Field Notes
San Joaquin County
February 2018

University of California
Agriculture and Natural Resources

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The Report from Pennsylvania

In December, I returned from a six-month sabbatical leave from UCCE, which I spent at Penn State University in central Pennsylvania (see pictures on page 2). There, I worked on several vegetable disease research projects and helped out in their Plant Disease Diagnostic lab. The primary research project with which I was involved was on management of center rot of onions, a bacterial disease caused by *Pantoea* spp. (formerly named *Erwinia*). We evaluated the susceptibility of different sweet onion varieties, as well as assessed how disease severity was impacted by different colors and types of plastic mulch, various nitrogen fertilization rates, and chemical control programs. Other projects were on powdery and downy mildews of cucurbits, looking at pathogen sensitivity to fungicides among pathogen populations in different regions of the state.

Through my visits to farms and my time in the diagnostic lab, I also became acquainted with a number of pests and diseases that we thankfully don't see in California:

- Allium leaf miner, which has recently invaded Pennsylvania and is quite damaging to onions (see http://ento.psu.edu/extension/vegetables/pest-alert-allium-leafminer)
- Foliar fungal diseases of tomato: Septoria leaf spot (*Septoria lycopersici*), Leaf mold (*Passalora fulva*), and early blight (*Alternaria solani*). Late season is really rough on the tomatoes.

Due to the frequent summer rains and moderate temperatures, tomato growers in PA also face more severe pressure than we do here from foliar diseases such as late blight, bacterial speck and spot, and anthracnose fruit rot of tomato. In their favor, they have little to no problem with viruses, Fusarium wilt, or blackmold fruit rot, and only rarely see powdery mildew in tomatoes. It just goes to show how much of a difference climate makes in determining disease pressures.

Vegetable farming in PA also differs considerably from California in many other respects besides diseases. The majority of vegetable farms and fields are small, and a great many of the vegetables are farmed with horses (by so-called "plain sect" - Amish and Mennonite - farmers). Much of the produce is sold through regional produce auctions, bustling places great for watching both produce and people (and horses!).

There is a tomato processor in central Pennsylvania, and much was familiar to me about the process of harvesting, grading, and processing. Major differences are the cannery tomatoes are grown on the flat and with either surface drip tape or no irrigation. The fresh market tomatoes are staked and many are grown in high tunnels. Really great people, beautiful farms and barns, and no, it is not as humid as you all warned me it would be! Other personal highlights for me were the dramatic summer thunderstorms and rainbows, the remarkable history of the mid-Atlantic region, the beautiful landscapes, the fireflies (they call them lightning bugs), learning about the plain sect communities, meeting new research colleagues, and making new friends.

Now I am back and am planning local field trials and projects. I'm continuing to work on evaluations of grafted plants in both fresh market and processing tomatoes. I'm also continuing to support the Geisseler lab at UCD that is developing a nitrogen and irrigation online decision support tool for processing tomatoes. If you are interested in testing out a new, free software program that provides site-specific recommendations, let me know! I will also be working with campus-based plant pathologist, Cassandra Swett, on Fusarium wilt race 3 in tomatoes, surveying local fields looking at other crops, weeds, and resistant varieties to see to what extent they support the growth and survival of the pathogen. And lastly, if you see TSWV in a resistant tomato variety, please let me know. Resistance-breaking strains have been reported from other areas, including eastern Contra Costa County, and they could be present here as well.

Brenna Aegerter, Vegetable Crops Farm Advisor

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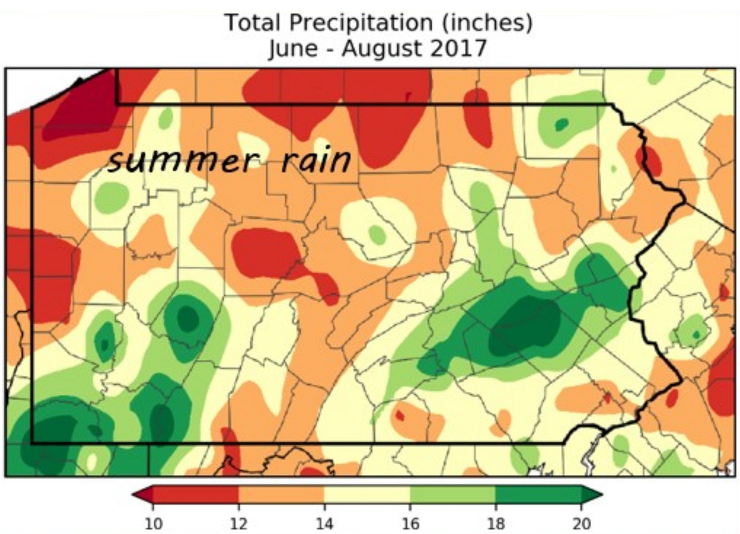
typical farm with onions,
field crops and a small dairy


