Subsurface Tillage Effects on Soil Strength and Crop Yield

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Introduction

- *Information is needed on the **benefits** that may be obtained from **subsoiling** to address adverse soil physical conditions that **exist naturally** and/or are aggravated by **heavy wheel traffic** in Saskatchewan soils.*
- *Deep tillage subsoiling requires specialized equipment, high draft requirement = ~$30.00/acre, reported benefits were limited where no dense subsoil or compaction (Ewen, 2015).*

Background

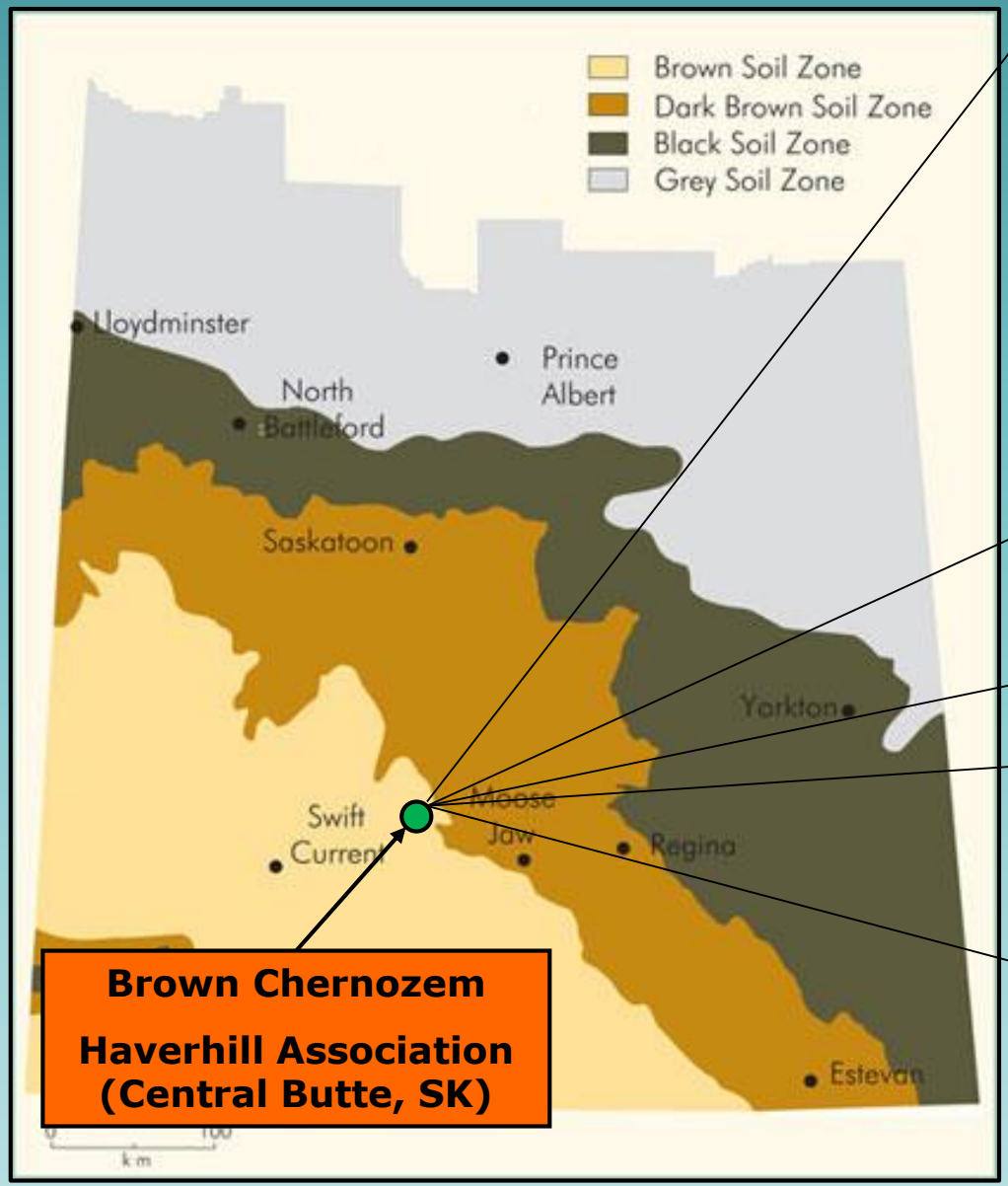
- *Previous research on deep tillage indicated it was not a viable option to address soil structural limitations in Saskatchewan due to severe soil disturbance and mixing of subsoil with surface soil (Grevers & de Jong, 1993; Grevers & Taylor, 1995).*
- *Subsoiling with an implement (Paraplow) designed to lift and shatter soil at depth while minimizing surface disturbance was found to reduce density, increase water infiltration but only produced small and variable yield increases in Chernozemic and Vertisolic soils (Ewen, 2015).*
- *Ewen (2015) recommended **subsoiling be restricted to only specific field areas where structural limitations** (soil compaction) have been identified.*



