University of California
Agriculture and Natural Resources
Cooperative Extension
April 2022, Vol. 27 Issue 2

THE SCOOP

on fruits and nuts in Stanislaus County

Irrigating with a Limited Water Supply

Roger Duncan, UCCE Pomology Advisor, Stanislaus County

A full-canopy almond orchard in the North San Joaquin Valley uses about 48 inches of water in a typical season using local CIMIS weather data. Peaches generally use six or seven inches less than almonds. Currently, the Modesto and Turlock Irrigation Districts have capped allotments at 30 and 27 acre-inches, respectively, for the 2022 season. Clearly orchards that rely on irrigation district water will experience significant water stress this year.

Even though winter rain was less than average this year, we began the season with a full soil profile. Sandy loam to clay loam soils hold an average of 1.5-1.9 inches of water per foot, but only about half is easily removed by the trees (allowable depletion). Assuming a three-foot root depth, that means roughly 2.2 – 2.9 inches of water can be used in the spring before trees begin to stress excessively, depending on soil type.

We are still researching how much water almond trees NEED vs. how much they will USE, but clearly irrigating with only 75% of full ET will lead to excessive water stress, which generally results in yield loss in the current year and likely the next year. Exactly how much your current and future yield will be reduced depends on how the water is allocated through the season.

In this issue…

Contributors

Roger Duncan, raduncan@ucanr.edu
Kari Arnold, PhD, klarnold@ucanr.edu
Jhalendra Rijal, PhD, jrijal@ucanr.edu

The Scoop on Fruits and Nuts in Stanislaus County is a combined effort of UC Cooperative Extension Farm Advisors Roger Duncan, Kari Arnold, and Jhalendra Rijal and covers topics on all tree and vine crops and associated pest management.

You may reach us at 209-525-6800 or by email.

Drought Irrigation Strategy for Almonds. The first thing that growers who rely on district water have to accept is that their trees will experience stress. All we can do is manage when and how much stress the trees will experience. Fortunately, University of California researchers, including David Goldhamer and Ken Shackel, have conducted some important drought irrigation experiments on almond trees. In Dr. Goldhamer’s experiment, he imposed three levels of deficit irrigation, 34 inches, 28 inches, and 23 inches of seasonal irrigation water. He also experimented with three strategies of when to use the water: 1) Using most of the water early in the season and stressing the trees late in the season; 2) Stressing the trees early and saving the water for later, including post-harvest; and 3) Spacing the irrigations out through the year to maintain an even level of stress throughout the season. The experiment was conducted for four consecutive years.

The results showed the lower the amount of water applied, the lower the yield. However, the timing of the deficit made a difference in how much yield was reduced. Trees that experienced an even deficit throughout the season always had higher yields than the other irrigation strategies. This means that almond growers with limited irrigation water should try to

spread the pain and not use the water too early or save it until the end. Research conducted by the University of California showed that almond flower buds begin initiation around the first of July the previous year, or even a few weeks earlier in a warm year. The process of flower bud differentiation continues through early October. Therefore, severe stress during any of this time can significantly affect the next year's crop.

Almonds, by nature, are drought tolerant. They are farmed in many countries without irrigation. However, yield is very low under dry-farmed conditions. In a 2009 experiment led by Dr. Ken Shackel at UC Davis, almond trees in a previously irrigated orchard survived the season without any applied irrigation. He also saw that unirrigated trees utilized deep soil moisture more than irrigated trees. Yield was reduced significantly compared to irrigated trees. Yield was impacted even more severely the year after severe deficit, even though trees were returned to full irrigation. The good news is that all irrigation treatments regained full yields by the second year of full irrigation.

Deficit Irrigation Strategy in Peach. There are three phases of peach fruit growth. Phase 1 begins after the flower is fertilized during bloom and is characterized by rapid initial fruit growth, primarily due to cell division. While this stage of fruit development is sensitive to drought stress, it occurs early in the season when soil moisture is usually plentiful, and transpiration demand is low. Because trees don't begin using water until leaves are present, significant water stress is not likely to occur for many weeks after bloom. Therefore, it is not likely that peach trees will experience significant water stress during most of Phase 1.