leaf mold
of tomato


stone
farmhouse
built in
1819


center rot
of onion


Total Precipitation (inches)
June - August 2017
summer rain
10
12
14
16
18
20


processing
tomato trial


downy
mildew of
cucumber


processing tomato
field at harvest time

Effects of Medusahead on Beef Cattle Gains

Livestock and Natural Resource Advisors, Specialists, and faculty have been researching Medusahead (an invasive grass with low grazing quality) for many years now. We know it reduces carrying capacity on rangelands, creates a thatch that can become a fire hazard, and reduces the diversity of plants on rangelands to the extreme monoculture of Medusahead in some locations. We have also found many different management options to control Medusahead, all varying in cost, amount of effort required, and level of control. With seeds living in the seedbank up to three years, a plan of attack needs to be made, with more than a one-time treatment applied. Research that is just coming to completion at the Sierra Foothill Research and Extension Center provides a look at the cost of Medusahead invading rangelands and is summarized here.

Unlike other projects where we selected a control option (or two) and applied it to the existing Medusahead cover, this project manipulated the amount of Medusahead, in some cases planting more Medusahead to achieve the desirable percent of cover for each pasture. Prior to the grazing portion of the project, the amount of Medusahead cover was either reduced by using grazing, fire, seeding, or herbicides, or the amount of cover was increased with seeding. The pastures ranged from 1-50% Medusahead, levels that are pretty representative of rangelands in our area.

A year after Medusahead cover targets were reached, the 5-acre pastures were stocked with six steers, each weighing about 650 pounds. Pastures were grazed from March to May, and stocking rate was adjusted so that equal utilization was reached in each pasture, with a target of 800 lb/ac of dry matter left.

While average daily gains (ADG) were not affected by the percent of Medusahead, ADG were higher in March than April (4.2 lb/animal/day compared to 3.1 lb/animal/day). Typically, quality is better on annual grasses in March, prior to grasses setting seeds, so this makes sense, even with Medusahead at higher levels. In the vegetative stage, we know from previous work that Medusahead is palatable and has similar crude protein levels as more desirable grasses. However, stocking rate was found to be negatively affected by Medusahead. The more Medusahead in the pasture, the lower the stocking rate. We found, on average, for every 10% increase in Medusahead, there was a decrease in gains over 30 lb/ac over the grazing season. To calculate a dollar value, we used the price 800-900 lb steers were selling for at time of shipping, which was $1.19. Using this value, for every 10% decrease in Medusahead, there could be an associated $38 more per acre market value. Most of the treatment cost on a per acre basis will be that or less, so it pencils out to control Medusahead on your ranch if you are able to take advantage of the increase in carrying capacity.

If you have any questions about Medusahead control on your ranch, please give me a call so we can talk about your particular ranch and what management options might work better for you and your operation.

Theresa Becchetti, Livestock and Natural Resource Advisor
Stanislaus and San Joaquin counties

Announcements / Calendar of Events

Fresh Market Tomato Production
Date: Wednesday, February 28, 2018
Time: 9:00am-12:00pm, followed by lunch
Pea Soup Andersen's in Santa Nella
(I-5 & CA-33/Santa Nella Blvd.)
Contact: Brenna Aegerter, 209-953-6114 or bjaegerter@ucanr.edu
Please RSVP if you plan to stay for lunch!

Quad County Walnut Institute
Date: Monday, March 5, 2018
Time: 7:30am-12:00pm
Robert J. Cabral Agricultural Center
2101 E. Earhart Ave., Stockton, CA
Contact: Kari Arnold, 209-525-6800 or klarnold@ucanr.edu

Golden State Dairy Management Conference
Date: March 29-30, 2018
Time: 8:30am-4:15pm on March 29 and 8:30am-12:00pm on March 30
Robert J. Cabral Agricultural Center
2101 E. Earhart Ave., Stockton, CA 95206
Contact: Jennifer Heguy, 209-525-6800 or jmheguy@ucanr.edu
See flyer on page 4.

Golden State Dairy Management Conference

March 29-30, 2018
UCCE San Joaquin County
Robert J. Cabral Ag Center
2101 E. Earhart Ave.
Stockton, CA 95206

University of California
Agriculture and Natural Resources

California Topics for California Dairies
Our speaker line-up includes University of California Farm Advisors, Specialists, and Dairy Faculty on topics relevant to California dairying.

Who should attend
Dairy producers, nutritionists, veterinarians, and other members of allied industry who are interested in topics related to dairy production in California.

Continuing Education
ARPAS and CCA credits requested.

