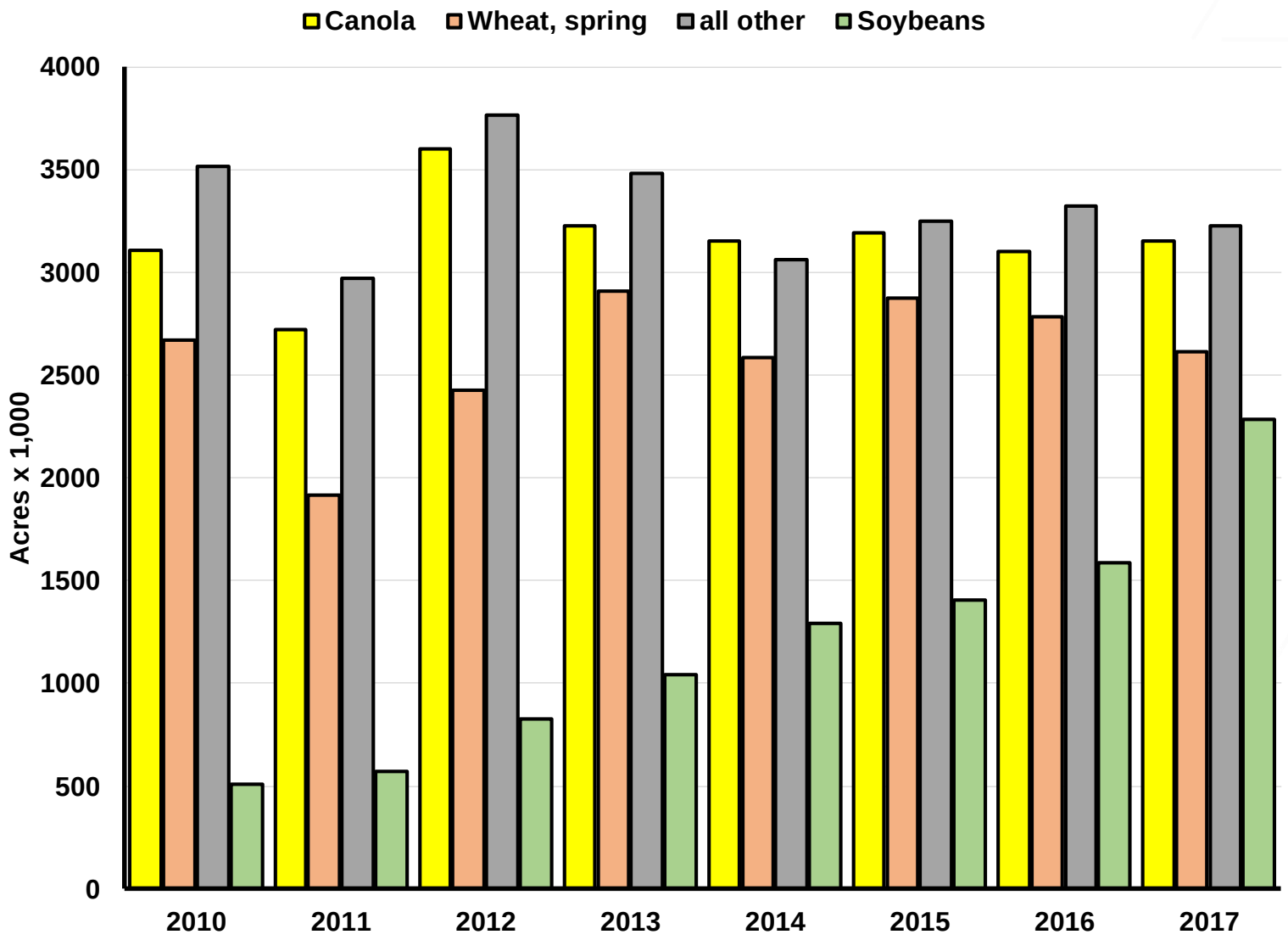
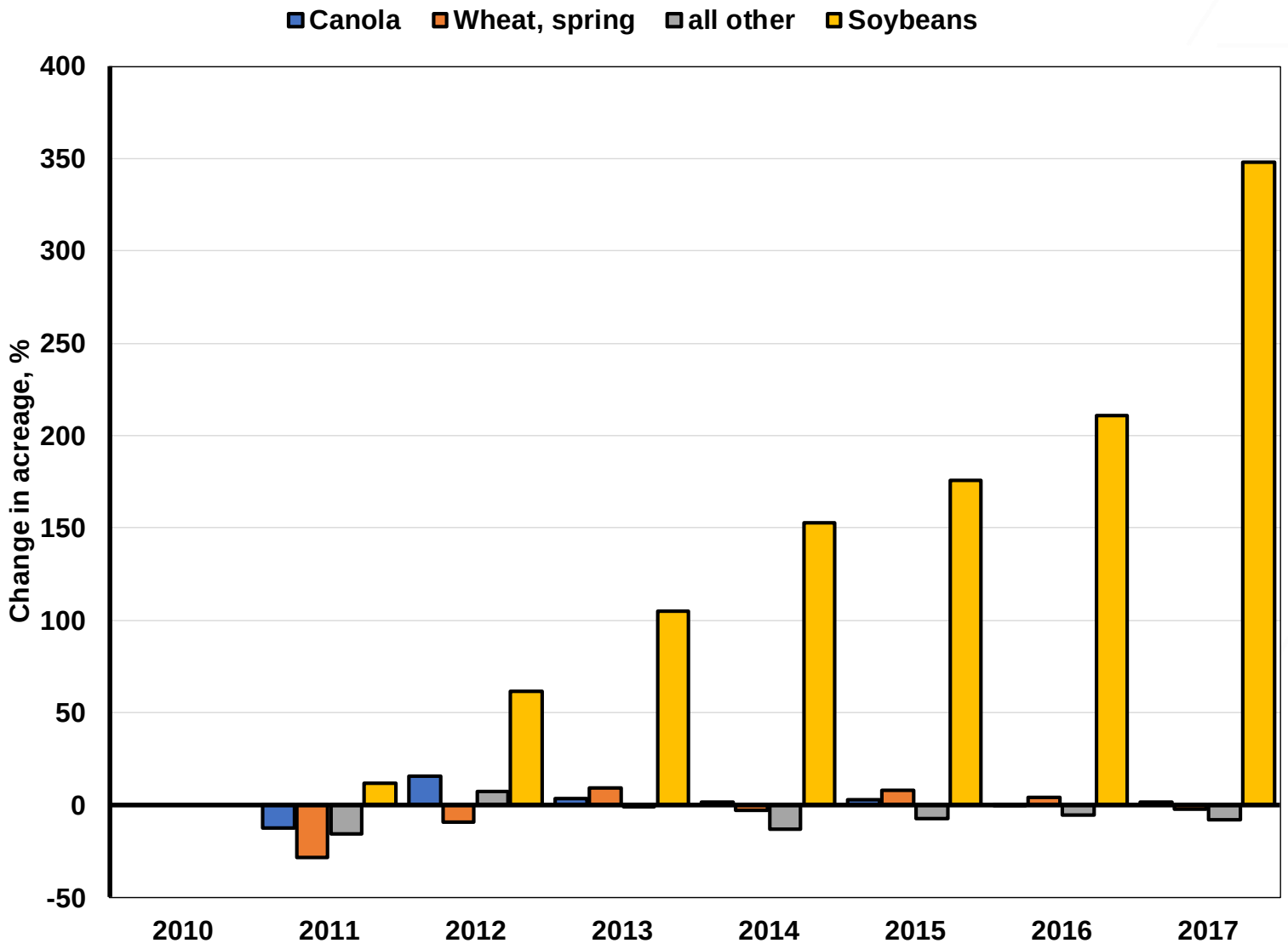
Beyond N and P Eight Years Later
What's Changed?

A major change in Manitoba that may impact nutrients



Source: http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0010017&tabMode=dataTable&p1=-1&p2=9&srchLan=-1

A major change in Manitoba that may impact nutrients



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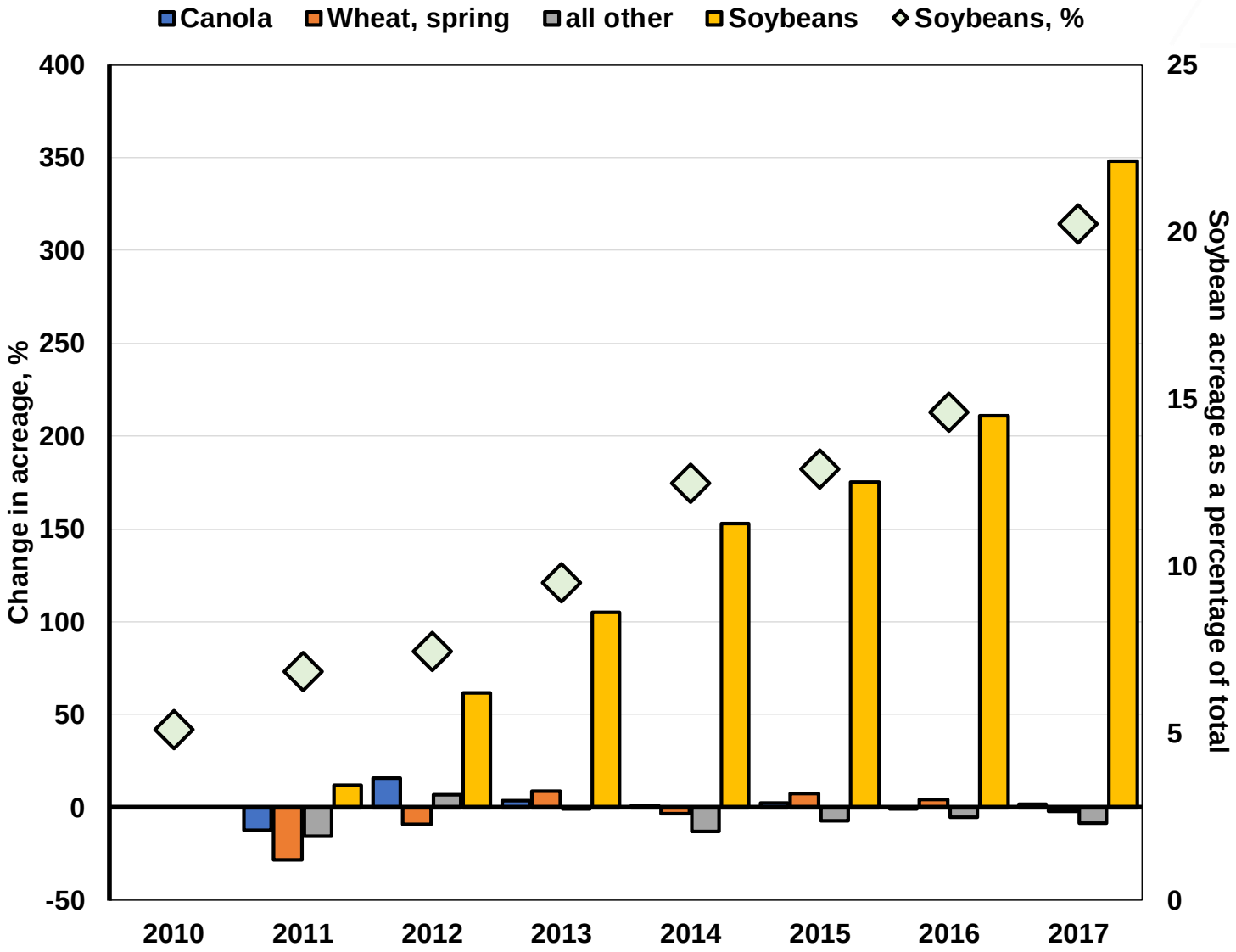
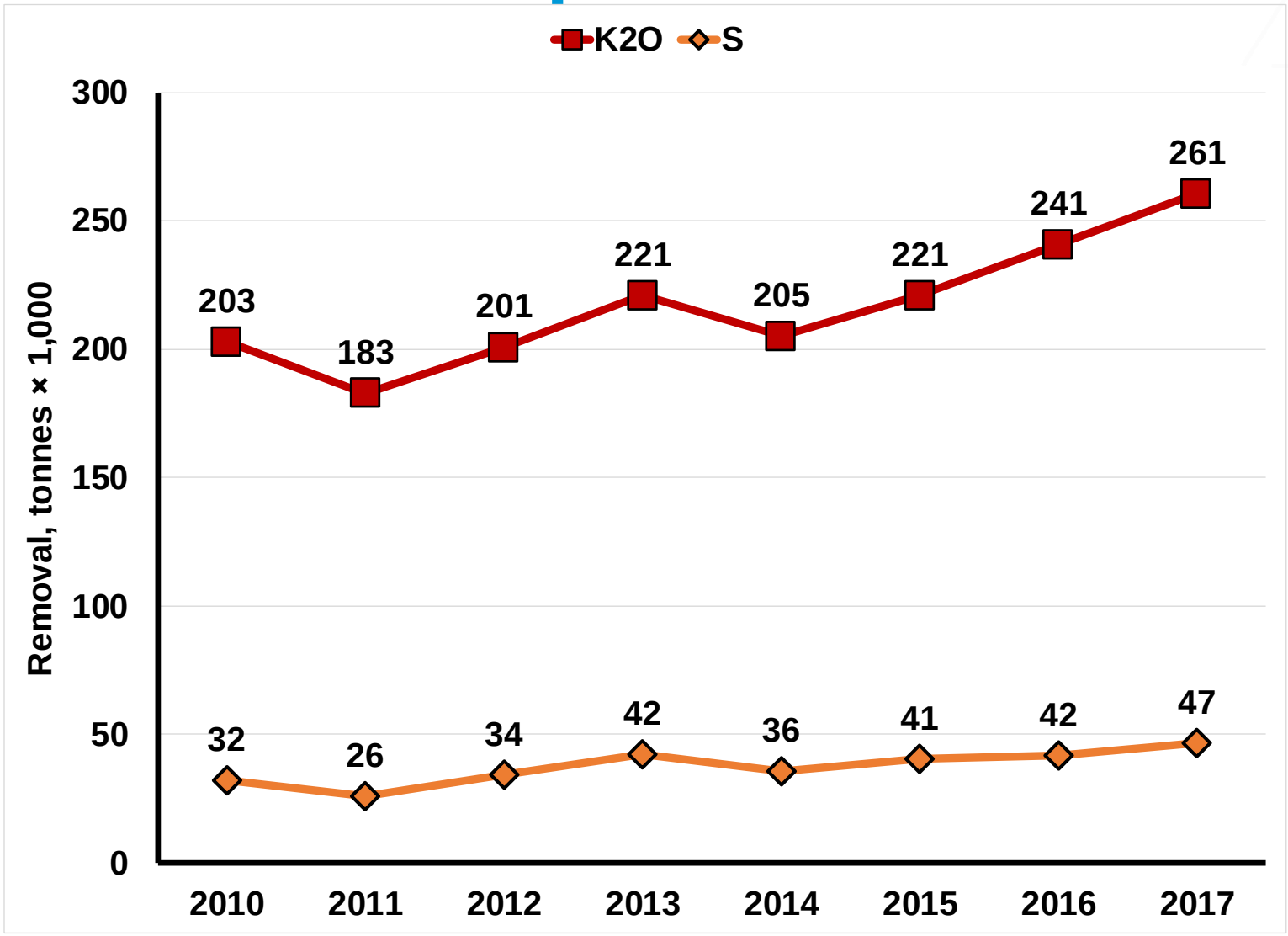
A major change in Manitoba that may impact nutrients



