Subsurface Tillage Effects on Soil Strength and Crop Yield

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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).
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.
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)
**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 1\textsuperscript{st} week Sept. prior to subsoiling in 1\textsuperscript{st} 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

Wheel track - compaction

Penetrometer insertion point
Results and Discussion
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

Soil resistance (cone index) (kPa)

Compaction
Non-Compaction

Transect point

41  43  45

NC  C  NC  NC

400-600
600-800
800-1000
1000-1200
1200-1400
1400-1600
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.

<table>
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<th>Grain Yield kg ha⁻¹</th>
<th>Grain Yield kg 0.30 ha⁻¹</th>
<th>HRSW Price CDN $ MT⁻¹</th>
<th>HRSW Return $ 0.30 ha⁻¹</th>
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†Sask MOA 2016-2017 Farm Machinery Custom and Rental Rate Guide
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.
  ✔ Effect of subsoiling on water, air permeability, soil aggregation next R. Avila).
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Thanks For Your Attention!