CENTER for PRODUCE SAFETY

CPS 2017 RFP
FINAL PROJECT REPORT

Project Title
UA Ag Water app-language expansion and practical grower-inspired improvements

Project Period
January 1, 2018 – December 31, 2018 (extended to January 31, 2019)

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Objectives

To improve functionality of the Ag Water app based on real-world grower feedback, as well as deploy a fully functioning Spanish version of the app and associated on-line tools developed by the University of Arizona.

Funding for this project provided by the Center for Produce Safety through:
CPS Campaign for Research

FINAL REPORT

Abstract
The Produce Safety Rule (PSR) requires growers to establish a Microbial Water Quality Profile (MWQP) for each agricultural untreated surface water source. Growers must also conduct annual surveys for that water source in subsequent years (21 CFR Parts 16 and 112). The microbial water quality profile is based on the levels of generic *E. coli* in agricultural water. An initial MWQP must be established with a minimum of 20 water samples collected as close to harvest as possible over a period of between two to four years. Geometric mean (GM) and Statistical Threshold Value (STV) are calculated from these 20 samples (minimum) and are considered the MWQP. Several tools have been developed over the past year to compare the MWQP to the microbial water quality criteria stated in the Produce Safety Rule. These tools were developed to make it easier to calculate the GM and STV and to determine if water meets the standards for unrestricted application to produce before harvest. The tools were also designed to assist with making food safety management decisions if water does not meet the standards, including calculation of die-off requirements. While extremely useful, the initial development of these tools was restricted to English only and had not been broadly evaluated by a diversity of grower/users of the tools attempting to implement the FSMA Produce Safety Rule. The University of Arizona team worked with the original Ag Water app developer to improve the functionality of the Ag Water app based on grower feedback over the course of this one-year project. Additionally, the University of Arizona established relationships with Spanish translators and the project PI and co-PIs utilized these resources. The project team worked with local grower stakeholders in Arizona, California, and Mexico to review and revise the draft translations to ensure appropriate word usage and word meaning. Additionally, the research team had a collated list of grower suggestions and feedback collected over previous years on the overall functionality of the app as well as the need for improved data importing and report printing functions. After functional improvements and translations were completed for the Ag Water app and associated online tools, the project PI and team members hosted a series of "open house" events to evaluate the enhanced version of the Ag Water app as well as provide additional feedback to the developer for final consideration.

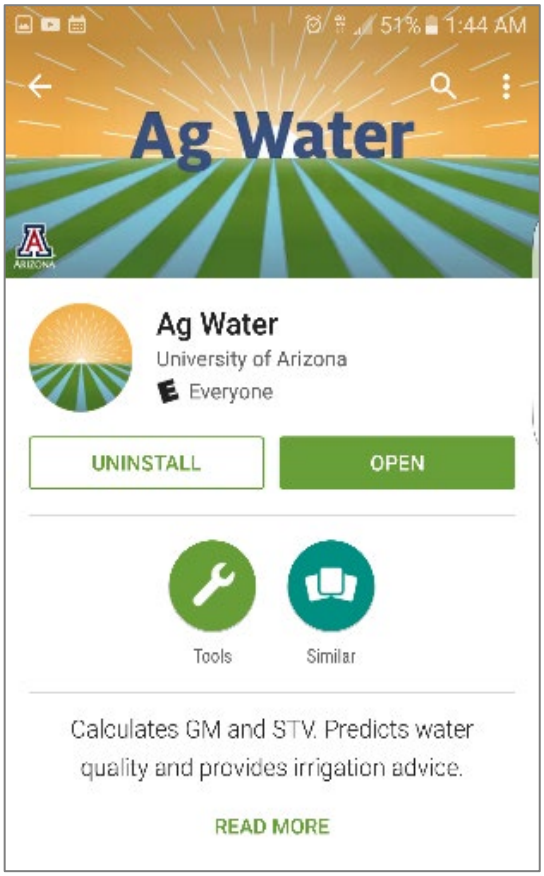
Background
In 2014, the Center for Produce Safety funded the project PI to develop water quality sampling guidelines for the fresh produce industry. Outcomes of this work included an increased understanding of the impact of environmental factors on microbial water quality risk and improvement of established Quantitative Microbial Risk Assessment (QMRA) frameworks for the fresh produce industry (Rock and Gerba 2014a, 2014b; Rock et al. 2015; Haas et al. 1999; Stine et al. 2005a, 2005b.) Additionally, one of the major outputs of this research was the development of the Ag Water app, webpage, and online calculator (http://agwater.arizona.edu - detailed information below).

