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Correlating Soil Microbial Properties with Crop Yields in the Canadian Prairies

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Introduction

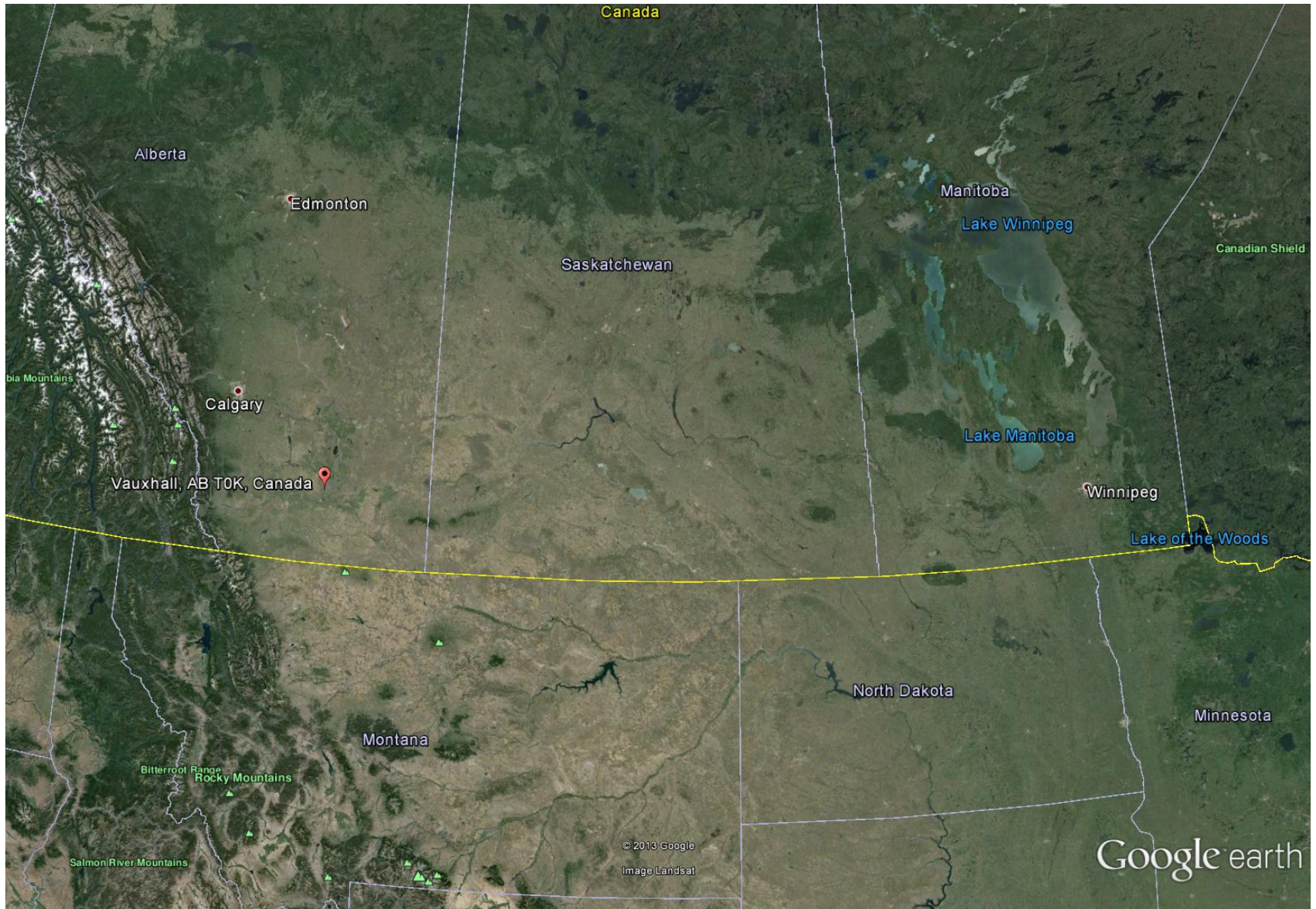
- Soil microorganisms mediate many important biological processes for sustainable agriculture.
- However, correlations between soil microbial properties and crop productivity cannot always be demonstrated.
- Two case studies on the Canadian prairies were used to correlate soil microbial biomass with wheat and canola yields.



