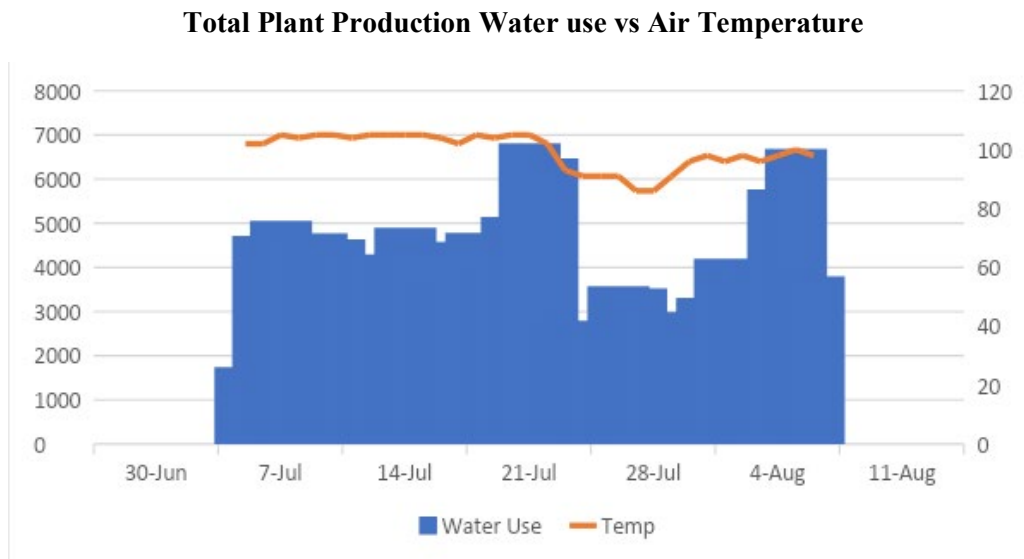


## SARE Water Usage Report & Outreach

### Pre-Commercial Irrigation Installation Water Use

Pre-commercial irrigation meter MG's total plant production water use, including hydroponic & aquaponic production from July 7<sup>th</sup> – August 7<sup>th</sup> totaled 106,446 gallons of water. Additionally, water used for evaporative cooling totaled 28,939 gallons. Altogether 135,381 gallons were metered from 31 days of operation. This averages out to 4,512 gallons a day at an average temperature of 99.4 °F.

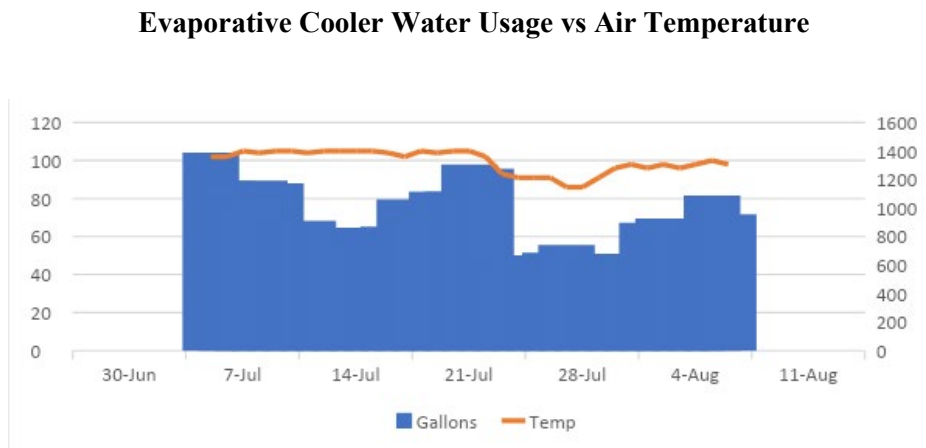
Figure 1.



*Note.* During the 31-day span water usage was metered in hour increments and air temperature was recorded at 12:00 AM daily.

MG tracked the relationship between water use and air temp, large spikes in temperature prolonged or increased water usage.

Figure 2.



*Note.* The 31-day span of water usage from the evaporative cooler and air temperature.

### Water Use & Plant Production

MG's facility has capacity for 25,920 plants to be grown at one time. Between July 7th – August 7th crops grew on an average in 21 days. During the 31 days of data collected during the period more than 37,039 plants were brought to mature harvesting age. Respectively in the same period 106,446 gallons were metered for plant production. This includes both hydroponic and aquaponic plant production.

