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# Malting Barley Nutrient Management

Bill Verbeten  
Cornell Cooperative  
Extension  
NWNY Dairy, Livestock, &  
Field Crops Team

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# Take Home Points

- Barley is not tolerant of acidic soils.
- Nitrogen management is critical for yield, CP content, & kernel plumpness.
- Phosphorus is key to winter barley establishment & survival.
- Potassium is vital to overall plant health, grain fill, & disease resistance.
- Sulfur response is likely, but application is not recommended for distilling grains.

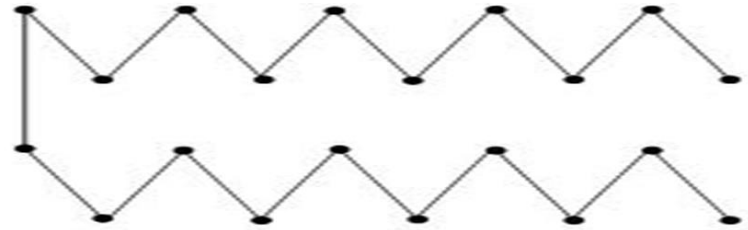
# pH for Malting Barley

- Lime to at least pH 6.3
- Barley cannot tolerate low pH like some other small grains



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# Sampling Soil

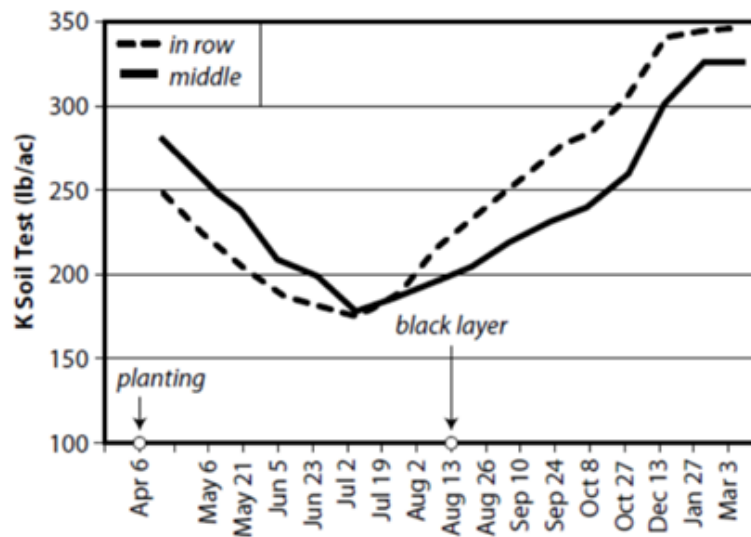
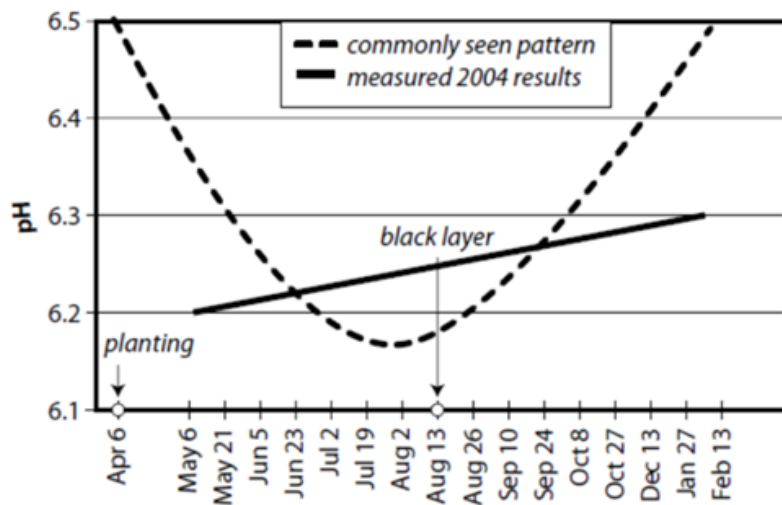


- Take 2-3 samples per acre up to 10-15 acres for each sample.
- Sample different soil types/drainage areas separately.
- Regularly sample fields every 3-4 years **at the same time of the year.**



# Sampling Soil

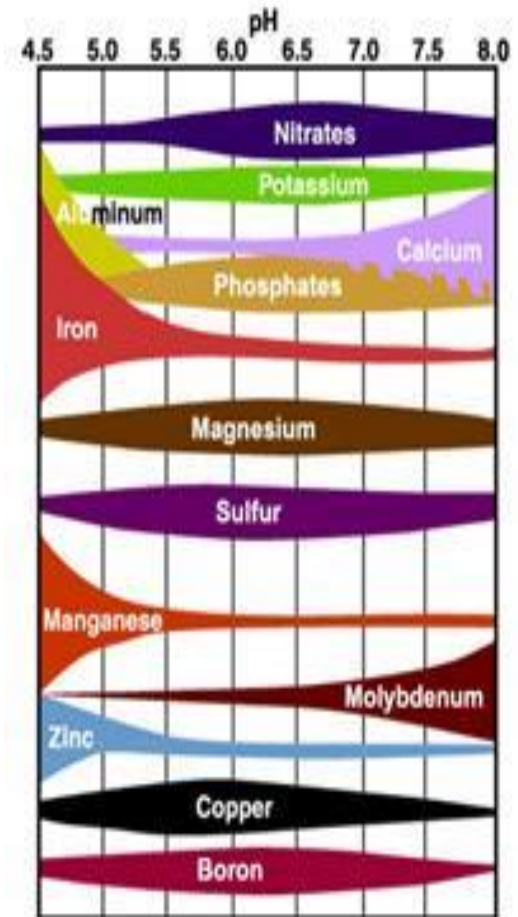
- pH & K vary throughout the growing season. [Kentucky](#)



