certain types of insecticides will flare spider mites, producers are beginning to utilize other chemistries less likely to flare mites when they are present in the system.

This paper will address ways producers can minimize their losses from some of the most damaging insect pests of cotton in the mid-south.

Program 6C-2

▸ Practical Irrigation Scheduling In Cotton

Presented by Dr. Leo Espinoza
Associate Professor and Extension Soil Scientist, University of Arkansas

Irrigation management is of paramount importance to maximize yield potential in cotton. Lint quality and quantity are affected by water management. A 2008 irrigation survey conducted by the Cotton Advisory Committee indicated that irrigation water pumping represents 49% of the energy consumption in cotton production. The survey results revealed needed improvements in scheduling cotton irrigation. More than half of the growers responding to the survey stated that visual assessment was the preferred method to schedule irrigation, which normally results in excessive irrigation. For the last 5 years, a demonstration project using atmometers or ET gages, to schedule irrigation, has been underway in Arkansas. Results show the atmometers provide reproducible estimates of potential evapotranspiration and can be placed 3 miles apart. Evapotranspiration readings were collected every 3 days, with soil moisture deficit to trigger irrigation set at 2 inches for silt loams and 3 inches for clayey soils. Significant water savings have been achieved using this approach. During the 2010 season, more than 10,000 acres were irrigated following this approach, but this figure may increase as collaborators plan on increasing the number of acres. The objective of this talk is to present results of such project, including experiences implementing such approach at a whole farm scale.

Program 6C-2

▸ Using Wireless Soil Moisture Sensors For Increased Yields

Presented by Dr. Joe Henggeler
State Irrigation Extension Specialist, University of Missouri

Wireless soil moisture sensor technology combines two things:
(A) traditional soil moisture monitoring (e.g., with gypsum blocks, tensiometers, etc.).
(B) wireless communication.

The end result is that the soil moisture status of one's crop can be monitored 24-7 from a computer or smart phone. A farmer can see how much rain the field got, how deep it soaked, and the water being slowly extracted from the soil at different depths. The sensor technology has been available for about 100 years, but coupling it with wireless technology has imbued it with new synergism. Ordinarily, sensors were read periodically, in the order of once a week. This provided a SNAPSHOT of the root/soil/moisture complex for the farmer to make management decisions about irrigation. After sensors were tied to data-loggers the farmer was given a HOME VIDEO of the root/soil/moisture complex for making these decisions. Tying the data-logger to wireless technology quickly followed, and now an irrigator (once the sensors are installed) only needs to turn on his computer to see the current soil moisture situation in his fields.

Farmers seem ready to embrace this new technology. Three Wireless Irrigation Sensor workshops were scheduled a year ago in Missouri with over 100 attendees, most of them farmers, signed up for the workshops. Wireless sensor companies present were Decagon, Irrometer, Campbell Scientific and Onset.

Normally, growers put sensors in at three depths (6, 12, and 18 inches) at each locale and have three locales in their field. Growers are told to carefully monitor the 18-inch depth, since when it starts to deplete it means that the 6 and 12-inch depths are running short of water. No one was arguing that the data from the sensors would not help farmers make informed choices about irrigation.

However, past research by the University of Missouri showed that one of the most critical factors in making this technology successful is that the communication between the sensors in the field and the farmer's home computer be flawless. Cotton Incorporated (CI) likewise felt that trouble-free links must exist are the busy farmer will abandoned using the technology. Therefore, they initiated several demonstrations in various states in the mid-South to see if the technology could be taken off the shelf and made to work in the fields of typical cotton farmers.

In the CI demonstration the project manager asked me to be the cooperating researcher and asked me to test Decagon sensors/wireless equipment. I was to locate a suitable cotton famer in southeast Missouri to evaluate everything about using wireless sensors to grow cotton. The farm I found was run by three generations of cotton farmers: Max Ray, Marty & Ryan. I visited them in early April to explain the project and look at the field. They indicated that they would be involved, but wanted the right to make the final call on whether to irrigate or not; that was perfectly fine with me and, in fact, that was how I had planned to work with them. Ryan is the most computer-savvy, so most of the work was with him. The location had good AT&T service

Since Decagon makes both a sensor that records soil moisture tension (like a tensiometer does with units in centibars), as well as one that records volumetric soil moisture that records data in % moisture or inches per foot, we hoped to use both types to see if the growers had a preference. Unfortunately, their new tensiometric sensors were not ready for delivery, so we evaluated just volumetric sensors. We also added a rain gage to the group of sensors, which turned out to be very useful.

