

The Response of Wheat to Rates, Forms, And Application Method of Copper Fertilizer in a Range of Prairie Soils

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**UNIVERSITY OF
SASKATCHEWAN**

Soil Copper Research: Why?

- **Essential micronutrient involved in physiological processes (e.g., enzymes, photosynthesis, and respiration).**
- **The micronutrient most likely to be deficient in prairie soils.**
- **Cereals, especially wheat, are most sensitive to low soil Cu supply.**



**Leaf Pig-tailing
(Cu-deficiency)**

Soil Copper Research: Why?

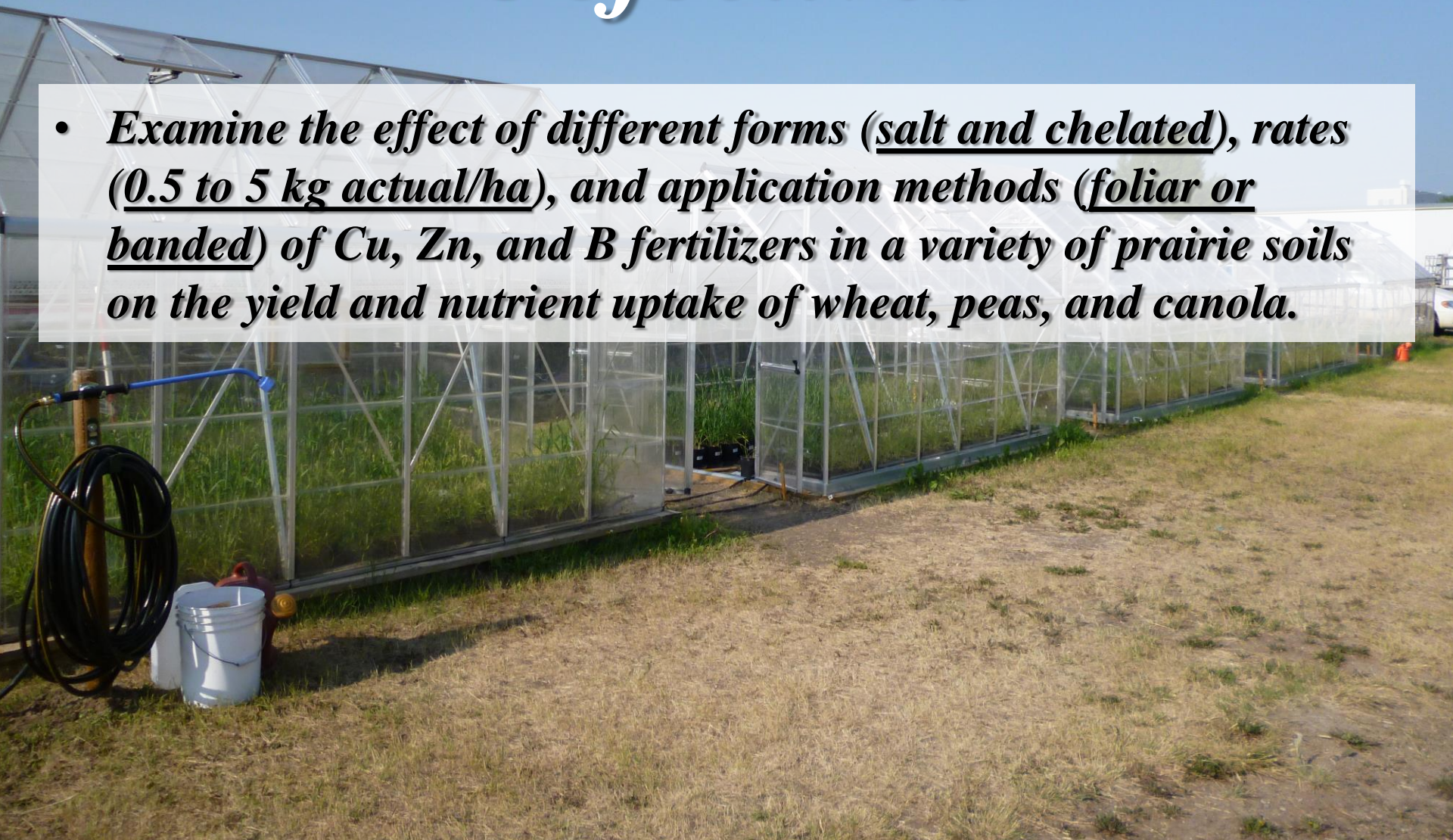
- **Essential micronutrient involved in physiological processes (e.g., enzymes, photosynthesis, and respiration).**
- **The micronutrient most likely to be deficient in prairie soils.**
- **Cereals, especially wheat, are most sensitive to low soil Cu supply.**
- **Limited understanding of micronutrient (Cu, Zn, and B) fertilizer interactions.**
- **Uncertainty regarding identifying soil Cu deficiency and applying fertilizer = risky business.**



