EFFECT OF SUBSURFACE AND SURFACE TILLAGE ON STRUCTURE AND PERMEABILITY OF SOLONETZIC AND CHERNOZEMIC SOILS

R. Avila, J. Schoenau, T. King , B. Si, and M. Grevers

Department of Soil Science
College of Agriculture and Bioresources
University of Saskatchewan

INTRODUCTION

- Saskatchewan has 44% of Canada's total cultivated farmland (Statistics Canada, 2012).
- Considering soil physical attributes (structure, permeability) is important because it especially influences root growth, exploration volume, nutrient and water acquisition.
- Wheel traffic compaction and natural dense horizons can negatively affect the root zone (Soane et al., 1994).

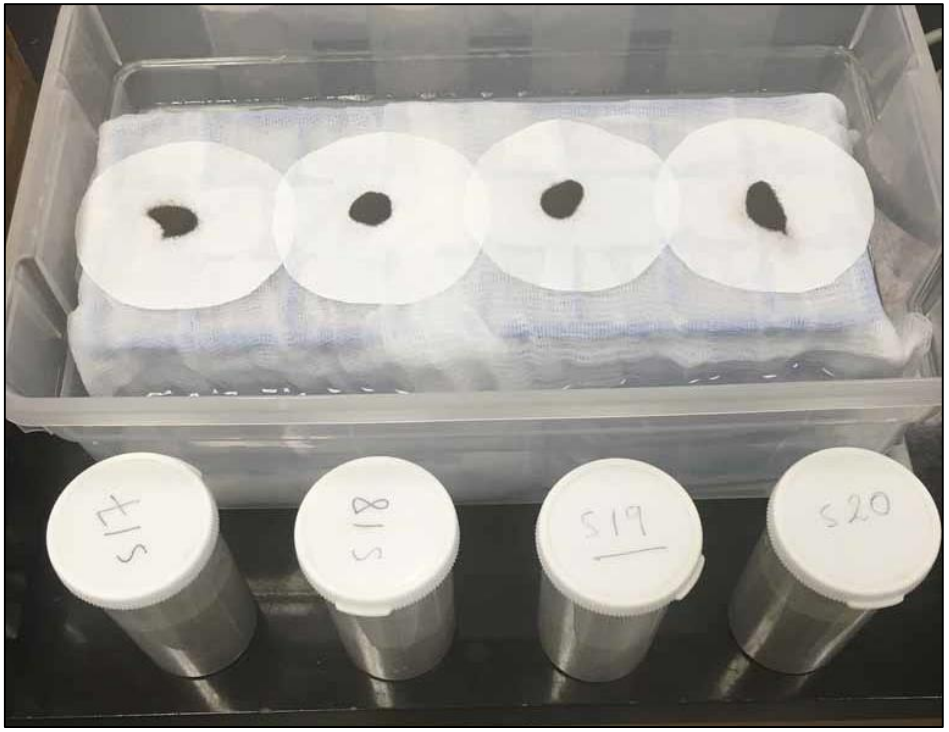
Tillage is one management strategy to alter structure, water and air permeability