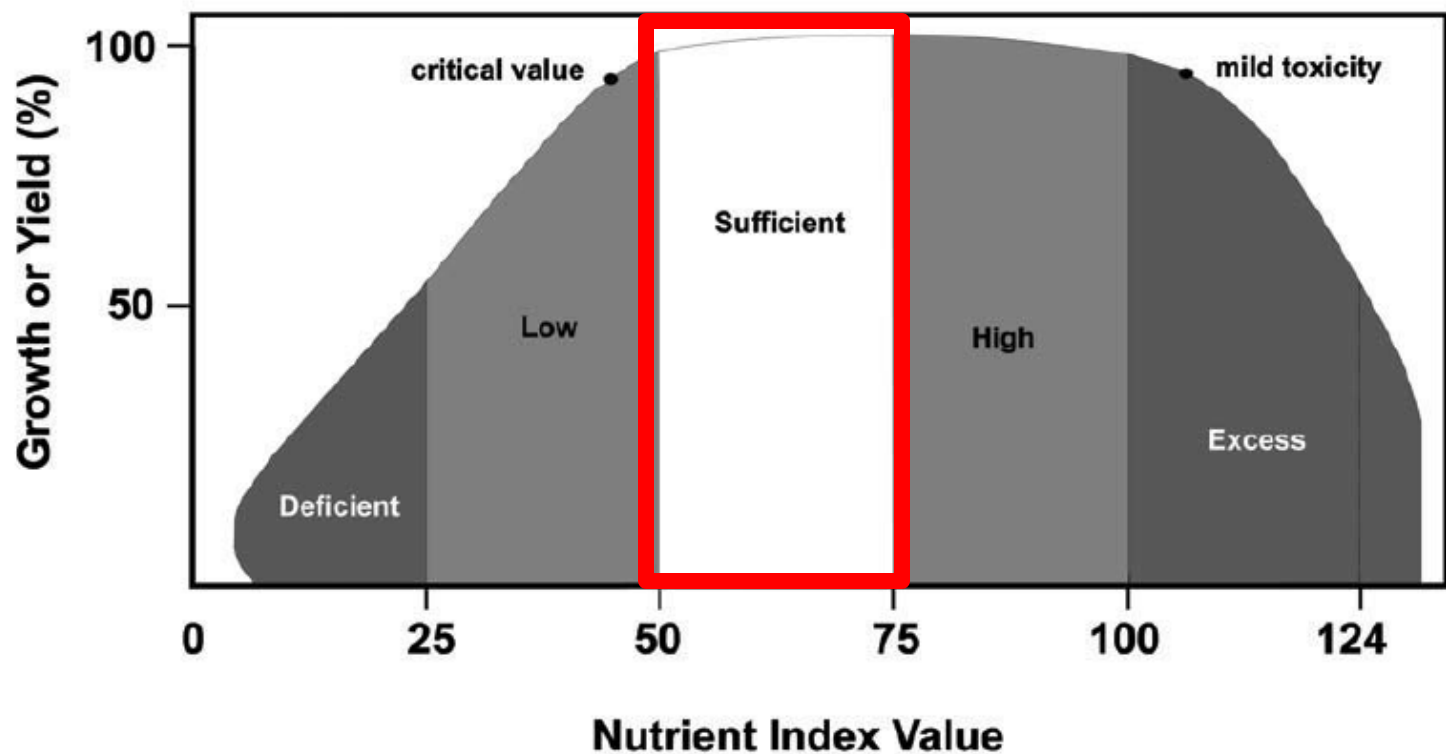
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# Correcting Soil pH

- Liming & fertilizer recommendations on soil test report.
- No yield or quality responses to changing base saturation ratios of Ca, Mg, & K.
- Increasing pH (up to 7.0) increases nutrient availability.



# Crop Removal of Nutrients



Source: Reference Sufficiency Ranges for Plant Analysis in the Southern US

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# Malting Barley Nutrient Removal

- 100 bu of grain & 2.5 tons of straw/A removes

N 100 lb./A

P<sub>2</sub>O<sub>5</sub> 40 lb./A

K<sub>2</sub>O 80 lb./A

S 14 lb./A

Zn 0.22 lb./A

[Franze & Gerwing 1997. University of Nebraska](#)

- Typical yields are 70-80 bu/A for winter barley & 50-60 bu/A spring barley.



# Malting Barley Fertility

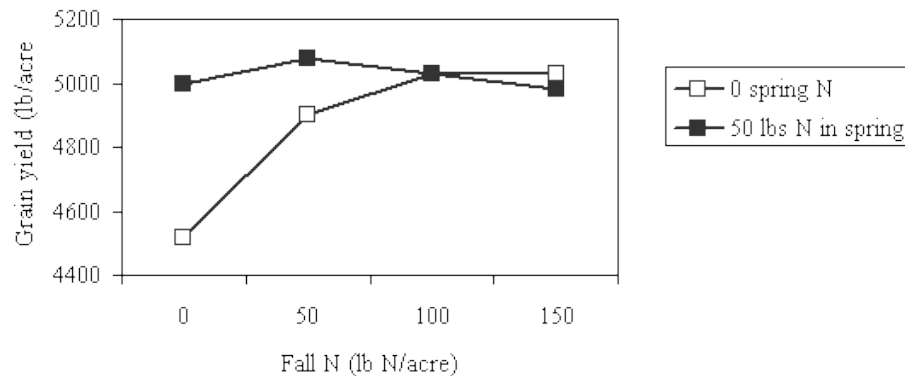
- Goal: healthy, disease-free, high-yielding grain with CP 9-12% DM.