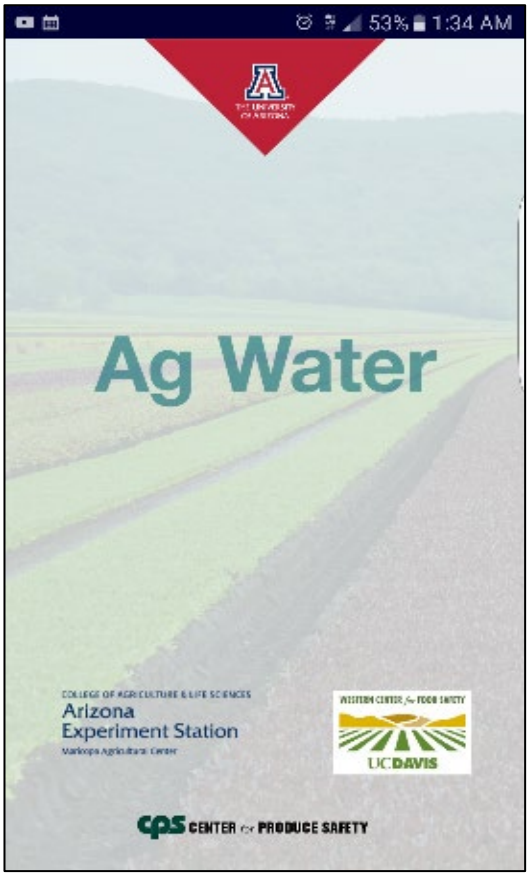
The Ag Water app (University of Arizona Cooperative Extension) can be downloaded onto any Wi-Fi enabled mobile device (Android, Apple, cell-phone, tablet, laptop) or home computer by visiting the Google Play or Apple app store. Users are invited to open the app and create an account with a username and password. All information added to the app is saved in an encrypted personal account and can be accessed from any device that supplies the appropriate login information. The Ag Water app assists growers in calculating their MWQP, including their GM and STV, and if their water source meets current PSR and LGMA requirements. In the event the sampled water source does not meet requirements, the app provides recommendations for water remediation, including die-off based on log reduction calculations.

The Ag Water app Webpage (University of Arizona Coop. Ext.) is an online version of the app, accessible from any device connected to the internet and uses the same login information as the mobile app.

The Online Calculator (University of Arizona Coop. Ext.) is an online webpage accessible from any device connected to the internet. Data entered cannot be saved using the Online Calculator but can be printed for record keeping and reporting.

Original Ag Water App Download page and Splash Screen –





Under the initial development of the app, the project team conducted 7 formal trainings, reaching over 400 individual growers and industry members. The developed tools (mentioned above) have also been distributed through numerous industry trade groups and tools are currently being used in the Produce Safety Alliance FDA grower and Train-the-trainer certified trainings across the country, thus indicating the usefulness of these grower-focused tools to industry.

Research Methods and Results

This project builds on the current body of knowledge related to agricultural water and its evaluation for the protection of public health. In addition, outcomes of this project specifically address stakeholder needs in an immediate way to help provide needed information to comply with FDA FSMA regulations to the broadest stakeholder group possible.

Spanish Translation:
The University of Arizona team worked with the original Ag Water app developer to improve the functionality of the Ag Water app based on grower feedback. This work was facilitated through in-person meetings and email communications. Additionally, the University of Arizona worked with established relationships with Spanish translators to ensure that the final product is both accurate and appropriate. Once draft translations were completed, the project team worked with local grower stakeholders in Arizona, California, and Mexico to review and revise the translations to ensure appropriate word usage and word meaning.

App Functional Improvements:
The research team collated a list of grower suggestions and feedback collected over the past years on the overall functionality of the app, including look and feel as well as the need for improved data importing and report printing functions.

The following provides a list of functional improvements suggested by industry that were incorporated into revisions:

- Updating user sign-in features so that users can remain signed in to the App after each session; addition of a "Remember me" box at login so users can remain logged in if they choose to.
- Lab-link upload function so that results from contract labs could be fed into the App so the user could show an auditor where they got their lab results from as well as have the lab input data for selection in the guidance calculation.
- Additional text and reference materials about FSMA, the PSR, and any recent updates in real time.
- Ability to connect the App with a cloud service or create app storage so files can be uploaded and saved while maintaining password protection.
- Update the LGMA portion of the App so that information and advice are presented clearly in tables.
- Improvement to the overall visual appearance of the App to make the look visually appealing, including smoother transitions from page to page.

