Progress Report January 2021

Comparing Soil Moisture Sensors and Their Effectiveness in Blueberry Soils: The experiment is taking place at an acre field at the University of Georgia blueberry farm at Alapaha, GA (Lat: 31.346890º, Long: -83.240882º), 6.2 acres commercial blueberry field at Manor, GA (Lat: 31.161752º, Long: -82.601050º) and 8.5 acres commercial blueberry field at Alma, GA (Lat: 31.664496º, Long: -82.605160º). Each field is equipped with drip irrigation system. Two Aquacheck Classic probes, four Irrometer tensiometers, six Watermark sensors and six Decagon ECHO EC-5 were installed at each field to record soil moisture and to evaluate their performance. Two locations were selected randomly at each field where we installed the sensors next to each other (Figure 1).

Figure 1. All four different soil moisture monitoring systems installed at the blueberry fields.

Aquachecks Classic probes: Details about these probes can be found here (https://aquacheckusa.com/probes/). The installation of the probes was easy and it required a metallic pipe to open a hole on the ground. Probes are setup with a datalogger that is connected wirelessly. However, the datalogger must be very close to the probe otherwise the connection is lost. The menu of the datalogger is complicated and it is very easy for someone to make a mistake during the configuration process of probes. Additionally, there is not a user manual. The advantage of these probes is that they record soil moisture at the whole soil profile so as users can have a better understanding of the soil moisture variability. The probes that have been used at the current project record the volumetric water content at 8in, 16in and 24in (Figure 2).

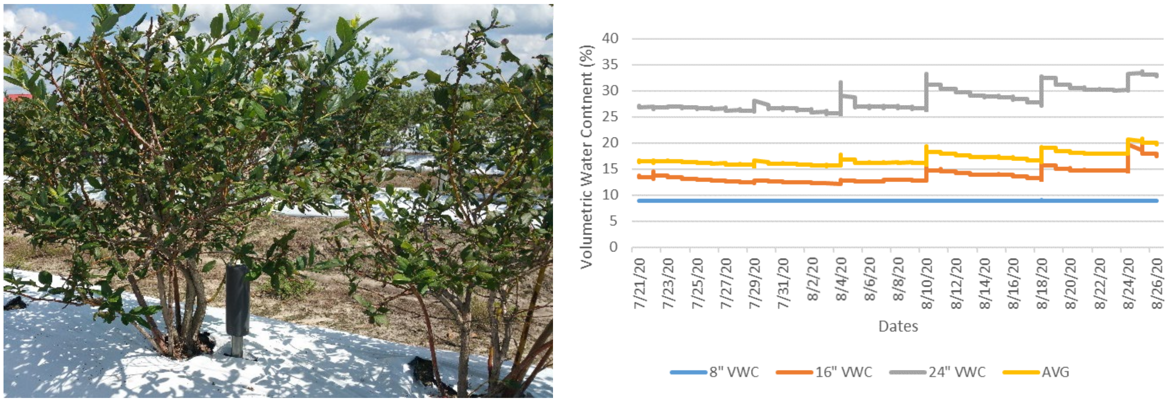


Figure 2. *Left:* The Aquacheck Classic probe installed at a blueberry field. *Right:* The graph shows an example of the collected volumetric water content data at three different depths. It is clear that there is not enough moisture at the depth of 8in. This usually occurs because of the high infiltration rate of the sandy soils.

Irrometer tensiometers: Details about these tensiometers can be found [here](https://www.irrometer.com/sensors.html#irro) (https://www.irrometer.com/sensors.html#irro). At the current work the tensiometers were installed at the depths of 4in and 8in. The installation process was very easy (we just pushed them gently to the ground). However, it took long time to prepare the tensiometers for the installation. The preparation requires the use of a special colored liquid that has to be poured inside the tensiometer and then the trapped air inside the tensionmeter has to be removed using a special hand pump (Figure 3). Definitely, the preparation procedure should not be done at the field.

