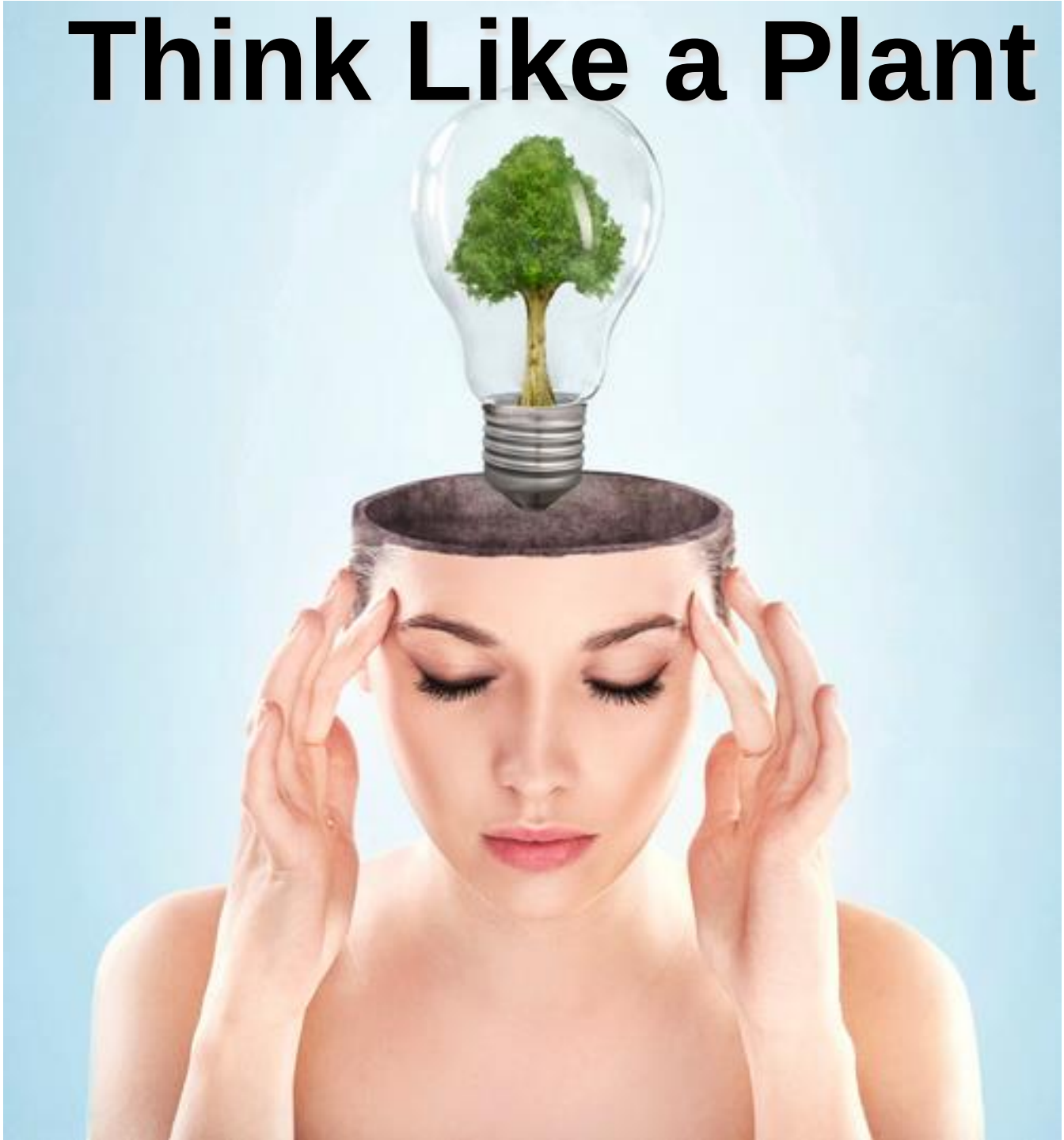
What your Plants are DYING to tell YOU!!!

