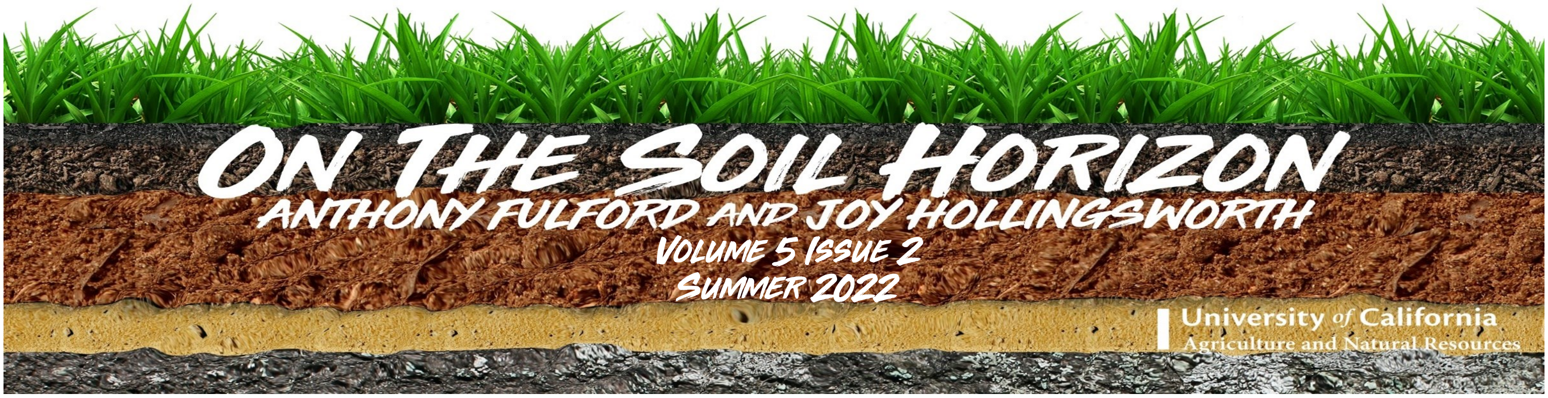


# Practical Considerations Around Growing Cover Crops in the San Joaquin Valley

Peas and brassicas (left) and yellow ray goldfields and tidy tips (right) blooming in March

## Introduction

It has been well documented that cover crops can provide many agroecosystem benefits to growers, such as improving water infiltration, contributing to soil fertility, preventing nutrient loss, and providing resources for pollinators and beneficial insects (Mitchell et al., 2017; Shackelford et al., 2019; Unger, 1998). However, growers in California's southern San Joaquin Valley worry that the lack of consistent winter rainfall and high cost of water make cover cropping impractical (Mitchell et al., 2015). Because of this, we wanted to assess how different winter cover crop mixes grew with and without supplemental irrigation in our region. Last year, we carried out a research trial at two locations – Shafter (Kern County) and Parlier (Fresno County) - and found that while there were slight differences in biomass between irrigated and non-irrigated plots, the differences were not significant. Cover crops that did not receive any supplemental irrigation were still able to contribute a decent amount of biomass, and simply by having roots in the ground, the rainfed cover crops were feeding the soil and preventing erosion.

This year, we wanted to replicate our trial and include species that performed well with low water, as well as include a native cover crop mix. Beyond evaluating performance under different irrigation levels, we wanted to assess more practical questions around the implementation of cover crops, such as methods of planting and termination. We also used our cover crop demonstration site to host a field day, where we invited farmers to look at the different mixes and share their own thoughts and experiences. This article will outline what we found in our trial, farmer feedback from our field day, and reflections on what may be needed to make cover cropping a more widespread practice in the San Joaquin Valley.

## Experimental Design

This trial took place at the Kearney Agricultural Research and Extension Center (KARE) in Parlier, California. The soil type is a Hanford Sandy Loam and the site received 5.7" of rainfall during the period of time that the cover crops were in the ground.

Three cover crop mixes were planted on December 1, 2021 using two different methods – a Schmeiser seed drill and a broadcast seeder. Table 1 outlines the mixes planted and the seeding rates used. Half of the plots received 1.06" of supplemental irrigation via solid set sprinklers spread out over 4 irrigation events, while the other half of the plots received an initial 0.25" to help with germination but were then dependent on rainfall for the rest of the season.

