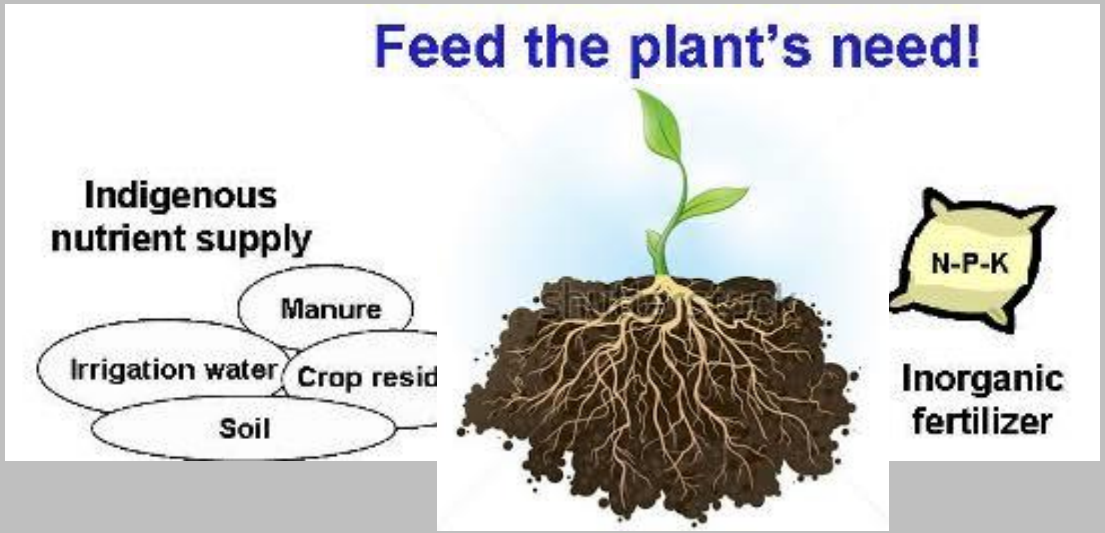
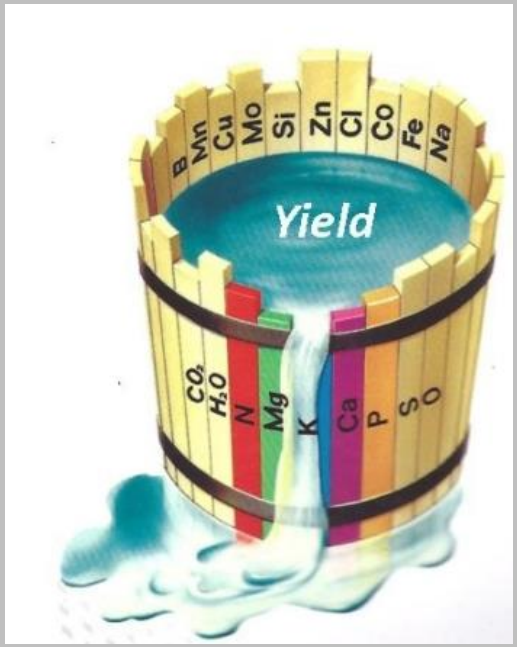
# Nutrient Balance starts with Soil pH