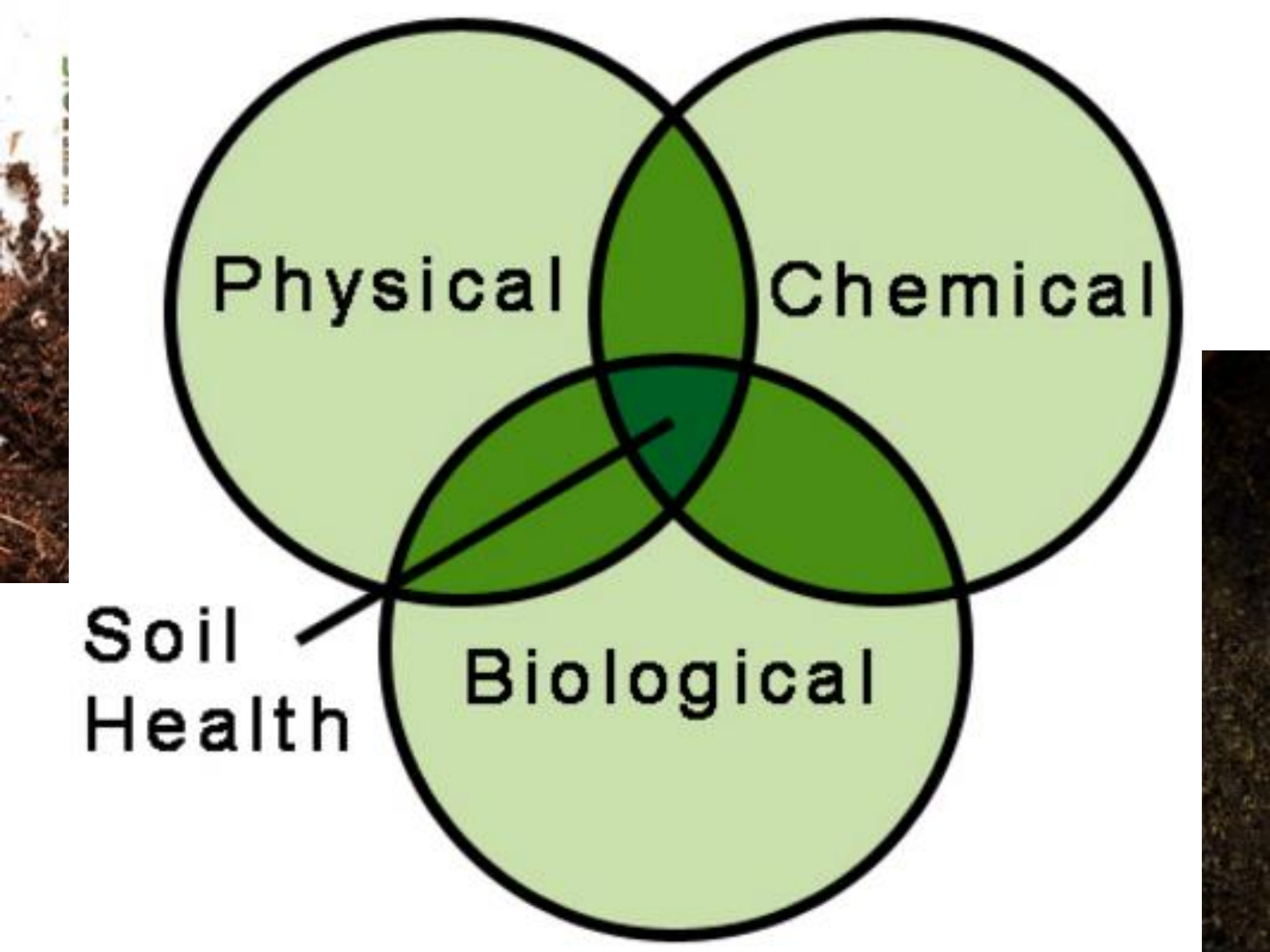
Poor soil structure lacks moisture-holding capacity, potentially leading to drought stress or a multitude of other factors

Think Like a Plant



Nutrient Uptake

- Soil-water solution
- 98% obtained in soil-water solution
- 2% directly from soil


Physical
Chemical
Biological
Soil
Health

My Home

Chemical/Biological:

- EC (salt)
- Water holding capacity
- CEC
- Plant available nutrients
- pH
- OM content
- $CaCO_3$ content
- Mineralizable N (SOM)
- Disease history

Physical:

- Texture
- Structure/restrictive layers
- Soil depth

Other:

- Soil management history
- soil variability

We want to create a Root Dominant Plant

Do you want to know me?

As photosynthesis activity increases, greater amounts of plant sugars are transferred out through the roots, to feed soil microbes, which in turn, make minerals available to the plant. These minerals act as coenzymes in the production of complex carbohydrates and especially amino acids which go on to be peptides, which then go on to form proteins. In the absence of these minerals as coenzymes, the plant is unable to form these complex proteins and the plant has high levels of amino acids (the precursor to protein) in the sap

WHY IS THIS IMPORTANT?

Because we readily feed on this sap.

Understanding the Plant

- First, if there are more sugars and other beneficial components like minerals and amino acids (building blocks), the plant is able to build more good stuff (oils, flavors, resins, etc.)
- The plant is healthier to us, however, at the same time, insects and pathogens don't like these compounds.

- A healthy plant has a high Brix level and proper mineralization is the key to everything.

Critical to the Plant

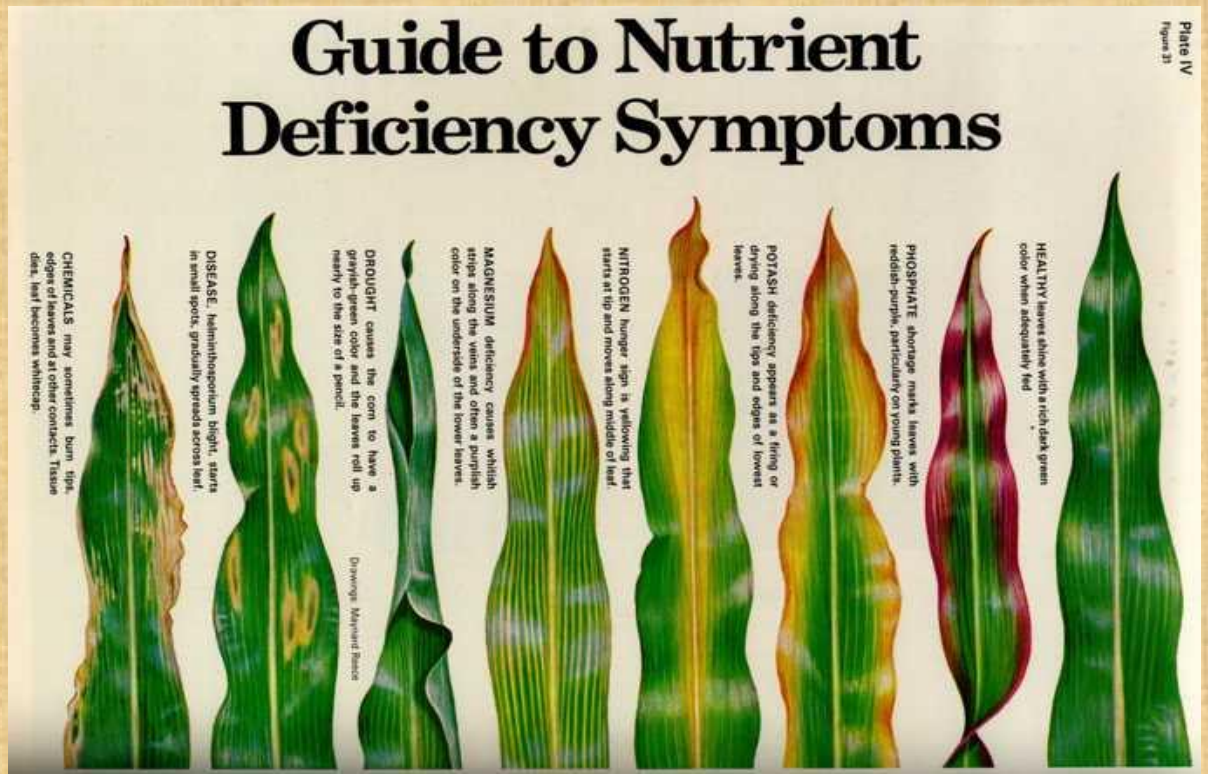
- **Calcium** plays a key role in increasing Brix level. Since calcium is immobile AND near the beginning of the biochemical sequence of uptake, **it's absorption affects most of the rest of the minerals**. If calcium availability and uptake is optimized, then all other mineral uptake will be more balanced and effective.
- For example,
  if you have a plant infected with powdery mildew (a systemic fungal disease), you are guaranteed to have a low plant sap pH (**under about 5.5**). The good news is if the pH is raised, powdery mildew will not appear, because the plant will send a different frequency signal that will NOT attract fungus.

