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Malting Barley Nutrient Management

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

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.

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pH for Malting Barley

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

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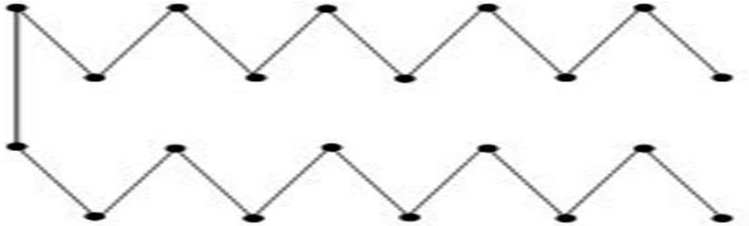

Sampling Soil

- 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.**

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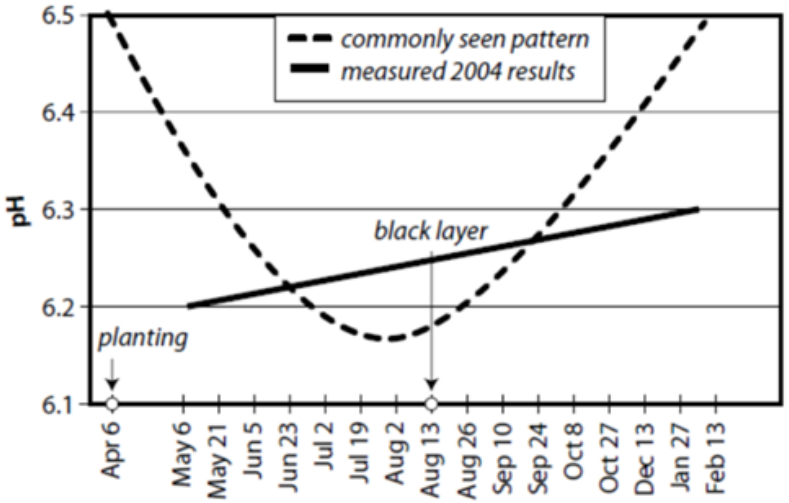
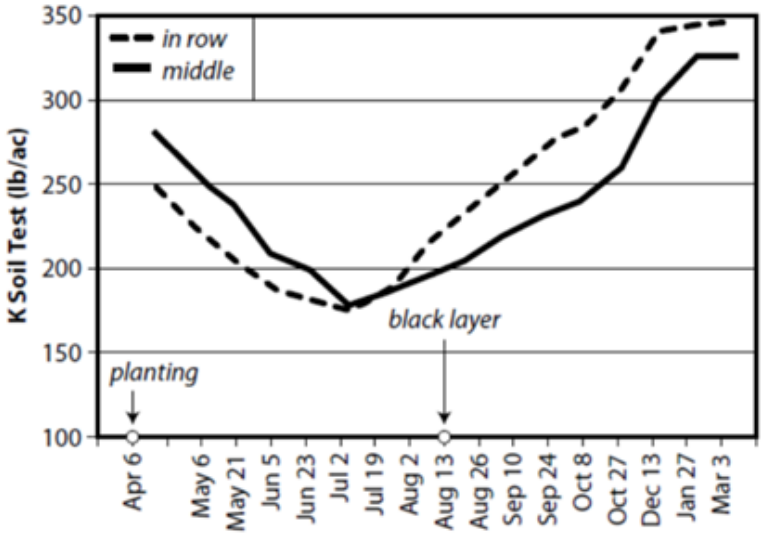
Sampling Soil

- pH & K vary throughout the growing season. Kentucky





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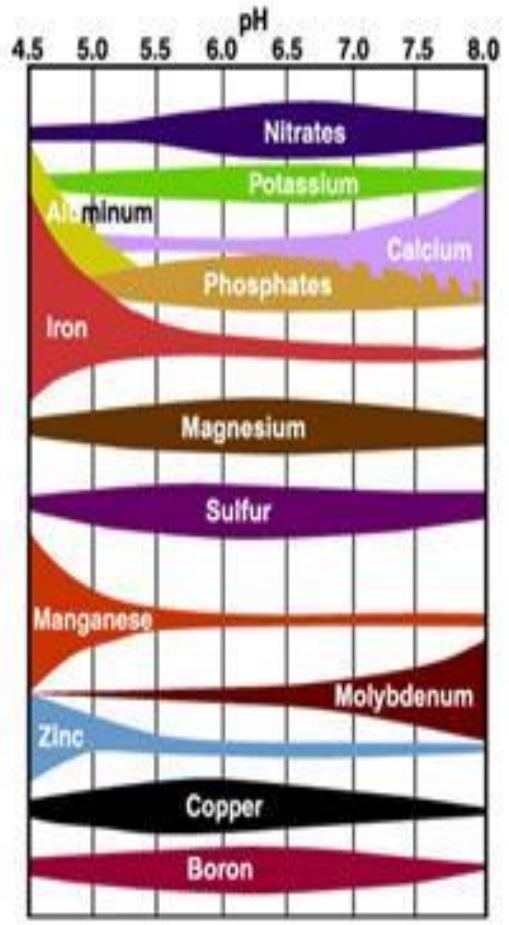
Correcting Soil pH

- 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.