1. Spring Wheat in Irrigated Crop Rotations: 2002 to 2011 at One Site



Vauxhall, Alberta



Rotations

Code	Length	Rotation	Management
1CONV	1 Yr	W	Conventional
3CONV	3 Yr	P-B-W	Conventional
3CONS	3 Yr	P-B-W	Conservation
4CONV	4 Yr	SB-B-P-W	Conventional
4CONS	4 Yr	SB-B-P-W	Conservation
5CONS	5 Yr	P-W-SB-W-B	Conservation

W = wheat; P = potatoes; B = beans; SB = sugar beet

Outline of Conservation Practices used over 12 yr

1. Composted beef cattle manure as a substitute for inorganic fertilizer



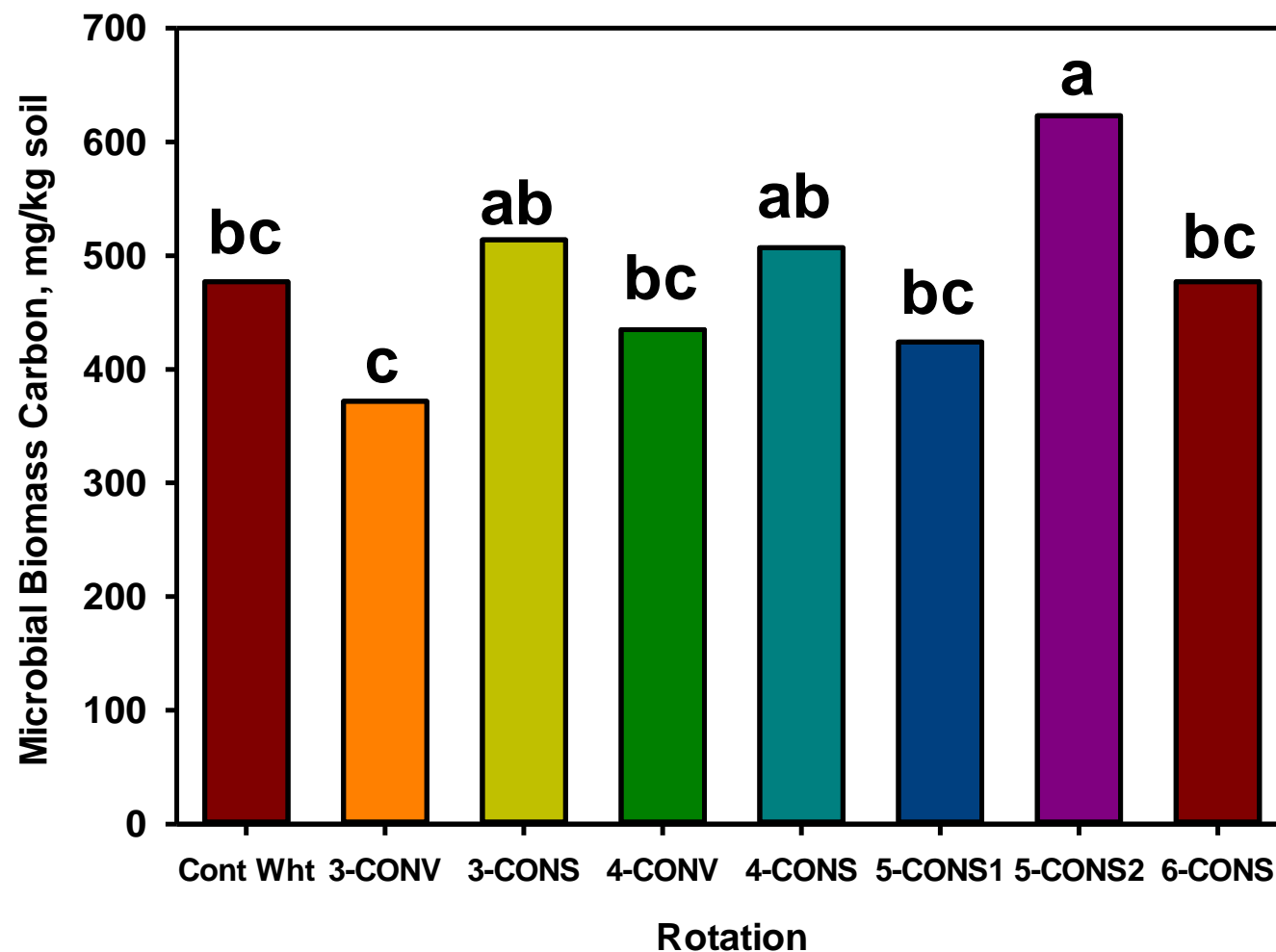
2. Reduced tillage or direct seeding where possible