Nutrients

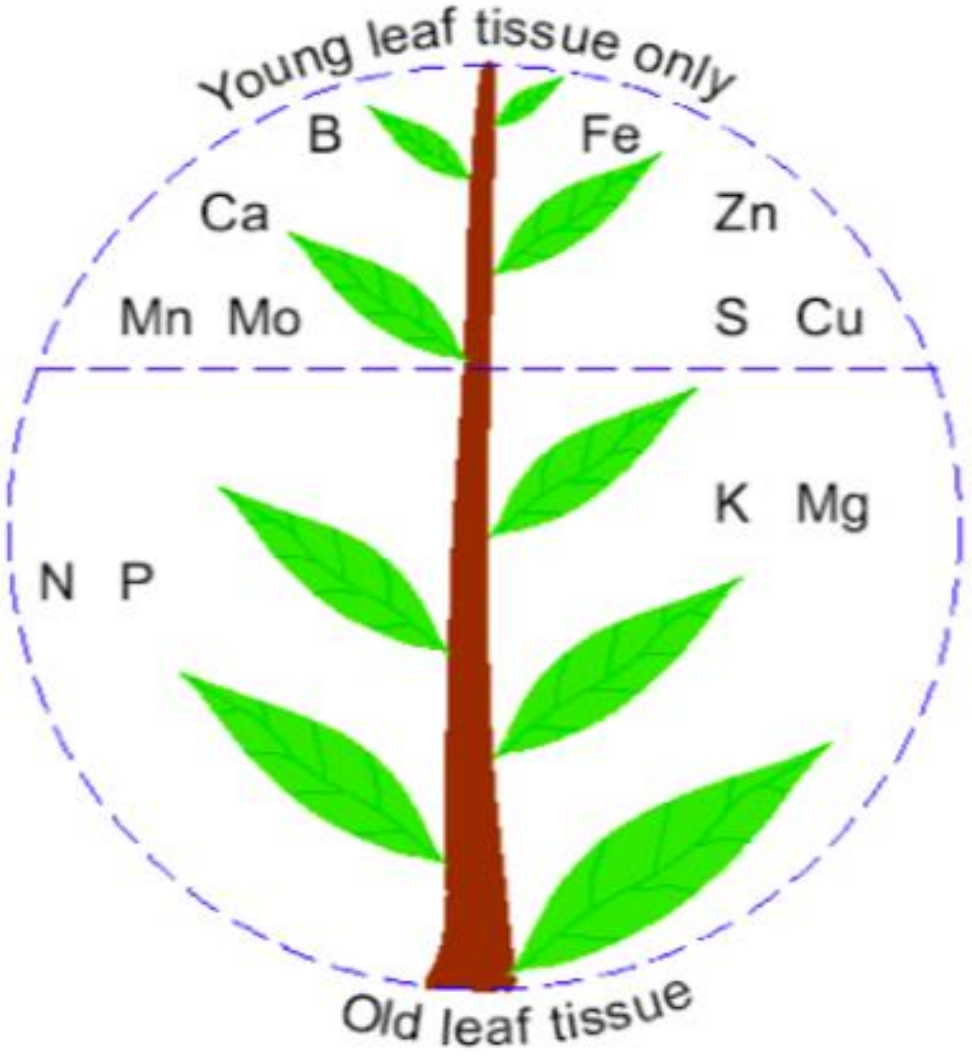
- Macronutrients –

  are needed/used in large amounts

- N, P, K, Ca, Mg, S



Help me!



The absence of any one essential plant nutrient will cause the plant to grow poorly or show signs of poor health

Help me!

The excess of any one essential plant nutrient can cause the plant to grow poorly or show signs of poor health

Reported* Effects of Nutrients on Disease

Mineral element	Disease is: Decreased	Increased	Variable
Nitrogen ($N/NH_4/NO_3$)	168	233	17
Phosphorus (P)	82	42	2
Potassium (K)	144	52	12
Calcium (Ca)	66	17	4
Magnesium (Mg)	18	12	2
Manganese (Mn)	68	13	2
Copper (Cu)	49	3	0
Zinc (Zn)	23	10	3
Boron (B)	25	4	0
Iron (Fe)	17	7	0
Sulfer (S)	11	3	0
Other (Si, Cl, etc.)	71	6	8

*Based on 1,200 reports in the literature.