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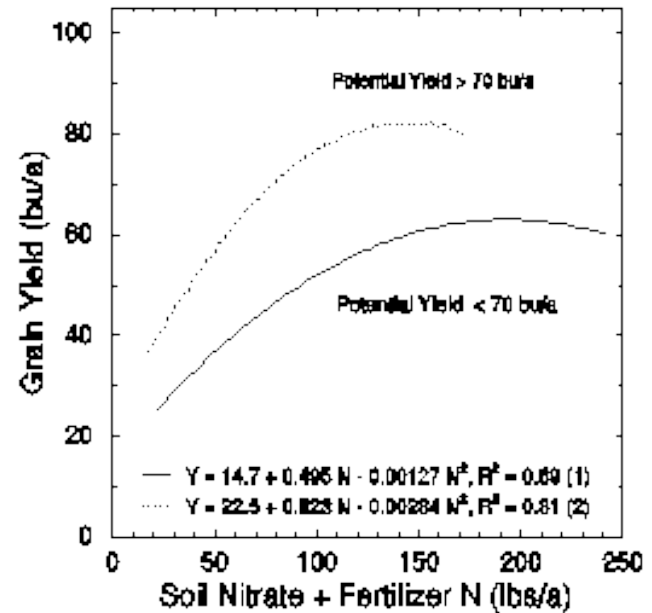
# Malting Barley Yield from N

## ○ Oregon State



○ *~1 to 1.5 lb N/bu*

## ○ Montana

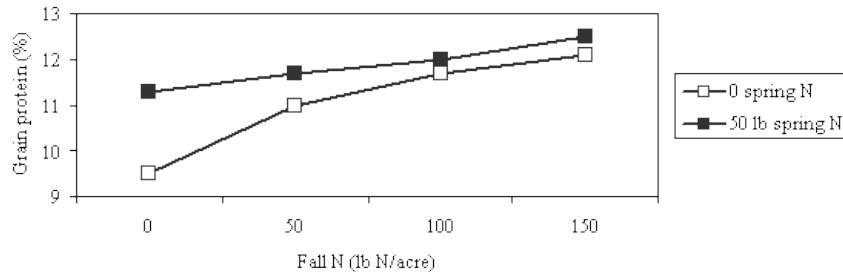


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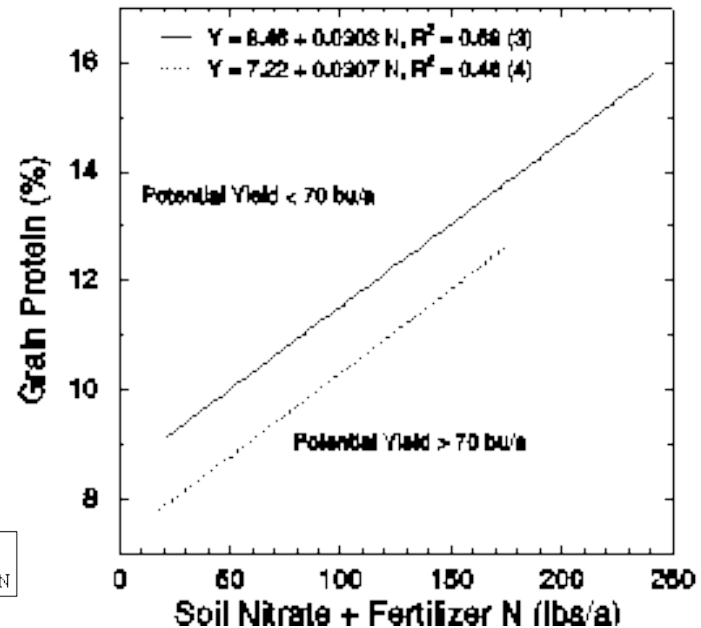
# CP & Nitrogen

- CP increases as soil N+ fertilizer increases

- Oregon State



- ~0.5%-1.5% CP for 50 lb./A



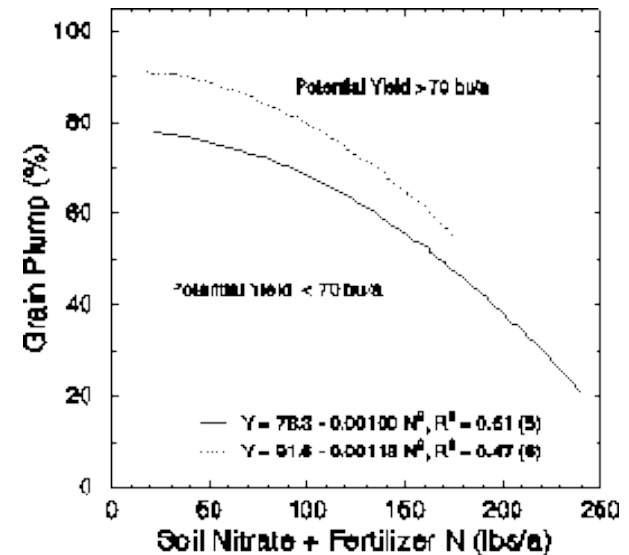
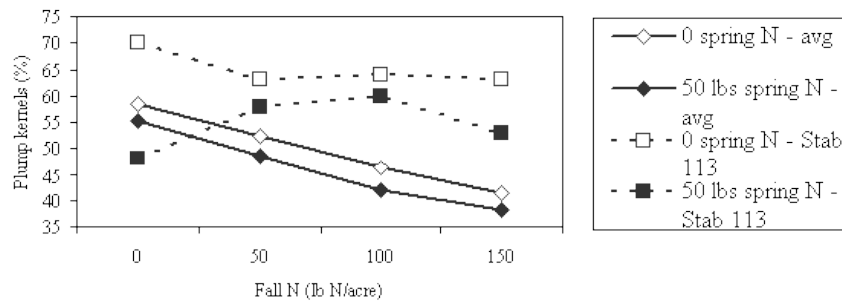
- Montana