Study Objectives

- *To examine the effect that **deep subsoiling would have on soil penetration resistance, crop yield and economics in a Saskatchewan Brown Chernozem affected by truck wheel traffic.***

Study Location



Brown Chernozem

Haverhill Association (Central Butte, SK)

Study Design

- **Experimental Design:** RCBD with 3 Replicates of Treatments
- Treatments:

  1) Wheel Track (Compaction) - *Subsoiled*

  2) NO Wheel Track – *Subsoiled*

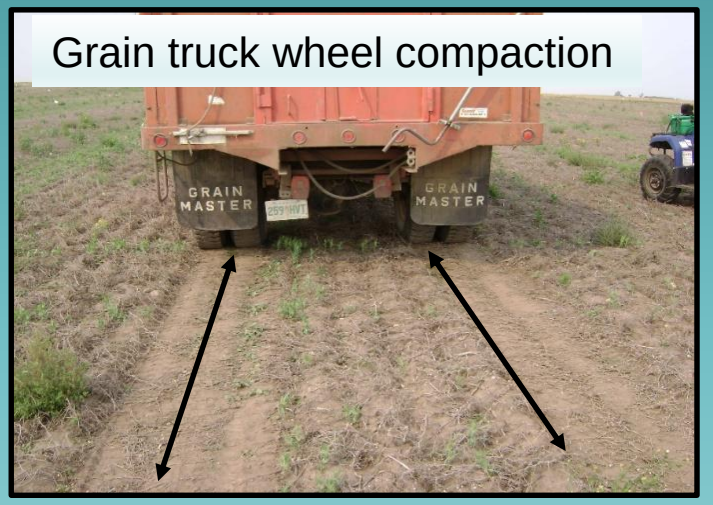
  3) Wheel Track (Compaction) - *NO Subsoiling*

  4) NO wheel track - *NO subsoiling*

Treatment Plot Transects:

  - 4 Transects spaced 10.0 m apart.
  - 5 measurement points per transect, spaced 10.0 m apart.

- Grain truck loaded to a weight of 10 T made 3 passes over selected transect points in 1st week Sept. prior to subsoiling in 1st week Oct., 2015.