Plant Stressors

- Plants create simple sugars through photosynthesis and convert into complex sugars with the right minerals and light.
- Stressors on the plant reduces the ability to form complex sugars
- Drought, salinity, low temperature and flooding, in general, increases soluble sugar concentrations
- High rates of nitrogen creates sick plants with more soluble sugars, therefore leading to more insect attack
- Insects sense changes in sugar concentrations in the plant

AVOID STRESS

Plant

- Sugars and nitrogen are more concentrated in water-stressed plants, allowing insects to obtain more useable food in a shorter time. Water-stressed plants produce fewer chemicals that deter insect feeding.
- Younger leaves tend to contain more water and nitrogen than older leaves, making them more vulnerable to some insects.

If I Had a Magic Wand

pH

Affects pretty much everything including:

- Root Growth
- Nutrient Use Efficiency
- Nodulation
- Herbicide efficacy and carry forward

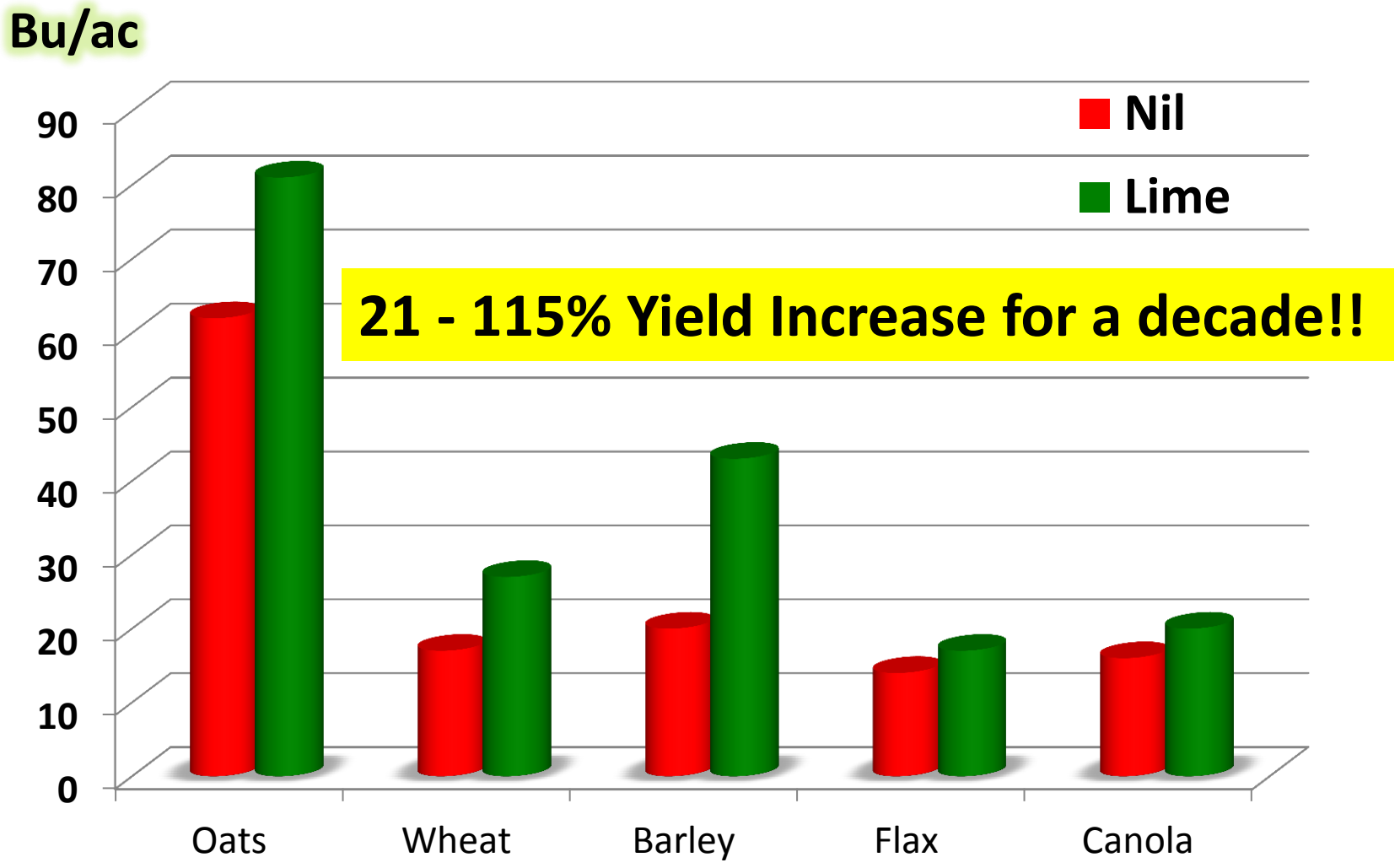
Low pH Soils

- 3.15 million wheat acres OR and WA alone
  - Approximately 200 million bushels
- 40-50% of individual fields affected
- 30-50% yield potential increases
- 10 year positive effects

- **Magic Wand Calculation**
  - $33,000,000 – 55,000,000/year

  Increased production

Results


Bu/ac
90
80
70
60
50
40
30
20
10
0
Nil
Lime
21 - 115% Yield Increase for a decade!!
Oats
Wheat
Barley
Flax
Canola