Source: http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0010017&tabMode=dataTable&p1=-1&p2=9&srchLan=-1

Potassium and Sulphur removal in Manitoba



Source for removal values:
http://www.ipni.net/ipniweb/portal.nsf/0/CBDC9962624CDFCD85257AC60050BBD2/$FILE/NAm%204_1%20&%204_5%200115.pdf

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Potassium









Beware of Potassium Recommendations based on the BCSR Concept

- According to the BCSR concept, maximum plant growth will be achieved only when the soil's exchangeable Ca, Mg, and K concentrations are approximately **65% Ca, 10% Mg, and 5% K** (termed the ideal soil).
- Using this system, **will usually mean applying more nutrients than suggested by the sufficiency system -with a low probability of actually getting a higher yield or better crop quality.**
- **We have solid criteria based on research in the area.**

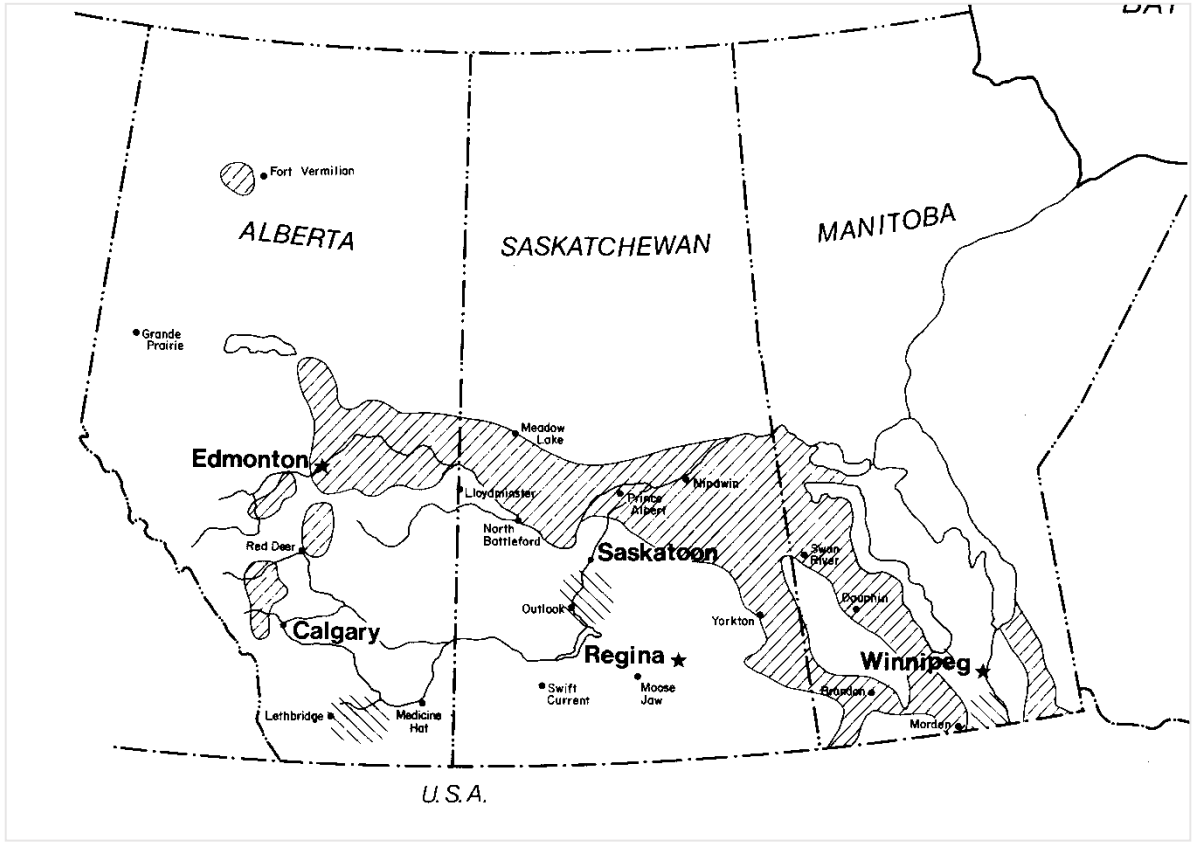
Imbalance between K and Mg in grass tissue can lead to grass tetany in cattle

K in straw is mostly soluble

K Deficient Areas on Canadian Prairies

May be deficient in K

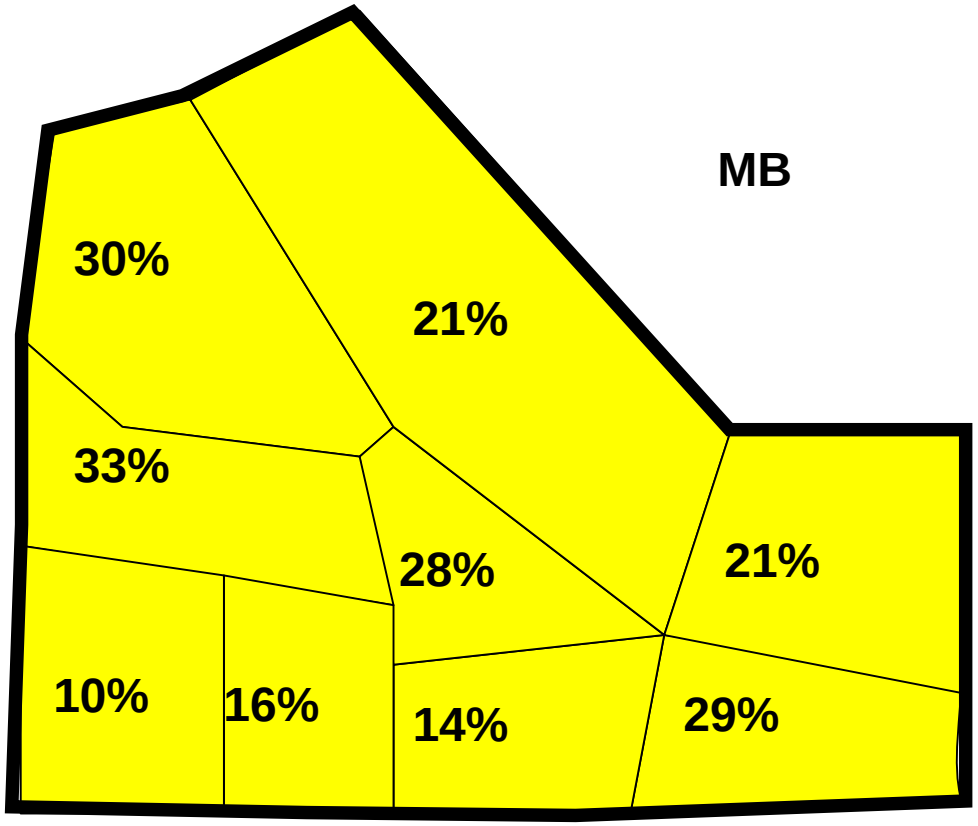
May need K for irrigated crops



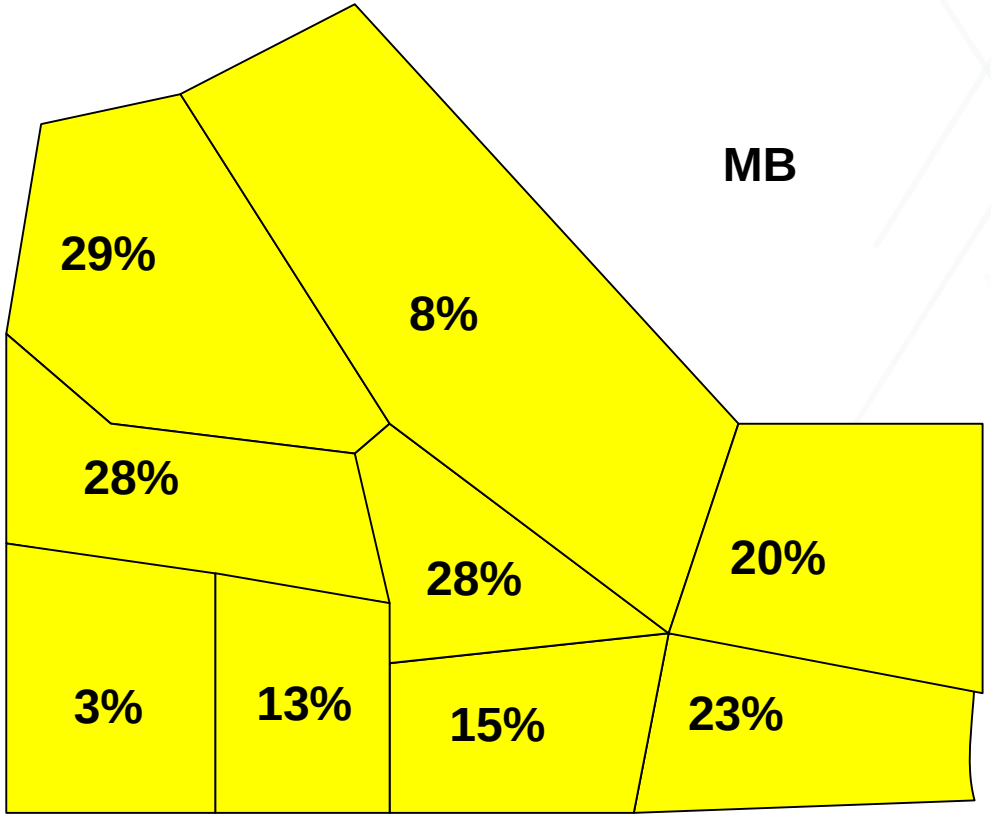
Soil Test Calibration of K in western Canada

Potassium Category (lb K acre)	Average K Response (%)	Number of Sites Responding (%)
less than 50	1000	100
51-100	240	75
101-150	50	66
151-200	30	24
201-250	30	18
more than 250	10	3

% Soil Samples with Potassium less than 150 ppm

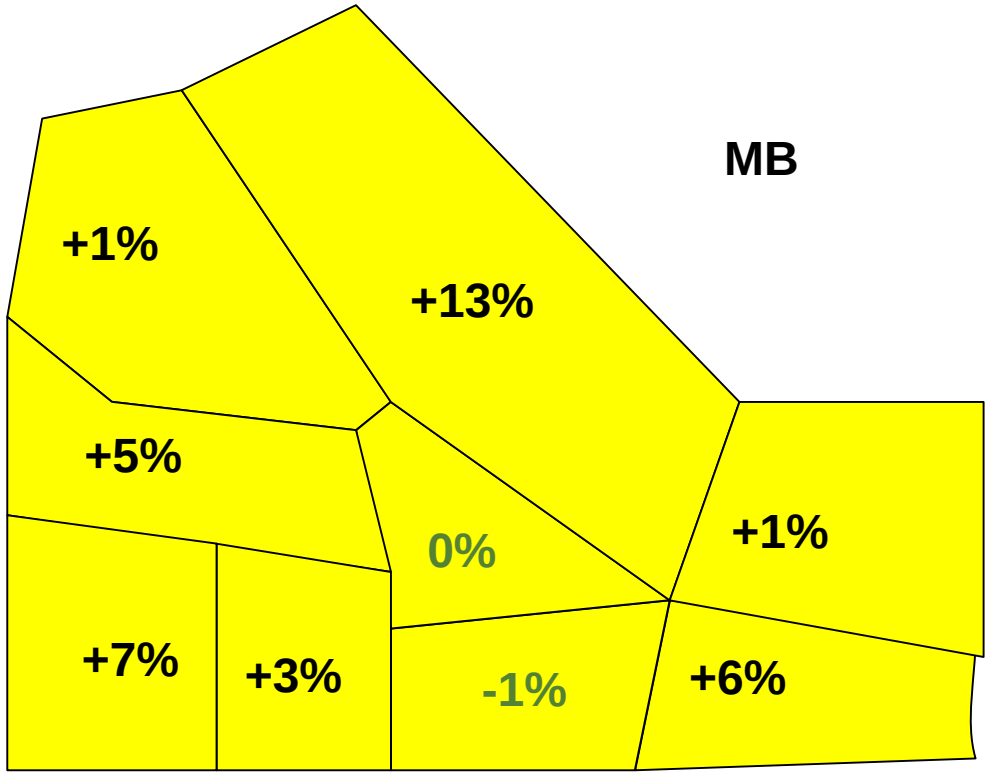


Fall 2017 samples
(0-6” samples)



Fall 2011 samples
(0-6” samples)

% Soil Samples with Potassium less than 150 ppm



Change in the last 8 years

(0-6” samples)

It takes about 8 to 16 pounds of K_2O above crop removal to raise soil test potassium one part per million.

Source: https://www.ipni.net/ppiweb/agbrief.nsf/$webindex/article=47A7A85E852569670056EC4A3057B332