**Empty Heads
(Cu-deficiency)**

Objectives

- *Examine the effect of different forms (salt and chelated), rates (0.5 to 5 kg actual/ha), and application methods (foliar or banded) of Cu, Zn, and B fertilizers in a variety of prairie soils on the yield and nutrient uptake of wheat, peas, and canola.*



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THE COPPER FERTILITY OF SASKATCHEWAN SOILS

COPPER FERTILIZATION OF WHEAT

GARY ALEXANDER KRUGER
1984

PATRICIA LYNN FLAHERTY
2002

THE COPPER FERTILITY OF SASKATCHEWAN SOILS

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Department of Soil Science, University of Saskatchewan, Saskatoon, Sask. Can.
Received 10/27/83, accepted 1/20/84, received 3/20/84, received 5/20/84

KRUGER, G. A., KARAMANOS, R. E. and SINGH, P. S. 1984. The copper fertility of Saskatchewan soils. *Can. J. Soil Sci.* 64: 23-30.

Effectiveness of seedrow placement of granular copper products¹ for wheat

R. E. Karamanos², F. L. Volley³ and P. L. Flaten³

¹Western Cooperative Fertilizer Limited, P.O. Box 2000, Calgary, Alberta, Canada T2P 2H1, and ²Saskatchewan Centre for Soil Research, 21 Campus Drive, University of Saskatchewan, Saskatoon, Saskatchewan, Canada S7N 5A6. Accepted 12/10/83, accepted 1/10/84

Karamanos, R. E., Volley, F. L., and Flaten, P. L. 1984. Effectiveness of seedrow placement of granular copper products for wheat. *Can. J. Soil Sci.* 64: 23-30. The purpose of this study was to determine the effect of seedrow placement of granular copper products on wheat yield and nutrient uptake. The study was conducted on a brown forest soil in Saskatchewan. The results showed that seedrow placement of granular copper products significantly increased wheat yield and nutrient uptake compared to broadcast application. The effect was more pronounced at lower rates of application. The authors conclude that seedrow placement is a more effective method for applying granular copper products to wheat.

Key words: broadcast and incorporation, nitrogen, phosphorus, potassium, calcium, sodium

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Wheat: Response to Cu in seedrow placement, nitrogen, phosphorus, potassium, calcium, sodium

In western Canada, copper (Cu) fertilizers are applied to corn and alfalfa rather than to wheat, sorghum, and soybeans. Cu fertilizers are applied to wheat in Saskatchewan, but the response of wheat to Cu fertilizers is not well understood. The authors of this paper have conducted a study to determine the effect of seedrow placement of granular copper products on wheat yield and nutrient uptake. The results showed that seedrow placement of granular copper products significantly increased wheat yield and nutrient uptake compared to broadcast application. The effect was more pronounced at lower rates of application. The authors conclude that seedrow placement is a more effective method for applying granular copper products to wheat.

A review of copper fertilizer management for optimum yield and quality of crops in the Canadian Prairie Provinces

S. S. Malhi¹ and R. E. Karamanos²
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Received 10/27/83, accepted 1/20/84, received 3/20/84, received 5/20/84

Relative effectiveness of various sources, methods, times and rates of copper fertilizers in improving grain yield of wheat on a Cu-deficient soil

S. S. Malhi¹, L. Coetzee², and M. R. Kutcher³

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²Western Cooperative Fertilizer Limited, P.O. Box 2000, Calgary, Alberta, Canada T2P 2H1
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Determining wheat responses to copper in prairie soils¹

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Received 11/10/83, accepted 1/10/84