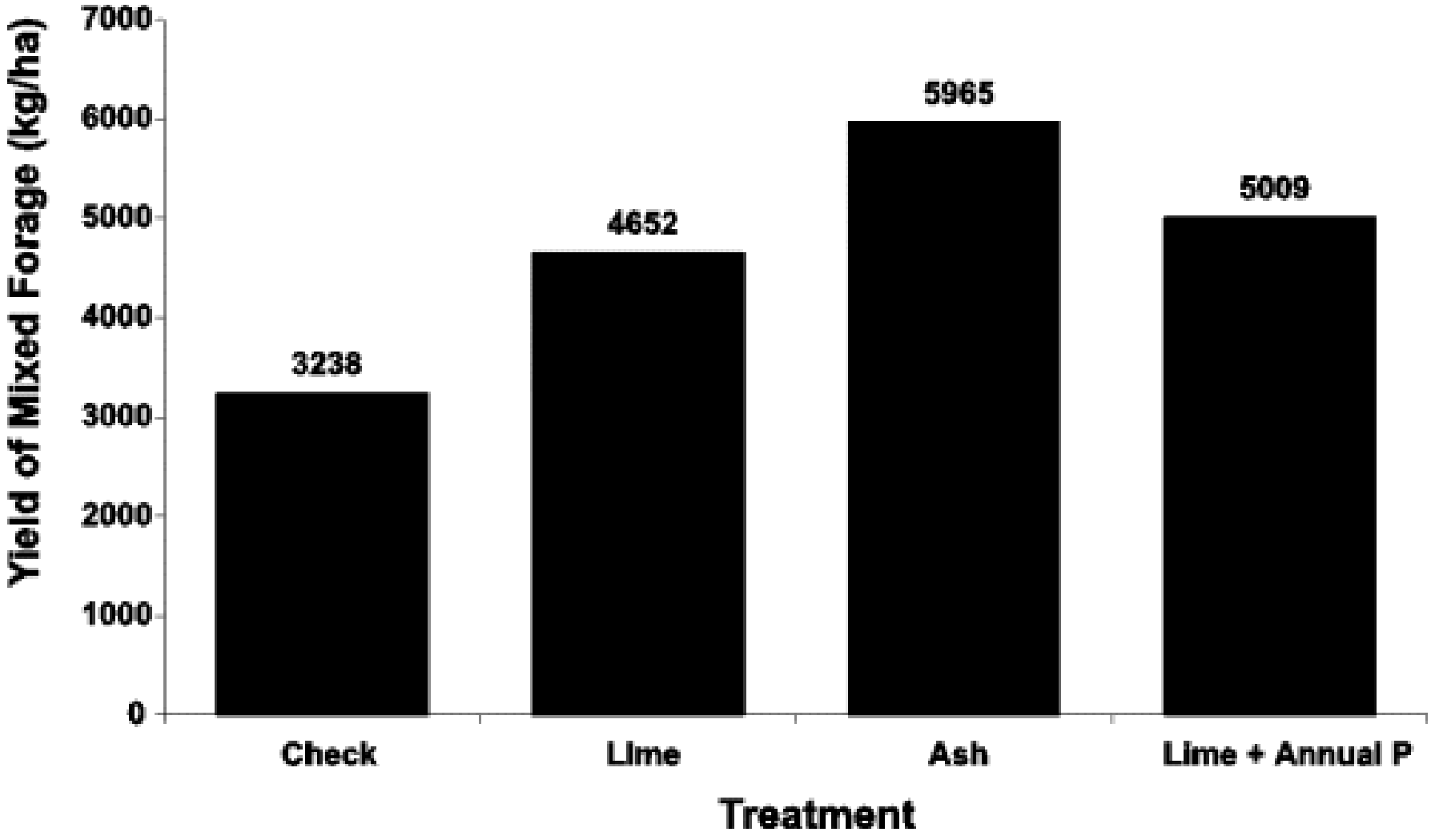
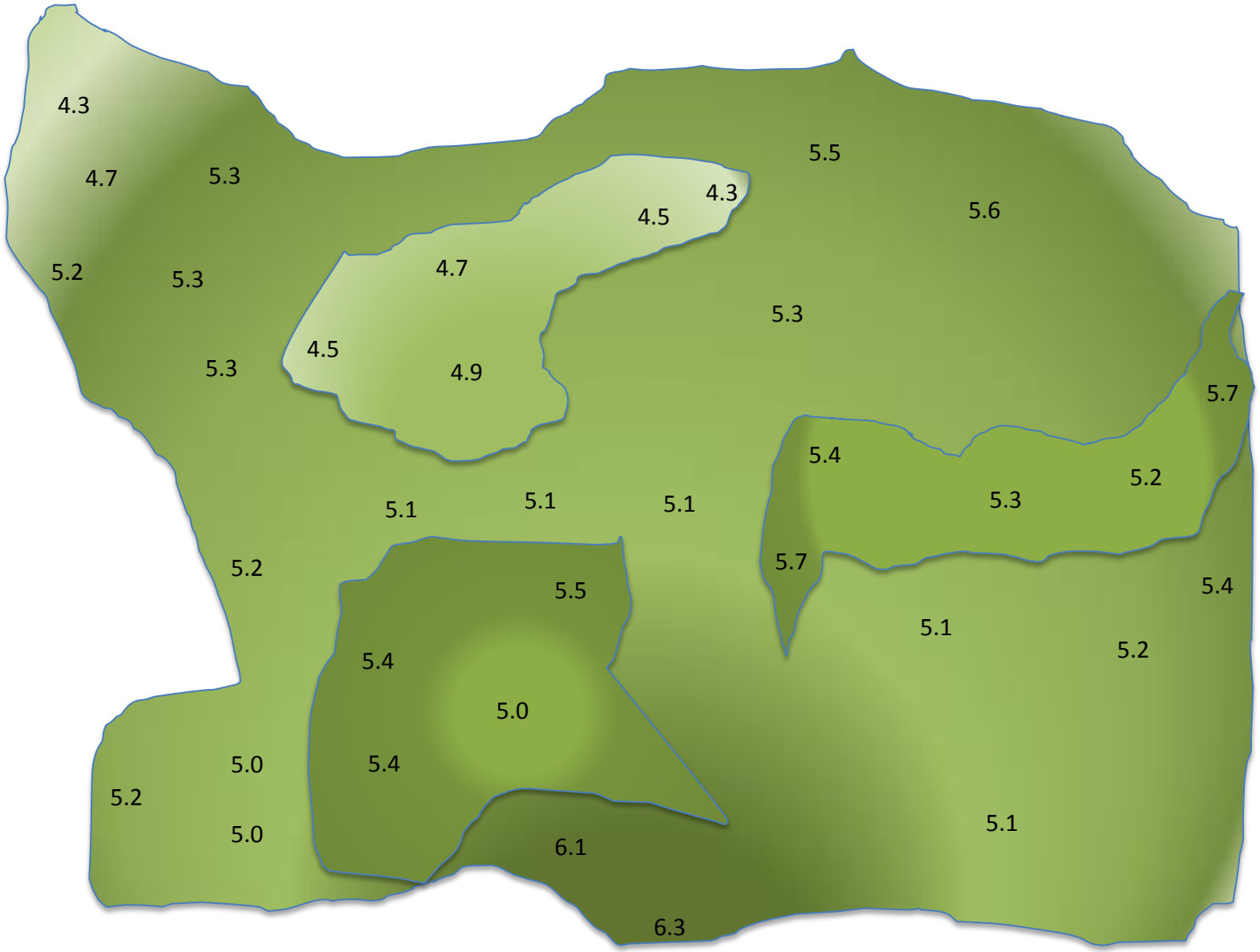


