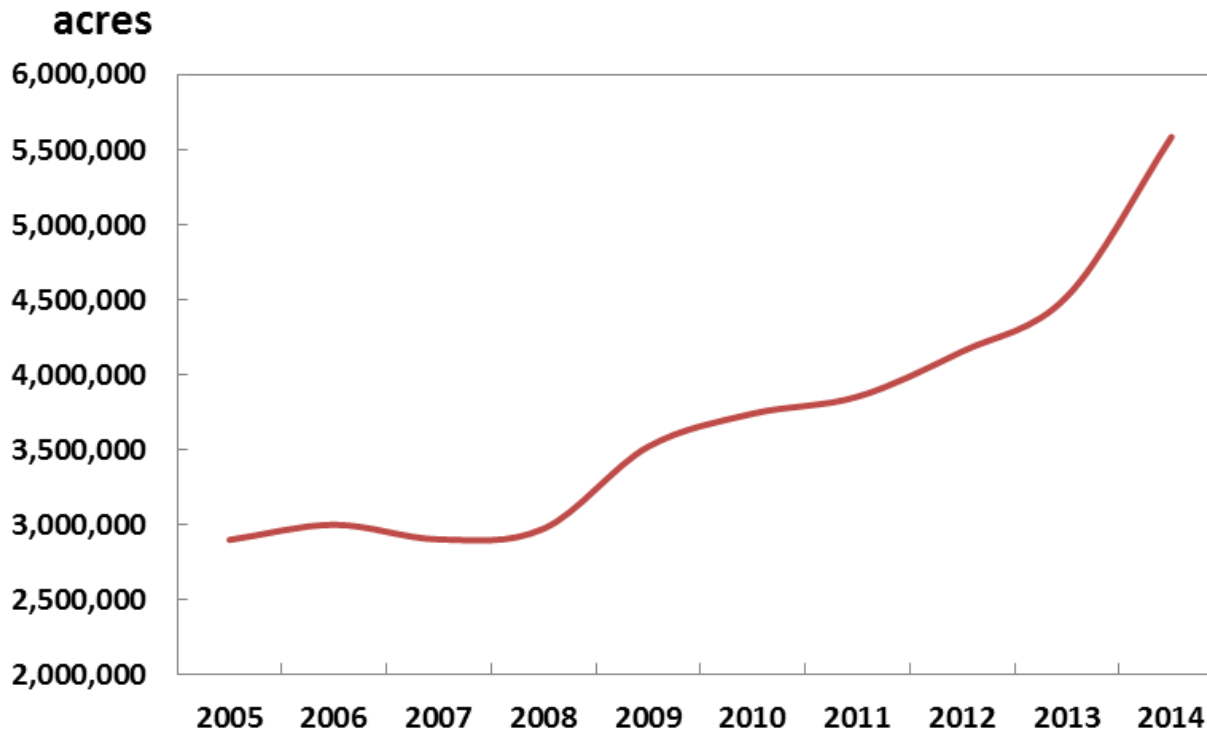




Soybean yield and release of nutrients from soybean residue in comparison to pea and lentil in Saskatchewan soils

Jing Xie, Jeff Schoenau, Tom Warkentin

Canadian national soybean acreage, 2005 to 2014



In Saskatchewan:

- 2012: 75,000 acres
- 2013: 170,000 acres
- 2014: 300,000 acres

Mainly in Ontario, Quebec, and Manitoba

Objectives

The primary objective of this study is to quantify the nutrient uptake, content, and release by three soybean varieties and their impacts on the yield and nutrition of succeeding crops, in comparison to pea and lentil, under Saskatchewan growing conditions.

Objectives

A secondary objective is to provide a detailed tracking of the cycling of nitrogen contained in the pulse crop residue through the soil-plant system.

Hypotheses

It is hypothesized that soybean, pea, and lentil differ in their:

- Nutrient content and uptake, release of available nutrients from residue, and nutrient distribution in plant components;
- Contribution to the nutrition and yield of succeeding cereal crops in rotation and to soil nutrient stores;
- Influence on soil microbial activity and the fate of nutrients in the soil-plant system.