App Dissemination:
After functional improvements and translations were completed to the Ag Water app and associated online tools, the project PI and team members hosted a series of “open house” events to evaluate the enhanced version of the Ag Water app as well as provide additional feedback to the developer for final consideration. The team worked to host a series of statewide open house learning events to disseminate the revised content. These events were held at existing grower meetings and trainings across the state. Additionally, our team was fortunate to be invited to industry related events, including those hosted by the Yuma Safe Produce Council, Western Growers, Produce Safety Alliance, and Arizona Department of Agriculture.

Project Challenges:

- A challenge that occurred during the final reporting period included the development of the tutorial videos and translation from English to Spanish. Some of the videos would not install properly into the app’s pages and had to be reconfigured to fix this bug.
- A second challenge included the discovery of broken links within the app after the final version was completed. App capabilities vary slightly between devices (Android vs iOS) and iOS versions of the app seemed to have a bug that Android versions did not have. Upon discovery, this bug was fixed by our app developer.

Outcomes and Accomplishments

Spanish Translation:

- The Ag Water app and the Online Calculator have been translated in entirety. The online calculator includes a Spanish link, which directs users to the Spanish version of the calculator and all features. The app includes a new Spanish link on the sign-in page, which directs users to the Spanish version of the app. Users can use the same username and password to login for both languages in the app.
- Each page and feature of the app has also been translated from English to Spanish. This includes the following app features and pages:
    - App Overview Page
    - Microbial Water Quality Profile feature, including samples, PSR results, and LGMA results
    - Current Water Sampling Conditions feature, including survey, water quality parameters, and results
    - 9 Approved Testing Methods
    - Recommended Mitigation Steps
    - Municipal Water for Agricultural Use
    - Water Testing Labs
    - App Help pages
    - Approved Testing Methods
    - Print Preview pages
    - Login page
    - New Account page
    - About Us and Contact page
    - Reset Password page
    - Settings
    - All error messages and pop-ups
- App pages were translated in batches (or chunks of content). Several translation reviews took place to ensure that the Spanish translations were accurate.

YouTube Tutorial Videos:

- YouTube tutorial videos were also developed as a project add-on to improve Ag Water user experience and provide a visual demonstration of key app features. Four videos were developed in both English and Spanish and were embedded on each help page within the app. Users now have the option to read or view app tutorials in their preferred language.
- The development of tutorial videos was outside of the project's original plan; however they are very useful and improve the usability of the app. Help pages in the app include a significant amount of text, which may be mundane for users to read when they need fast and accurate MWQP results. The tutorials are succinct and provide all of the information needed to easily navigate through the app and use each feature. The videos also show examples of how to use each feature, which is useful for users who prefer visual help over text.
- A YouTube channel was also developed to host the English/Spanish tutorials, which was not included as part of the original project plan but we feel is beneficial to the user stakeholders.

Functional Upgrades:

- An intermittent error where the app gave incorrect information regarding STV values less than 410 was corrected.
- A ground water feature was added to the app. Users can now calculate MWQP for both surface water and ground water sources. Notes regarding municipal water use were added to the app.
- The app overview was updated to include ground water rules as stated in the PSR.
- The edit feature for text fields in the MWQP samples page was updated to auto-populate text for the sample(s) being modified.
- A setting to turn help pop-ups on/off was added to the Settings menu. Previously, users were not able to turn help pop-ups back on after turning them off.
- Links on the home screen were updated to have an improved “button” appearance.
- The overall appearance of the app was improved to include a new theme with brighter colors. The app is much more inviting and includes an inner and outer screen to improve navigation throughout the app.
- The print preview screen was updated with new formatting. The new format includes the Ag Water logo, and an organized table displaying water sampling values and results. This update was made to improve the legitimacy of the printout when being used for an audit or other record-keeping purposes.
- The “Use My Location” feature of the Water Sampling Conditions tool stopped working in the previous version of the app. This bug was fixed so that users can use the app’s GPS feature to find their location.

