

The image shows a close-up view of a lush green wheat field. The wheat stalks are vibrant green and densely packed. In the center of the image, there is a large, bright green oval with a thin black border. Inside this oval, the title 'Wheat Grain Nutrient Content' is written in a bold, black, serif font. Below the title, the author's name 'Tom Jensen' and his affiliation 'International Plant Nutrition Institute, Saskatoon, SK' are written in a smaller, black, sans-serif font.

# **Wheat Grain Nutrient Content**

Tom Jensen  
International Plant Nutrition Institute  
Saskatoon, SK

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# Plant Mineral Nutrients



## Macro Nutrients

**Nitrogen (N)**

**Phosphorous (P)**

**Potassium (K)**

## Secondary Nutrients

**Sulfur (S)**

**Calcium (Ca)**

**Magnesium (Mg)**

## Micro Nutrients

**Boron (B)**

**Chloride (Cl)**

**Copper (Cu)**

**Iron (Fe)**

**Manganese (Mn)**

**Molybdenum (Mo)**

**Nickel (Ni)**

**Zinc (Zn)**

# Fertile Soils

- adequate supply of nutrients.
- balanced supply of nutrients.
- the nutrients are available to the crop plants at the correct time to allow adequate growth.
- no toxic concentration of one or more nutrients or elements

# Nutrient Content of Wheat



- Nutrient content, wheat samples from some of the main wheat growing areas of the world.
  - India, China, Russia, South-East United States, and the Northern Great Plains of North America.
- 130 samples were analyzed
  - India 10 samples; China 20 samples; Russia 25; SE USA 20; Northern Great Plains (NGP) 16 from North Dakota, 15 from Alberta, and 24 from Montana.
- Information to be used in development of a decision support system.

# Results



Nutrient	Canada	Russia	China	USA	India	Overall Mean	CV	LSD 0.1	n
% N	<b>3.0 a</b>	2.7 b	2.6 c	2.4 d	2.0 d	<b>2.50</b>	10.8%	0.2	130
% P	<b>0.37 b</b>	0.45 a	0.18 d	0.40 b	0.29 c	<b>0.36</b>	22.2%	0.06	130
% K	<b>0.47 a</b>	0.46 a	0.33 c	0.40 b	0.34 c	<b>0.40</b>	15.4%	0.05	130
% S	<b>0.18 b</b>	0.22 a	NA	0.16 c	0.13 d	<b>0.17</b>	13.5%	0.02	110
Ca mg kg <sup>-1</sup>	<b>367.3 c</b>	1601.5 a	257.2 c	1050.0 b	271.0 c	<b>894.2</b>	27.0%	178.4	130
Mg mg kg <sup>-1</sup>	<b>1407.3 b</b>	873.7 d	1176.7 c	1633.3 a	978.0 d	<b>1340.8</b>	19.6%	195.4	130
Zn mg kg <sup>-1</sup>	<b>48.6 a</b>	28.8 b	23.1 b	27.4 b	47.8 a	<b>31.1</b>	29.6%	6.8	130
Fe mg kg <sup>-1</sup>	<b>57.3 b</b>	37.5 c	45.6 bc	73.2 a	NA	<b>59.1</b>	35.3%	12.7	120
Cu mg kg <sup>-1</sup>	<b>4.77 b</b>	2.39 c	3.95 b	7.85 a	NA	<b>5.7</b>	27.3%	0.94	120
Cl mg kg <sup>-1</sup>	<b>NA</b>	See Table 5 below	NA	NA	NA	<b>334.1</b>	31.4%	256.8	25
B mg kg <sup>-1</sup>	<b>1.2</b>	0.8	NA	3.35	7.5 a	<b>2.85</b>	26.8	0.57	110

Different letter within a row are statistically different at 0.1.

# Follow-up in Northern Great Plains



- **Six Sites**
  - Vulcan, Three Hills, and Delia, AB
  - Watrous, Regina, and Moose Jaw, SK
- **Ten Wheat Genotypes**
  - Five Hard Red Spring: 5602HR, AC Barrie, Kane BW, 880 WR, 859CL, 5702PR
  - Two Cdn Prairie Spring Red: AC Foremost, Bridgade
  - Three Durum Spring: Bridgade, Kyle, CDC Verona
- Analyze the soil for plant available nutrients and compare to grain nutrient content.
- **Hypothesis that soil content will affect grain content.**