This presentation will discuss:

Recovery efficiencies of nutrients contained in pea, lentil and soybean above-ground residue

Impacts of pea, lentil, and soybean residue on soil microbial activity and greenhouse gas production

The yield of pea, lentil and soybean at four Saskatchewan sites in 2014

This presentation will discuss:

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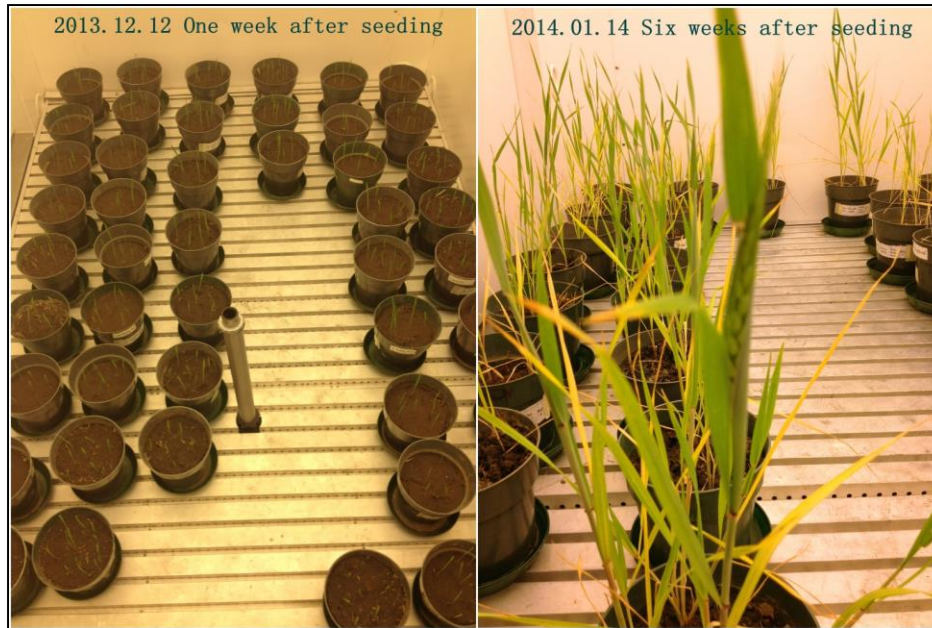
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Table 1 Total added N and P per pot in pea, lentil, and soybean residues (1 kg soil)

Residue	N content	P content	Residue rate	Added N	Added P
	%			g/kg soil	mg/ kg soil
pea	1.27	0.063	9.27	117.69	5.84
lentil	1.11	0.088	4.29	47.58	3.77
soybean	0.764	0.053	5.47	41.81	2.90



- Ardill clay loam soil;
- Soil water content was maintained at near field capacity;
- Wheat was harvested 7 weeks after germination.

Table 2 Summary of treatments

Trt 1	Trt2	Trt3	Trt4	Trt5	Trt6	Trt7
50 mg N/kg soil	100 mg N/kg soil	200 mg N/kg soil	Pea residue	Soybean residue	Lentil residue	Control

Table 3 Wheat yield, nutrient uptake, and nutrient recovery efficiency with different treatments. NRE and PRE are nitrogen recovery efficiency and phosphorus recovery efficiency, respectively.

Soil type	Treatment	Yield	N uptake	P uptake	NRE	PRE
		kg/ha	kg N /ha	kg P/ha	_____ % _____	
Ardill	50_urea	1256 _{bc}	11.0 _b	4.1 _b	15.2 _a	6.5 _b
	100_urea	1608 _b	11.8 _b	4.2 _b	9.1 _{ab}	3.4 _b
	200_urea	3072 _a	17.9 _a	7.8 _a	10.1 _{ab}	4.9 _b
	Control	678 _d ^A	6.8 _d	2.4 _c	-	-
	Lentil	1033 _{bcd}	10.3 _b	3.4 _{bc}	13.4 _{ab}	51.5 _a
	Pea	873 _{cd}	9.4 _{bc}	3.4 _{bc}	4.0 _c	33.7 _a
	Soybean	700 _{cd}	7.4 _{dc}	2.4 _c	2.7 _c	3.2 _b

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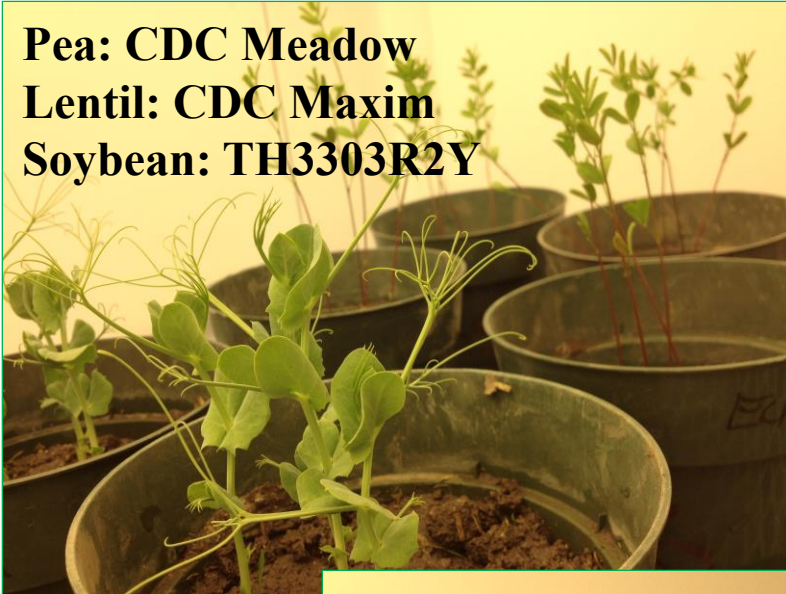
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Pea: CDC Meadow
Lentil: CDC Maxim
Soybean: TH3303R2Y