Summary of Findings and Recommendations

During this project, the team conducted formal trainings and reached over 500 individual growers and industry members. The developed tools (mentioned above) have also been distributed through numerous industry trade groups, and tools are currently being used in the Produce Safety Alliance FDA grower and Train-the-trainer certified trainings across the country, thus indicating the usefulness of these grower-focused tools in industry. At the time of the writing of the original proposal for this project, the Ag Water app and Online Calculator had collectively received 4,385 page views and 1,186 active sessions. The data presented below outline analytics collected to date for both the app and online calculator. These recent values represent an increase of over 1,000% in page views and an increase of nearly 800% in active sessions over the last year alone!

Ag Water app and Online Calculator metrics –

- Ag Water app:
    - Users: 3,275
    - Pageviews: 48,741
    - Sessions: 5,742

- Online Calculator:
    - Users: 2,313
    - Pageviews: 5,223
    - Sessions: 3,541

APPENDICES

Publications and Presentations

2019:
The project PI, Dr. Channah Rock, presented an overview of the revisions and new user functions at the Southwest Ag Summit in Yuma, AZ, on February 21, 2019.

2018:
Dr. Channah Rock and Assistant in Extension provided a hands-on workshop and industry-testing event with the Arizona Department of Agriculture, and Yuma Safe Produce Council in coordination with the pre-season Vegetable meeting in Yuma, AZ, on September 4, 2018.

Dr. Channah Rock presented the project status in an oral presentation at the 2018 CPS Produce Research Symposium in Charlotte, North Carolina, June 19-20, 2018. This is an important event due to the interaction between research scientists; produce industry members and government regulatory personnel.

Dr. Channah Rock presented the project status in an oral presentation at the 2018 Western Regional Center to Enhance Food Safety annual meeting. This meeting was held on March 27-28 in UC Davis, California. This is an important event due to the interaction between research scientists, cooperative extension educators, and government regulatory personnel.

Dr. Channah Rock and Assistant in Extension fielded numerous phone calls and conducted one-on-one trainings on the use of the Ag Water app and online calculator after each of the Produce Safety Rule and Produce Safety Alliance grower trainings as well as On Farm Readiness Reviews conducted in the state of Arizona in 2018 and 2019.

Budget Summary

Total funds awarded were $36,727. Over the course of the project, grant funds were used to cover costs associated with the following:

- Salaries for research specialists and staff. A substantial amount of time was spent by our health educator, Dametreea Carr, in working with the App developer and translators, communicating edits to the app, and tracking progress of the Ag Water app development. She should also be commended by the level of effort that she provided to this project, well beyond the scope and budget.
- Salary for research scientist. Responsibilities included advising the project members and supporting industry questions and comments.
- Travel. Costs were allocated in the budget for travel from Tucson and Maricopa, AZ, to Yuma and Phoenix, AZ. Costs included mileage, per diem for lodging and meals, as well as any incidentals incurred. Additionally, the project PI and staff traveled to a number of industry support events and the 2018 Center for Produce Safety annual research meeting.
- Consumables. A portion of the budget was dedicated to expendable supplies related to workshop/training events.
- Subcontractor. Funds were allocated to the original app developer to complete revisions of the online calculator, native app, and Ag Water app for iOS and android devices into Spanish.

Figures 1–3

Figure 1. Previous App Views (user entered lab results and GM/STV Calculations)

