

# Soil Testing and Fertilizing

With High Fertilizer Prices

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Good fertility = Good Pastures = Good Crops

Know where you are.....Soil Test

# What Nutrients Do Plants Require?

- **Macro-nutrients - N, P, K, Ca, Mg, S**
  - Needed in greatest quantities
  - N, P, K likely to show economic responses
- **Micro-nutrients - B, Fe, Cu, I, Mn, Mo, Zn, Cl, Na, Co, Si**
  - Unlikely to show economic responses unless severely deficient
- **Soil pH – not a nutrient, but regulates the availability of nutrients to plants**
- **Air and Water,**

# Determining Fertilizer Needs



- **Determine nutrients in Soil**
- **Yield - Replace the nutrients removed**
- **Soil Capability and Nutrient Buildup**
- **Crop and System- No till or irrigated**
- **Hay or Grazing System/ manure recycling**

# Why Soil Test

- Meet plant needs
- Optimize production
- Use fertilizer **\$\$\$\$** effectively
- Reduce potential pollution to water
- Reduce fertility effects on livestock and crops
- Improve quality of forage and crops
- Maintain and improve soil fertility

# Soil Sampling

- Each test should represent 20 acres or less
- Avoid sampling near limestone roads, feeding areas, water tanks, loafing areas, ditches, fresh manure piles, etc.
- Take 15 to 20 cores at random locations in the paddock. A zig-zag or "M" pattern works well.
- Take cores to a 6 inch depth or hit rock

<http://www.soiltest.psu.missouri.edu/>

FIELD INFORMATION			
Field ID ADAMS FIELD		Sample no 1	
Acreage 35	Last Limed >5 yrs	Irrigated No	
Last crop 18 COOL SEASON GRASS HAY		FSA Copy N	

<b>Serial no. S14964-1</b>		<b>Lab no. D0804005</b>	
County Iron		Region 7	
Submitted 3/19/2008		Processed 4/4/2008	

Soil sample submitted by: Firm Number: Outlet:

This report is for:

DARRELL MILLER  
RT 1, BOX 165  
ANNAPOLIS MO 63620

SOIL TEST INFORMATION		RATING					
		Very Low	Low	Medium	High	Very High	Excess
pH <sub>s</sub> (salt pH)	6.7	*****					
Phosphorus (P)	7 lbs/A	*****					
Potassium (K)	174 lbs/A	*****					
Calcium (Ca)	2647 lbs/A	*****					
Magnesium (Mg)	700 lbs/A	*****					
Sulfur (SO <sub>4</sub> -S)	ppm						
Zinc (Zn)	ppm						
Manganese (Mn)	ppm						
Iron (Fe)	ppm						
Copper (Cu)	ppm						
Organic matter	3.0 %	Neutralizable acidity	0.5 meq/100g	Cation Exch. Capacity	10.3 meq/100g		
PH in water		Electrical Conductivity	Mmho/cm	Sodium (Na)	lbs/A		
Nitrate (NO <sub>3</sub> -N) Topsoil	ppm	Subsoil	ppm	Sampling Depth	Top Inches	Subsoil	Inches
NUTRIENT REQUIREMENTS							LIMESTONE SUGGESTIONS
Cropping options	Yield goal	Pounds per acre					
		N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Zn	S	
3 CLOVER/CLOV-GRASS EST	0	0	100	20		Effective Neutralizing Material (ENM)	0
6 OVERSEEDING LEGUMES	0	0	100	20		Effective magnesium (EMg)	0
16 CLOVER/CL-GRASS HAY	2 T/A	0	65	90			
16 CLOVER/CL-GRASS HAY	3 T/A	0	75	125			

Comments

---No nitrogen fertilizer is recommended when establishing legumes because it promotes grass and weed competition.

---Some herbicide labels list restrictions based on soil pH in water. This sample has an estimated pH in water of 7.2 . Use this estimated pH in water as a guide. If you wish to have soil pH in water analyzed, contact your dealer or Extension specialist listed below.

