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Evaluation of Automated Soil pH Mapping

Viacheslav Adamchuk
Mark Morgan

Agricultural and Biological Engineering
Purdue University

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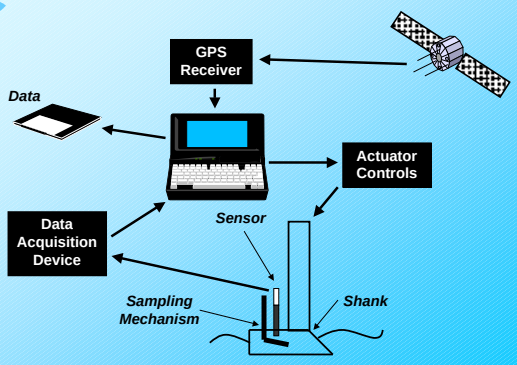
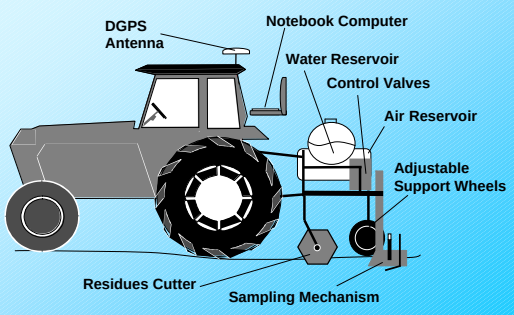
Background

- A prototype of automated soil sampling system measuring soil pH on-the-go has been created
- Flat surface ion-selective electrode
- Naturally moist soil sample
- 5 s stabilization time
- 8 s between consecutive samples

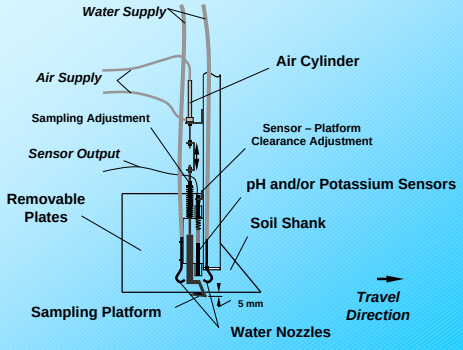
Objective: On-the-go Determination of Soil pH



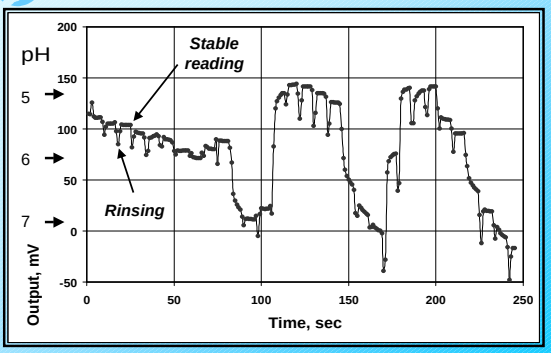
Automated Soil Sampling System



Soil Sampling Mechanism



Field Test — Sensor's Output



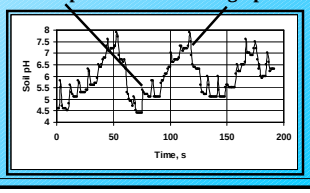
Objectives

- To determine reliability of automated measurements of soil pH in the field
- To illustrate importance of increasing spatial resolution of pH measurements
- To establish basic recommendations and limits for use of the automated soil sampling system in site-specific crop production

Agronomy Research Center, Field 14

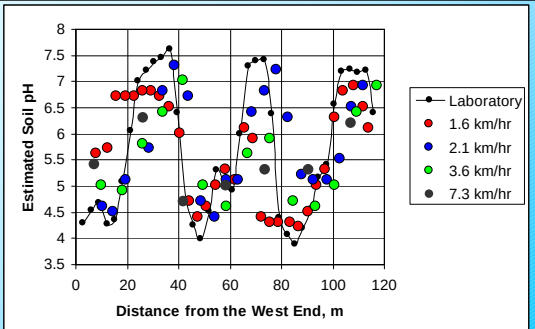
Low pH

High pH

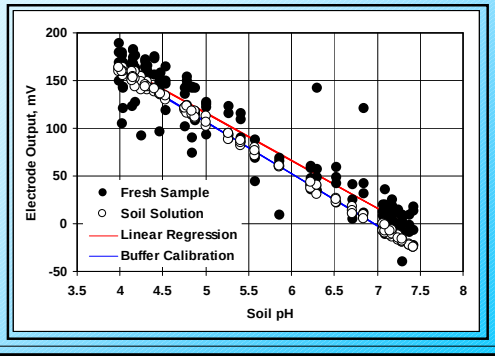


1 m stripe tested at different speeds and in different directions

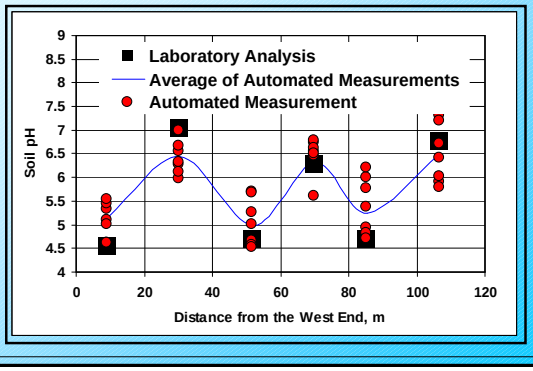
Field 14 Multiple Passes (6/29/99)