**Figure 3.**

| <b>Harvestable Plants Produced</b> | <b>Plant Production Water Metered (Gallons)</b> |
|------------------------------------|---|
| 37,039                             | 106,446   |
| 1                                  | 2.87  |

For every harvestable plant 2.87 gallons of water are used for plant production. It is likely that most water loss was due to high evapotranspiration.

### Water Use & Sales

During this period a total of 9674.90\$ of produce was sold. The total water consumption metered was 135,381. For every dollar of sales, 13 gallons of water were metered for all operational water needs.

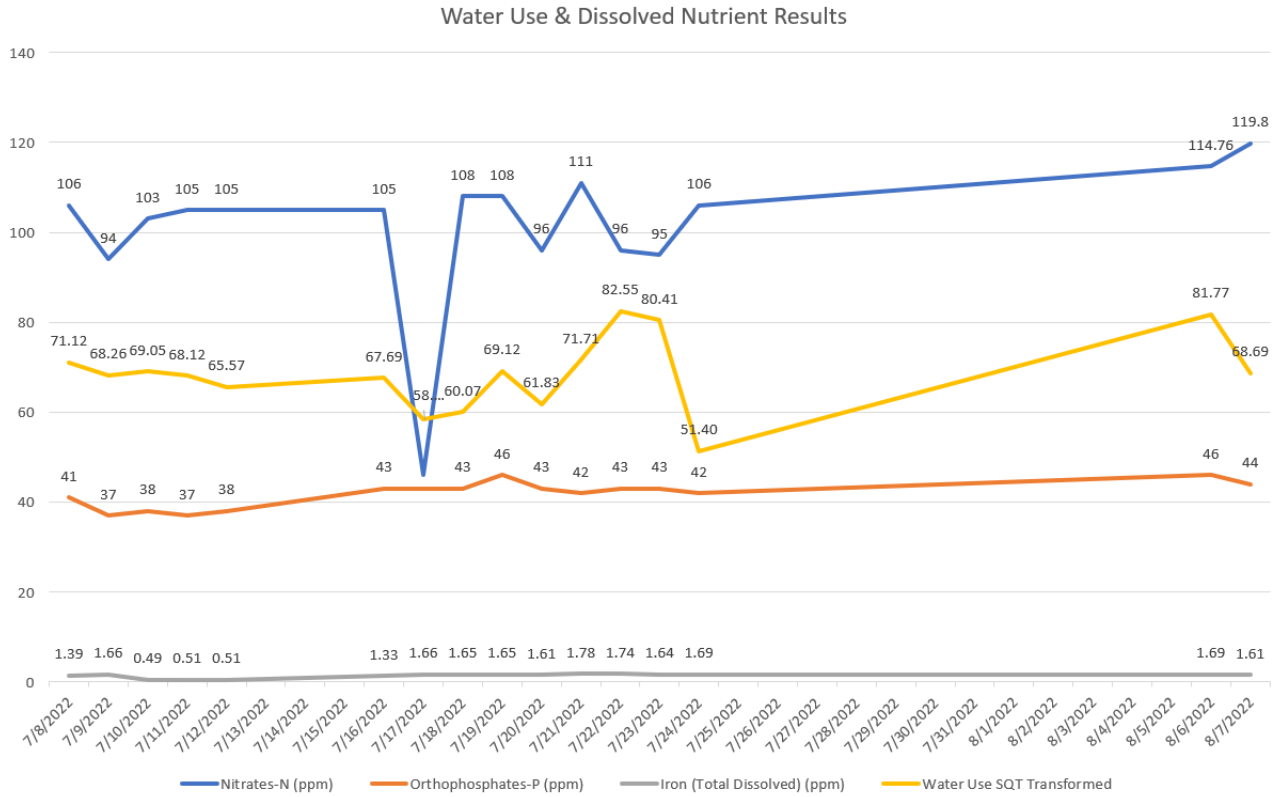
**Figure 4.**

| <b>Sales Amount \$</b> | <b>Watered Metered (Gallons)</b> |
|------------------------|----------------------------------|
| 9674.90                | 135,381                          |
| 1                      | 13.99                            |

## Dissolved Nutrients in Hydroponic Production vs Water Use

Critical nutrient parameters are measured with KETOS water quality monitoring systems. During the 31-day test period 16 samples were taken measuring Nitrates, Orthophosphates & Iron. Each data point was paired with metered water use. Water use data was transformed for best model fit using square root transformation.

