



# Residual effects of preceding crops on wheat yield and profitability

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# Research background

- Pulse crops have become essential to farming practices in the Northern Great Plains, but less known about their residual effects and how rotation systems with different crop mixes affect the economic returns.

# Objectives

- The objective of this study was to evaluate residual effects of preceding crops on wheat yield and profitability

# Experimental Design

A four-year cycle crop rotation study (wheat crop with a range of pulse and mustard at different frequency and sequence in rotation) was established at three sites

- Swift Current (Swift1) in 2010
- Swift Current (Swift2) in 2011.
- Crop Diversification Centre South in Brooks, Alberta in 2011.

# Crop rotation and pulse crop frequency in rotation at Swift1, Swift2 and Brooks

Crop rotation <sup>a</sup>	Crop sequence				# of pulse phase	# of oilseed phase
	Year 1	Year 2	Year 3	Year 4		
1: W-W-W-W	wheat	wheat	wheat	wheat	0	0
2: P-W-W-W	field pea	wheat	wheat	wheat	1	0
3: C-W-W-W	chickpea	wheat	wheat	wheat	1	0
4: P-W-P-W	field pea	wheat	field pea	wheat	2	0
5: P-W-L-W	field pea	wheat	lentil	wheat	2	0
6: L-W-C-W	lentil	wheat	chickpea	wheat	2	0
7: L-W-L-W	lentil	wheat	lentil	wheat	2	0
8: C-W-C-W	chickpea	wheat	chickpea	wheat	2	0
9: P-M-C-W	field pea	mustard	chickpea	wheat	2	1
10: P-M-L-W	field pea	mustard	lentil	wheat	2	1
11: P-P-P-W	field pea	field pea	field pea	wheat	3	0
12: L-L-L-W	lentil	lentil	lentil	wheat	3	0
13: C-C-C-W	chickpea	chickpea	chickpea	wheat	3	0
14: L-C-P-W	lentil	chickpea	field pea	wheat	3	0

<sup>a</sup>W=wheat, C=chickpea, P=pea, L=lentil and M=mustard.

# Field experiments 2009 - 2014



**Field plots in Swift Current**

# Crop seed and fertilizer application rates

Product	Swift1	Swift2	Brooks
<b>Seed</b>	----- Kg ha <sup>-1</sup> -----		
Wheat (AC Lillian)	78	84	65
Chickpea (CDC Frontier)	207	243	200
Field pea (CDC Meadow)	200	204	162
Lentil (CDC Maxim CL)	56	56	56
Mustard (Cutlass)	6	6	6
<b>Fertilizer</b>			
yr1 N for wheat plots	80	80	80
yr1 N for non-wheat (pulse) plots	4	4	4
yr1 P <sub>2</sub> O <sub>5</sub> for all plots	17	17	17
yr2 - yr4 N for wheat plots	55	55	50
yr2 N for mustard plots	55	55	50
yr2 - yr4 N for non-wheat (pulse) plots	5	5	4
yr2 - yr4 P <sub>2</sub> O <sub>5</sub> for all plots	22	22	20

# Methodology

- Annual net revenue (NR) was calculated for wheat by subtracting production and input expenses from gross income.
- Average 8 years (2010-2017) input and crop prices was used to calculate NR.
- Input and crop price distributions were used in Risk analysis but the results are not presented here.



## Residual effect of preceding crops on wheat yield at Swift Current site-year 1 (Swift1) and site-year 2 (Swift2), Saskatchewan and Brooks, Alberta

