



Ryan Dickson
ryand@uark.edu

Volume 8 Number 27 May 2019

Choosing the right pH/EC meter

Measuring pH and electrical conductivity (EC) can be used to check the quality of irrigation water, calibrate fertilizer and acid injectors, and measure nutrients and availability for plant uptake in applied fertilizer solutions and the root zone. Several types of pH/EC meters are available, and vary in size, cost, and how they are used in horticultural practice.

It is important for growers to choose a meter that best meets the measurement needs of their operation. This e-GRO Alert discusses the basics of using pH and EC meters, common types for greenhouses and nurseries, and relative costs.

Basics of using pH and EC meters

What is pH? pH refers to the acidity-basicity of a solution, which influences the solubility and availability of nutrients for plant uptake. This is particularly the case for micronutrients like iron, manganese, and boron. A $\text{pH} < 7$ is acidic, $\text{pH} > 7$ is basic, and a pH equal to 7 is neutral. For most plant species, nutrients are adequately available for uptake at a slightly acidic root zone pH between 5.6 and 6.4.

What is EC? Electrical conductivity (EC) is a measure of total soluble and dissolved salts in solution. EC is measured in units of electrical charge. Dissolved nutrients and non-essential ions such as sodium and chloride all contribute to the EC. EC does not indicate specific concentrations of nutrients or elements—this would require sending samples to a commercial testing laboratory.

www.e-gro.org

2019 Sponsors



Funding Generations of Progress
Through Research and Scholarships

Ball®

fine



P.L. LIGHT SYSTEMS
THE LIGHTING KNOWLEDGE COMPANY

Calibrating and storing pH and EC meters. Regular calibration and maintenance of pH/EC meters ensures measurement accuracy and a long meter shelf-life. pH sensors can become damaged if they dry out, and should be kept protected and in a proper storage solution when not in use. EC sensors can usually be stored wet or dry without damage. It is important to keep standard calibration and storage solutions on stock for your pH/EC meter, and refer to the instruction manual for guidelines on using, calibrating, and storing meters.

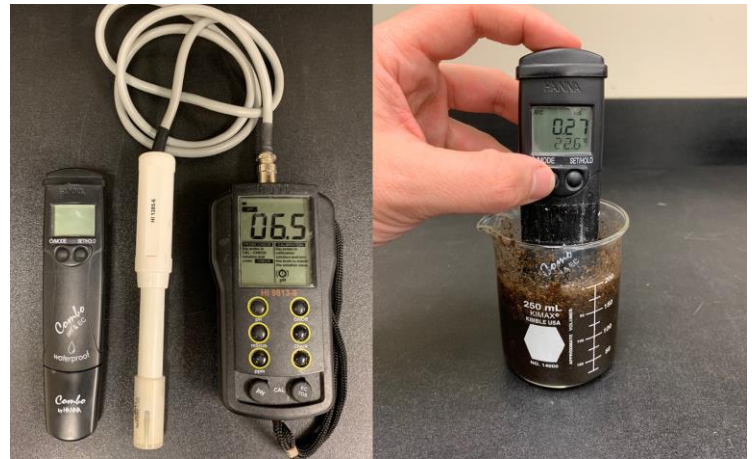


Figure 1. Examples of hand-held and portable pH/EC meters. Both are combination meters, and measure both pH and EC. Main advantages include low-cost, easy calibration, and easy transport around the greenhouse.

Testing pH and EC. Monitoring irrigation water EC is important because soluble salts in the water supply can fluctuate and influence fertilization and irrigation. Checking pH and EC of applied fertilizer and hydroponic nutrient solutions helps determine whether fertilizer and mineral acid injectors are working and if sufficient nutrients are being supplied. Measuring root substrate pH and EC can indicate the quantity and availability of nutrients for plant uptake.



Figure 2. Conducting pH/EC tests in the greenhouse to measure nutrient availability in the root zone.

To learn how to calibrate fertilizer injectors using EC meters, check out the University of New Hampshire Extension article by Dr. Brian Krug titled ‘Fertilizer-Injector Calibration’ (<https://bit.ly/2D3Jude>). For more information and step-by-step protocols on pH/EC soil testing, check out this article by Drs. Paul Fisher and Bill Argo (<https://bit.ly/2VKMLoU>).



Figure 3. Examples of benchtop meters. In this scenario, separate electronic consoles are needed for pH and for EC, although many benchtop meters have the ability to measure both.



Figure 4. In-line pH probe plumbed into the irrigation line, measuring the pH of the irrigation water and fertilizer solution going to the crops.

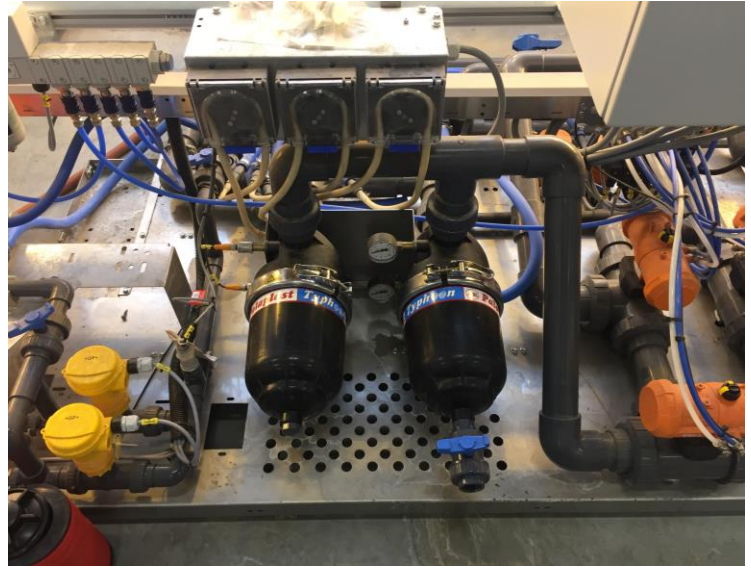


Figure 5. Example of fertilizer and acid/base injectors plumbed into the irrigation water supply. In-line pH and EC meters measure the nutrient level and acidity-basicity, and trigger injectors to add fertilizer and acid/base as needed.