Phase 2 is generally characterized by seed development, and there is very little fruit growth during this period. Phase 2 is the least sensitive stage to water stress for peaches. Growers can recognize the beginning of Phase 2 by the earliest onset of pit hardening. Mild water stress applied during this intermediate developmental period of slow fruit growth has little effect on crop yields but can significantly reduce vegetative growth.

Phase 3 is a period of very rapid fruit size and weight increase due primarily to cell expansion, and ends with ripening. During this final growth phase, about 80% of a fruit's fresh weight is accumulated. Water is primarily what drives cell expansion and therefore this final period of rapid fruit growth is very sensitive to water stress. Withholding water during Phase 3 will result in significant yield reduction.

The overall plan for peach growers should be to avoid irrigating too soon during Phase 1, extend intervals between irrigations during Phase 2 and use the water saved during Phase 3. Significant water savings can also occur postharvest, but growers should be aware that severe water stress during August and September can increase the number of double fruit the following year. Stone fruit growers with limited irrigation water might also want to thin a little more heavily. Peach trees with heavy crops are more sensitive to drought stress. You can watch a short video on using the pressure chamber to monitor tree water stress at https://www.youtube.com/wa tch?v=iDgPG88ie18

Warm Spring Means Early Harvest and Small Fruit

Roger Duncan, UCCE Pomology Advisor, Stanislaus County

During the first phase of growth in peaches, fruit growth is limited by competition from other organs. The respiration rate of vegetative organs and fruit increases with increased temperature, and subsequent demand for carbohydrates can be 5 to 10 times higher during a warmer spring than during a cooler spring (DeJong). In addition, faster development means an earlier harvest. So, not only do fruit have less time for growth because of an earlier harvest, but they also have to deal with increased competition for carbohydrates from increased maintenance respiration. Therefore, a warm spring means an early harvest and smaller fruit.

We can get a good idea of how early harvest will be by calculating the number of Growing Degree Hours (GDH) during the first 30 days after full bloom at the UC Davis Fruit& Nut Center Website:

https:fruitsandnuts.ucanr.edu/Weather_Services/Chill_Calculators/index.cfm?type=harvest.

As a rule of thumb, 6,000 GDH30 is a critical turning point for fruit size reduction and earlier harvest dates. When GDH30 goes above this threshold, growers should thin earlier in the season. A GDH30 significantly below 6000 means less thinning is required. If we use the official Canning Peach Association full bloom date of March 9 for the Modesto area, we accumulated 7306 GDH during the first 30 days after full bloom in 2022. This is comparable to 2017 when we had problems with small fruit. This means stone fruit growers should prepare to thin earlier and harder than average to achieve adequate fruit size this year.

Research Update: Hemiptra "True Bugs" Survey in Almond Orchards

Jhalendra Rijal, UCCE Area IPM Advisor, Stanislaus County
Sudan Gyawaly, UCCE Associate Research Specialist, Stanislaus County

Background

Hemipteran "true bugs" are important pests in almonds. These include native stink bugs, leaffooted bugs, and invasive brown marmorated stink bugs (BMSB). Leaffooted bug and BMSB feeding in the spring (March – April) can result in high almond drops and gummy kernels during May. Other commonly known native stink bugs such as green stink bug, redshouldered, consperse, and small hemipterans such as *Lygus*, *Phytocoris*, etc., are not known to cause damage to almonds in the spring. The mid-to-late season (May – July) infestation by major hemipterans can result in necrotic kernels - broadly referred to as "brown spots." In addition, these hemipterans can cause shriveled or completely defective – "gummy kernels." In the last 4-5 years, the incidence of brown spots and gummy kernels in almonds has increased steadily. Besides direct damage, there is the potential that these hemipterans' feeding can lead to a bigger problem such as secondary fungus/mold infection to kernels. However, this aspect of the study has not been studied systematically.