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Sulphur

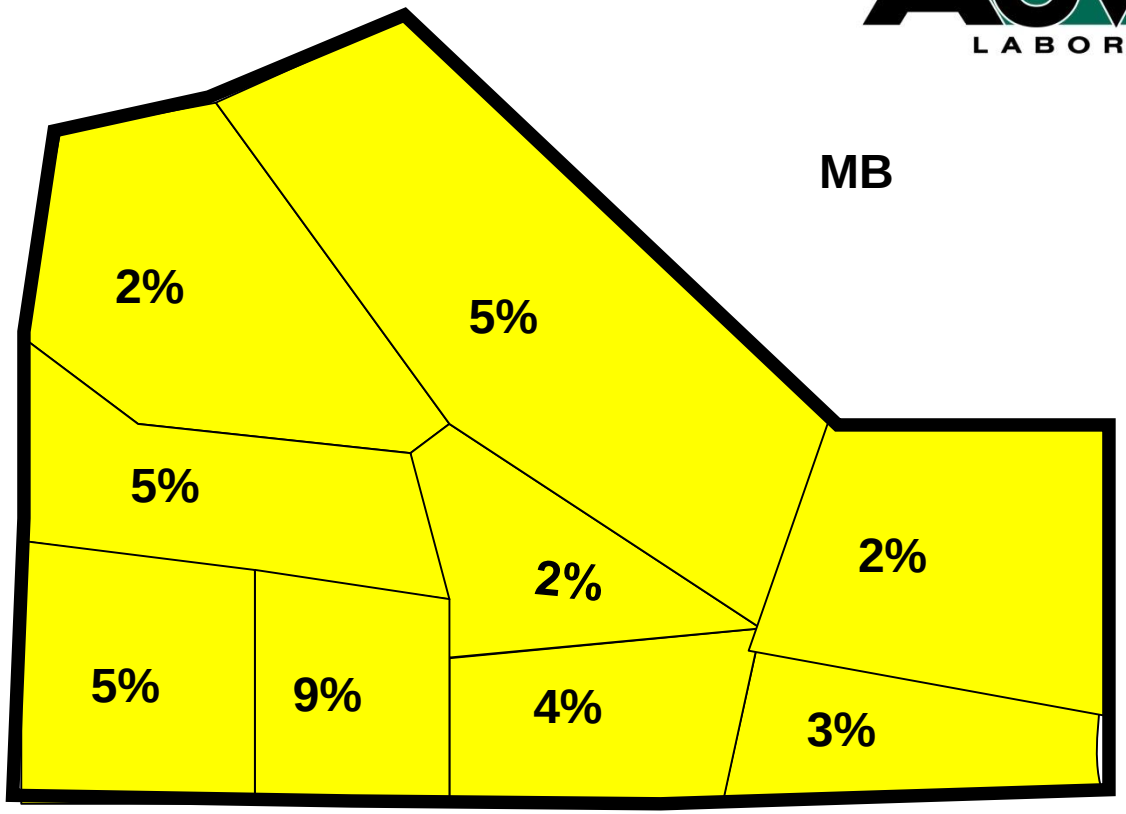




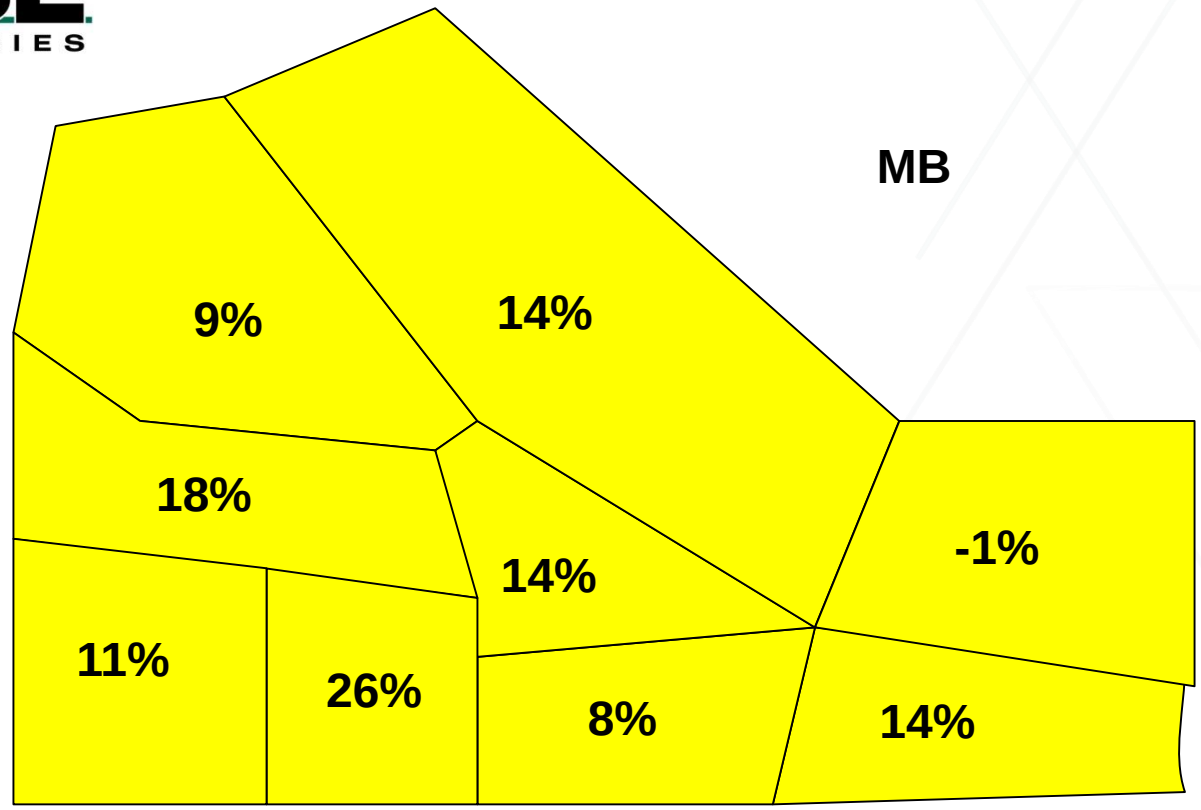




% Soil Samples with Sulphur less than 15 lb/a



Fall 2017 samples
(0-6” samples)



Fall 2011 samples
(0-6” samples)

% Soil Samples with Sulphur less than 15 lb/a

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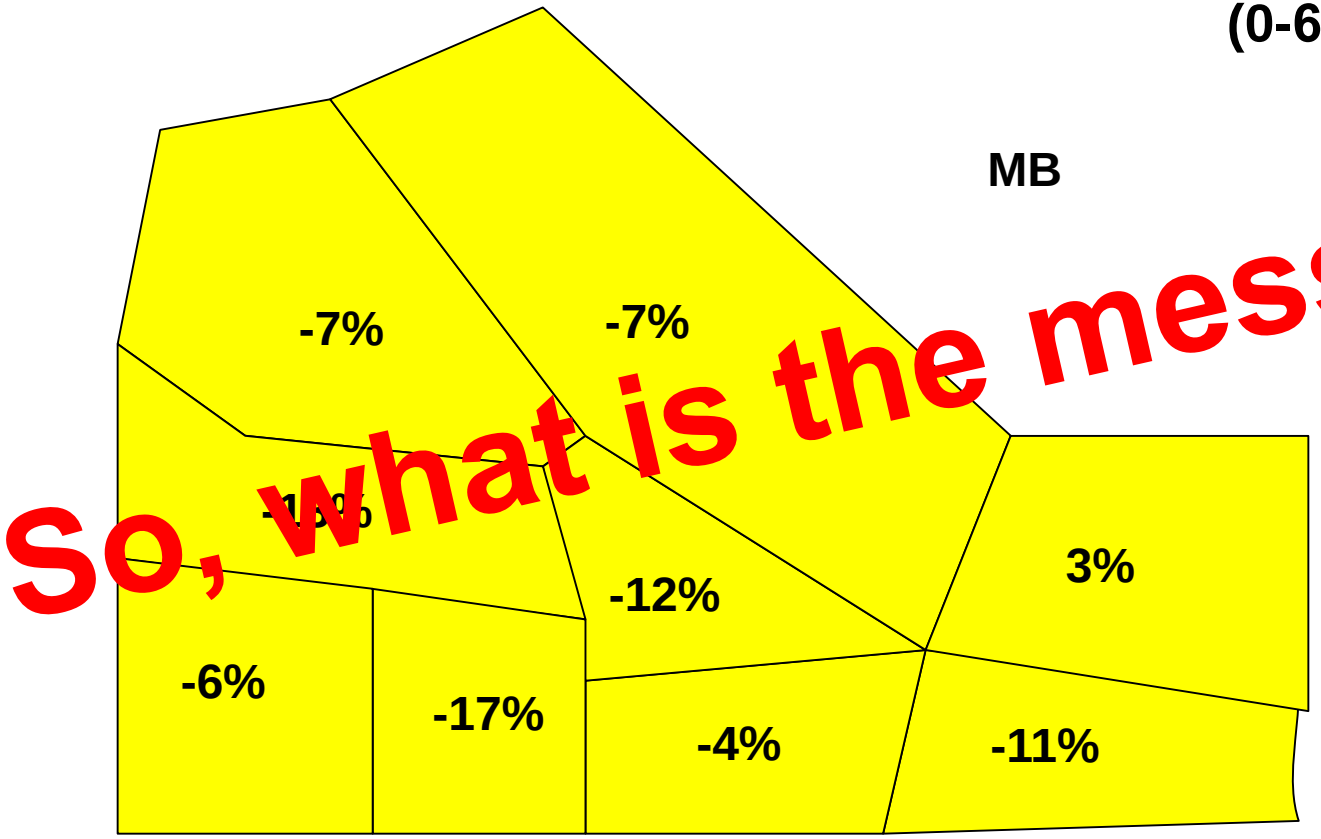
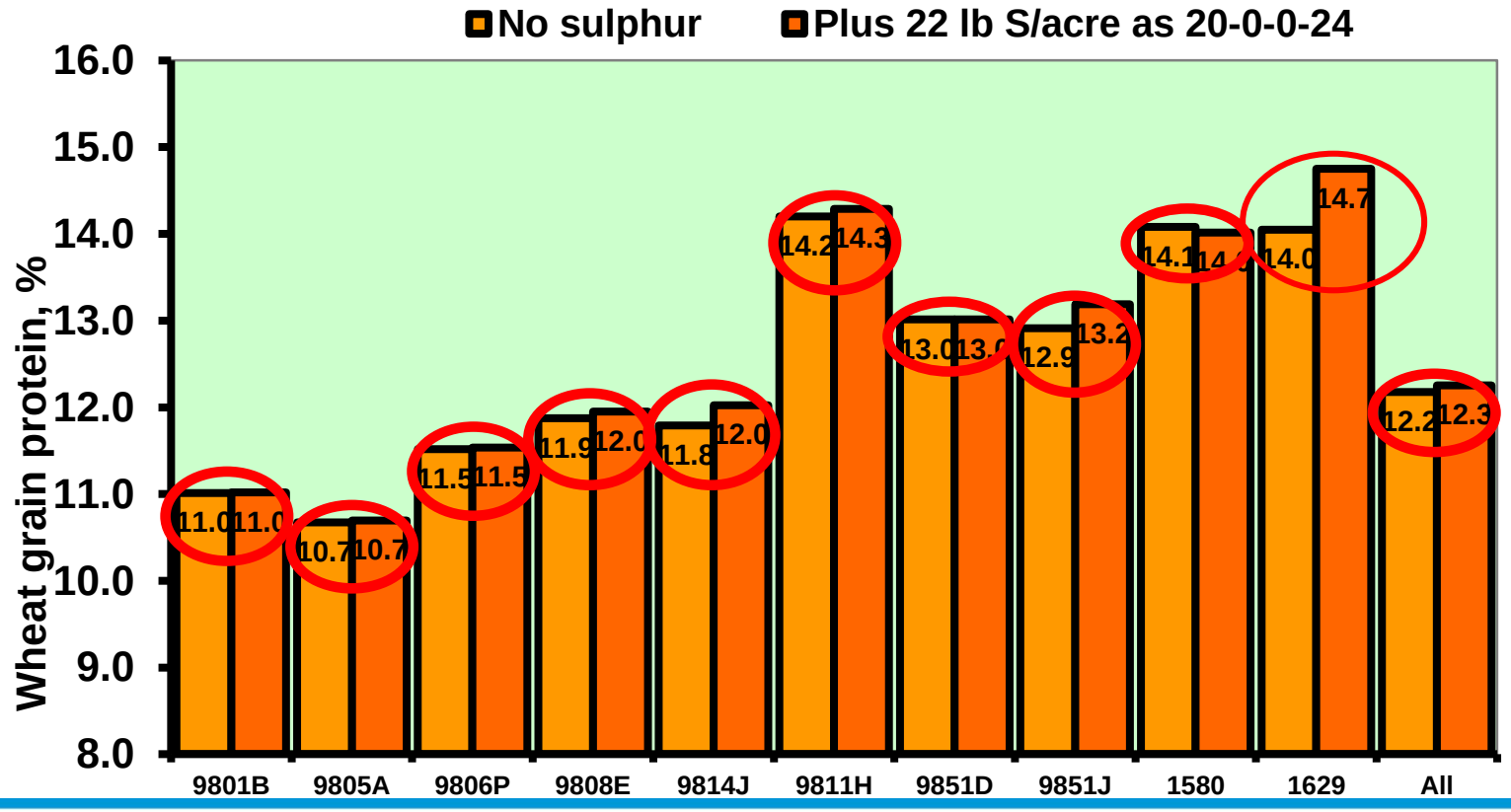
Change in the last 8 years
(0-6” samples)



So, what is the message?

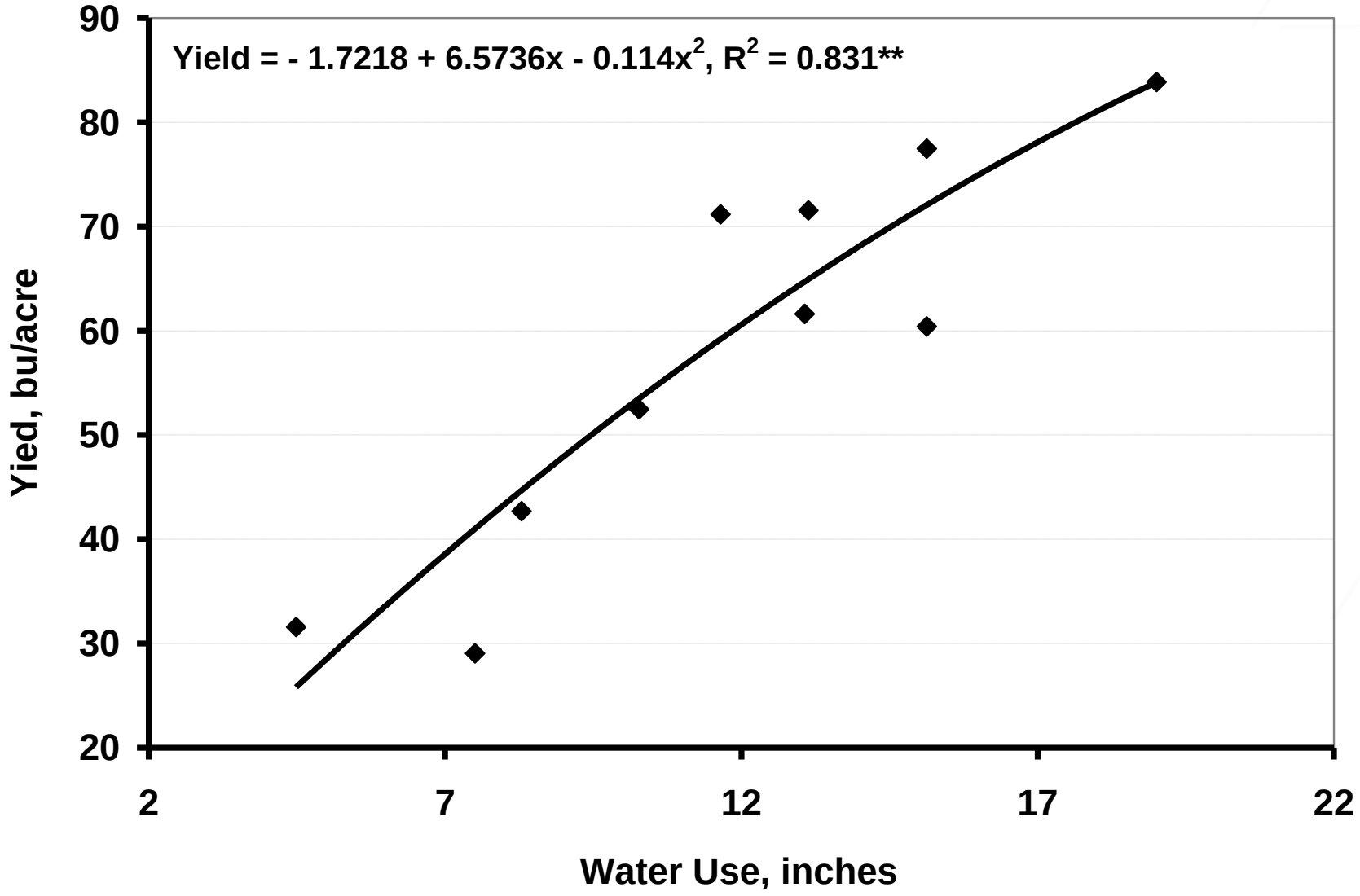
Sulphur Fertilization and Wheat Quality

- **Bread-making wheat requires protein quantity & quality**
- **Protein premiums for wheat reflect the importance of protein in crop quality … <u>but only protein N is measured</u>**
- **As currently measured, S has little effect on % protein**

