Virginia Cooperative Extension
Virginia Tech • Virginia State University

Publication HORT-227P

GroZone Tracker

A free mobile app to help you record, monitor, and share water quality and substrate pH and electrical conductivity data within your nursery and greenhouse operation.

James Owen Jr., Assistant Professor, Horticulture, Virginia Tech, and Extension Specialist, Hampton Roads Agricultural Research and Extension Center
Sarah A. White, Associate Professor, Horticulture, Clemson University, and Nursery Extension Specialist, Clemson Cooperative Extension
Brian Whipker, Professor, Horticulture, North Carolina State University, and Extension Specialist, North Carolina Cooperative Extension
Brian Krug, former Extension Specialist, University of New Hampshire Cooperative Extension

In-house testing of pH and electrical conductivity (EC) helps to avoid many nutritional problems. Knowing the chemical elements of your irrigation water — and if they vary over time — can help you manage crop quality.

GroZone Tracker (http://grozonetracker.com/) is a free website for use on your mobile device (and desktop) that provides a digital platform to record, monitor, and share production-related data within your company. Once the company profile is created, managers, growers, or employees can add other administrators or users, create locations (e.g., farms), and add new geotagged sites (e.g., beds or benches, crops) using the embedded map feature, which allows users to accurately pinpoint a greenhouse section or production bed (Figure 1). Water or plant production-related data can be updated periodically to each site until a crop is sold or moved, at which time data are archived for future reference.

Figure 1. Interactive "site map" used to add sampling sites.

Frequently Asked Questions

What is the difference between users: Company Administrator versus General User?

Company administrators are the primary contact for the GroZone Tracker app, and they invite users or additional administrators to use the app for a given company. Under the menu item "User Accounts," a company administrator can add individuals using the plus icon followed by "Add User Account."

When adding a user, company administrators assign a temporary password and an email containing login information is automatically sent to the new user. Users can change their assigned password when they log in for the first time. General users have limited ability to add or modify locations, but they

Produced by Communications and Marketing, College of Agriculture and Life Sciences, Virginia Tech, 2016

VT/0916/HORT-227P

can manage, add, delete, and modify site data. All collected data are shared within a company and with the creators and web developers.

What is a new location, and how do I add one?

A location is a farm, nursery, or entire greenhouse range. You can add a new location for each geographic address where a production facility is located. Company administrators can add multiple sites where plant and water sampling occur within a single location.

Add a new location by selecting "Locations" under the menu bar and selecting the plus icon "Add Location." Input fields will ask for details such as location name, address, city, state, ZIP code, country, and time zone. In addition, you can add notes about the location, such as "52-acre nursery production facility producing 188 taxa in 1- to 15-gallon containers."

What is a new site, and how do I add one?

A site pertains to a specific crop or water source within a specific location. Add a new site the first

Table 1. Pour-Through sample decision criteria matrix for containerized ornamental perennial crops.

Substrate EC* categories	Substrate pH† categories			
	4.5-5.5	5.5-5.8	5.8-6.2	6.0-6.5
Low 1.3-2.0 mS/cm‡ (SME§ = 0.9-1.3 mS/cm) (1:2** = 0.4-0.6 mS/cm)	Few species	*Echinacea* Ferns Salvia ×*sylvestris*	*Aquilegia* *Coreopsis* *Digitalis* *Echinacea* *Ferns* *Gaillardia* *Gaura* *Hosta*	*Ajuga* *Aquilegia* *Carex* *Dianthus* *Echeveria* *Hemerocallis* *Phlox* *Sedum* sp.
Medium 2.0-3.0 mS/cm (SME = 1.3-2.0 mS/cm) (1:2 = 0.6-0.9 mS/cm)	Few species	*Salvia ×sylvestris* *Veronica*	*Astilbe* *Campanula carpatica* *Coreopsis* *Digitalis* *Gaillardia* *Heuchera* *Hosta* *Penstemon* *Perovskia* *Rudbeckia*	*Carex* *Hemerocallis* *Phlox* *Sedum* sp.
High 3.0-4.9 mS/cm (SME = 2.0-3.3 mS/cm) (1:2 = 0.9-1.5 mS/cm)	Few species *Salvia nemerosa*	Few species *Salvia nemerosa*	*Aster* *Lamium* *Veronica*	*Aster* *Calamagrostis* *Miscanthus* *Panicum* *Pennisetum*

* Electrical conductivity (EC) values are for actively growing plants.

† pH is a unitless value.

‡ Units of electrical conductivity are provided in siemens. 1.0 mS/cm = 1.0 dS/m = 100 S/cm = 1,000 µS/cm.

§ Saturated media extract.