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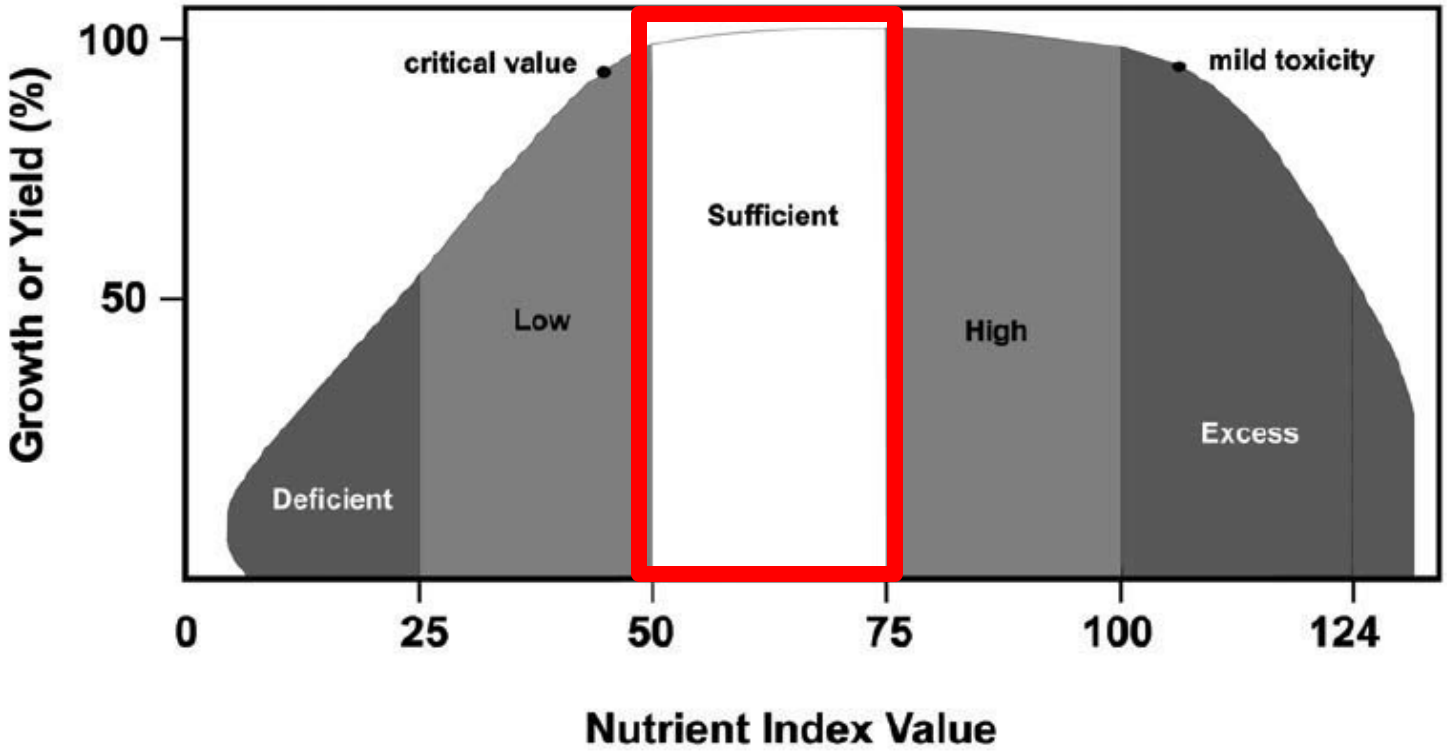
Crop Removal of Nutrients



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_2O_5	40 lb./A
K_2O	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.

