

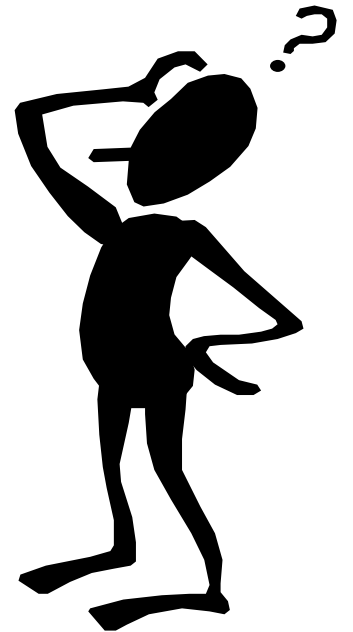
Soil Tests: What Do They Tell Me?

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)

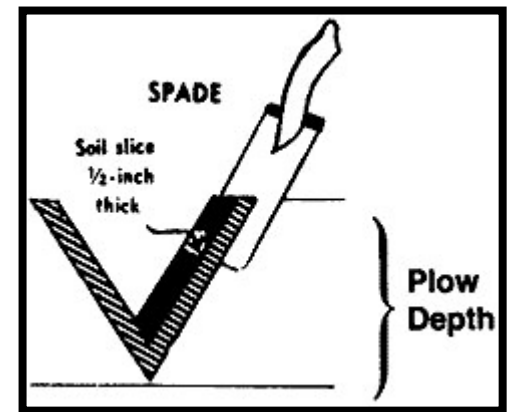
Lacks a research base to interpret the these tests.

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)

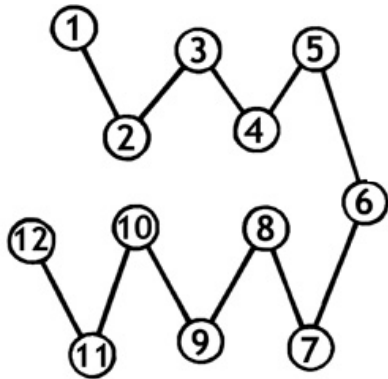


or



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” (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

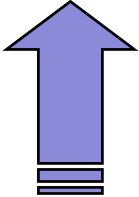
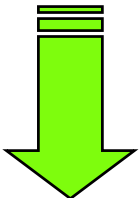
Soil testing

- 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

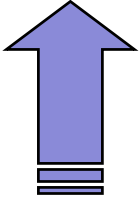
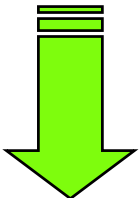
Soil Test Interpretation

- 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

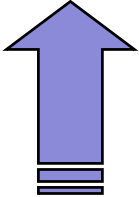
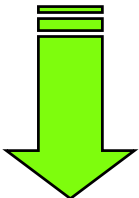
	<u>pH</u>	<u>H⁺:OH⁻</u>	<u>Principle Cations</u>
	>8.3		
Alkaline	7.5		
	7.2	more OH ⁻	Ca ²⁺ , Mg ²⁺
Neutral	7.0	H ⁺ = OH ⁻	
Acid	6.8	more H ⁺	H ⁺ , Al ³⁺
	6.0		
	5.5		
	<4.6		