# pH

## affects everything in the soil

Nodulation

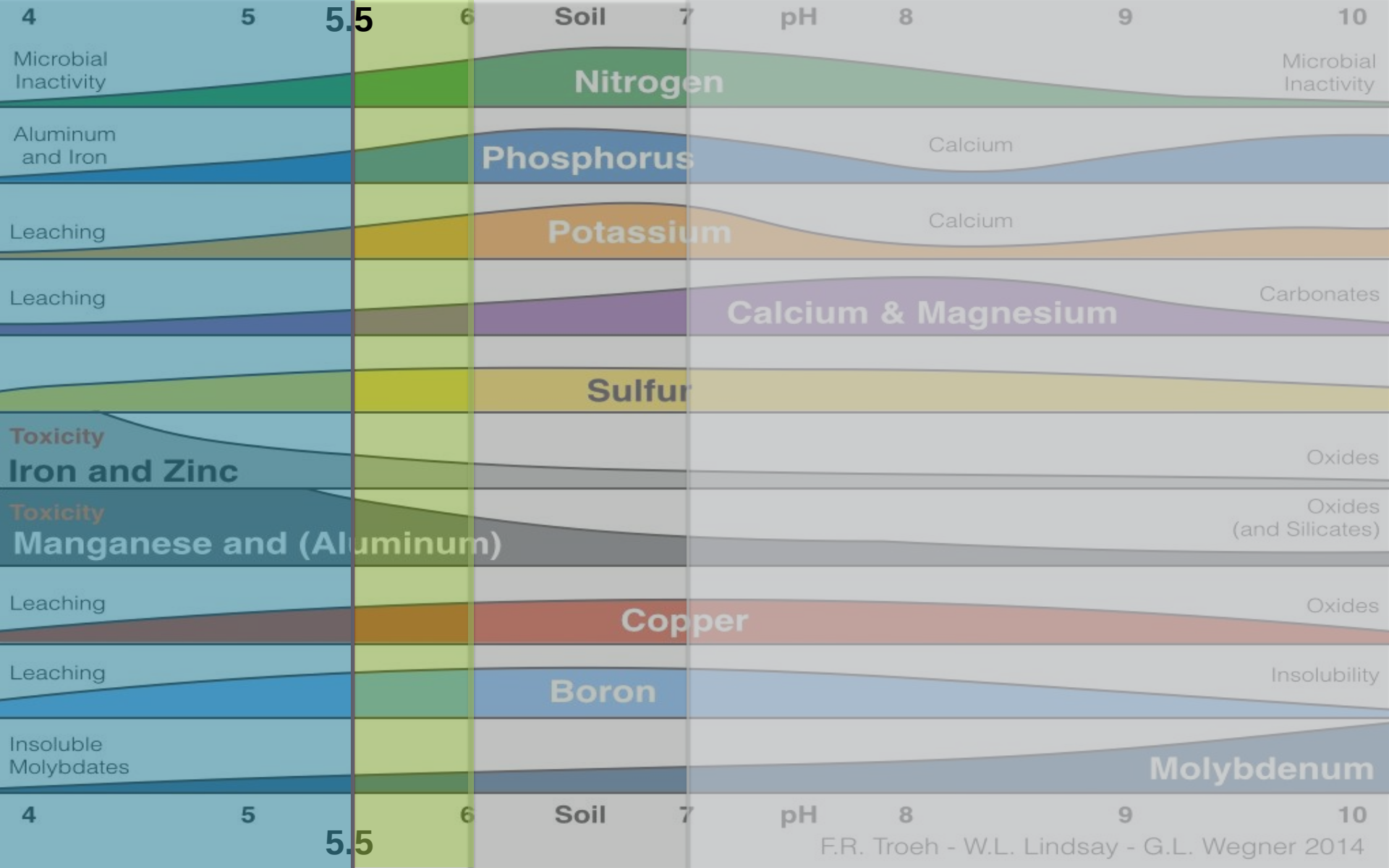
Root Growth

Overall Soil Biology

Nutrient Use Efficiency

Herbicide Efficacy and Carry Forward

OSU WHEAT


4
5
5.5
6
Soil
7
pH
8
9
10
Microbial Inactivity
Nitrogen
Microbial Inactivity
Aluminum and Iron
Phosphorus
Calcium
Leaching
Potassium
Calcium
Leaching
Calcium & Magnesium
Carbonates
Sulfur
Toxicity
Iron and Zinc
Oxides
Toxicity
Manganese and (Aluminum)
Oxides (and Silicates)
Leaching
Copper
Oxides
Leaching
Boron
Insolubility
Insoluble Molybdates
Molybdenum
4
5
5.5
6
Soil
7
pH
8
9
10
F.R. Troeh - W.L. Lindsay - G.L. Wegner 2014

# Nutrient Use Efficiency

# Soil pH and Nutrient Availability

| Soil pH | % Fertilizer Efficiency | | | % Fertilizer Unavailable |
|---|---|---|---|---|
| | N | P | K | |
| 4.5 | 30 | 23 | 33 | 71 |
| 5.0 | 53 | 34 | 52 | 54 |
| 5.5 | 77 | 48 | 77 | 33 |
| 6.0 | 89 | 52 | 100 | 20 |
| 7.0 | 100 | 100 | 100 | 0 |