For more information, including the agenda and to register, visit our website:
http://ucanr.edu/sites/CAdairyconference

For more information about the program, please contact:
Jennifer Heguy, UCCE Farm Advisor - jmheguy@ucdavis.edu or (209)525-6800
Betsy Karle, UCCE Dairy Farm Advisor - bmkarle@ucanr.edu or (530)865-1156
Deanne Meyer, UCCE Waste Management Specialist: dmeyer@ucdavis.edu

Sorghum Seeding Rate Trial Results

The purpose of the Delta sorghum seeding rate trial was to better understand optimal seeding rates for grain sorghum grown in the Sacramento-San Joaquin River Delta. While such information exists for Midwest sorghum production, applied information is lacking for California, and more specifically for the Delta. This information is important because sorghum has similar growth habits as corn and is sometimes grown as a substitute for corn because of its tolerance of drought and low-input conditions. In the United States, sorghum is used in a wide array of feedstocks for biofuels, pet foods, dairy, cattle, pork and poultry feed, and more recently as a gluten-free cereal grain for human food systems. This article summarizes the 2016-17 trial results, and the full report is available from www.ucanr.edu/sites/deltacrops. (See "Corn and Sorghum" tab.)

The trial took place during the 2016 and 2017 growing seasons on Tyler Island in Sacramento County. In 2016, the plot was established on a Rindge mucky silt loam, and in 2017, the plot was established on a Gazwell mucky clay. The 2016 trial was planted on May 20th, and the 2017 trial was planted on May 25th using a cone planter. Seed was planted approximately 2 inches deep. We used the grower's varieties, which were white sorghum varieties having 16,000 seeds/lb and 85 percent germination, according to the labels. Five seeding rate treatments (5, 6, 9, 12, and 15 lb/acre) were tested. Each plot consisted of four rows (30-inch row spacing) that were approximately 50 feet in length. The previous crops in the fields were wheat (2016) and corn (2017). The fields were managed similarly in both years. Subsurface irrigation by "spud ditch" was employed twice. Spud ditches were dug approximately 60 feet apart. The fertility program was 35 gallons/acre of 8-24-0 with ½ percent of zinc at planting. The field was cultivated one time, and bromoxynil and atrazine, plus adjuvant were applied for post-emergence weed control in mid-June. The plots were harvested on November 14, 2016 and October 12, 2017 using a research combine, harvesting the center two rows from the four-row plots.

The seeding rates are expressed as plant populations in Table 1. The number of sorghum seeds per pound is highly variable across varieties. For this reason, when determining seeding rates, growers should first determine their desired plant population. Stand counts were made as the number of plants per 10-foot row length approximately two weeks and one month after planting. The counts were scaled up to plants per acre. Across both years, stands generally decreased from the first count date to the second. Stand counts were lower in 2017 compared to 2016, but this did not translate into lower yields. Weeds were also counted in the month after planting (data not shown), but overall weed pressure was very low in both years.

Sorghum bloom occurs when at least half of the panicle is shedding pollen. There were no differences in the number of days to bloom among treatments in either year; however, there were differences among treatments in the other maturity characteristics (data available in the full report). In both years, plants in the higher seeding rate plots were taller and/or had longer panicle exsertion (the length of the stem from the top leaf to the bottom of the panicle), suggesting that at higher densities, plants were competing with each other and growing longer internodes. In both years, panicles were longest in the 5-lb seeding rate. There were no statistical differences in grain moisture at harvest in either year. In 2016, when harvest occurred later in the season, grain moisture at harvest averaged 17.9 percent across treatments. In 2017, grain moisture at harvest averaged 12.3 percent across treatments. In 2017, the weight of 1000 seeds was also analyzed to understand whether certain treatments were producing heavier seeds. We found that the seed of the 6-lb rate had the heaviest weight and was significantly heavier than the 12-lb rate but not different from the other treatments.

While there were no statistically significant differences in yield across treatments in either year (Fig. 1), the take-home message of the trial is that there appears to be no benefit to planting the highest seeding rates. In both years, the trend was for the 15-lb seeding rate to have the lowest yield. In 2016, there was a lot of variability in the data. There was a trend for the 9-lb treatment to have higher yield; however, we suspect this was due to the experimental design. In 2016, by random chance, there were several 9-lb treatment plots next to the spud ditches, which were exterior to the experiment on both sides. For this reason, the 9-lb treatment may have been inadvertently favored with better moisture conditions. To correct this, the experimental design was improved in 2017 in order to better control field variability in the data analysis. The 2017 yields were consistent across treatments, around 7000 lbs/acre. The 2017 results best illustrate how planting the higher seeding rates provided no yield benefit, yet would incur a higher seed expense. We recognize that growers will need to consider site characteristics, like weed or wireworm pest pressure, when determining optimal seeding rates; nevertheless, this research indicates that good yields can result from seeding rates of 5 or 6 lb/acre (estimated plant populations of 80,000-96,000 plants/acre), and that planting higher plant populations would not only cost growers more in seed expense but could also cost them in yield.