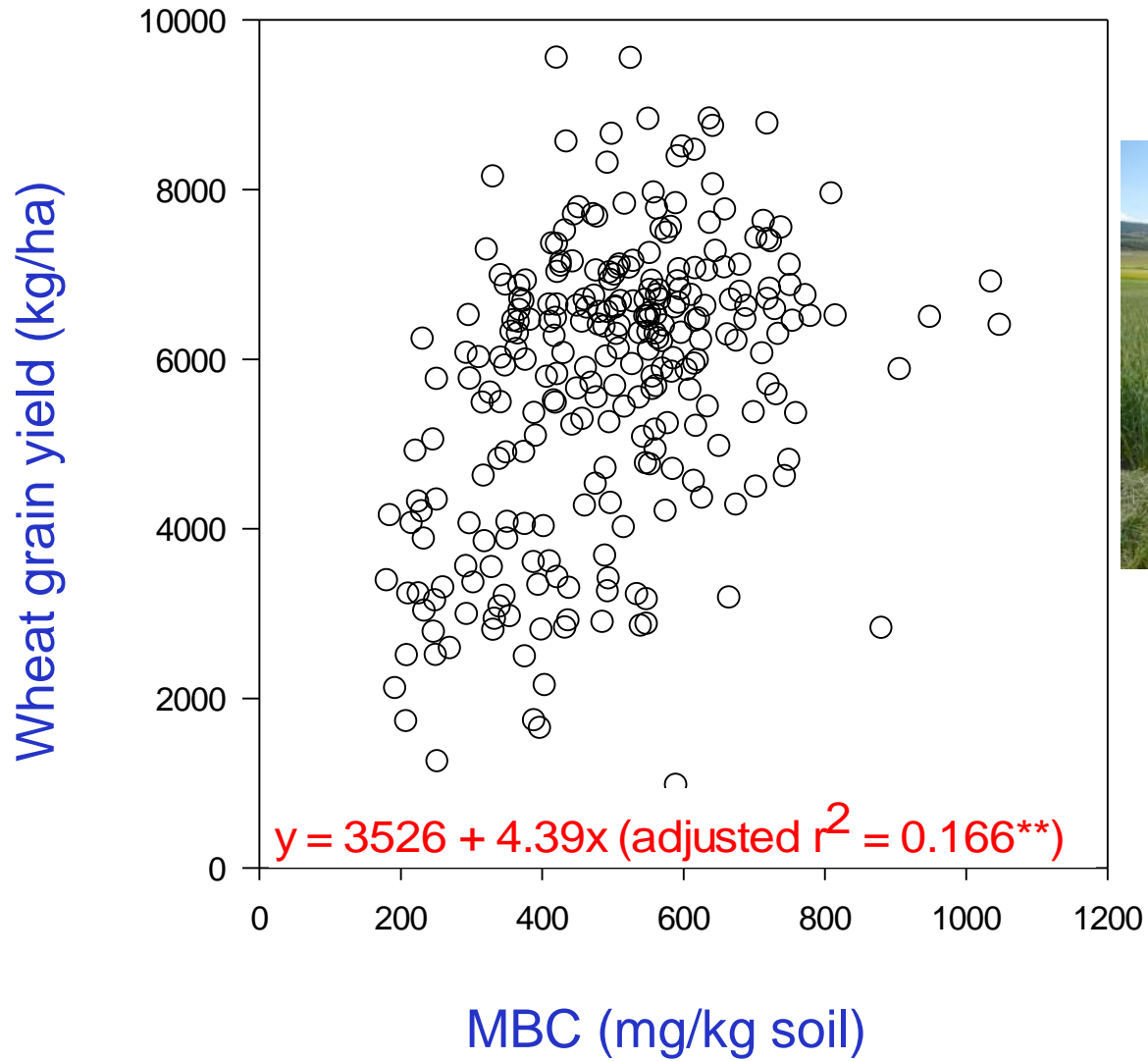
3. Beans: Narrow-row (20 cm) straight cut vs. wide-row (60 cm) undercut



Microbial Biomass Carbon (MBC) in 2011 (but used 2002-2011 data for regression analysis)



