**WERA 1022 (Engineering) / WERA 102 (Climatology) Meeting**

September 12, 2017

**Day 1**

**Introduction by Ed Martin, University of Arizona Maricopa County Extension Director**

* Largest extension office in US
* Detailed the origins of this meeting and the importance

**Presentation 1: L. Neil Allen, Utah State University State Irrigation Specialist, Civil and Environmental Engineering**

* FY2016 Extension Water Conservation Initiative $950,000 per year
  + Three new positions
  + Research grants
  + Center of Water Efficient Landscapes
* Lots of small farms
* Surface water source 5M acft/year
* High Resolution Remote Sensing Info for Yield estimation under deficit irrigation for water conservation Sept 2016-Dec 2017
  + Fly drone before harvest
  + Fly drone after harvest, can pinpoint each yield measurement
  + Look at relationships between yield and indices
* Management of drip irrigation for saline soils in Utah (Sep 2016-Dec 2017)
  + Acclima TDR sensors in grid form for both VWC and Salinity
  + Drip tape was surface or 3 inches below surface on potatoes
  + Ed Martin talked about salt accumulation on surface by burying drip tape 8 inches below surface and pushing the salts up. Caused failed growth
  + Neil has access to sprinkled irrigation to help with that problem
* Evaluation of Low Energy Precision Application (LEPA) Irrigation with Center Pivots
  + Straight and circular rows
  + 30” spacing, 18-24” above soil surface
  + Trying to use in windy locations (showed video of the difference)
  + Was worried about high application rates that may cause runoff due to low infiltration rates from the clay
  + Retrofitted one span, but applies same amount of water per acre and under same pressure restriction (10 psi)
* Documenting Human Health impacts of exposure to microbial and chemical hazards in reclaimed wastewater used in urban agriculture, Cache Valley (USDA NIFA Water for Agriculture Aug 2017-2019)
  + Water is step below drinking quality
  + Concerned about drugs, but the ag side will have pesticide issues due to canal systems
* Irrigation Management Concerning the Food Safety Modernization Act (Extension Mini-Grant)
  + Raw consumables (onions, apples, etc.)
  + Sample irrigation water for E. Coli and choloform
  + Managing irrigations and harvest to minimize E. Coli
  + Ed Martin – water quality part has been put off until 2020, attended a meeting that went through the requirements and it was super confusing
  + Someone said that processors are requiring FSMA ahead of the deadline on the east coast
* Impact of shortened irrigation season on pasture water use and yield/pasture wate use efficiency and irrigation management to conserve water (Utah Ag Exp Station 2013-2018)
  + 7-12 inches of rain, grass lives but yield is zero
  + In another location, high water table helps with a ton to 1.5 ton difference in yield
  + Next step is to quantify how much the water table contributes to the yield
* Impact of Urban Irrigated Agriculture on Utah’s per Capita Water Use (Utah Water Research Lab, Utah Mineral Lease Fund, 2014-2016)
  + Big farmers do well, but small farmers have trouble
* GridET Model
  + Plant Consumptive Use and Surface Evaporation Estimates for Utah using a gridded weather forcing data set
  + Combined with crop maps, they can estimate crop water needs across the state for planning purposes
  + Third mile grid, but you can choose different grids
  + NLDAS framework
  + Groundtruthed with agricultural sites with good accuracy
  + LandSAT doesn’t have a field scale grid, so definitely less accurate
* Ed Martin asked if he was doing any irrigation scheduling
  + Neil says they have it available on a website and winter meeting discussions suggest farmers are using it
  + ET equation is Penman-Monteith, but Hargreaves does well in Utah
  + Jama said that their weather network is in her program, putting in new weather stations and eddy covariance systems to supplement current system