Study Methods

In 2021, we conducted season-long surveys in 21 almond orchards in northern and southern San Joaquin Valleys 1) to identify the new area of expansion of invasive brown marmorated stink bug and understand the seasonal phenology of BMSB in the San Joaquin Valley, and 2) to determine the species composition of hemipterans in almond orchards. For individual orchards, three sampling stations (~150-200 ft. apart) were established where all insect and damage samplings were conducted biweekly from spring through harvest. Here are the sampling methods adopted:

Sticky Trap Sampling: Each sampling station had one clear sticky panel trap with a BMSB dual lure (BMSB trap) and one yellow sticky trap (for parasitoid and small plant bugs). The sticky panel traps were installed on the orchard edge, while the yellow sticky cards were installed in the interior of the orchard.

Sweep Net Sampling: Fifty sweeps were performed on the ground vegetation. Collected insects were stored in 70% alcohol and processed later in the laboratory.

Visual Count Sampling: A total of 6 trees (2 trees at each station) were selected at the perimeter row bordering the wild habitat and used for visual sampling. Three-min visual inspections of all parts of the tree were performed for all stages of hemipterans (stink bugs + leaffooted bugs) and for damaged/gummy fruits.

Beating Tray Sampling: Beating tray sampling was conducted for a total of 6 trees (2 trees at each station) on the orchard edge. Two limbs on opposing sides of the tree were selected and sampled by shaking each limb five times vigorously onto a 1-m^2 size canvass beating tray. All hemipterans on the sheet were collected and identified.

Harvest Sampling: For each variety, a total of 1200 nuts representing the border (600 nuts) and interior (600 nuts) of the orchard were collected, hand-cracked, and evaluated for hemipteran damage.

Study Results

BMSB phenology and expansion into the new area

In the northern SJV, BMSB was captured in six out of 11 orchards (55%) surveyed and was the most common hemipterans captured from this region. In northern SJV, BMSB adults were captured as early as April 8 and were found throughout the summer, indicating overlapping generations. BMSB first-generation nymphs were captured starting 3rd week of June. BMSB adults were again found beginning in July and continued through September. In the southern SJV, BMSB was captured in 2 almond orchards in Fresno County, which is the first report for the southern SJV. This study indicated that BMSB infestation in commercial almond orchards is expanding beyond the northern San Joaquin, where the established population and damage has been reported since 2017.

Hemipterans diversity in almond orchards

All sampling methods we used caught hemipteran bugs. However, the **clear panel trap** captured the most diverse hemipteran species (>12 species) (Fig. 1), including hundreds of Harlequin bugs which were not included in the counts. It suggests that a clear panel trap could be helpful

to detect smaller hemipterans besides its regular use for BMSB detection and monitoring. **Beating tray** sampling effectively captured over eight hemipteran species, including major stink bugs, BMSB, leaffooted bug pests, and some predatory hemipterans such as damsel bug assassin bug and rough stink bugs (Fig. 2). Comparable results from visual sampling with multiple hemipteran pests were recorded (Fig. 3). We caught several species of small hemipterans in **sweep net** and **yellow sticky** traps. The species included *Lygus*, false chinch, *Phytocoris*, and *Calocoris* bugs. Among small hemipterans, false chinch, *Lygus*, and *Phytocoris* bugs were the most common. Several other species of natural enemies were collected in **yellow sticky** traps, however, their effects on hemipterans are unknown. These include generalist parasitoid *Encarsia*, minute pirate bug, six spotted thrips, *Stethorus* beetle (commonly known as spider mite destroyer), big-eyed bug, green lacewing, and several other parasitic wasps. Among them, *Encarsia* wasp and *Stethorus* beetles were the most common.

Hemipterans vs. kernel damage at harvest

Three of 11 orchards from north San Joaquin Valley had no visible hemipteran damage. Orchards with the higher number of large hemipterans recorded in multiple sampling methods resulted in higher levels of damage based on our 1200 nut crack out samples from individual orchards (Fig. 4). The relationship was not strong in the *Letteau* site, which had heavy early-season damage and nut drops by BMSB, and therefore, the severity was not reflected in the harvest samples.