I had asked Ryan to sit in on a "webinar" that Decagon was going to give on their data- logger. It was totally Greek to him and I had to assure him that the information he was going to receive would be helpful. To this end, I wrote an Excel program that took all the data that was being stored at the company's data storage site and allowed the data to be viewed in three additional graphs:

- By site (averaging the 6-, 12-, and 18-inch depths into one graph [Fig. 1]).
- By depth (averaging each depth from the three sites into one graph [Fig. 2])
- Averaging all nine sensors (3 sites X 3 depths) into one graph.

My staff did the actual installation of the sensors (Figs. 3 and 4). We also had to initially help Ryan get on the website, after this we was able to do so unaided and could put the data into the Excel graphs we had developed. He and his father looked at the graphs & understood when they should irrigate. Ryan and I texted each other concerning when to irrigate. Through this I had the wake-up call that their world did not center around this one pivot, that they had watermelons to harvest and sell, spraying that need to be done and the keep-out periods adhered to, etc. One of the points we were keying in on was not to let the 18-inch depth start to dry out (meaning that the 6- and 12-inch depths were heavily depleted [Fig. 5]).

Several problems encountered during the study were:

- One sensor that "bled" (Fig. 6) making it useless as a sensor as is (in the Excel program I cleaned up the data so it could be used)
- One of the data-loggers that stopped sending data (I could go out & manually download it [Fig. 7]).

However, over all, the operators of the farm felt that it caused them to change the way they were irrigating. They feel that this field (one of 17 pivots they operate) will out-yield the other ones. One of the things that helped them was seeing the amount of moisture that actually got into the soil after a rain or irrigation. Figure 8 shows the number of bolls in three feet of row.

As already mentioned, one of the original stratagems was to apply enough irrigation water so that the water content in the 18-inch depth did not noticeably decline. It can be seen in Figure 2 that the content at this depth began to decline about mid-July. We had a very hot, dry summer and this pivot has watermelons planted on a quarter of it, so water was shared between two crops. What ended up as the practice was to keep smaller, frequent applications continuing so that the 6-inch depth had adequate water. Near peak bloom the water was ramped up so that the 12-inch depth was also being supplied water. So what was happening was the 18-inch level declined and the 6- and 12-inch were "spoon-fed". It reminded me of sub-surface drip irrigation. You could say that with these wireless sensors, the soil moisture was managed as if by a conductor.

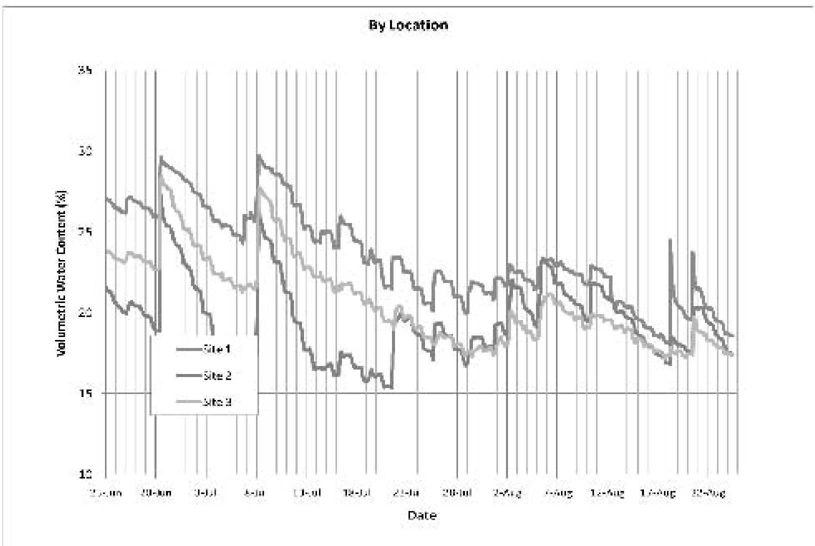

Fig. 1. Graph of average soil moisture % for 6-, 12-, and 18-inch depths for Site 1, 2, and 3. "Bleeding" data has been corrected.