# Nutrient Analyses, Soil Test by Location



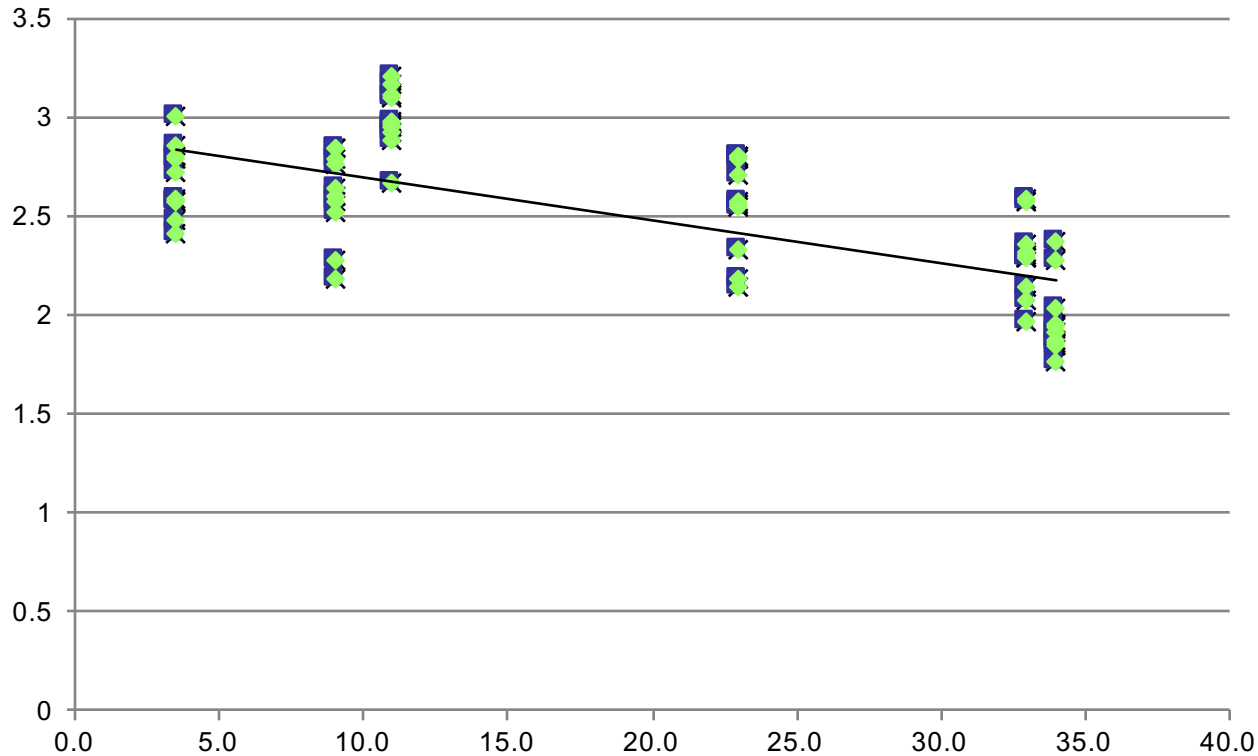
Site	lb A-1													
	Texture	pH	EC	OM %	NO3-N	P	K	SO4-S	Cu	Mn	Zn	B	Fe	Cl
Delia, AB	CL	6.0	0.2	4.8	22.0	35.0	540.0	49.0	1.6	37.4	2.9	1.0	169	33
Three Hills, AB	CL	5.6	0.1	7.6	46.0	44.0	540.0	29.0	1.3	50.1	4.7	1.7	160.0	17.0
Vulcan, AB	CL	6.1	0.2	2.9	7.0	11.0	242.0	12.0	1.4	30.3	1.3	0.8	108.0	4.0
Watrous, SK	L	6.1	0.2	5.0	68.0	60.0	600.0	47.0	2.2	42.1	3.2	1.9	165.0	8.0
Regina, SK	L	8.0	0.5	3.1	18.0	19.0	600.0	12.0	1.4	6.7	0.9	2.6	27.0	14.0
Moose Jaw, SK	CL	7.8	0.4	3.0	66.0	19.0	510.0	16.0	2.6	4.4	0.6	2.6	17.0	8.0

# Nitrogen



Corr (r)	S.E. of r	P(r=0)	n
Slope (b)	Y Int (a)	S.E. of b	
<b>-0.69328237</b>	<b>0.0946280878</b>	<b>.0000 ***</b>	<b>60</b>
-22.159916245	74.4937366097	3.0246701	

**ug g-1  
Grain**



- △ N ug g-1
- × N ug g-1
- N ug g-1
- ◆ N ug g-1
- Linear (N ug g-1)

**ug g-1  
Soil**

# Wheat Varieties and Nitrogen



Wheat Variety	N Content %	Differences 95%
1 HRS-5602H	2.78	a
2 HRS-WR 85	2.62	ab
3 HRS-AC Ba	2.62	ab
4 HRS-BW 88	2.55	bc
5 HRS-Kane	2.54	bc
6 Dur-Kyle	2.54	bc
7 Dur-CDC	2.47	bc
8 CPSR-5702	2.39	bc
9 Dur-Bridg	2.37	c
10 CPSR-AC F	2.20	d
LSD	0.15	
CV 5.4%		

# Sites and Nitrogen



Rank	Site	Grain N	Diff. 95%
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1	1	2.988	10 a
2	3	2.671	10 b
3	5	2.594	10 b
4	2	2.536	10 b
5	6	2.284	10 c
6	4	1.975	10 d