In summary, it is important to study sorghum cultural practices in California because currently most applied information comes from the Midwest. California growers need information on sorghum cultivation because sorghum may be grown as a lower-input substitute for corn. Sorghum seeding rates were studied to assist growers with determining optimum rates for the Delta environment, and the research has applicability to grain sorghum production in other parts of the state. The results indicate that there is no yield benefit to planting seeding rates greater than 6 lb/acre (estimated plant population greater than 96,000 plants/acre), and that planting higher rates is just added expense for the grower. Future research should investigate these plant populations on narrower row spacing, as is done in other states. We wish to thank the growers for their cooperation.

Michelle Leinfelder-Miles, Farm Advisor, Delta Crops
Jeff Dahlberg, Director, UC Kearney Research and Extension Center

Table 1. Plant establishment characteristics of the 2016 and 2017 UCCE Delta sorghum seeding rate trial. Data represent mean values for the four (2016) or five (2017) replicates. Treatments were considered statistically different if the P value was less than 0.05, or 5 percent, using Tukey's range test. Differences among treatments are indicated by different letters following the mean.

Seeding Rate (lbs/acre)	Estimated Plant Population (# seeds/acre)	2016 Stand Counts 1-June (plants/acre)		2016 Stand Counts 16-June (plants/acre)		2017 Stand Counts 13-June (plants/acre)		2017 Stand Counts 30-June (plants/acre)	
5	80,000	82,756	e	79,489	e	69,515	d	68,818	e
6	96,000	106,712	d	96,258	d	76,832	d	86,763	d
9	144,000	149,396	c	130,667	c	124,395	c	111,154	c
12	192,000	196,436	b	161,156	b	161,679	b	151,399	b
15	240,000	248,267	a	190,338	a	200,705	a	187,463	a
Treatment P value		<0.0001		<0.0001		<0.0001		<0.0001	
Standard Error		4432		3748		4812		5760	

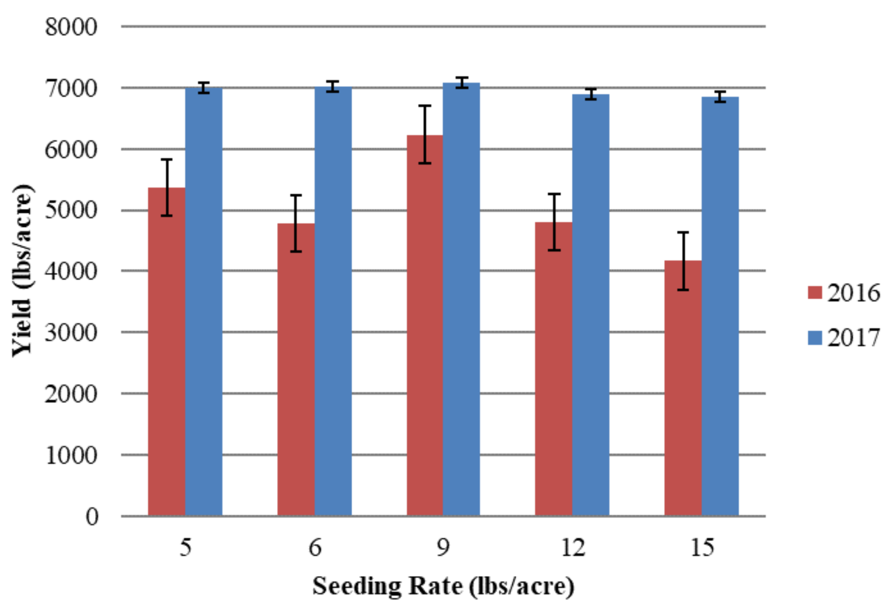


Figure 1. Yield at 13 percent moisture of UCCE Delta sorghum seeding rate trial. Data represent mean values for the four (2016) or five (2017) replicates. There were no significant differences in yield among treatments in 2016 (P = 0.1278) or 2017 (P = 0.2419).

Almond Bloom Disease Control

Almond trees are susceptible to blossom and foliar diseases when it rains at bloom time. Many of these diseases can be effectively managed with properly-timed fungicide applications. The fungi that cause these diseases are usually present in almond orchards, depending on the previous year's disease incidence and current environmental conditions.