# Kernel Plumpness & N

- More N will decrease kernel plumpness

- Montana

- Oregon State



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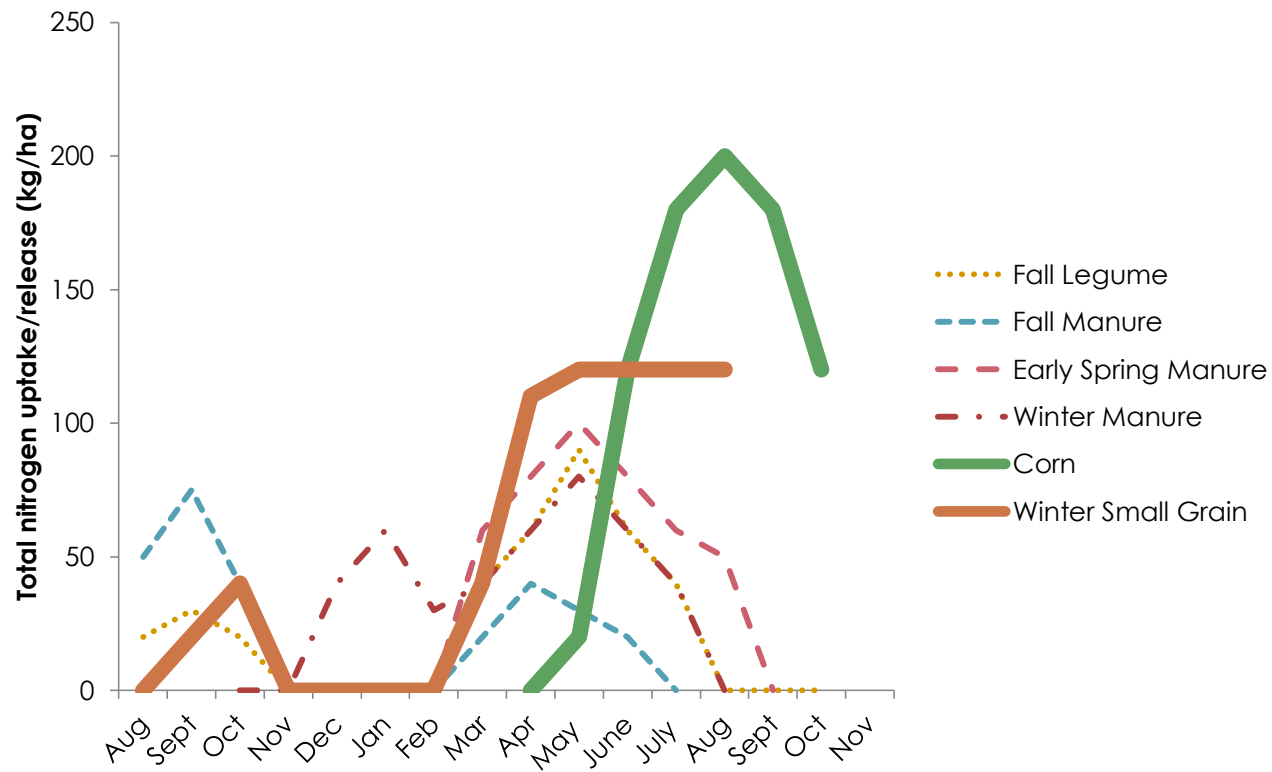
# Malting Barley & Nitrogen

- Between **70-100 lb./A** nitrogen from all sources will likely achieve reasonable yields, protein, & plumpness.
- Need to *account for all nitrogen contributions*-soil OM, manure, legumes

**Modified Table 5.5.1. Fertilizers for small grains.<sup>1</sup>**

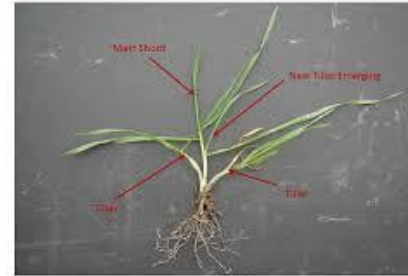
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<b>Soil Mgt. Group</b>	<b>Crop</b>	<b>Nitrogen (N)</b>		<b>Phosphorus (P<sub>2</sub>O<sub>5</sub>)</b>					<b>Potassium (K<sub>2</sub>O)</b>				
		<i>No Manure</i>	<i>Manure</i>	<i>Soil Test Levels<sup>3</sup></i>					<i>Soil Test Levels<sup>3</sup></i>				
				<i>Very Low</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Very High</i>	<i>Very Low</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Very High</i>
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# Nitrogen Mineralization

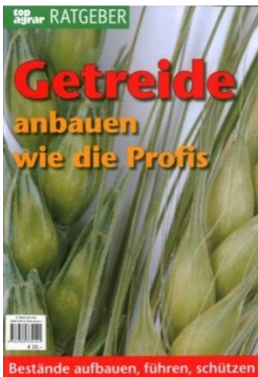


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# Tiller Counts



Soil Type	Sand	Silt	Loam	Clay
Tillers/plant	N to apply lb./A			
1-3	36	45	45-62	53-71
4-6	22	31	31-45	40-53
6+	13	22	27-36	36-45



Getreide anbauen wie die Profis: Bestände aufbauen, führen, schützen.