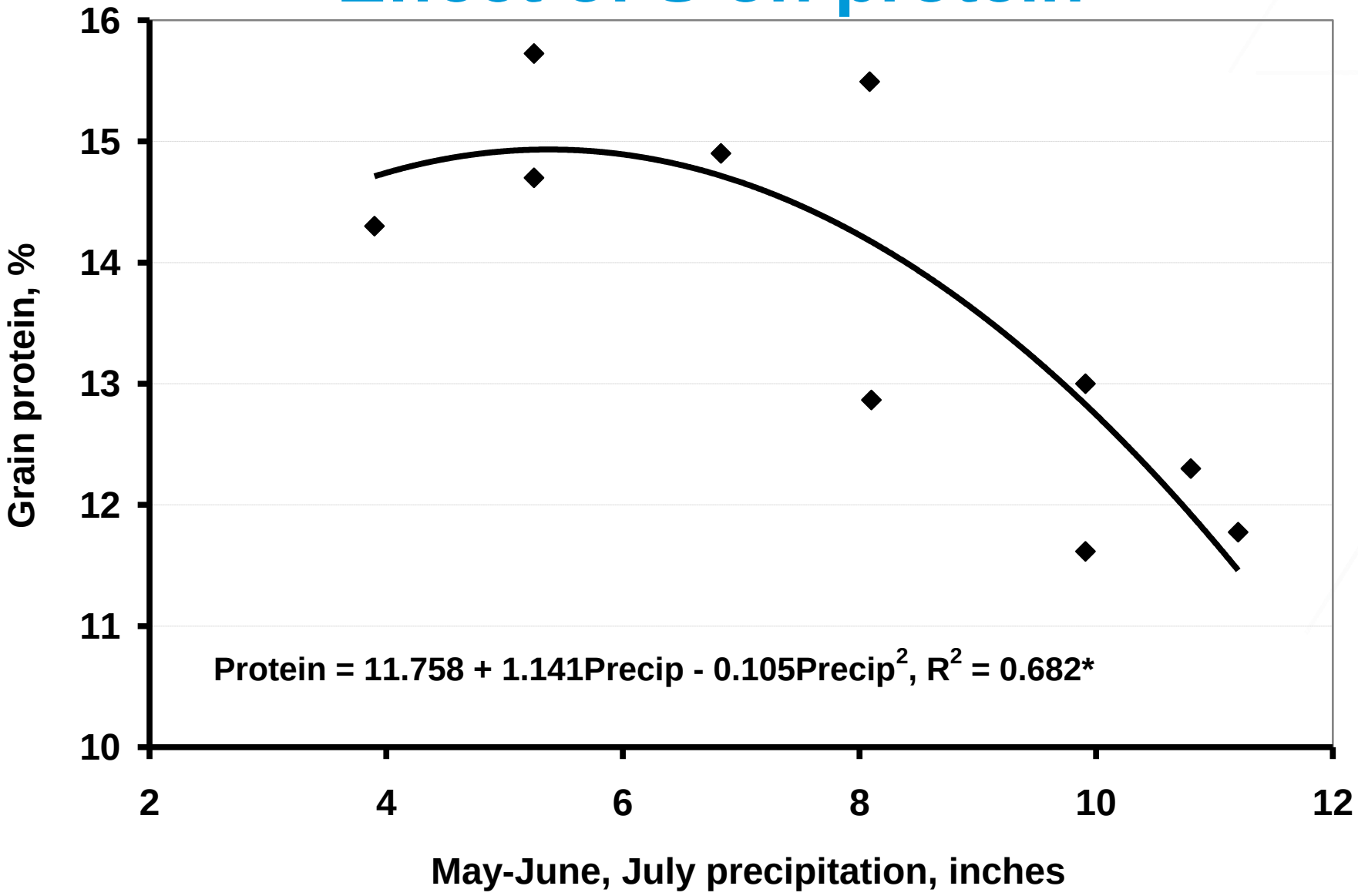


Source: Karamanos et al. 2013 Can. J. Soil Sci., 93, 223-228.

Effect of S on wheat yield



Effect of S on protein



N is a Major Constituent of Protein

- **Remember producers get paid based on:**

  %N × 5.7

Conclusion

- **Deliberate and indiscriminate application of S to increase protein in CWRS and Durum wheat grain is not a recommended practice, unless S deficiency is corrected in which case an indirect benefit of increased grain protein might ensue.**

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Zinc



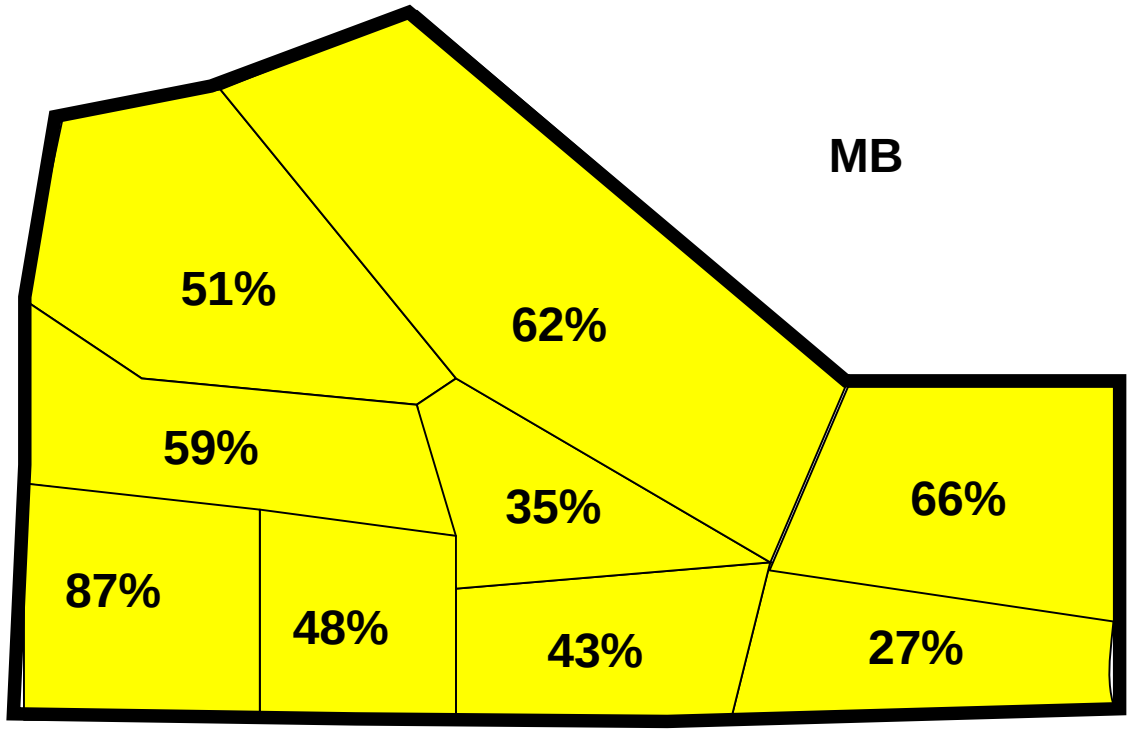




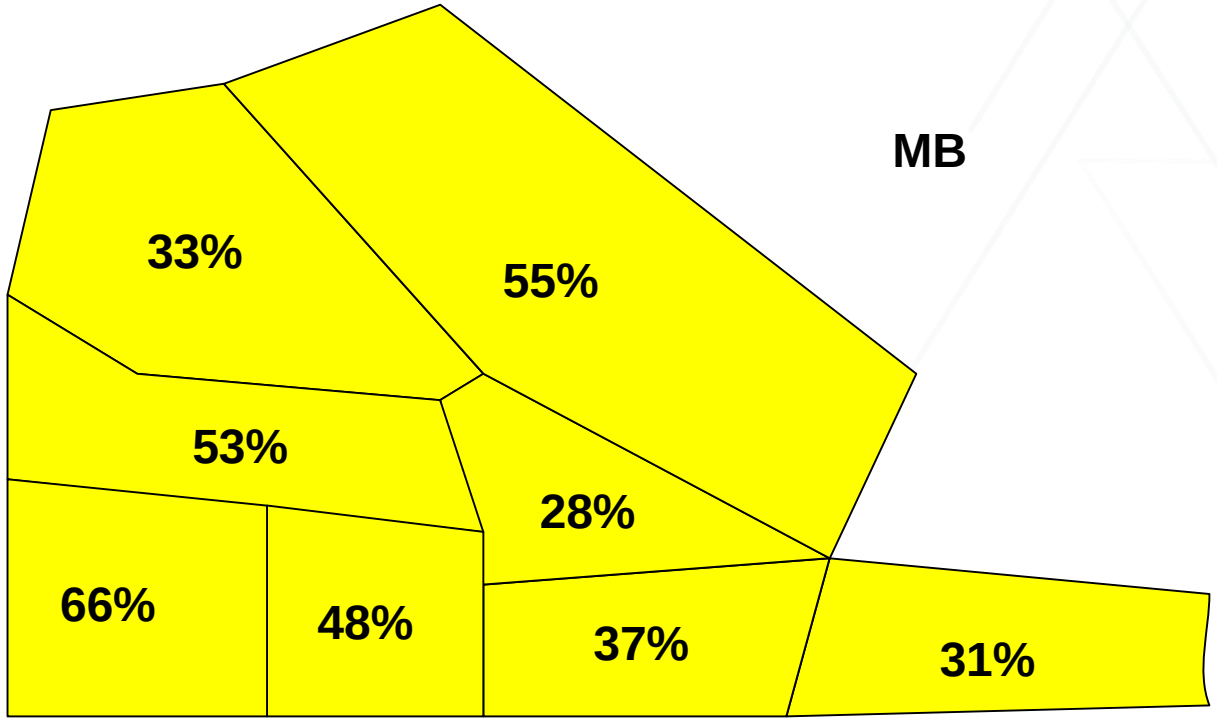


Zinc remains a corn issue

% Soil Samples with Zinc less than 1.0 ppm



Fall 2017 samples
(0-6” samples)



Fall 2011 samples
(0-6” samples)

% Soil Samples with Zinc less than 1.0 ppm

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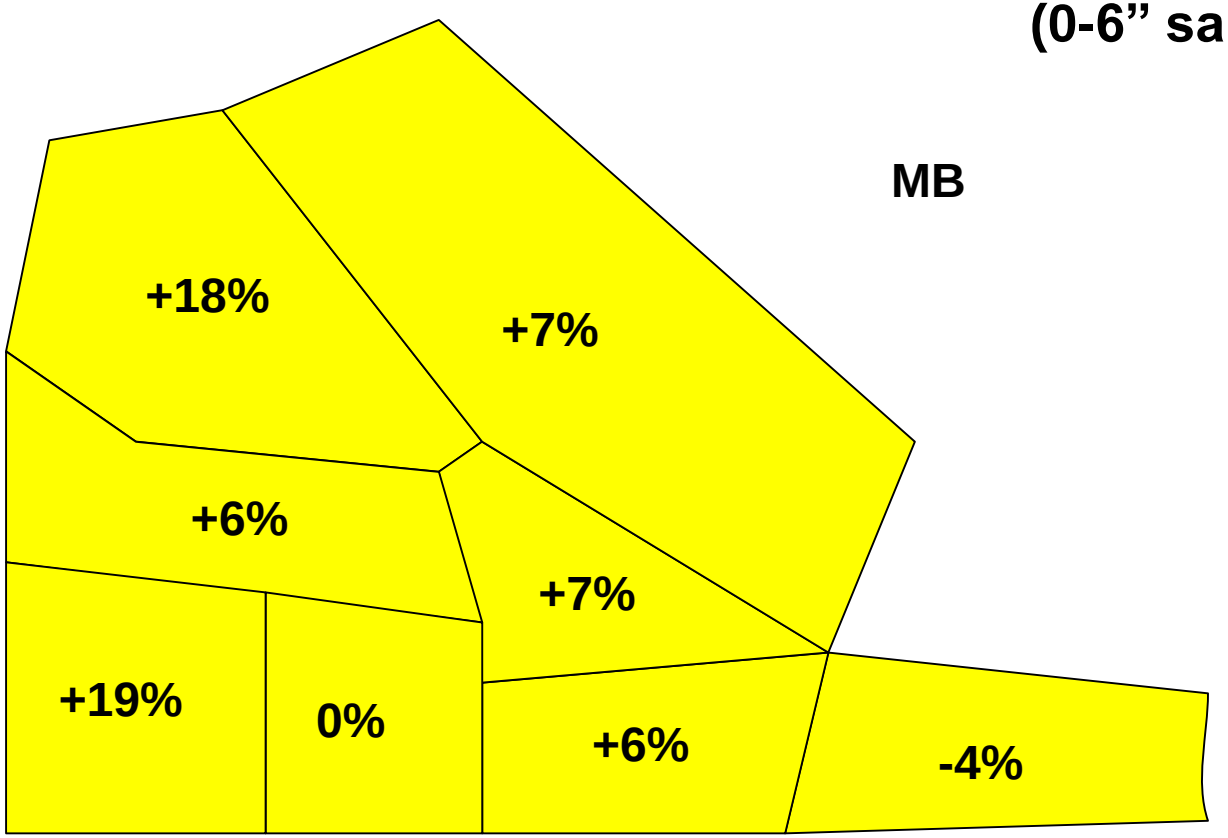
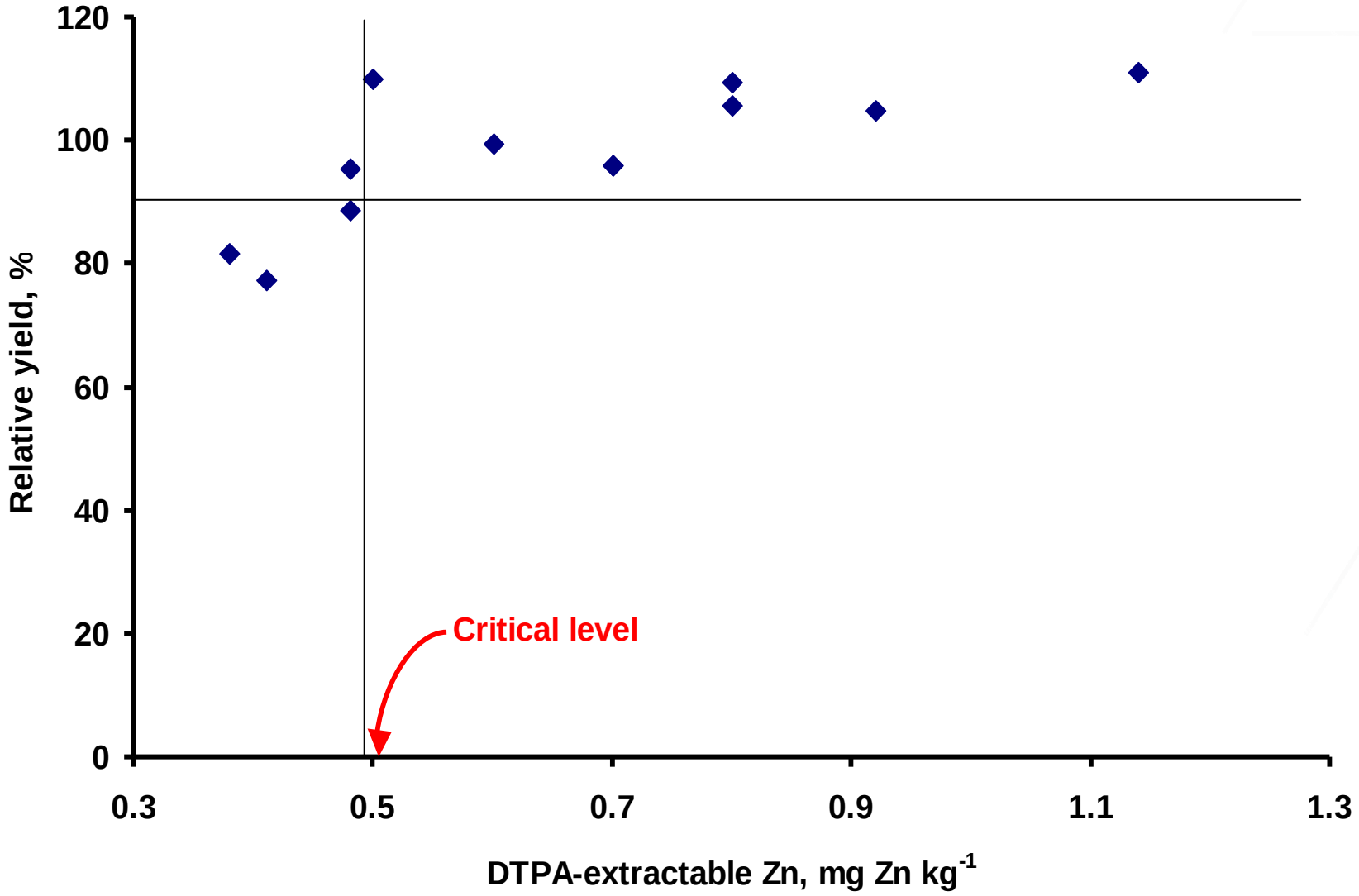
Change in the last 8 years
(0-6” samples)