Common types of pH and EC meters

Hand-held and portable meters. Sometimes referred to as “pen” meters, hand-held and portable meters are battery-powered, low cost, and practical for both small and large grower operations (Figures 1 and 2). Many are combination meters and measure pH and EC. An advantage of hand-held/portable meters is that they can be carried easily by workers to conduct “spot-checks” of pH/EC in the greenhouse. Some pH/EC meters have special “needle” probes designed for sticking directly into substrates, but most are designed to measure in liquid or extracted substrate solution. Cost of many hand-held and portable meters ranges from approximately \$100 to \$300.

Bench-top pH/EC meters. These meters are placed on benches or tables as shown in Figure 3, and typically consist of separate pH and EC sensors plugged into an electronic console. Some consoles can log measurements for record-keeping, and may also have options for measuring individual nutrients, dissolved oxygen, and other parameters. Bench-top meters are common in research laboratories and large growing operations that process numerous samples. Bench-top meters are usually more expensive compared to hand-held meters, and range from approximately \$500 to over \$3,000.

In-line pH/EC sensors. “In-line” sensors are installed in irrigation pipes or reservoir tanks to monitor pH and EC of fertilizer solutions entering and leaving the crop (Figure 4). Sensors are often linked with environmental control computers and injection systems for automatic injection of mineral acids/bases and fertilizer to maintain target pH and nutrient levels (Figure 5). In-line sensors for pH and EC are relatively inexpensive (<\$1000), but there are extra costs associated with installation, plumbing, and environmental control systems. In-line pH/EC meters are most common with larger growers as well as hydroponic operations.

Conclusions

pH and EC meters can be used to check the quality of irrigation water, calibrate fertilizer and acid injectors, and measure nutrient availability for plant uptake.

Expect to invest at least \$100 for a quality pH/EC meter, and refer to the instruction manual for guidelines on proper use and handling.

Hand-held and portable meters are low-cost and often practical for both smaller and larger growers. Bench-top and in-line pH/EC meters are more expensive, but often come with extra measurement capabilities and are useful in certain production and research scenarios.



e-GRO Alert

www.e-gro.org

CONTRIBUTORS

Dr. Nora Catlin
Floriculture Specialist
Cornell Cooperative Extension
Suffolk County
nora.catlin@cornell.edu

Dr. Chris Currey
Assistant Professor of Floriculture
Iowa State University
ccurrey@iastate.edu

Dr. Ryan Dickson
Greenhouse Horticulture and
Controlled-Environment Agriculture
University of Arkansas
ryand@uark.edu

Nick Flax
Commercial Horticulture Educator
Penn State Extension
nzf123@psu.edu

Thomas Ford
Commercial Horticulture Educator
Penn State Extension
tgf2@psu.edu

Dan Gilrein
Entomology Specialist
Cornell Cooperative Extension
Suffolk County
dog1@cornell.edu

Dr. Joyce Latimer
Floriculture Extension & Research
Virginia Tech
jlatime@vt.edu

Heidi Lindberg
Floriculture Extension Educator
Michigan State University
wolleage@anr.msu.edu

Dr. Roberto Lopez
Floriculture Extension & Research
Michigan State University
rglopez@msu.edu

Dr. Neil Mattson
Greenhouse Research & Extension
Cornell University
neil.mattson@cornell.edu

Dr. W. Garrett Owen
Floriculture Outreach Specialist
Michigan State University
wgowen@msu.edu

Dr. Rosa E. Raudales
Greenhouse Extension Specialist
University of Connecticut
rosa.raudales@uconn.edu

Dr. Beth Scheckelhoff
Extension Educator - Greenhouse Systems
The Ohio State University
scheckelhoff.11@osu.edu

Dr. Paul Thomas
Floriculture Extension & Research
University of Georgia
pthomas@uga.edu

Dr. Ariana Torres-Bravo
Horticulture/ Ag. Economics
Purdue University
torres2@purdue.edu

Dr. Brian Whipker
Floriculture Extension & Research
NC State University
bwhipker@ncsu.edu

Dr. Jean Williams-Woodward
Ornamental Extension Plant Pathologist
University of Georgia
jwoodwar@uga.edu

Copyright © 2019

Where trade names, proprietary products, or specific equipment are listed, no discrimination is intended and no endorsement, guarantee or warranty is implied by the authors, universities or associations.

Cooperating Universities



Cornell University **IOWA STATE UNIVERSITY**



University of New Hampshire
Cooperative Extension



PennState Extension



VIRGINIA TECH

MICHIGAN STATE UNIVERSITY

UConn

PURDUE UNIVERSITY



The University of Georgia



THE OHIO STATE UNIVERSITY

NC STATE UNIVERSITY

UofA DIVISION OF AGRICULTURE RESEARCH & EXTENSION
University of Arkansas System

In cooperation with our local and state greenhouse organizations

MAUMEE VALLEY GROWERS
Choose the Very Best.



Metro Detroit Flower Growers Association



Indiana Flower Growers Association



Michigan Floriculture Growers Council