## In This Issue



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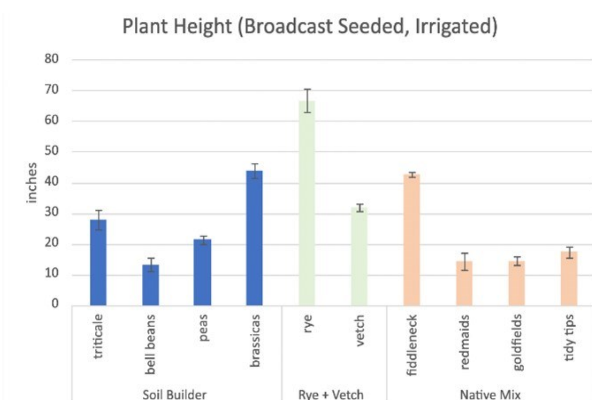
Cover crops were terminated on April 7th, using various termination methods. 1/3 of the plots were mowed with the crop residue being left on the soil surface, 1/3 of the plots were mowed with the residue being disked into the soil after, and the final 1/3 were left standing to assess when the different species might re-seed and die off on their own.

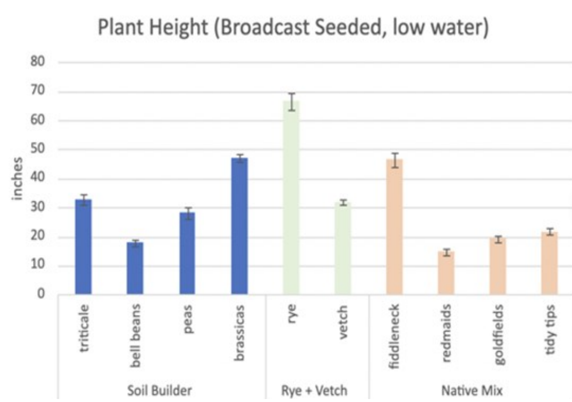
TABLE 1

| | |
|---|---|
| **Cover Crop Mixes Planted** | **Soil builder mix**: *30 % Triticale, 35% Bell Beans, 28% Peas, 1% Canola, 1% Common Yellow Mustard, 5% Daikon Radish (Seeding rate: 75 lbs./acre, Price: $0.55/lb.)* |
| | **Rye + vetch mix:** *20% Merced rye, 80% hairy vetch (Seeding rate: 75 lbs./acre, Price: $1.74/lb.)* |
| | **Native mix:** 25% *layia platyglossa (tidy tips), 25% lasthenia glabrata (yellowray goldfields), 25% calandrinia menziesii (red maids), 25% amsinkia menziesii (fiddleneck)*<br>*(Seeding rate: 35 lbs/acre, Price: $100/lb.)* |
| | **Resident vegetation:** *plots with nothing planted to compare what emerged without seeding a cover crop* |
| **Establishment** | Field was disked to prepare the soil and cover crops were planted on December 1, 2021 – half of the plots were planted with a Schmeiser seed drill and the other half with a broadcast seeder. |
| | 0.25” of irrigation was applied for germination |
| **Irrigation** | Half of the field was irrigated 4 times from December to April |
| | The irrigated plots received 6.76” of total water (1.06” from irrigation + 5.7” from precipitation). |
| | The non-irrigated plots received 5.95” of total water (0.25” from irrigation + 5.7” from precipitation)** |
| **Termination** | Cover crops were terminated on April 7th<br>• 1/3 of the plots were mowed and the crop residue was left on the soil surface<br>• 1/3 of the plots were mowed and the crop residue was disked into the soil<br>• 1/3 of the plots were left standing to assess when the different species might re-seed and die off on their own |

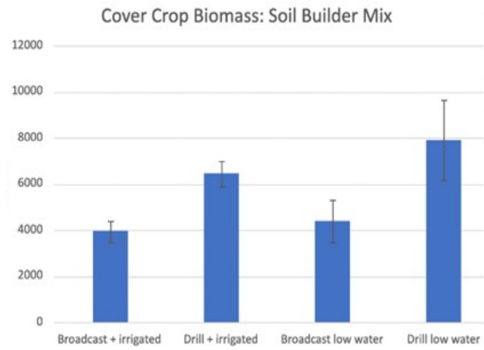
**We also discovered that an irrigation pipe was leaking near our field, so an amount of supplemental water that cannot be quantified ended up in the “non-irrigated” half of our trial. Thus, the “non-irrigated” half received more water than intended in our experimental design.