**Figure 5.**



**Note.** Critical nutrient parameters Nitrate, Orthophosphates, Iron & Water use SQT transformed.

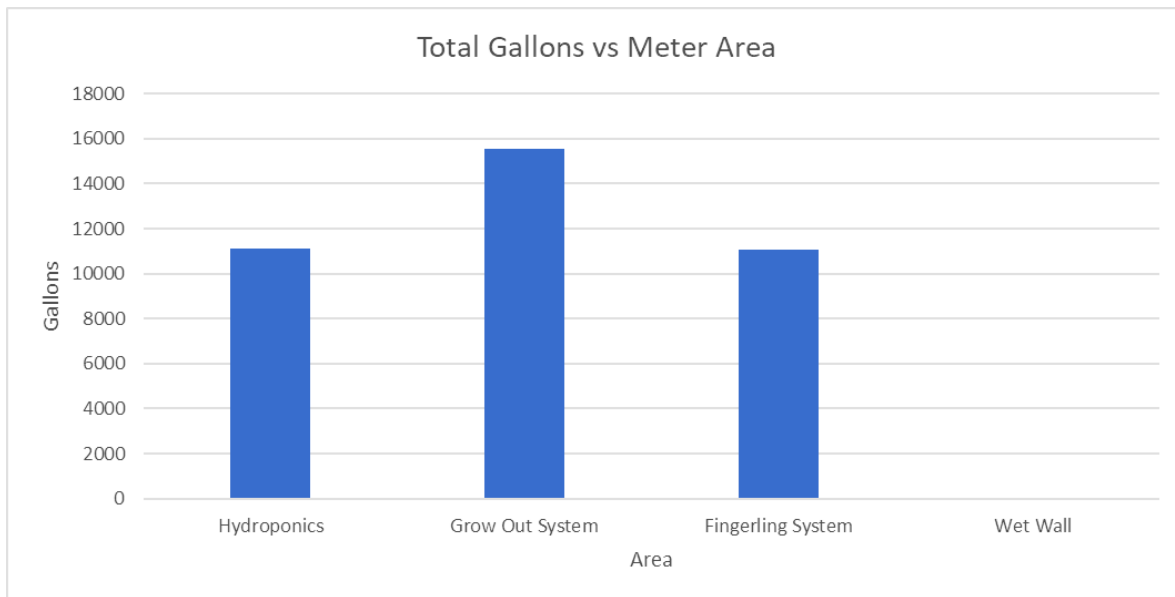
Water use can be seen loosely following all nutrient parameters but most closely with orthophosphates values after 7/16. Peaks in water use can be seen both increasing and decreasing nutrient parameters. Although after one day spikes in water use, predominantly nutrient values decrease. When water use is declining there is a smaller percent change on nutritional value, than when increasing.

Although trends can be seen there is no statistical correlation between dissolved nutrients and water use.

### Post-Commercial Irrigation Installation Water Use

After the commercial irrigation line was installed 66 days of water metering data was collected. MG's total plant production water use, including hydroponic & aquaponic production from Oct 17<sup>th</sup> – December 22<sup>nd</sup> totaled 37,734 gallons of water. Additionally, water used for evaporative cooling totaled 0 gallons during this time period. This averages out to 571 gallons a day at an average temperature of 83.9 °F.