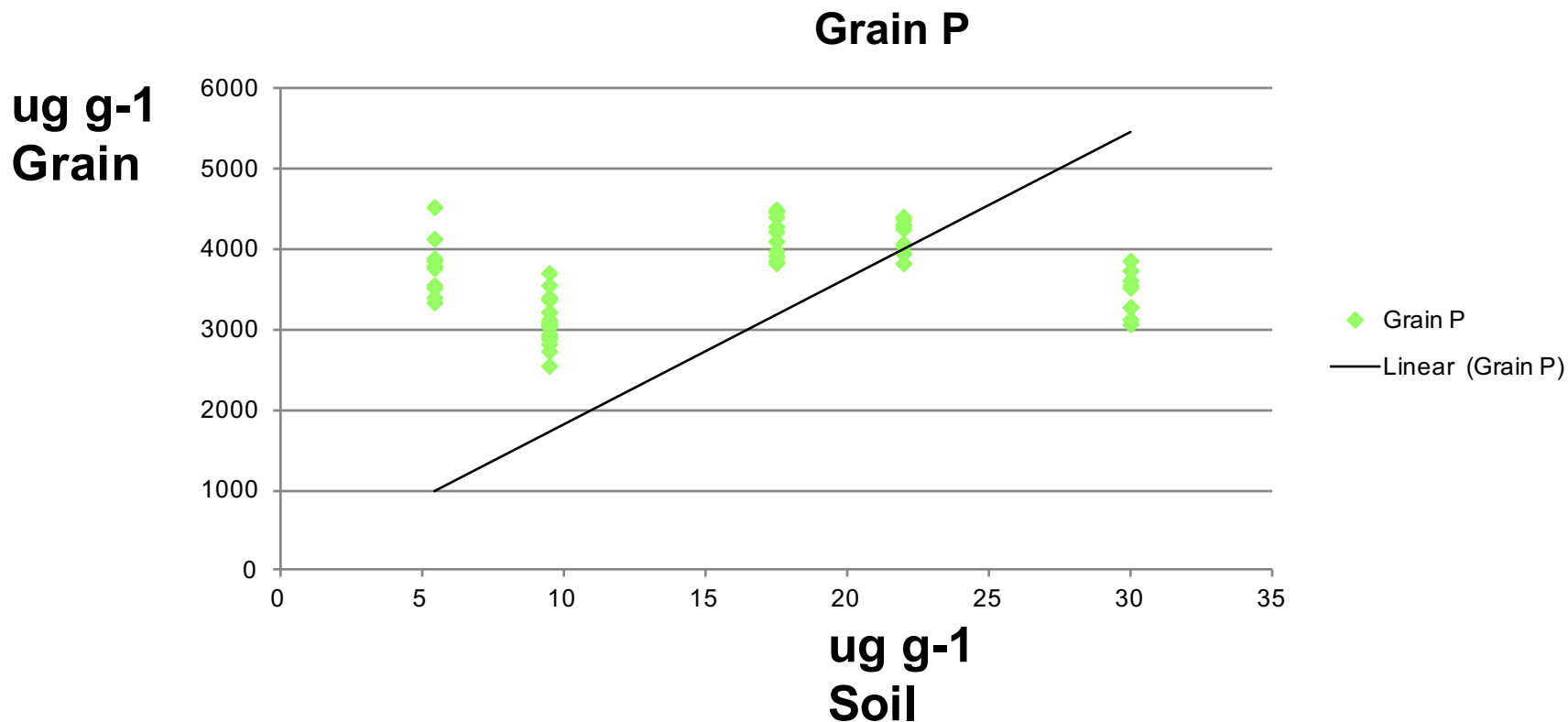
LSD 0.12

CV 5.4%

# Phosphorus



Corr (r)	S.E. of r	P(r=0)	n
Slope (b)	Y Int (a)	S.E. of b	
<b>0.23619864</b>	<b>0.1275910899</b>	<b>.0692 ns</b>	<b>60</b>
<b>0.0038673945</b>	<b>1.71890841293</b>	<b>0.0020891</b>	



# Wheat Varieties and Phosphorus



Rank	Variety	ppm P	Diff 95%
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1	HRS-WR 85	3916	a
2	HRS-AC Ba	3798	ab
3	HRS-BW 88	3770	ab
4	HRS-Kane	3725	abc
5	HRS-5602H	3598	bcd
6	Dur-Kyle	3575	bcd
7	CPSR-AC F	3490	bcd
8	Dur-CDC V	3453	cd
9	Dur-Bridg	3403	d
10	CPSR-5702	3335	d

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LSD 210

CV 5.0

# Sites and Phosphorus



Rank	Site	ppm P	n	Diff 95%
1	1	4145	10	a
2	2	4137	10	a
3	3	3769	10	b
4	4	3406	10	c
5	6	3297	10	c
6	5	2885	10	d
LSD		163		
CV 5.0				