Summary

We found that brown marmorated stink bug, green stink bug, and leaffooted bug were the most common hemipteran pests in these almond orchards. The invasive hemipteran pest, brown marmorated stink bug, was found in over 50% (of 11 orchards) surveyed in the northern and 20% (of 10 orchards) in the southern San Joaquin Valley, suggesting its infestation is expanding. Infestation by major hemipterans in almond orchards resulted in significant crop damage. For example, we found as high as 5.5% damage to almond kernels in our samples. Scouting hemipterans is necessary for detecting insect population and potential damage. For monitoring BMSB, a clear panel trap with a BMSB lure is effective. However, for leaffooted bug, green stink bug, and others, beating tray or visual sampling methods are more effective. We will continue the study of surveying hemipterans and their natural enemies in several orchards in the 2022 season. The goal is to develop action thresholds to help make IPM decisions.

Acknowledgments

We thank the Almond Board of California for funding this research. We also thank project collaborators A. Joyce, R. Bansal, and technicians C. Vue and J. Peacock for their assistance.

Figures

Fig. 1. Total no. of hemipterans captured in clear panel traps in NSJV almond orchards

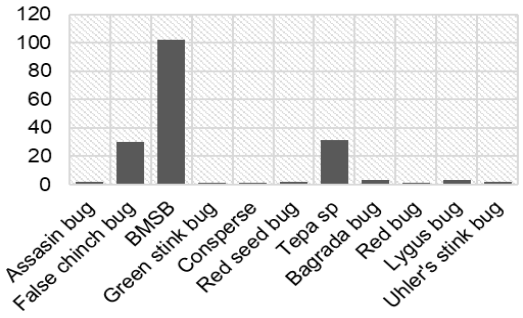


Fig. 2. Total no. of hemipterans captured in beating tray sampling in North SJV almonds

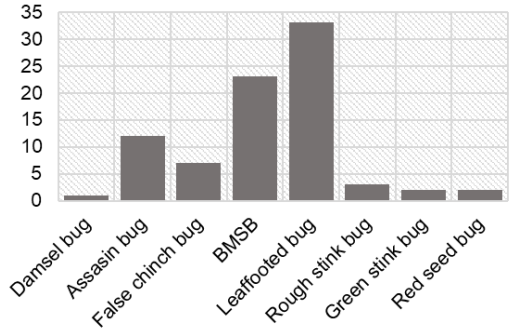


Fig. 3. Total no. of hemipterans recorded in visual sampling in North SJV almonds

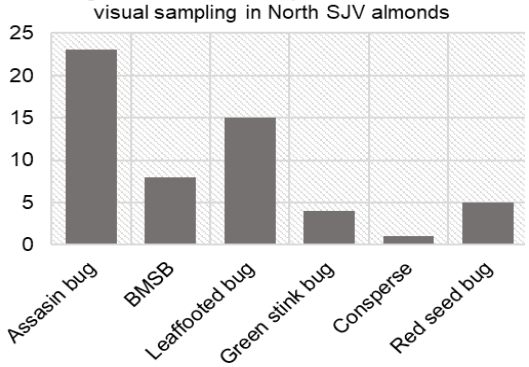
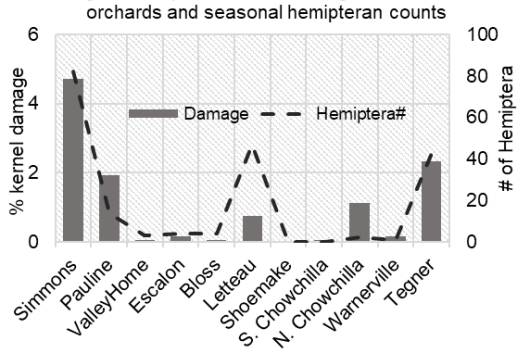


Fig. 4. Hemipteran kernel damage recorded at orchards and seasonal hemipteran counts



Nitrogen Management in Walnuts

Kari Arnold, Ph.D. UCCE Area Orchard and Vineyard Systems Advisor, Stanislaus County,
Phoebe Gordon, Ph.D. UCCE Area Orchard Crops Advisor, Madera-Merced Counties,
Katherine Jarvis Shean, Ph.D. UCCE Area Orchard Systems Advisor, Capitol Corridor,
Mohamed Nouri, Ph.D. UCCE Area Orchard Systems Advisor, San Joaquin County,
Janine Hasey, UCCE Tree Crop and Environmental Hort. Advisor, Sutter-Yuba Counties

The following is a summary of a previous publication "Guide to Efficient Nitrogen Fertilizer Use in Walnut Orchards" written by Kathy Kelley Anderson, Joseph Grant, Steven A. Wienbaum and Stuart Pettygrove.