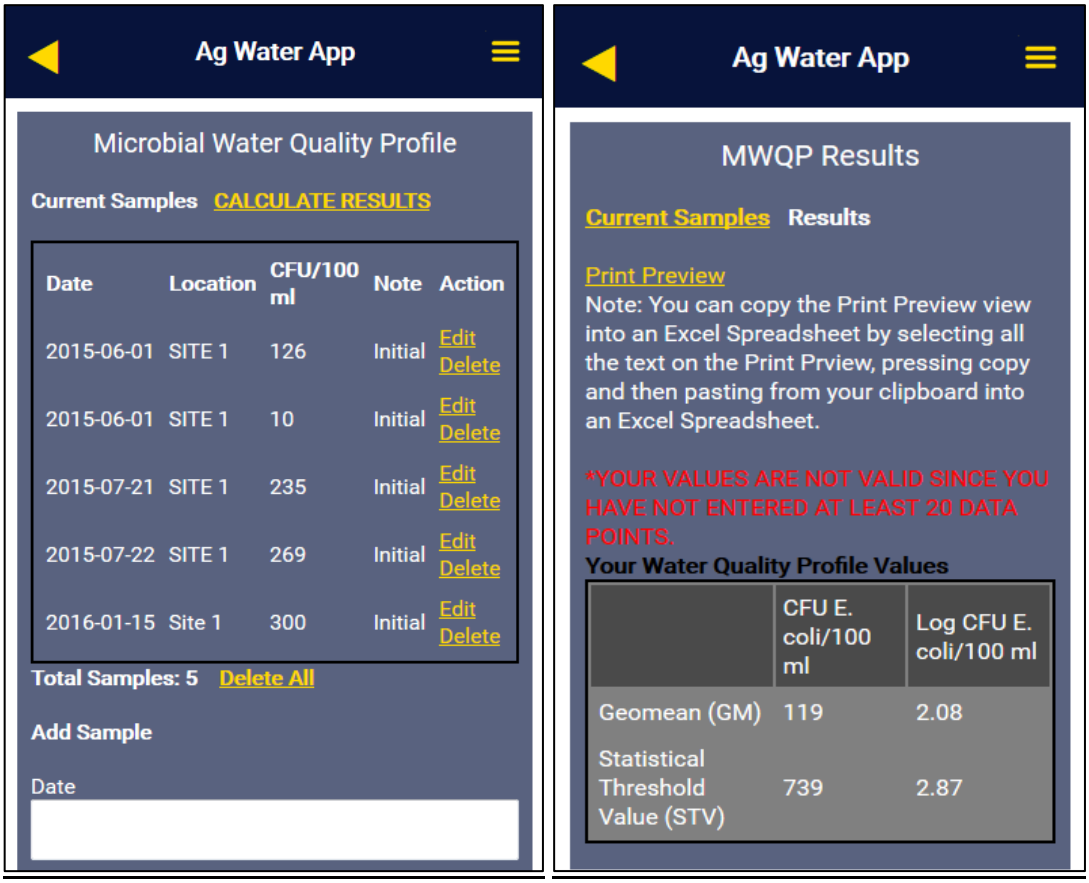


Figure 2. NEW Ag Water App Video Tutorial pages in English and Spanish

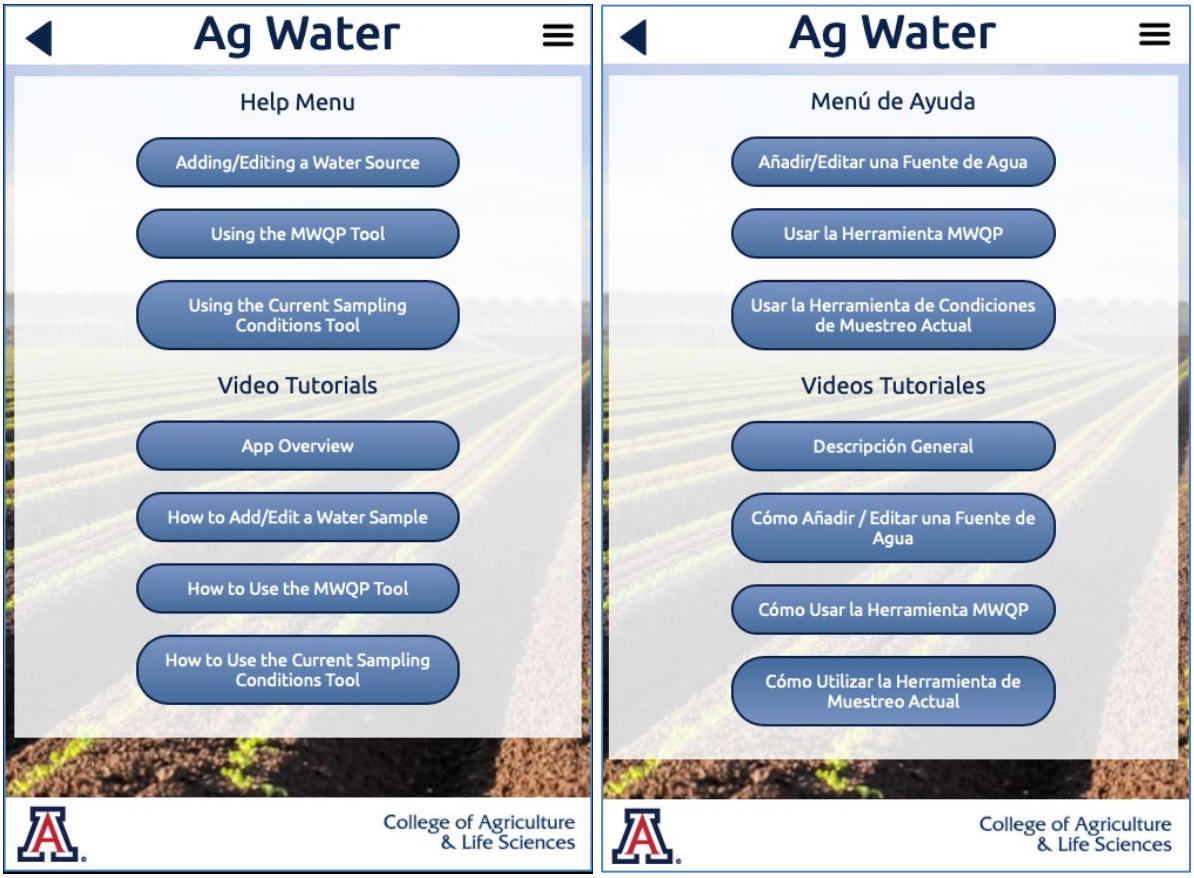