**Figure 6.**

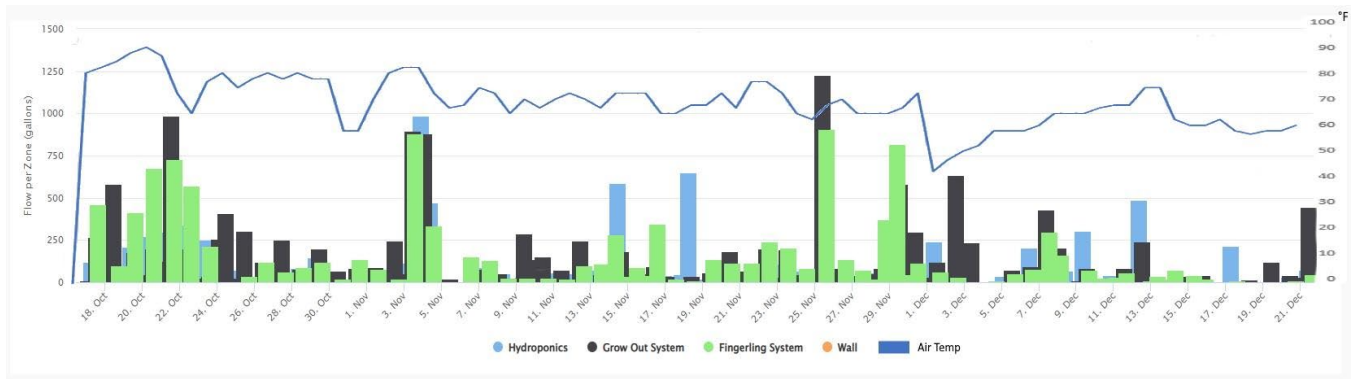


**Note.** Total water usage from the 66 day span separated by each meter area.

The largest consumer of water was the large grow-out system which is MG's main aquaponic system, followed by the hydroponic system, then the fingerling system which is a smaller aquaponic system. Each used 15,571, 11,109 and 11,090 respectively.

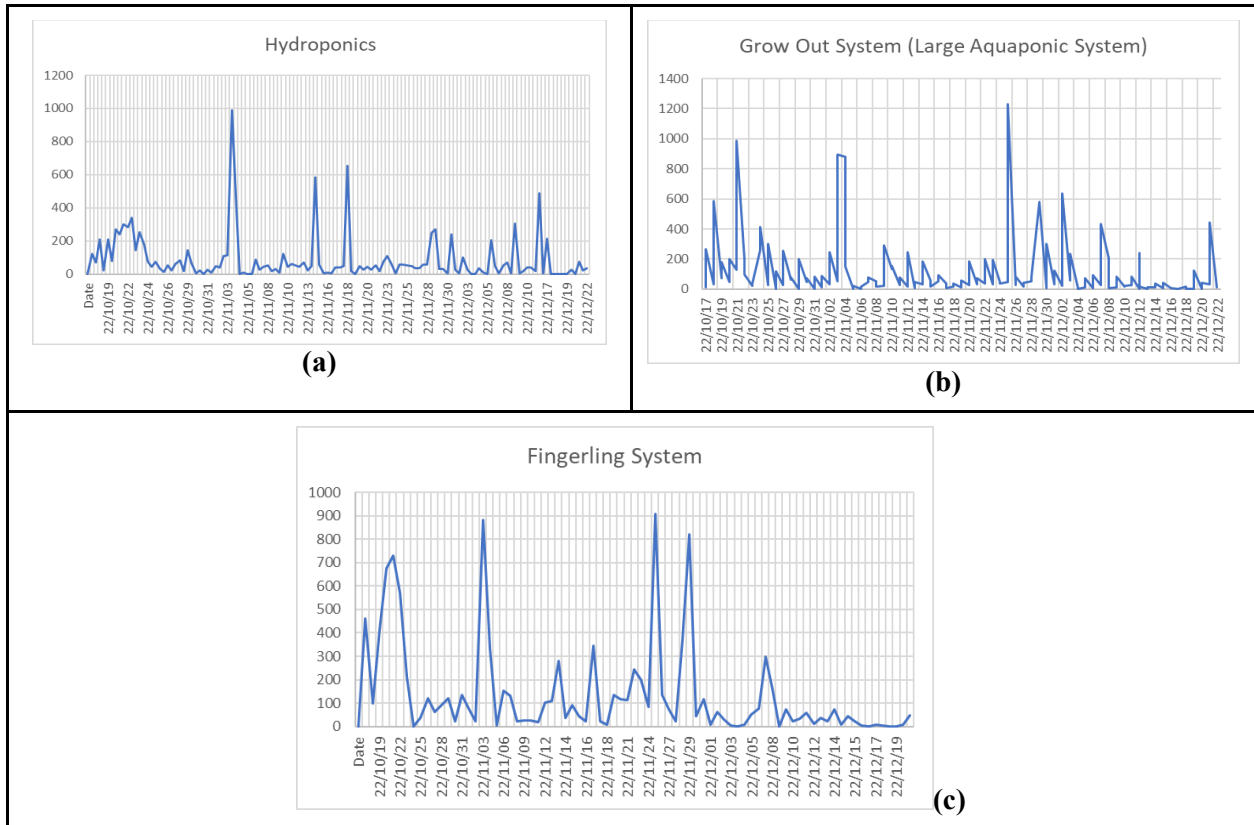
**Figure 7.**

### Metered Area Gallons vs Air Temperature



*Note.* Total water usage by day during the 66-day span separated by each metered area vs air temperature.