The effect of foliar copper application on grain yield and quality of wheat¹

R. E. Karamanos², G. Ponomareva³, T. B. Goss³, and N. A. Fries⁴

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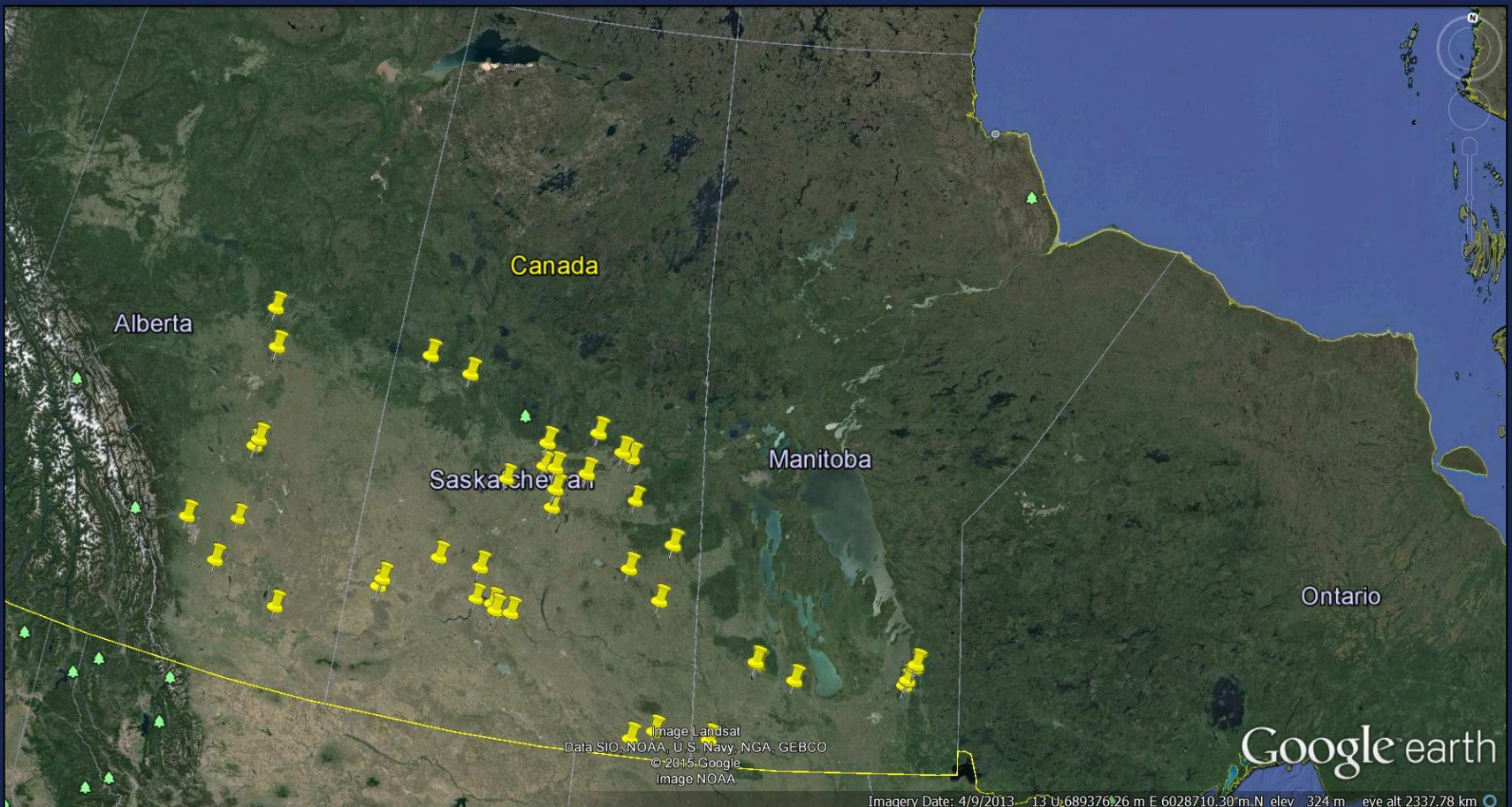
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- *Identify any micronutrient fertilizer interactions during a cereal, pulse, and oilseed crop rotation common on the prairies.*
- *Develop an improved method for detecting micronutrient deficiency across a broad range of western Canadian soil types.*

Soil Collection *(47 soils)*



Many Thanks!!!!!!

