Cooperative Extension
University of Hawai'i at Mānoa
College of Tropical Agriculture and Human Resources

The Importance of Testing pH and EC in Agriculture

Aimee Taniguchi, Lindsey Okumura, Gerardo Spinelli, Josh Silva, Jensen Uyeda, and Jari Sugano
University of Hawai`i at Mānoa
College of Tropical Agriculture and Human Resources
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Testing for pH and electrical conductivity (EC) is essential to success in agricultural production systems. Together, the two are easily measured and can provide vital information on the growing media, hydroponic substrates and other crop inputs being used. As technology advances, there are different ways to measure pH and EC in a field environment.

Electrical Conductivity (EC)

EC measures the salinity and electrically charged nutrient ions in a solution (Bluelab, 2015). Even if you cannot see sediment or particles in a solution this does not mean there are no electrically charged nutrient ions. Pure water does not conduct electricity, whereas, irrigation water may be full of impurities which may conduct electricity (Bluelab, 2015). EC does not specifically measure certain ions or salt compounds, but the correlation to concentrations of nitrates, potassium, sodium, chloride, sulfate, and ammonium (Natural Resource Conservation Service).

Photo 1

In soils, properties that contribute to EC are clay content and mineralogy, soluble salts, soil water content, bulk density, organic matter, and soil temperature (Corwin & Lesch, 2005). Those properties are characteristics of soil that may contribute to the final EC measurement.

Plant roots impacted by salinity can be expressed as reduced growth rate, changes in leaf color, leaf necrosis, changes in root to shoot ratio and affect how the plant ages (Shannon & Grieve, 1998). There are different factors that influence the salinity in the soil. Some factors are temperature, wind, humidity, light, and air pollution (Shannon & Grieve, 1998). Different plants have different thresholds of salinity in which that they can thrive in. With the right level of EC, favorable effects on yield, quality, and disease resistance are possible outcomes (Shannon & Grieve, 1998).

To measure the EC in soil: 1) collect a representative soil sample from the targeted area, 2) place the soil sample in a Buchner funnel, 3) wet the soil (approximately 100g) until the sample is fully saturated and glistening, 4) apply suction to collect the excess water, and 5) conduct the EC measurement on the water extract (personal communication, Jonathan Deenik, 2019). To apply this laboratory approach to a field setting, simply: 1) take a representative soil sample, 2) make a saturated paste of soil and deionized water, 3) extract the water, then 4) measure the EC of the extracted solution (Meter, 2018). EC can be calculated in the field using a calibrated, handheld EC pen (Photo 1). Simply, place the tip of the pen into the extracted water sample and wait for the LCD screen to stabilize. When using an EC pen, an electrical current is passed from one electrode (located in the probe), through the water and back to the other electrode which in turns counts the number of electrically charged ions present (Bluelab, 2015). The measurement is easy to take and is commonly used in agriculture systems.

A handheld EC pen can also be used to measure EC in water systems such as hydroponic solutions (Photo 2), surface and irrigation water. In a hydroponic system, the EC is a common indicator of solution strength. Sampling via containers or with poles to access the sample are common ways to collect reservoir or various irrigation water.


Photo 2

Testing water quality in stream systems are a bit more intricate. While handheld meters can be used to test pH and EC values in stream systems, these systems typically require a more in-depth testing protocol than testing standard irrigation water. Location, depth, time of day, water flow, turbidity and other variables may affect the final pH and EC values. A multi meter or device that can measure multiple variables is typically used when testing stream systems (personal communication, C. Evensen, 2019). As stream conditions change, it is important to take good notes on the time, date, location, environmental conditions, sampler, and methodology used in taking water samples from open systems. As with any sample, the results reflect the conditions at that given point in time.

pH

A pH meter (Photo 3) is used to give the measurement of acidity and alkalinity. The measurement ranges from 0.0 to 14.0; 0.0 is acidic, 7.0 is neutral and 14.0 is basic. Measurements of soil or water pH are commonly used in agriculture since pH determines plant nutrient availability. Low pH measurements can increase concentration of certain nutrients in the soil that are known to be toxic and harmful to numerous plants (Gough, Shaver, Carroll, Royer, & Laundry, 2000). For


Photo 3

vegetable production, there are different ranges that will allow the plants to thrive. In Hawaii, the ideal pH range for soils is 5.8-6.2 for general vegetable production (Tamimi, Silva, Yost, & Hue, 1997).

When measuring soil pH, it is important to keep in mind that the ratio of water to soil needs to be constant and as low as possible (Hendershot, Lalande, & Duquette 1993). For example, if there is greater amount of water added then the pH value may increase. To test the pH measurement in soil, the ratio should be 1:1, one-part deionized water and one-part soil, usually 20g soil and 20mL deionized water (Deenik, 2019). Mix the solution until the mixture is a slosh, then insert the pen and wait for the LCD screen to stabilize (Photo 4). This can easily be done in an outdoor field setting. When measuring pH in water, the pen should be inserted into the representative sample and held until the LCD screen reading stabilizes (Bluelab, 2011).


Photo 4

New testing instruments allow growers to test pH directly in the soil or in various growing mediums. New handheld meters can read pH levels directly from the device and also be paired with smartphone devices (Photo 5 &6).

Photo 5

Calibration and maintenance of these meters are essential to promote accuracy, consistency and validity of the measurements. Calibration is typically required before the first use and after changing batteries of most pH meters to ensure accuracy and consistency. The convenience of these meters is that all of the testing is done through observation, and the tool does the calculations.

Photo 6

Follow the instructions that comes with the tool to accurately measure pH or EC, respectively. The calibration of the tools and maintenance are essential for accurate results. When purchasing these meters, remember to purchase the calibration solutions that come with these devices. Follow the instruction manual for best and accurate results. Store meters in appropriate storage solutions to maximize the life of the probe.

Handheld EC and pH meters are easy to use and provide growers with timely, laboratory-like information that can aid in on farm decision making.

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