**Presentation 2: Peter Goble - State climatologist for Colorado (RA fill-in, position being advertised)**

* CoAgMet is expanding
  + BoR expanding network with additional stations
  + website overall
* ET demand-related projects
  + Irrigation scheduler tool with app for weather station
* Drought activities (NIDIS collaboration)
  + Spread info and recommendations to extension and public agencies for planning
* Comparing CoAgMET to NLDAS evaporative demand
  + Similar pattern and fairly good accuracy
  + NLDAS tends to be higher
  + Difference is attributable to irrigation (remarkably close in dryland)
  + Can correlate between the two lines based on percentage of irrigation
  + Grid resolution is 12 km, too large
  + Dan McEvoy did the same thing on 4 KM grid, but found the same thing
  + Neil also found the same thing, agriculture is just different
  + Though close, predicting drought indexes led to different results
* Temperature predictions? Missed it ☹
* CoCoRaHS collected information from Harvey and Irma hurricanes, unprecedented amount of data (collaborative network)
  + Gene Stevens - Discussion about Zulu time vs. daily times that mess up rainfall inputs to scheduler, others haven’t had this problem
  + NRCS requirements for irrigation scheduling payments are dependent on state and regional decisions
  + Jama said that the largest power company in Pacific NW has found that irrigation scheduling has no impact, so they’re reducing funding
    - Study was not done scientifically
    - After 34 year partnership, they gave USBR 90 days’ notice that they were terminating their funding

**Presentation 3: Amir Haghverdi, UC Riverside for Urban Water Management**

* Amount of drought has been extreme
* ET-based smart irrigation controller project
  + 72 plots 12 ft by 12 ft 2-3 ft borders, tall fescue and bermudagrass, 6 irrig levels (100% et to 50% et), 2 frequencies 5 d/wk and 3 d/wk
  + Plots have flow meters, pressure regulator, filter
  + SM monitoring (Acclima TDT and watermarks)
    - Watermarks at 8, 13, 17, and 25 inches
    - TDT and MPS6 at 4-5 inches
    - Generating water retention curves
  + NDVI and Thermal
    - Cell-phone based imaging
    - Seek, FLIR, Green Seeker NDVI, Thermometer
  + Weather station was CIMIS with Penman-Monteith equation
  + WBIC (Weathermatic)
    - Uses Hargreaves equation
    - Picks amount based on ET accumulation
  + Results
    - Some over-application of irrigation, but definitely differences in treatments for both warm and cool season grasses
    - NDVI differences show deficit
  + Discussion about urban irrigation scheduling, how to handle urban agriculture when ET doesn’t incorporate concrete surroundings
    - Look and feel method
    - 10 gpm per acre rule
    - Give maximum curves to target below maximum need combined with penetrometer for verifying infiltration
    - Time is an issue – one on one need but can’t help everyone

**Presentation 4: Kendall DeJonge - USDA ARS Colorado, ET-based scheduling, remote sensing**

* Building an irrigation training center (more information next year)
* Deficit irrigation management (research potato farm visited during Colorado WERA 1022 meeting)
* Physiological constraints of water transport and photosynthesis
* Corn/sorghum rotation (corn/sunflower rotation previously)
* Subsurface drip area to do an irrigation scheduling project
* Irrigation applied through Campbell Scientific system based on volume measured by flow meters (not timed)
* Discussion about timed method vs. flow meter method and leaks that can occur and how to detect them
* Neutron probe and TDR data showed soil water deficit for two treatments (full irrigation vs. deficit irrigation) and relationship with readily available water
* Discussed the difference between what a sensor does for a researcher and what a producer wants. Gas gauge vs. actual measurement
* Gene Stevens asked about growth stage – Kendall said that they’re only deficit irrigating until tassel. Jay said that the stress delays the growth stages, which makes it difficult to compare
* Swears by neutron probes as ultimate sensor for research
* Crop water production functions yield vs. water applied OR ET
* Physiology - sap flow via heat balance,
  + relates to transpiration
  + break frequently
* Root growth and distribution
  + Minirhizotron system images recorded every 14 d viewing area down to 1 m
  + Must train software
* Will give private tour of the research if requested