Rhizosphere





2. High-Yield No-Till Canola: Seven Sites



Seven Sites in the Canadian Prairies



Treatments

Treatment	Seeding rate (seeds m ⁻²)	N rate (x recommended rate)	N form
1	75	1	Uncoated
2	75	1	Uncoated + Fungicide ^a
3	75	1	Coated + Fungicide
4	75	1.5	Uncoated
5	75	1.5	Uncoated + Fungicide
6	75	1.5	Coated + Fungicide
7	150	1	Uncoated
8	150	1	Uncoated + Fungicide
9	150	1	Coated + Fungicide
10	150	1.5	Uncoated
11	150	1.5	Uncoated + Fungicide

Soil Characteristics at The Sites

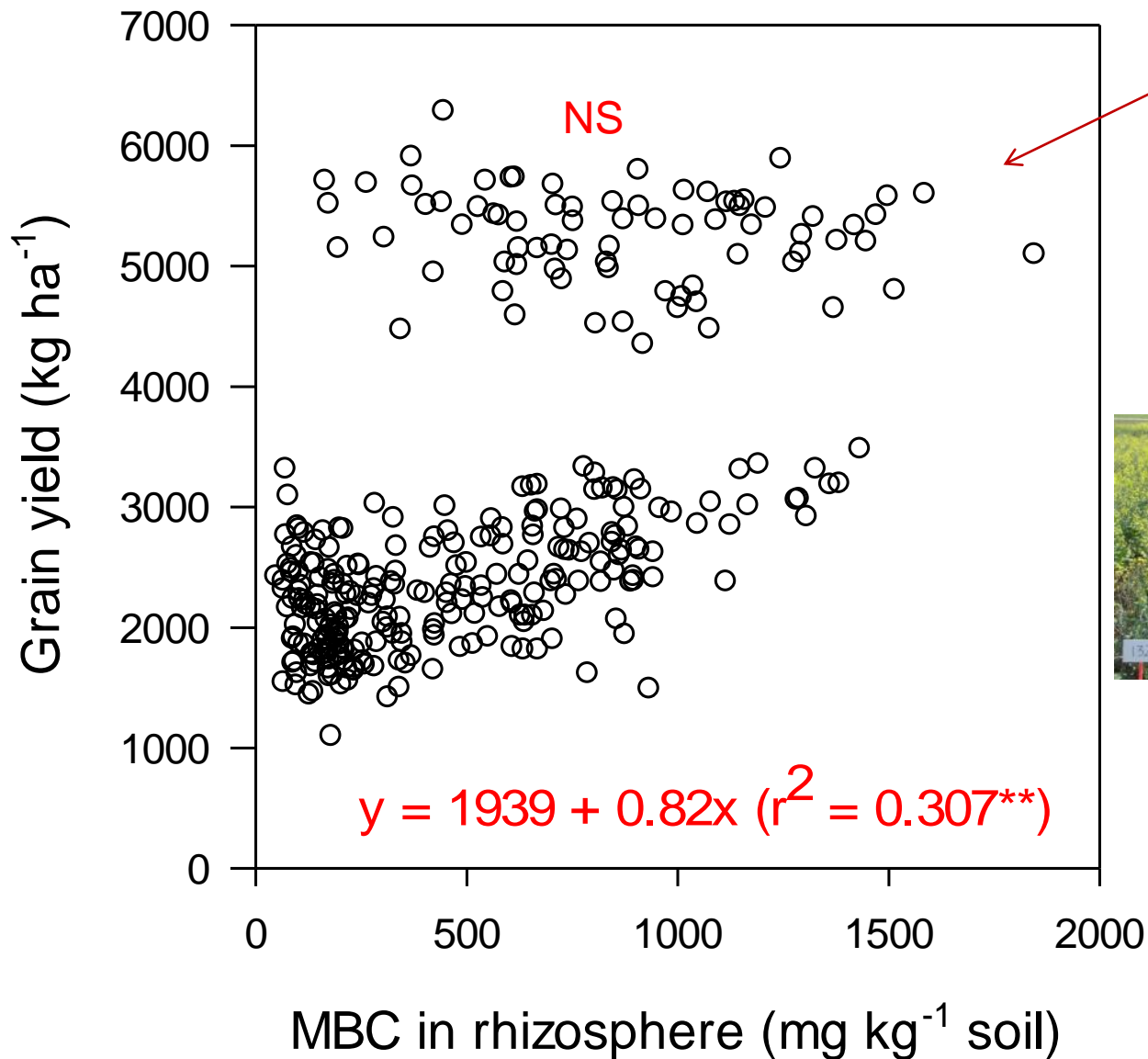
Site	Soil type	pH	OM (%)	Clay (%)
Beaverlodge, AB	Dark Gray Luvisol ^a	6.5	5.4	22.0
Brandon, MB	Black Chernozem ^b	8.1	5.0	33.0
Edmonton, AB	Black Chernozem	7.6	13.0	36.5
Indian Head, SK	Black Chernozem	7.6	3.2	21.4
Lacombe, AB	Black Chernozem	6.4	8.3	21.0
Lethbridge, AB	Dark Brown Chernozem ^c	8.0	3.0	33.0
Swift Current, SK	Brown Chernozem ^d	6.5	3.4	18.2