Sarah Anderson

Lyle Cowell

Dave Cubbon

Garrett Darby

Emile deMilliano

Christian Doelger

Norm Flore

Edgar Hammermeister

Ken Harms

Jeremy Hodges

Rigas Karamanos

Gary Kruger

Kristyn MacDonald

Ken Morey

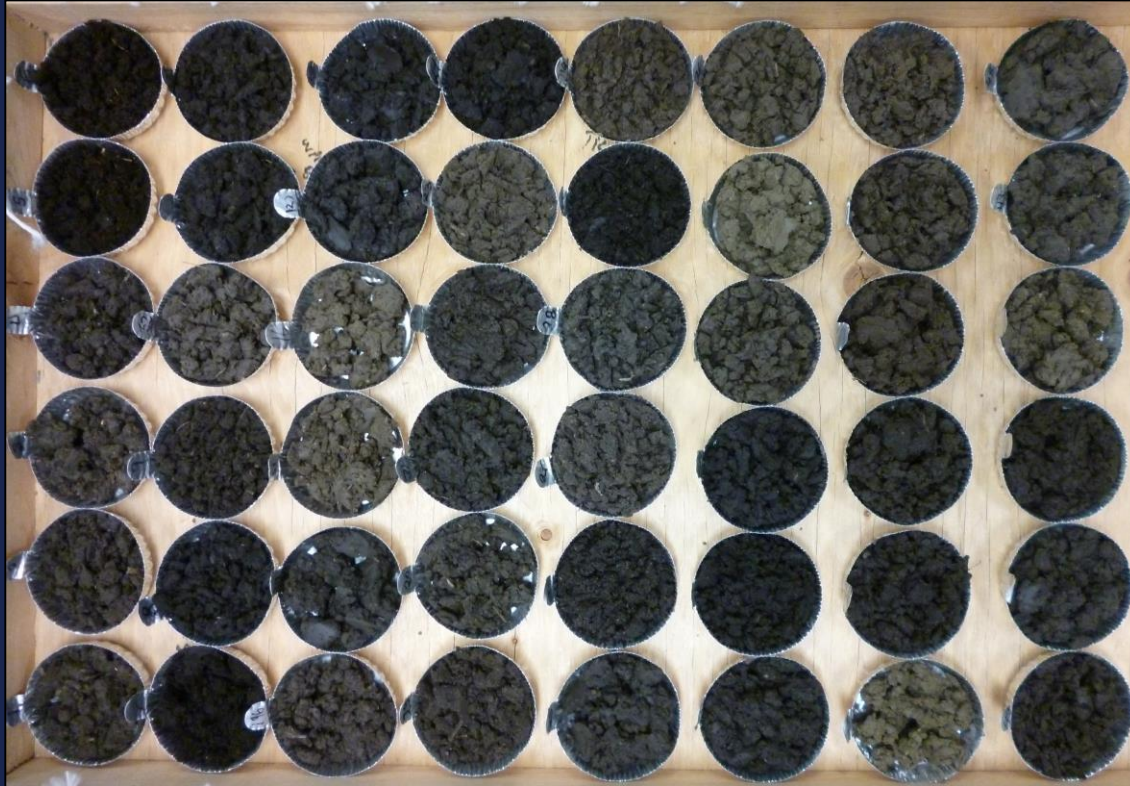
Gary Topham

Randy Usick

Growers who let me collect two cans of their “dirt”



A Variety of Soils Collected



Diverse array of soil characteristics (texture, organic matter content, pH, carbonates, micronutrient availability, etc.)

Copper-Deficient Soils

(The Usual Suspects)



POLICE DEPARTMENT

CALCAREOUS

PROFILE #: 001241972

POLICE DEPARTMENT

SANDY

PROFILE #: 001241999

POLICE DEPARTMENT

GRAY

PROFILE #: 001242002

POLICE DEPARTMENT

PEAT

PROFILE #: 001241874

Experimental Design

- **Two factors, completely randomized design, four replicates**
- **Factor #1: soil type (15 soils; 12 mineral and three organic)**
- **Factor #2: Cu fertilizer (5 treatments):**
 - 1) Control (i.e., no Cu fertilizer added)**
 - 2) Foliar CuSO_4 (0.25 kg Cu/ha; flag leaf; Feekes 8)**
 - 3) Foliar EDTA-Cu (0.25 kg Cu/ha; flag leaf; Feekes 8)**
 - 4) Banded CuSO_4 (6 μg Cu/g soil; 5 or 2.5 kg Cu/ha for mineral and organic soils, respectively)**
 - 5) Banded EDTA-Cu (2 μg Cu/g; 2 or 1 kg Cu/ha for min/org soils)**