**Presentation 5: James Adkins - University of Delaware Research Farm**

* Geared toward nutrient management and profitability, not water conservation due to Chesapeake Bay issues
* Non-graded fields, no furrow
* Wanted to create Irrigation BMPs for nutrient credits, but hasn’t worked out like planned
* Using Veris to handle different irrigation treatments using EC for soil texture
* VRI on pivot
* Soil moisture – watermarks at different depths, no deeper than 18” due to pH issues that create shallow root zones
* Allocation of groundwater ~12 inches per year, can argue to get more easily. Farmers can turn in hours on a diesel engine as approximate usage
* Find lots of problems with pivots found all over the area
* Drip tape buried at 16” for SDI
* Best treatment was to not irrigate during the flowering period
* Soybeans – early stress benefits yield best was 60 cb to R3 to R6 then 30 cb rest of season
* Drone imaging, NDVI, NDRE, NIR

**Presentation 6: Kevin Brinson - runs MESONET for Delaware, University of Delaware Department of Geography**

* The DEOS network – Delaware’s mesonet with many stations in a small state
* 10 m towers were challenging, so they use 3 m stations
* Drop in bird issues from ultrashields
* DIMS – Delaware irrigation management system for irrigation scheduling
  + Web-based tool
  + Automatically determines soil type and weather data for field location
* Special ET sensing projects
  + Measuring the variability of ETo under different irrigation methods
  + Spatial variability of ETo with respect to synoptic and mesoscale weather conditions
* Lima bean disease risk
  + Hyre Model (temp/rain based)
  + Raniere Model (Temp/Dewpoint Temp based)
  + 1 to 10 risk scale

**Presentation 7: Gene Stevens - University of Missouri soil scientist (works closely with Earl Vories)**

* MU Crop Water Use App ([www.cropwater.org](http://www.cropwater.org)), projects ET forward to help plan for irrigation
* Discussion of rooting depths, most roots in the top 18 inches
* Looked at yield differences in triggering irrigation at different depths
* DD60 Crop modeling, using GDD
* Solar radiation stress index for cotton (Michelle Reba Ark ARS and Tina Teague Ark State U)
* Next year: furrow irrigation option from well flow rate, hours pumped, and acres irrigated
* Ed Martin asked about the Woodruff Chart. Gene explained that it is for a normal year and not this year, so it can over or under water. If you have the weather system, then you should use it. However, it’s a good low-tech option and something is better than nothing.
* Discussed irrigation scheduling at the pivot panel. Charles Hillyer said that Lindsay is already doing that with FieldNet. They’ve incorporated CropWat into the program. Troy Peters and Charles Hillyer helped them develop it.
* Discussed rainfall variability and how to handle it with technologies and extension.
* Jama went over her data systems (Pisces, etc.)

**Day 2**

**Presentation 8: Jama Hamel, USBR, Chair of both committees, civil engineer and geology background**

* USBR manages water in the west, focused on conservation right now
* AgriMet weather station network is primary focus, began in 1983
* Stations are maintained once per year due to their large distribution
* AgriMet has over 25 partners across public and private entities
* Discussion about how the funding works and how station sponsorship works.
  + No one wants to fund on-going O&M costs.
  + Cities have begun to use AgriMet to meet DEQ requirements for applying wastewater effluent to lands
  + Bonneville Power Administration (BPA) pulled their funding with 90 days’ notice, putting future weather stations in jeopardy
  + Bonneville’s decision has radiated to outside the Pacific NW
  + Reduced funding would change the AgriMet program, but it would not go away completely
  + Questions were raised about whether WERA can draft an open letter to BPA about the problems with their study and estimating its implications
  + Jama emailed information related to the BPA study for review by the group
  + Charles Hillyer agreed to draft a letter to send around the group for review and signatures
* Sorry – I missed most of this with other work