3 days old wheat
root


**High Al levels**
**52 F**
15 days old
wheat root

# Both winter wheat plants are 8 months since planting


# pH

## affects everything in the soil

Nodulation

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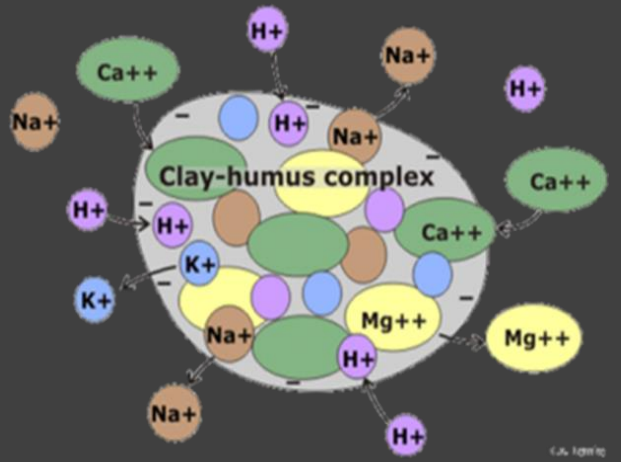
OSU WHEAT

# Soil Stewardship

"You cannot escape the responsibility of tomorrow by evading it today."

**Abraham Lincoln**



# Degraded soils cost farmers billions annually

## Yet soil care often remains a relatively low priority

**“I think there was a perception that if you want to no till and you stopped the soil erosion, the soil would regenerate or restore itself,” David Lobb (Ontario Farmer).**

https://www.manitobacooperator.ca/crops/degraded-soils-cost-farmers-billions-annually/

Soil sampling is essential in getting the balance of soil nutrients right.

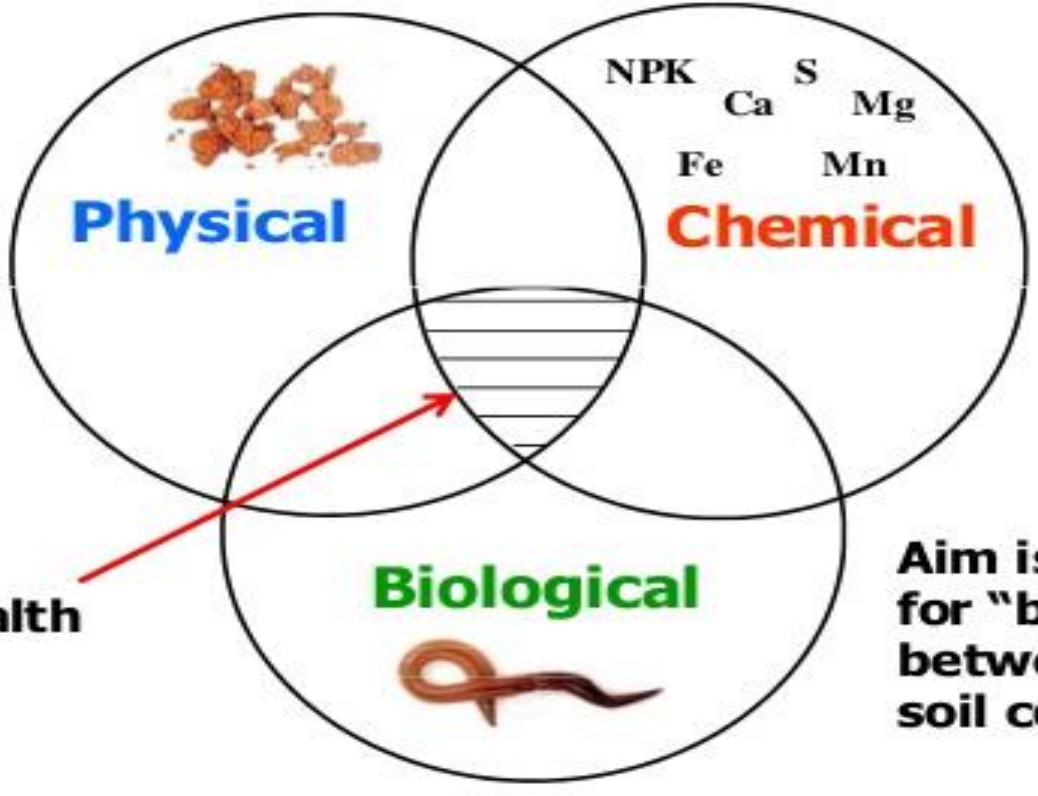
# Soil Sampling

## A relatively simple task?


when you consider the variability that likely exists within a field because of inherent soil formation factors and past production practices, the collection of a representative soil sample becomes more of a challenge