Ray



*EDTA-Cu
(14% Cu)*

Rosie



*CuSO₄
(25% Cu)*

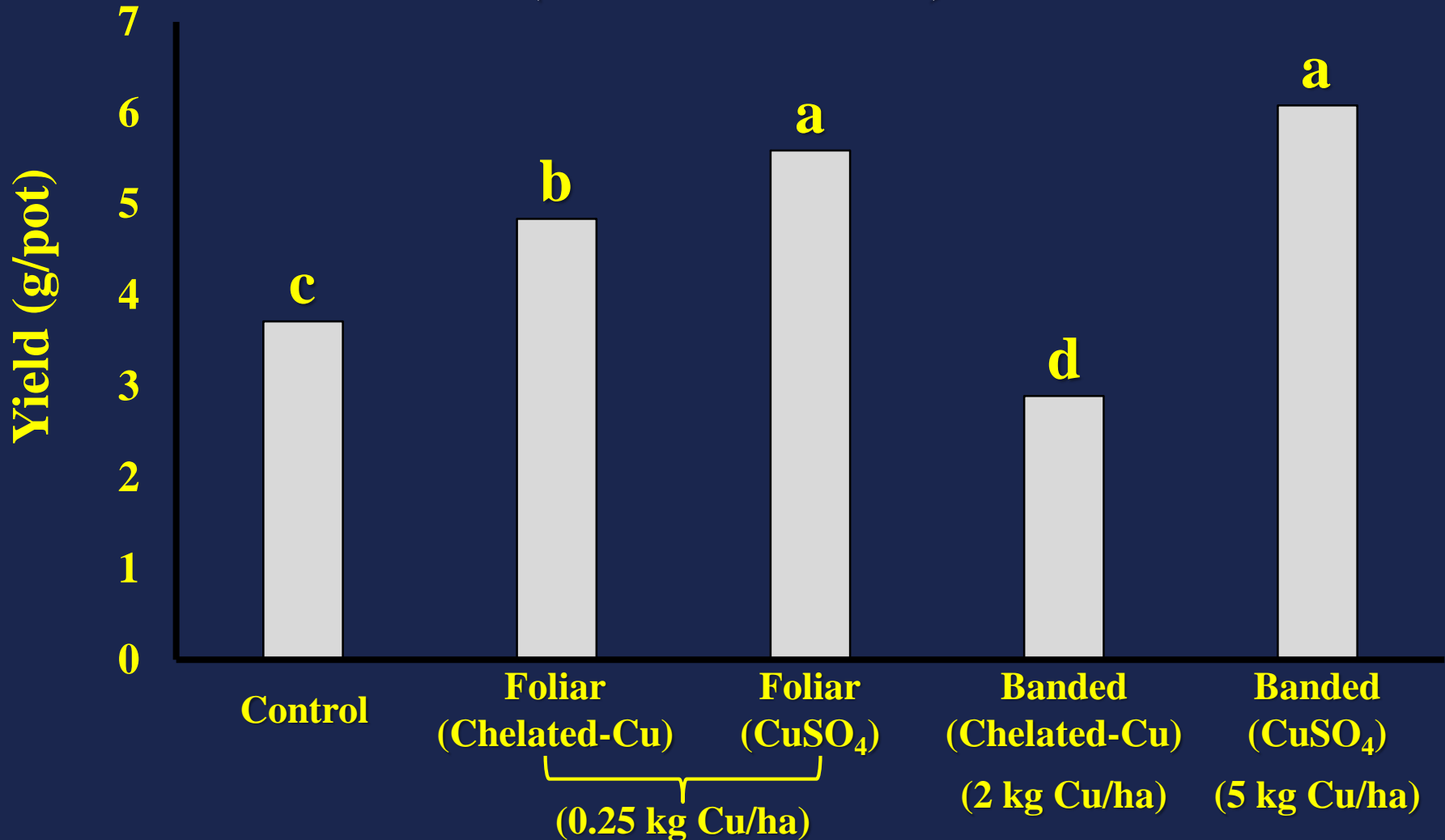


*Hard Red Spring Wheat
