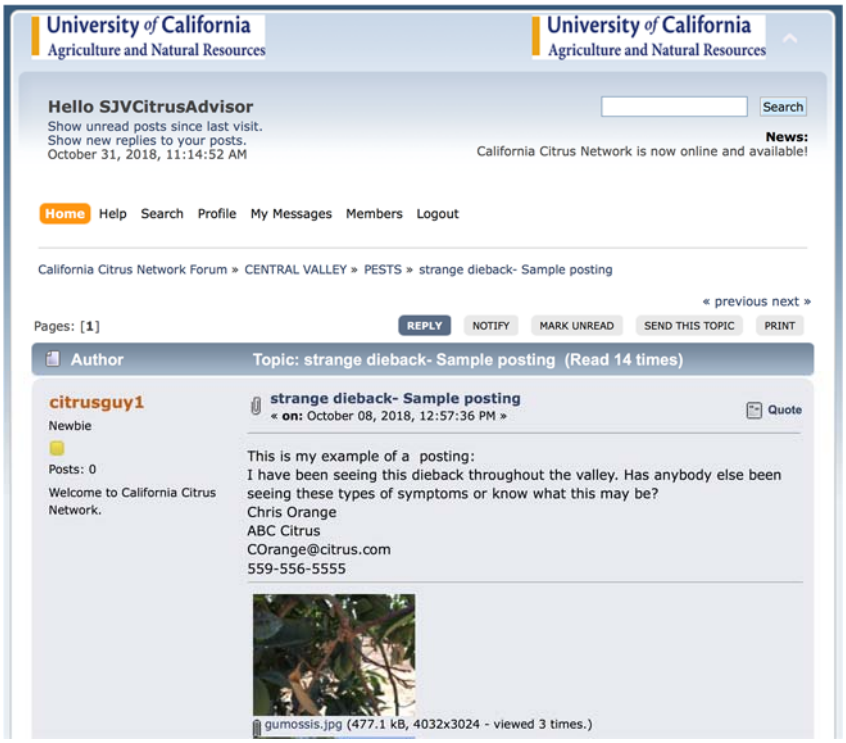

Figure 2. Example posting of citrusguy1 including text and a picture of the issue he is observing in the field.

The utility of this forum is that a person has the ability to make an observation in the field, snap a couple of pictures of what he/she sees, and easily post this information to the forum where the citrus community at large could view and respond to start a thread on the topic. This could be done out in the field using a smart phone or tablet or from an office computer at the user's leisure. The success of this network will rely on individuals in the citrus industry to utilize this new important tool. The site is up and running but is certainly in the beta-testing phase. Therefore, having individuals using the site and reporting any problems or making suggestions on making it better is highly desirable. If the forum is successful, support will be sought to produce an app for cellular phones to make the process easier than a web-based forum. For further information or ideas of how this site can be improved, please contact Greg W. Douhan, SJV Citrus Advisor, UCCE, Tulare, California: gdouhan@ucanr.edu

High Density Planting for Avocado Production: A Chilean Perspective.

Dr. Philippe E. Rolshausen, UCCE Specialist, University of California, Riverside.
Dr. Mary Lu Arpaia, UCCE Specialist, University of California, Riverside.
Dr. Ben Faber, UCCE Advisor, Ventura County.

California avocado growers face several challenges to maintain a high production level and remain competitive in the marketplace. Rising price of irrigation water, salt toxicity, shortage of qualified labor and pest and disease issues are some of the major challenges that limit the profitability and competitiveness of our industry. To remain profitable, growers must reach the highest productivity with the lowest cost of

production per lbs. One business model is to increase productivity per acre by planting trees at a higher density. This has been the paradigm for several crops, although one could argue that the challenges are greater for avocado, because of the tree growth habits and the lack of dwarfing rootstocks. Nonetheless, several countries have shifted the industry standards towards higher planting density (**Fig. 1**). In this article, we propose to highlight the many advantages of high-density planting (HDP) for avocado production, a practice largely adopted by the Chilean avocado industry. Dr. Mary Lu Arpaia (MA) and Dr. Phillipe Rolshausen (PR) visited 6 orchards with different planting densities, under the management guidelines of Francisco Mena Volker and Juan Enrique Ortuzar, two consultants for Gama and Agricom, respectively. In addition, we (MA & PR) had the opportunity to visit with Dr. Ben Faber, UC Cooperative Extension Advisor from Ventura County, three California orchards that are evaluating high density planting. In light of our overall observations, we discuss some of the hurdles for implementing this strategy at a large scale under current California standard practices.