# Soil Test Report



## Soil Test Report

Soil Testing Laboratory  
28 Mumford Hall, MU  
Columbia, MO 65211  
Phone: (573) 882-0823

or  
Soil Testing Laboratory  
P.O. Box 160  
Portageville, MO 63873  
Phone: (573) 379-5431



FIELD INFORMATION			
Field ID	Hill top field	Sample no.	1
Acres	40	Last Lined	Not known
		Irrigated	No
Last crop	019 Cool-Season Grass Pasture		

**A**

Serial no.	M9999	Lab no.	9969999
Area	015	County	010
		Region	3
Submitted	06/10/96		Processed
			06/12/96

Soil sample submitted by:

This report is for:

Example Report  
University of Missouri  
Columbia, MO 65211

B SOIL TEST INFORMATION	C RATING					
	Very low	Low	Medium	High	Very High	Excess
pH <sub>s</sub> (salt pH)	4.9	*****				
Phosphorus (P)	22 lbs/acre	*****				
Potassium (K)	303 lbs/acre	*****				
Calcium (Ca)	2091 lbs/acre	*****				
Magnesium (Mg)	278 lbs/acre	*****				
Sulfur (SO <sub>4</sub> -S)	ppm					
Zinc (Zn)	ppm					
Manganese (Mn)	ppm					
Iron (Fe)	ppm					
Copper (Cu)	ppm					
Organic matter	2.2 %	Neutralizable acidity	6.0 meq/100g	Cation Exch. Capacity	12.8 meq/100g	
pH in water		Electrical Conductivity	mmho/cm	Sodium (Na)	lbs/a	
Nitrate (NO <sub>3</sub> -N)	ppm	Subsoil	ppm	Sampling Depth	Top	Inches
					Subsoil	inches

E Cropping options	D Yield goal	F G POUNDS PER ACRE					H LIMESTONE SUGGESTIONS	
		N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Zn	S		
Alfalfa/Grass Establishment	0	20	55	0			Effective neutralizing material (ENM)	1,395
Clover/Grass Establishment	0	20	45	0				
Alfalfa/Grass Hay	6	0	80	235			Effective magnesium (EMg)	
Cool-Season Grass Pasture	150 CD/A	90	30	20				

**I**

To determine limestone needs in tons/acre, divide ENM requirements by the guarantee of your limestone dealer.

When N requirement for cool-season grass exceeds 90 lbs/acre, apply 2/3 of it during the period from December through February, and the remainder in August.

Do not use nitrogen on spring seedlings of legumes after May 1st because of potential weed competition.

Area Agronomy Specialist Agronomy Specialist Phone (573) 882-1000

White - Farmer, Yellow - ASCE, Blue Firm, Pink - Extension

MP 189 Revised 1/95

Signature



## (A) Field information

- This section contains information provided by you to identify the field and summarize previous management. This information includes, for example, the field name or number, field size and previous crop.

## B) SOIL TEST INFORMATION

- **This provides the results of the soil tests performed on your sample.**
- The regular soil tests include the soil salt pH; available phosphorus, potassium, calcium and magnesium; organic matter; neutralizable acidity; and cation exchange capacity.
- Tests for other nutrients can be obtained at additional charge.
- The basic set of tests provides the necessary data to develop nitrogen, phosphate, potash, and ag lime recommendations for your intended cropping plan.

## C) Rating

- This section provides a rating for the salt pH and nutrients tested.
- The rating system helps you interpret the soil test information in Section B.
- The soil test rating indicates the relative level of each nutrient tested and provides information on the probability that application of a particular fertilizer will increase crop yield.
- Use Table 1 to determine the probability of a yield increase from fertilizer applications for your soil test rating.

**Table 1**

Your probability of yield increase from fertilizer drops as your soil test ratings in Section C rise.

Rating						Probability of response to fertilizer
Very low	Low	Medium	High	Very high	Excess	
*****						very high
*****						high
*****						medium
*****						low
*****						none
*****						none

# **(D) Nutrient requirements**

- **This section contains three parts:**
  - **cropping options,**
  - **yield goal, and**
  - **fertilizer recommendations**

# Species Differ in their Nutrient Requirements



## (E) Cropping options

- This section lists cropping plans or crops for requested fertilizer recommendations.
- You can request recommendations for up to four different cropping scenarios.
- Additional scenarios can be done at your local MU Extension center if you change plans after you receive your lab report.