(AC[®] Waskada)*



AC[®] Waskada Wheat Grain Yield

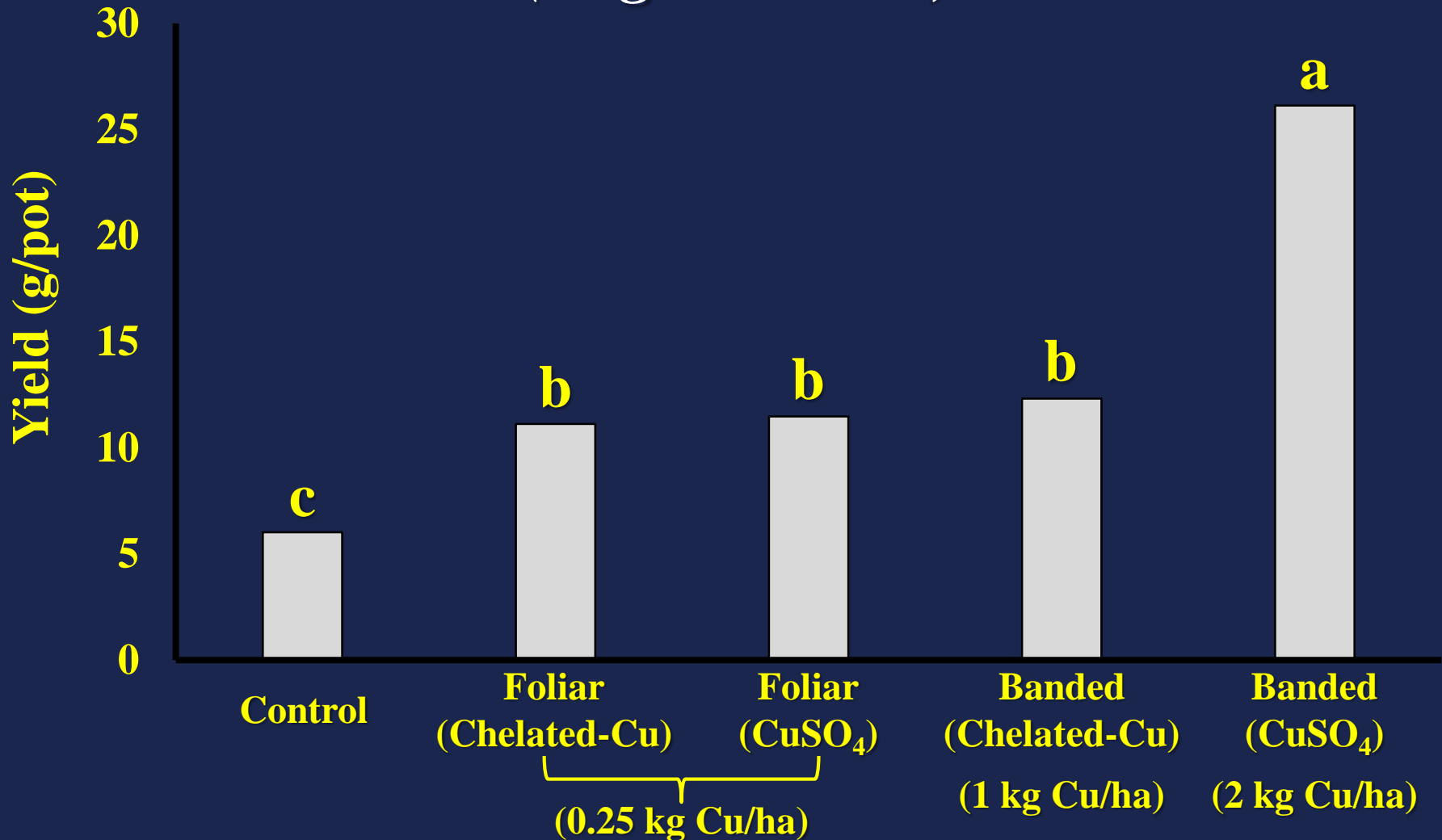
(Mineral Soils)