Not all fungicides are equally effective against all diseases. Growers should assess the diseases present in their orchards and select materials carefully. The UC IPM website provides more information (http://www.ipm.ucdavis.edu/PDF/PMG/fungicideefficacytiming.pdf). To reduce the risk of fungi developing resistance, fungicides with the same mode of action should not be used repeatedly. The Fungicide Resistance Action Committee (FRAC) has categorized fungicides into groups based on mode of action; those in different groups are suitable rotation partners in a resistance management program. When making fungicide applications, keep track of their FRAC numbers, and if possible, make only one application per season from each of the FRAC numbers 1, 3, 7, 9, 11, and 17. After using one of these fungicides, rotate to another number. Don't use the same number for two consecutive sprays.

In El Niño or wet years, growers have observed late-spring and summer diseases such as scab, rust, and Alternaria leaf spot. If we do not receive additional rainfall, we would expect less disease in 2018 than in 2017. If we receive rainfall into late spring, additional fungicide applications may be necessary. Growers often concentrate their control measures on brown rot sprays at early bloom and often neglect their scab and Alternaria sprays after bloom. 'Monterey' and 'Carmel' are susceptible to scab and should be sprayed at 2-5 weeks after petal fall. 'Nonpareil' is typically sprayed for brown rot at pink bud, but it is a highly disease-resistant variety that in most years only needs a full bloom spray to control brown rot.

Usually two sprays are made for brown rot control. The first is usually done at 5-20% bloom using a systemic fungicide, such as a DMI (FRAC 3) or AP (FRAC 9). The second spray should be done near 80% to full bloom, or 7-10 days after the first spray. This is the most effective brown rot spray. Depending on the weather, a third spray may be necessary for protecting against jacket rot and green fruit rot caused by *Monilinia*, *Botrytis* and *Sclerotinia* species, as well as other diseases if rains persist and two weeks of protection have passed. This application can be with a systemic or a contact fungicide. The risk of resistance is reduced by using a multi-site compound (such as Ziram or chlorothalonil).

Application techniques are important. Ground applications are better than air, but care must be taken that both are applied correctly. Use properly calibrated and directed nozzles while spraying, and maintain a slow ground speed (<2.5 mph). The brown rot fungus (*Monilinia laxa*) attacks the tree by invading the stamens and pistils of the flower when it is open (Fig. 1). From there, the fungus can move into and kill the spur or shoot. Young fruit are also susceptible in early spring, and infection of fruit may extend to spurs and shoots. Although all cultivars of almond are susceptible to brown rot, they vary in their susceptibility. 'Nonpareil, 'Peerless,' and 'Aldrich' are the least susceptible. 'Sonora', 'Fritz', 'Monterey', and 'Carmel' are less susceptible, and 'Butte', 'Wood Colony', 'Mission', and 'Livingston' are some of the most susceptible varieties. Varieties that are susceptible to green fruit rot or jacket rot are 'Butte', 'NePlus Ultra', 'Merced', 'Carmel', 'Price', and 'Wood Colony', or any variety with tight clusters. If bloom is extended and the weather is wet and rainy, no more than ten days should elapse between treatments.

The shot hole fungus (*Wilsonomyces carpophilus*) is notoriously more prevalent in wet years. This fungus requires water for all of its activities, so periods of extended rainfall create a situation that favors shot hole disease epidemics. The fungus can cause lesions on leaves and fruit, but most of the time it infects the leaves as they emerge from the leaf bud. Leaf infections lead to defoliation, which usually occurs in early spring. Shot hole infections of young fruit, shortly after they emerge from the jacket, can cause the fruit to drop. As fruits enlarge, shot hole infection results in a lesion, but the fruit no longer fall. About the first of May, when the embryo of the nut begins to grow, the hull becomes resistant to infection and no further lesions develop. Shot hole is usually controlled by fungicide applications after bloom (when leaves emerge), usually from petal fall to two weeks after petal fall. An IPM strategy for shot hole control is to monitor orchards in the fall and spring for shot hole lesions and fruiting structures. Fruiting structures appear in the center of leaf lesions as small black spots (sporodochia) and can be seen with a hand lens. If fruiting structures are present in leaf lesions in fall, then a treatment the following spring should be applied at leaf emergence. (Sometimes this can be concurrent with bloom.) If fruiting structures are not present, you can hold off the petal fall spray and monitor leaves in the spring for lesions. As soon as fruiting structures are evident, however, apply a fungicide as long as conditions are wet. If fruiting structures are absent, delay treatment until they are visible.

Scab (*Cladosporium carpophilum* or *Fusicladium carpophilum*, Fig. 2) was initially controlled with the strobilurin or QoI fungicides (Group 11), but resistance to

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Figure 1. Brown rot blossom blight.