INTRODUCTION

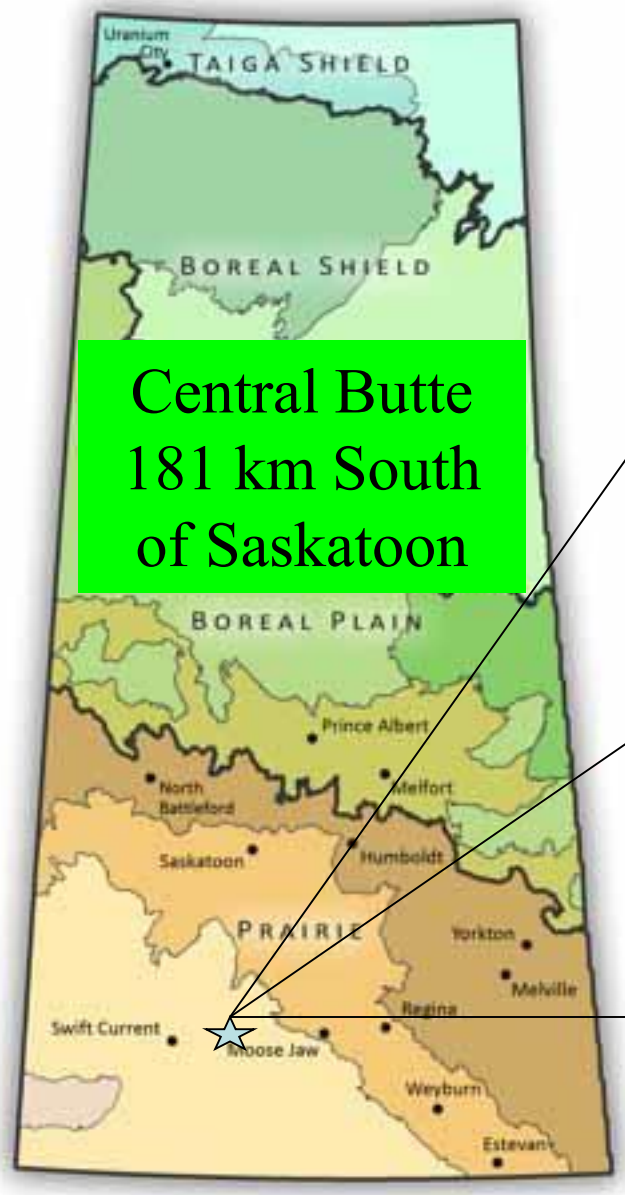
- High concentrations of Na lead to clay dispersion, formation of dense solonetzic B horizons that affect productivity and workability as the air, water, and penetration by roots and seeding tools are limited (Miller & Brierley, 2011).
- Subsoiling at depth (15-30cm) with a subsoiler may be a solution to improve conditions in compacted, dense subsoils (Thorne & Thorne, 1979; Ewen, 2015).
- Surface tillage with discs or combinations of disc + rolling basket (vertical tillage) is utilized for residue management and alter soil conditions at surface (0-20cm).
- Raking and burning may also be used for residue management of difficult crop residues like flax.

OBJECTIVES

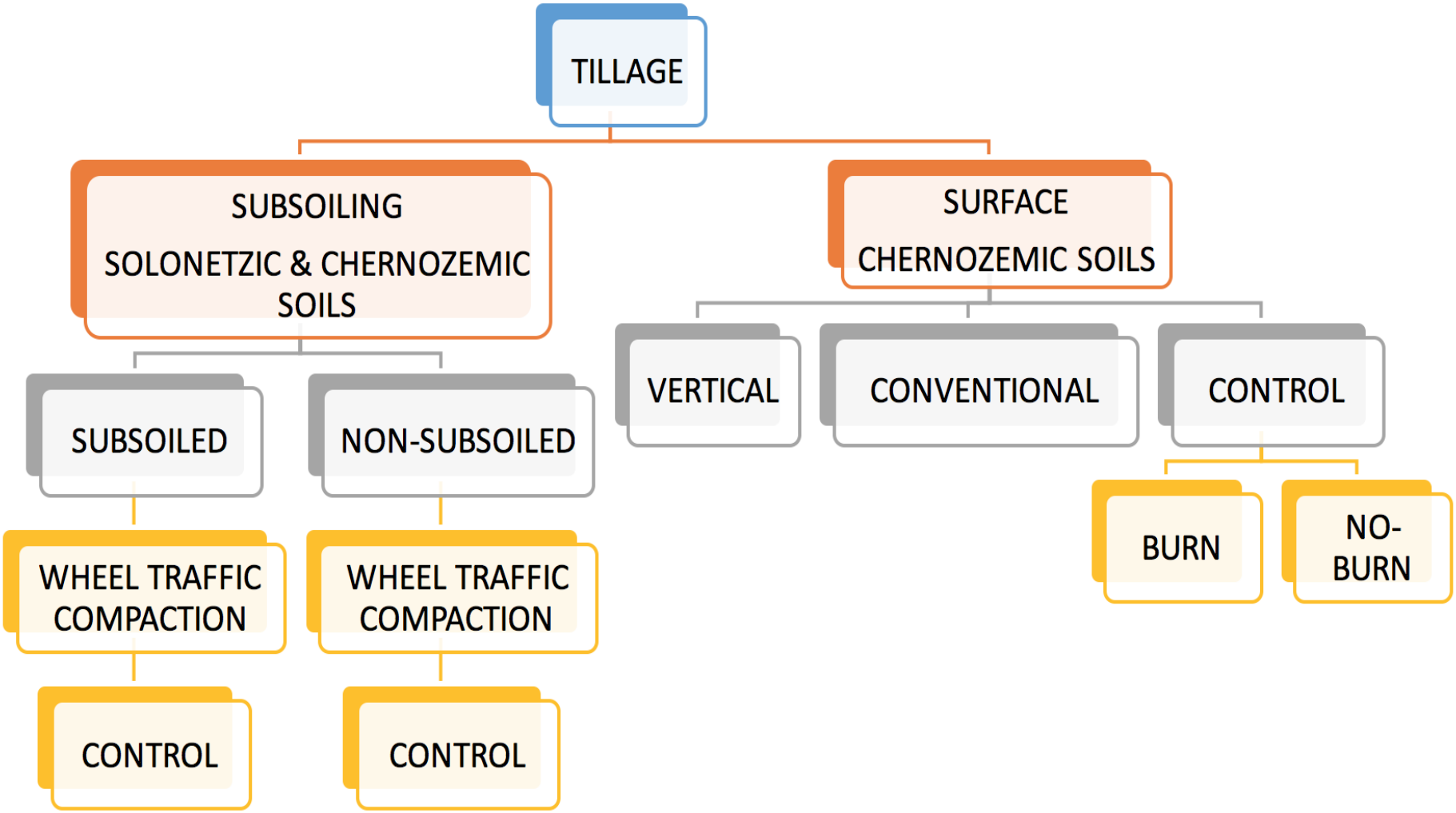
- To assess soil **water infiltration**, **air permeability**, **structural attributes**, as influenced by subsurface and surface tillage treatments in Solonetzic and Chernozemic soils.