Figure 5. Comparison of Wood Ash, Lime and fertilizer Phosphorous on Forage Yield (1999-2000)

+ ph_SURF

Zone ID	Zone Name	Acres
5.5000	5.5000	43.04
5.9500	5.9500	44.98
6.2000	6.2000	45.93
6.6000	6.6000	44.9
7.2500	7.2500	43.52


4.3
4.7
5.3
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5.4
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5.4
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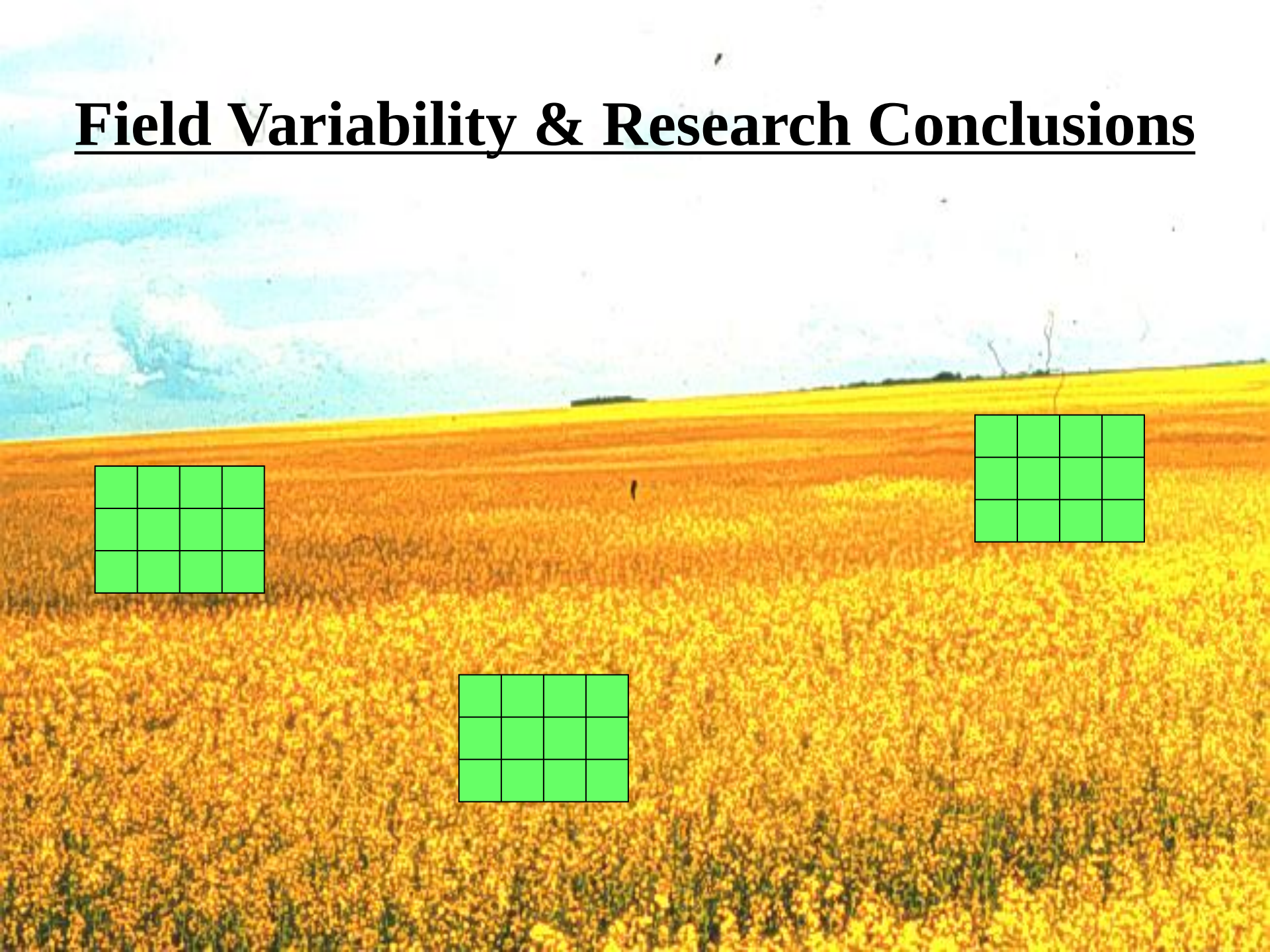
5.0
5.1
6.1
6.3