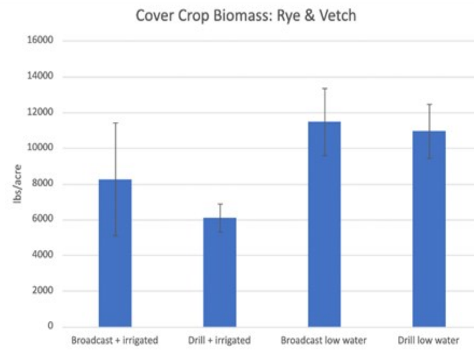
## Height and Biomass




Within the native mix, the height of fiddleneck was significantly higher than the height of the other three native flower species in that mix. Under both different irrigation and seeding environments, rye grew significantly taller than the vetch in the rye and vetch mix. In the soil builder mix, the triticale and brassicas grew significantly taller than the two pea varieties in the mix regardless of seeding and irrigation methods.




Total cover crop biomass was not significantly different between the soil builder and rye/vetch mix across seeding methods and irrigation levels. Similarly, the presence of weeds was not significantly different across seeding and irrigation methods, except for the rye/vetch mix that was drill seeded and received low water. Those particular plots had significantly more weed biomass than the other rye and vetch plots that were broadcast seeded (with and without irrigation) and drill seeded with irrigation.

## Seeding Methods

The soil builder mix had significantly more biomass when drill seeded than when it was broadcast seeded. For the rye/vetch mix, there was no significant difference in biomass whether the seed mixes were broadcast or drill seeded. The seeding rate (75 lbs./acre) was kept the same for both seeding methods and non-native seed mixes. Based on our results, we would recommend increasing the recommended seeding rate 1.5-2 times when broadcast seeding cover crops as compared to drill seeding. Broadcast seeding can often result in more spotty coverage of a field and seeds are not buried as deep as with a drill, which can impact germination rates. That being said, broadcast seeding with the recommended rate did yield a considerable amount of biomass for both mixes and is still beneficial if a drill seeder is not accessible and/or purchasing seed at a higher rate is not financially feasible.

## Termination Strategies

Although disking is a widely used practice on small-scale and large-scale farms throughout the San Joaquin Valley, it often results in increased levels of erosion and soil compaction which can negatively impact air quality and soil aggregate stability (Baker et al., 2005; Hernanz et al., 2002). In this trial, we tested two alternative termination strategies in addition to disking to see if there was an impact on soil quality. The most immediate observation between the mowed and disked plots was that the soil of the mowed section was less susceptible to erosion due to the layer of cover crop residue resting on the surface of the soil. The soil of the disked section, on the other hand, was fully exposed to the sun and easily susceptible to erosion (caused by wind and other external physical disturbances).

Retaining residue on the soil surface also reduces evaporation of water from the soil and helps to reduce soil temperature. About a month after termination, an infrared thermometer was used to assess soil temperature in the parts of the field where the cover crop residue has been disked and where the cover crop residue had been mowed and left on the soil's surface. The average temperature on the part of the field where the residue was disked was 126.03° F, while the average temperature for the mowed section was 101.73°F, over 20 degrees cooler. When soil temperatures rise above optimal ranges, plant water and nutrient uptake can be impeded. Dry, sandy soils can heat up very fast and bare land heats faster than soil that is covered. Extreme air and soil temperature can alter the water transport rate from the soil into the root and plant system, which can reduce plant transpiration rate where plant transpiration cannot keep pace with high atmospheric evaporative demand (Irmak 2010). Crop surface residue is important to consider as concerns about cover crops and consumptive water use will likely increase as new groundwater sustainability plans under SGMA come into effect. Recent studies have found that there is not a significant difference in soil moisture between cover cropped fields and bare soil throughout the winter, while evapotranspirative losses due to winter cover crops are negligible relative to bare soil (DeVincentis, 2022). If it can be shown that cover crop residue left on the soil surface after termination can reduce evapotranspirative losses into spring and summer, this may encourage more growers to consider cover cropping as a water conserving practice.