Growing grains like the professionals: Establishing stands, directing, & protecting

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# Nitrogen

- Organic Sources:
  - Manure
  - Hay or legume credit?
  - Organic fertilizer  
*~5-10 lb./100 lb. of product*
  - Chilean nitrate,  
 $\text{NaNO}_3$  16-0-0



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# Nitrogen

- Conventional Sources:
  - Urea, UAN, AMS, etc.
  - Enhance efficiency products
- Apply early, not late
- Apply with stream bars



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## Bottom line:

- Most malting barley fields will need **10-60 lb./A of nitrogen applied.**
- Apply 10-20 lb./A at fall planting, remainder early spring at green up.
- 70-100 lb./A of nitrogen from all sources should meet yield & quality goals.

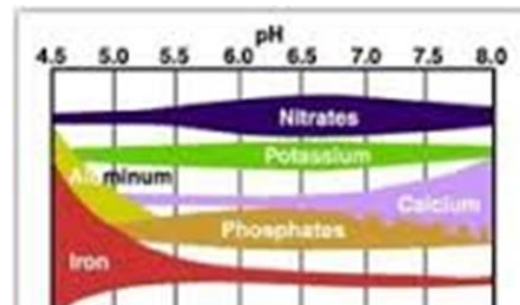
# Phosphorus

- P placement and amount critical for small grain establishment, winter survival, & yield.



# Phosphorus

- Place P with the barley seed, band, or work P fertilizer into ground prior to planting
- `0.3-0.35 lb.  $P_2O_5$  removed/bu
- Keep pH 6.2-7.0  
*Max P available*



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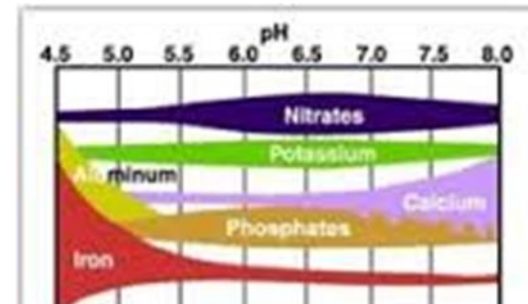
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# Phosphorus

- Organic Sources
- Manure/Compost  
*Apply in fall*
- Organic fertilizer  
*~0-5 lb./100 lb. of product*
- Rock Phosphate & bone meal?  
**Low availability 10-20%**  
*P Not available  $\geq 7.0$*   
*More P available  $< 6.0$*



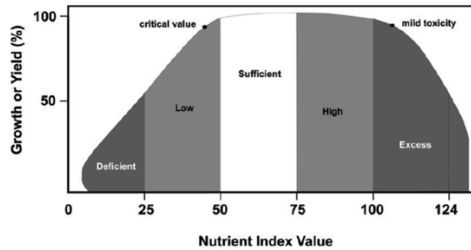
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# Phosphorus

- Conventional Sources
  - Superphosphate, MAP, DAP—highly available P
  - Made from rock phosphate treated with strong acid.
- *Can easily apply with seed at planting.*







# Potassium

- Deficiencies can lead to
  - Poor root growth
  - Restricted leaf development
  - Fewer grains per head
  - Smaller grain size affecting both yield & quality
  - More vulnerable to drought, frost and waterlogging as well as pests and diseases.



# Barley Diseases



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# Potassium



- Organic Sources:
- $K_2SO_4$   
50 lb.  $K_2O$  + 17 lb. S
- K-Mag  
22 lb.  $K_2O$
- Manure
- Organic fertilizer  
~0-5 lb./100 lb.

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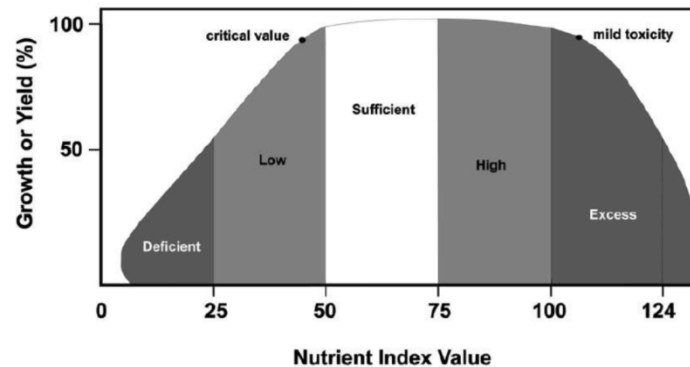
# Potassium

- Conventional Sources: KCl
- Cl<sup>-</sup> is universal present
  - in soils ([~100 ppm or 200 lb/acre](#))
  - In manure 5-10 lb./ton
- Cl<sup>-</sup> rapidly leaches from the soil
- Cl<sup>-</sup> doesn't not decrease biological activity
- Chlorine gas (Cl<sub>2</sub>) does not occur naturally.
- KCl does have a higher salt index than other fertilizers and should be limited in furrow with seed.



# Barley & Chlorine

- Low sensitivity-tolerate up to 4% DM, some other crops sensitive to 0.5 to 2.0% DM.
- Slight yield increases out west where soil tests are low.