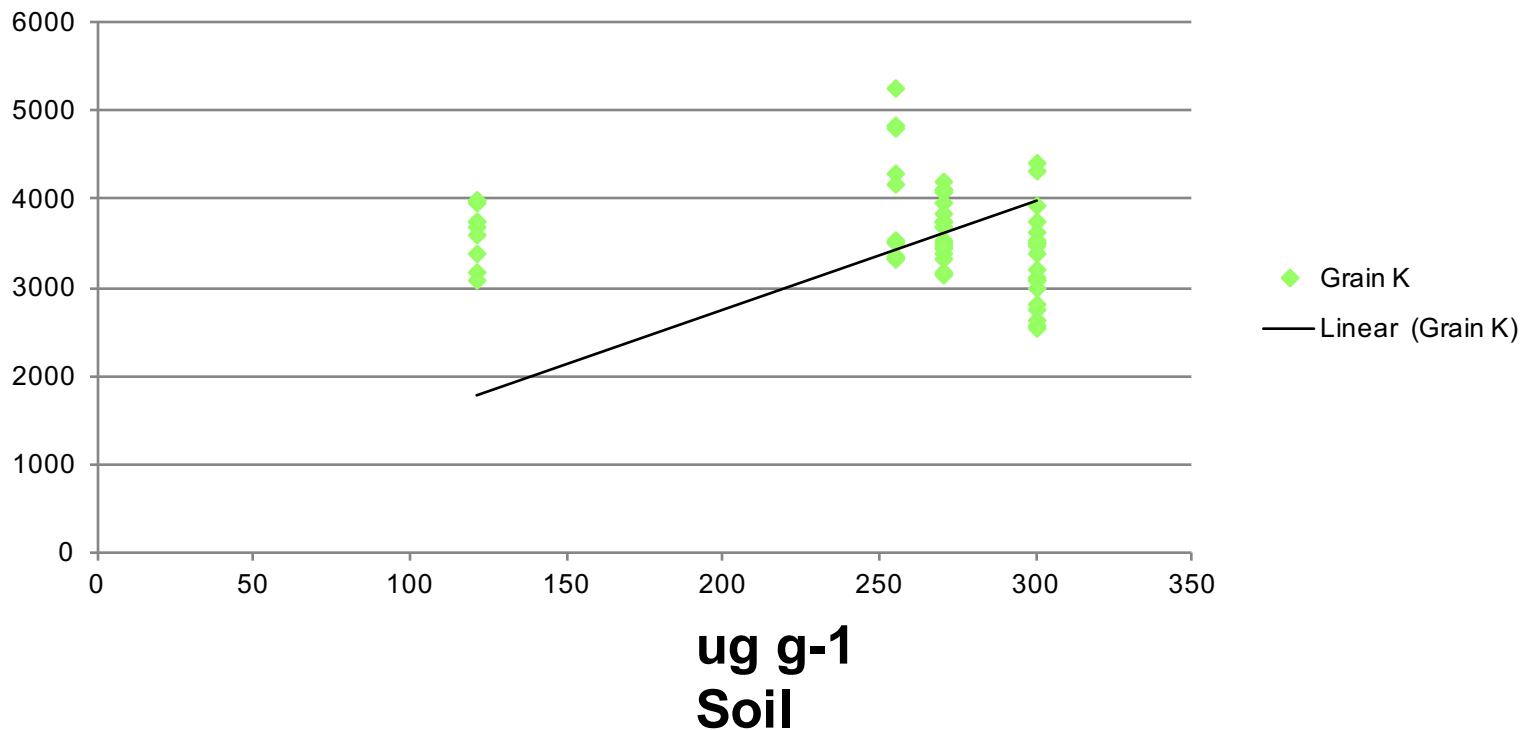
# Potassium



Corr (r)	S.E. of r	P(r=0)	n
Slope (b)	Y Int (a)	S.E. of b	
<b>-0.14604185</b>	<b>0.1298986195</b>	<b>.2655 ns</b>	<b>60</b>
-0.0169060576	313.514385618	0.0150373	

**ug g-1  
Grain**

## Grain K





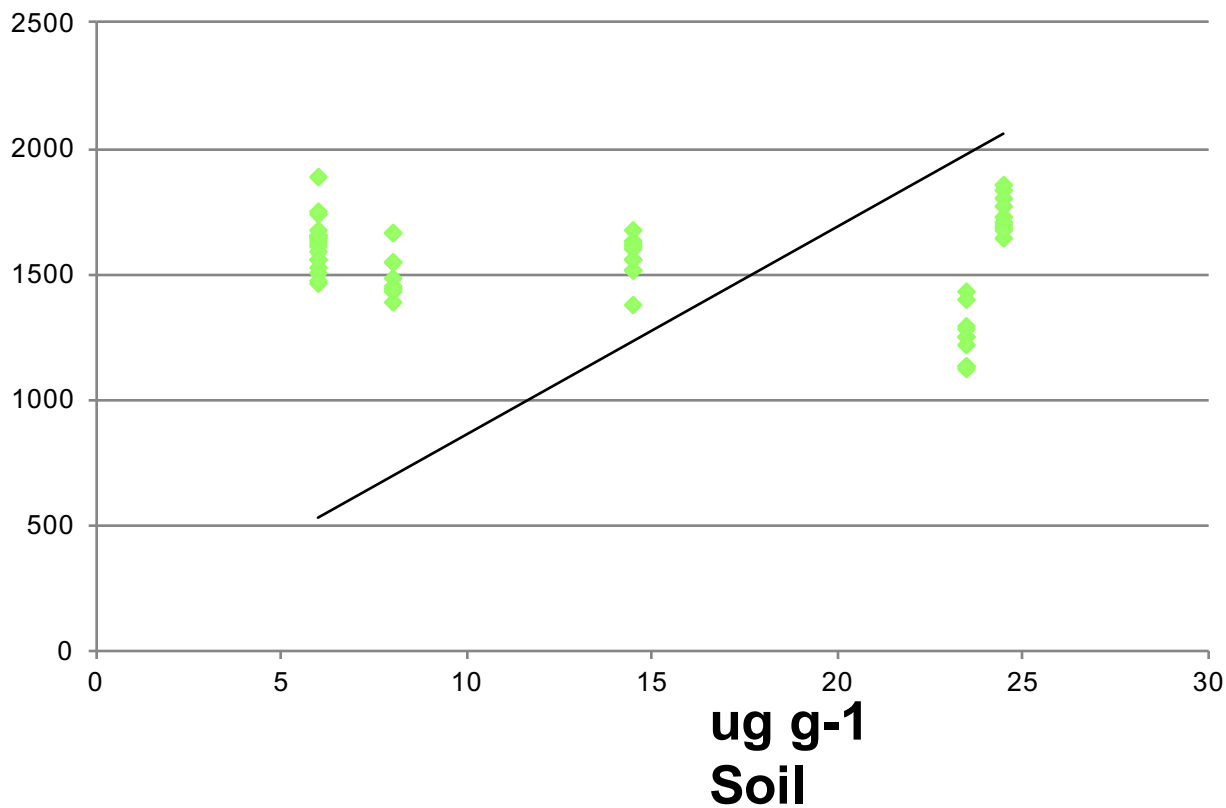
# Sulfur



Corr (r)	S.E. of r	P(r=0)	n
Slope (b)	Y Int (a)	S.E. of b	
<b>-0.21084632</b>	<b>0.12835456202</b>	<b>.1059 ns</b>	<b>60</b>
-0.0092882555	28.1839489998	0.0056543	