There are about 70,000 acres of planted avocados in Chile located in a range of latitudes similar to those in California, but in the southern hemisphere. Chile has pushed for higher levels of production efficiency by increasing tree density and lowering labor costs. Planting density at 7.5x7.5 (774 trees per acre) is considered standard in Chile today but some of the highest densities we visited were at 4x4 (about 2700 trees per acre; **Fig.1**). At this spacing, trees are very crowded, compact and short compared to standard California commercial standards. Tree height is managed early on at the establishment of the orchard by removing water shoots, tree topping and cutting side branches to reduce shading effects (**Fig.2**). Pruning is commonly done in spring right after harvest and then in fall to minimize vegetative growth during summer and early autumn, which can affect flower bud induction. Failure to follow these guidelines implies that severe tree pruning will need to be done later on, which in turn has a short-term negative impact on productivity. But with tree heights at 6-8 feet, fruit picking is more cost effective. At 5- 6 cents/lbs. (vs. 25-30 cents/lbs. for CA), pickers can make $50 per bin (vs. $80-$100 per bin in CA) and at this attractive price owners can secure and retain their workforce. At an ultra-high planting density (4x4), trees come quickly into production (20,000 lbs. per acre, two years following planting in one orchard) with yield expectations of over 30,000 lbs. per acre at full production after 4 years (**Fig. 3**). At lower planting densities, maximum productivity is reached after 6 years with yields of at least 10,000 lbs. per acre.

In HDP, managing tree vigor is a key and growers have adopted several practices. Girdling, selecting rootstocks with low vigor and applying plant growth regulators are among some of the strategies adopted. Application of commercial PGRs (plant growth regulators) or PBRs (plant bio regulators) inhibiting gibberellin production is standard. A PGR foliar spray in the spring at flowering stage increases fruit size in the “on” flowering year and yields in the “off” flowering year. A second PGR application through the irrigation system in late spring is also recommended to manage tree vigor. Phenotypic traits of treated trees include bushier flush with short internodes and downward growth habit, with increased branching. One additional advantage for using a soil application of PGR is that it increases tolerance to salt and allows growers to reach higher production under saline water conditions. About 60% less water is applied at this time to force the trees to uptake the PGR. Once again timing of application is critical because some PGRs stays in the soil for 140 days and residual product at fall could have an effect on flowering the following spring. Some growers also girdle branches to reduce vigor. Girdling starts in year 3 of the orchard on established trees. It is meant to limit tree vigor by increasing the number of flowers and fruits per girdled branch. Finally, planting varieties grafted on low vigor West Indian rootstocks is sometimes recommended (although some other West Indian rootstocks are known to also increase vigor) as trees are shorter with less flushing. In addition, those rootstocks showed increased tolerance to salt and drought as compared to the industry standard Mexicola.

Traditionally in California growers planted at a 20 x 20 spacing (109 per acre), and ideally thinning when canopy closure approached. Closer spacings have been used, especially on steep slopes where trees tend to grow smaller, but with varying success. Under California conditions, HDP has displayed different optimal planting densities (300-500 trees per acre) in part because of limited number of cost-effective strategies to

manage tree vigor. PGR treatments are not registered and growers are mostly left with pruning, girdling and selection of varieties with lower vigor such as Gem or Lamb Hass. Trees are pruned once or twice a year, in the winter and after picking depending on planting densities and tree vigor and market conditions. In addition, girdling is implemented at the first or second year following planting, at an earlier time than in Chile. Yield at 18,000lbs per acre in a 6x15 orchard (484 trees per acre) was visited in CA and were comparable to those for similar planting densities in Chile. However, California growers do not plant at higher densities and one can argue that the absence of registration for a commercial PGR may be a limiting factor. All of the growers we visited unanimously said they would consider PGR if it were registered for California avocado production and we could certainly speculate about the benefits and implications for our industry. Higher productivity per acre with higher tree density, lower labor costs with less pruning and quicker and safer fruit picking because of smaller trees, and increased tolerance to salt especially in areas that use reclaimed irrigation water would increase our grower's competitiveness in the marketplace.

This article originally appeared in California Avocado Commission's "From the Grove, Fall 2016" edition.

Figure 1. An example of high-density planting of avocado production in Chile.

Figure 2. Ultra High Density Planting (4x4; 2700 trees per acre) in a Chilean orchard (Mexicola x Hass) planted in 2013. Look how crowded, compact and shorts the trees are next ML Arpaia. Production in 2015 was 17,000 lbs. per acre.