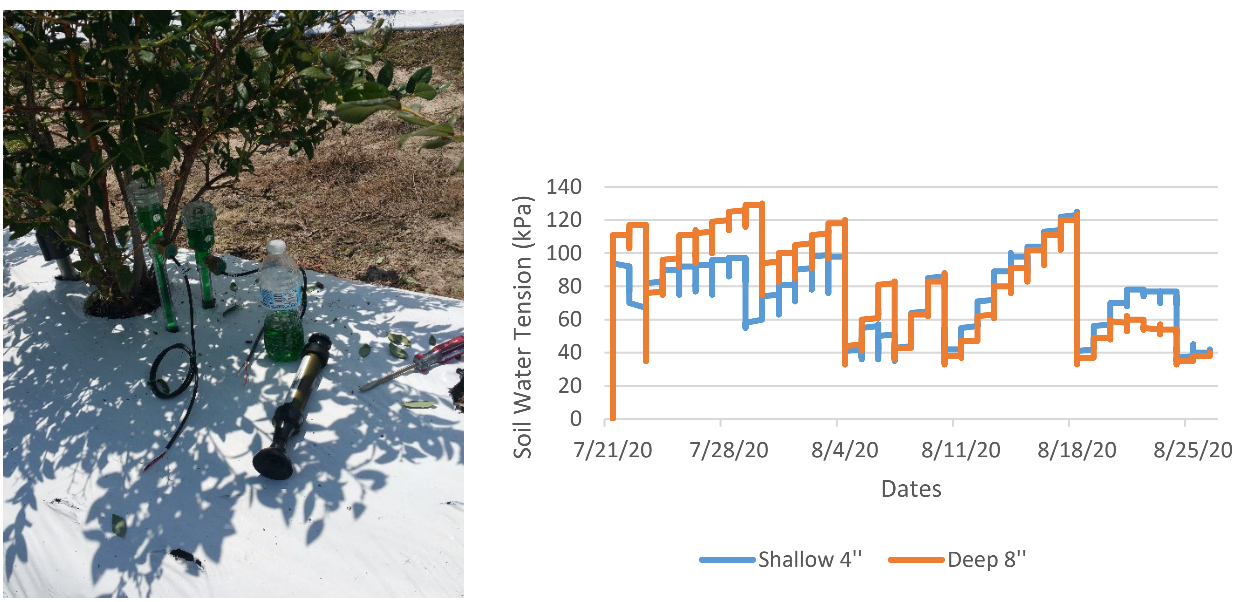
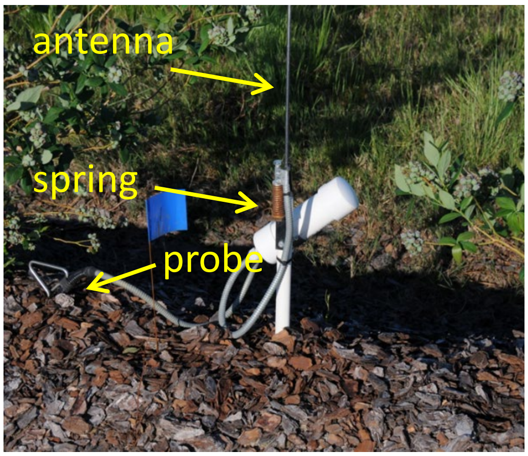


Figure 3. *Left:* An Irrometer tensiometer installed at a blueberry field. It presents also the pump and green liquid that were used for the preparation of the tensiometers. *Right:* The graph shows an example of the collected soil water tension data at two different depths. In most cases the soil is more dry at the 8in that at the 4in. This means that the roots at 8in are more active and absorb more water than at 4in.

Watermark sensors: Details about these sensors can be found here (https://www.irrometer.com/sensors.html#irro). The University of Georgia Smart Sensor Array (UGA SSA) system was installed at the three fields (Figure 4). This system records soil moisture data every hour. It consists of several nodes and a basestation that collects the data from the nodes. Each node consists of three soil moisture sensors (Watermarks) at three different depths (4in , 8in and 16in). The installation of the sensors was very easy we just had to push the sensors gently in the ground. The main advantage of this system is that it sends the data to a server every hour and users can see them in real time. The only drawback of this system is that it requires battery changes about three times per year.



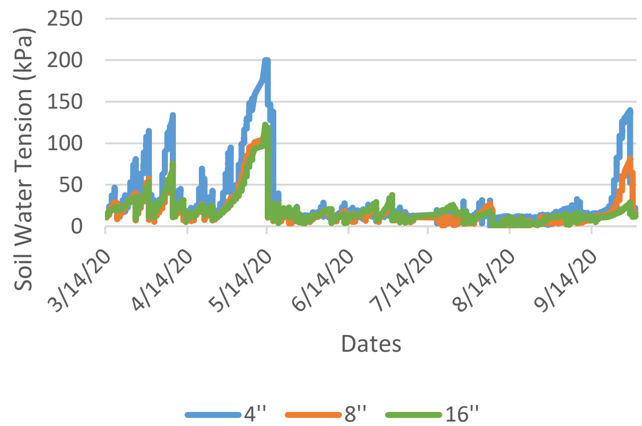


Figure 4. *Left:* A University of Georgia node that uses Watermark soil moisture sensors. *Right:*The graph shows an example of the collected soil water tension data at three different depths. The top soil dries very fast due to the high infiltration rates of the sandy soil.

Decagon ECHO EC-5 sensors: Details about this sensor can be found here (https://www.metergroup.com/environment/products/ec-5-soil-moisture-sensor/). The installation of the sensor requires the use of an auger to open holes at specific depths (4in, 8in and 16in). The sensor works good with the datalogger. The drawback we noticed so far is that the dataloggers run out of battery very quick and we have to go to the field very often to replace batteries. The second disadvantage is that the ECHO EC-5 sensors have very long unprotected wires and they can be damaged during an agricultural task or chewed from animals (Figure 5).

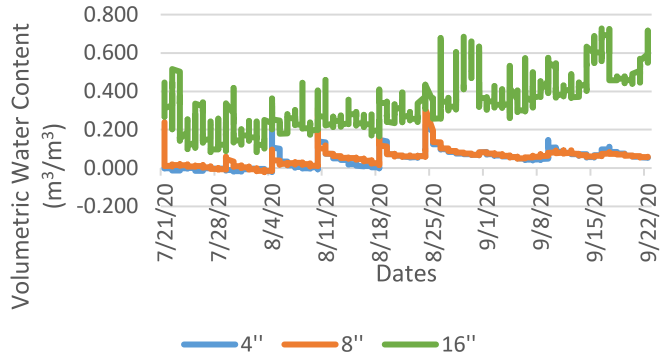


Figure 5. *Left:* Decagon ECHO EC-5 sensors installed at a blueberry field. *Right:* The graph shows an example of the collected volumetric water content data at three different depths. In this case, the volumetric water content data at 4in and 8in are similar and show that the soil was dry. On the other hand, the volumetric water content is higher at 16in. This confirms that the water is not available at roots at depths up until 8in and it flows to deeper depths.