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these fungicides has developed. We now recommend not using group 11 fungicides unless in pre-mixtures or tank mixtures, and only in orchards without known resistance. Dr. Jim Adaskaveg has developed a three-spray strategy for scab control that includes a delayed dormant application of copper-oil or chlorothalonil, a two-week after petal fall spray that includes chlorothalonil (Echo, Bravo, Equus; group M5), and a five-week after petal fall spray that includes Captan (group M4), Ziram (group M3), or pre-mixtures of DMI (group 3), SDHI (group 7), or QoI (group 11) fungicides. Ph-D (FRAC 19) can also be used in tank mixtures. Maneb (recently cancelled) can be used until supplies are exhausted. The mancozeb product (FRAC M3) was registered as Manzate in 2012. All of these multi-site mode of action fungicides will have little chance of resistance developing to them.

Recent work by Dr. Adaskaveg also has shown that delayed dormant applications of chlorothalonil and oil are even better than copper and oil at reducing scab inoculum. *Cladosporium (Fusicladium)* causes greasy black spots on fruit, leaves, and green shoots. The shoot lesions are the overwintering sites for the fungus and the source of new spores in the spring. No apparent damage is done to the fruit, but leaves may fall prematurely. Scab can completely defoliate a tree in a short time. All cultivars appear susceptible, but 'Carmel', 'Peerless', and 'Monterey' are especially vulnerable. One of the more complicated aspects for managing this disease is that it is slow to develop, and symptoms apparently develop all at once. When this happens, most growers and PCAs want to start treating; however, it is very difficult to manage the disease at this stage, and use of single-site mode of action fungicides may lead to resistance due to high inoculum levels. Under these conditions only multi-site mode of action materials like sulfur or Captan should be used.

An extremely damaging fungal disease, anthracnose (*Colletotrichum acutatum*, Fig. 3), can be severe in warm, wet springs, with average daily temperatures above 63°F. We saw a lot of anthracnose in the 2011 El Niño year. On fruit, anthracnose can cause deep crater-like lesions; the affected area turns a rusty-reddish brown. Older fruit often gum profusely, and the nut meat is usually destroyed. A good scab control program will usually control or reduce anthracnose. Orchards that have a history of anthracnose should be treated during bloom, starting at pink bud (with your brown rot spray to protect blossoms), to help reduce inoculum build-up. Ideal conditions for disease are warm rains, and protecting trees before every rain is necessary for ideal control. All cultivars appear to be susceptible to anthracnose. In orchards that have a history of anthracnose, apply fungicide sprays every 10 to 14 days if rains persist after bloom. Late spring rains may necessitate additional applications into May. Alternate fungicides as previously discussed. Pruning out dead, infected wood reduces inoculum. If sprinkler irrigation is practiced, use low-angle nozzles to prevent the tree canopy from being wetted by sprinklers.

Brent Holtz, Almond Advisor and County Director

Figure 2. Scab on almond hulls

Figure 3. Anthracnose.

Insect Pest Monitoring for Tree Crops (Bloom-Spring)

Navel orangeworm (NOW). Every year is different. Last year, too much rain created a problem for winter sanitation, a foundation of NOW control in nut crops. This year, too little rain has caused some delays in winter sanitation practices due to the stick tight mummies on the tree. Regardless, winter sanitation should be our regular orchard operation for effective control of NOW. According to UC IPM Guidelines, the recommended timeline for growers to accomplish mummy shaking is February 1, and destroy mummies with flail mowing by March 15. Mummy nuts not only harbor overwintering larvae but also serve as the only available resource for overwintering moths to deposit eggs in the spring. Also, one mummy can support multiple worms, which makes mummy sanitation a vital task to reduce the population (2^{nd} -4^{th} generations) that attack current season nuts.

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For NOW egg-laying monitoring, we use egg traps. The trap contains attractant (almond meal, crushed pistachio, or combinations) that encourages females to lay eggs on traps. Female moths respond to the bait and lay eggs on outside ridges of the trap. The trap should be hung in the orchard by mid-March in order to establish the biofix date for degree-day calculation (http://ipm.ucanr.edu/calludt.cgi/DDMODEL?MODEL=NOW&CROP=almonds). When you start seeing increased egg-laying on two consecutive monitoring dates in at least 50% of your traps, the first date will be the biofix. Hang the traps at head height in Nonpareil trees, at least five trees inside from the edge. Hang one trap per 10 acres, with a minimum of four traps per orchard. Since these traps have a small active space for attraction, more is better. Remember to change the bait as needed, as rancid bait is not effective in attracting females. Female NOW can be trapped using a regular wing or delta trap using 'almond or pistachio baited bags' (e.g., Peterson bait) as an attractant. These traps also indicate the female egg-laying activity in the orchard. These bait-based traps are useful in tracking moth flight activity in the orchards with mating disruption, or influenced by the mating disruption nearby. In Figure 1, we compared NOW flight pattern in two almond blocks (next to each other) with or without mating disruption. The pattern of female moths captured in the 'bait bag' (MD Peterson) coincided well with the pheromone trap activity (No MD Pheromone). Also, notice that the pheromone trap (No MD pheromone) is useless to track the flight, as mating disruption impairs the male's ability to find the female or pheromone trap. Pheromone traps and lures are available to monitor male NOW activity and provide a good sense of NOW flight patterns under 'normal' orchard conditions.

