

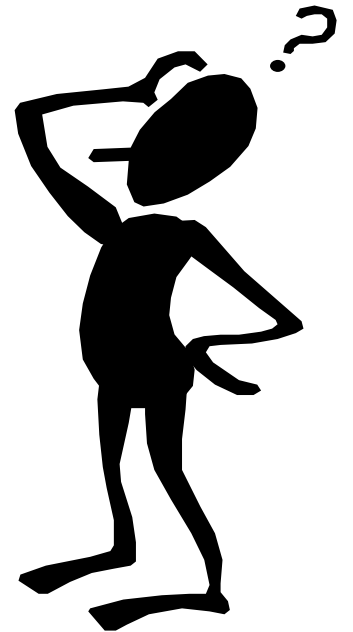
# Soil Tests: What Do They Tell Me?

2008 Sustainable Landscaping Conference



Ernie Marx, CSU-Larimer County Extension

# Why test your soil?



# Why test your soil?

- Select plants appropriate for the site
- Plan nutrient/fertilizer management
- Diagnosis of plant problems
  - Test soils from good and poor performing areas for comparison

# Value of soil tests for fertilizer recommendations

## Valuable

Agronomic crops

Lawns & turf

Greenhouse crops

Nursery crops

General gardens

## Questionable Value

Established shade trees and other woody plants in a landscape

Specific herbaceous plants in the landscape

Micronutrients

(except in a few high value crops)

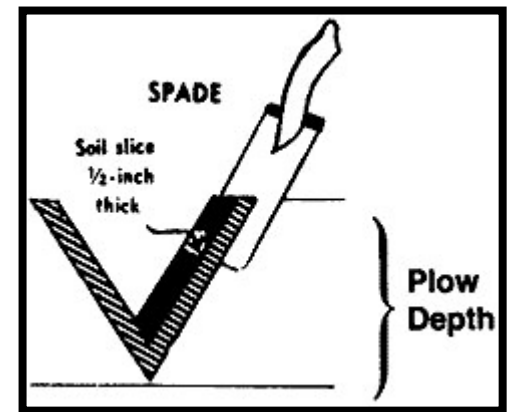
**Lacks a research base to interpret the these tests.**

# Soil Sampling

- Soil test results are only as good as the sample collected
- Probes are better than shovels
- Clean stainless steel or plastic shovels and buckets (not galvanized metal or brass)

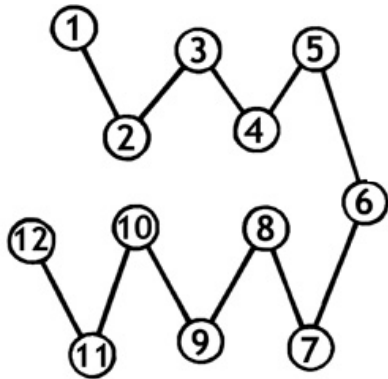


or



# Soil Sampling

- Sample to rooting depth of plants to be grown
- Do not mix dissimilar areas
- Discard surface organic matter/turf thatch
- Collect 5 to 20 samples in a bucket
- Mix thoroughly
- Fill a sandwich baggie with soil to submit to lab
- Discard the rest



# Soil testing

- Send sample to a reputable soil testing lab
- Find a lab you like and stick with them
- Don't waste your money on a “home test kit”



# What should I test for?

“Basic” soil test in arid regions could include:

- pH
- Salts or conductivity
- Sodium Adsorption Ratio (SAR) depending on salinity
- “Free lime” ( $\text{CaCO}_3$ )
- Gypsum
- Soil texture
- Cation Exchange Capacity (CEC)
- Organic matter
- Nitrate nitrogen
- Phosphorus
- Potassium
- Calcium
- Magnesium
- Zinc
- Iron
- Manganese
- Copper
- Boron



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# Soil testing

- Soil tests DO NOT measure all the potassium, phosphorus, etc. in the soil
- Tests estimate plant available nutrients

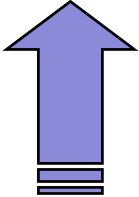
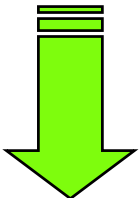
# Soil testing

- Soil tests DO NOT measure all the potassium, phosphorus, etc. in the soil
- Tests estimate plant available nutrients
- Different labs use different methods resulting in different numbers
- Interpretation of the numbers is the important information

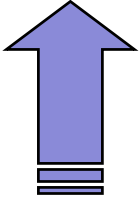
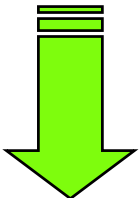
# Soil Test Interpretation

- Since lab procedures and objectives differ, the lab doing the test should make the recommendations.
- Be careful using “soil test interpretation” fact sheets, even from universities.
- Find a lab you like and stick with them.