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

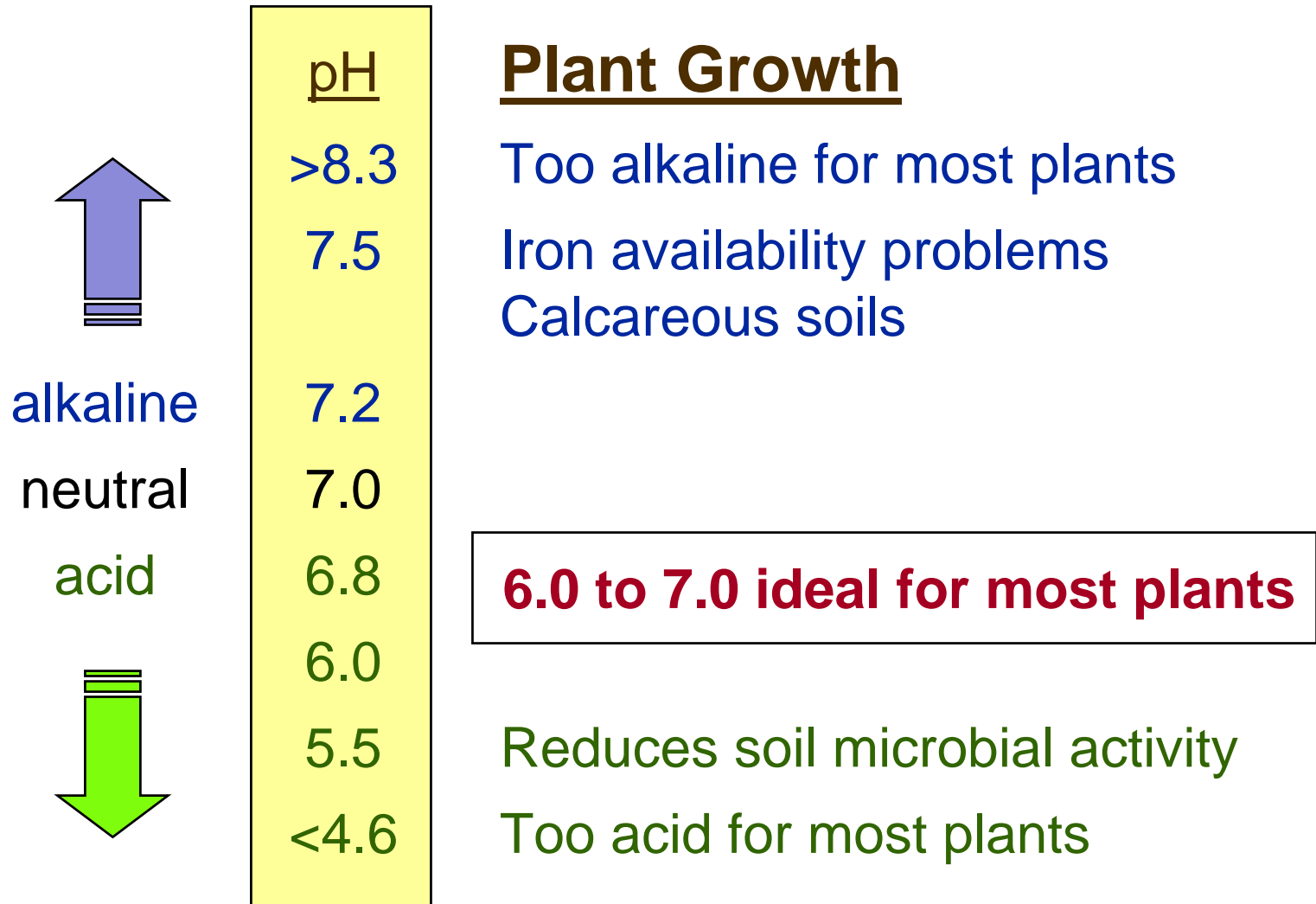
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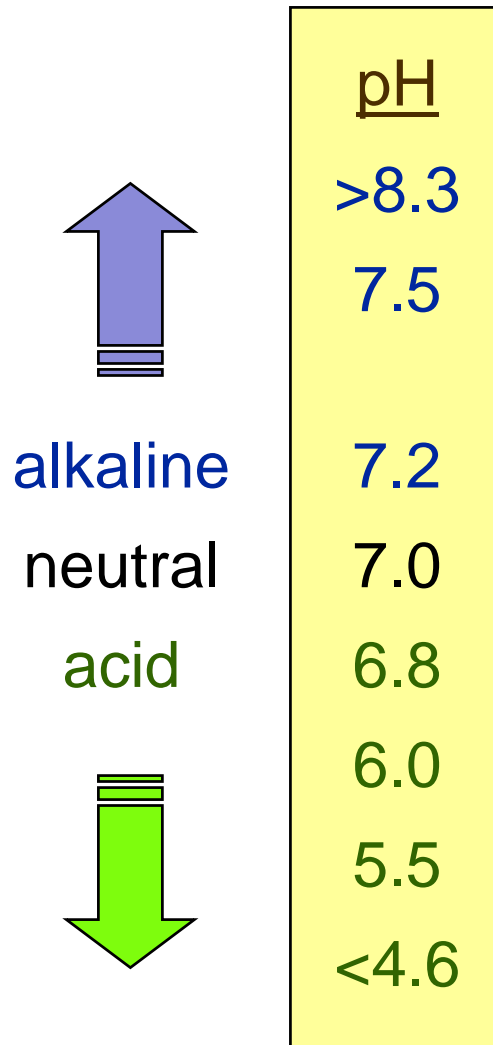
Do you expect Colorado soils to have high or low pH?



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 (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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- 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 ₃	
0 - 3	0 - 6	very low
4 - 7	7 - 14	low
8 - 11	15 - 22	medium
> 11	> 22	high

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- Phosphorus does not move into the soil with irrigation water very well.
- 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)

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

Available potassium (ammonium acetate test)

Test values in ppm		
< 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

Quality Measure	GH or Nursery Crops	General Use (Bagged or Bulk)	Soil Amend. (Veg or Fruits)	Mulch
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>NH₄-N</i>	<i>Total N^a</i>	<i>P₂O₅</i>	<i>K₂O</i>
	%	----- lb/ton -----			
Swine, with bedding	18	5	6	7	7
Beef, no bedding	52	7	21	14	23
Beef, with bedding	50	8	21	18	26
Dairy, no bedding	18	4	9	4	10
Dairy, with bedding	21	5	9	4	10
Sheep, no bedding	28	5	18	11	26
Sheep, with bedding	28	5	14	9	25
Poultry, no litter	45	26	33	48	34
Poultry, with litter	75	36	56	45	34
Horse, with bedding	46	4	14	4	14
Poultry compost	45	1	17	39	23
Dairy compost	45	<1	12	12	26

Manure as Fertilizer

Species	% Dry Matter	N	P ₂ O ₅	K ₂ O	S
----- Pounds per ton -----					
Dairy	24	10	5	9	1.3
Beef	35	14	9	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.

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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 03.09-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