STUDY LOCATION



STUDY DESIGN

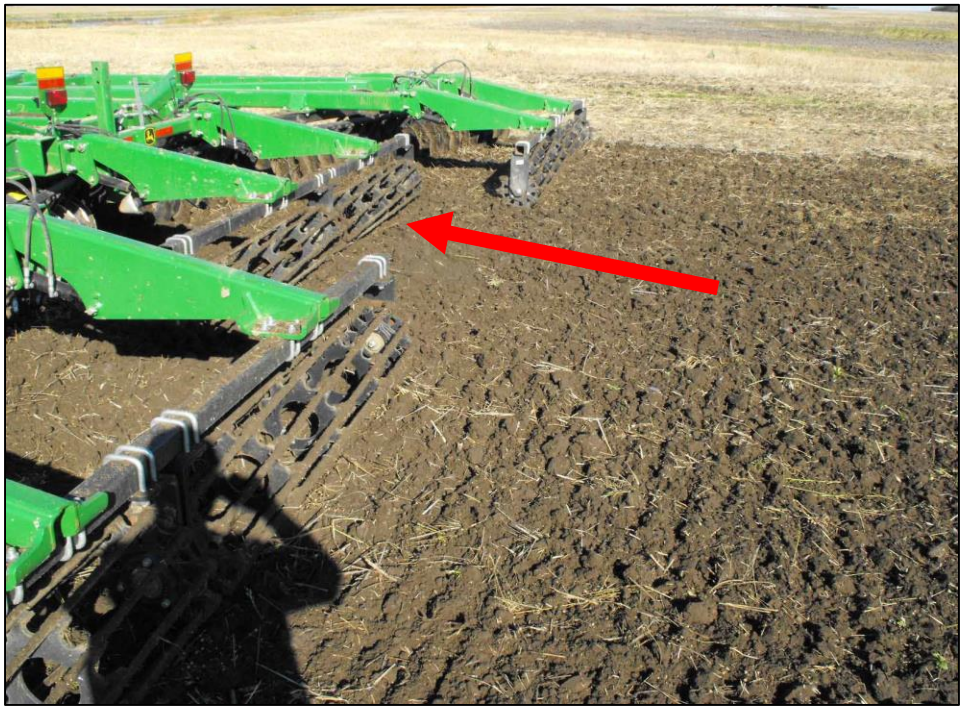


Subsoiling Tillage Operation

- A John Deere 2100 Minimum-Till subsoiler with five standards utilizing plow type shares spaced 76.0 cm apart and set to penetrate 30.0 cm into the soil on October 2nd, 2015.

Vertical and Conventional Tillage Operations

- Vertical Tillage with John Deere 2623VT to a depth of 5 cm on October 8th, 2015 .