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Malting Barley Fertility

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

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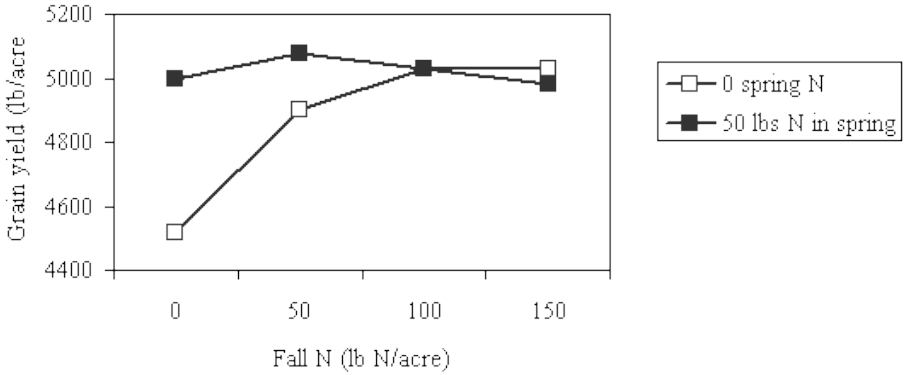
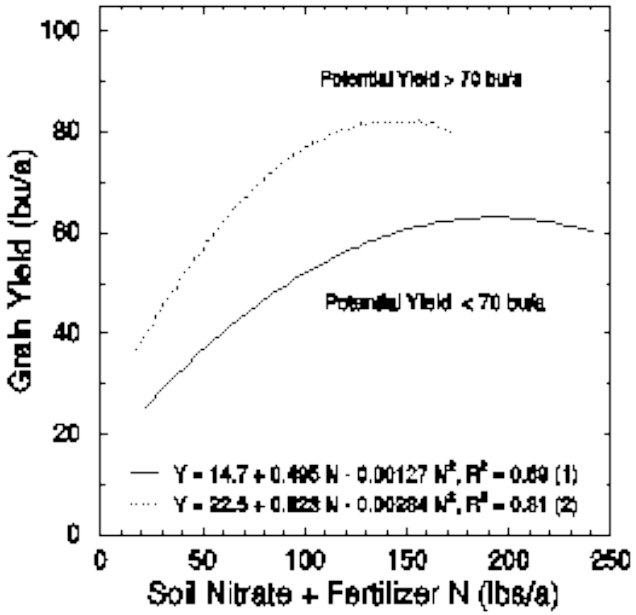
Malting Barley Yield from N

- Oregon State



- *~1 to 1.5 lb N/bu*

- Montana



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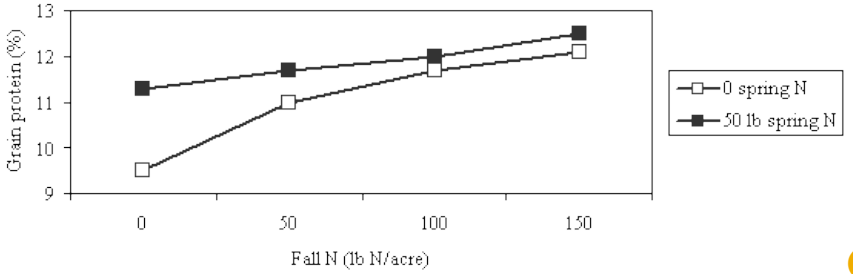
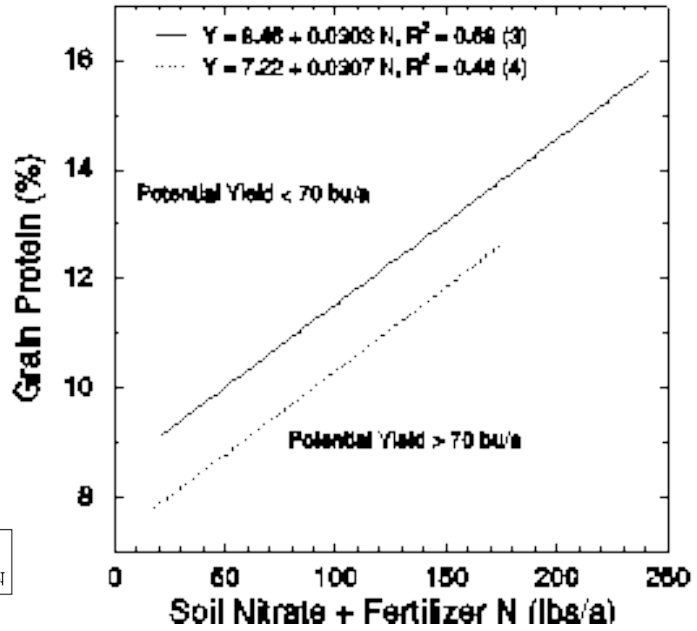
CP & Nitrogen