Zinc Identification

- **Extensive database**
- **NO RESPONSES with cereals and oilseeds**
- **Responses with corn and beans**
- **Low incidence of responses with soybeans**

Soil test critical level for beans



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Boron









Boron

- So, what's up with boron?
- B deficiency? Seen it twice!

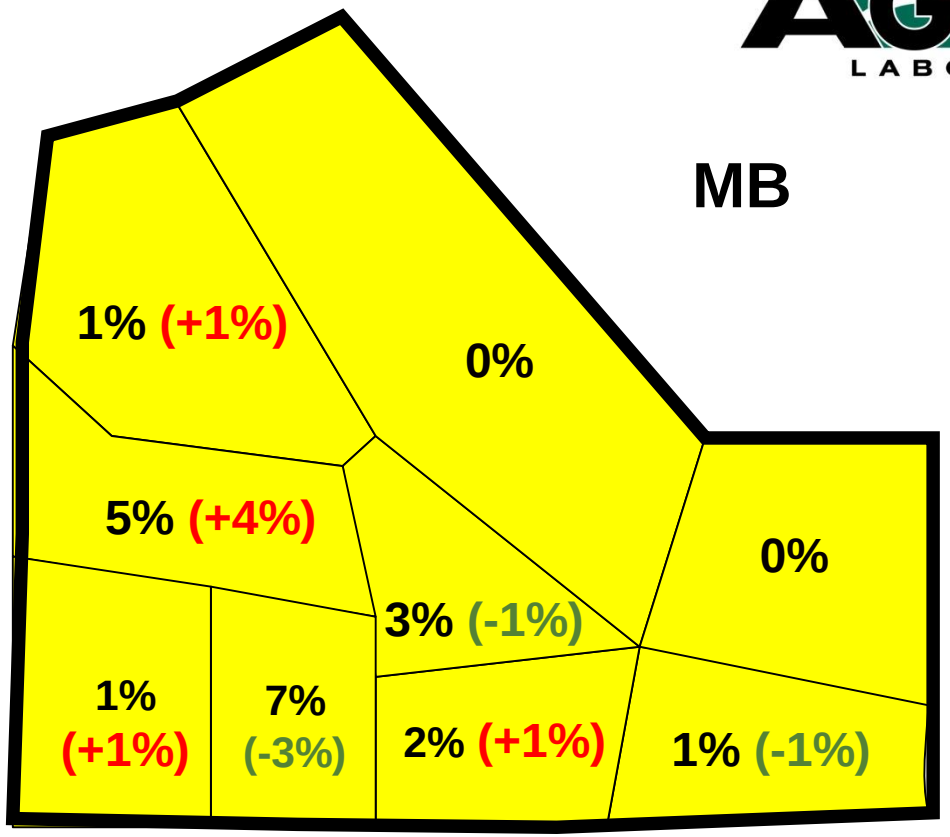
Boron Deficient Canola, bolting and leaves

Boron Deficient Canola, podding

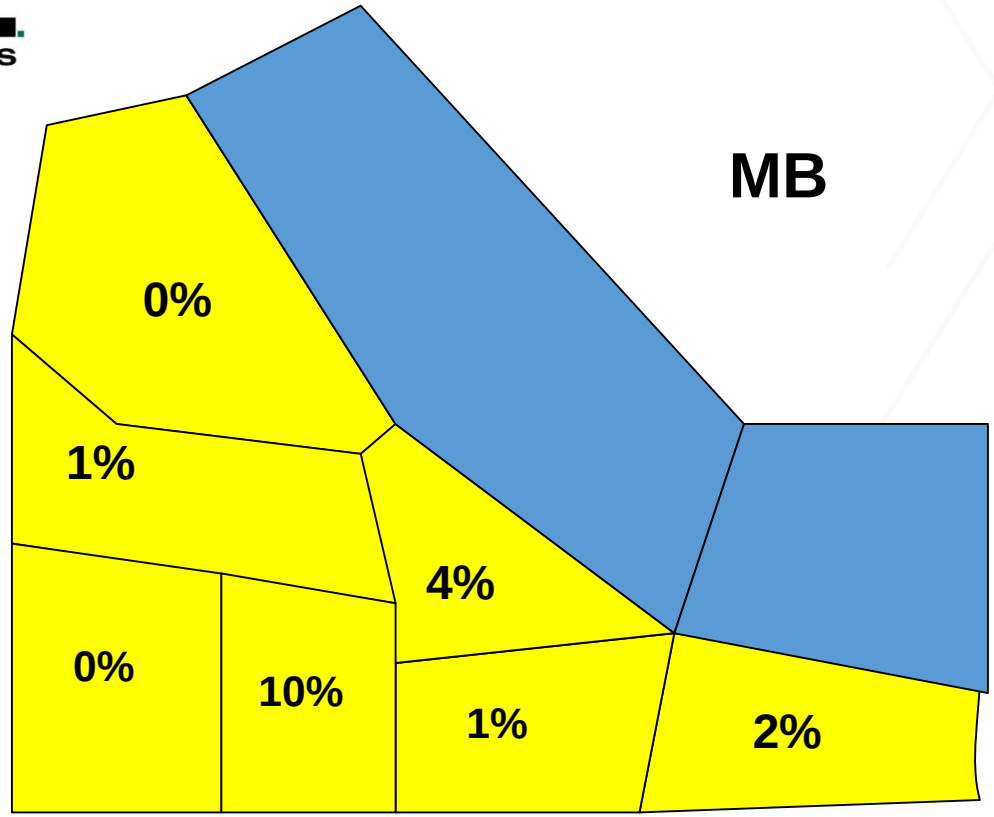
Boron Deficient Canola

Does not ‘hold’ flowers, unlike S Deficiency

% Soil Samples with Boron less than 0.4 ppm

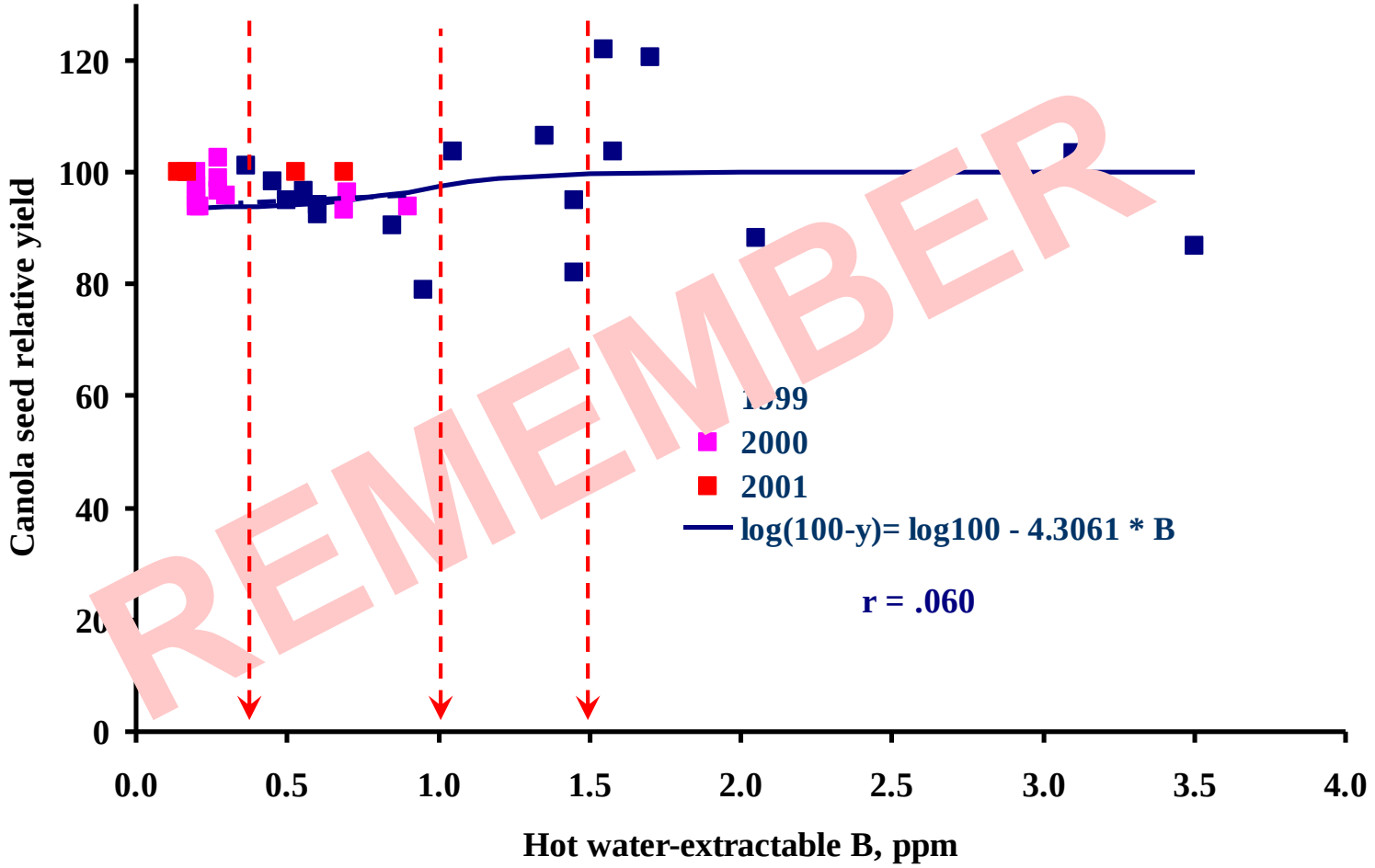


Fall 2017 samples
(0-6” samples)



Fall 2011 samples
(0-6” samples)

Interpretation of Soil Tests
w. Canada 40 sites; yield 18-63 bu/ac



Emphasis on the wrong crop!

- **Boron in alfalfa**

Boron in alfalfa

Boron deficiency in alfalfa. Contained 6 mg/kg boron (critical concentration is 25 mg/kg).

Boron for alfalfa

- **0.8 lb B/ac removed with 4t/ac**

Deficient soils

- **high pH**
- **sandy texture**
- **low organic matter**
- **“DRY WEATHER DISEASE”**

Boron for alfalfa

Visual signs

- **stunted regrowth**
- **yellow-purplish tips**
- **reduced flowering**

Tissue test < 20 ppm B

Soil test <0.35 ppm

Apply

- **1-2 lb B/ac to soil or 0.2-0.5 lb B/ac foliar**

The “other side” of Boron application

The “other side” of Boron application

The “other side” of Boron application

Boron for canola

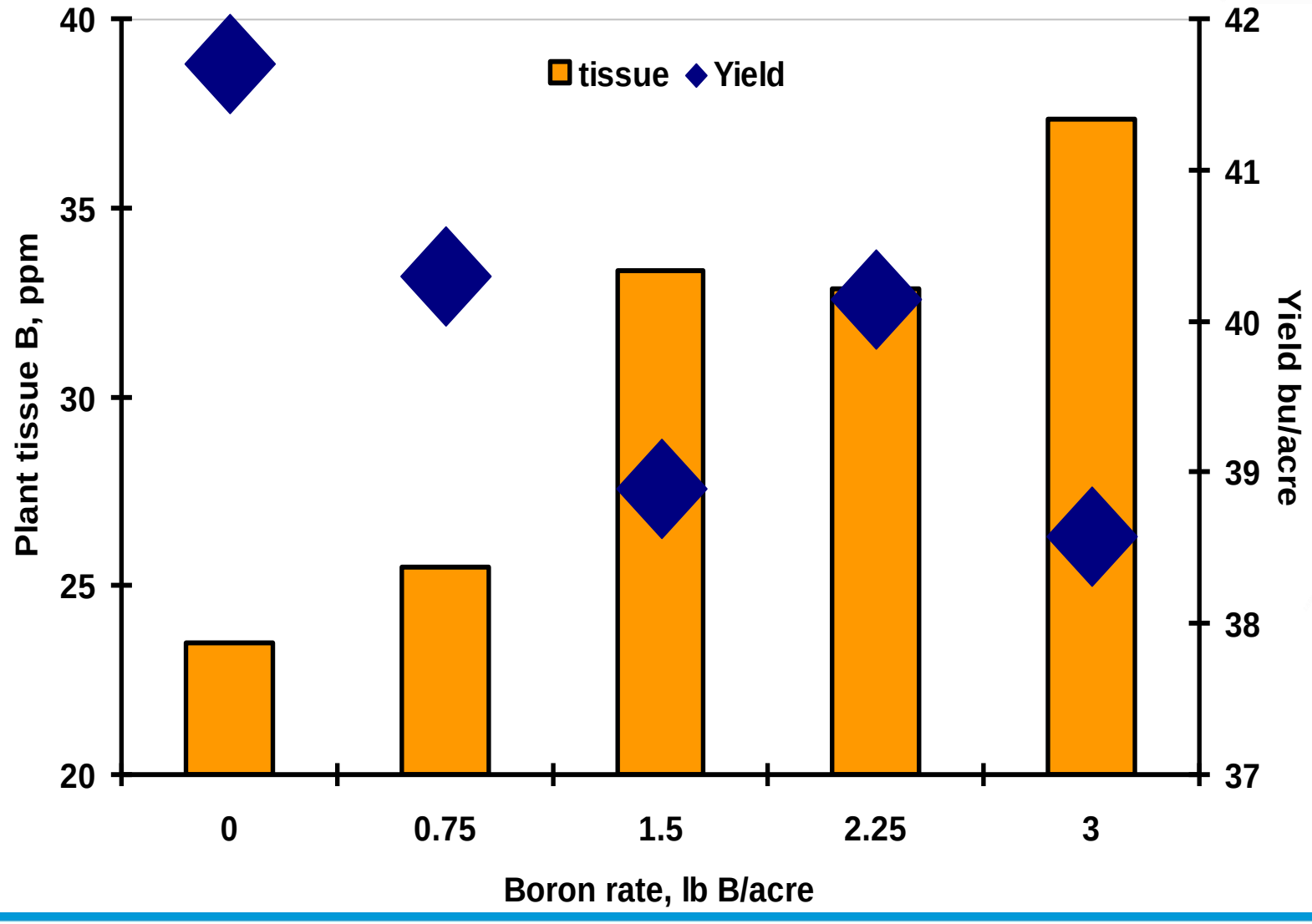
B in soils

- **released as OM decomposes**
- warm, moist soils
- very mobile - leached on sands, high rainfall