**Figure 8.**

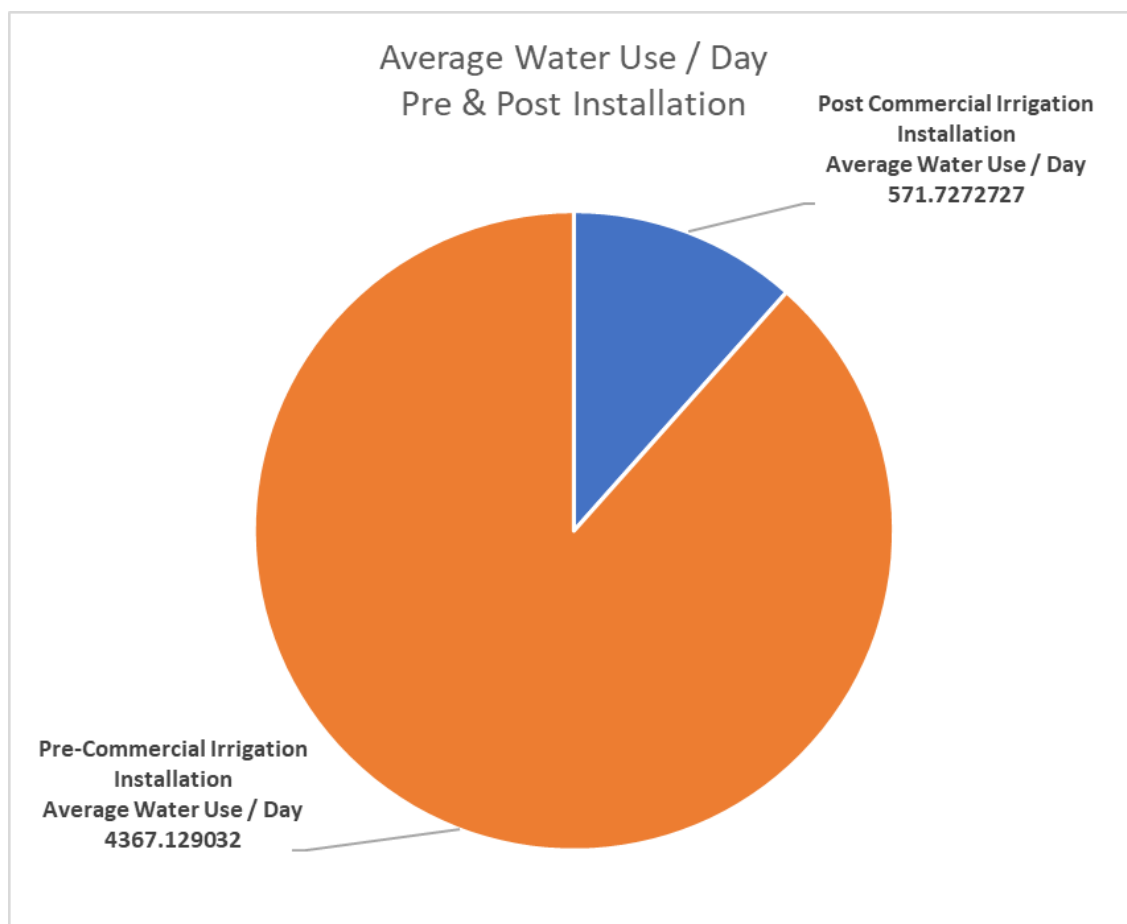


*Note.* Hydroponic System, Grow Out System & Fingerling System water use measured by day over a 66-day period.

### Pre-Commercial Irrigation Installation vs Post-Commercial Irrigation Installation

After the installation of the commercial irrigation line water usage dropped by an average of 3,796 gallons a day or 764 %. Mean air temp from the first 31-day study before the installation dropped from 99.4 °F to 83.9 °F in the 66-day span study post installation. Notably, because of the decrease in temperature water usage from evaporative cooling totaled 28,939 gallons pre-installation and was 0 post-installation.

**Figure 9.**



*Note.* A weighted average of water use per day of pre and post-installation of water line.