Oriental fruit moth (OFM). If necessary, OFM can be monitored using pheromone traps. Place traps 6-7 feet high in mid-February, and check them weekly. Place a minimum of three traps for orchards <30 acres and more traps for bigger orchards. Biofix is the date when the trap begins to catch moths consistently and is useful to track degree-day information to make a spray decision. For young orchards and orchards with OFM problems in the past, conduct shoot strike monitoring in addition to the pheromone traps, as trap counts are not a good indicator of the damage. More scrutiny should be given in peach orchards, as OFM can directly feed on developing fruits and cause significant economic damage.

Peach twig borer (PTB). The time to put the traps out for PTB is mid-March (2016 biofix was on March 28). Follow the guidelines for tracking PTB flight. PTB larvae overwinter as larvae in hibernacula, cell-like structures bored under thin bark and have a sawdust or frass-covered entrance. In almonds, *Bacillus thuringiensis* (Bt) is the only insecticide that is suggested for use during bloom time if there is a need for PTB control. As the temperature becomes favorable, these young larvae emerge from the hibernacula and move toward the top of the trees. Spraying Bt during that time kills the larvae after they ingest the Bt product. Two applications during bloom time are generally enough to control PTB, with the first application when 20-40% of the PTB larvae have emerged from the hibernacula, and the second application 7-10 days later. If the emergence is spread out, a third spray might be needed. In peaches, monitor trees for the presence of PTB, (also for fruittree leafrollers, obliquebanded leafrollers, and katydids) during bloom. UC IPM Guidelines recommend examining flowers and leaves (2- to 3-year-old branches at head height) of 50 trees. Pull off some flowers, and examine them for the presence of larvae or feeding holes. Conduct shoot strike monitoring from bloom onward at the end of each generation.

Codling moth (CM) in walnuts. In March, place traps in your orchards to determine first moth emergence. Put the regular pheromone traps (1x lure) in the southeast quadrant of the tree about 6-7 ft high. If the orchard has CM mating disruption or is influenced by a disrupted orchard nearby, the 1x lure will not be useful to track the flights (although useful to detect disruption failure). Use the CM-DA lures, and hang at mid-canopy height. Biofix is the first date that moths are captured consistently in traps and sunset temperatures have reached 62°F.

Leaffooted bug (LFB) and native stink bugs. In almonds, LFB adults move to the orchard during March-April and attack young nuts. Early infestation of the nuts before shell hardening likely causes abortion and may lead to significant nut drop. Late-season infestation (after shell hardening) results in stained nuts. Other native stink bug attacks in almonds can produce similar signs on nuts, including nut drops, but this will happen later in the season (June), compared to March-April for LFB. Stink bug feeding injury is manifested by a clear discharge (gumming) from the nut, while an amber-colored discharge indicates bacterial spot infection. Monitor true bug activity by regularly scouting for the presence of insects and dropped nuts.

Brown marmorated stink bug (BMSB). BMSB is an invasive stink bug that has been established recently in agricultural areas in California, especially near Modesto. Peach is one of the known preferred hosts. We started seeing damage on peaches in Stanislaus County in 2017 (Fig. 2). In June 2017, we discovered BMSB populations in two almond orchards with significant gumming and feeding injuries (Fig. 3). Harvest samples also showed a high degree of feeding on hulls, shells, and the nutmeats (Fig. 4). Overall, populations in California agricultural areas are still low. In fact, these are the first reports of BMSB invading crops in California. At this point, we urge growers and pest control advisers to pay close attention to this stink bug in orchards, particularly peaches and almonds in the northern San Joaquin Valley. If you have 'trees of heaven' or other ornamental hosts near to orchards, scout those for BMSB as well. Scouting in different parts of the orchard is recommended, especially in border rows. Visual observations of egg masses, live insects, and damaged fruit (deformed fruits, fruits exuding gum) and beat tray sampling (i.e., shaking branches/twigs to dislodge insects) are the early BMSB detection methods. In a 2017 study, BMSB lure baited in sticky panel traps (Fig. 5A) performed equally well in catching BMSB adults as the standard BMSB black pyramid traps (Fig. 5B). Sticky traps are much easier to use and significantly cheaper than pyramid traps. At minimum, place three

(Continued on page 10)

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traps in the border rows of the orchard. Since BMSB overwinters in human-made structures, such as houses and barns, early activity is likely to occur in portions of the orchard close to structures. Begin to put the traps out in mid-March, and continue monitoring until October. Researchers across the US have been using the sticky panel traps and lures produced by Trécé, Inc. based on recent trial results. The lures and sticky traps need to be serviced by following the manufacturer's instructions.