Deficient in dry weather

- slow OM breakdown
- restricted surface root growth

Tissue B and yield



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Copper

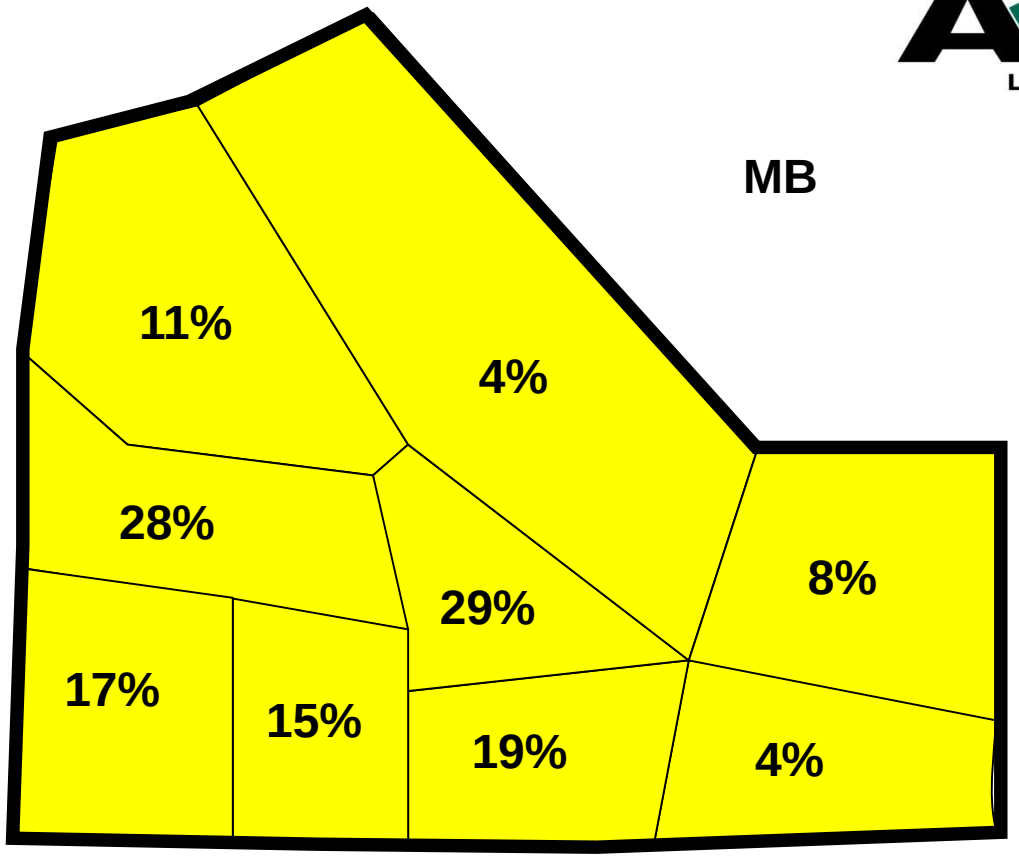




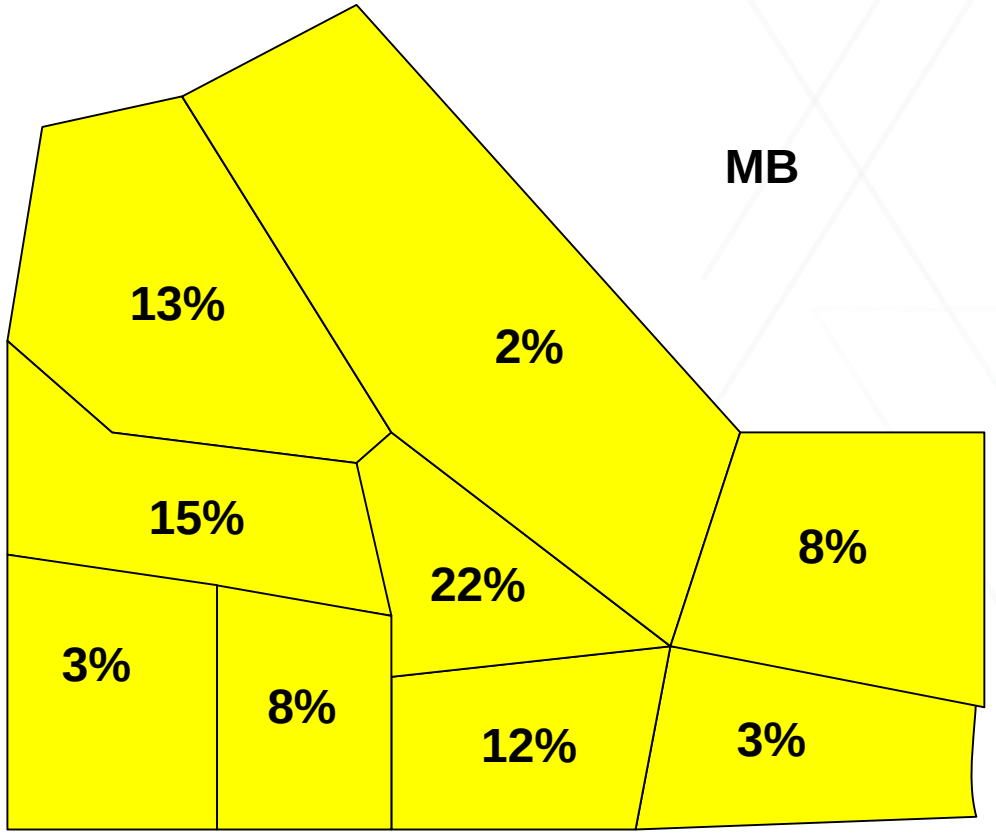




% Soil Samples with Copper less than 0.5 ppm



Fall 2017 samples
(0-6” samples)



Fall 2011 samples
(0-6” samples)

% Soil Samples with Copper less than 0.5 ppm

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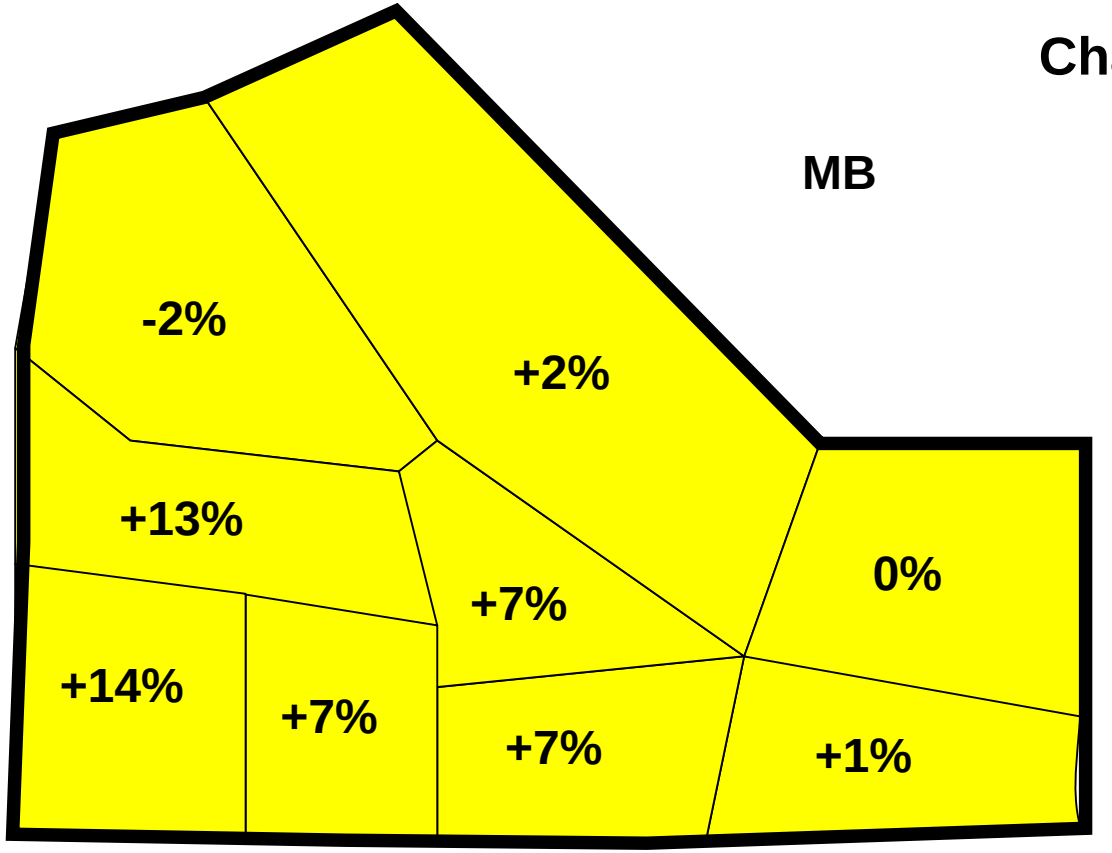
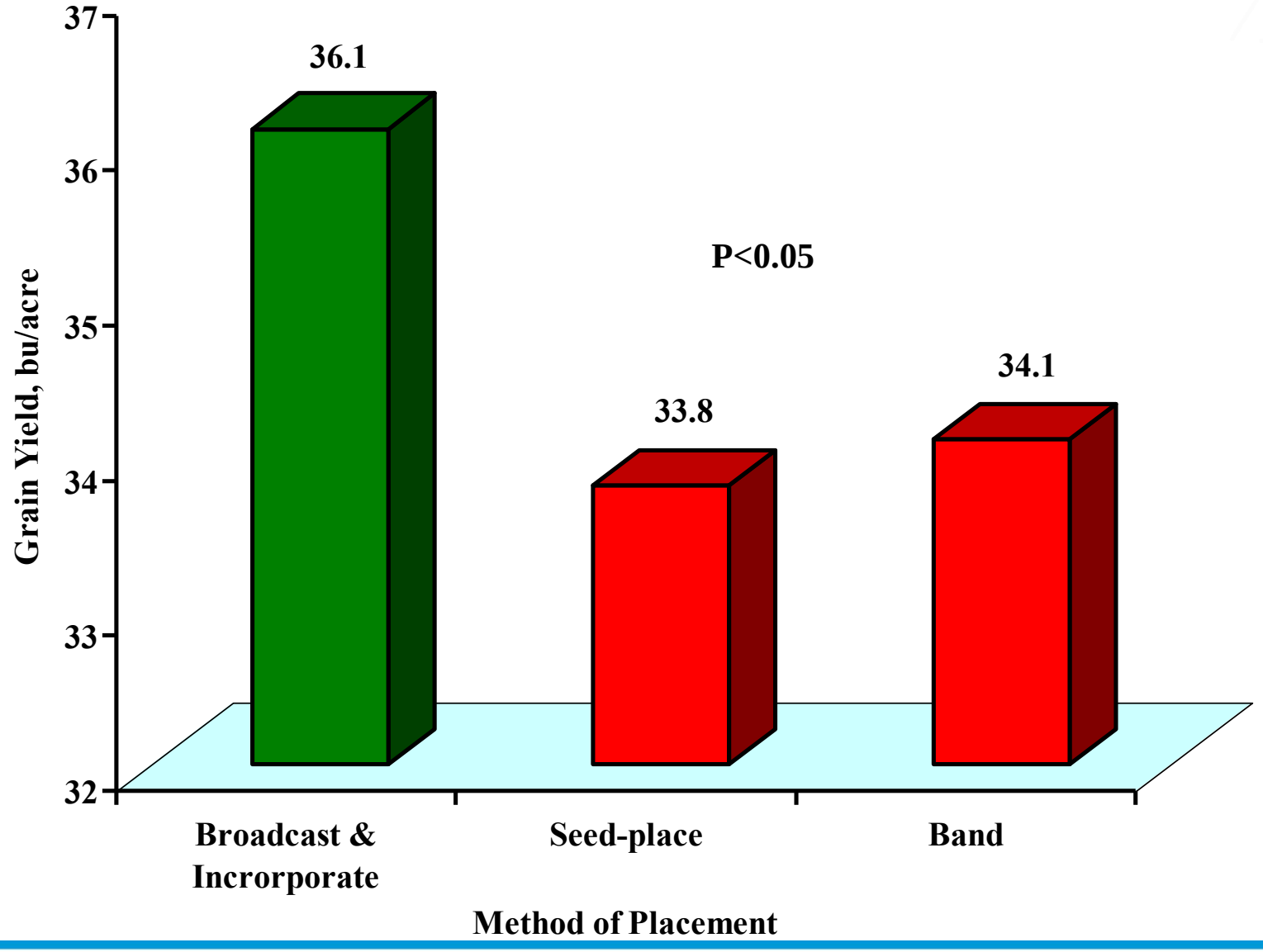