## (F) Yield goal

- The yield goal section shows the level of production you selected for the crops listed in Section E, "Cropping Options."
- Common yield goal ranges for Missouri crops are given in the appendix table in this publication.
- The yield goal you choose should be based on soil type, yield history, fertility level, irrigated versus nonirrigated land, and economic considerations.



## (G) Pounds per acre

- Fertilizer recommendations for the crops and yield goals listed. The recommendations are reported as pounds of N (nitrogen),  $P_2O_5$  (phosphate), and  $K_2O$  (potash) per acre.
- The fertilizer recommendation is designed to provide a recommendation of the nutrients needed to:
  - meet yield goal in Section F
  - improve soil fertility over time.
    - Following soil test recommendations will build or maintain soil test phosphorus and potassium to the high rating category if the recommended fertilizer rate is applied annually for eight years.
    - Micronutrient recommendations, for example zinc and sulfur, should be applied once and the soil resampled in three to five years to determine the need for additional applications.

# (H) Limestone suggestions

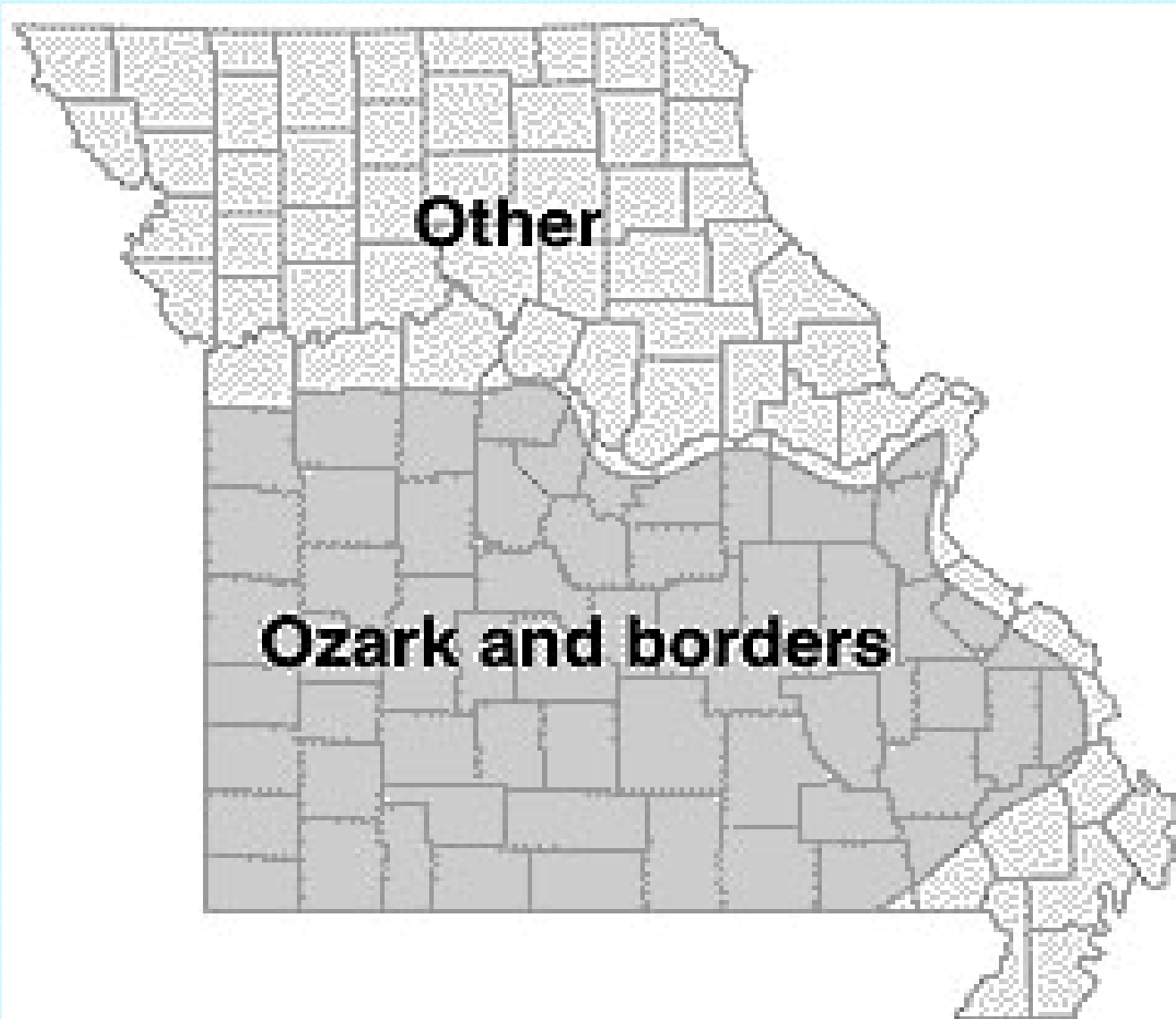
- This section gives the suggested amount of limestone to raise soil salt pH to an optimal level for the cropping options listed. Desired soil salt pH ranges for Missouri crops are given in Table 2.