## Grain S

**ug g<sup>-1</sup>  
Grain**

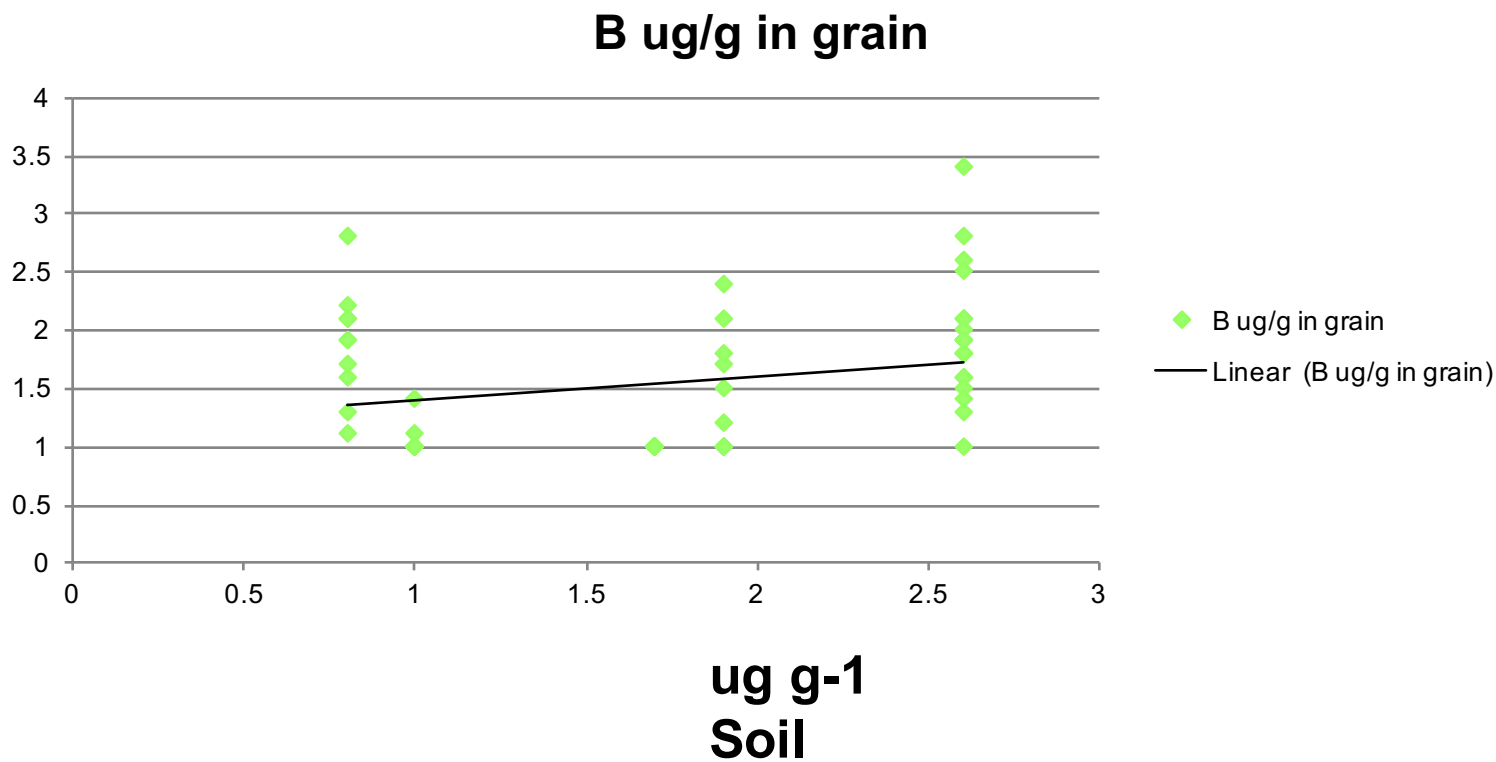


# Boron



Corr (r)	S.E. of r	P(r=0)	n
Slope (b)	Y Int (a)	S.E. of b	
<b>0.30927129</b>	<b>0.12486898419</b>	<b>.0162 *</b>	<b>60</b>
0.3740928249	1.1886932522	0.1510408	

ug g<sup>-1</sup>  
Grain



# Wheat Varieties and Boron



Rank	Variety	ppm B	n	diff 95%
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1	HRS-Kane	1.93	6	a
2	HRS-AC Ba	1.85	6	ab
3	CPSR-5702	1.63	6	abc
4	HRS-WR 85	1.63	6	abc
5	HRS-BW 88	1.61	6	abc
6	HRS-5602H	1.53	6	abc
7	CPSR-AC F	1.48	6	abc
8	Dur-Kyle	1.45	6	abc
9	Dur-Bridg	1.2	6	bc
10	Dur-CDC V	1.11	6	c