Crop rotation <sup>†</sup>	Crop yield (kg ha <sup>-1</sup> )											
	Swift1			Swift2			Brooks			Swift1, Swift2 and Brooks combined		
	Yr 2	Yr 3	Yr 4	Yr 2	Yr 3	Yr 4	Yr 2	Yr 3	Yr 4	Yr 2	Yr 3	Yr 4
1: W-W-W-W	2189b	2034a	1914c	2054b	2200a	2456bcd	2527a	3698a	3138abc	2256b	2644b	2503cd
2: P-W-W-W	2884a	2096a	2232bc	2398a	2475a	2385cd	3166a	4133a	2745abc	2816a	2901a	2454d
3: C-W-W-W	3234a	2227a	2335abc	2299a	2443a	2367cd	3188a	3454a	2739abc	2907a	2708ab	2480d
4: P-W-P-W	2920a		2652ab	2310a		2901abc	3090a		3356ab	2774a		2970ab
5: P-W-L-W	2943a		2520abc	2346a		2645bcd	3382a		3529a	2890a		2898abc
6: L-W-C-W	2879a		2189bc	2473a		2377cd	3328a		2673bc	2893a		2413d
7: L-W-L-W	2849a		2685ab	2446a		2810bcd	3175a		3152abc	2823a		2882bc
8: C-W-C-W	2821a		2333abc	2374a		2366d	2987a		2461c	2727a		2387d
9: P-M-C-W			2569abc			2669bcd			2706bc			2648bcd
10: P-M-L-W			2905a			2955ab			3101abc			2987ab
11: P-P-P-W			3002a			3416a			3455ab			3291a
12: L-L-L-W			2507abc			2926ab			3517a			2983ab
13: C-C-C-W			2393abc			2369cd			3419ab			2727bcd
14: L-C-P-W			2782ab			2990ab			3167abc			2980ab

Note: W=wheat, C=chickpea, P=pea, L=lentil and M=mustard. In the first year of study, all crops were seeded on wheat stubble seedbeds across three sites-years. Means followed by the same lower letter in a column for each site-year are not significant ( $p > 0.05$ ).

# Residual effect of preceding crops on net revenue of wheat production at Swift Current site-year 1 (Swift1) and site-year 2 (Swift2), Saskatchewan and Brooks, Alberta.

Crop rotation	Net revenue (\$ yr <sup>-1</sup> ha <sup>-1</sup> )											
	Swift1			Swift2			Brooks			Swift1, Swift2 and Brooks combined		
	Yr 2	Yr 3	Yr 4	Yr 2	Yr 3	Yr 4	Yr 2	Yr 3	Yr 4	Yr 2	Yr 3	Yr 4
1: W-W-W-W	-183b	-138a	-186c	-134b	-229a	-38bcd	-107a	89a	78abc	-141b	-93b	-49cd
2: P-W-W-W	-50a	-126a	-125bc	-68a	-176a	-51cd	16a	172a	2abc	-34a	-43a	-58d
3: C-W-W-W	18a	-101a	-105abc	-87a	-182a	-55cd	21a	42a	1abc	-16a	-80ab	-53d
4: P-W-P-W	-43a		-44ab	-85a		48abc	2a		119ab	-42a		41ab
5: P-W-L-W	-38a		-70abc	-78a		-1bcd	58a		153a	-19a		27abc
6: L-W-C-W	-51a		-134bc	-54a		-53cd	48a		-12bc	-19a		-66d
7: L-W-L-W	-56a		-38ab	-59a		30bcd	18a		80abc	-32a		24bc
8: C-W-C-W	-62a		-106abc	-73a		-55d	-18a		-53c	-51a		-71d
9: P-M-C-W			-60abc			3bcd			-6bc			-21bcd
10: P-M-L-W			4a			58ab			70abc			44ab
11: P-P-P-W			23a			147a			138ab			103a
12: L-L-L-W			-72abc			53ab			150a			44ab
13: C-C-C-W			-94abc			-54cd			131ab			-6dbc
14: L-C-P-W			-19ab			65ab			83abc			43ab

Note: W=wheat, C=chickpea, P=pea, L=lentil and M=mustard. In the first year of study, all crops were seeded on wheat stubble seedbeds across three sites-years. Means followed by the same lower letter in a column for each site-year are not significant ( $p > 0.05$ ).

# Research conclusions

- Preceding legume crop residues significantly increased the average yield and annual NR of the following wheat
- The performance of following wheat in year 2 was the same regardless of whether the preceding crops were chickpea, lentil, or field pea
- The performance of following wheat in year 4 was significantly higher when the preceding crops were field pea or lentil compared to when chickpea was preceding crop.
- More frequencies of chickpeas in wheat rotations resulted lower net revenues

# Research conclusions

- More diversified rotations including field pea and lentil and mustard provided net revenues comparable to rotations with more frequencies of pea or lentil

# Research funding



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