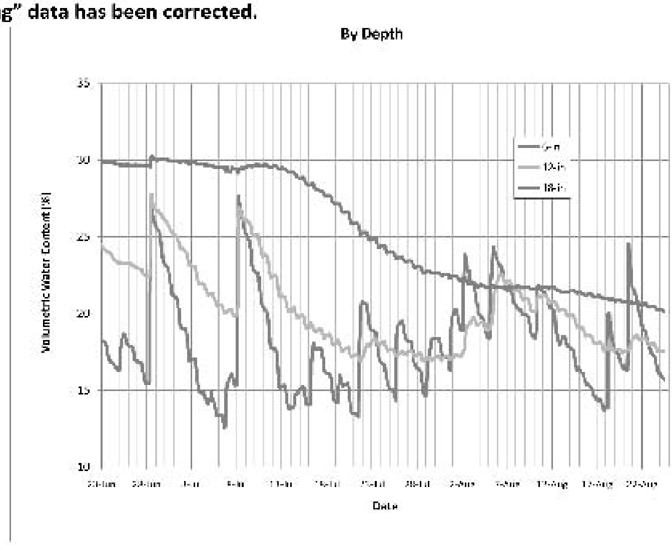

Fig. 2. Graph of the average soil moisture % at 6-, 12-, and 18-inch depths by averaging values from Site 1, 2, and 3. "Bleeding" data has been corrected.

Fig. 3. Installing PVC stand to allow the PVC pipe used for the pole to be pulled up and laid flat if the farmer needed to farm over it.

Fig. 4. Getting ready to install an EC-5 volumetric moisture sensor.

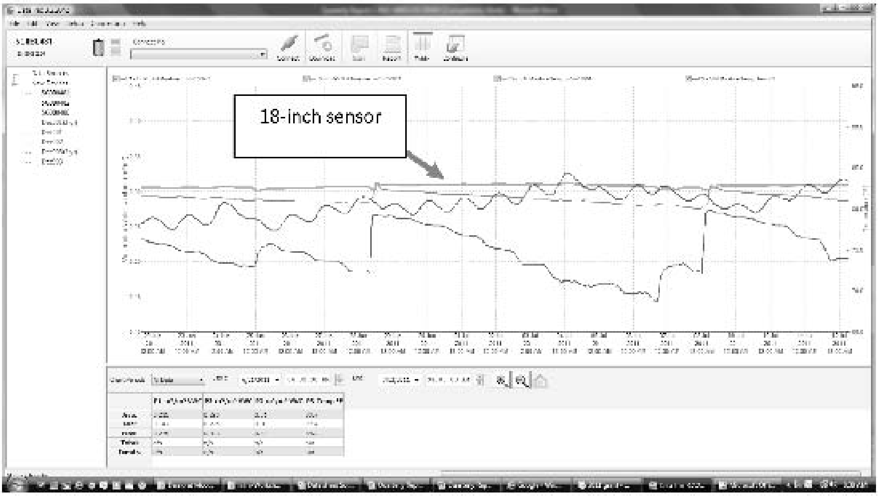

Fig. 5. A DataTrac graphic of the first of three location under the pivot. One of the things that the growers learned was that it becomes dangerous when the 18-inch sensor begins to drop down.

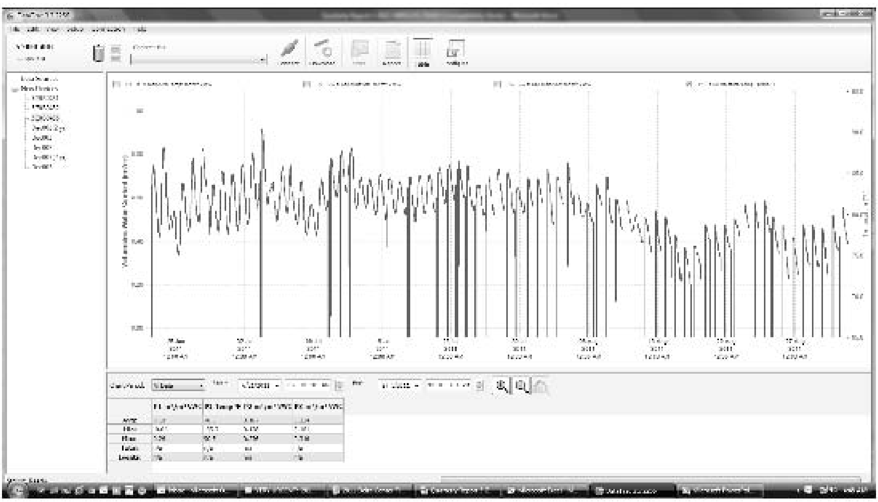

Fig. 5. DataTrac graph of Site 3 sensor that had "bleeding" problems.

Fig. 7. Downloading the EG-50 data logger manually after it lost contact with DataTrac central.

Fig. 8. The number of green bolls harvested in 3-feet of row.