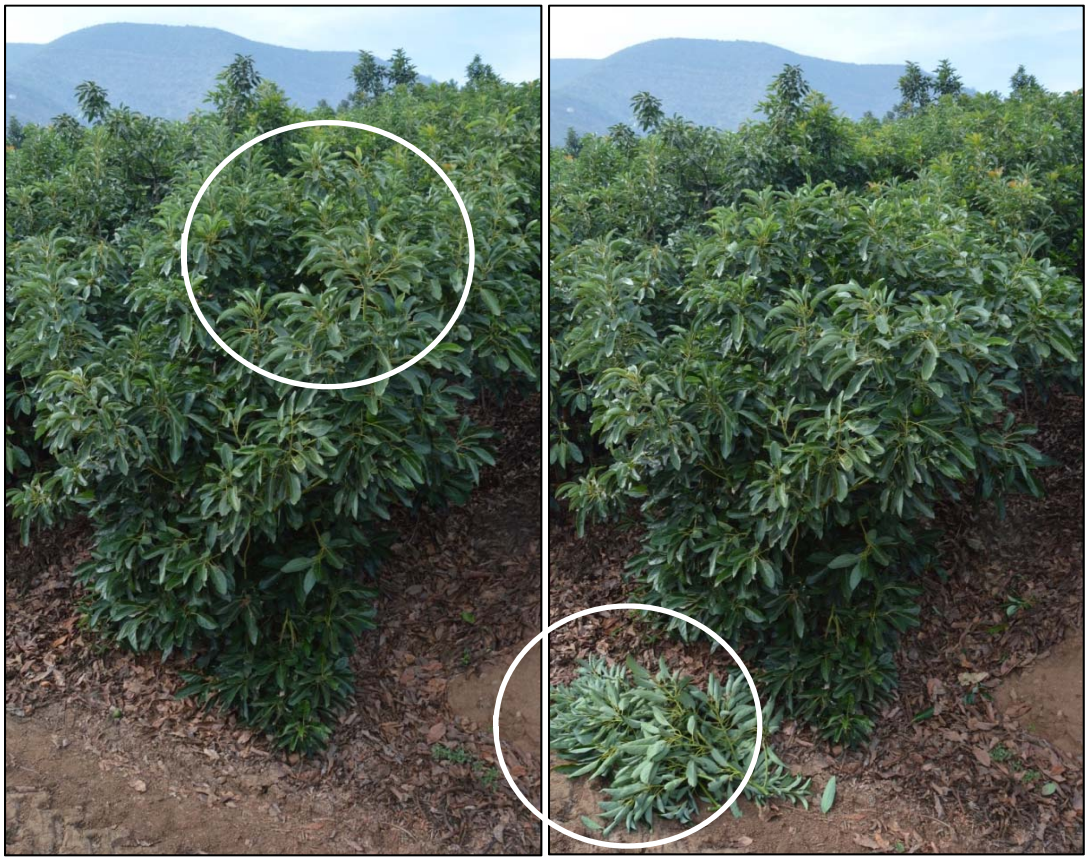

Figure 3. Post-harvest hand pruning of lateral shoot in a HDP orchard (Mexicola x Hass; 7.5x7.5; 700 hundred trees per acre) to keep tree height under control and limit shading effect.

Avocado Brainstorming 2018

Dr. Tim Spann, Ph.D., Research Program Director, California Avocado Commission

The Avocado Brainstorming meeting was held May 28 – June 1, 2018 in Tzaneen, South Africa. Tzaneen, in Limpopo Province in northeastern South Africa, is the heart of South Africa's avocado industry. This is a warm subtropical climate with average annual rainfall > 40 inches. There also is significant production in KwaZulu-Natal province in the southeast, which is a cooler climate, and Western Cape province, which is a warm dry climate like California.

The South African Industry

The South African avocado industry is currently about 30,000 acres and is growing by about 2,500 acres annually. 'Hass' and 'Hass'-like ('Lamb Hass', 'Maluma', 'Carmen', 'Gem') cultivars make up the largest percentage of South Africa's production at about 40 percent, while 'Fuerte' is a close second at just under 40 percent. Varieties like 'Pinkerton', 'Ryan', 'Reed' and 'Edranol' make up the balance of the country's production. Europe, is South Africa's largest market, and as their preference for 'Hass' has grown the South African industry has begun to shift its production away from 'Fuerte' and other greenskin varieties. Eastern Europe and the United Kingdom absorb about 90 percent of South Africa's exported fruit, with Western

Europe and the Middle East absorbing the balance. Efforts are underway to gain access to the United States, Japan and China.