**Figure 10.**

|                   | <b>Harvestable Plants Produced</b> | <b>Plant Production Water Metered (Gallons)</b> |
|-------------------|------------------------------------|---|
| Pre-Installation  | 1                                  | 2.87  |
| Post-Installation | 1                                  | .86   |

### **Water Usage Conclusion**

The 66 days of data shows significant water savings when switching from residential to commercial irrigation. Greenhouse systems remained constant during this study with no interruptions in production. The season change reflected water savings due to the shut off of the evaporative cooler but this does not disrupt the findings. Even with evaporative cooling factored to represent pre-installation usage, the result is a 432% decrease of water use. Aquaculture systems represented a higher water consumption than hydroponic systems and spikes in air temperature correlated with spikes in water consumption. Nutrient concentrations and water usage in the first 31 day pre-installation study yielded no significant result. Merchant's Garden produced results to answer the questions in objective II on water consumption of urban farming in arid climates. Gallons used per head of lettuce was measured in Figure 10. Water consumption was reduced by more than the outlined goal of 15% from baseline numbers pre-installation. Gallons used per head of lettuce reduced by 70%. Merchant's Garden continues to track water usage on a monthly basis to gather more data to further understand water usage in arid environments.

## Specific Community Action

### City of Tucson's Climate Action and Adaptation Plan - Community Dialogue

Merchant's Garden took initiative at the City of Tucson's Climate Action and Adaptation Plan Community Dialogue. This gathering's goal was to solicit feedback to Mayor Romero's office aiming to build a more climate-resilient Tucson, centering the needs of communities disproportionately impacted by climate change.

**Date & Time:** Friday, August 5 / 9 AM - 12 PM

#### Merchants Gardens Attendees:

Brennan Glow

*Head Grower & Biosystems Engineer*

#### Other Attendees:

Anna Darian, [hello@annadarian.com](mailto:hello@annadarian.com)

Underrepresented Business Owners

Living Streets Alliance

Local First Arizona

#### Agenda:

The primary goal was to bring suggestions to the city for implementation. The agenda facilitated a workshop, idea presentation and idea distillation in groups and that was recorded by the mayor's office.

#### MGs Topics Presented:

- Water rates in the city
- \$10,000 cost to install a new 1in commercial irrigation meter.
- The potential to reduce our water bill by over 50%
- Water usage by large scale farmers
- Our approach is intentional about saving water
- Our 4-year journey & plans
- Not accessible to other farmers
- Our proposed solution: New rate for urban farmers that wouldn't require commercial irrigation meter installation OR subsidy or payment terms on new meter install.



## All Outreach Activities

*Funded by Western SARE*

| Speaker Engagement  | Purpose  | Date                       | Grant Fund Area     | Participant Numbers |
|---|--|----------------------------|---------------------|---------------------|
| <b>AZ Farm Bureau - Women's leadership conference</b>                     | Outreach to 200 women farmers in AZ  | 15-Jul                     | Farmer Outreach     | 200                 |
| <b>2022 Food Safety Conference</b>  | Discuss & understand food safety   | Oct 26-27th                | Farmer Outreach     | 100                 |
| <b>Green Valley Gardeners Tour</b>  | Help align local gardeners with cultivation practices  | Nov 17                     | Farmer Outreach     | 23                  |
| <b>Arizona YF&amp;R Tour</b>  | Educational outreach to young farmers and ranchers   | Nov 4                      | Farmer Outreach     | 26                  |
| <b>"What the Farm" with Rob Sharkey (Aka - the SharkFarmer) podcast -</b> | Messages are shared to over 150,000 farmers and get 2500 downloads each podcast. National Reach          | Aired 8/1/22               | Farmer Outreach     | 2500                |
| <b>SIRIUS XM RuralRadio channel 147 at 4 pm ET</b>                        | Messages are shared to over 150,000 farmers and get 2500 downloads each podcast. National Reach          | Live 8/1/22 4pm            | Farmer Outreach     | 2500                |
| <b>Tucson Water Townhall</b>  | Understand   | Aug. 16, 4-6 p.m.          | Stakeholder Meeting | 20                  |
| <b>Tucson City Council has declared a Climate Emergency PART I</b>        | Help align climate policy with farmers' needs. Learn needs from other farmers and regulatory constraints | August 5 / 9 AM - 12 PM    | Stakeholder Meeting | 20                  |
| <b>Tucson City Council has declared a Climate Emergency PART II</b>       | Help align climate policy with farmers' needs. Learn needs from other farmers and regulatory constraints | September 9 / 9 AM - 12 PM | Stakeholder Meeting | 20                  |