**How do we measure Soil Health?**

**Soil quality is the capacity of a soil to function (in a farm or ecosystem) and thereby sustain productivity, maintain environmental quality, and promote plant and animal health**




**Aim is to manage for "balance" between all three soil components**

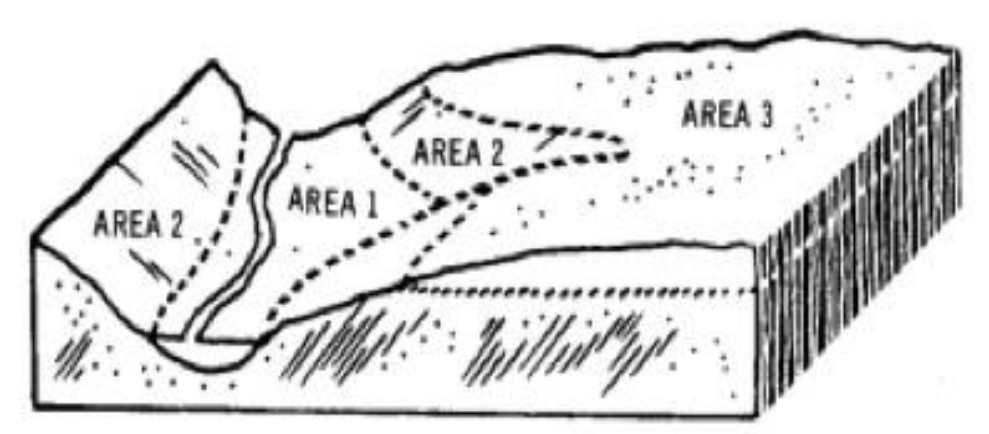
# Tools

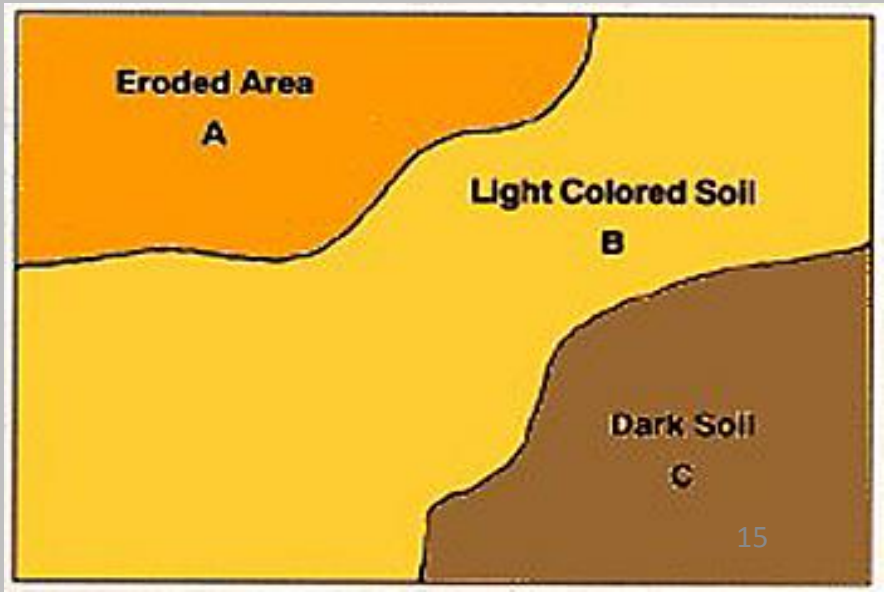



# Sampling Plan

Before heading to the field, be sure you have your objectives clearly in mind. What do you want to learn?

**Management zones**
**Yield maps**
**Topography**
**Soil type**
**Soil color**




Unusual spots obvious by plant growth and/or visual soil color/texture differences should be collected as a separate composite sample from other areas.

# Soil sample depths

What depths to sample?
Normally in most areas of the country, samples are taken from the 6-8” top sample

A six-inch depth is suggested for routine tests of pH, organic matter, phosphorus (P), potassium (K), and zinc (Zn).