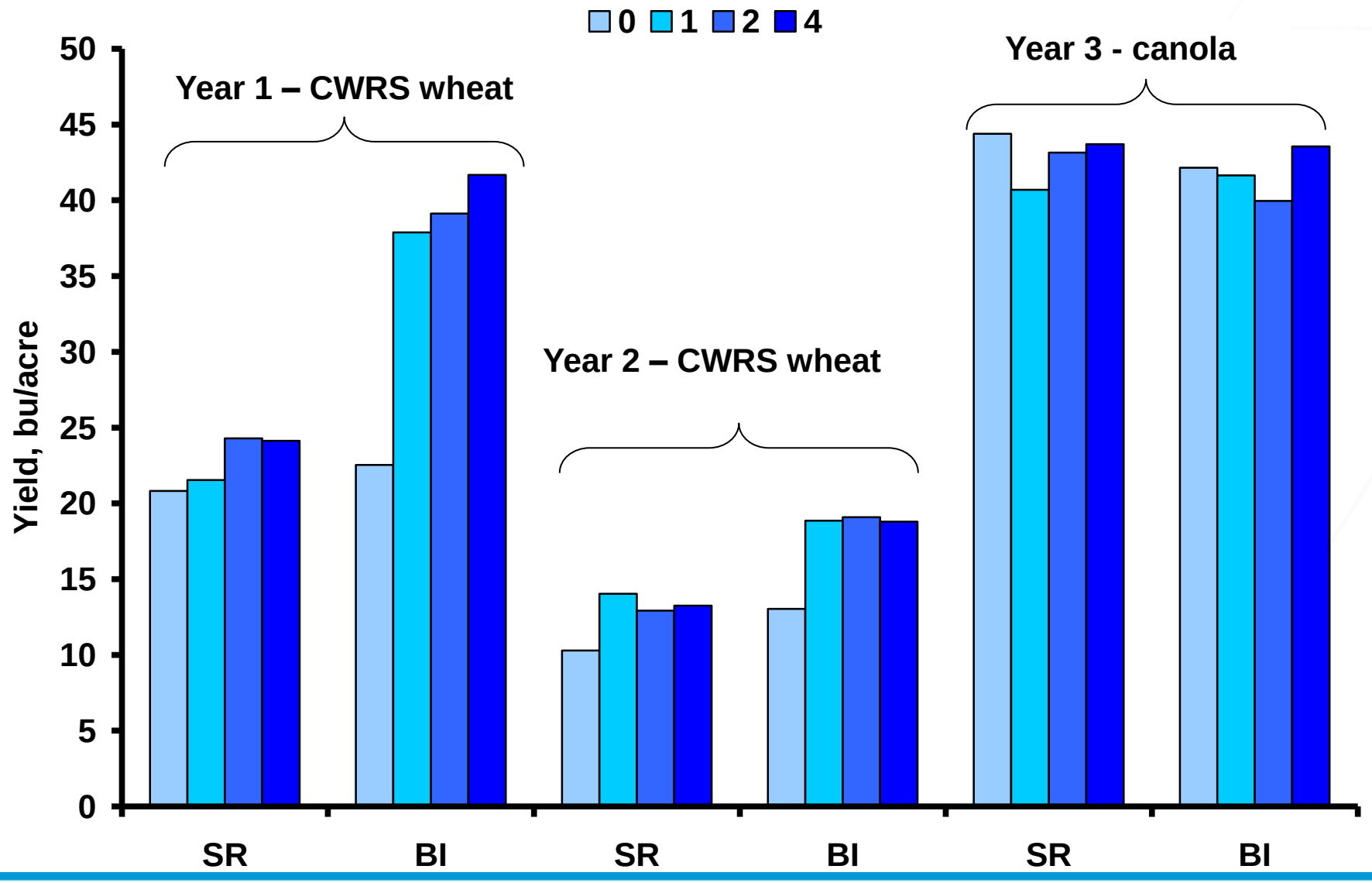
Change in the last 8 years
(0-6” samples)

Fall 2017 samples
(0-6” samples)