As the growing season approaches (and fertilizer prices rise), many walnut growers are asking the question, "How much nitrogen do I need to fertilize my orchard and when?" Although walnuts, a proteinaceous crop, need more nitrogen than some stone fruit, nitrate, being negatively charged, leaches easily in the soil. Compost, organic fertilizers, urea, and ammonium containing fertilizers are all eventually converted to nitrate by soil bacteria so regardless of form, leaching can occur at one point or another. Therefore, the right rate, time, place, and type become increasingly important as environmental concerns, regulatory restrictions and nitrogen prices increase. The best way to manage nitrogen applications is to first estimate orchard nitrogen requirements (based on your yield estimate), then determine your nitrogen need (yield estimate minus other sources of nitrogen), determine your applied nitrogen for the season (nitrogen needs divided by application efficiency) and determine the timing of nitrogen applications based on the phenology of the crop (during the growing season, nitrogen is taken up by the tree at a relatively even rate throughout fruit development, nothing needed after harvest, nothing needed during dormancy). This is referred to as nitrogen budgeting.

Let's first discuss the right rate. Nitrogen management plans require estimating the orchard nitrogen requirement based on yield estimates. It is suggested to determine this value by averaging the previous five years (while excluding very low yielding years). Nitrogen can be present in irrigation water, therefore, testing your water source is necessary for determining your application amount for the coming season. Nitrogen in irrigation water has been demonstrated to be taken up by trees, so we can incorporate this nitrogen value into our nitrogen budget, saving money and water resources. In rare cases, these resources have been found to contain as much as the equivalent of 100 to 200 lbs. of nitrogen in 3 acre-feet of water. More often some irrigation water sources are found to contain the equivalent of 20 to 40 lbs. of nitrogen in 3 acre-feet of water. Growers can send samples to a lab to determine the amount of nitrogen present in the water. This amount can then be calculated on an acre-feet basis and subtracted from the initial estimate of nitrogen needed which is based on the five-year average yield estimate. The resulting amount of nitrogen needed for the season is then divided into how many times you plan to apply nitrogen during the season. The number of times you choose to apply nitrogen should be partly determined based on the leaching capability of the soil (sandier soil is more likely to allow nitrogen to pass through it), and the form of nitrogen used (nitrate will leach more readily than ammonium). Furthermore, walnut trees take up nitrogen steadily through the growing season so applying smaller amounts more often is better for your crop. Unfortunately, even at our best attempts, not all the nitrogen applied and/or present is taken up by the plant. Research shows approximately 70% is taken up by the plant, so we also incorporate an efficiency factor of 0.70 into our budgeting estimates. Don't worry, we will circle back to this later.

Please see **Table 1** for ppm nitrate present in irrigation water and how that converts to lbs. of nitrogen applied per acre in volume of applied water per acre.

continued on page 6

Table 1. Amount of nitrogen applied in irrigation water as a function of nitrate-N (NO_3^-N), or nitrate (NO_3^-) concentration and the amount of irrigation water applied.

Nitrogen concentration in irrigation water		Pounds of nitrogen applied per acre in volume of applied water per acre	
ppm N as NO_3^--N	ppm NO_3^-	2 acre-feet	3 acre-feet
5	22.1	27	41
10	44.2	54	82
20	88.5	109	163
30	133	163	245

Note: Agricultural laboratories report results of water analysis as either ppm N (NO_3^-N) or ppm NO_3^-. Multiply ppm NO_3^-N in the water by 2.72 to calculate the pounds of nitrogen applied per acre foot of applied irrigation water. Multiply ppm of NO_3^- by 0.614 to obtain pounds of nitrogen.

