Canadian Agronomist

DIGGING INTO RESEARCH

Special crop diversification can increase net returns

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The inclusion of diversified oilseeds such as industrial mustard, oriental mustard, yellow mustard, camelina and flax, and specialty crops like sunflower, quinoa and canary seed in rotation with field pea or lentil and wheat produced the highest annual net returns.

No-till seeding has allowed farmers to diversify their cropping systems beyond a conventional wheat-fallow system in the semi-arid region of the Canadian Prairies. Diversification with legumes and specialty crops can help reduce fertilizer requirements and improve soil health and sustainability.

A research study looked into the profitability of a diversified cropping system over a 5-year period from 2018 through 2022. The research was carried out at Scott and Swift Current, SK, and Brooks and Lethbridge, AB. The objectives were to assess the net returns of diversified cropping sequences with legumes and specialty crops, and to look at the impacts of the preceding crop on subsequent crops.

The research study included two different crop rotation options. Experiment 1 included industrial mustard, oriental mustard, yellow mustard, camelina and flax as diversified oilseed crops when in rotation with spring wheat, field pea and lentil compared to Argentine canola (Table 1). It also included a treatment with only spring wheat, and a spring wheat-chemfallow rotation.

Table 1. Crop sequences studied in Experiment 1.

Sequence	Year of crop rotation				
	2018	2019	2020	2021	2022
1	Spring wheat	Spring wheat	Spring wheat	Spring wheat	Spring wheat
2	Spring wheat	Spring wheat	Chemical fallow	Spring wheat	Spring wheat
3	Spring wheat	Argentine canola	Spring wheat	Field pea	Spring wheat
4	Spring wheat	Argentine canola	Spring wheat	Lentil	Spring wheat
5	Spring wheat	Industrial mustard	Field pea	Spring wheat	Yellow mustard
6	Spring wheat	Argentine canola	Field pea	Spring wheat	Yellow mustard
7	Spring wheat	Oriental mustard	Field pea	Spring wheat	Yellow mustard
8	Spring wheat	Camelina	Field pea	Spring wheat	Yellow mustard
9	Spring wheat	Flax	Field pea	Spring wheat	Yellow mustard
10	Spring wheat	Industrial mustard	Lentil	Spring wheat	Yellow mustard
11	Spring wheat	Argentine canola	Lentil	Spring wheat	Yellow mustard
12	Spring wheat	Oriental mustard	Lentil	Spring wheat	Yellow mustard
13	Spring wheat	Camelina	Lentil	Spring wheat	Yellow mustard
14	Spring wheat	Flax	Lentil	Spring wheat	Yellow mustard

Source: Khakbazan et al. 2026

Experiment 2 included sunflower, quinoa and canary seed as specialty crops, and industrial and yellow mustard, in rotation with spring wheat and pulses (Table 2).

Table 2. Crop sequences studied in Experiment 2.

Sequence	Year of crop rotation				
	2018	2019	2020	2021	2022
1	Spring wheat	Industrial mustard	Field pea	Spring wheat	Yellow mustard
2	Spring wheat	Sunflower	Field pea	Spring wheat	Yellow mustard
3	Spring wheat	Quinoa	Field pea	Spring wheat	Yellow mustard
4	Spring wheat	Yellow mustard	Field pea	Spring wheat	Yellow mustard
5	Spring wheat	Canary seed	Field pea	Spring wheat	Yellow mustard

Source: Khakbazan et al. 2026

No-till systems were used in both experiments. Recommended agronomic practices for weed control and nitrogen (N) and phosphate (P) fertility were followed. Target yield and N requirements were based on the Saskatchewan Crop Planning Guide 2021. Chopped straw was returned to the plots after harvest.

An economic analysis was conducted using 12-year average gross revenue and expenses (2012-2023) for seed, fertilizer, pesticides and machinery operating costs from the Saskatchewan Crop Planning

Guides. Grain transport costs were also calculated. Interest rate of 7% was calculated on the input costs. Grain drying, land tax and other miscellaneous costs were obtained from the Manitoba Guidelines for Estimating Crop Production Costs (Manitoba Agriculture 2012-2023).