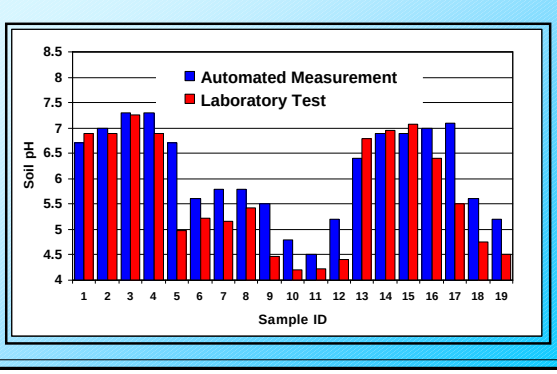
Laboratory Analysis of Soil Samples Collected in Field 14



Repeatability Test



Sampling Verification

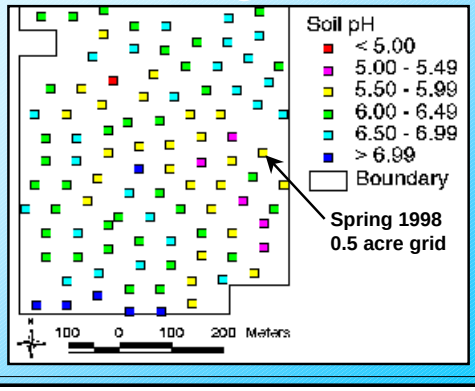


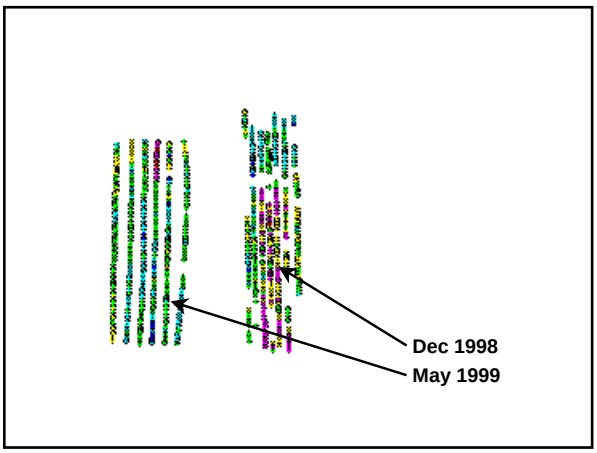
Estimated Sampling Density

(samples / ha)

Vehicle Speed,	Distance between	Distance between Passes, m			
km/h	Samples, m	5	10	20	50
1	2.2	900	450	225	90
2	4.4	450	225	113	45
3	6.7	300	150	75	30
5	11.1	180	90	45	18
8	17.8	113	56	28	11

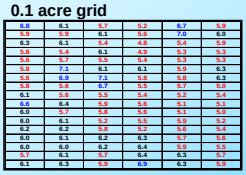
Davis-Purdue Agricultural Center





Estimated Soil pH

0.1 acre grid



2.5 acre grid

5.6	5.3
6.2	5.6

1 acre grid

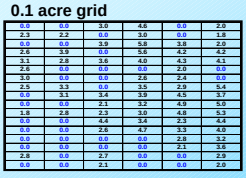
5.9	7.0
6.4	5.6
5.6	5.2
6.1	5.7
6.1	6.3

Uniform Treatment

5.8

Lime Application, t/acre

0.1 acre grid



2.5 acre grid

3.3	4.2
0.0	3.3

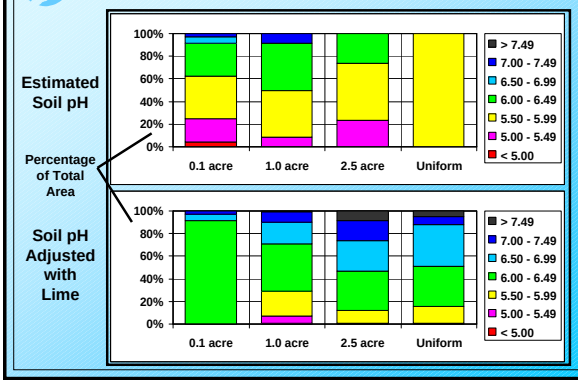
1 acre grid

2.2	0.0
0.0	3.2
3.1	4.5
0.0	2.8
0.0	0.0

Uniform Treatment

2.3

Effect of Soil Sampling Density



Conclusions

- Automated soil sampling system could be used to estimate soil pH on-the-go
- Current prototype takes soil samples at a fixed depth that does not account for depth variation of soil pH
- Several verification samples might be recommended for specific field conditions
- Automated soil pH measurement is appropriate when variable acidity is a factor limiting plant growth

Integrated Measurement of Soil Properties

- Soil pH
- Potassium Content
- Soil Compaction (Mechanical Resistance)
- Organic Matter Content (Color)
- Moisture Content
- Texture (Particles Size)

- ISE (Ion Selective Electrode)
- Vertical Blade with an Array of Strain Gages
- Utilization of a Spectroradiometer to Establish Subsurface Soil Reflectance in Visual and NIR Parts of the Spectrum

Additional Note

- Automated measurement of soil pH on-the-go allows discovering relatively small cells of land that potentially could be treated on a variable application bases
- An estimate of soil buffering capacity should be known to draw lime recommendations
- On-the-go soil pH measurement does not identify calcium or magnesium deficiencies

http://ecn.purdue.edu/~adamchuk
E:mail: adamchuk@ecn.purdue.edu