

**PORTABLE pH METER FOR IN-FIELD  
SOIL TESTING**

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**Abstract**

The accuracy of a hand held pH meter was compared to a bench top pH meter. Hand held pH meters have a similar accuracy to bench top meters.

**Introduction**

Soil acidity is a major limiting factor to cotton lint production in Southeast Missouri. Approximately 35% of the soil samples submitted to the Delta Regional Soils Testing Lab from cotton producers have a soil pH low enough to be causing yield reductions. Plant symptoms of low pH include crinkled leaves, stunted plants, and low boll counts. Visually these symptoms may be confused with insect damage.

To help Southeast Missouri cotton producers diagnose pH problems in the field all of our University Outreach and Extension Agronomy Agents have been supplied with hand held pH meters. Questions are often asked as to the accuracy of these meters. This study attempts to answer this question.

**Materials and Methods**

To test the accuracy and reproducibility of the Schindengen hand held pH meter under laboratory conditions three soils were selected. These soil samples were provided to the Delta Soils Lab as part of the North American Proficiency Testing (NAPT) Program. These soils were analyzed for  $pH_{water}$ ,  $pH_{salt}$ , and  $pH_{buffer}$  using the standard methods of the Delta Soils Lab. A Schindengen hand held pH meter was used instead of the Accumet Bench top pH meter. Each analysis was replicated 4 times and each analysis was preformed with 4 different hand held meters. The results were tabulated and compared to data supplied by the NAPT program.

To test the accuracy and reproducibility of the hand held meter under "field" conditions one meter and one NAPT soil were selected. Seventeen University of Missouri-Delta Center employees were given a soil sample and distilled water. They were then asked to measure the  $pH_{water}$  of the soil following the instructions provided by the manufacture of the Schindengen hand held pH meter. The results were tabulated and compared to data supplied by the NAPT program.

**Results and Discussion**

When one trained operator compared the Accumet bench top pH meter in laboratory conditions to a single Schindengen hand held pH meter results were found to be similar. Both were found to be accurate to within 2.5 X Median Absolute Deviation (MAD) for 89% of the analysis performed. The median readings from both types of meters compared favorably with the median from the 82 soil labs participating in the NAPT program. When the results from four different Schindengen pH meters were compared to the NAPT results the hand held meter had a higher MAD for 8 of the 9 analysis preformed (Table 1a, 1b, and 1c). The average MAD value for the NAPT labs was 0.08 while the value for the Schindengen meters was 0.11.

When 17 untrained operators analyzed NAPT soil 00-107 for  $pH_{water}(1:)$  the results ranged from pH 5.9 to 6.6 (Table2) The average was 6.3 and the MAD value was 0.15. This compares well with the average from 82 soils abs of 6.34. The MAD value however was more than twice as great.

**Conclusions**

Hand held pH meters are useful for measuring soil acidity in the field. Errors in pH measurement can result from instrument variability. When the same meter is used by different people greater variability of results occurs. This is due to differences in interpretation of the manufacture directions for use.

Table 1a. Evaluation of Schindengen hand held pH meter for water pH, salt pH and buffer pH using NAPT soil 00-103.

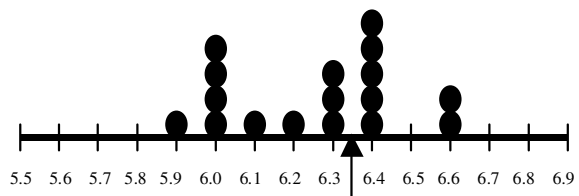
<u><b>pH Meters</b></u>	<u><b>NAPT Soil Sample 00-103</b></u>	
	<b>Median</b>	<b>MAD</b>
<b><math>pH_{water}(1:)</math></b>		
Average 82 Soil labs	7.86	0.07
Accumet bench top	7.8	
Schindengen handheld	7.7	0.05
<b><math>pH_{salt}(1:)</math></b>	<b>Median</b>	<b>MAD</b>
Average 82 Soil labs	7.66	0.07
Accumet bench top	7.7	
Schindengen handheld	7.5	0.15
<b><math>pH_{buffer}(1:)</math></b>	<b>Median</b>	<b>MAD</b>
Average 82 Soil labs	7.75	0.05
Accumet bench top	7.7	
Schindengen handheld	7.2	0.1

Table 1b. Evaluation of Schindengen hand held pH meter for water pH, salt pH and buffer pH using NAPT soil 00-107.

<u><b>pH Meters</b></u>	<u><b>NAPT Soil Sample 00-107</b></u>	
	<b>Median</b>	<b>MAD</b>
<b><math>pH_{water}(1:)</math></b>		
Average 82 Soil labs	6.34	0.09
Accumet bench top	6.5	
Schindengen handheld	6.3	0.15
<b><math>pH_{salt}(1:)</math></b>	<b>Median</b>	<b>MAD</b>
Average 82 Soil labs	5.91	0.09
Accumet bench top	6.2	
Schindengen handheld	5.8	0.1
<b><math>pH_{buffer}(1:)</math></b>	<b>Median</b>	<b>MAD</b>
Average 82 Soil labs	6.76	0.05
Accumet bench top	6.77	
Schindengen handheld	6.7	0.1

Table 1c. Evaluation of Schindengen hand held pH meter for water pH, salt pH and buffer pH using NAPT soil 00-113.

<u><b>pH Meters</b></u>	<u><b>NAPT Soil Sample 00-113</b></u>	
	<b>Median</b>	<b>MAD</b>
<b><math>pH_{water}(1:)</math></b>		
Average 82 Soil labs	5.55	0.14
Accumet bench top	6	
Schindengen handheld	5.5	0.15
<b><math>pH_{salt}(1:)</math></b>	<b>Median</b>	<b>MAD</b>
Average 82 Soil labs	5.22	0.09
Accumet bench top	5.45	
Schindengen handheld	5.3	0.15
<b><math>pH_{buffer}(1:)</math></b>	<b>Median</b>	<b>MAD</b>
Average 82 Soil labs	6.82	0.03
Accumet bench top	6.81	
Schindengen handheld	6.7	0.05



Average for 82 soil labs

Figure 1. Distribution of readings from 17 untrained people using a Schindengen hand held pH meter for soil 00-107 from the NAPT program. Each dot represents one reading.