Jhalendra Rijal, IPM Advisor, San Joaquin, Stanislaus, and Merced counties

Timeline to deploy traps in orchards			
Insect species	**Trap placement date**	**2017 Biofix dates (Modesto area)**	**Purpose**
Navel orangeworm (eggs)	1 April	18 April (egg-laying biofix)	Determine biofix, and time May and hull-split sprays.
Navel orangeworm (pheromone and/or kairo-mone)	15 March	Male NOW activity began on 20 March (not a biofix)	Follow seasonal moth flight activity, which can help to properly time sprays. Deploy-ing pheromone traps is critical for mating disrupted orchards.
Oriental fruit moth	15 February	2 February (1st biofix)	Determine biofix and spray timing; monitoring needed only in orchards with a history of damage.
Peach twig borer	20 March	28 March (1st biofix)	Set biofix for each generation, and determine may spray tim-ings.
Obliquebanded leafroller Fruitree leafroller	1 April 1	12 April (2016 biofix for OBLR)	Determine biofix; monitoring needed only in orchards with history of leafroller damage.
Codling moth-Walnuts (1x lure) Use CMDA-Combo for mating disruption blocks	1 March	30 March (1st biofix)	Determine biofix dates for each generation; make spray deci-sions following degree days.
Modified from: Almond UC IPM Guidelines			

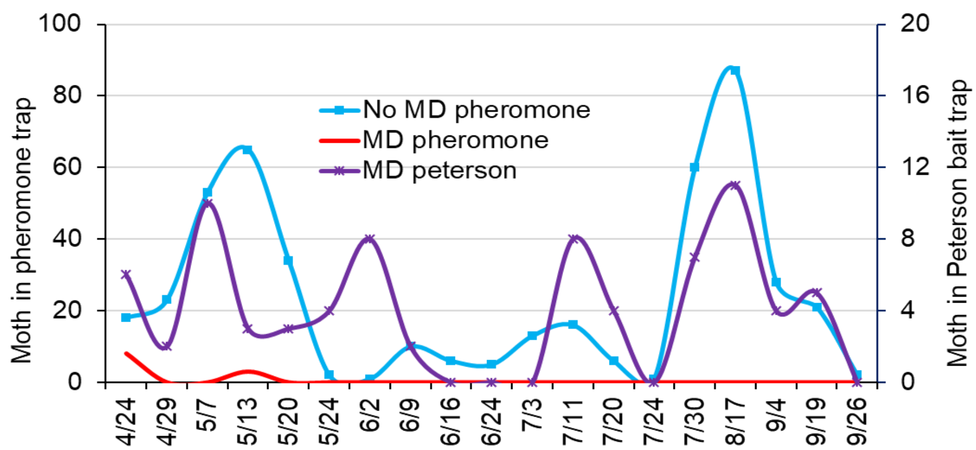

Figure 1. Number of NOW moths/week in an almond orchard.

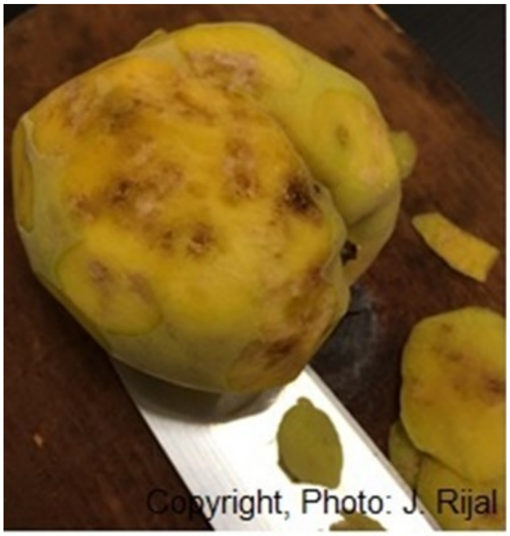

Figure 2. BMSB damage on peach

Figure 3. BMSB damage on developing almonds.

Figure 4. BMSB damage signs on almond hull, shell, and nutmeats. Presence of necrotic spots is typical of BMSB damage.

Figure 5. BMSB traps. A) sticky panel trap (left),
B) black pyramid trap (right). Trap top/sticky card is about 4 ft. high from the ground.

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