- CP increases as soil N+ fertilizer increases

- Oregon State





- Montana

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

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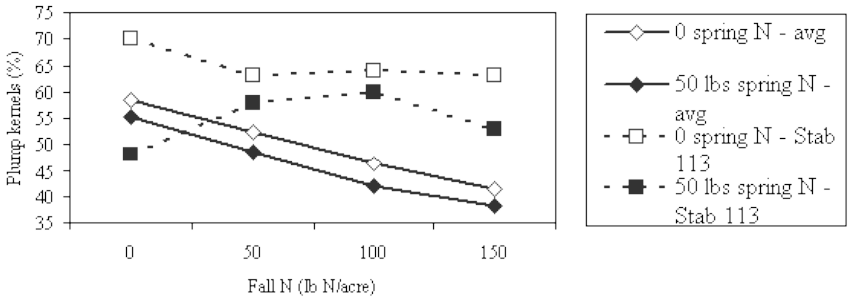
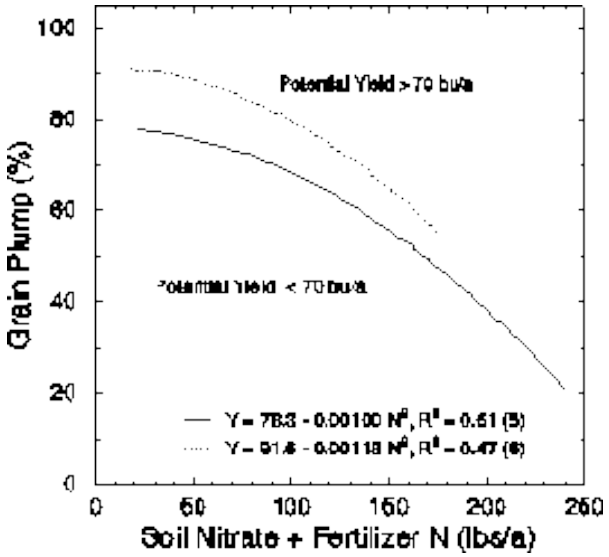
Kernel Plumpness & N

- More N will decrease kernel plumpness

- Oregon State



- Montana



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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.[1]

Soil Mgt. Group	Crop	Fertilizer Nutrients to be Added (lb./A)											
		Nitrogen (N)		Phosphorus (P_2O_5)					Potassium (K_2O)				
				Soil Test Levels[3]					*Soil Test Levels[3]*				
		No Manure	*Manure*	*Very Low*	*Low*	*Medium*	*High*	*Very High*	*Very Low*	*Low*	*Medium*	*High*	*Very High*
I	**Winter barley**	40–60	10–20	65	50	40	20	10	50	40	20	20	0
	Spring barley	40–60	10–20	50	40	30	20	10	50	40	20	20	0
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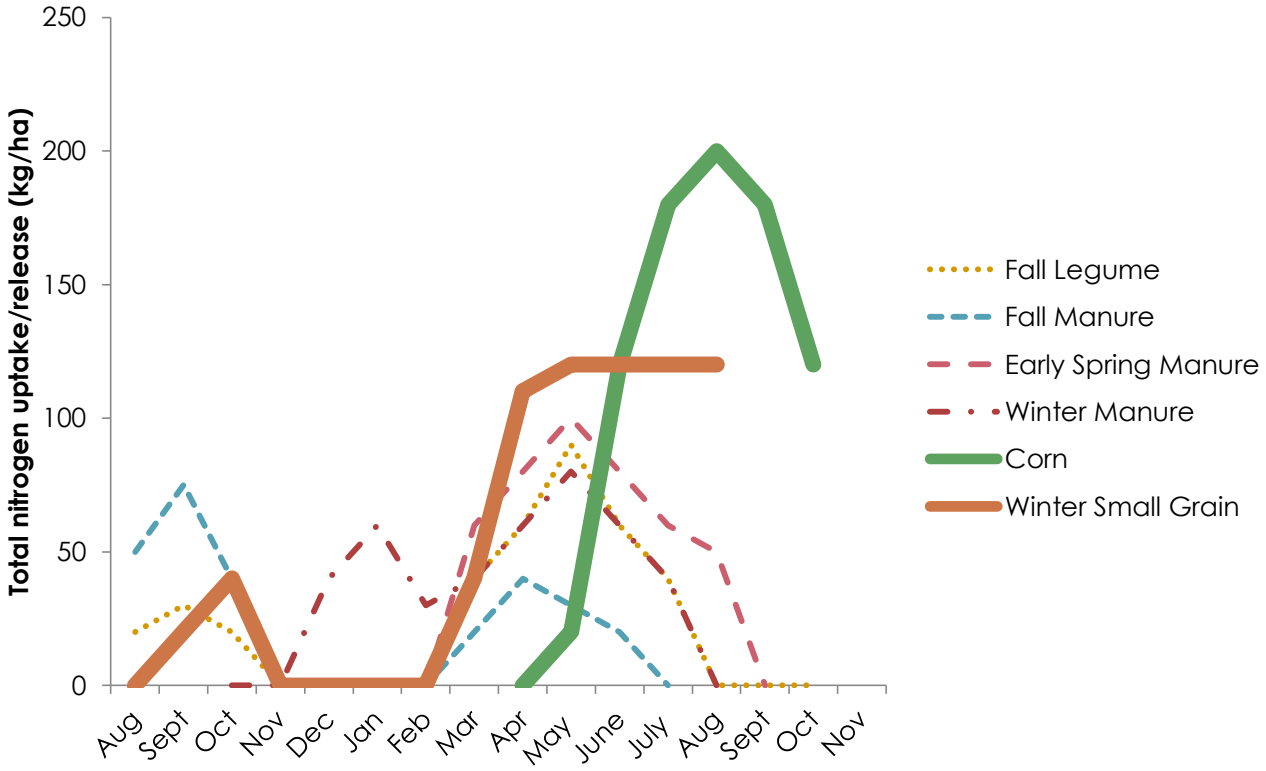
Nitrogen Mineralization