# Desired soil salt pH (pH<sub>s</sub>) ranges for Missouri crops

<u>Crop</u>	<u>Soil region</u>	
	<b>Ozark and borders</b>	<b>Other</b>
Alfalfa and alfalfa-grass establishment	6.6 to 7.0	6.1 to 6.5
Birdsfoot trefoil and birdsfoot trefoil-grass establishment	6.1 to 6.5	5.6 to 6.0
Clover and clover-grass establishment	6.1 to 6.5	5.6 to 6.0
Cool-season grass establishment and production	5.6 to 6.0	5.6 to 6.0
Lespedeza and lespedeza-grass establishment	6.1 to 6.5	5.6 to 6.0
Overseeding legumes	6.1 to 6.5	5.6 to 6.0
Warm-season grass establishment and production	5.6 to 6.0	5.6 to 6.0
Sudan grass and sudan/sorghum crosses	5.6 to 6.0	5.6 to 6.0
All row crops	6.1 to 6.5	6.1 to 6.5

# Soil Regions



## (H) Limestone suggestions

- The limestone recommendation is given for the cropping option requiring the highest salt pH range. For example, if a cool-season grass and alfalfa were both listed in Section E, the limestone recommendation would be for alfalfa since it requires a higher soil salt pH level. The recommendation is reported as pounds of ENM (effective neutralizing material) per acre.

## (H) Limestone suggestions

- To determine the amount of lime needed in tons per acre, divide the ENM value by the ENM guaranteed by your ag lime dealer. If the soil test ENM requirement is 1,395 pounds per acre and lime quarry guarantees 400 pounds ENM per ton of limestone, then you need 3.48 tons of limestone per acre ( $1,395 \div 400 = 3.48$ ).

## **(I) Special notes**

(II)

Many times notes appear at the bottom of the soil test report to help you interpret and use your results and recommendations.

# Fertilization

- Soil Test

- Lime

- Raise pH 1 level= 2X available NPK
- More Growth Prior to Dry Weather
  - Deeper roots, better uptake of water and nutrients
- Favors legumes
  - Increases N from clovers/soybeans
  - Lowers N costs- Save \$\$\$
  - Improves Forage/Hay Quality and distribution
- Winter survival



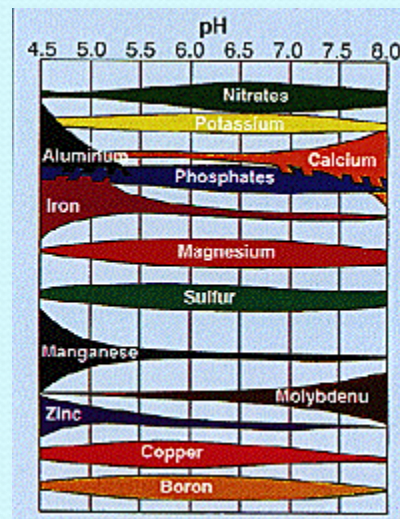


# Soil pH – The Regulator

A measure of acidity  
or alkalinity

pH scale = 1-14  
(7 = neutral)