6 weeks



**10 kg N /ha NH_4NO_3
labelled with N-15**



Table 4 Cumulative CO₂ emissions and cumulative N₂O emissions from soils amended with or without residue at the end of the six-week incubation. Values followed by the same letter are not significantly different from each other at the significance level of $p < 0.15$. Values are the median of six replicates rather than means, as the data are non-normally distributed.

Treatment	Cumulative CO ₂ emission	Cumulative N ₂ O emission
	g/m ² /6 weeks	mg/m ² /6 weeks
Control	329.3 bc	2.3 a
Pea	294.6 c	12.6 a
Lentil	340.5 b	8.2 a
Soybean	408.1 a	3.0 a

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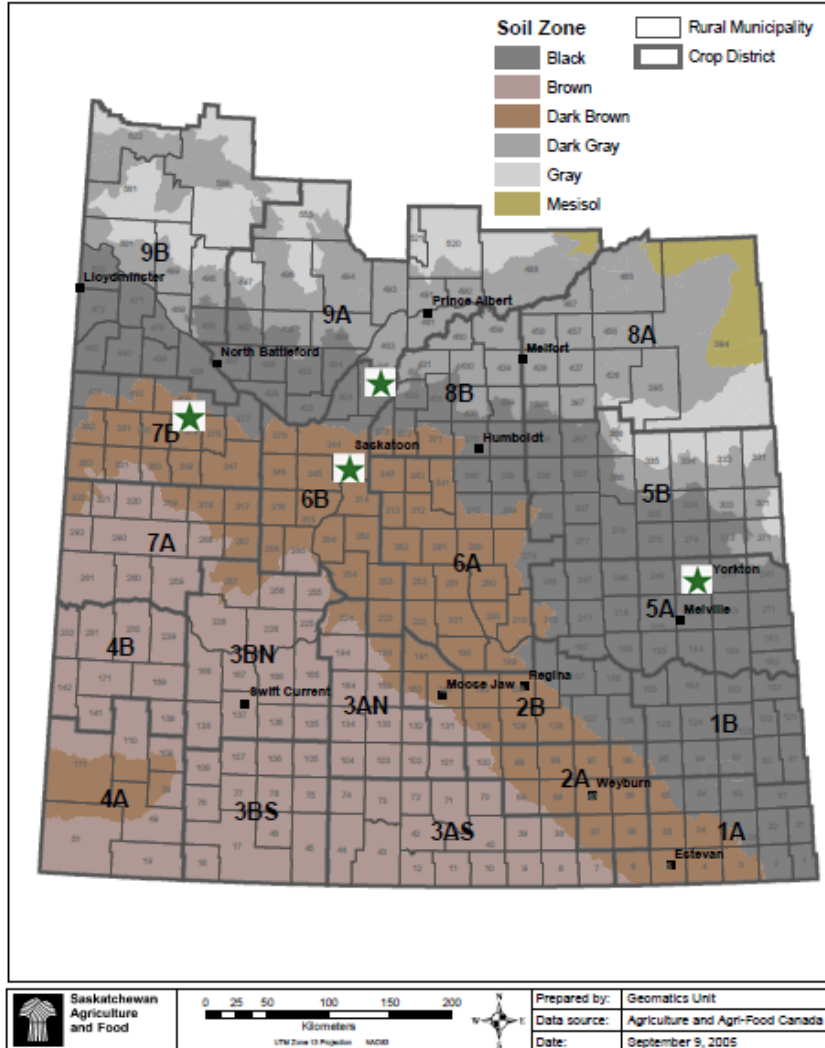
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Soil Zones of Saskatchewan



Four field sites:

- Saskatoon (Dark Brown)
- Scott (Dark Brown)
- Rosthern (Black)
- Yorkton (Black)

Two field seasons:

- 2014 (Soybean, lentil, pea)
- 2015 (Spring wheat)

Experimental design:

- Randomized complete block design (RCBD)

Table 5 Basic information on crop varieties in the field study

Crop	Variety	Market class	Breeder	Herbicide resistance	Variety #	¹⁵N-study
pea	CDC Meadow	yellow	CDC	group 2	P-1	✓
pea	CDC Amarillo	yellow	CDC	group 2	P-2	×
pea	CDC Limerick	green	CDC	group 2	P-3	×
lentil	CDC Impower	large green	CDC	group 2	L-1	×
lentil	CDC Invincible	small green	CDC	group 2	L-2	×
lentil	CDC Maxim	small red	CDC	group 2	L-3	✓
soybean	P001T34R	oilseed	Pioneer Dupont	group 2	S-1	×
soybean	TH3303R2Y	oilseed	Thunder	group 2	S-2	✓
soybean	NSC Moosomin	oilseed	Northstar Genetics	group 2	S-3	×
wheat	CDC Abound	hard red	CDC	group 2	W	✓

Table 6 Pre-seeding May 2014 available nutrient content in 0-15 cm at the four sites (kg ha⁻¹).