Summary of Soil Microbial Results

- Treatment effects on soil **MBC**, **β -glucosidase enzyme activity** or **bacterial diversity** were usually not significant.
- Where significance occurred:-
 - Doubling the **seeding rate** from 75 to 150 seeds m⁻² usually **increased** these microbial properties.
 - Increasing **N rate** to 1.5x the recommended rate had mostly **positive effects** in canola rhizosphere.
 - The effects of **N form** (including addition of fungicide) were **inconsistent**.



2008: Microbial Biomass - All Sites

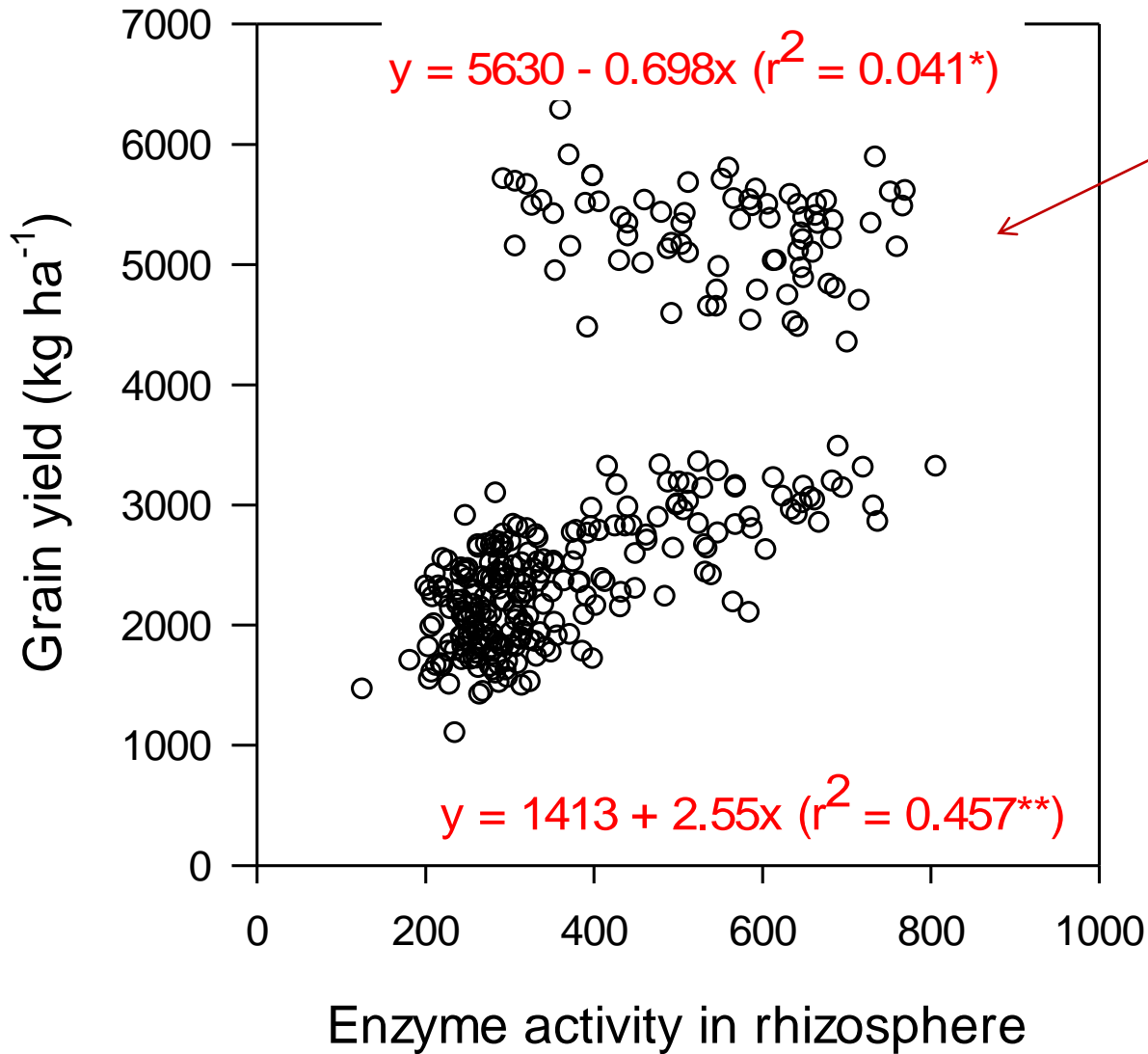


2 sites with high org. C

Lacombe MBC data - unusual