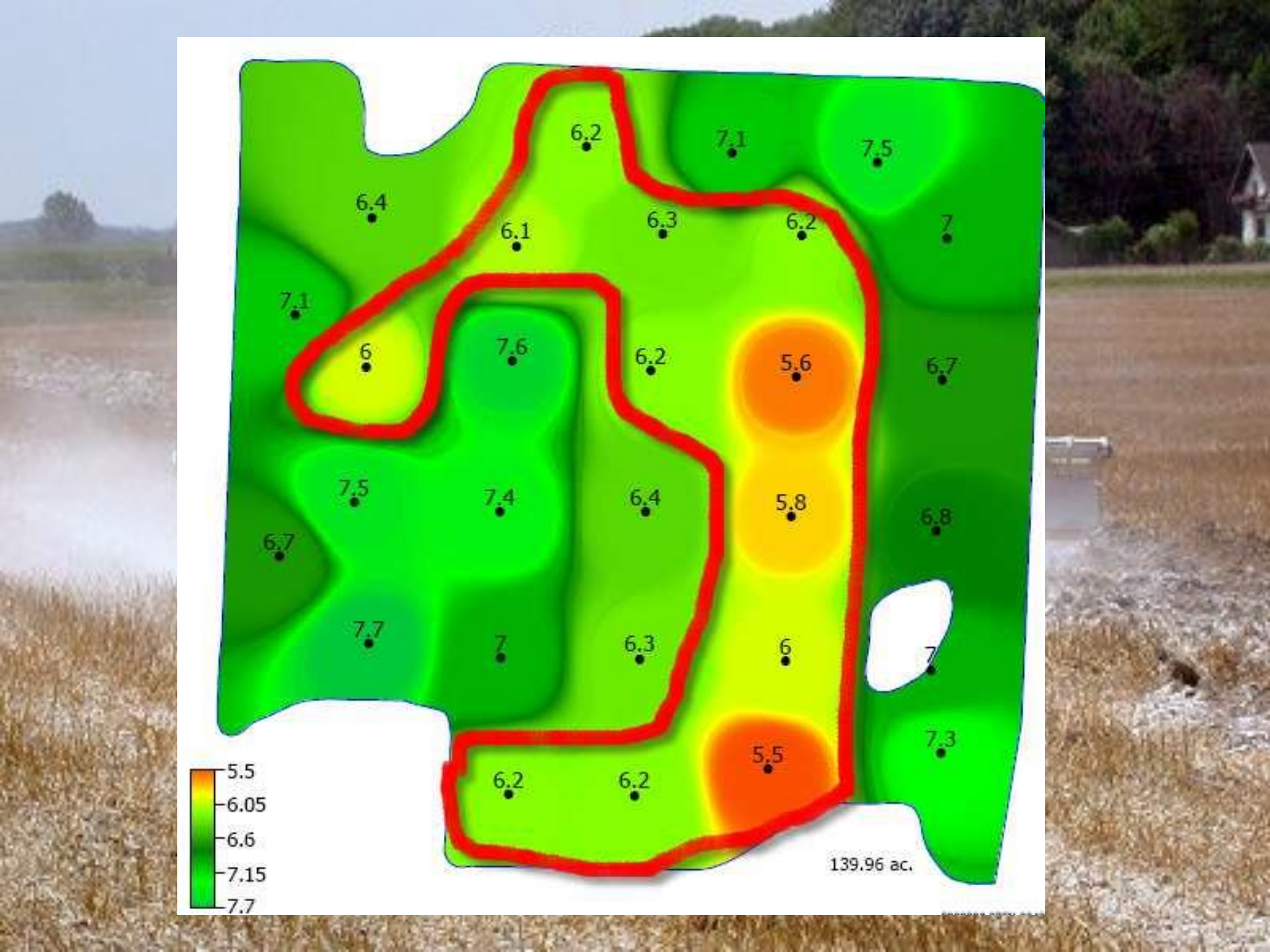
Field Variability & Research Conclusions



Samples from Chem Fallow

0-12"

Location/Soils	SAMPLE NO.	DEPTH	NO3N mg/Kg	NH4N mg/Kg	S mg/Kg	Total N mg/kg	Total N lbs/ac 2 ft	Soil stik pH meter readings pH 1"	pH 3"	pH 6"	pH 24 "	Native soil pH
Long Hollow Dufur	1	0-24	7.4	0.8	6.326	8.2	56.2		5.1			6.1-7.3
Cantala/Condon soils	5	0.24	10.5	0.2	8.396	10.7	73.3		5.3			6.1-7.3
	6	0.24	6.1	0.5	8.064	6.6	45.2		5.1			6.1-7.3
	2	0.24	5.9	0.6	7.099	6.5	44.6		6.5			6.1-7.3
	4	0.24	8.5	0.3	6.496	8.8	60.3		6.4			6.1-7.3
	8	0.24	3.2	0.2	6.229	3.4	23.3		6.3			6.1-7.3
	2	0.24	2.8	0.3	5.975	3.1	21.2		6.3			6.1-7.3
Wrentham Dufur	1	0.24	4.9	1.5	6.648	6.4	43.9		6.2			6.6-7.8
Walla Walla soils	5	0.24	6	0.6	7.548	6.6	45.2		6.3			6.6-7.8
	1	0-24	6.3	1.2	4.53	7.5	51.4		6.5			6.6-7.8
	7	0.24	6.6	0.8	5.22	7.4	50.7		6.1			6.6-7.8
	6	0.24	2.5	0.4	4.78	2.9	19.9		6.4			6.6-7.8
												6.6-7.8
Emerson Loop	17	0-24	7.3	1	8.3	8.3	56.9	5.7	5.4	5.6		6.6-7.8
Walla Walla soils	18	0-12	6.4	0.9	7.3	7.3	50.0	6.2	5.2	5.8		6.6-7.8
	19	0-24	3.9	1.4	5.3	5.3	36.3	5.8	5.4	5.2		6.6-7.8
	20	0-24	7.1	2.3	9.4	9.4	64.4	5.3	5.2	5.5		6.6-7.8
	21	0-24	5	2.9	7.9	7.9	54.1	5.4	5.1	4.8		6.6-7.8
	22	0-24	6.3	1.9	8.2	8.2	56.2	5.4	5.1	5.3		6.6-7.8
	23	0-24	3.8	5.3	9.1	9.1	62.4	5.6	5.7	5.8		6.6-7.8
	24	0-12	5.4	6.5	11.9	11.9	81.6	5.5	5.3	5.5	6.2	6.6-7.8
Juniper Flat	3	24"	4.4	0.7	8	5.1	37.4		6.7			6.1-7.3
Maupin/Watama/Wapinitia soils	1	12 "	11.9	2.1	13	14.0	95.2		5.6			6.1-7.3
	52	24"	6.4	3	10	9.4	63.4		5.6			6.1-7.3
May in Crop Samples:												
North Wasco Co.	1								4.9			6.6-7.8
Walla Walla soils	2								5.1			6.6-7.8