Site	Texture	NO ₃ -N	P	SO ₄ -S	K	pH	EC
Saskatoon	Loam	19	33	>48	>600	5.9	0.6
Scott	Loam	25	26	9	>545	6.6	0.1
Rosthern	Loam	6	28	5	322	6.2	0.1
Yorkton	Loam	8	47	5	463	7.9	0.1

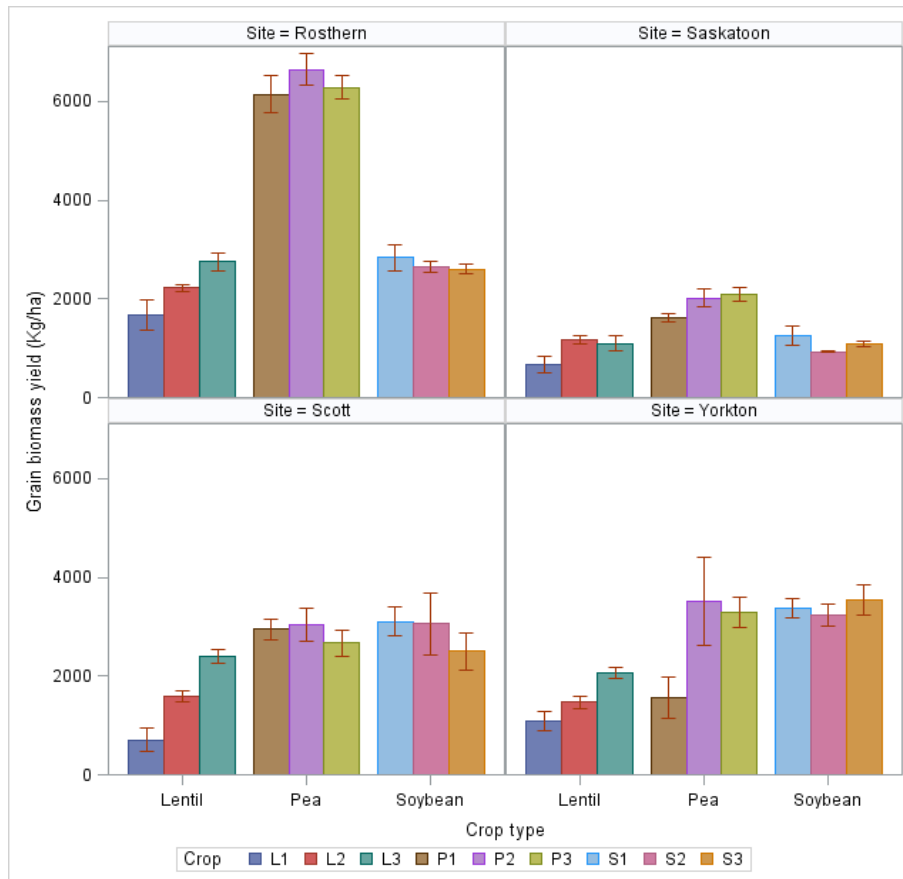


Fig.1 Grain yield of lentil, pea, and soybean at four sites. Error bars represent one standard error.

- Pea and lentil yielded highest at Rosthern (Black), soybean highest at Yorkton (Black); Saskatoon site (Dark Brown) had the lowest grain and total biomass yield for all crops.
- Peas \geq Soybean $>$ Lentil
- Variety effects were only detected at Scott site for lentils and at Yorkton site for peas.

Conclusions

- Of the three residues, lentil had the highest nitrogen recovery and soybean the lowest.

The N recovery from lentil residue was similar to inorganic N fertilizer addition at a rate of 50 mg urea N/kg soil.

- Lentil residue supplied the greatest amount of N and P and soybean the least.

- Pulse crop residue type did not significantly influence nitrous oxide emissions, but soybean residue did significantly increase carbon dioxide production.

- Pulse grain yield was the highest at Rosthern site, and the lowest at Saskatoon site, with Scott site and Yorkton site intermediate.
- The three tested modern short-season soybean varieties yielded comparably or better than pea and lentil at three of the four sites, with only peas having superior yield at Rosthern site.
- Variety effects were greatest for lentil.

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Thank you!