## Cover Crop Trial Field Day

In April, we hosted a Cover Crop Trial Field Day for farmers and technical assistance providers, and we were very pleased with how many farmers came out to the event. After walking through the research plots and viewing different cover crops, we all convened and had a group discussion. Farmers shared insights and asked questions pertaining to cover crop varieties and the ways they can incorporate them into their current farm management practices. Their main concerns were related to accessing proper and affordable equipment, as well as building soil health and soil structure on their farms.

After the cover crop field day, we sent out a farmer feedback survey to attendees which included take-aways on the different planting methods, timing of planting, and using resident vegetation to keep soil covered. Future research ideas from farmers included focusing on cover crop mixes that do not harbor pests for subsequent crops and evaluating how cover crops can impact soil organisms, such as nematodes. Questions remained about the impact of cover cropping practices and water conservation, like the advantage of using mulch and how changes in soil organic matter may impact water use. Others asked for practical information around cover cropping, such as preparing the ground and methods of irrigation.

## Conclusion

This trial looked at how this ecologically beneficial practice can be incorporated practically on farms. This inquiry included comparing different seeding and termination techniques, and recognizing – through farmers' feedback in group discussions and a survey – the financial challenges farmers face in acquiring the necessary equipment to plant, terminate, and purchase cover crop seed. What we discovered was that both drill and broadcast seeding strategies fared well in producing a considerable amount of cover crop biomass, with the drill seed having significantly more biomass for the soil builder seed mix. In regards to termination methods, mowing is recommended for building soil health and structure because it resulted in cooler soil temperatures and less observed top soil loss.

Purchasing the seed and equipment for growing cover crops was a main concern for growers interested in this practice. The paper outlined some strategies farmers could use to reduce costs such as mixing and matching different priced seeds and reaching out to local agencies and organizations to apply for cover crop incentive programs, in addition to vocalizing that it still remains difficult to access equipment even with grants. Programs local to the Central Valley and California at large include:

- Xerces Society (Nonprofit) - https://www.xerces.org/
- Seeds for Bees program - https://www.projectapism.org/seeds-for-bees.html
- CDFA's Healthy Soils Program - https://www.cdfa.ca.gov/oefi/healthysoils/incentivesprogram.html
- USDA NRCS EQIP Program - https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/contact/local/

In the future, we are interested in testing out more cover crop seed mixes, especially those that will not only provide biodiversity above and beneath the soil, but also seed mixes that are economically practical for farmers. We are also interested in trialing perennial cover crops (which also have the potential to reduce overhead costs) and summer cover crops. Finally, we plan to continue to engage with farmers to assess what is working and not working on their farms, with a focus on water conservation and pest management, two areas of interest brought up by farmers in our group discussion and survey responses.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**Sources:**


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***This is an abbreviated version of a longer article. To read the full length article https://ucanr.edu/sites/Soils_and_Nutrients/Publications/***

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## Hollingsworth Shifting Focus from Soils to Grapes

Joy Hollingsworth, UCCE Table Grape Advisor, Tulare and Kings County

As you have probably realized from the article title and byline, I have changed jobs, but am still working for UC ANR. As of May 16, I stopped being the Nutrient Management/Soil Quality Advisor for Fresno, Madera, Kings, and Tulare Counties, and will now focus on Table Grapes in Tulare and Kings Counties only. Being an advisor in this area has been a great experience and I enjoyed getting to work with Anthony and the NRCS over the last three years. I have learned a lot and I look forward to applying much of that knowledge to my new job. I am excited for this opportunity to be the table grape advisor, because it will allow me to continue working in my local community in a long-term position.

So, what does that mean for this newsletter? Well, this will be the last time I send out On the Soil Horizon, but Anthony will continue to publish it for his north valley contacts. For those of you who are interested in grapes, I will begin contributing to a quarterly newsletter called Vit Tips. I will be collaborating on it with my fellow viticulture advisors ranging from Kern to Merced counties, and the next edition will be coming out soon. For those of you working with other commodities in Fresno/Madera/Kings/Tulare Counties, I encourage you to check out the newsletters of our other advisors in the area.