Table extracted from Guide to Efficient Nitrogen Fertilizer Use in Walnut Orchards, UCANR publication #21623

So how much nitrogen is taken away from the field at harvest and how do we determine the right rate from that? Research shows that for every ton of nuts/hulls removed per acre, approximately 29 lbs. of nitrogen is removed, per acre. With an additional few pounds for limb and leaf growth, the CDFA assumes 40 lbs. of nitrogen is needed per one ton of walnuts removed, per acre (for current information please see their website: https://www.cdfa.ca.gov/is/ffldrs/frep/FertilizationGuidelines/).

We've covered quite a bit of ground here, let's run through an example. If my previous five-year yield average is three tons per acre from my orchard, I could assume I need to replenish this much nitrogen: 3 tons per acre multiplied by 40 lbs. nitrogen per ton equals 120 lbs. nitrogen per acre. Furthermore, if my water sample reflects approximately 40 lbs. of nitrogen per acre in my annual irrigation, I can remove 40 lbs. of nitrogen from that total, thus my application needed for the season becomes 80 lbs. of nitrogen per acre. Furthermore, I do not want to apply all that nitrogen at the same time because the trees need it throughout the fruit development process. Depending on my application method I could apply this amount of nitrogen across four to several applications until August, thereafter, walnut trees are no longer utilizing nitrogen for nut development. So, if I decide to apply four times during the season, my application rate would then become 20 lbs. of nitrogen per acre. Please see **Formula 1** for details:

Formula 1.

$$\frac{\left[\left(\frac{3\ tons\ of\ nuts\ per\ acre * 40\ lbs.of\ N\ per\ ton}{0.7\ efficiency\ factor}\right) - 40\ lbs.of\ N\ in\ irrigation\ water\right]}{4\ N\ applications}$$

$$= \mathbf{20\ lbs.of\ N\ per\ acre\ per\ application}$$

Right time: In general, trees can take up nitrogen when leaf out begins, but they don't need it until nut development begins to a greater extent. This is because early nitrogen needs are supplied by nitrogen remobilization in the tree. Therefore, applying nitrogen after harvest, during the winter, or even early spring, in the case of walnuts, is just a waste of money, resources, and can be an environmentally destructive action. That said, research has shown that walnuts take up nitrogen steadily during the fruit development period, therefore, "spoon-feeding" nitrogen gives you the best bang for your buck. Therefore, we suggest applying frequent small doses during the growing season. This will

continued on page 7

provide better nitrogen use efficiency. From the example above, **Formula 1**, applying 20 lbs. of nitrogen once a month from May to August is ok, but applying 10 lbs. of nitrogen every two weeks from May to August is better.

Right place: Depending on the application form, certain measures can be taken to reduce leaching even further. If fertigating, add the nitrogen during the last half or third portion of the irrigation set. This allows water to flush and move the nitrogen into the soil and rootzone. If fertigation occurs during the first four hours of a 24-hour set, much of the applied nitrogen will be carried too far into the soil depth, wasting money, and risking environmental detriment.

Knowing more about your soil and leaching capacity can help determine which forms of nitrogen you could use to reduce leaching, although all forms will convert to nitrate eventually so don't assume any form of nitrogen is "safer" than another. As a reminder, more frequent, smaller applications of nitrogen are more likely to keep the nitrogen in the rootzone where the roots can access it. One big nitrogen application in May and July reduces the available nitrogen for the crop in June and August when the crop still needs it for production (not to mention this practice increases leaching risk). Keeping nitrogen in the rootzone with more frequent applications at smaller application rates provides for a better crop in October (Ching!).