**Bars with the same letters are not significantly different ($P > 0.05$) using LSD.*

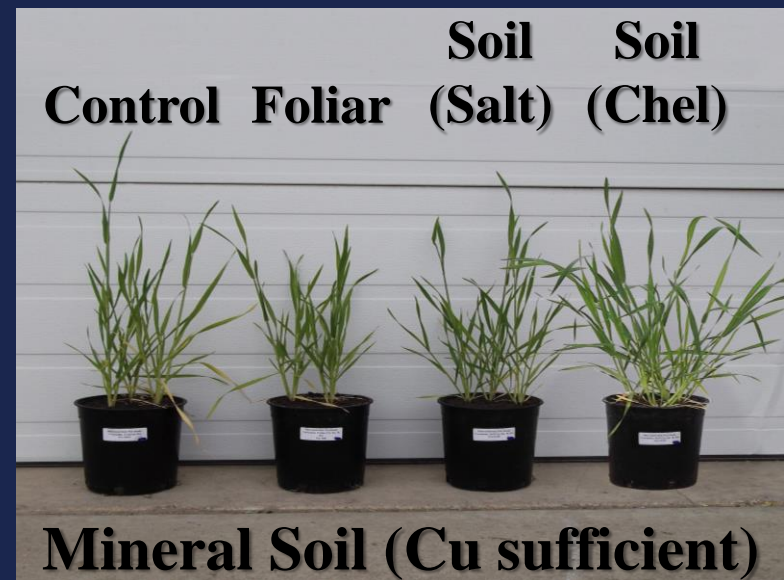
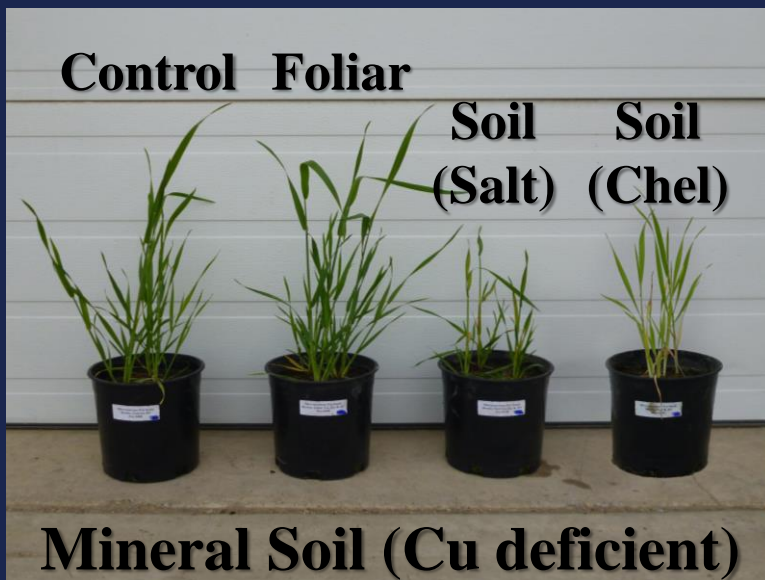
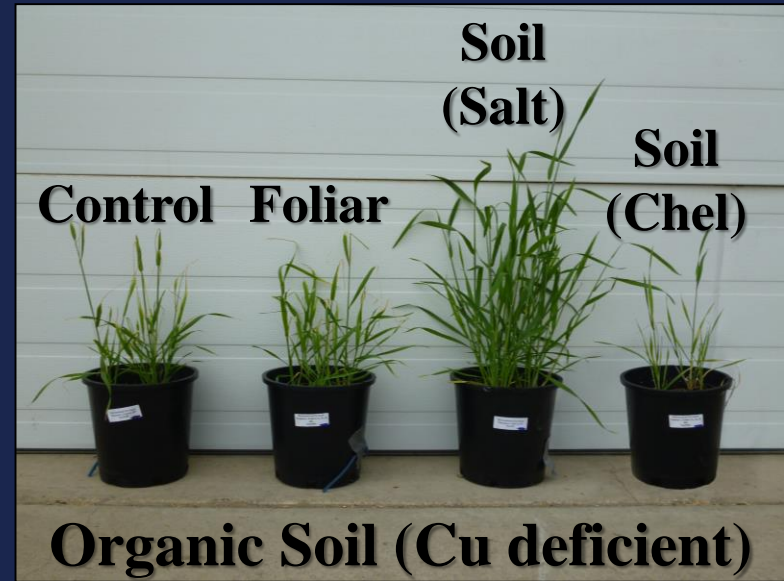
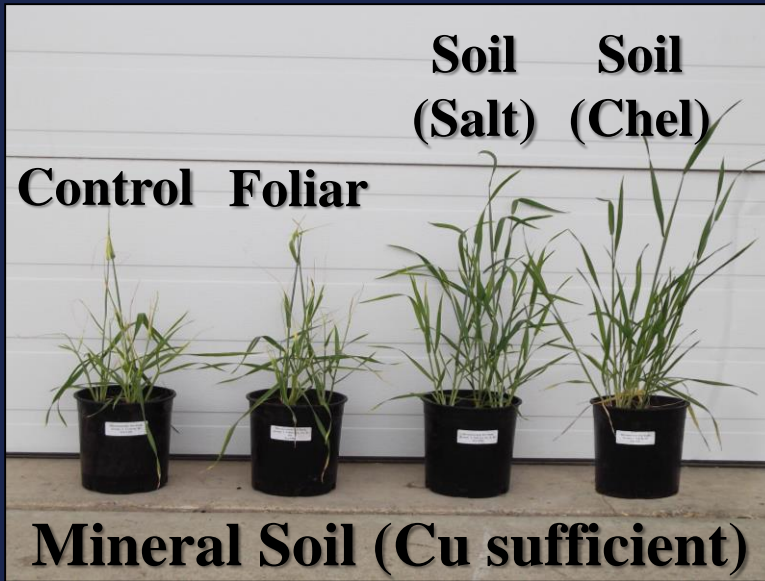
AC[®] Waskada Wheat Grain Yield

(Organic Soils)



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Variable Growth Response to Copper Fertilizer