LSD 0.05 = 0.43      CV 24.1

# Sites and Boron



Rank	Site	ppm B in Grain	n	diff 95%
1	6	2.12	10	a
2	3	1.87	10	ab
3	5	1.76	10	ab
4	4	1.47	10	b
5	1	1.05	10	c
6	2	1.0	10	c

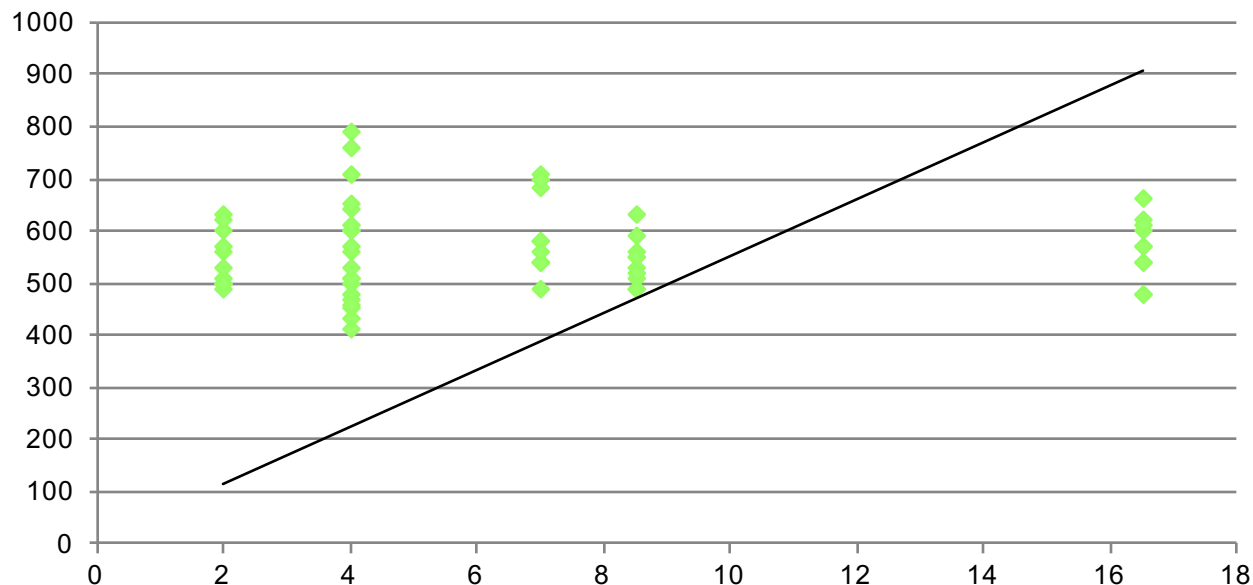
# Chloride



Corr (r)	S.E. of r	P(r=0)	n
Slope (b)	Y Int (a)	S.E. of b	
<b>0.03272730</b>	<b>0.13123609444</b>	<b>.8040 ns</b>	<b>60</b>
0.00200180392	5.87365165851	0.0080272	

**ug g-1  
Grain**

**Cl**



◆ Cl  
— Linear (Cl)