** Winter wheat gets about 70% of water and nutrients from the top 24 inches of the soil

Stratified layers: Which ones?

Sample for stratified layers:

- 0-3 inches or plow layer
- 3-6 inches
- 6-12 inches
- 1 foot increments

# Soil Test Labs

- Use a "certified" lab that incorporates a QA/QC program
- For annual sample comparisons, use the same lab
- Sample same time of the year for comparing year-year results

A study from the University of Kentucky found that soil values will vary seasonally, and that they tended to be lowest in the fall.

You are making purchasing decisions of $100,000's based on a few soil sample results.

North American Laboratory Proficiency Program is administered by the Soil Science Society of America (www.naptprogram.org) and certifies labs

# Soil pH

(measure of the acidity or alkalinity of the soil)

Soil pH affects the:

availability of nutrients
soil structure and porosity
herbicide activity
micro-organisms
and plant diseases

Low soil pH may have toxic levels of iron, manganese, and aluminum and are subject to more diseases and less beneficial bacteria

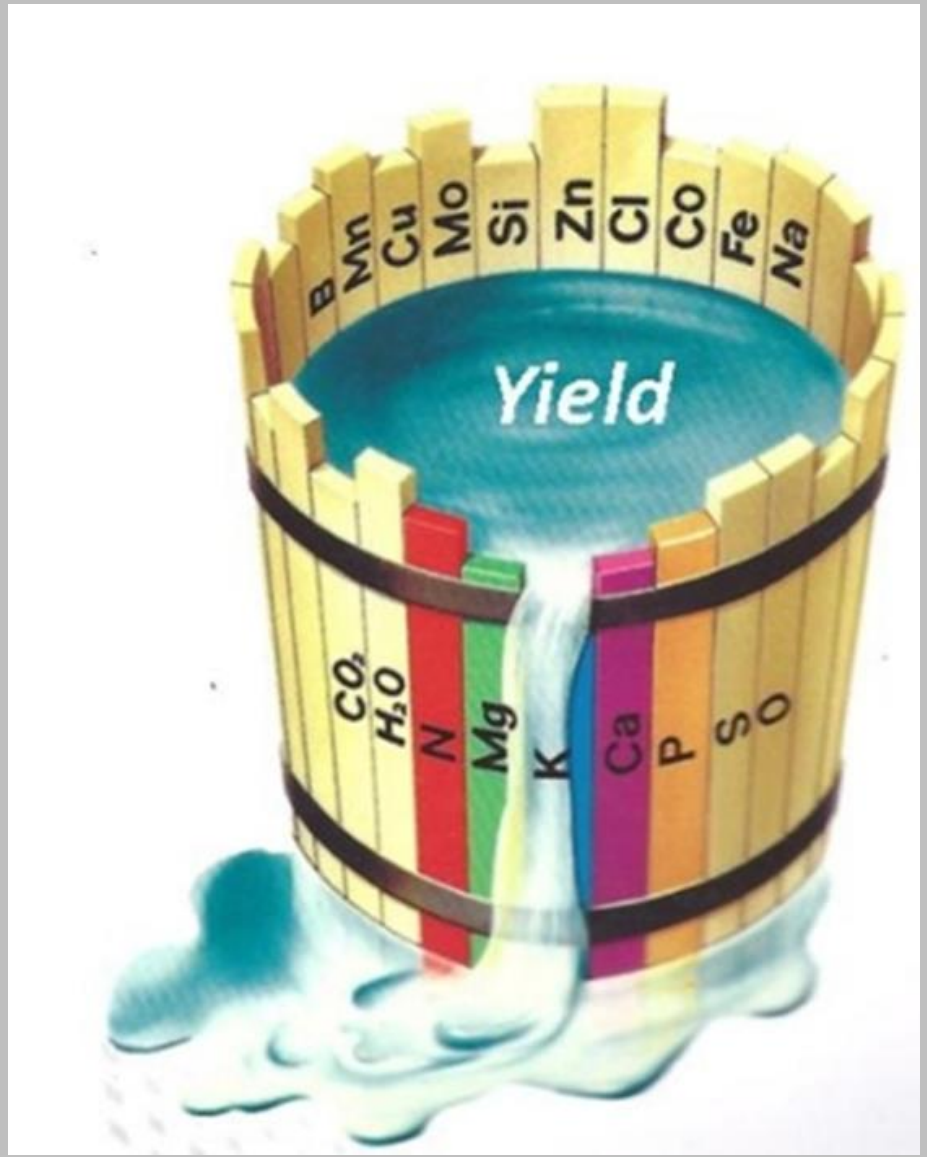
- Macro-nutrients tend to be less available in low pH soils