If you have any suggestions on research or extension topics related to table grapes that you think I should work on, please let me know. Also, feel free to reach out with any questions. My email will remain the same joy-hollingsworth@ucanr.edu and my new phone number is (559) 684-3313.

My new website is https://cetulare.ucanr.edu/Agriculture782/Viticulture/ where you can find information about grapes and the Vit Tips newsletter (sometimes called Grape Notes).

**Newsletters and other extension outlets**

https://ucanr.edu/sites/Dairy/California_Dairy_Newsletter/

https://cetulare.ucanr.edu/newletters/Field_Crop_-_Nutrient_Notes/

https://ucanr.edu/sites/Nut_Crops/From_the_Shell/

https://cetulare.ucanr.edu/newletters_898819/In_a_Nutshell_84/

https://ucanr.edu/sites/livestockandnaturalresources/News/

https://www.sjvtandv.com/

https://www.growingthevalleypodcast.com/

Thanks, and looking forward to working with you in my new capacity!

# Waste Not, Want Not—Monitor nitrogen availability of fall-applied compost and know what to expect in the spring

Anthony Fulford[1] and Zheng Wang[2]

[1]Nutrient Management and Soil Quality Advisor; [2]Vegetable Crops and Irrigation Advisor

To accomplish the statewide goal of reducing landfilled organic waste by 75% before 2025, it is necessary to remove a third of the total waste currently entering landfills in California, a tall task indeed. Creating alternative disposal options for large amounts of yard and food waste will be required to meet reduction targets. One option is to use these waste as a source of "greenwaste" compost, which is widely used in agricultural crop production to improve soil health and affect soil nitrogen availability. In the previous issues of On the Soil Horizon and Vegetable Views Newsletters, we discussed the nitrogen availability of the "greenwaste" compost applied to sub-surface drip-irrigated processing tomato fields in fall 2019 and shared some preliminary results. To briefly recap, greenwaste compost (GWC) derived from yard trimmings and food waste was obtained from Recology Organics (Vernalis, CA) with an average moisture content of 25%, total nitrogen of 1.7% and C:N of 16:1. Compost was surface broadcast in the fall 2019 to two processing tomato fields (PTF1 and PTF2) near Patterson, CA at rates of 5, 10, and 15 tons/acre. After compost application, inorganic nitrogen and nitrogen mineralized from compost was monitored during the fall and winter months and was continued until just prior to transplanting in the spring 2020. Now, we have finalized the results from this monthly measurement of soil inorganic nitrogen and would like to discuss a few key takeaways to keep in mind when considering fall application of compost as a supplemental fertilizer or soil amendment.

## Key Takeaways:

### Don't Guess, Soil Test

The inorganic nitrogen remaining in the soil between crop harvest and next planting is commonly known as residual nitrogen. While residual nitrogen can come from different sources, even the soil itself, the biggest contributor is typically the nitrogen in fertilizer that has not been taken up by the crop during the growing season. This residual inorganic nitrogen remains in the soil but can be lost to leaching due to winter precipitation. The residual nitrogen was noticeably greater in PTF2 (49 lbs N/acre) than in PTF1 (30 lbs N/acre) in Nov-19 without compost application and remained greater by an average of 15 lbs N/acre during the winter months. Interestingly, we also noticed a two-time greater nitrogen mineralization from compost in PTF2 

compared to PTF1 across the 4-month off-season period (Dec-19 to Mar-20). While we cannot draw a direct link between greater inorganic nitrogen in PTF2 and the greater nitrogen mineralization rate, it does appear that compost was a source of residual soil nitrogen in both fields between fall application and spring transplanting. Residual soil nitrogen can be very different among fields receiving a similar amount of compost in the fall. Therefore, accounting for residual nitrogen with soil testing removes the guesswork from fertilizer nitrogen rate adjustments in the spring.

### Monitor Soil Inorganic Nitrogen after Compost Application

A substantial decrease of soil inorganic nitrogen was observed without compost or with the rate of 15 tons/acre applied one month thereafter (Dec-19) in both fields (Figure 1). However, the relatively low concentration of soil inorganic nitrogen tended to last for three months with the compost application of 15 tons/acre in both fields. Across both fields, inorganic nitrogen increased by an average of 23 lbs N/acre from one to four months after compost application. This suggests that although there is an increasing trend of soil inorganic N beginning two months after compost application, the initial decrease that occurred within a month of compost application may overall persist for several months (Figure 1). Consequently, it may be necessary to delay soil testing in composted fields until spring when nitrogen soil tests provide a better indication of the amount of residual nitrogen in the soil prior to planting.