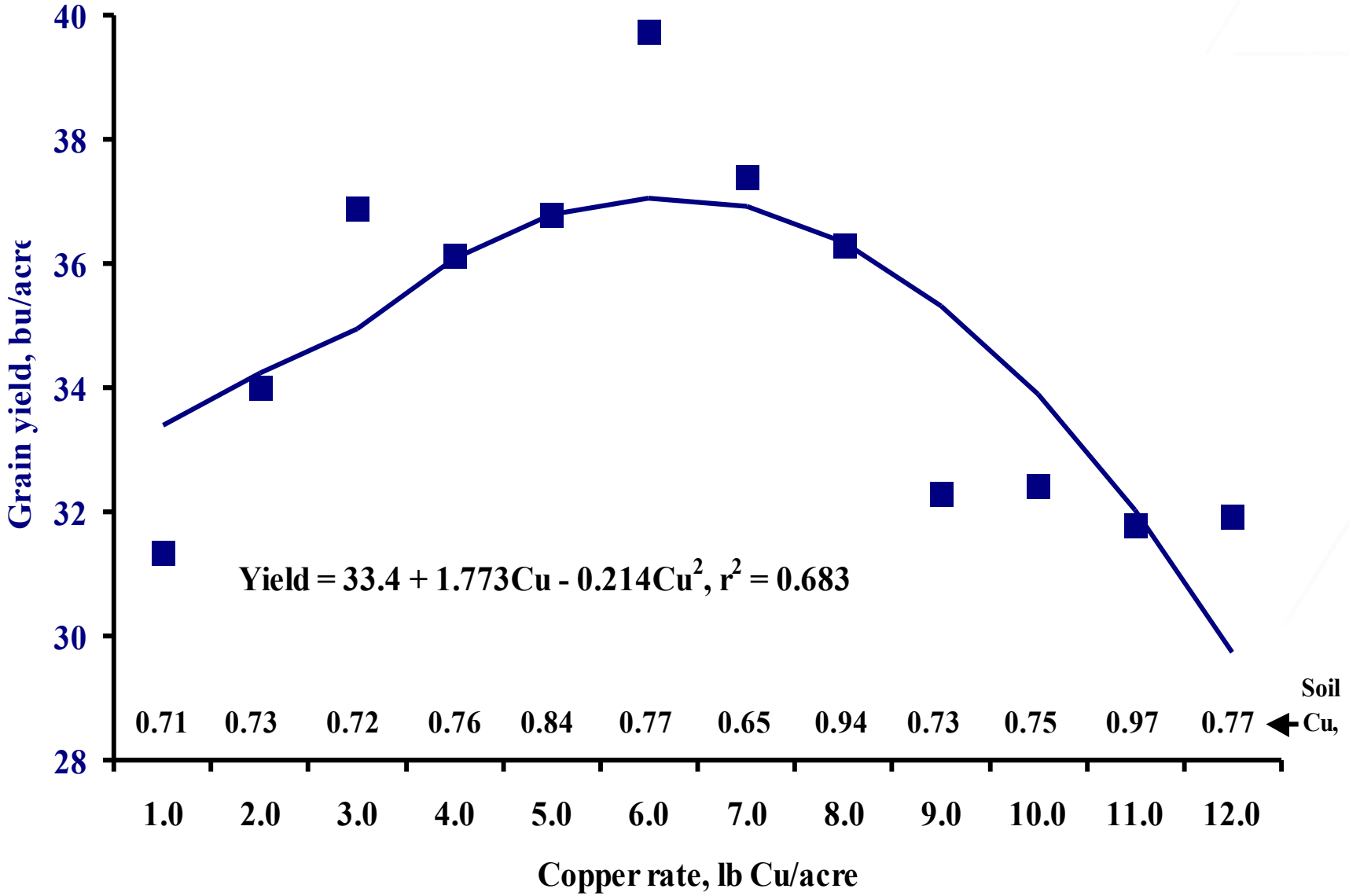
Carberry – Cu Placement



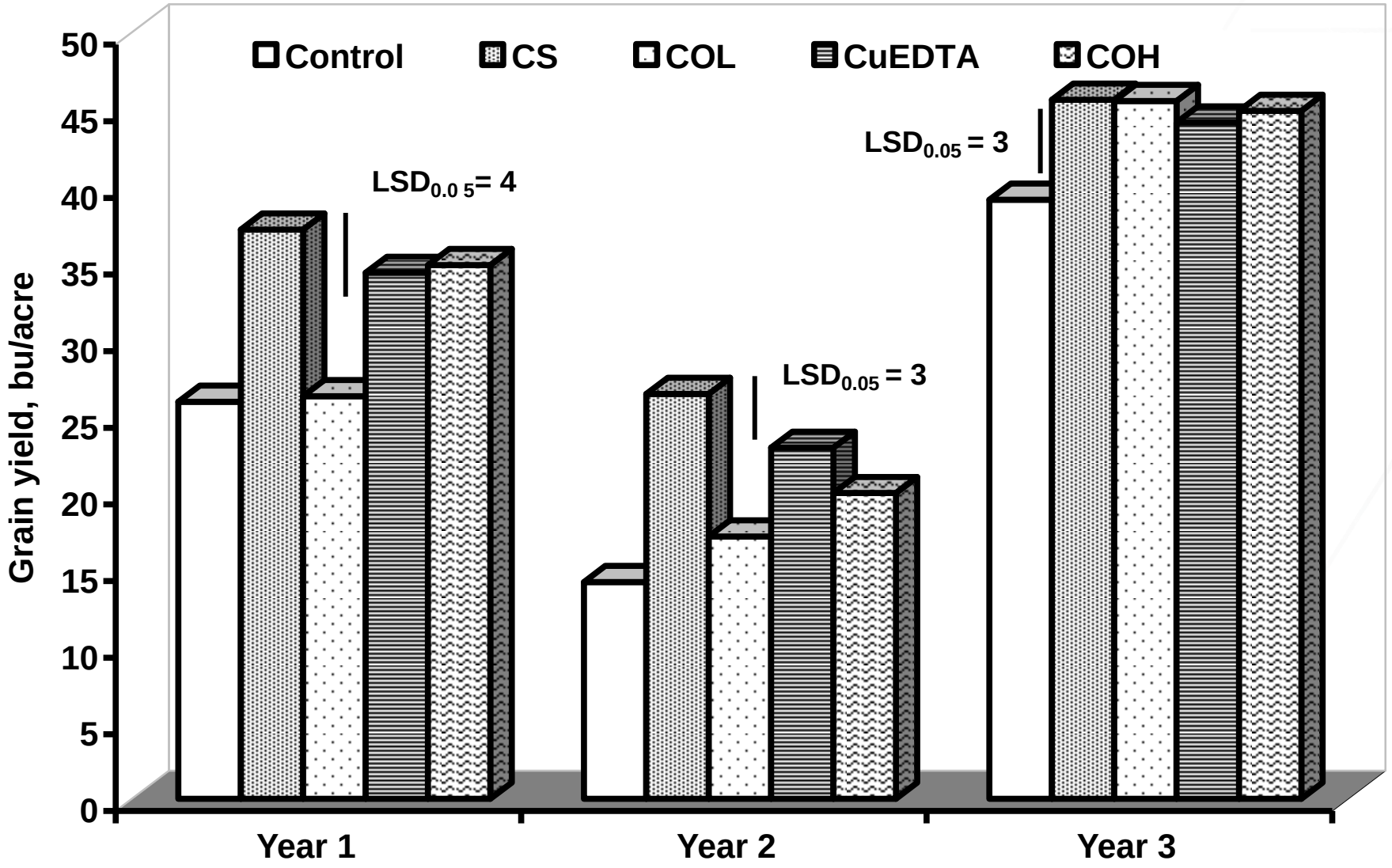
Elm Creek – Cu Placement & Rates



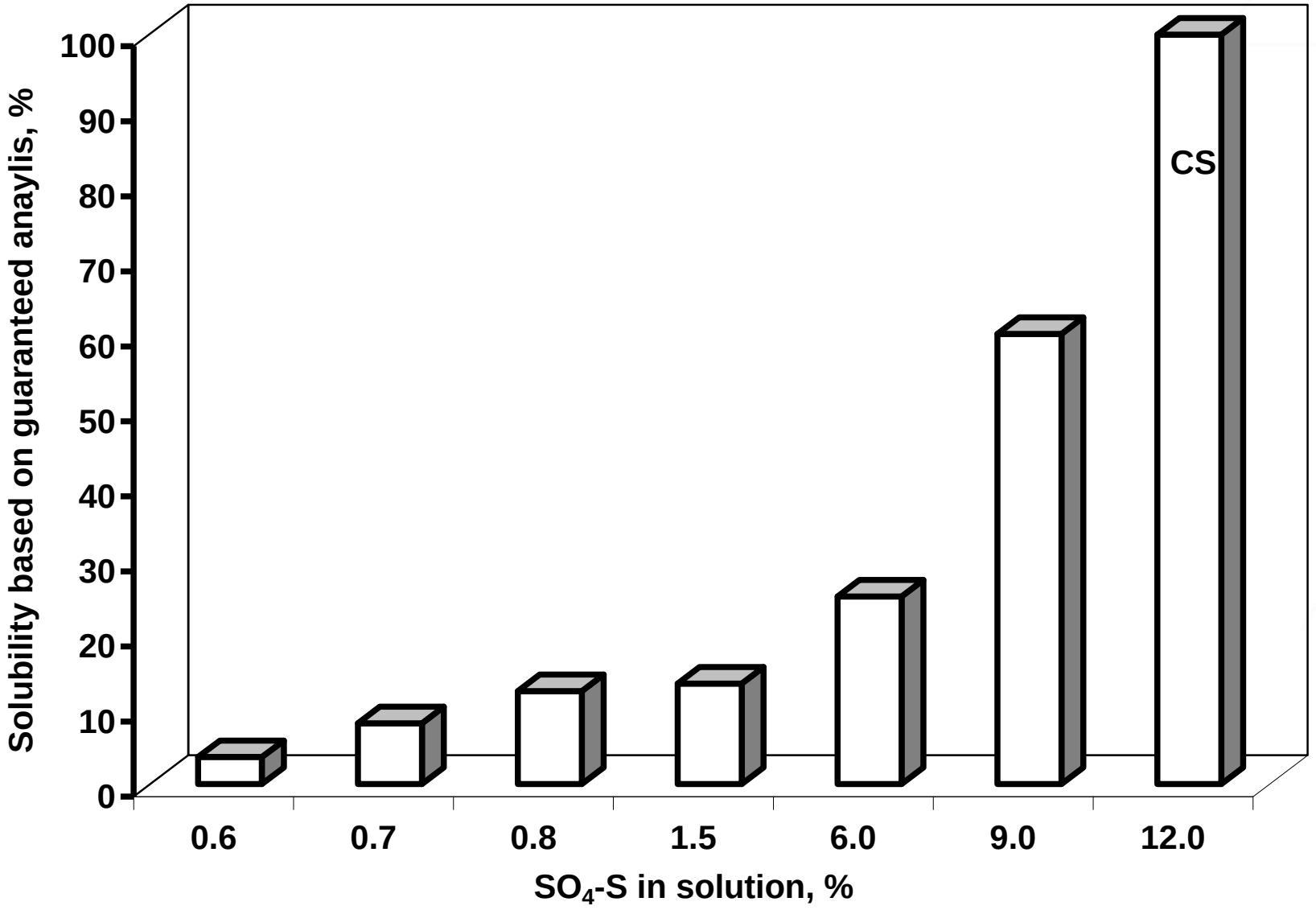
Carberry – $CuSO_4$-Cu Rates



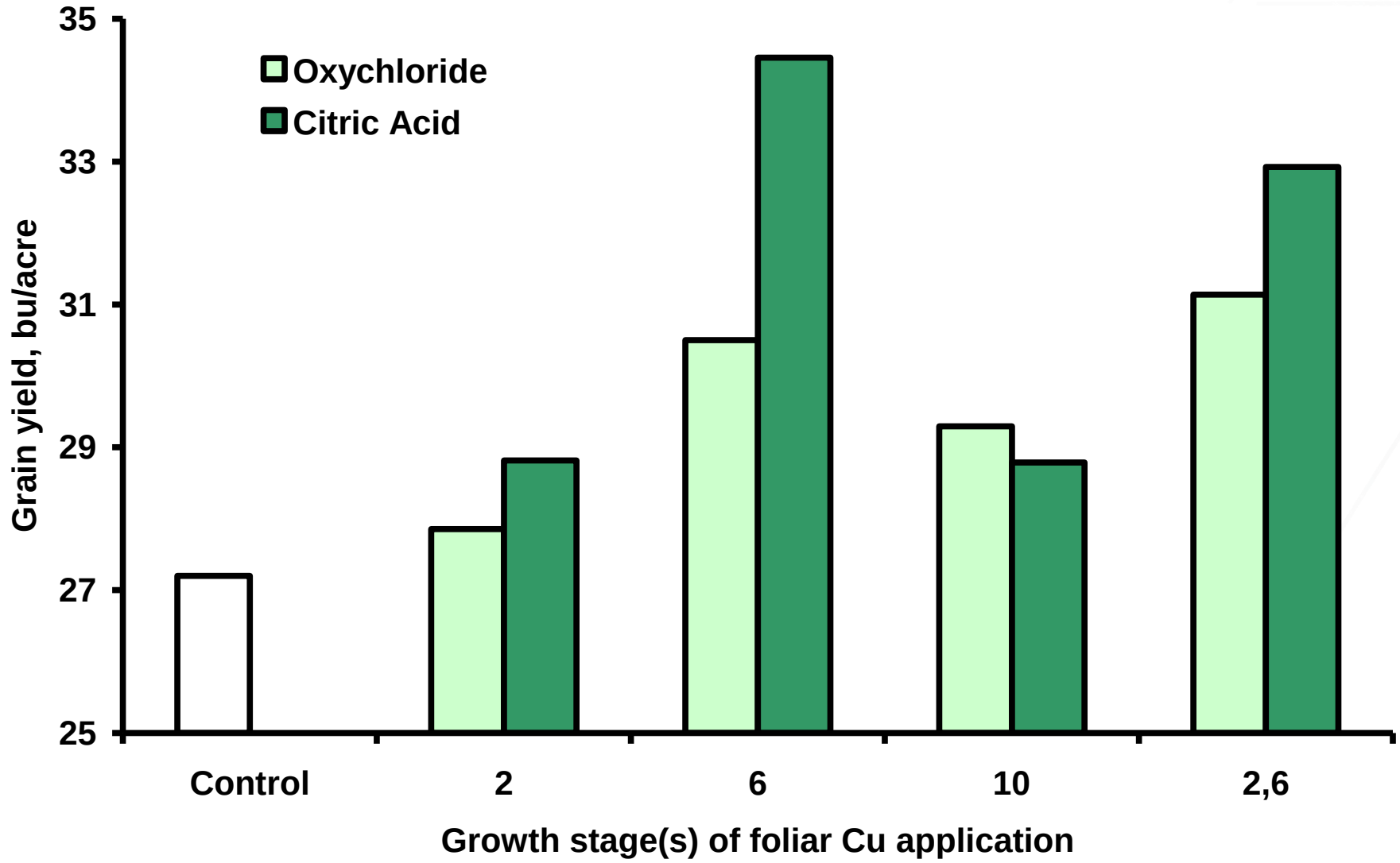
Elm Creek – Cu Products (BI)



Cu Oxysulphates



Foliar Cu Products



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Manganese









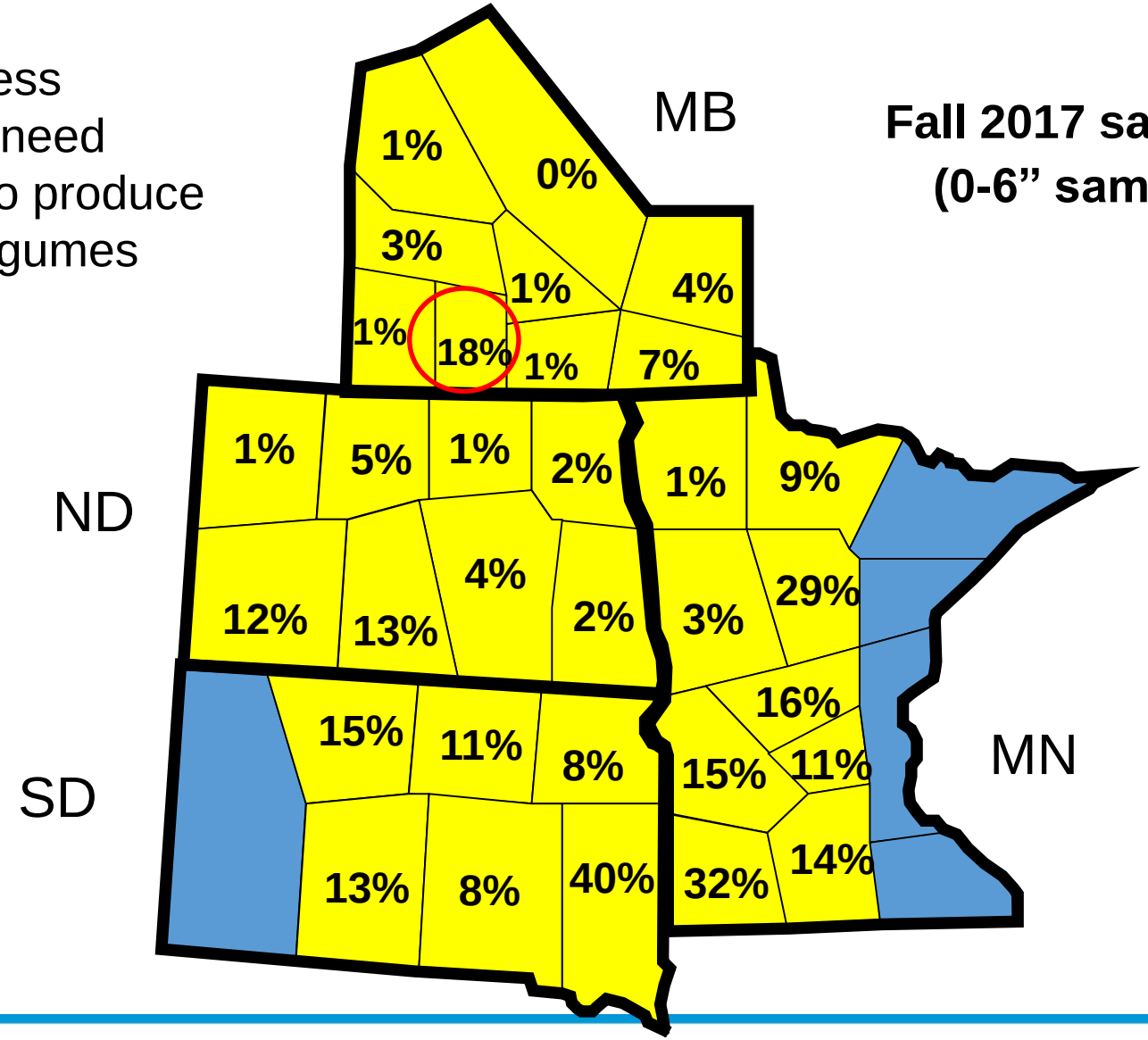
Manganese

Manganese

- Responses on organic soils only
- DTPA extraction
  - Manitoba: 7 ppm
- Mn/Cu ratio but requires modification
  - routine 1:2; proposed 1:5
    - Mn/Cu < 1 Mn deficiency
    - Mn/Cu > 15 Cu deficiency

% Soil Samples with Soil pH less than 6.0

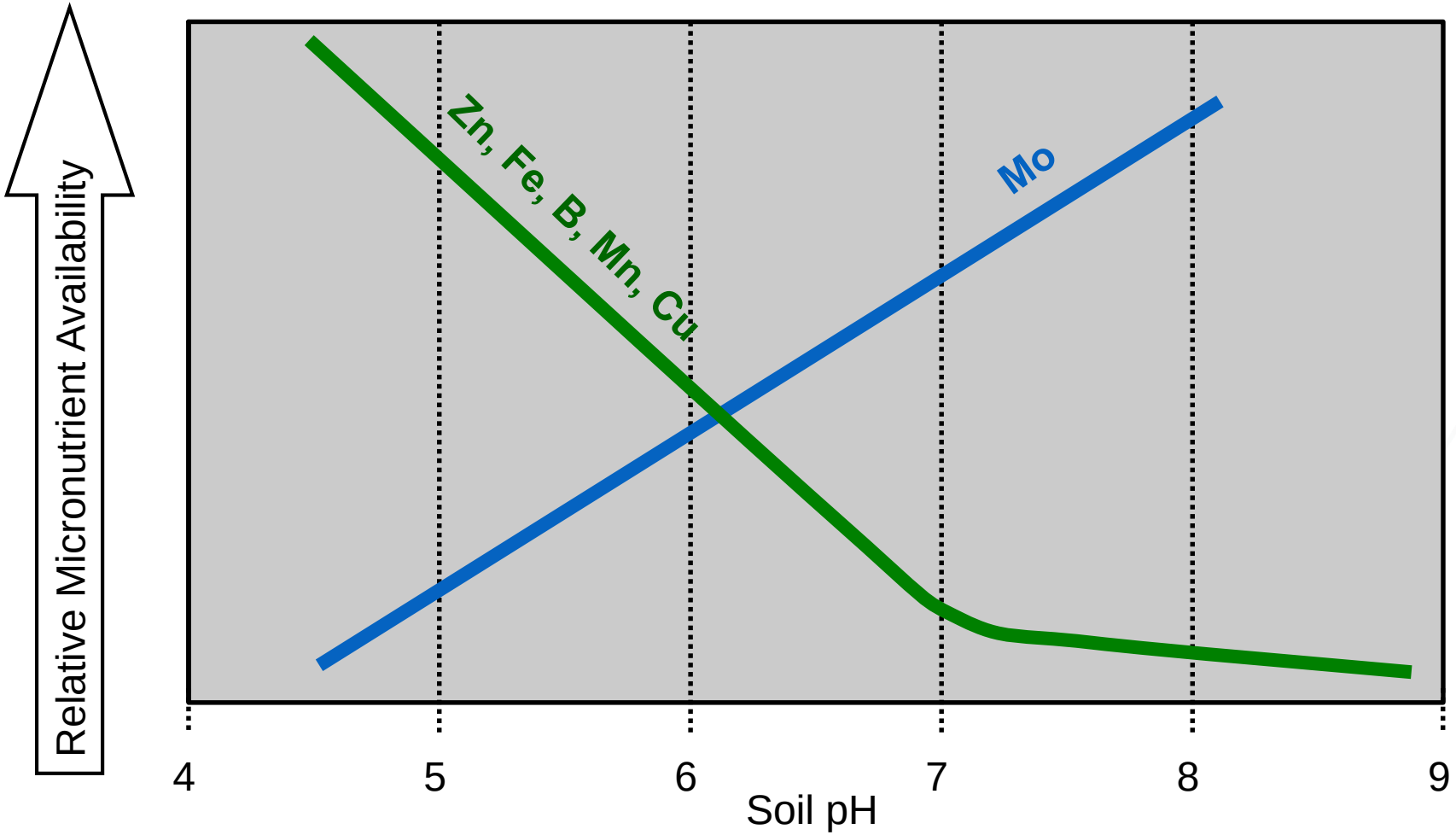
Soil with pH less than 6.0 may need lime applied to produce top yields.(Legumes affected first)



Fall 2017 samples (0-6” samples)

Courtesy John Lee, Agvise Laboratories

Soil pH Influences Micronutrient Availability



Manganese toxicity

- The problem of predicting whether or not a soil will be Mn toxic is rather complicated. Information is required as to the crop grown and the soil Mn levels, which will cause toxicity for that crop as well as the initial level of Mn available in the soil and, equally important, how this level will change during the season. (R.P White, CDA, Charlottetown, PEI, Soil Sci Soc, Amer. Proc – Vol 34, 1970)
- Soil Mn levels were well correlated with pH and tissue Mn levels. Manganese toxicity symptoms were observed at tissue Mn levels of approximately 1,000 ppm in beans, 550 ppm in peas, and 200 ppm in barley. (R.P White, CDA, Charlottetown, PEI, Soil Sci Soc, Amer. Proc – Vol 34, 1970)

Manganese toxicity

- Normal levels of Mn content of canola with and without Mn toxicity symptoms are about 400 mg kg^{-1} and greater than 1500 mg kg^{-1}, respectively (Moroni, et al., 16th Australian Research Assembly on Brassicas. Ballarat Victoria 2009)
- Soil pH was the best measure of predicting Mn status of soybean growing on acid soils (Anderson and Mortvedt, 1982). Toxic concentrations of Mn did not accumulate in soil or in leaf tissue at pH levels > 5.5.
- **Symptom description: Chlorosis of leaf margins, cupping of leaves but also chlorotic mottling of leaves and stunting of overall plant growth was apparent in areas most affected**

Manganese toxicity symptoms

Manganese toxicity symptoms

Manganese toxicity indicators

- **Soil tests (Manganese (Mn) / pH)**
  - **Good area (0-6”) Mn = 37 ppm, pH = 6.1**
  - **Good area (6-12”) Mn = 24 ppm, pH = 5.9**
  - ***Poor area (0-6”) Mn = 120 ppm, pH = 5.0***
  - ***Poor area (6-12”) Mn = 5 ppm, pH = 5.2***
-
- **Tissue Tests (Mn)**
  - **Good area (top leaf) Mn = 376 ppm**
  - **Good area (rest of plant) Mn = 308 ppm**
  - ***Poor area (top leaf) Mn = 1090 ppm***
  - ***Poor area (rest of plant) Mn = 972 ppm***

Manganese toxicity indicators

- **Additional soil tests – pH**
  - ***Poor area (0-3”) pH = 4.8***
  - ***Poor area (3-6”) pH = 5.2***
- **Additional soil tests – Aluminum**
  - ***Good area (0-6”) = 8260 ppm***
  - ***Poor area (6-12”) = 6450 ppm***

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New confusion in the market!







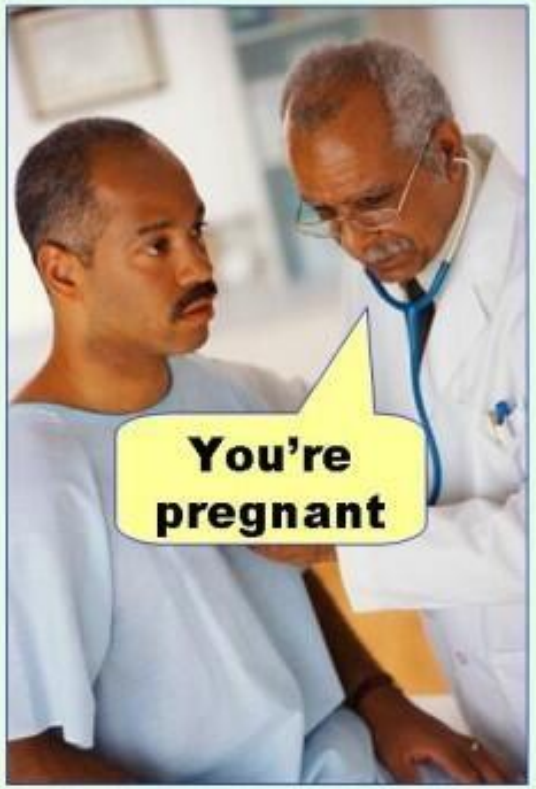


% P saturation

- **FOR MANURE APPLICATION ONLY!**
- **Calibrated and legislated in Quebec**
- **Mostly irrelevant for western Canada**
- **Tested on only FIVE fields in Alberta**

Correct statistical analysis is vital!

Type I error
(false positive)



Type II error
(false negative)