# pH, a measurement of soil alkalinity or acidity

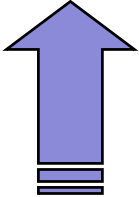
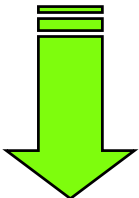
	<u>pH</u>	<u>H<sup>+</sup>:OH<sup>-</sup></u>	<u>Principle Cations</u>
	>8.3		
<b>Alkaline</b>	7.5		
	7.2	more OH <sup>-</sup>	Ca <sup>2+</sup> , Mg <sup>2+</sup>
<b>Neutral</b>	7.0	H <sup>+</sup> = OH <sup>-</sup>	
<b>Acid</b>	6.8	more H <sup>+</sup>	H <sup>+</sup> , Al <sup>3+</sup>
	6.0		
	5.5		
	<4.6		

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Soil pH decreases with time and rainfall as cations are leached out of soil.

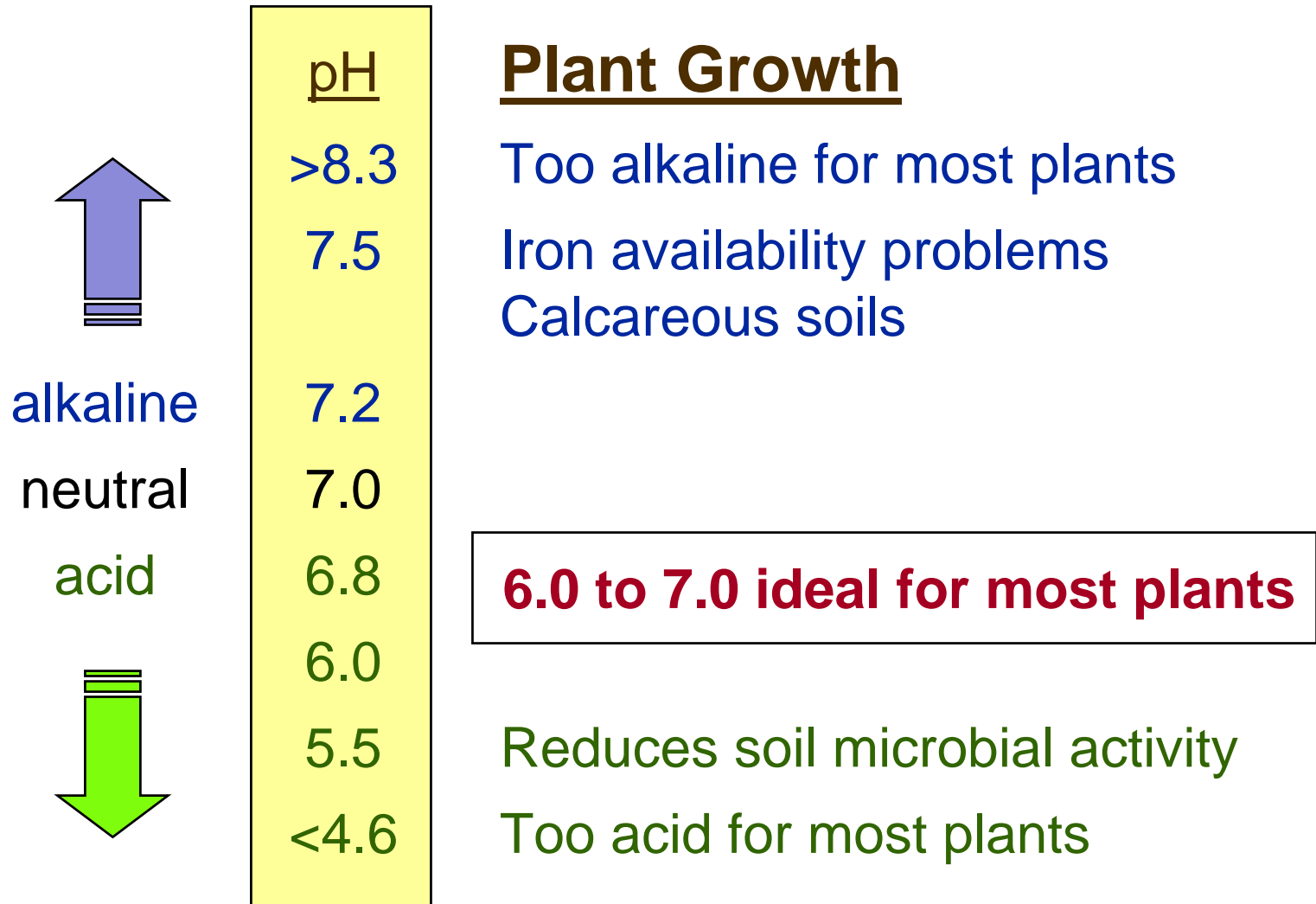
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Do you expect Colorado soils to have high or low pH?