**ug g-1  
Soil**

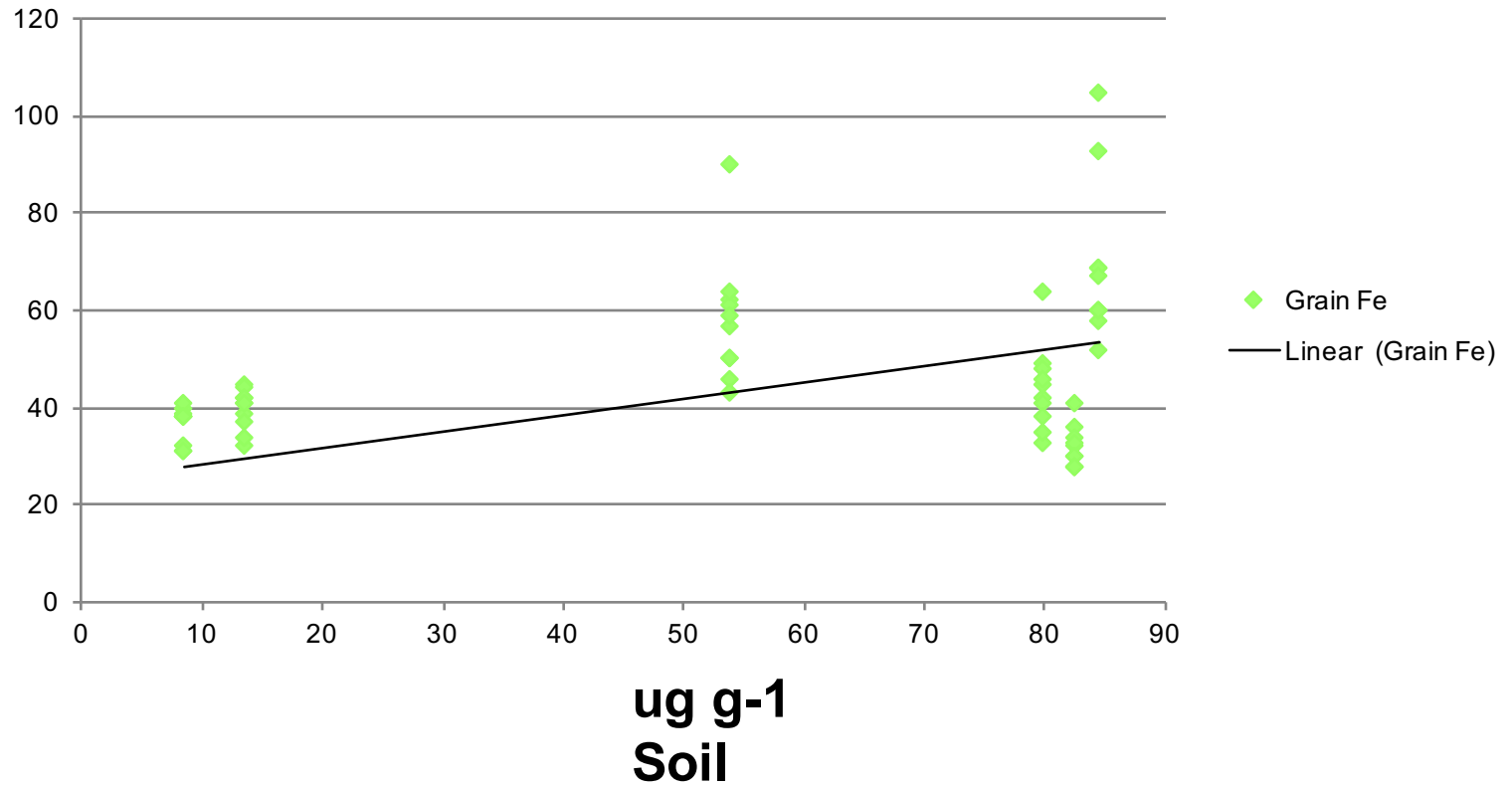
# Iron



Corr (r)	S.E. of r	P(r=0)	n
Slope (b)	Y Int (a)	S.E. of b	
<b>0.30760534</b>	<b>0.12493991369</b>	<b>.0168 *</b>	<b>60</b>
<b>0.61318170472</b>	<b>25.2284068082</b>	<b>0.2490557</b>	

