Yield, Nitrogen and Phosphorus Removal By Silage Barley in Commercial Fertilized and Manured Watersheds at the LFCE

2018 and 2019 Agronomic Results

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Adding manure to soil at the right time, rate and placement adds nutrients and organic matter that stimulates crop growth, microbial activity and increases carbon stored in the soil.

Adding manure recycles nutrients through soil-plant systems.
Objective

To evaluate agronomic and environmental performance of cattle manure applications made at constant (traditional) and variable (precision) rates.
Site Description

- Section 21 of RM 343 (Blucher)
- LFCE Feedlot
- Dark Brown Chernozem of Bradwell association.

- Map generated from Saskatchewan Soil Information System [https://sksis.usask.ca/#/map](https://sksis.usask.ca/#/map)
Study Treatments

- 4 year study with manure application every 2nd year: 2019, 2021.

- 3 ~40 acre treatment blocks: C, T, V

- Estimated removal of ~400 kg N/ha and 140 kg P₂O₅ ha⁻¹ by silage barley crop over 2 years.

- Non-composted content of ~0.6% N and ~0.3% P₂O₅

- Manure application based on P removal over 2 years -> 45 tonnes manure ha⁻¹

- 1st manure application May 1st and 2nd of 2019.
Equipment and Application

- 30 ft JBS Manure variable rate spreader with spreading width of 30 ft

- Variable rate application determined by Nutrien Echelon 16 yr NDVI imagery

- Variable Rate Precision Prescription (V zone): *Less productive, higher slope positions received greater amounts of manure, footslopes received less, depressions received least. Set back with no manure in basin centers*
Design

- 3 Watersheds in each treatment zone block

- Manure spreader used set-back from watershed basin centers in variable rate application zone.

- All zones (C, T, V) received 80 kg N ha\(^{-1}\) as anhydrous ammonia in April 2019 to account for low N availability of fresh manure N in year of application.

- Commercial fertilizer (C zone) received 50 kg P\(_2\)O\(_5\) ha\(^{-1}\) as MAP at time of seeding. Other zones received no P fertilizer.
Seeding

- Site seeded May 30th 2019

- 2 bu ac\(^{-1}\) 6-row Ranger barley (*Hordeum vulgare*) with 25 cm row spacing at a depth of 1.5 inches.

- 2019 growing season: drier than normal.
Biomass Yield, N and P Uptake Results
2018: Year Before Manure Application
2019: Manure Application

Upper Mid Foot Depression

YIELD (TONNES HA⁻¹)

Commercial Fertilizer Zone Silage Barley Yield

SLOPE POSITION

2018  2019

A   A   AB   AB

B   B   AB   AB
2018: Year Before Manure Application
2019: Manure Application
Stephen, change X axis to start with "Upper" at the left moving downslope to "Depression" at the right of the figure to be consistent with how you depict the N uptake and P uptake graphs.

Variable Rate Manure Zone Silage Barley Yield

2018: Year Before Manure Application
2019: Manure Application

YIELD (TONNES HA⁻¹)

SLOPE POSITION

Upper Mid Foot Depression

2018 2019
2019 Silage Barley Biomass N Uptake (kg N ha\(^{-1}\))

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2019 Silage Barley Biomass P Uptake (kg P ha$^{-1}$)

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*Values marked with the same letter are not significantly different at the 5% level of probability.*
Soil N & P Results
Fall (Post - Harvest) 2018 (Before Manure) & 2019 (Manure Applied) Soil NO$_3$-N 0-15 cm (kg N ha$^{-1}$)

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<tr>
<th>Location</th>
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Commercial Fertilizer: C

Constant Rate Manure: T

Variable Rate Manure: V

2018
2019
Fall (Post-Harvest) 2018 (Before Manure) and 2019 (Manure Application) Soil MK-P 0-15cm (kg P ha\(^{-1}\))
Key findings to date

- Overall, silage barley yields among treatment zones C, T, and V were similar, not significantly different.
- Yields and nutrient uptake were more variable across constant rate landscapes. Variable rate smoothing out yield and uptake.
- Reduction or elimination of manure application in footslopes and depressions did not result in yield reduction. N and P uptake, however, were reduced.
- Variable rate manure application resulted in significantly greater NO$_3$-N in the top 0-15 cm of the upper slope position.
- In dry years, increasing rate on upper slopes may not be beneficial.
- Accumulation of soil available P at lower slope positions in commercial fertilizer and constant rate manure application zones points to benefit from reduced rates in these landscape positions.
Future Research

- Continue monitoring yields, N and P uptake, soil residual P and N as manure organic matter mineralizes over subsequent growing seasons.

- Evaluate accumulation of NO$_3$ and P in the soil at depth over time.
Acknowledgments

- Team Schoenau
  - Cory, Ranjan, Tom, Ryan, Nancy, Colin, Gravel and Deborah
- BCRTU Staff: Brian, Teresa and Roger
- Brianna and Amy
- Nutrien® Echelon
- Saskatchewan Agriculture Development Fund
Questions