Net return in each year was calculated by subtracting nominal operating and fixed costs from nominal gross revenue. The results were averaged over all crops in the five year rotation, and presented on an annual average per hectare basis.

Diversified rotations most profitable

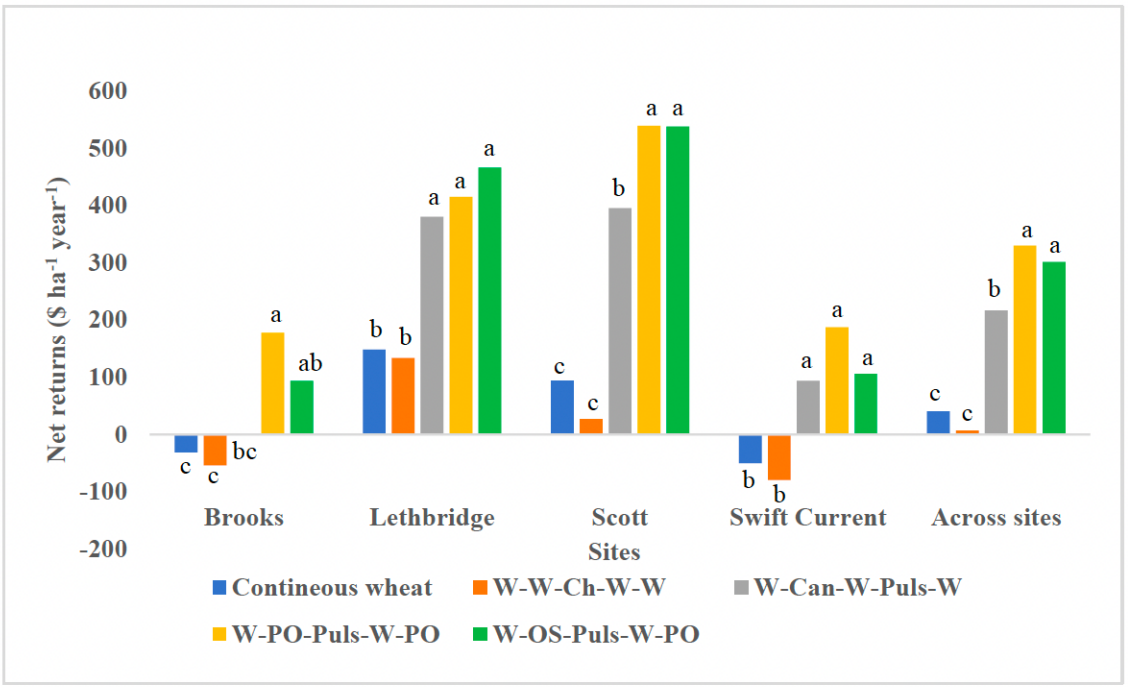
In Experiment 1, across all four sites, the lowest annualized net return was wheat with chemfallow at $2.43/ac/year ($6/ha) and continuous wheat at $16.19/ac/year ($40/ha).

The low net return for the wheat-chemfallow rotation is explained by the lack of revenue in the chemfallow year.

The statistically highest net returns was wheat-oriental mustard-lentil-wheat-yellow mustard (wheat-oriental mustard-lentil-wheat-yellow mustard) at $152.23/ac ($376/ha/) and wheat-oriental mustard-pea-wheat-yellow mustard (wheat-oriental mustard-pea-wheat-yellow mustard) at $150.61/ac/year ($372 ha/year). These trends were observed across the four sites.

In Experiment 1, further analysis was conducted by grouping together industrial mustard, oriental mustard, yellow mustard, camelina and flax as promising oilseeds. The more profitable crop rotations generally had higher frequency of promising oilseeds and legumes in the rotations.