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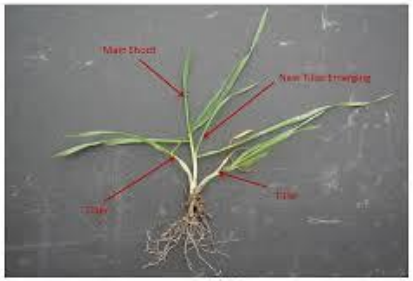
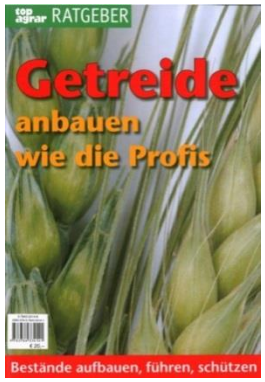


Tiller Counts

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, $NaNO_3$ 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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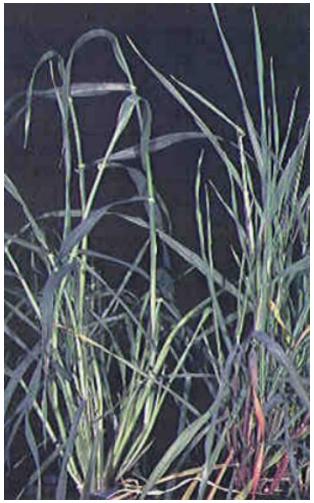
Bottom line:

- 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.



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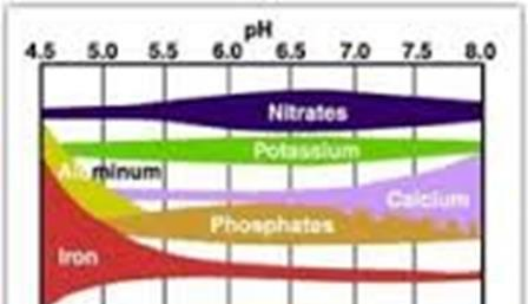
Phosphorus

- 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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Modified Table 5.5.1. Fertilizers for small grains.[1]

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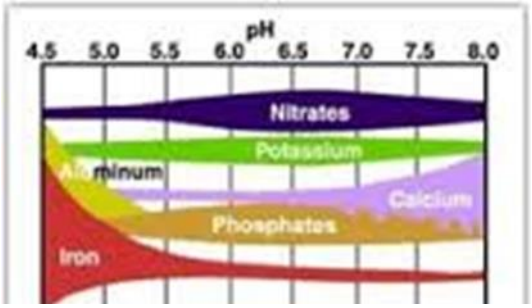
Phosphorus

- 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 ≥7.0
  More P available <6.0



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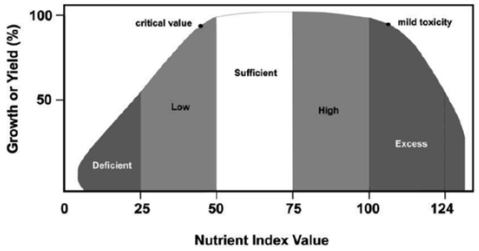
Phosphorus

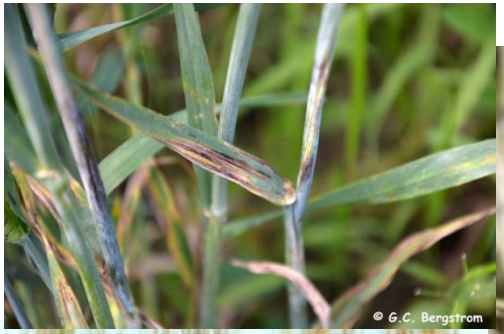
- Conventional Sources
  - Superphosphate, MAP, DAP—highly available P
  - Made from rock phosphate treated with strong acid.
  - *Can easily apply with seed at planting.*



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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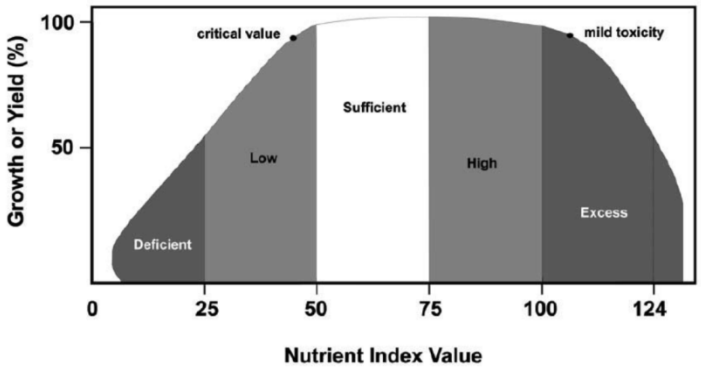
Potassium

