

Contribution of Legume Preceding Crops to Improve Economic and Non-renewable Energy Use Efficiency of Canola Production



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Outline

- **Background**
 - Contribution of legume preceding crops
- **Objective**
- **Materials and Methods**
- **Results**
- **Conclusions**



Research background

The rising cost of nitrogen (N) has created interest in alternative sources of N fertilizer.

Legumes have the ability to fix N supply for subsequent crops, but knowledge of the effects of legumes on subsequent canola is limited.

Effects of crop rotation on energy use efficiency in the Canadian prairies

Rotation group	Crop rotation ¹	Tillage ¹	Fertilizer and pesticide application ¹	Energy output/ input ratio
1	C-W-B-B ²	CT	F	6.60
	C-B-FP-W ²	CT	F	7.24
2	W _S -F _X -C ³	ZT	R	6.66
	W _W -FP-C ³	ZT	R	7.97
3	W _S -W _S -F _X -W _W ⁴	MT	R	5.13
	W _S -F _X -W _W -FP ⁴	MT	R	6.16

Effects of preceding crop on energy use efficiency in the Canadian prairies

Crop	Preceding crop	Tillage ¹	Fertilizer and pesticide application ¹	Farm system (type) ¹	Yield per unit of energy
					kg GJ ⁻¹
Spring wheat ²	Cereal	MT	R	CONV	299
Spring wheat ²	Field pea	MT	R	CONV	370

Objectives

- to evaluate contribution of legume preceding crop to improve economic and non-renewable energy use efficiency of canola production

MATERIALS AND METHODS

Research time:

- 2009 through 2011

Research sites:

- Beaverlodge, Lacombe and Lethbridge located in Alberta
- Indian Head, Scott and Swift Current in Saskatchewan, and
- Brandon in Manitoba

MATERIALS AND METHODS


Preceding crops (P) grown in 2009:

- pea (CDC Golden) grown for seed
- lentil (CDC Imperial) grown for seed
- faba bean (Snowbird) grown for seed
- faba bean (Snowbird) grown as a green manure
- canola (45H73) grown for seed
- wheat (CDC Imagine) grown for seed

Methodology: ***Revenue/Cost Analysis***

- Revenue/Cost analysis
 - Budgeting techniques to measure economic performance of management practices in regard to costs of production, gross revenue, and net revenue
 - Net revenue calculation by subtracting all production and input expenses from gross revenue.

Energy Efficiency Assessment

- Process analysis (Fluck and Baird, 1980) was used to assess the energy performance of various management systems.
 - The assessment involves identifying all direct and indirect non-renewable energy going into manufacturing, formulation, packaging, transportation, maintenance and application of all purchased inputs used in each production system, as well as the energy content of all products removed from the fields for each management system.
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Methodology:

- Statistical analysis
 - Statistical analysis was conducted using PROC Mixed of SAS ([Littell et al., 1996](#)).
 - The analysis was done by site and by preceding crop types.
 - Treatment effects were considered significant at $P < 0.05$, with values of $P < 0.1$ reported as a possible trend.

RESULTS AND DISCUSSION



Average annual net revenue as affected by preceding crop over seven sites in western Canada from 2009 to 2011.

	C	P-C-B
Preceding crop	Mean (\$ ha ⁻¹) ^Y	Mean (\$ ha ⁻¹) ^Y
Canola	240C	188B
Faba bean as GM	586A	76C
Faba bean	373B	256A
Field pea	425B	284A
Lentil	442BC	292AB
Wheat	348B	169B
ANOVA		
Experimental site	<0.0001	<0.0001
Preceding crop	<0.0001	<0.0001
Experimental site × preceding crop	<0.0001	<0.0001

^Y Means followed by the same capital letter in a column are not significant (p>0.05).

Energy efficiency assessment of canola and cropping systems as affected by preceding crop over seven sites in Western Canada from 2009 to 2011

P (across N rates)	C†		P-C-B†	
	Output energy/input energy ratio	Yield harvested per GJ of energy input	Output energy/input energy ratio	Yield harvested per GJ of energy input
Canola	6.21c	228c	6.34cd	237cd
Faba bean as GRM	8.61a	316a	5.30e	200e
Faba bean	7.06b	259b	6.65c	223cd
Field pea	7.07b	260b	7.27b	233cd
Lentil	7.06b	260b	7.79a	240cd
Wheat	6.78bc	249bc	6.17d	217e

CONCLUSIONS

- 1. When the preceding crop was faba bean GM, the average annual canola net revenue and canola energy use efficiency was the highest in comparison with other preceding crops grown for seed over seven sites. However, this positive contribution was not enough to compensate for the loss of income or energy output during the GM production year.**
- 2. Annual canola net revenue or canola energy efficiency was usually higher when the preceding crop was faba bean or peas or lentils grown for seed compared to wheat or canola grown for seed at all sites.**

CONCLUSIONS

3. Over the three-year crop rotation, Faba bean, pea, and lentil grown for seed as preceding crops performed generally better than wheat and canola as preceding crops. Growing faba bean as a GM was not efficient due to loss of crop revenue and energy output in the faba bean GM year.

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