- Micro-nutrients tend to be less available in high pH soils

# Soil Sample Lab Results

| Depth (ft.) | Available Inches | NO3-N lbs/acre | NH4-N lbs/acre | Sulfur ppm | pH | Soluble Salts mmhos/cm) | Organic Matter Percent | P(bic) ppm | K(bic) ppm | P(ace) ppm | K(ace) ppm | Calcium (meq. per 100 grams) | Magnesium (meq. per 100 grams) | Sodium (meq. per 100 grams) | Eff. | Boron ppm | Zinc ppm | Manganese ppm | Iron ppm | Copper ppm | CEC (meq. per 100 grams) | % Base Sat. | Chloride lbs. per. acre | Bray 1P ppm | Total Bases (meq. per 100 grams) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | 1.26 | | | | 5.2 | | | | | | | | | | | | | | | | | | | | |
| 1 | 2.20 | 8 | 9 | 4 | 5.1 | 0.05 | 1.53 | 33.0 | 175 | | | 5.20 | 1.07 | 0.17 | None | 0.22 | 1.23 | 24.8 | 54 | 1.2 | 11.2 | 62 | | | 6.89 |
| 2 | 1.64 | 7 | | 1 | | | | | | | | | | | | | | | | | | | | | |
| 3 | 1.81 | 9 | | 2 | | | | | | | | | | | | | | | | | | | | | |
| 4 | 1.83 | 11 | | | | | | | | | | | | | | | | | | | | | | | |
| Total | 8.74 | 35 | 9 | | | | | | | | | | | | | | | | | | | | | | |

| Depth (ft.) | Available Inches | NO3-N lbs/acre | NH4-N lbs/acre | Sulfur ppm | pH | Soluble Salts mmhos cm) | Organic Matter Percent | P(bic) ppm | K(bic) ppm | P(ace) ppm | K(ace) ppm | Calcium (meq. per 100 grams) | Magnesium (meq. per 100 grams) | Sodium (meq. per 100 grams) | Eff. | Boron ppm | Zinc ppm | Manganese ppm | Iron ppm | Copper ppm | CEC (meq. per 100 grams) | % Base Sat. | Chloride lbs. per. acre | Bray 1P ppm | Total Bases (meq. per 100 grams) | Sample ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.98 | 14 | 6 | 2 | 5.0 | | 1.59 | | | | | | | | | | | | | | | | | | | |
| 2 | 1.40 | 9 | | 2 | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 1.56 | 9 | | 2 | | | | | | | | | | | | | | | | | | | | | | |
| Total | 3.94 | 32 | 6 | | | | | | | | | | | | | | | | | | | | | | | |


B
Mn
Cu
Mo
Si
Zn
Cl
Co
Fe
Na
Yield
$CO_2$
$H_2O$
N
Mg
K
Ca
P
S
O

# In field soil diagnostic tool

- Identify problem areas in fields
- Collect soil core
- Use a soil pH meter to make instant field checks.
- Check soil column inch by inch
- Observe stratified layers
- Record soil pH results


EXTECH
INSTRUMENTS
pH
3.85
pH Meter
MODE
HOLD
CAL
RECALL
ON
OFF
PH100
ExStik

**4.1 pH**

| No-Vegetation Area | | Vegetation Area | |
|---|---|---|---|
| 1” | 4.1 | 1” | 5.7 |
| 2” | 5.1 | 2” | 4.9 |
| 3” | 5.4 | 3” | 5.0 |
| 4” | 5.4 | 4” | 5.1 |
| 5” | 5.2 | 5” | 5.3 |

**5.7 pH**


Seed Row pH
1 inch
2 inch
3 inch
4 inch
5 inch
6 inch
Seed Row pH
1 inch
2 inch
3 inch
4 inch
5 inch
6 inch
FIELDSCOUT
pH
MODE HOLD
CAL RECALL
ON OFF
Spectrum
SoilStik
Questions