- Conventional Sources: KCl
- Cl- is universal present
  - in soils (~100 ppm or 200 lb/acre)
  - In manure 5-10 lb./ton
- Cl- rapidly leaches from the soil
- Cl- doesn't not decrease biological activity
- Cholrine gas (Cl_2) 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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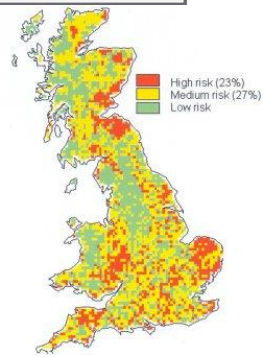
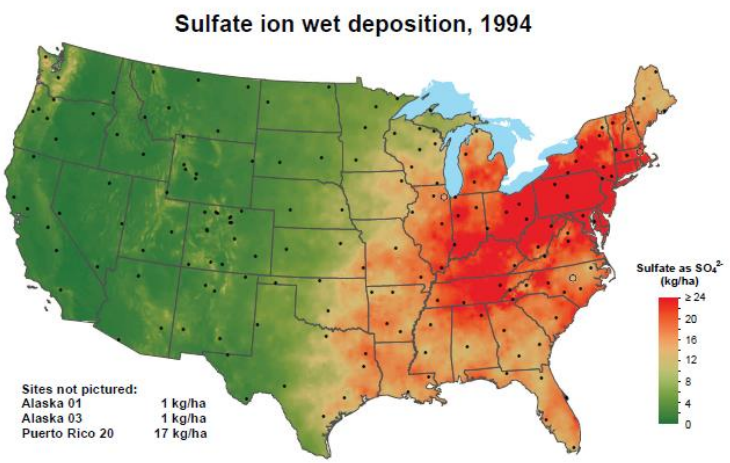
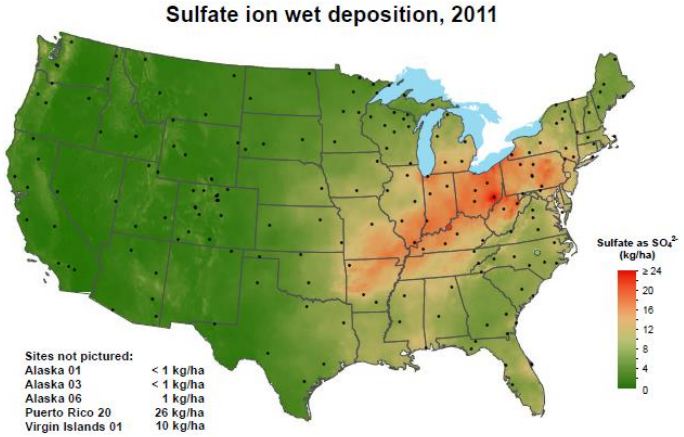


Sulfur

- Barley may respond to 10-20 lb./A.
- Don't apply on grain for distilling.



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



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http://nadp.isws.illinois.edu

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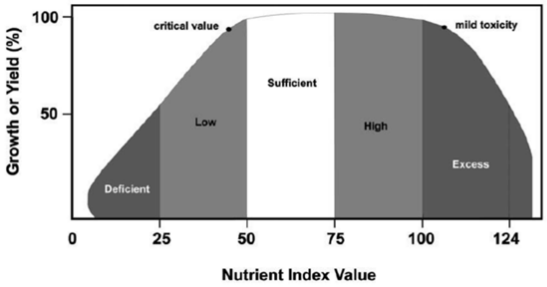
Calcium & Magnesium

- 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.