Best growth & most  
efficient fertilizer use:  
6.2-6.5



# Low pH



- **Reduced nutrient availability**
  - Phosphorus
- **Poor legume growth**
  - Survival and activity of N fixing bacteria reduced
- **Increased aluminum availability**
  - Stunted root growth
  - Reduced nutrient uptake-Mg, Ca, P

# Lime Makes Fertilizer Work

## Percent Nutrient Availability

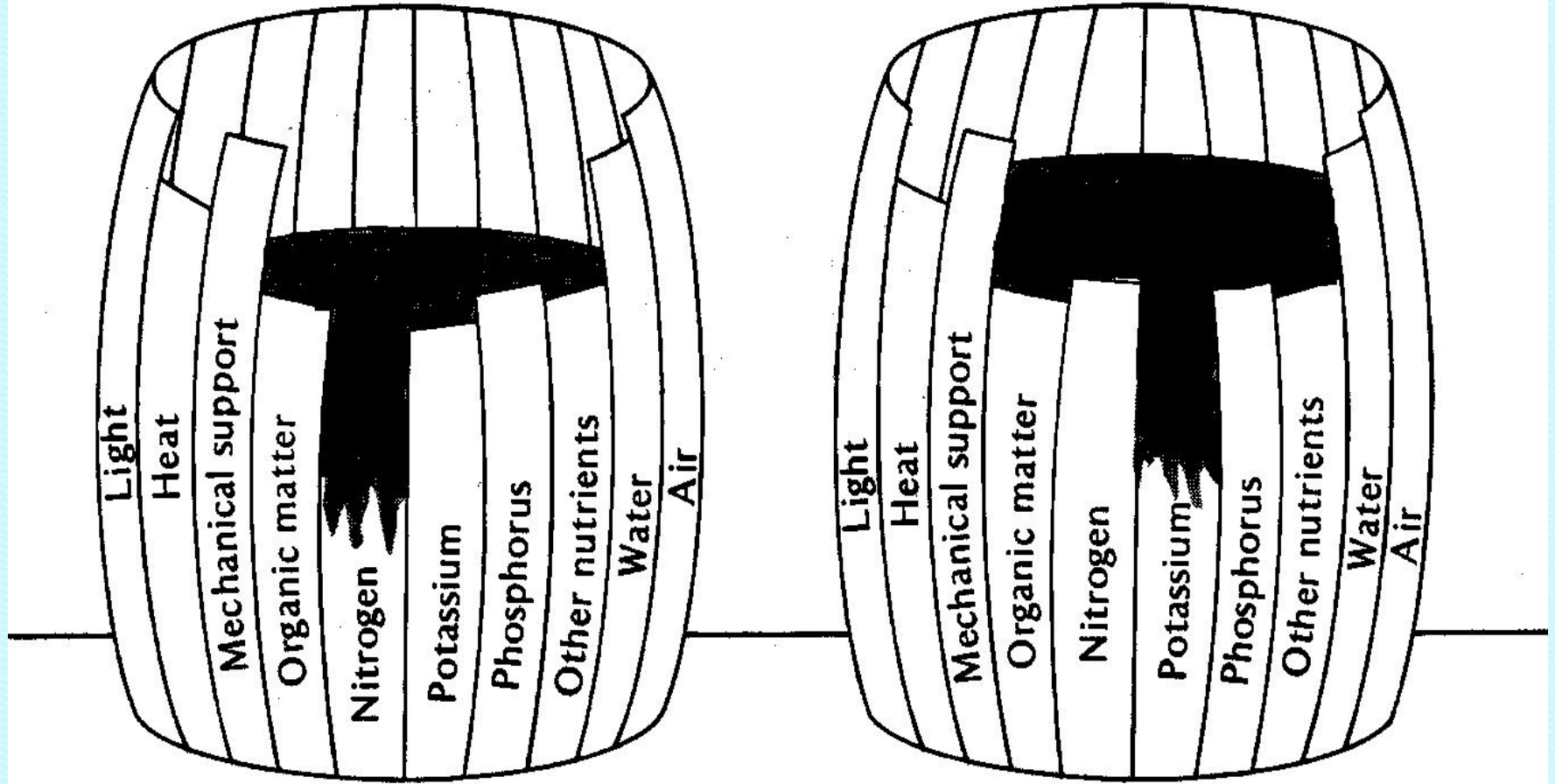
pH (salt)	Nitrogen %	Phosphorus %	Potassium %
4.0	30	23	33
4.5	53	34	52
5.0	77	48	77
5.5	89	52	100
6.5	100	100	100