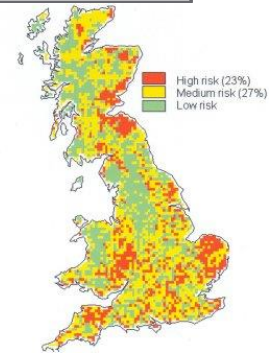


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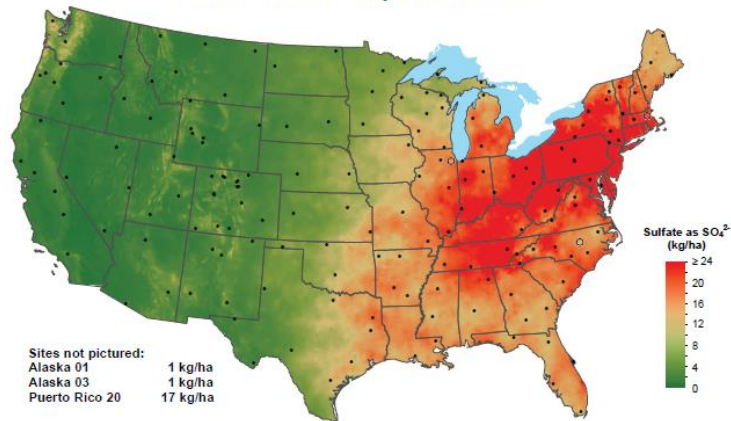
# Sulfur

- Barley may respond to 10-20 lb./A.

- Don't apply on grain for distilling.

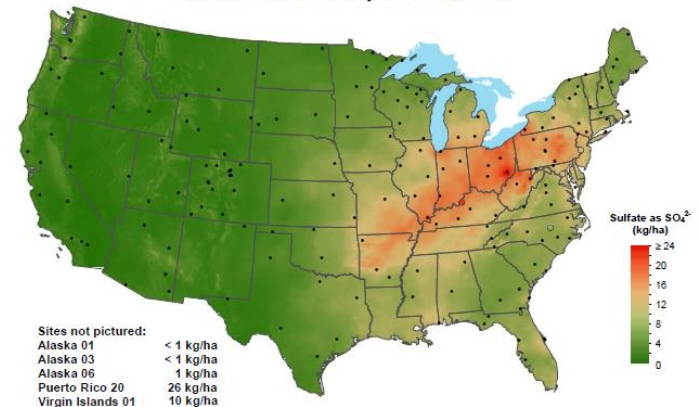


Sulfate ion wet deposition, 1994



National Atmospheric Deposition Program/National Trends Network  
<http://nadp.isws.illinois.edu>

Sulfate ion wet deposition, 2011



National Atmospheric Deposition Program/National Trends Network  
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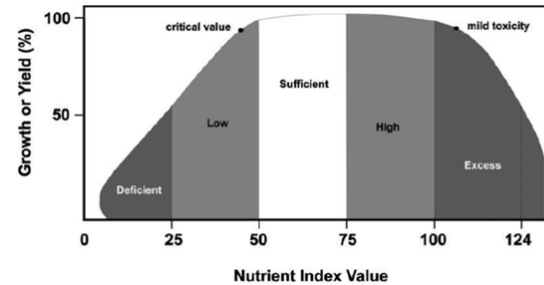
# Calcium & Magnesium

- Soils supply high rates of these nutrients (and Potassium).
- Regular liming with dolomitic limestone replaces removal rates
- 5 tons DM of grass only removes 150 lb./ac of Ca and 30 lb./acre of Mg.
- Some crops may respond to foliar Mg if tissue tests are low.



# Manganese

- pH >6.5 & low soil levels, [Delaware](#)
- Corn starter N acidified soil, made Mn available on 30 in. centers
- Standard N stunted between rows, foliar Mn rescued.



R Taylor

- Broadcast 30 lb./A Mn pre-plant or foliar apply 1-2 lb./A at V5.

# Boron, Zinc, Copper

- Response is most likely
  - on sandy soils
  - muck soils
  - no history of manure
  - extreme soil pH (<5.0 & >7.0)
- Response to foliar spray possible.
- 5 tons DM of grass only removes about
  - 0.4-0.5 lb./A Boron
  - 0.2-0.30 lb./A Zinc

# Tissue Sampling Timing

- *More samples* taken than soil samples to account for variability, usually **30+ plants/field**
- Sample from “good” and “bad” areas **separately**
- Samples need to be **air-dried** in a paper bag prior to shipping

