# Developing a Soil Kit for Extension Programming


Caitlin Youngquist[1], Jay Norton[2], James Harsh[3]

[1]University of Wyoming Extension, Washakie County, cyoungqu@uwyo.edu
[2]University of Wyoming, Department of Ecosystem Science and Management, jnorton@uwyo.edu
[3]Washington State University, Department of Crops and Soils, harsh@wsu.edu



## ABSTRACT

Soil and Horticulture Extension programs are enhanced by hands-on and interactive activities. Readily available and inexpensive soil test kits can be useful in Extension programming in the classroom and the field. With the addition of a few extra supplies and tools, a complete kit can be created for Extension educators to use in horticulture and soil programming for gardeners and professionals. Five soil test kits from different manufacturers were evaluated for both ease-of-use and accuracy. Kits included tests for nitrogen, phosphorus, potassium, and pH. The kits used for this project are available at many garden centers and online retailers. To expand the kits for use with large groups, inexpensive and readily available materials were added. Additional teaching and soil assessment tools were also evaluated and added to the kit for measuring or demonstrating soil texture, pH, and salinity. By using and evaluating several kits and tools, a set of supplies and protocols was developed that work well in both the classroom and the field.


## CLASSROOM KITS

Soil test kits add a fun and interactive component to a classroom lesson. Participants can bring soil samples from home for testing. Comparing test results provides an opportunity for discussions about soil fertility, the differences between mineral vs. organic nitrogen, seasonal changes in nitrogen levels, effects of pH on nutrient availability, and phosphorus dynamics in soil. A soil texture kit can be added for additional hands-on activities and adds context to a discussion about cation exchange capacity, compaction, and water holding capacity in different soils.

**Five soil chemistry test kits were compared for accuracy, ease-of-use, and expandability**.

All kits included tests for nitrogen (N), phosphorus (P), and potassium (K). Six Wyoming soils were tested with each kit and nutrient results were compared to lab analyses[1]. The soils ranged from 1.0% to 4.4% organic matter (OM) with a pH of 7.0 to 8.3. Accuracy of soil test kits will likely vary based on certain soil characteristics (pH, texture, OM, etc.). The goal of this project was to share observations about the usefulness of various kits as teaching tools, not complete a statistically rigorous comparison between kits.

**Results from the five soil test kits matched the lab analysis results about two thirds of the time and no single kit stood out as more, or less accurate, than the others**.

- Kit results for N correlated with laboratory results more closely than kit results for P and K.
- Kit results for P were consistently lower than lab results for P.
- The K results from all soil test kits were moderately consistent with the lab results.

**Accugrow® Soil Test Strips**
by Environmental Test Systems

Cost: $24
Tests: 10 N, P, K + 10 pH
Advantages:
•Very easy to use
•Easily expandable
•Requires minimal reagents
•Very little spill risk
•Suitable for individuals with limited motor function
Disadvantages:
•Cost per test ~ $2.40.
•No refills or extra components
•Results reported as letters (A-D) instead of levels, interpretation is confusing

**Grade: A**

**NPK Soil Test Kit**
by LaMotte

Cost: $30
Tests: 50 N, P, K
Advantages:
•Easy to use
•Easily expandable
•Reagents in tablet form, low spill risk
•Reagents, extra components available from manufacturer
•Easy to interpret results
•Results correlated with lbs/acre
• Cost per test: ~ $0.60
Disadvantages:
•pH test not included
•Reports only 3 levels (H, M, L)
•Extra components are expensive

**Grade: A**

**Rapitest® Digital Soil Test Kit**
by Luster Leaf Products, Inc.

Cost: $27
Tests: 5 N, P, K + 10 pH
Advantages:
•Easy to use
•Refills on capsules available
•Easy to interpret results
Disadvantages:
•Cost per test ~ $3.00
•Not easily expandable
•Tubes not designed for reuse; hard to clean; cannot be purchased separately
•Not suitable for individuals with limited motor function
•Too easy to spill
•Digital meter is useless