# Fertility Needs are Complex

## Soil, Crops and Economics



# Law of the Minimum



# Fertilizer

- Nitrogen for Yield
  - 40# N = 1 ton forage
  - 1.0 to 1.2 #N per bushel corn or wheat
- Phosphorus for Healthier Stands/ Yields
  - Roots
  - Legumes
- Potash (K) for Persistence and Drought Resistance
  - Hay
  - Legumes and soybeans
- Apply only what is needed and saleable
- Avoid micros, wonder products
  - Boron-alfalfa, soybeans
  - Zinc- corn
  - Sulfur- wheat

# Soil Test Reports

- **Report is:**
  - Good as your sample
  - Don't get sample from truck wheel well
  - Sample less than 20 Acres with 1 or more subsamples per Acre
  - Recommendations are annually except for lime– apply one time only
  - Resample every 3-5 years

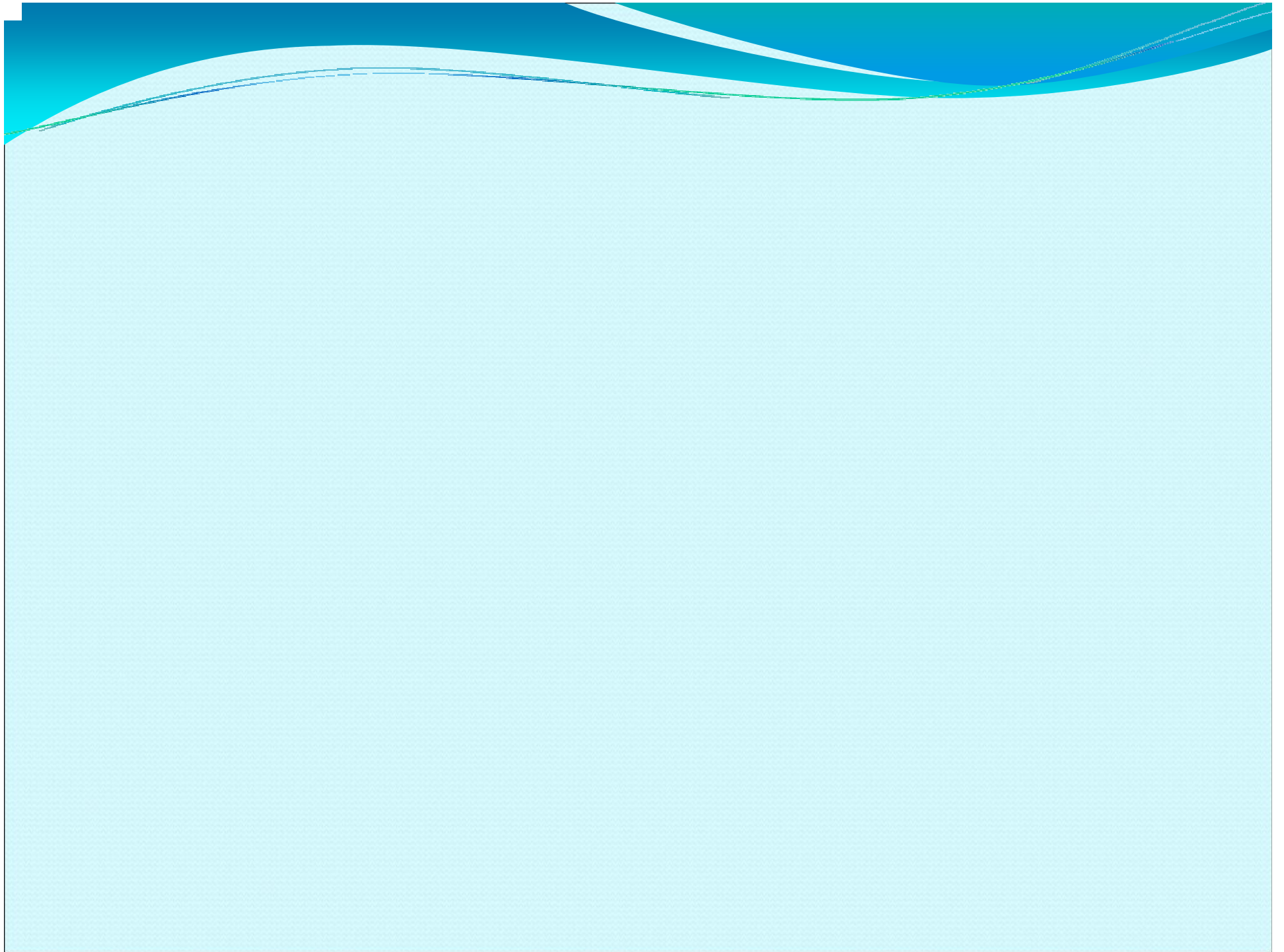
# Summary

- Soil Test
  - Talk to spouse and banker
- Lime First
- Limiting Nutrient(s)
- Meet Crop Needs
- Healthy Stands
- Control Weeds
- Pray for Rain



# Thank you

- For additional information contact:
  - Local Extension Office
    - Gerald Bryan
  - Extension Agronomist
    - Jackson, MO
    - 573-243-3581



# Minimum Soil Fertility

<b>Species</b>	<b>pH(s)</b>	<b>P</b>	<b>K</b>
<b>- lb / acre -</b>			
<b>Cool-season grass</b>	<b>5.0</b>	<b>20</b>	<b>200</b>
<b>Warm-season grass</b>	<b>5.0</b>	<b>20</b>	<b>200</b>
<b>Alfalfa 6.5</b>	<b>40</b>	<b>300</b>	
<b>Red Clover</b>	<b>6.0</b>	<b>25</b>	<b>250</b>
<b>White Clover</b>	<b>5.5</b>	<b>25</b>	<b>250</b>
