Interpretation of Soil Tests for Environmental Considerations

> Ray Ward Ward Laboratories, Inc Kearney, NE

www.wardlab.com

"Guiding Producers Today to Feed the World Tomorrow"



www.wardlab.com

### Saline County Corn

•	Year	Corn Yield, bu/A
•	1879	40
•	1889	47
•	1929	33
•	1955	9
•	1956	8
•	1994-2010	100
•	1994-2010 (ot	urs) 115







#### Phosphorus-Corn



#### Potassium—Corn



## Nutrient Mining, Ibs/Bu CORN

#### Nutrient

Nitrogen, N Phosphorus, P205 Potassium, K20 Sulfur, S Zinc, Zn

0.33 0.23 0.09 0.001

75

200 b

# Nutrient Mining, lbs/Bu CORN

Chloride Manganese

Nutrient

Iron Copper Boron Molybdenum

024 0006 0.24 00120.00040.08.0006 0.120.000010.002

### Crop Nutrient Mining, Ibs/bu SOYBEAN

#### Nutrient

Nitrogen, N Phosphorus, P2O5 Potassium, K2O Sulfur, S Zinc, Zn

### lb/bu, 60 bu/A

3.62160.77461.2720.18110.0030.18

### **Crop Nutrient Mining, lbs/bu SOYBEAN**

Nutrient lb/bu 60 bu/A Chloride Iron Manganese Copper Boron Molybdenum

0.016 110 0.005 0.3 0.002 0.12 0.001 0.06 0.0006 0.04 0.00001 0.0006

#### • Right Source

- Means identifying the best fertility sources, including manure.
- Soil conditions and properties
- Fertilizer delivery and application issues
- Environmental risks
- Economic constraints

#### • Right Place

- Means ensuring that nutrients are located and retained where they are accessible to the plant.
- Concentration of fertilized volume.
- Relation to the plant root system.
- P and K move to plant roots by diffusion.
- Plant nutrient demands are greatest during rapid vegetative growth.

#### Right Rate

- Means determining nutrient requirements to achieve production goals
- All 17 essential nutrients must be present.
- A deficiency in one nutrient cannot be overcome by applying an excess of another nutrient.
- Match nutrient supply with plant requirements.

#### • Right Time

- Means ensuring that the nutrients are available to meet crop demands.
- The availability characteristics of the nutrient source.
  - Controlled release fertilizers.
- Sight specific conditions such as soil characteristics.
- Weather and other environmental conditions.



- Serious problem when soil pH 5.0 or less.
  - Soil pH is corrected with Ag Lime
- Soil pH between 5.1 and 5.6 should be limed as soon as possible
- Soil pH between 5.7 and 6.0
  - Watch soil pH so it does not go below 5.7



#### HOW SOIL PH AFFECTS AVAILABILITY OF PLANT NUTRIENTS



### Buffer pH

- Measures total acidity
  - Soil pH measures "active" acidity in the soil solution
  - Buffer pH measures the total acidity that is held on the cation exchange capacity (CEC).
- Lime recommendation
  - (7.0 Buffer pH) times 4 = Tons of ECC per acre
  - Tons of ECC divided by effectiveness = Tons of Ag
     Lime per acre

### EC (1:1 soluble salts) mS/cm

Soluble Salts mS/cm (mmho/cm)

 0-1.5 mS/cm No crop hazard
 1.6-3.0 Yield reduction on sensitive crops
 3.1-5.5 Moderate yield reduction
 5.6+ Severe yield reduction

### **Organic Matter**

- Organic matter holds water and plant nutrients
- Organic matter is 58 % carbon
- Ratios
  - -C:N = 10:1
  - C to N to P to S
  - 100C:10N:2.3P:1.4S

#### **Residual Nitrate**

- Carryover nitrate
- It is available to the next crop
- If residual nitrate is high may want to pick a crop that needs nitrogen fertilizer so N fertilizer can be reduced
- Nitrate is soluble. It will move if water is moving through the soil. How do you keep nitrate out of tile drains?



#### Phosphorus

- Phosphorus is attached to soil particles and does not move very far in the soil from year to year.
- Yes, phosphorus does move in the soil. About ¾ of an inch per year for silt loam soils and about 2 inches in sandy soils.
- Phosphorus is not fixed but remains available for future use by plants.

#### **Phosphorus Recommendations**

Soil test ppm P	Rating	<u>lbs P2O5/A</u>
0-5	Very Low	60-140
6-12	Low	35-75
13-25	Medium	20-45
26-50	High	0-30
51+	Very High	None

#### Potassium

- Potassium is getting lower in many of our soils.
- Potassium is exchangeable and is held on the CEC.
- Most potassium is found in the forage while most phosphorus is found in the grain



K

K



#### **Potassium Recommendations**

Rating	lbs K2O
Very Low	90-200
Low	50-120
Medium	25-60
High	0-35
Very High	None
	Rating Very Low Low Medium High Very High

### Calcium, Magnesium, and Sodium

- Part of the base saturation. Needs to be 70 % or greater. % K, %Ca, %Mg, and % Na should add up to 70 % or greater.
- The other cation is Hydrogen. % H should be less than 30 %. This is another way to determine if lime is needed.
- Ca:Mg ratio. Wide range is acceptable.