6.2
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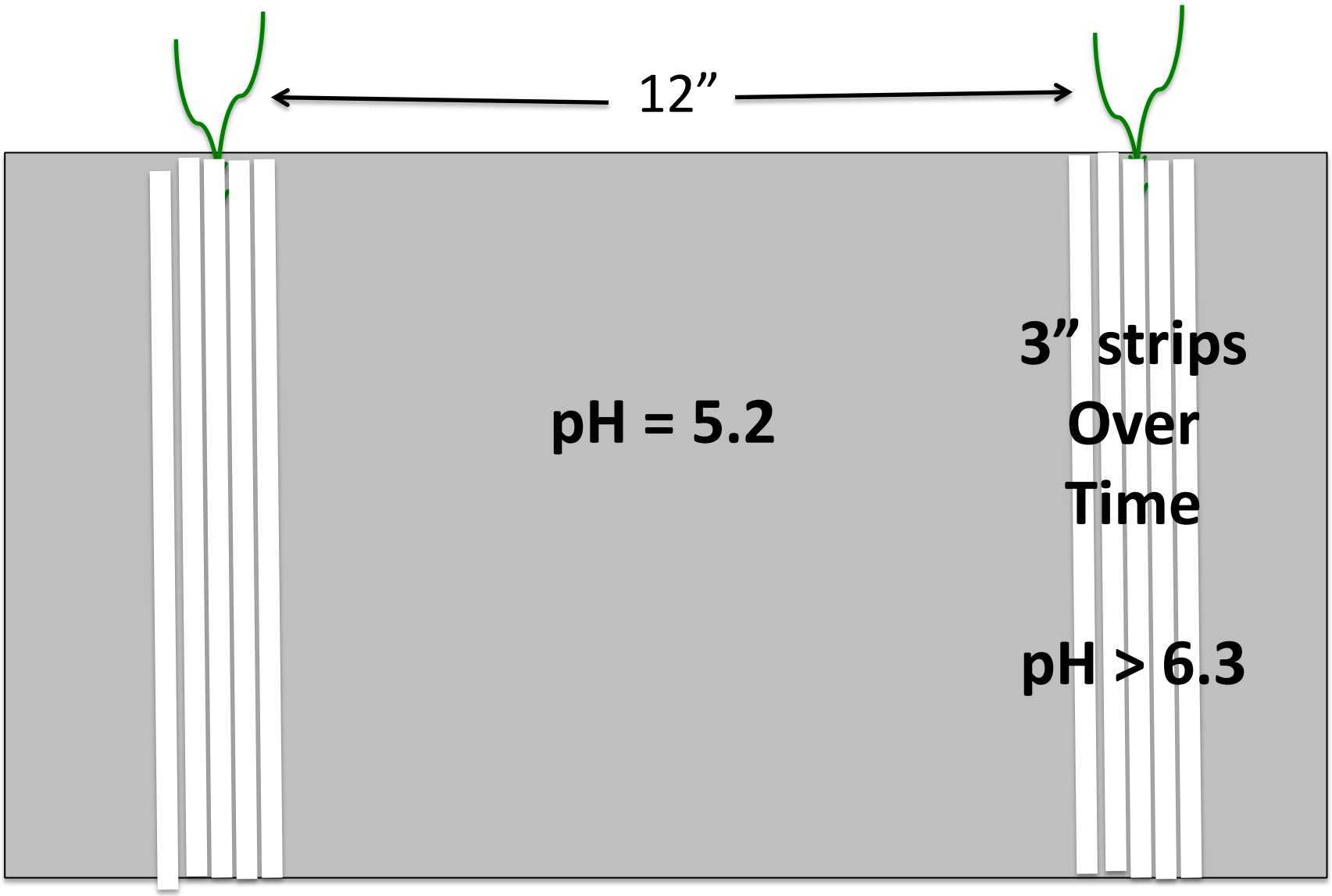
7
6.3
6
7
7.3
5.5
6.2
6.2
5.5
6.05
6.6
7.15
7.7
139.96 ac.

Zones of Alkalinity (Lime) – RTK & ???



Yield Loss Due To Low pH

Crop	pH 4.7	pH 5.0	pH 5.7	pH 6.8
Corn	66%	27%	17%	0%
Soybeans	35%	21%	20%	0%
Wheat	32%	24%	11%	0%
Alfalfa	98%	91%	58%	0%

* Adapted from Smith & Doran 1996

Soil pH	% Fertilizer Efficiency			% Fertilizer Wasted
	N	P	K	
5.0	53	34	52	54
5.5	77	48	77	33
6.0	89	52	100	20
7.0	100	100	100	0