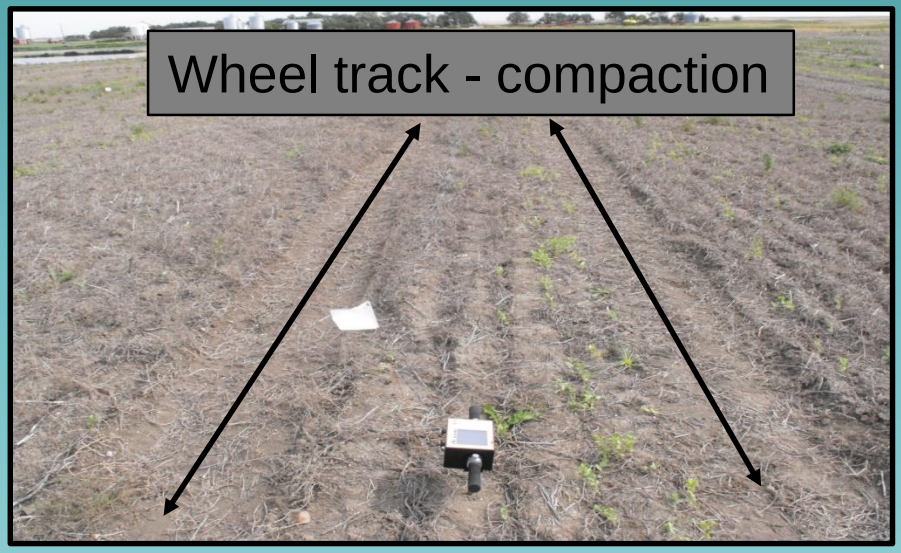


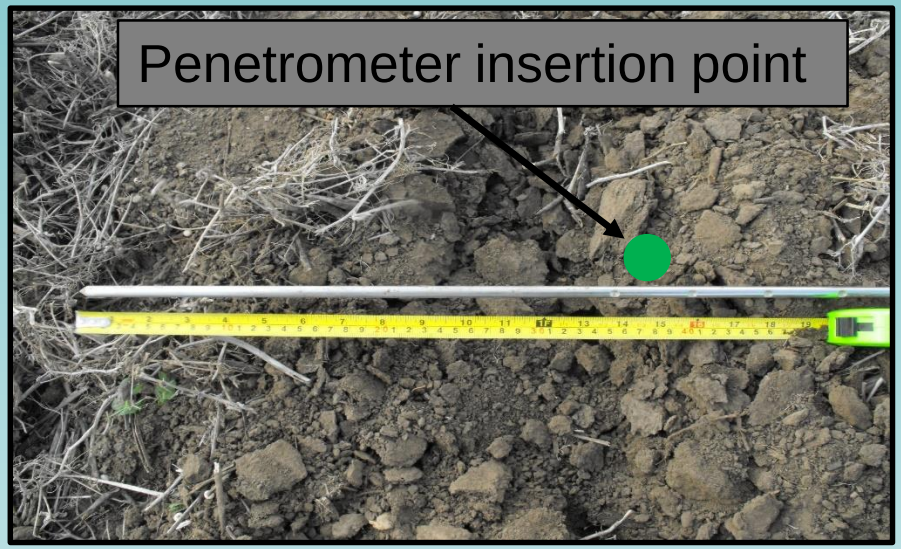
Subsoiling Treatments

- JD 2100 Minimum-Till Subsoiler equipped with 5 shanks spaced 76.0 cm apart, set to penetrate at 30.0 cm operating depth.