## Estimate Nitrogen Availability from Compost

Estimating the amount of nitrogen in compost that may become plant-available after application is difficult because there are numerous factors that can affect nitrogen mineralization in soil. The results of this project revealed an average of 9% (PTF1) and 16% (PTF2) of the total nitrogen in greenwaste compost was in an inorganic/plant available form three months after application. While these estimates of plant-available nitrogen from compost are greater than previous reports, this is not necessarily a surprise due to the site-specific effect of crop rotation and management on nitrogen mineralization. Monthly monitoring of nitrogen availability can be time consuming and labor intensive, however, there is an online decision-support tool (http://geisseler.ucdavis.edu/Amendment_Calculator.html) capable of estimating how much of the total nitrogen in compost will be mineralized based on the application date, rate, and depth of compost incorporation. Combining estimated nitrogen mineralization from online decision support tools with in-field monitoring would provide a better prediction of the amount of residual nitrogen present in the soil prior to spring planting.

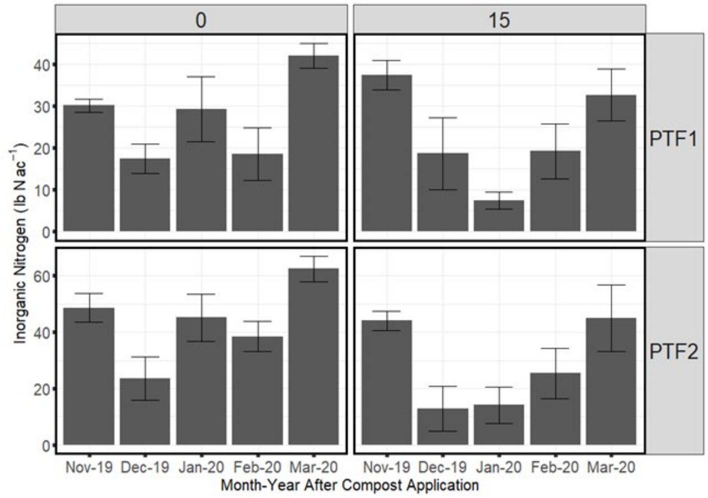


**Figure 1.** Inorganic nitrogen concentration (lbs N/acre) measured between November 2019 (Nov-19) and March 2020 (Mar-2020) following application of 0 or 15 tons/acre of greenwaste compost in two processing tomato fields (PTF1 and PTF2) near Patterson, CA in October 2019.

**Resources**

Nitrogen Accumulation in Processing Tomato Fields Following Fall-applied Compost. 2020. *On the Soil Horizon.* Volume 3, Issue 2. https://cestanislaus.ucanr.edu/news_102/On_The_Soil_Horizon/

2020 Research Projects. 2020. *Vegetable Views*. Spring 2020, Issue 1. https://cestanislaus.ucanr.edu/news_102/Veg_Views/

Nitrogen Calculator for Processing Tomatoes. http://geisseler.ucdavis.edu/Tomato_N_Calculator.html

Nitrogen Mineralization from Organic Amendments. http://geisseler.ucdavis.edu/Amendment_Calculator.html

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## "Open House" of Watermelon Rootstock Variety Trial and Demo of CropManage on Guiding Irrigation

**When**: Wednesday, June 29, 2022, from 8:00 to 12:00 pm. Visit the field any time in between. Individual tour can be given if you miss the date.

**What**: You will view and walk through a grafted watermelon rootstock variety trial including a field scion grafted onto a total of seven commercial interspecific hybrid squash, bottle gourd, and Citron rootstocks. On the other hand, you will learn how we ground-truth the validity of the irrigation decision-support tool, CropManage ( https://cropmanage.ucanr.edu/ ), to guide watermelon irrigation management.

**Where**: Coordinate (37.732394, -121.226828, Manteca).

Questions and RSVP to Dr. Zheng Wang at 209-525-6822 or zzwwang@ucanar.edu