- 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

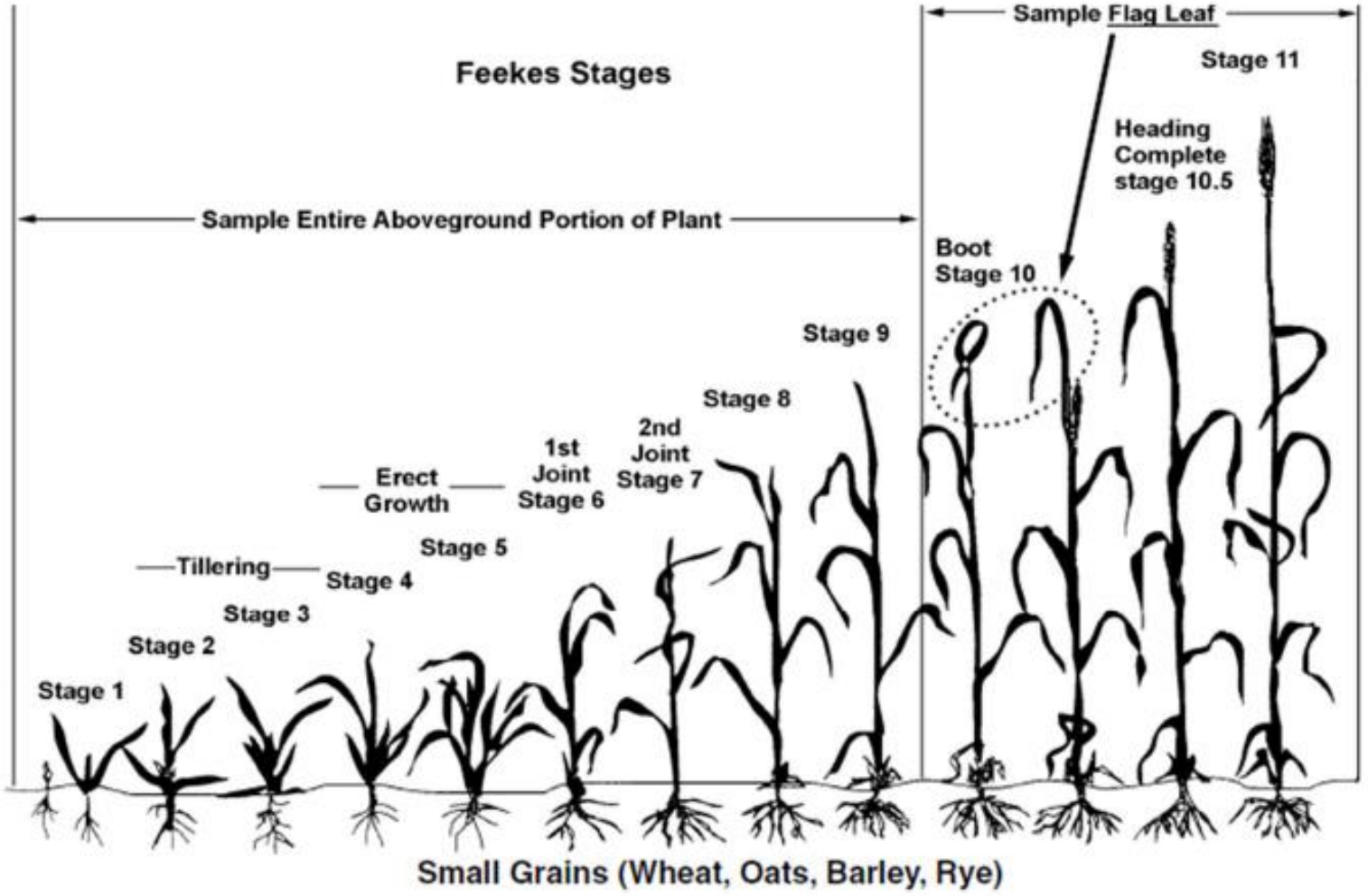
- *More samples* taken than soil samples to account for variability, usually **30+ plants/field**
- Sample from "*good*" and "*bad*" areas **separately**
- Samples need to be **air-dried** in a paper bag prior to shipping

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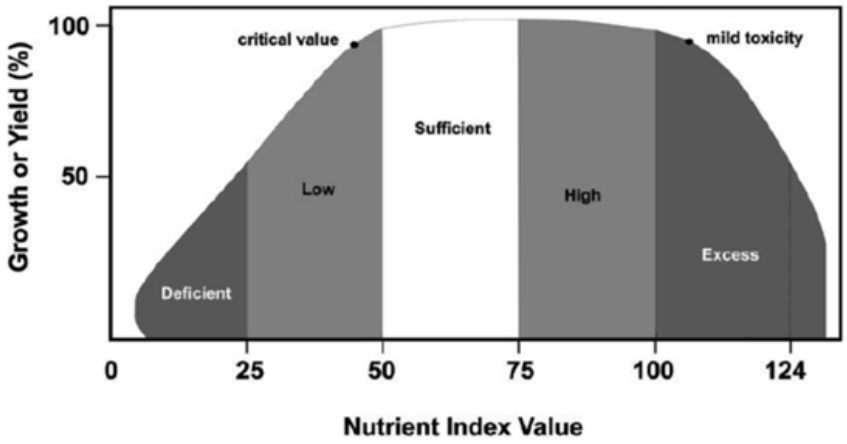
Spectrum Analytic Inc., Illustrated Guide to Sampling for Plant Analysis

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	**2.0-2.7**	0.1-0.5	1.0-3.0	1.0	**0.15-1.0**	**N/A**	3-40	**10-70**	**3-10**	15-200	25-300	N/A
2	**4.0-5.0**	0.2-0.5	2.5-5.0	0.2-1.0	**0.14-1.0**	**0.15-0.65**	1.5-4.0	**18-70**	**4.5-15**	20-150	30-200	0.1-2.0
3	**4.0-5.0**	0.2-0.5	2.0-4.0	0.2-1.0	**0.14-1.0**	**0.15-0.65**	1.5-4.0	**18-70**	**4.5-15**	20-150	30-200	0.1-2.0
4	**1.7-3.0**	0.2-0.5	1.5-3.0	0.2-0.5	**0.15-0.5**	**0.15-0.40**	5-10	**15-70**	**5-25**	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

- 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.

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Questions?