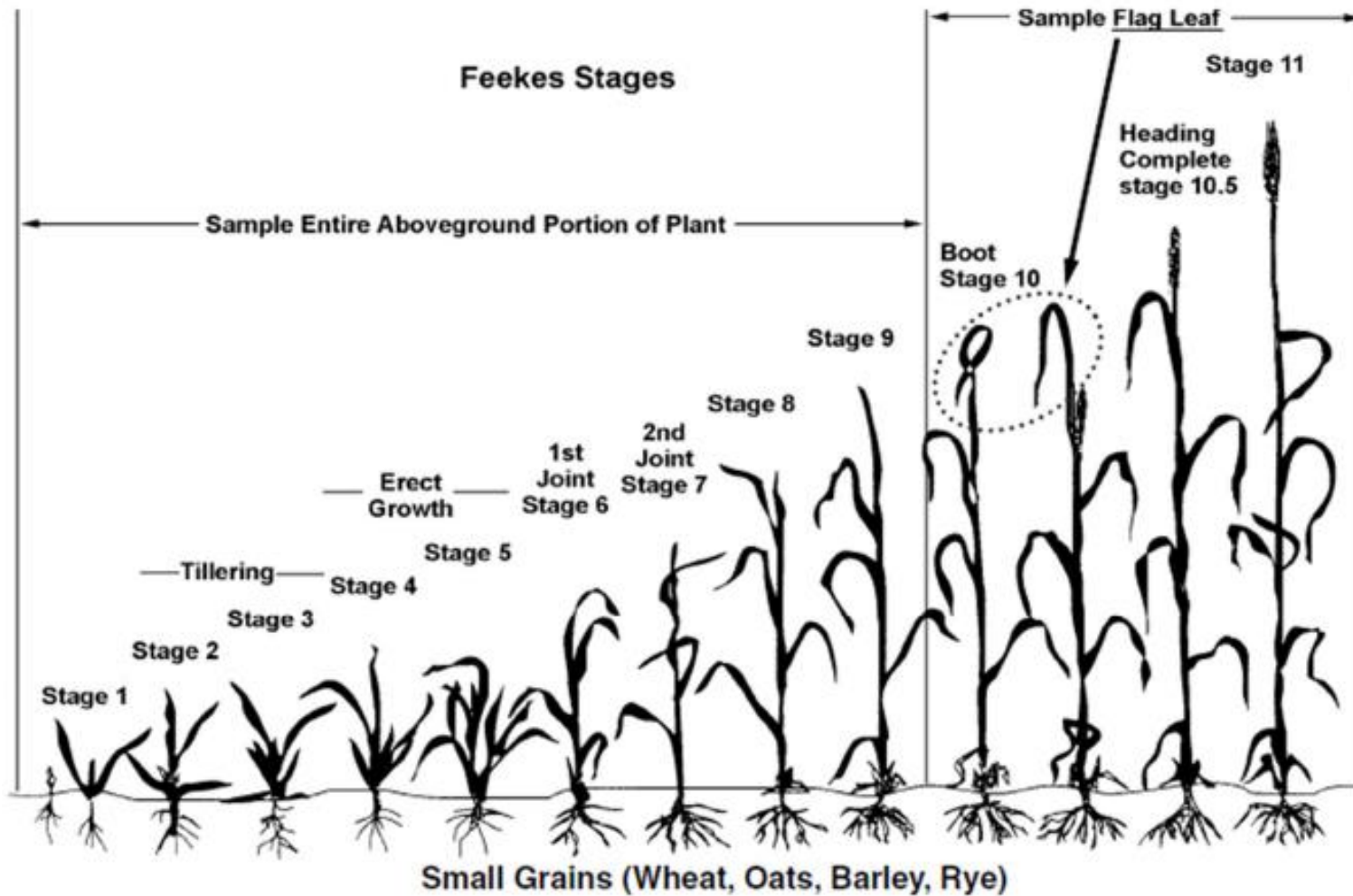
# Tissue Sampling Timing

- Needs to be at *proper plant growth stage*
- May be **too late to correct** if sampled at a later growth stage.
- *Soil sampling* is often done at the **same time** for comparison

# Methods-Tissue Sampling

- Small Grains
  - Sample 25-35 areas of field
- **Prior to Stem Elongation**
  - All the above ground tissue
  - 50-75 plants
- **Prior to Heading**
  - Top 4 leaf blades with leaf collar visible
  - 30-40 plants



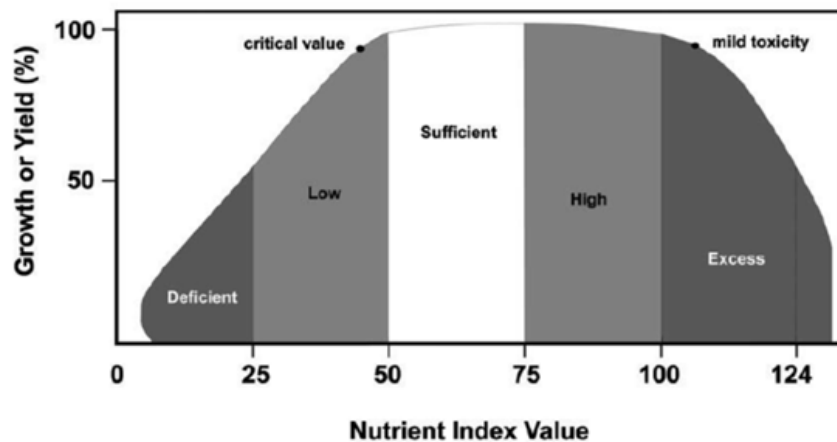


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Spectrum Analytic Inc., Illustrated Guide to Sampling for Plant Analysis

# Methods-Tissue Sampling

- Small Grains
- Response common for **N, S, Mg, Cu, Zn, & possibility Mn.**



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# Nutrient Tissue Levels in Small Grains

	N %	P %	K %	Ca %	Mg %	S %	B ppm	Zn ppm	Cu ppm	Mn ppm	Fe ppm	Mo ppm
1	<b>2.0-2.7</b>	0.1-0.5	1.0-3.0	1.0	<b>0.15-1.0</b>	<b>N/A</b>	3-40	<b>10-70</b>	<b>3-10</b>	15-200	25-300	N/A
2	<b>4.0-5.0</b>	0.2-0.5	2.5-5.0	0.2-1.0	<b>0.14-1.0</b>	<b>0.15-0.65</b>	1.5-4.0	<b>18-70</b>	<b>4.5-15</b>	20-150	30-200	0.1-2.0
3	<b>4.0-5.0</b>	0.2-0.5	2.0-4.0	0.2-1.0	<b>0.14-1.0</b>	<b>0.15-0.65</b>	1.5-4.0	<b>18-70</b>	<b>4.5-15</b>	20-150	30-200	0.1-2.0
4	<b>1.7-3.0</b>	0.2-0.5	1.5-3.0	0.2-0.5	<b>0.15-0.5</b>	<b>0.15-0.40</b>	5-10	<b>15-70</b>	<b>5-25</b>	25-100	50-150	N/A

1: [Ontario](#): Prior to flowering sample four upper leaves and flag leaf. Critical to normal concentrations listed.