** 1:2 media extract.

time you sample a new crop. A site can be added from the menu via "Locations" or "Sampling Sites." Under "Sampling Sites," select the plus icon "Add Sampling Site" in the top left corner. You will be directed to the "Locations" tab where you can select the location where you want to add a new site. When adding a new site, you will be asked to select crop type (annual, perennial, or woody), desired values for pH range (low to high), and desired EC range (low to high). You can also select "Water Sample," which does not require pH and EC ranges to be selected.

Select "Mark as Complete" under "Sampling Site Details" when a crop is saleable or will be moved to a new location and there are no more data to collect at that sampling site.

How do I record or add a water or plant reading?

On the dashboard screen, select a recent "Reading" icon or "Sampling Site" to go to a selected page, which will have a "+ water" or "+ plant" icon to select if collecting either a water or pour-through extract sample (Figure 2). If you are adding a water sample,

Table 2. Decision criteria matrix for nonsaline, untreated water quality.

		Desired water quality ranges			
		Pump/Pond*		Nozzle*	
Water quality - nonsaline waters	Units	Low	High	Low	High
pH (unitless)		5.5	7.4	5.5	7.0
Conductivity (EC)	mS/cm	0.5	2.0	<500.0	1,000.0
Total dissolved salts (TDS)	ppm	<500.0	1,000.0	0.1	2.0
Bicarbonate (HCO_3-)	meq/L	0.1	2.0	0.1	2.0
Alkalinity (carbonate - CO_3)	meq/L	0.1	1.5	0.1	1.5
Sodium absorption ratio (SAR)	meq/L	—†	10.0	—	10.0
Dissolved organic carbon (DOC)	ppm	1.0	4.0	1.0	4.0
Aluminum (Al)	ppm	0.5	4.0	0.5	4.0
Boron (B)	ppm	0.2	0.5	0.2	0.5
Calcium (Ca)	ppm	60.0	120.0	60.0	120.0
Chloride (Cl)	ppm	1.0	50.0	1.0	50.0
Copper (Cu)	ppm	0.1	0.2	0.1	0.2
Fluoride (F)	ppm	0.0	1.0	0.0	1.0
Iron (Fe)	ppm	1.0	4.0	<0.2	4.0
Magnesium (Mg)	ppm	6.0	25.0	6.0	25.0
Manganese (Mn)	ppm	0.3	1.0	0.2	0.3
Total nitrogen (N)	ppm	<1.2	12.0	2.0	50.0
Ammonium (NH_4)	ppm	<1.0	10.0	2.0	50.0
Nitrate (NO_3)	ppm	<1.0	10.0	5.0	50.0
Phosphate (PO_4)	ppm	0.2	1.0	1.0	8.0
Potassium (K)	ppm	0.9	9.0	1.5	38.0
Sodium (Na)‡	ppm	0.0	30.0	0.0	30.0
Sulfur (S)	ppm	10.0	30.0	10.0	30.0
Sulfate (SO_4)	ppm	25.0	45.0	25.0	45.0
Zinc (Zn)	ppm	0.0	0.3	0.2	0.3

*Pump/pond refers to water sampled prior to treatment; nozzle refers to samples after treatment.

†See water quality flow chart if your SAR is >1.

select the "Source" (point of collection): pond, pump, nozzle, or well. Enter the pH, electrical conductivity, or alkalinity measurements, or choose "Full Analysis" by using the plus icon to expand the chemical parameters to be measured and recorded. Adding a "Plant" sample only requires that you enter pH and electrical conductivity.

Regardless of where a value is entered, each value will turn green if it is within the acceptable range, yellow if it is within the margin of error and should be monitored, or red if it requires action to ensure crop health. If you choose to enter a full water analysis, the values will not change color, but after you have saved the page, you can view your results and see if they are in the green, yellow, or red range.

The default ranges used represent nontreated water in the southeastern U.S. So, if for example you fertigate (add fertilizer to irrigation water), a conductivity (EC) reading could be high, but that would be expected because you are actively adding fertilizer salts.