As we progress into the growing season (late June/July), we should start thinking about tissue samples. This helps determine how much nitrogen is needed based on the plant status and allows for rate adjustment in the following year. We collect samples in June and July because this is when leaf nitrogen content tends to stabilize. Collect 4 terminal leaflets per tree from spur leaves that are fully expanded at approximately 6 to 8 feet above the ground around the outside of the tree. To assess the entire orchard, make these collections from 29 randomly selected trees within the orchard. Submit the samples to a nutrient analysis laboratory. If leaf concentrations are below 2.3%, the trees are deficient and need additional nitrogen. If nitrogen leaf concentrations are between 2.3% and 2.7%, this orchard is adequate and needs no more nitrogen than previously assessed. If the concentrations are above 2.7%, this orchard is in excess of nitrogen, and savings can be taken advantage of by reducing or even eliminating nitrogen applications for a year or more depending on soil type (sandier soils are more prone to leaching). In other words, if your sampling numbers are above 2.7%, you can save money by not buying nitrogen when nitrogen is expensive and walnut prices are low. This is because of the stored nitrogen in the plant. If you go this route, be sure to follow your sampling next year to help determine the following year's application rates. This nitrogen savings is only good for about a year or two, and you don't want to short yourself in yield when the prices go back up. The current year's tissue samples will guide next year's nitrogen decisions and maybe save you some cash.

So, we've made it to August. By now we have a pretty good handle on our nitrogen budgeting. As a reminder, don't apply nitrogen after August, not only is this a waste of money and time since the tree is no longer using nitrogen for nut development, but this also makes trees more prone to freeze damage in the fall due to the unnecessary encouragement of new growth. September is best thought of as a slowdown month where we allow the trees to develop dormant buds and dormant tissues. Any nitrogen inputs during this time delay dormancy, furthering the risk of fall freeze damage. Take this moment to pat yourself on the back, farming is hard.

Now let's discuss the right type. Although we made it through the growing season, there is more to consider when it comes to nitrogen management in the orchard. For instance, certain forms of nitrogen and certain soils are more prone to nitrogen leaching. Ammonium is positively charged and held to clay soil particles, whereas nitrate is negatively charged and not held in place by clay soil particles. Sandier/siltier soils are at greater risk for nitrogen leaching and nitrate-based fertilizers are more prone to leaching. That said, ammonium will convert to nitrate at some point, so using only ammonium-based fertilizers does not put you in any "safe" zone, it just slows down the process a little bit. Additionally, since water moves nitrate through the soil profile, high rainfall and heavy irrigation are also situations more prone to leaching. Therefore, as stated previously, fertigation is recommended to be done at about halfway or one third of the way through an irrigation set as opposed to the beginning. This will keep your money spent on nitrogen in the root zone, and not below it.

Organic amendments such as manures, composts, blood meal, feather meal and fish waste do contain nitrogen, but

continued on page 8

the amount varies drastically based on the source and batch. Furthermore, some composts and manures contain potentially detrimental levels of other salts than what they may be worth for nitrogen content. Frequent chemical analyses of the compost sources are strongly encouraged before use. Compost and manures must be incorporated into the soil soon after application to avoid loss due to volatilization.

Cover crops can provide quite a bit of nitrogen depending on the current nitrogen content in the soil and species selection. Vetch, clover, and other legumes can provide as much as 150 lbs. of nitrogen per acre, but these species do not fix nitrogen when adequate levels of nitrogen are present for plant growth. If these cover crops are not fixing nitrogen, they are demanding it and in turn reduce available nitrogen for the trees. Thus, careful nitrogen management is necessary when growing cover crops for nitrogen production. To estimate the amount of nitrogen available in the cover crop, collect a small area, such as a square meter (3 feet by 3 feet) of mature cover crop and submit the sample to a laboratory for nitrogen analysis. After cutting, weigh the sample (fresh weight), place it in a plastic bag and immediately drop it off at the lab. Nitrogen budgeting assumes a 50% recovery if the cover crop is only mowed. Further information on cover crops in walnut orchards can be found in *Cover Crops for California Agriculture* (UC ANR publication 21471, 1989) and *Cover Cropping in Vineyards-A Grower's Handbook* (UC ANR Publication 3338, 1998).
Although we expect all forms of nitrogen to become nitrate (leachable) at some point, different forms of nitrogen have different levels of leaching risk and volatilization potential. Additionally, different formulations consist of different percentages of nitrogen. Please see **Table 2** for a quick digest of this information.