2008: Enzyme Activity - All Sites

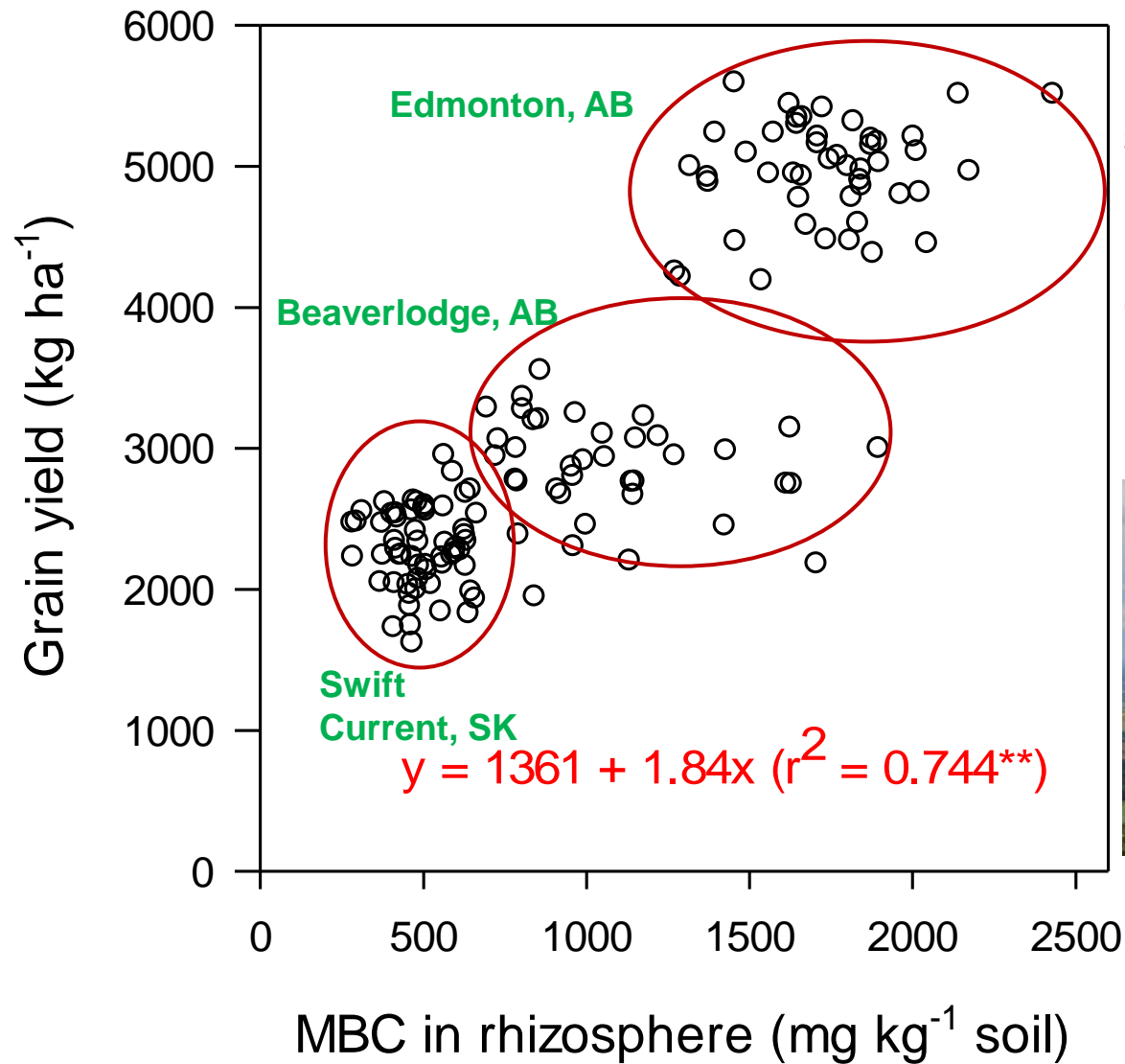


2 sites with
high org. C

Lacombe enzyme
data - unusual



2010 (3 sites): Microbial Biomass - Without Lacombe Data

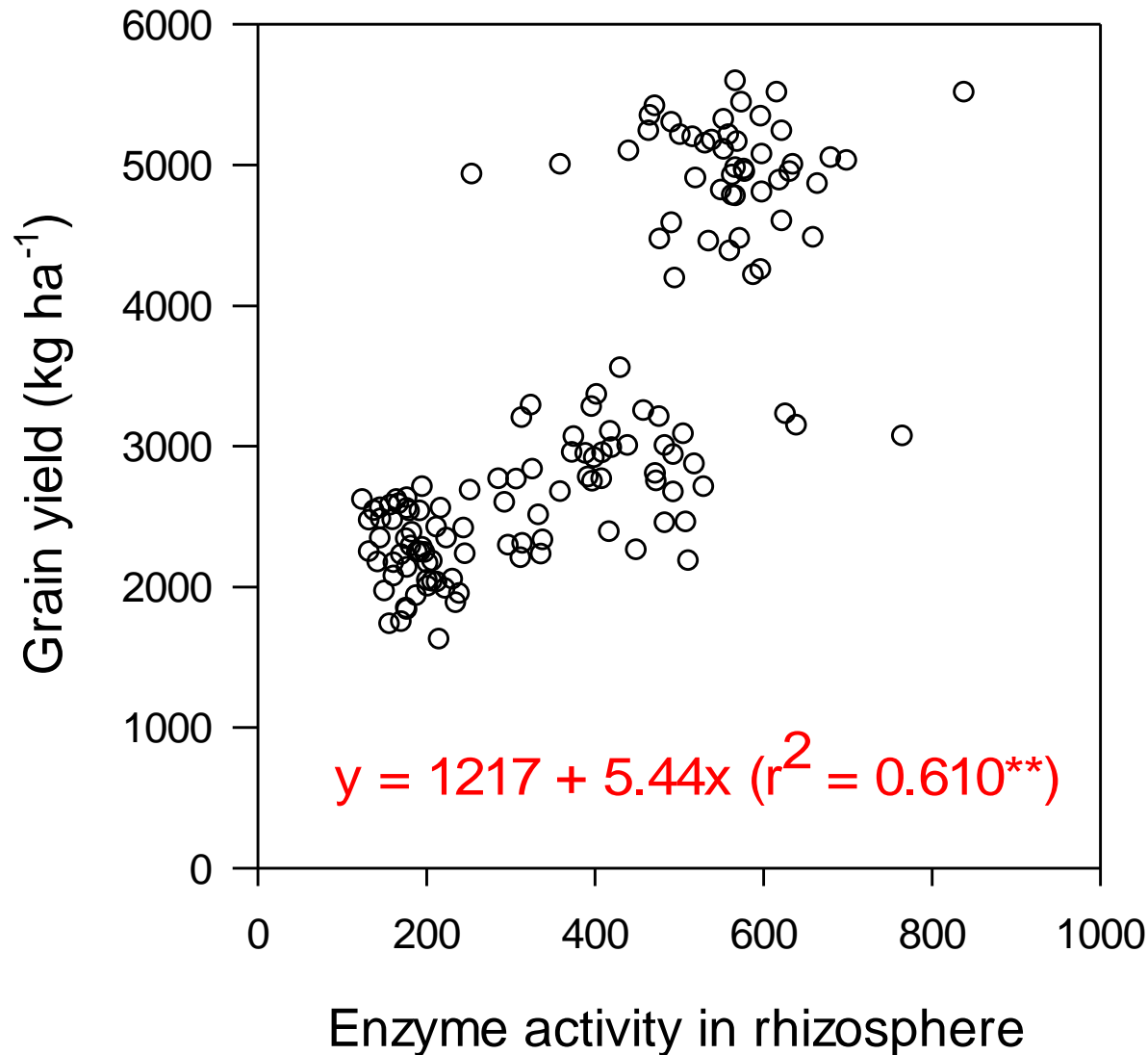


No correlations within sites.

Large, regional datasets - important.