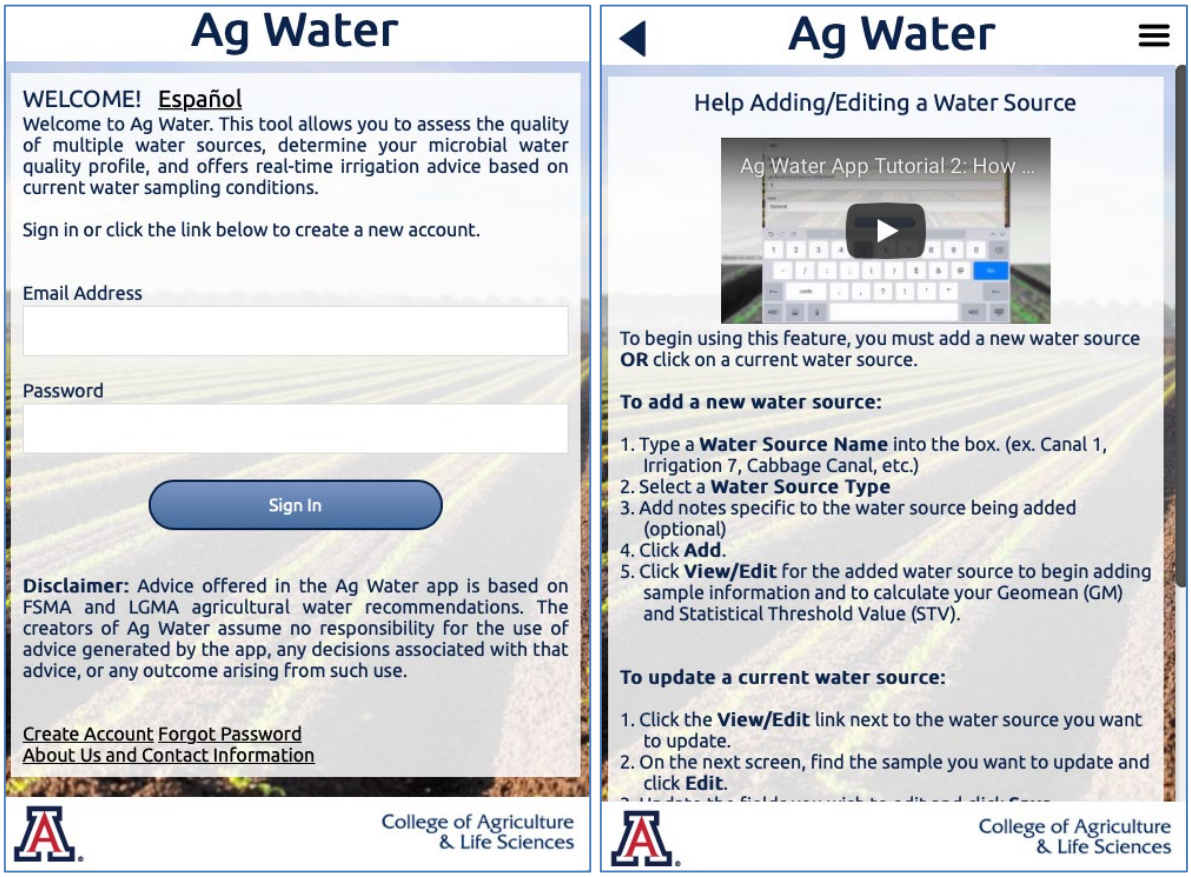


Figure 3. NEW App Views (user sign in and entering lab results, with video tutorial)



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