2: [Kentucky](#): Seedling (before jointing) sample whole plant. Sufficiency range listed.

3: [Kentucky](#): Flowering, sample flag leaf only. Sufficiency range listed.

4: [Oklahoma](#): Seedling stage sample whole plant. Prior to heading sample four uppermost leaves. Sufficiency levels listed (seedling stage-prior to heading).

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# Take Home Points

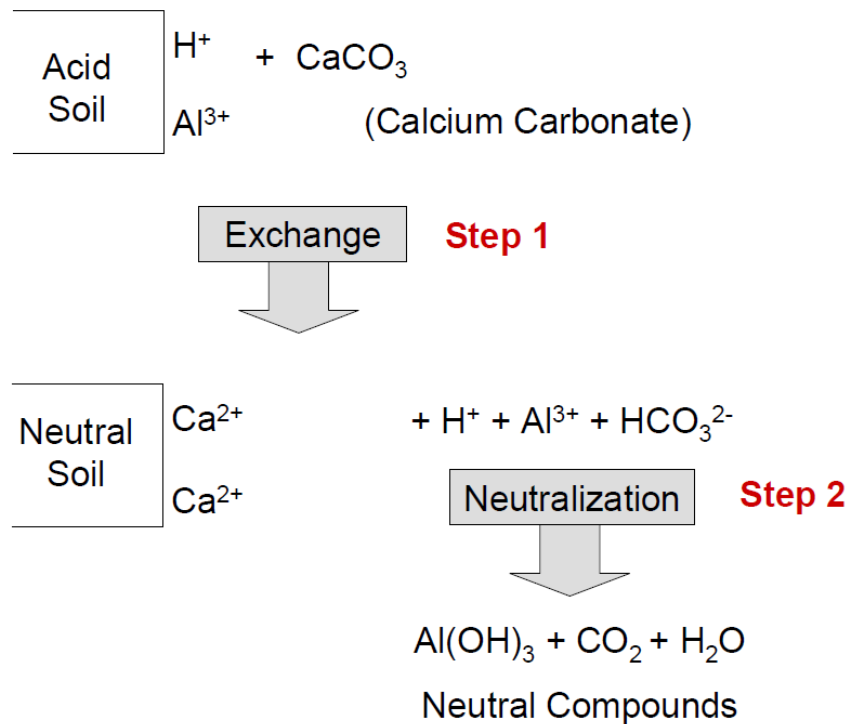
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- Potassium is vital to overall plant health, grain fill, & disease resistance.
- Sulfur response is likely, but application is not recommended for distilling grains.

# Questions?



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# How Lime Works



# Liming Materials

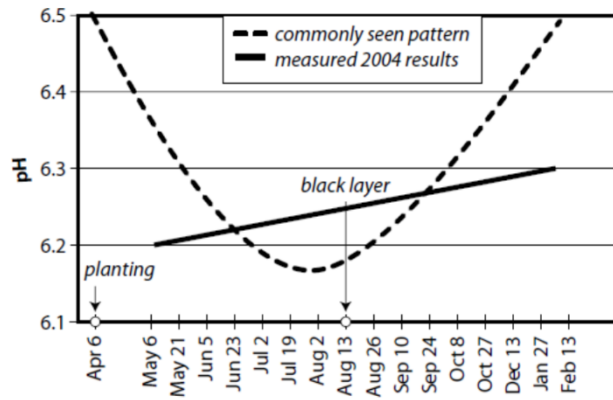
Common Name	Chemical Formula	CCE
Calcitic Limestone	CaCO <sub>3</sub>	100
	MgCO <sub>3</sub>	119
Burned Lime, Quick Lime	CaO	179
Hydrated Lime, Slack Lime	Ca(OH) <sub>2</sub>	136
Dolomitic Limestone	CaMg(CO <sub>3</sub> ) <sub>2</sub>	109
	CaSiO <sub>3</sub>	86
Wood Ash	Variable	50-80

- Increases mesh size only increases speed of the reaction (only use 20 to 100 mm mesh lime)

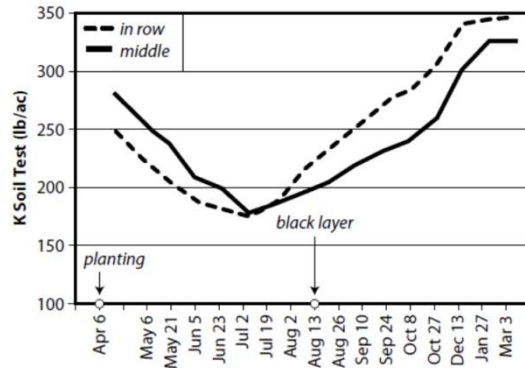
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# Yearly Soil Variation

○ pH

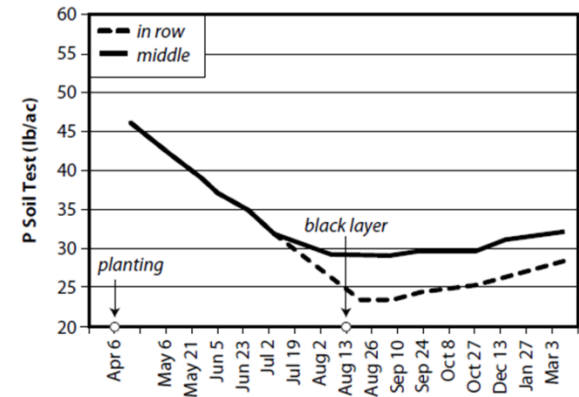


○ K



Kentucky

○ P



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