This was my first visit to South Africa and I was surprised at the level of sophistication in their industry. Nursery production practices, planting practices and grove management are top notch, and their harvesting, packing and shipping protocols are rigorous. Unlike the California industry, the South African industry is dominated by a couple of large, vertically integrated companies — Westfalia, Allesbeste and ZZ2. For more details about the South African avocado industry, please see the article about Allesbeste in the Summer 2018 issue of *From the Grove,* and the articles about Westfalia, and 'Maluma' and 'Bounty' in this issue.

Brainstorming

There were about 80 attendees at this, the fifth, Brainstorming meeting, representing 11 countries. This was the first time the meeting was not held in conjunction with the World Avocado Congress. South Africa had the largest representation at the meeting with 30 participants, followed by 18 participants from the U.S. The meeting program was divided into eight sessions over 2.5 days, with an additional half-day tour of Allesbeste Nursery and Groves, and a full-day tour of Westfalia Fruit.

The eight session topics were:

1. Providing for the Consumer: Health, Safety, Flavor
2. New Technology to Improve Avocado Production
3. Challenges to Productivity: Diseases
4. Challenges to Productivity: How the Tree Regulates Return Bloom and Crop Load
5. Where Theory Meets Practice
6. Challenges to Productivity: Genetics, Genomics and Biotechnology
7. Meeting the Challenges of the Future
8. Tying the Loose Pieces Together: Planning for the Future

Notable Research Reports

Dr. Aureliano Bombareley, Virginia Tech University, reported on the accomplishments of an international group working on the avocado genome. He reported that the group will have an annotated genome published by the end of 2018, but if everything goes smoothly it could be published as early as September. The avocado genome was previously reported to have been sequenced by a Mexican group, but it has never been published. A Chinese group recently published an avocado genome, but it is only half the expected size, so it is likely not a good genome.

Having the avocado genome does not, in and of itself, provide anything real and tangible for growers. However, researchers will be able to search the genome, when published, for orthologs — genes with similar sequences to known genes of known function in other species — and thereby begin to identify specific avocado genes and link them to functions. Knowing which avocado varieties/races/species possess different traits can allow breeders to have more focused selection programs, or possibly allow for gene editing through any number of biotechnology techniques.

Dr. Iñaki Hormaza, Institute of Subtropical and Mediterranean Horticulture in Malaga, Spain, updated the group on work he has been doing to understand why so many avocado flowers do not set fruit. With laborious hand pollination avocado fruit set is barely 1 percent, and is well under 1 percent naturally. Dr. Hormaza has been leading a group that has developed a technique to assess the carbohydrate storage (energy) of individual flowers without removing the flowers from the tree. This allows them to know the energy status of a flower and then track that flower to see if it sets fruit. They've conducted their studies with both natural pollination and hand pollination. They have collected very convincing data that suggests the fruiting potential of an individual flower is directly correlated with that flower's carbohydrate storage

— the higher a flower's carbohydrate storage, the greater likelihood that flower will produce a fruit. The next step in this work will be to understand what, if any, management practices can be implemented to increase overall flower carbohydrate storage and if this leads to greater fruit set.

In the session concerning new technology to improve avocado production, the topics of remote sensing, image analysis for grove mapping, and trellising for high density plantings were discussed. Remote sensing continues to hold a lot of promise for a lot of different applications but has yet to deliver on many of these. There are many different systems around the world using remote sensing — specifically NDVI, normalized difference vegetation index — for estimating crop water status and calculating crop evapotranspiration. But promises for systems that can detect disease or nutrient deficiencies have still not had much success outside the laboratory and uniform row crop situations.

Zander Ernst from Allesbeste discussed the use of aerial image analysis for grove development. Allesbeste, with their in-house IT department, recently developed a new block on a steep slope. The terrace layout and specific grading requirements were all computed using aerial images and computer software. This information was then used with GPS equipped grading equipment to create the desired contours that were calculated to maximize row spacing and use of the site.

Zander also presented on Allesbeste's trials using vertical and tatura (Y-shaped) style trellises for growing avocados at high density. In their trials to date, they have seen up to a 137 percent yield increase on vertical trellises and up to a 321 percent yield increase on tatura trellises. They are currently planting larger scale (several hectares) trials of the tatura trellis system to determine its commercial feasibility.