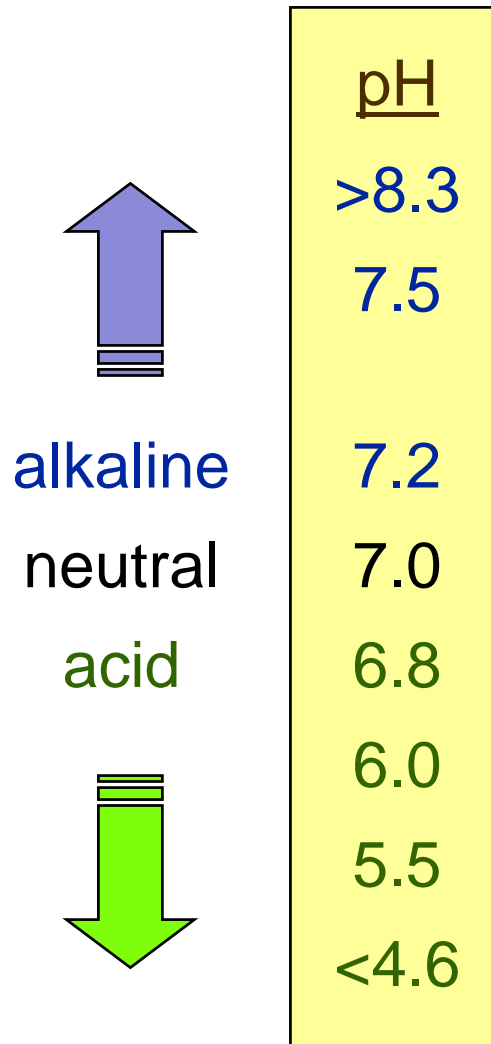


# pH and plant growth





# pH and plant growth



## Plant Growth

Match the plant to the soil

Some plants (e.g. blueberries, rhododendrons) are very sensitive to soil pH

# Managing Soil pH

- Very difficult to lower soil pH
- Ammonium or urea nitrogen fertilizers can help over time
- Sulfur applications can help if “free lime” levels are low.
- DO NOT add gypsum ( $\text{CaSO}_4$ )
- If you suspect micronutrient problems and pH is very high, consider foliar instead of soil applied fertilizers

# Salts (Electrical conductivity)

- High salts are probably the most common management-induced soil chemistry problem
- Application of manures with high salt content is a common culprit
- Difficult to fix problem

# Salts (Electrical conductivity)

mmhos/cm	Interpretation
0 – 2	Satisfactory for most plants
2 – 4	Affects sensitive plants
4 – 8	High for many plants
above 8	Very high for most plants

# Salts (Electrical conductivity)

If salts are high:

- Increase irrigation frequency
- Plant salt tolerant (drought tolerant) species
- Lay off the manure...don't make the problem worse

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- Plant salt tolerant species
- Lay off the manure...don't make the problem worse
- Test soil **BEFORE** designing an installation so you can plan with appropriate plant material

# Phosphorus (P)

- Olson (sodium bicarbonate) method should be used on high pH soils.
- CSU lab uses a different, but related method

ppm P in soil		Relative level
AB-DTPA	NaHCO <sub>3</sub>	
0 - 3	0 - 6	very low
4 - 7	7 - 14	low
8 - 11	15 - 22	medium
> 11	> 22	high

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- If soil tests are medium or low, incorporate phosphorus during site preparation.