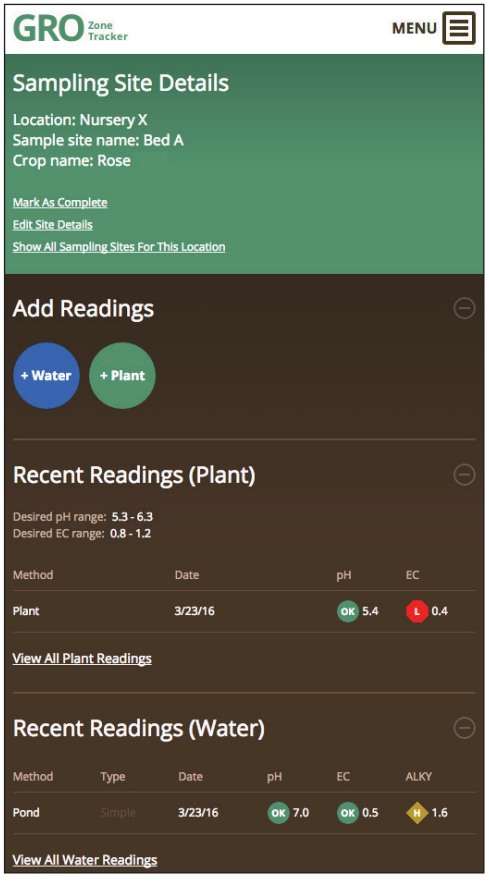
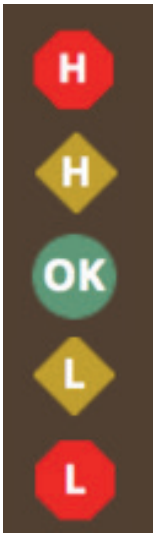


Figure 2. "Dashboard" showing example of sampling site detail page where one can add a water or plant reading and track previous readings.



Requires immediate attention.

Above suggested range, requires regular monitoring.

Within suggested limits.

Below suggested range, requires regular monitoring.

Below suggested range, requires immediate attention.

Figure 3. Interpretation of symbols and color of text for your water or plant readings.

What criteria were used for electrical conductivity and pH measurements when extracting substrate pore water?

EC and pH ranges for annuals, perennials, and woody ornamentals were selected by reviewing scientific literature, Extension publications, reference texts, and the authors' own research. Table 1 was created for each plant category to provide a matrix of pH and EC values and corresponding examples of taxa that are recognized as having optimal growth within the noted ranges. Additional values were provided for annuals and perennials to offer growers more flexibility among different taxa.

What criteria were used for irrigation water quality measurements?

Water quality criteria were selected by reviewing literature, Extension publications, reference texts, and the authors' research. Suggested sufficiency ranges for nontreated, nonsaline water (the ranges your data are compared with) are listed in table 2. We also reference a water quality flow chart that can assist in determining how to manage irrigation water if pH, EC, salinity, or alkalinity is identified as out of range.

How do I interpret my water or plant readings?

After the values have been entered and the data is saved, the color of the text changes to indicate whether values are OK (green), need watching (yellow), or

need immediate action (red) (Figure 3). These symbols are used to categorize the readings and indicate whether additional action is needed.

Additional Reading

Camberato, D. M., R. G. Lopez, and M. V. Mickelbart. *Commercial Greenhouse and Nursery Production: pH and Electrical Conductivity Measurements in Soilless Substrates*. Purdue Extension. Publication HO-237-W. https://www.extension.purdue.edu/extmedia/HO/HO-237-W.pdf.

Cavins, T. J., B. E. Whipker, W. C Fonteno, B. Harden, I. McCall, and J. L. Gibson. 2000. *Monitoring and Managing pH and EC Using the PourThru Extraction Method*. North Carolina Cooperative Extension. Horticulture Information Leaflet 590. http://content.ces.ncsu.edu/monitoring-and-managing-ph-and-ec-using-the-pourthru-extraction-method.

Dudek, T. A. 2011. "Check Your Greenhouse Crop pH and EC Lately?" Michigan State University Extension Website. http://msue.anr.msu.edu/news/check_your_greenhouse_crop_ph_and_ec_lately.

Park, D. M., S. A. White, L. B. McCarty, and N. Menchyk. 2014. *Interpreting Irrigation Water Quality Reports*. Clemson University Cooperative Extension. Publication CU-14-700. http://tinyurl.com/interpreting-irrigation-water.

Park, D. M., S. A. White, N. Menchyk. 2014. "Assessing Irrigation Water Quality for pH, Salts, & Alkalinity." *Journal of Extension* 52 (6): 6TOT8. www.joe.org/joe/2014december/tt8.php.

Acknowledgements

A special thank you to Andrea Davis, Ursula Deitch, Sam Doane, Norman Lafaille, Anthony LeBude, Alex Niemiera, and Cory Tanner for their comprehensive review of this Virginia Cooperative Extension publication and the mobile web application. Funding for this work was provided in part by the Amercian Floral Endowment; Horticulture Research Institute; North Carolina, South Carolina, and Virginia agricultural experiment stations; the U.S. Department of Agriculture, Agricultural Research Service; and the Hatch Programs of the USDA National Institute of Food and Agriculture, including work under award No. 2014-51181-22372 and the NC-1186 multistate research project: Water Management and Quality for Ornamental Crop Production and Health.