- Narrow profile subsoiler shank creates minimal surface disturbance with foot creating a lifting action. Soil profile was moist at time of subsoiling in fall 2015.

Soil Strength (penetration resistance)

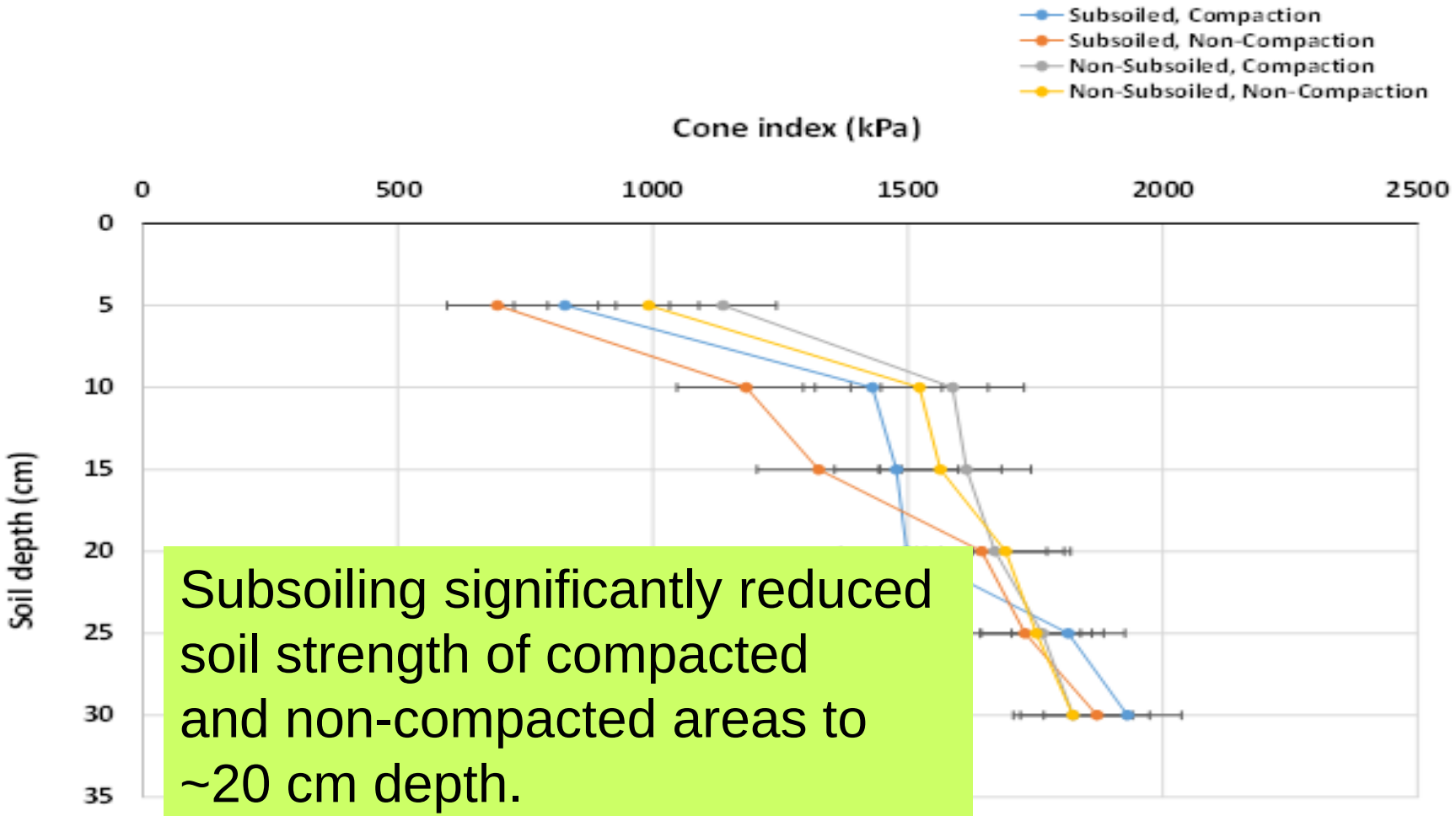
Measured using RIMIK CP 40 II wireless cone penetrometer