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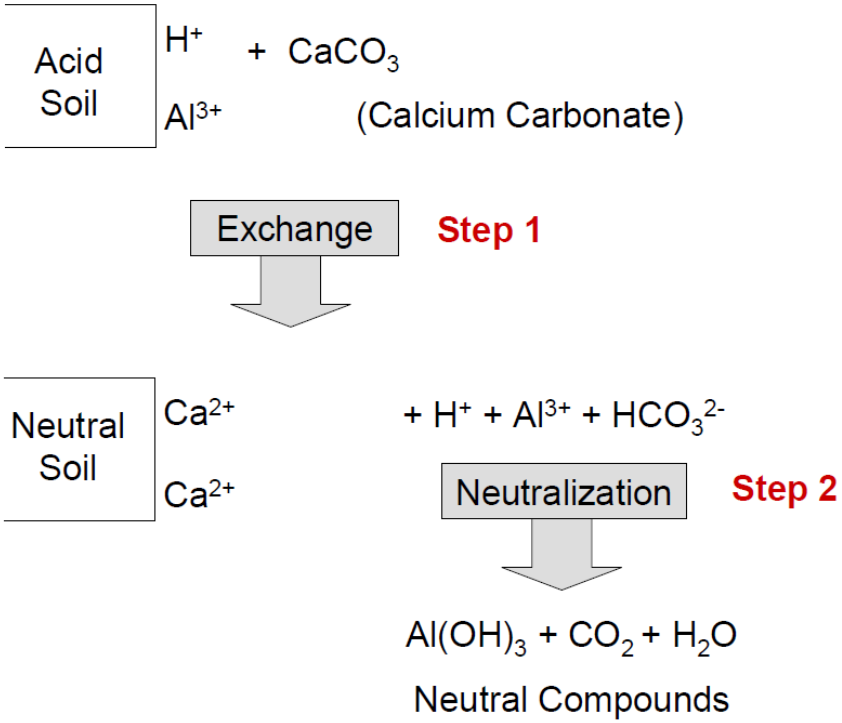
How Lime Works



Liming Materials

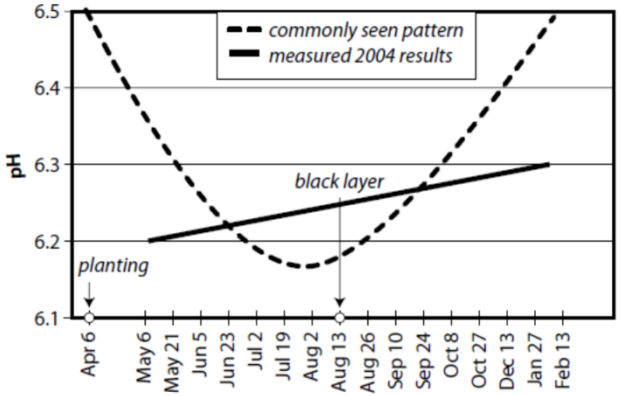
Common Name	Chemical Formula	CCE
Calcitic Limestone	CaCO3	100
	MgCO3	119
Burned Lime, Quick Lime	CaO	179
Hyrdated Lime, Slack Lime	Ca(OH)2	136
Dolomitic Limestone	CaMg(CO3)2	109
	CaSiO3	86
Wood Ash	Variable	50-80

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

Bill Verbeten Cornell Cooperative Extension

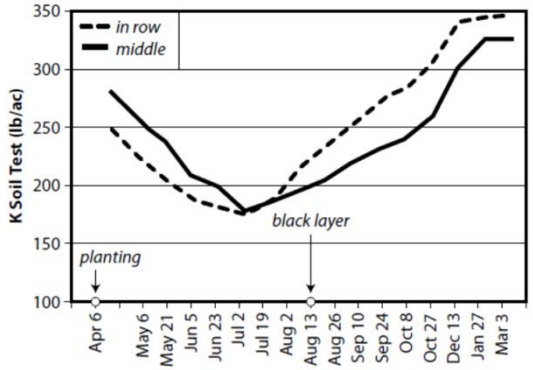
Yearly Soil Variation

- pH

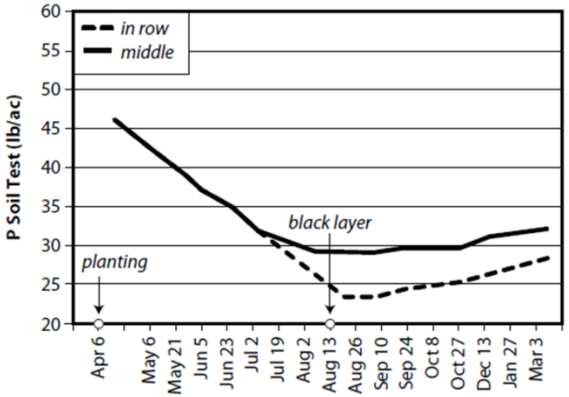


[Kentucky]

- K



- P



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