<b>Birdsfoot Trefoil</b>	<b>5.5</b>	<b>20</b>	<b>225</b>
<b>Lespedeza</b>	<b>5.0</b>	<b>20</b>	<b>200</b>

# **pH Ranges for Successful Production**

<b>Fescue</b>	<b>4.7-6.8</b>
<b>Alfalfa</b>	<b>5.8-7.7</b>
<b>Red Clover</b>	<b>5.6-7.2</b>
<b>Lespedeza</b>	<b>5.0-6.6</b>

# Added Expense of a Low pH

## 3 Ton Cool Season Grass Hay Crop

<b>pH (salt)</b>	<b>Fertilizer Wasted %</b>	<b>Required Fertilizer Bill</b>
<b>4.0</b>	<b>71</b>	<b>\$370</b>
<b>4.5</b>	<b>54</b>	<b>\$230</b>
<b>5.0</b>	<b>33</b>	<b>\$160</b>
<b>5.5</b>	<b>20</b>	<b>\$142</b>
<b>6.5</b>	<b>0</b>	<b>\$102</b>

# Pasture Fertility

- Fertilizer requirements for pastures are different than for cropping systems or even hay production
  - More than 90% of phosphorus (P) and potassium (K) are returned to the soil
  - About  $\frac{1}{2}$  of the nitrogen applied to pasture is returned...about  $\frac{1}{2}$  lost

If apply \$40 of N --\$20 returned to soil

If apply \$40 of P&K--\$39 to soil

--Growing legume to supply N cheaper

# Nutrient Removal for Pasture

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<b>Crop</b>	<b>N</b>	<b>P<sub>2</sub>O<sub>5</sub></b>	<b>K<sub>2</sub>O</b>
	----- lb / acre -----		
<b>Alfalfa hay (6 ton)</b>	<b>270*</b>	<b>90</b>	<b>270</b>
<b>Cool-season grass hay (3 ton)</b>	<b>150</b>	<b>40</b>	<b>145</b>
<i><b>Cow-calf pair</b></i>	<i><b>10</b></i>	<i><b>7</b></i>	<i><b>1</b></i>

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