## Grain Fe

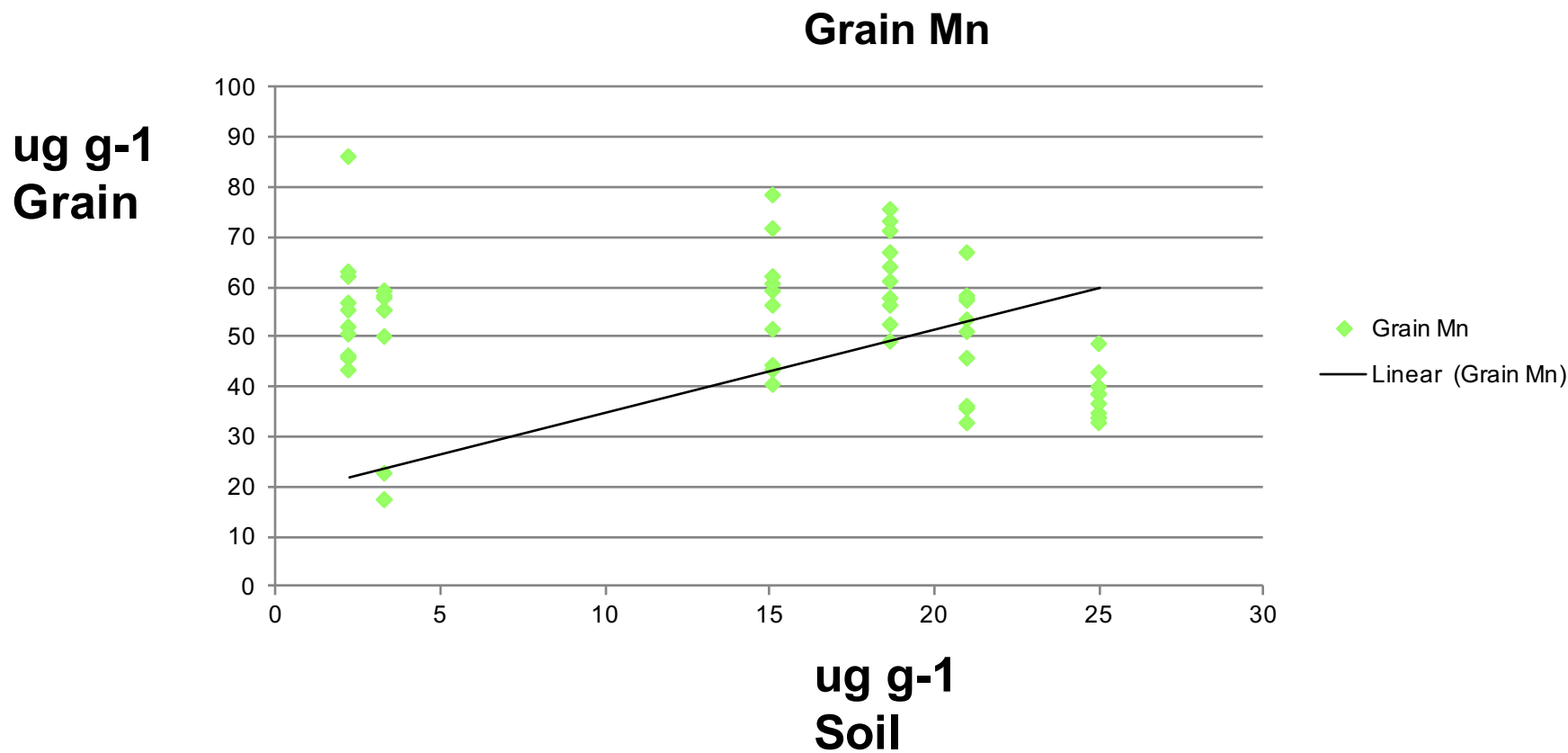
ug g-1  
Grain



# Manganese



Corr (r)	S.E. of r	P(r=0)	n
Slope (b)	Y Int (a)	S.E. of b	
<b>-0.12653437</b>	<b>0.13025102115</b>	<b>.3354 ns</b>	<b>60</b>
<b>-0.0774224001</b>	<b>18.2435764327</b>	<b>0.0796965</b>	



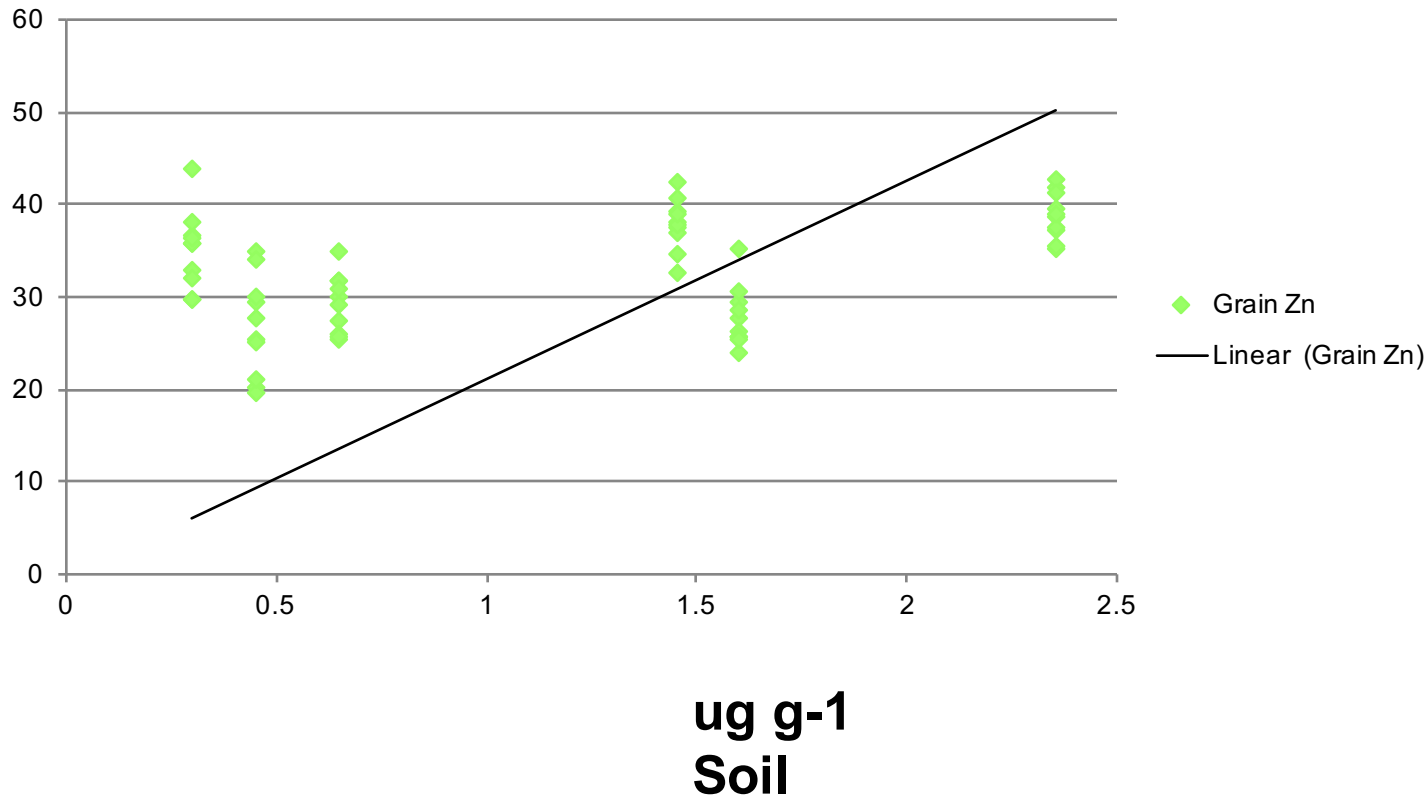
# Zinc



Corr (r)	S.E. of r	P(r=0)	n
Slope (b)	Y Int (a)	S.E. of b	
<b>0.40245070</b>	<b>0.12020337897</b>	<b>.0014 **</b>	<b>60</b>
<b>0.04910873841</b>	<b>-0.4673659952</b>	<b>0.0146677</b>	

## Grain Zn

ug g-1  
Grain





# Summary



- Hypothesis that soil test levels of plant nutrients would be significantly correlated to grain nutrient content is only valid for 3 nutrients out of 9 analyzed.
  - No sig. correlation: N, P, K, S, Cl, and Mn
  - Sig. correlation: B, Fe, and Zn
- Did have differences between sites and wheat genotypes, data being analyzed.
- Consider more research.



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# Questions