### Sulfur

- Sulfur is held in the organic matter. If we try to improve our organic matter level we will have less sulfur for plants.
- This is one reason sulfur fertilizer is needed.
- Another reason there is less free sulfur in the atmosphere today than in the past.
- Yields are greater so more sulfur is mined from the soil.

#### Sulfur Soil Test, Ca-P Extractable

Soil Test ppm S	Rating
0-4	Very Low
5-7	Low
8-11	Medium
12-15	High
16+	Very High

### Sulfur Requirement

Crop	Yield Unit	LBS of S
Corn	Bushel	0.18-0.26
Soybean	Bushel	0.20-0.29
Wheat	Bushel	0.28-0.35
Alfalfa	Ton	4.7 – 6.3
Grass	Ton	2.2 – 3.6

#### Zinc

- Trace element that is needed on the most acres in Nebraska and not so much in Minnesota.
- Our zinc recommendation is a correction recommendation. A recommendation should last 4 to 8 years, depending on crop removal

#### **Zinc Recommendations**

	<b>Corrective Rate</b>	
Soil Test ppm Zn	lb Zn/A	
0-0.25	3-12	
0.26-0.50	1-7	
0.5175	0-6	
0.76-1.00	0-3	
1.01+	None	
*Annual rate: Divide Corrective Rate by 6.		

### Iron Chlorosis and Excess Lime

- High excess lime
  - Fine calcium carbonate (CaCO3) crystals

#### $CO2 + H2O + CaCO3 \leftrightarrow Ca++ 2HCO3-$

 Cold wet soil increases carbon dioxide in the soil therefore increasing bicarbonate than precipitates iron in the plant.

"Guiding producers today to feed the world tomorrow"

www.wardlab.com



### Oats and Soybeans



#### Manganese Soil Test (DTPA) and Recommendations

		Mn Rate
<u>Mn Soil Test, ppm</u>	Rating	Lbs Mn/A
0-0.5	Very Low	12
0.6-1.5	Low	7-12
1.6 – 3.0	Medium	3-6
3.1 - 6.0	High	0-2
6.0 +	Very High	0

#### Copper Soil Test (DTPA) and Recommendations

Rating	Lbs/A
Very Low	3-6
Low	1-2
Medium	0
High*	0
Very High	0
	Rating Very Low Low Medium High* Very High

- \* Specialty crops get Copper up to 0.60 ppm
- \*\* Corrective application rate



Cu Rate\*\*

#### Boron Soil Test and Recommendations

#### **Boron Rate**

Boron Soil Test, ppm	Rating	Lbs B/A
0 – 0.25	Low	0.5 – 3.0
0.26 – 0.50	Medium	0.0 - 1.7
0.51 +	High	0

Alfalfa, clover, peanuts, cotton and sugar beets require more boron than other crops.



### Chloride Soil Tests and Cl Recommendations

Soil Test, ppm Cl	lbs of Cl/A
< 4 ppm Cl	20 lbs/A
4 – 6 ppm Cl	10 lbs/A
> 6 ppm Cl	0 lbs/A

KSU based on average Cl in 0 - 24 inch soil root zone.

#### Manganese Recommendations

- Foliar Treatment if deficiency is diagnosed with Plant Analysis
  - Manganese 0.5 to 1.0 lb Mn/A in 20 gallon water/A.
  - Possible soil treatment of 25 to 50 lbs of manganese sulfate per acre.

#### **Copper Recommendations**

Low copper soil test and long term no-till

 3 lbs of Cu per acre as copper sulfate or
 1 lb of Cu per acre as copper chelate

#### **Chloride Recommendation**

Soil Test, ppm Cl	lbs of Cl/A
< 4 ppm Cl	20 lbs/A
4 – 6 ppm Cl	10 lbs/A

# KSU based on average Cl in 0 - 24 inch soil root zone.

#### Nutrient Uptake and Root Structure



Fig. 10.2. Longitudinal section of herbaceous dicot root. I. Root tip with regions of cell division (A). elongation (B), and maturation (differentiation) (C). II. Section of mature root with lateral roots in varying stages of development. III. Meristem of a lateral root arising from the pericycle. IV. Cross section of a young root. Differentiated tissues: root hair (a), epidermis (b), cortex (c), endodermis (d), pericycle (e), central cylinder or stele (f), meristem with quiescent center (g), root cap (h), xylem (i), phloem (j).











#### Factors Affecting Active Nutrient Uptake

Oxygen Temperature Ion Interference

#### The Best Placement Method



#### The Best Combination:

Banding and broadcasting fertilizer P to build soil fertility levels and to optimize long-term yield potential and profits