**Grade: B**

**NPK Soil Chemical Test Kit**
by Hanna Instruments

Cost: $26
Tests: 10 N, P, K, + 10 pH
Advantages:
•Easy to use
•Easily expandable
•Reagents and extra components available from manufacturer
•Easy to interpret results
Disadvantages:
•Cost per test ~ $2.60
•Not suitable for individuals with limited motor function
•Too easy to spill
•Instructions poorly written, hard to read

**Grade: C**

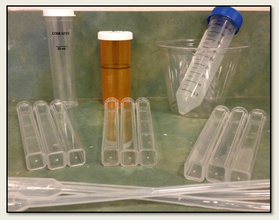
**Soil Test Kit 1662**
by Luster Leaf Products, Inc.

Cost: $22
Tests: 10 N, P, K + 10 pH
Advantages:
•Instructions are easy to read
•5 nutrient levels (VH, H, M, L, VL)
Disadvantages:
•Cost per test ~ $2.20
•Not easily expandable
•Reagents not pre-measured
•Extraction tube difficult to operate
•No refills or extra components available from manufacturer
•Not suitable for individuals with limited motor function
•Results difficult to interpret

**Grade: D**

### TEST KIT EXPANSION

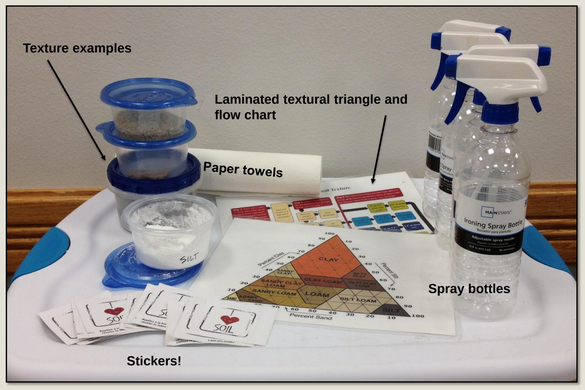
The AccuGrow® Soil Test Strips are easily expanded using medicine cups, coffee stir sticks, and kitchen measuring spoons.



The LaMotte NPK Soil Test Kit is easily expanded using repurposed containers or lab supplies for the extraction tube.

Pipets can be replaced with drinking straws and kitchen measuring spoons.

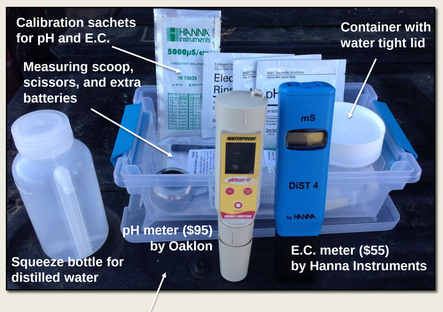
### SOIL TEXTURE KIT




Kit includes texture samples for sand, silt (cornstarch), clay (modeling clay), and organic matter (potting soil). Flow charts and video are available from Washington State University Extension: https://puyallup.wsu.edu/soils/soils/. A high resolution textural triangle is available at www.soilsensor.com. sticker templates are available at www.soils.org/stickers.