- Conventional with John Deere Frontier TM5132 tandem disk to a depth of 8-10 cm on October 8th, 2015 .

Raked Burn & No-Burn (Flax stubble)

Measurements

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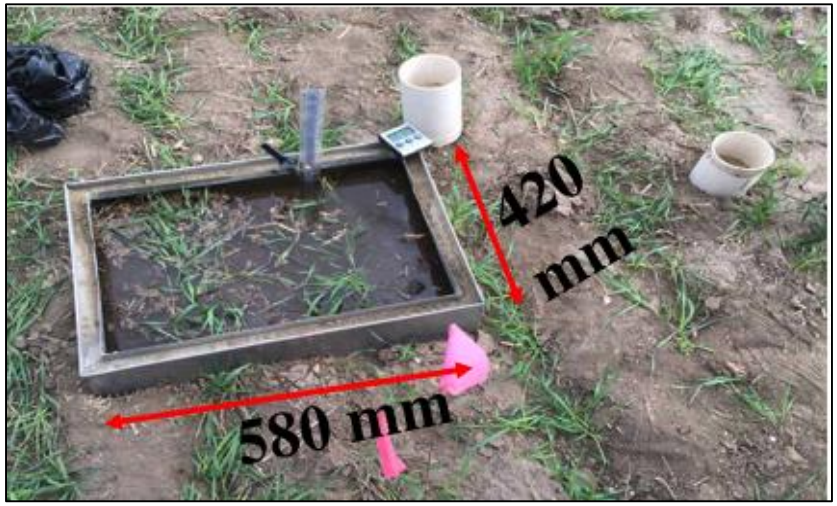
Field Saturated Hydraulic Conductivity



Air Permeability

Aggregate Size

Aggregate Stability


Results to Date

North Central Butte (Solonetzic) Site 2016 Subsoiling:

Measurements NCB 2016.

Site	Treatment		Measurements		
			Aggregate Size MWD (mm)	Hydraulic Conductivity (cm/min)	Air Permeability (m/s)
NCB	Subsoiled	Pre-Compacted	12.99	6.32E-02	1.15E-6
	Non-Subsoiled	Pre-Compacted	13.40	1.65E-02	9.78E-7
	(P value)		0.7335		309
	Subsoiled	Post-Compacted	12.37		)E-7
	Non-Subsoiled	Post-Compacted	14.05	5.05E-02	4.15E-7
	(P value)		0.4594	0.1399	0.6110
	Subsoiled	Control	10.03	2.86E-02	4.98E-7
	Non-Subsoiled	Control	11.60	6.23E-03	6.40E-7
	P value		0.1609	0.1474	0.3097

Wheel traffic on Solonetz increased aggregate size

South Central Butte (Chernozemic) Site 2016 Subsoiling:

Measurements SCB 2016.

Site		Treatment	Measurements		
			Aggregate Size MWD (mm)	Hydraulic Conductivity (cm/min)	Air Permeability (m/s)
SCB	Subsoiled	Compacted	AP increased by subsoiling of wheel traffic compacted areas		2.87E-6
		No Compacted			4.15E-6
	Non-Subsoiled	Compacted	15.14	1.58E-02	4.50E-7
		No Compacted	14.29	4.77E-02	1.38E-6
	P value	Subsoiling effects	0.7418	0.2901	0.0267
		Compaction	0.8645	0.3163	0.3028
		Till * Compaction	0.2190	0.9625	0.8685