The disease session included updates on laurel wilt, as well as several other emerging pathogens from around the world. Noelani van den Berg, University of Pretoria, discussed the latest information concerning a disease known as white root rot (WRR) caused by the pathogen *Rosellinia necatrix*. This is a root pathogen similar to phytophthora root rot but it is much more aggressive. It is known to occur in Israel and Spain and was recently confirmed in groves in the Nelspruit growing region of South Africa. There is an ongoing breeding program in Spain trying to develop WRR resistant rootstocks. They currently have 22 selections that are moving into field trials and they have identified 250 different genes that may play a role in WRR resistance.

Another pathogen that is emerging, particularly in humid subtropical and tropical regions of Australia, is called brown root rot (BRR), caused by the pathogen *Phellinus noxius*. This pathogen has a very wide host range (>200 species) and is very persistent. In Australia, they have been able to recover the pathogen from decaying root pieces in the soil 4 years after tree removal. BRR can be easily spread from tree to tree through root grafts or by using wood chips from infected trees as mulch.

Summary

As I am still relatively new to the avocado industry, meetings like this are a great way for me to place faces with names of various people whose work I read. For me, the highlight of the meeting was meeting Nigel Wolstenholme, retired professor from the University of KwaZulu-Natal. Nigel was a prolific avocado researcher and is co-author, along with Tony Whiley (Australia) and Bruce Schaffer (Florida), of the avocado bible — *The Avocado: Botany, Production and Uses* — now in its second edition. Nigel wrote and presented a fantastic piece at the meeting wrap-up about planning for the future. In it, he highlighted what he sees as the challenges to the world avocado industry (and agriculture in general) looking ahead to 2030 — commoditization, changes in land ownership, sustainable farming and safer food trends, low average yield, alternate bearing, phytophthora root rot, too few elite cultivars and rootstocks, and a lack of best orchard management practices.

Was this a successful meeting? This is a difficult question to answer and it depends, to some degree, on who is answering the question and what they wanted to gain from the meeting. For me, personally, yes, the meeting was a success. I made some great contacts and I learned about who is doing what in avocado research around the world. I took copious notes that I will be continuing to sift through for months to come.

That said, the Brainstorming and its structure poses some challenges. The Brainstorming was modeled on the Gordon Research Conferences (GRC). GRCs were started in the 1930s by Dr. Neil Gordon at Johns Hopkins University with the intent "to bring together a group of scientists working at the frontier of research of a particular area to discuss, in depth, all aspects of the most recent advances in the field and to stimulate new directions for research." GRCs are by invitation only and have several guiding principles, chief among them being "no publication." This policy is to ensure that the researchers present feel free to share ideas within a close group and that conversations will remain private.

As Avocado Brainstorming has evolved, and organizations like the California Avocado Commission and the Hass Avocado Board have become sponsors, the no-publication policy becomes difficult to manage since the funding agencies expect a report in return for their financial support. In addition, the invitation-only policy artificially restricts who attends — some don't attend on principle because they don't believe in the invitation-only policy, and others simply aren't invited.

Lastly, Brain storming really has been continuing almost exclusively because of the drive from Dr. Mary Lu Arpaia. And I wonder about the long-term sustainability of the meeting and who else in the world avocado industry is willing or able to pick up such a monumental task? In other words, is this meeting self-sustaining? This is the greatest challenge facing the Avocado Brainstorming meeting and its long-term success.

Meet our new subtropical crops specialist at UC Riverside

Dr. Rivera started as an Assistant Cooperative Extension Specialist at the University of California, Riverside campus in July 2018. Her responsibility is subtropical fruit crops with a special focus on citrus and avocado. This is her first time working in west coast agricultural systems. She first started working in agricultural entomology in her home state of Delaware. She double majored in plant science and entomology as an undergraduate at University of Delaware. She has worked in many systems, but the focus of her degrees was on tobacco (M.S. NC State), highbush blueberry (PhD, Rutgers), peaches (post-doc Rutgers), and citrus and avocado in Florida as a post-doc at University of Florida before moving to California to take this position. In Florida, she worked on vector borne diseases with a focus on Huanglongbing in citrus and Laurel wilt in avocado. Both of these diseases are threats to California agriculture. She hopes to translate her previous experiences and expertise into applied research that can prevent the spread and assist in the management of these diseases. She is actively seeking grower collaborators for on-farm research and looks forward to working with growers to help solve their problems. Please feel free to contact her with your research ideas and input. Her contact information can be found below:

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Fall Citrus Meeting Notice Reminder:

Friday, November 16, 2018
8:30 AM – 1:00 P.M.
Tulare County Agricultural Building
4437 S. Laspina St.
Tulare, CA 93274

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Greg Douhan
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