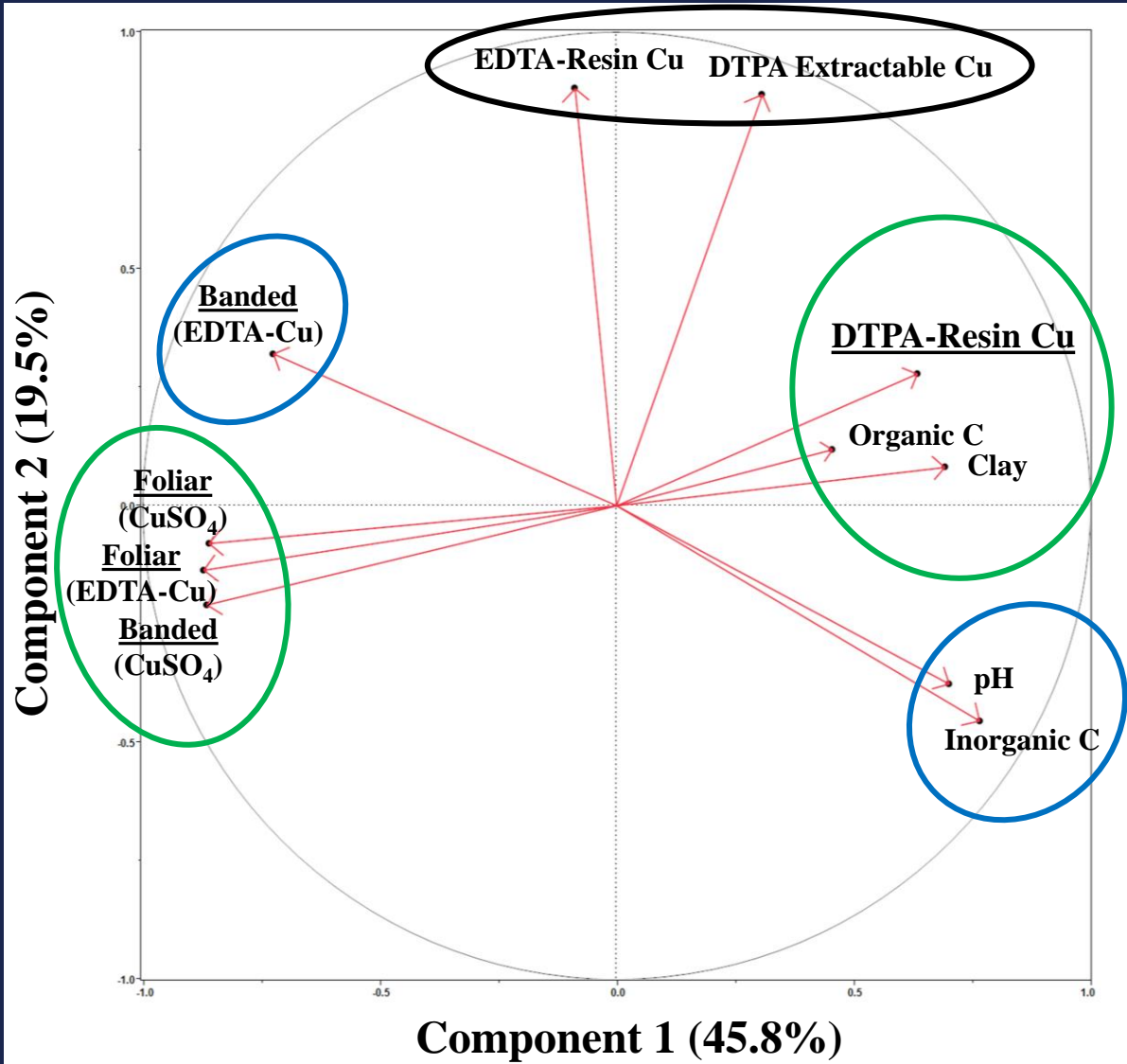


Ion-exchange Resin “Sandwich” Method



Qian, P., Schoenau, J.J., and Ziadi, N. 2008. Ion Supply Rates Using Ion-Exchange Resins. Soil Sampling and Methods of Analysis, Second Edition. Carter, M.R. and Gregorich, E.G. (Eds.)

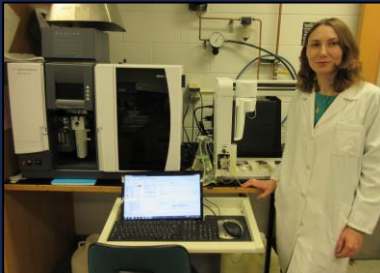
Principal Component Analysis of Wheat Grain Yield Response to Added Cu fertilizers and Selected Soil Properties (Mineral Soils)



Conclusions

- **Banded CuSO_4 provided a timely Cu supply; thus, promoting maximum yields in our study, especially with organic soils.**
- **Applying foliar Cu corrected the Cu-deficiency symptoms and prevented yield loss in the mineral soils, but not in organic soils.**
- **Foliar CuSO_4 was as effective as foliar chelated-Cu for most soils.**
- **Banded chelated-Cu had mixed results; likely due to direct (toxic) or indirect (Zn deficiency) effects of the relatively high application rates used (1 or 2 kg Cu/ha).**
- **DTPA-Resin appears to be provide a reliable index of soil Cu supply for identifying mineral soils responsive to Cu fertilization, however, field study validation is required.**

Thank You!!





Questions?