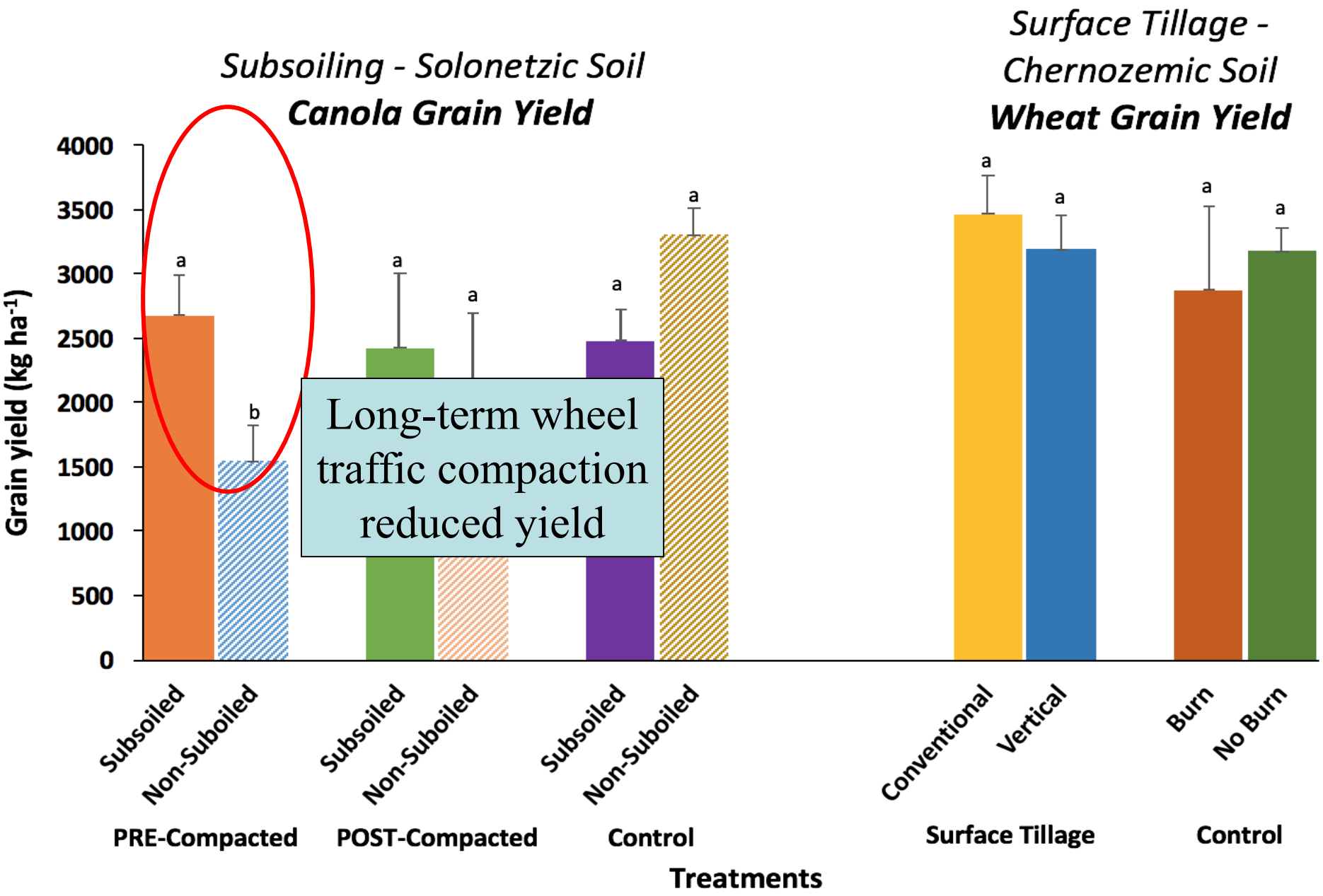
Vertical Tillage (Chernozemic) Site 2016

Measurements VTB 2016.

Site		Treatment	Measurements				
			Aggregate Size MWD (mm)	Hydraulic Conductivity (cm/min)	Air Permeability (m/s)	Aggregate Stability %Transmittance 625nm	
						2 Min.	20 Min.
VTB	Till	Conventional	12.67	1.09E-01	1.95E-6		
		Vertical	11.61	6.02E-02	6.09E-7		
	(P value)		0.2439	0.2140	0.0837		
	Control	Burn	12.43	5.37E-02	2.61E-6	0.86	0.79
		No Burn	12.58	6.91E-02	3.99E-6	0.88	0.82
	(P value)		0.9216	0.6967	0.3446	0.4738	0.3072
	P value	Till vs Control	0.6672	0.3853	0.0249	0.4013	0.6503

Action of baskets increases proportion of fine pores

Crop Yield 2016



Findings To Date

- Subsoiling increased air permeability at Solonetzic and Chernozemic sites.
- Long-term wheel traffic compaction significantly reduced yield of canola on Solonetz. Subsoiling tended to benefit canola grain yield.
- Vertical tillage decreased water and air permeability.
- No effect of vertical or conventional tillage or burning on wheat yield at the Chernozem surface site.
- I will examine 2nd year effects in 2017 with pea and wheat.

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