Fertilizer	Formulation	Nitrogen (%)	Equivalent acidity or basicity (lb. $CaCO_3$/100 lb. N)		Leaching Risk*	Volatilization potential
			Acid	Base		
ammonium nitrate	NH_4NO_3	33.5-34.0	62	--	M	L, M***
ammonium sulfate	$(NH_4)_2SO_4$	21.0	110	--	L	L, M***
calcium-ammonium nitrate solution	$Ca(NO_3)_2 \cdot NH_4NO_3$	17.0	9	--	M	L
calcium nitrate	$Ca(NO_3)_2$	15.5	--	20	H	L
urea	$CO(NH_2)_2$	45.0-46.0	71	--	L	M
UAN-32 solution** (urea-ammonium nitrate)	$NH_4NO_3 \cdot CO(NH_2)_2$	32	57	--	M	L

Table 2. Components of various nitrogen (N) fertilizers and their characteristics.

Notes: *L=Low, M=Medium, H=High. These terms are relative. All ammonium forms will leach after being converted to nitrate form. This takes place in 2 to 4 weeks in most soils Nitrate leaching can be severe on sandy soils and moderate on silt loams and clays.
**UAN is often inject through low volume irrigation.
***If not incorporated or banded below the soil surface, volatilization losses can be high on soils with a pH over 7.0.
Source: California Plant Health Association 2002, Cramer et. Al., 1986 and *Guide to Efficient Nitrogen Use in California Walnut Orchards* (UC ANR Publication 21623).

With rising prices related to nitrogen and increasing concerns related to nitrogen ground water contamination, I hope this article helps in deciphering your best nitrogen management practices. Young trees are different in their needs, if you have specific questions on young trees, please contact me or your local UCCE walnut advisor. For more information and guidance on nitrogen budgeting, please see the following resources:

https://www.cdfa.ca.gov/is/ffldrs/frep/FertilizationGuidelines/
https://www.growingthevalleypodcast.com/cures/2020/12/31/managing-nitrogen
https://anrcatalog.ucanr.edu/Details.aspx?itemNo=21623

Announcements

2022 Virtual Walnut Series

videos are now available! Please find them at this link:

https://www.youtube.com/channel/UCsTjd_N5GCh6MlEPqB3jUnQ

Stanislaus County UCCE Tree & Vine IPM Breakfast Meetings

Held at the Old Mill Café at 600 9th Street, Modesto, 7-8 am, the first and third Wednesday of the month in May and June. One hour of continuing education units are offered at each meeting.

UCANR is offering a Nitrogen Training Course.

The course is open to anyone interested in learning more about N management in California. The curriculum addresses all the learning objectives set forth by the American Society of Agronomy (ASA) for the new California nitrogen specialty exam. Each module is eligible for Certified Crop Advisor (CCA) continuing education units (CEUs) covering Environmental impacts, Soil N cycling, Plant N utilization, N sources and budgeting, Irrigation and N management, and California cropping systems. Please follow the link to register:

https://ucanr.edu/sites/nitrogencourse/

Peter Larbi, our UCCE Agricultural Application Engineering Specialist is leading a Spray Application and Modeling Conference.

Objectives/Goals: A 3-day conference covering airblast pesticide spray application practices in orchards and vineyards, decision support tools for planning and evaluating spray applications, and drift modeling support for pesticide regulatory practices. Participants will gain a holistic view to better understand ongoing partnerships between academia, industry, and the regulatory community towards better stewardship of pesticides.

This conference will focus on:

Day 1: General airblast spray application practice and equipment, and emerging technology.

Day 2: Modeling and decision support systems for improving spray deposition and efficacy.

Day 3: Pesticide drift modeling and data support for regulatory processes.

Who Should Attend: Anyone interested in or directly involved with tree and vine spray application practice, planning, supervision, advising, regulation, and/or advocacy.

Requirements: You will need a laptop/desktop computer (PC or Mac) or a mobile device and a stable internet connection in order to participate in this conference. Continuing Education Units: 17.28 CEUs (2.00 'Law' & 15.28 'Other') to be applied for from California Department of Pesticide Regulation (CDPR).

To register, please follow the link:

https://ucanr.edu/sites/ASAM/Registration/