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- Test soil **BEFORE** site preparation so fertilizers can be applied and incorporated

# Phosphorus (P)

- On established landscapes, especially turf, phosphorus values are often high.
- Consider fertilizer products with little or no phosphorus...they could be cheaper and better for the environment.

# Phosphorus (P)

- How far is your landscaping from the river?

# Phosphorus (P)

- How far is your landscaping from the river?
- Be careful with post-planting surface applications of phosphorus.



# Phosphorus (P)

- Rock phosphate products are not effective in our high pH soils.
- Commercial pelleted products or manures are most efficient sources of phosphorus.

# Potassium (K)

- Most eastern Colorado soils have adequate potassium
- Only sandy soils likely to have deficiency

# Potassium (K)

Available potassium (ammonium bicarbonate-DTPA test)

<b>Test values in ppm</b>	<b>Irrigated production</b>	<b>Dryland production</b>
0-60	Low	Low-medium
61-120	Medium	High
121-180	High	
above 180	Very High	

Available potassium (ammonium acetate test)

<b>Test values in ppm</b>		
< 150	Low	
150-250	Medium	
250-800	High	
> 800	Very High	

# Nitrogen (N)

- Nitrogen is the nutrient most commonly needing management.
- Unfortunately, nitrogen soil tests have limited value.







# Composts and Manures

- Require different test methods than soils.
- Use an STA certified compost testing lab.
- Asking compost supplier for test results is a reasonable request.

# Composts and Manures

Biggest concerns:

- Salts
- C:N ratios
- Germination/Plant growth tests
- Nitrogen and phosphorus if used as fertilizers

<b>Quality Measure</b>	<b>GH or Nursery Crops</b>	<b>General Use (Bagged or Bulk)</b>	<b>Soil Amend. (Veg or Fruits)</b>	<b>Mulch</b>
Plant Growth Response	++	++	++	-
Nutrient Content	-	+	+	-
pH/Sol. Salts	++	++	+	-
Color/Odor	+	++	-	+
Biol. Stability or Maturity	++	++	+	-
Particle Size	++	+	+	+
-, +, ++ low, mod., high importance      Source: Sullivan and Miller, 2001				

# Compost Quality

## Test results and interpretation: Soluble salts, electrical conductivity

Evaluation of SALINTY in Compost Tests, mmbos/cm				
<1.0	1 – 2	2 – 5	5 – 10	>10
V-LOW	M-LOW	MEDIUM	M-HIGH	V-HIGH
may be used as direct substitute for soils	Topsoil substitute container media	dilute 2- to 5-fold for most applications	dilute 3-to 10-fold for most applications	use only at low application rates

**Woods End Research Laboratory**

# Salt levels in Manures

<u>Manure</u>	<u>Ave. EC</u>	<u>Low</u>	<u>High</u>
Beef	28.2	8.4	42.5
Horse	6.2	3.3	10.2
Sheep	23.4	9.4	42.8
Chicken	23.7	16.0	40.7
Dairy	18.8	9.0	29.5
D. Compost	24.5	12.8	43.6

# Compost Quality

- C:N ratio should be between 10:1 and 25:1
- What might happen if C:N ratio is too high?





# Compost Quality

## Test results and interpretation: Phytotoxicity & Seedling Growth

Germination, % of Pro-Mix Control	Phytotoxicity Classification	Plant Weight, % of Pro-Mix Control	Phytotoxicity Classification
>85	V – Non-Toxic	>90	V – Excellent
70-85	IV – Moderately Toxic	80-90	IV – Good
50-70	III – Toxic	65-80	III – Fair
30-50	II – Very Toxic	40-65	II – Poor
<30	I – Extremely Toxic	<40	I – Extremely Poor