2010 (3 sites): Enzyme Activity - Without Lacombe Data

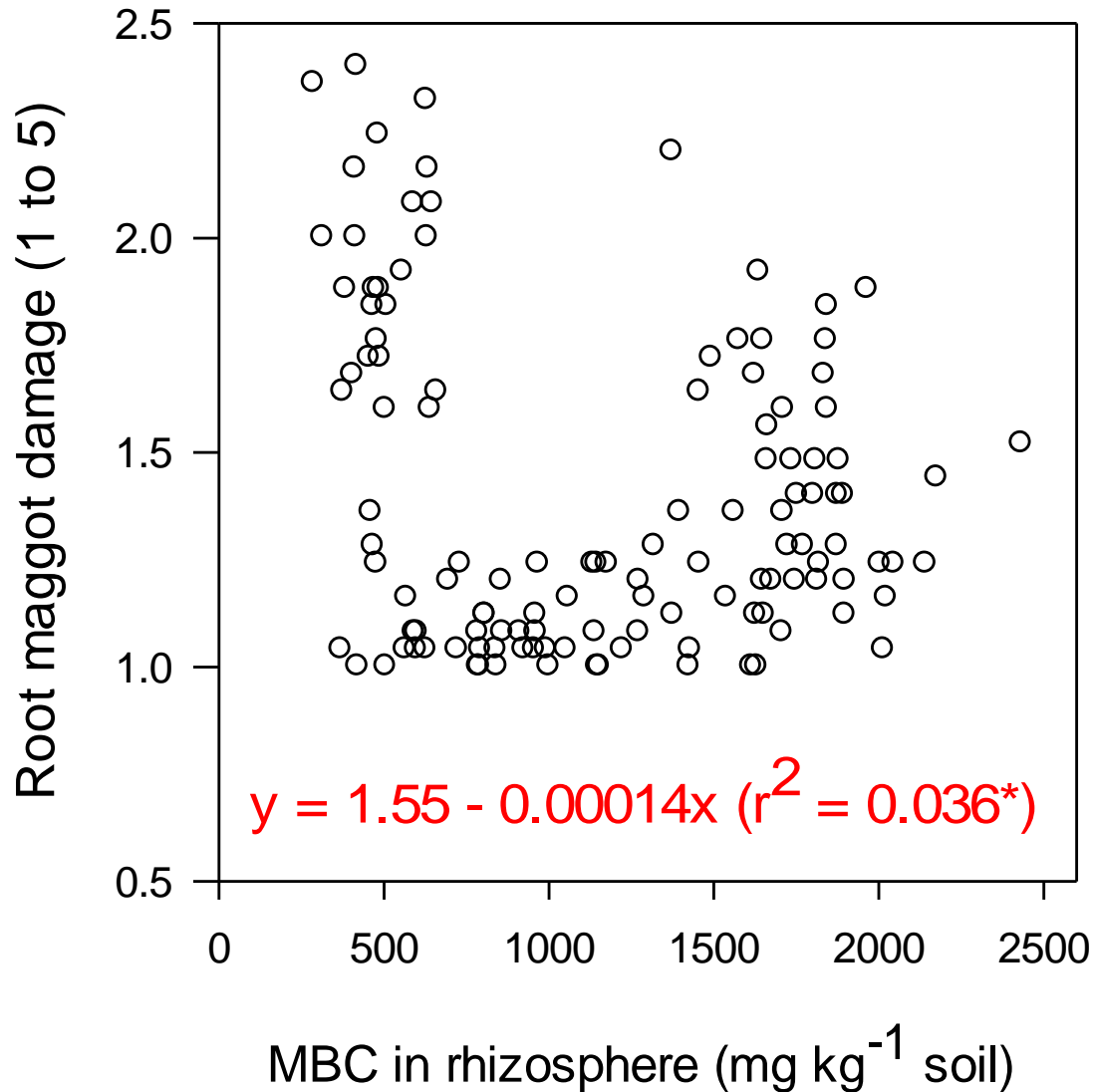


No correlations within sites.

Large, regional datasets - important.



Root Maggot Damage



Biological pest control

Less root maggot damage where MBC (and enzyme activity) - high.



Conclusion

- Crop/soil management practices that increased soil microbial biomass and enzyme activity were associated with improved crop **health** and **yields**.
 - Feedback: the crop affects rhizosphere soil microbials, which in turn affect the crop.
- **Multi-site experiments** show the relationships better than **single-site, single-year** experiments.



Acknowledgements