Annualized net returns of grouping of similar sequences in Experiment 1



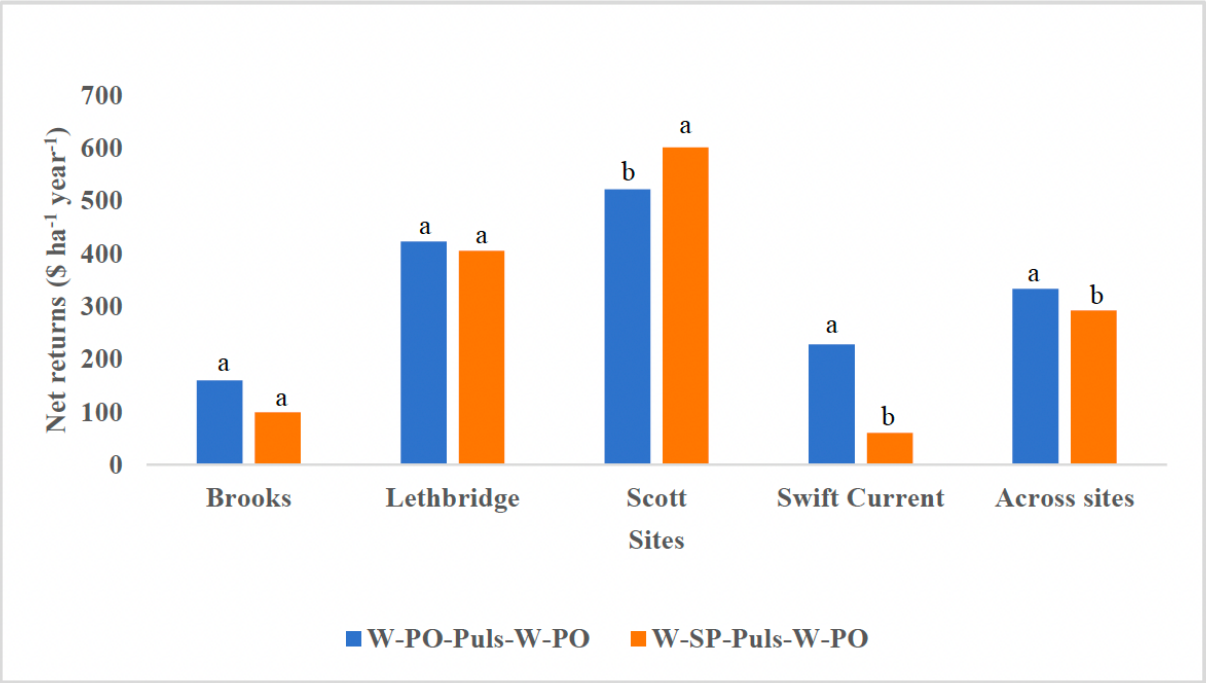
Legend: W, Wheat; Ch, Chemical fallow; Can, Canola; Puls, Pulse crops; PO, Promising oilseeds; OS, Oilseeds

Source: Khakbazan et al. 2026

In Experiment 2, the statistically highest annualized net return was wheat- quinoa-pea-wheat-yellow mustard at $147.77/ac/year and wheat-yellow mustard-pea-wheat-yellow mustard at $140.49/ac/year. The lowest net return was from the wheat-canary-seed-pea-wheat-yellow mustard at $86.64/ac/year.

Specialty crops (SP) of sunflower, quinoa and canary seed were grouped together, and promising oilseeds (PO) of industrial mustard and yellow mustard were grouped together for further economic analysis. Including these groups in the crop rotation in Experiment 2 tended to produce higher net return.

Annualized net returns of grouping of similar sequences in experiment 2



Legend: W, Wheat; SP, Specialty crops; PO, Promising oilseeds; Puls, Pulse crop

Source: Khakbazan et al. 2026

While the trend in both Experiments was that a more diversified crop rotation improved annualized net returns, there were site-specific differences depending on the oilseed or specialty crop grown. This indicates the need for site-specific crop rotations, and the results of this research can be used as a guide for farmers to investigate the potential for a more diversified crop rotation.

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Mohammad Khakbazan, Mervin St. Luce, Dilip Biswas, Manjula Bandara, Charles M. Geddes, Kui Liu, Prabhath Lokuruge, and Brian McConkey. 2025. Economics of cropping sequences diversified with specialty crops in the semi-arid Canadian prairies. *Canadian Journal of Plant Science*. **105**: 1-11. OPEN ACCESS https://doi.org/10.1139/cjps-2024-0217