**Woods End Research Laboratory**

# Manure as Fertilizer

Book values for nitrogen in manures – Univ. of Minnesota Extension

<i>Manure Type</i>	<i>Dry Matter</i>	<i>NH<sub>4</sub>-N</i>	<i>Total N<sup>a</sup></i>	<i>P<sub>2</sub>O<sub>5</sub></i>	<i>K<sub>2</sub>O</i>
	%	----- lb/ton -----			
<b>Swine, with bedding</b>	18	5	<b>6</b>	<b>7</b>	7
<b>Beef, no bedding</b>	52	7	<b>21</b>	<b>14</b>	23
<b>Beef, with bedding</b>	50	8	<b>21</b>	<b>18</b>	26
<b>Dairy, no bedding</b>	18	4	<b>9</b>	<b>4</b>	10
<b>Dairy, with bedding</b>	21	5	<b>9</b>	<b>4</b>	10
<b>Sheep, no bedding</b>	28	5	<b>18</b>	<b>11</b>	26
<b>Sheep, with bedding</b>	28	5	<b>14</b>	<b>9</b>	25
<b>Poultry, no litter</b>	45	26	<b>33</b>	<b>48</b>	34
<b>Poultry, with litter</b>	75	36	<b>56</b>	<b>45</b>	34
<b>Horse, with bedding</b>	46	4	<b>14</b>	<b>4</b>	14
<b>Poultry compost</b>	45	1	<b>17</b>	<b>39</b>	23
<b>Dairy compost</b>	45	<1	<b>12</b>	<b>12</b>	26

# Manure as Fertilizer

Species	% Dry Matter	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	S
----- Pounds per ton -----					
Dairy	24	10	5	9	1.3
Beef	35	<b>14</b>	<b>9</b>	11	1.5
Swine	20	14	10	9	2.5
Duck	35	17	21	30	3.3
Chicken	60	40	50	30	4
Turkey	60	40	40	30	4
Sheep	45	26	18	40	3.3
Horse	45	10	6	10	1.7

REPORT NO.  
F04323-8010  
ACCOUNT NUMBER  
83512

# A & L GREAT LAKES LABORATORIES, INC.

3505 Conestoga Drive • Fort Wayne, Indiana 46808-4413 • Phone 260-483-4759 • Fax 260-483-5274  
www.algreatlakes.com • lab@algreatlakes.com



TO: ANGELINA-NECHES RIVER AUTHOR.  
PO BOX 387  
LUFKIN, TX 75902-0387

COPY: AL RATTIE

STA

ATTN: JON CHEATHAM

## COMPOST ANALYSIS REPORT

LAB NUMBER: 25524

SAMPLE ID: NECHES COMPOST FAC. BIO SOLID COMPOST

DATE RECEIVED: 11/18/2004

DATE REPORTED: 12/07/2004 PAGE: 1

PARAMETER	UNIT	ANALYSIS RESULT	DRY BASIS RESULT	ANALYSIS METHOD
Moisture @ 70 C	%	31.90		TMECC 03.08-A
Dry Matter	%	68.10		TMECC 03.08-A
Total Nitrogen (N)	%	1.50	2.20	TMECC 04.02-D
Phosphorus (P)	%	1.52	2.23	TMECC 04.03-A
Phosphate (P205)	%	3.49	5.13	TMECC 04.03-A
Potassium (K)	%	0.18	0.26	TMECC 04.04-A
Potash (K2O)	%	0.21	0.31	TMECC 04.04-A
Magnesium (Mg)	%	0.19	0.28	TMECC 04.05-MG
Calcium (Ca)	%	1.63	2.39	TMECC 04.05-CA
Arsenic	mg/kg	8.192	12.029	SW846-6020 04.06-As
Cadmium	mg/kg	0.93	1.36	SW846-6020 04.06-Cd
Copper	mg/kg	215.27	316.11	SW846-6020 04.06-Cu
Mercury	mg/kg	0.56	0.82	SW846-7471A 04.06-Hg
Molybdenum	mg/kg	4.23	6.21	SW846-6020 04.06-Mo
Nickel	mg/kg	11.07	16.26	SW846-6020 04.06-Ni
Lead	mg/kg	23.69	34.79	SW846-6020 04.06-Pb
Selenium	mg/kg	1.162	1.706	SW846-6020 04.06-Se

# Soil Tests:

## What Do They Tell Me?

- Soil pH and salts (EC) help you decide which plants are appropriate for the site
- Soil P and K tests help you make fertilizer decisions
- Compost quality tests help you decide if the material is appropriate for your use
- Manure tests help you apply the correct amount if used as a fertilizer