**Presentation 9 (Guest): Anheuser Busch – Doug**

* Barley quality is a huge issue for beer
* SmartBarley Program started when they became a global company
  + Surveyed producers
  + Work directly with >20,000 barley growers across the world, >1M hectares of land
* Want a specific protein range for a good drink
  + about 9.5% to 11%
  + Controlled by nutrients, water, and variety
  + Nitrogen is the main issue out of all nutrients
* Needed weather stations in specific stations, so sponsored to add weather stations to AgriMet’s network
* Used to use Washington State’s Irrigation Scheduler program, but found that inputs are important and wouldn’t always look right
* Instead, started email program where ET is sent to the farmer daily so that they can make decisions – GREAT SUCCESS!
* LESA Irrigation Study
  + Partnered with Howard Neibling in 2016 with small scale systems
  + Moved to large scale systems in 2017
  + Three growers each year
  + Data collection included SMS, flow meters
  + Plans to continue in 2018
  + Learned that more water is getting into the ground!
* Jama showed an example of her crop water use emails so that we understand what the growers respond to.

**Presentation 10: Dan McEvoy - Western Regional Climate Center, Desert Research Institute, Reno, NV regional climatologist**

* How ET plays a role in drought, irrigation demand
* When first started, two weather stations in non-irrigated areas
* Started installation project in 2010
* Currently 18 stations
* NICE Net was incorporated into AgriMet for BoR
* Emphasized the need for accuracy in rain measurements, they included both a tipping bucket rain gauge and a Geonor weighing gague with Alter shield. Also collecting rain for isotopes to deterimine origin
* Discussion of rain gauge products, installation, and data accuracy. Suggested by UD that rain gauges should be installed at 1 meter or lower. Ideal location is buried in the ground.
* Discussed arid bias in ETo estimates
* Compared weather station to gridded data and saw some differences
* ETo Tools climate engine has ability to show drought, looking at anomalies
* Evaporative Demand Drought Index (EDDI), converted to drought monitor
* Transferring EDDI to NOAA product by 2019
* Forecasting ETo worked well but forecasting rainfall did not go well

**Presentation 11: Charles Hillyer – TAMU AgriLife**

* Data language development
* Scheduling tool for many sensors, need storage and analysis before going to the user
* Each sensor has a different language. So all of them need to be converted to a language that all of them can communicate
* Automation makes it even more complicated
* PAIL – precision ag irrigation language 🡪 standardizes the language, but pushes it back on the manufacturers
* Consortium of industry and researchers called AgGateway to address the issues and develop the language – close to the end now
* PAIL came out of a NEAA meeting and developed a diagram to show the different elements needed, but that they don’t talk to each other
* Scope includes both observations and operations
* Discussion about weather data providers participating in AgGateway and where they get their data
* Irrigation Scheduling Tool for TX North Plains – fully integrated tool that shows off PAIL
* SQL database, ASP .NET application, PAIL library in C#, and vendor specific adapter
* User interface was designed to be as simple as possible including field setup, schedule, management, summary, and setup
* Showed videos of the interface tabs to see how they work
* Discussion of Management tab with adjustments to MAD and target irrigation level and differences between arid and humid climates
* SWB uses a correction factor to add water when you know that the SWB is wrong
* Working on demos now and will continue next year
* Invited participation in X632 ASABE committee

**Presentation 12: Stacia Davis, LSU AgCenter State Irrigation Specialist**

* Discussed crop coefficient development from soil moisture sensor data
* Discussed plot work and difficulties surrounding my research conditions
* Discussed lack of functioning weather network during long transition to new system

**Presentation 13: Dirk Baker- Campbell Scientific Researcher**

* SPICE: WMO solid Precip intercomparison experiment
* Has a weather station that experienced (and survived) Hurricane Irma in Florida
* Showed some weather sensor products to update the group
* Mesonet essentials website created but not released to the public
* Looked at spectral error in two types of pyranometers (thermopile vs. silicon cell) caused by clouds
* Showed the CR300 with specs. Will have data plans directly

**Kevin Foley**

* USBR Great Plains Region – brand new!
* Background in sensing networks
* Introduced to group, but no presentation given this year