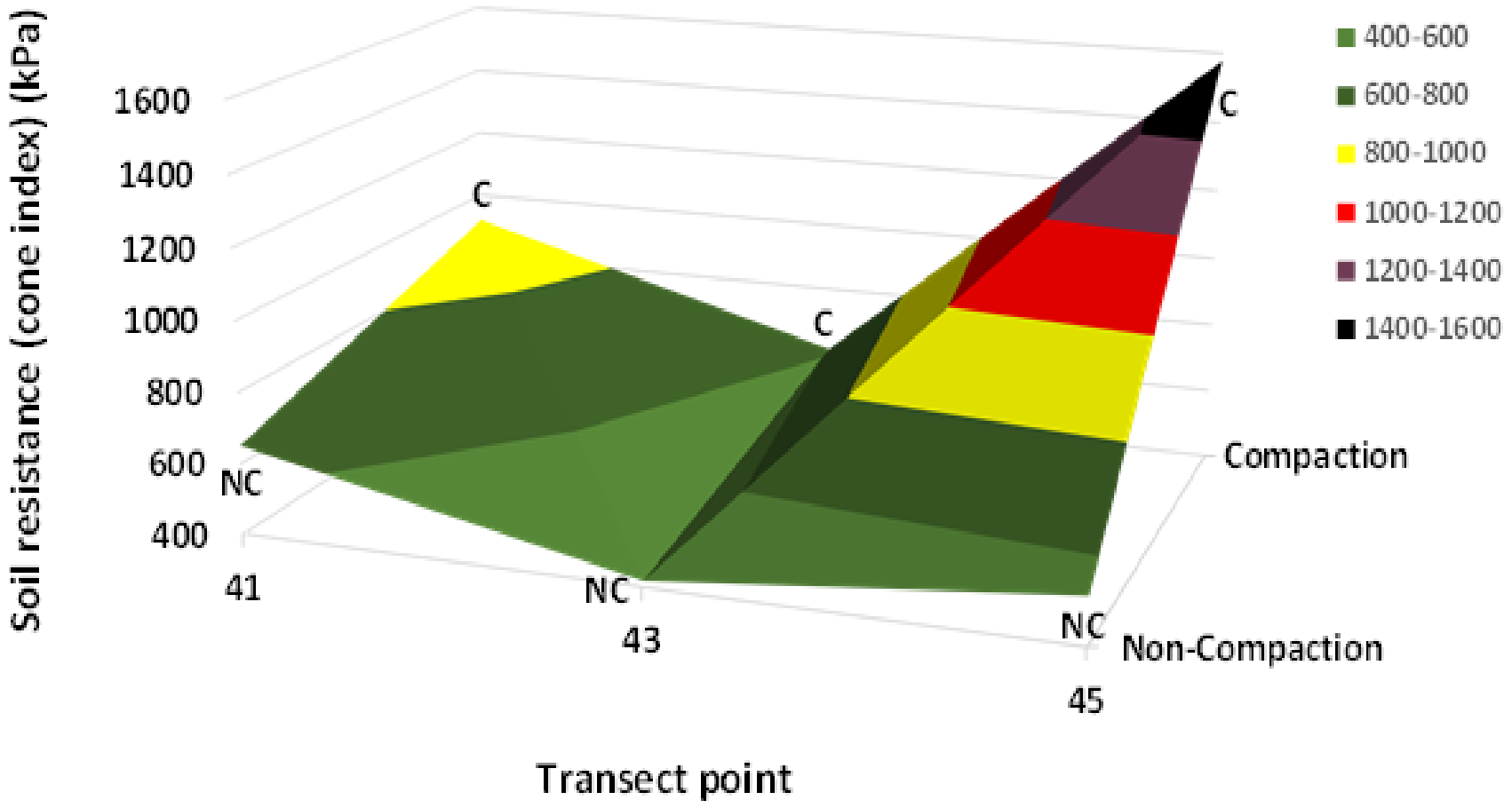
Results and Discussion

2016 - Soil Resistance in May After Fall 2015 Subsoiling

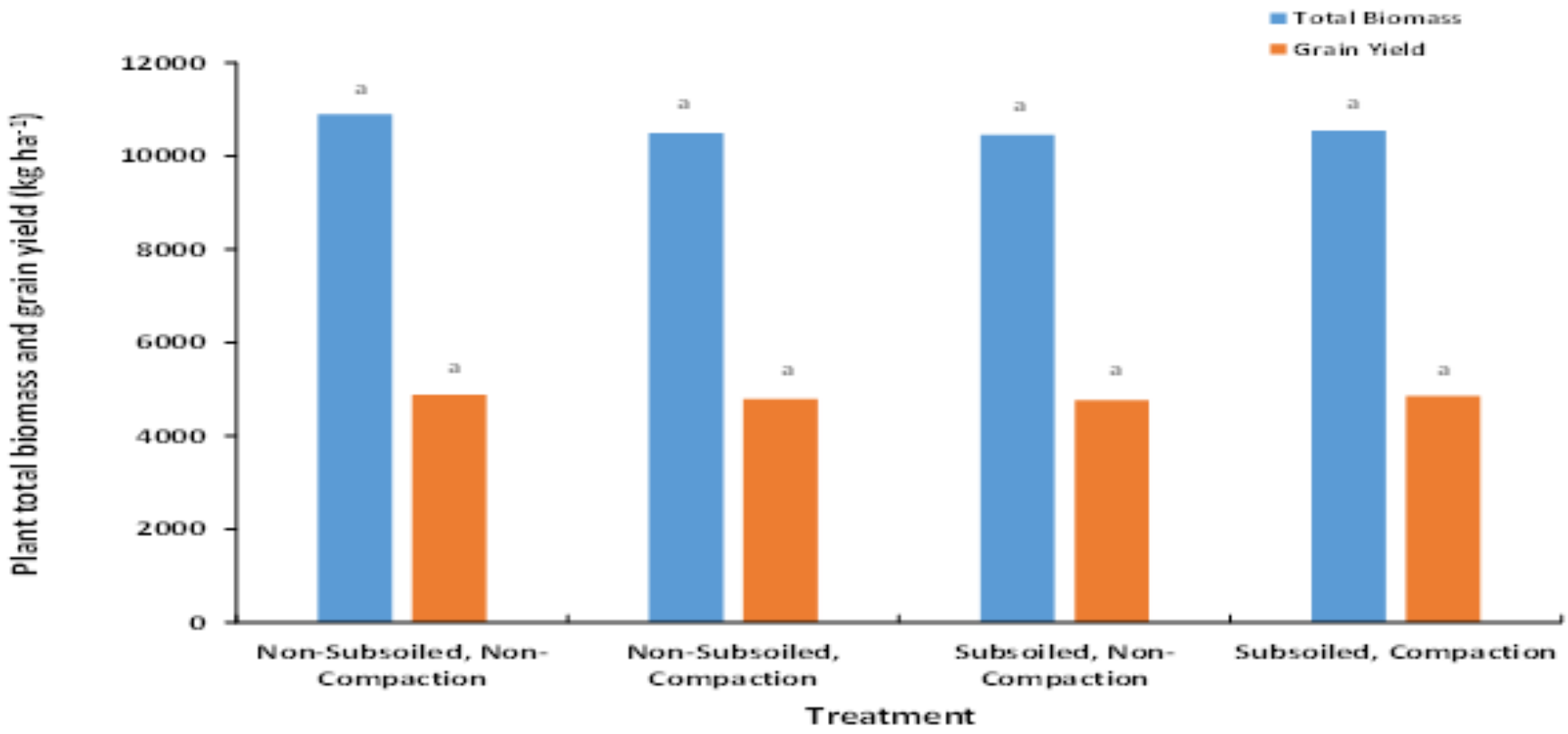


Subsoiling significantly reduced soil strength of compacted and non-compacted areas to ~20 cm depth.

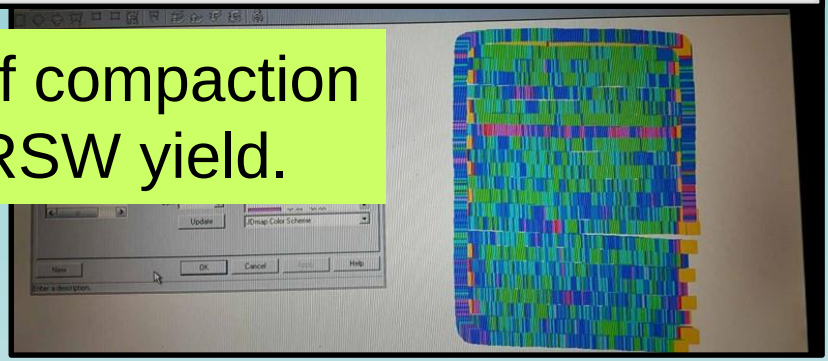
2016 Soil Resistance



2016 Crop Biomass



No significant effect of compaction or subsoiling on HRSW yield.



2016 Cost-Benefit of Subsoiling

- Fully subsoil 1.0 ha = **$83.00 ha^{-1}** ($50.30 tractor [$100.62† X 0.5 hr] + $32.70† subsoiler).
- Precision subsoil (15% of 1.0 ha): **$12.45 ha^{-1}**
- 2CW HRSW 13.0 protein: $220.00 MT^{-1}‡ = $0.22 kg^{-1}

  Fully Subsoiled ha Break-even: + 377 kg ha^{-1} or **~6.0 bu ac^{-1}**

  Precision Subsoiled ha Break-even: + 57 kg ha^{-1} or **~1 bu ac^{-1}**

➢ Subsoiled compacted areas +62 kg yield above Non-subsoiled areas, but yield benefit only in 15 % of field area.

Bottom Line:

Precision *subsoiling selected areas* ***potentially more economically favorable****, but w/o a yield benefit, matter of reducing loss vs. achieving a economic gain.*

	Grain Yield kg ha^{-1}	Grain Yield kg 0.30 ha^{-1}	HRSW Price CDN $ MT^{-1}	HRSW Return $ 0.30 ha^{-1}
Non-Subsoiled, Non-Compaction	4885	1465†	220.46‡	323.08
Non-Subsoiled, Compaction	4790	1437	220.46	316.80
Subsoiled, No Compaction	4770	1431	220.46	315.48
Subsoiled, Compaction	4852	1455	220.46	320.79

†Sask MOA 2016-2017 Farm Machinery Custom and Rental Rate Guide

‡Cargill, Moose Jaw, SK location. Delivered by truck. Online Quote January 31, 2017.

2016 Findings to Date

- Increased soil strength in wheel traffic affected areas was not an impediment to crop growth in 2016.
- No yield benefit from subsoiling wheel traffic or non-wheel traffic zones of the Chernozemic soil.
- Do effects *extend beyond the first year? 2017, 2018.*
  - ✓ *Effect of subsoiling on water, air permeability, soil aggregation* next R. Avila).

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Thanks For Your Attention!