## TAILGATE KITS

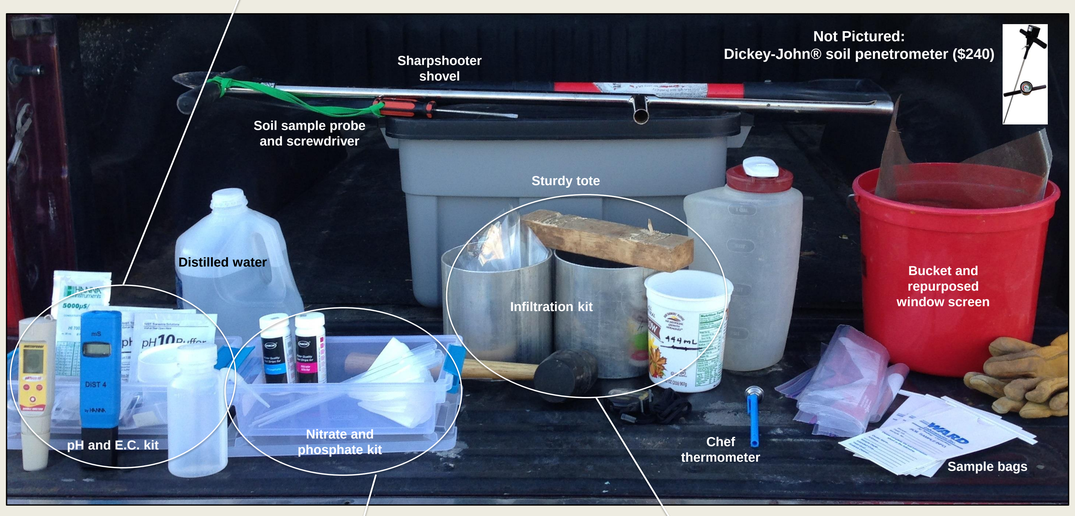
The tailgate kit includes tools for measuring and demonstrating several physical and chemical soil properties in the field including infiltration, compaction, pH, salinity, and water extractable nitrate and phosphate. The chemistry tools can also be used in the classroom for demonstration of pH, E.C., and soil nutrient levels.

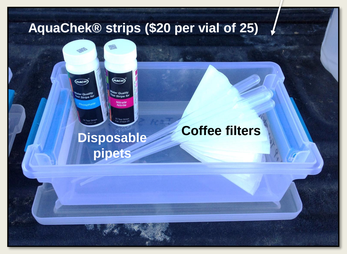



### SOIL PH AND SALINITY

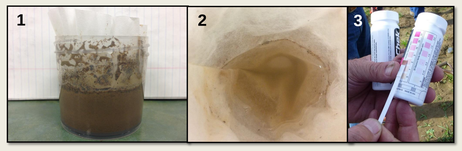
Handheld pH and E.C meters are useful tools for testing soil and irrigation water samples in the classroom, at the office, or in the field.

Protocols for measuring pH and E.C in the field using a 1:1 soil to water solution are available in the NRCS Soil Quality Test Kit Guide[5]. The same 1:1 solution can be used for measuring soil salinity, pH, and water extractable $NO_3^-$ and $PO_4^-$.



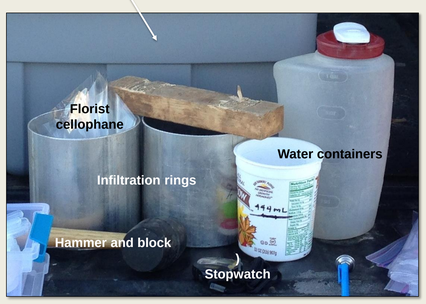




### WATER EXTRABLE $NO_3^-$ AND $PO_4^-$




AquaChek® water quality test strips can be used to measure water extractable $NO_3^-$ and $PO_4^-$ as described in the NRCS Soil Quality Test Kit Guide.[5] The accuracy of this method for soil $NO_3^-$ has also been verified by researchers at the University of California[6].

Use a coffee filter to separate soil water solution for analysis (1, 2). Match color on test swab to vial (3) to see ppm of water extractable $NO_3^-$ and $PO_4^-$.




### SOIL WATER INFILTRATION RATE

Soil water infiltration rates can be measured with a set of rings as described in the NRCS Soil Quality Test Kit Guide.[5] The infiltration rings are made from a set of 6 inch aluminum irrigation pipe. Florist cellophane is sturdier than plastic wrap, and re-usable.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*Issued in furtherance of extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Glen Whipple, Director, University of Wyoming Extension, University of Wyoming, Laramie, Wyoming 82071. The University of Wyoming is an equal opportunity/affirmative action institution.*



**Funding for this project was provide by the Western Sustainable Agriculture Research and Education Program (SARE)**



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