



## Economic performance of legume intercrops varied

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*The economic returns of cereal, oilseed and legume intercrop crops varied by location. Generally, intercropping reduced losses or outperformed less profitable monocrops but high value monocrops like corn and soybean outperformed intercrops. Net return stability also varied by different intercrop types and growth conditions.*

Legume intercrops with oilseeds or cereals have been shown to provide yield and stability benefits. However, research on the economics of intercropping has been lacking.

Two separate experiments were conducted over five years from 2018 through 2022 with several objectives. The first was to assess the net returns of pea-canola, pea-oat intercrops with different nitrogen fertilizer rates. The second was to compare net returns of pea-canola and faba bean-malt barley, malt barley-field pea, and corn-soybean intercropping systems with their monocrops.

The economic analysis used a 12-year average for input and commodity prices to calculate total production cost, gross revenue and net returns. Input costs included all costs including seed,

fertilizer, pesticides, fuel and oil, repairs, transportation, land taxes, interest costs on variable inputs, land investment costs, and ownership costs on machinery and buildings such as depreciation, interest on investment, insurance, housing, and labour. Grain separation costs for the intercrops was estimated at \$0.05/kg.

Gross income stability was also assessed using a coefficient of variation (CV). A lower CV indicated more stable income.

### **Pea-canola and pea-oat results varied**

Study 1 ran in 2021 and 2022 at Swift Current and Melfort, SK, and looked at pea-canola, pea-oat intercrops net returns compared to monocrops. CDC Inca yellow pea, PV200 CL canola, and CDC Arborg oat were the varieties grown in the intercrops and monocrops. The monocrops received full rate of recommended fertilizer N, while the intercrops received 0-, 25- and 50% of the recommended monocrop rate. Fertilizer was applied at seeding in a single pass.

Monocrop seeding rates were 125 seeds/m<sup>2</sup> for pea, 200 seeds/m<sup>2</sup> for canola and 300 seeds/m<sup>2</sup> for oat. The intercrop seeding rates were two-thirds of the recommended seeding rate for pea and one-half the seeding rate for canola and oat. Intercrops were seeded in mixed rows, and plots were managed with standard agronomic practices.

At Swift Current, pea, oat and canola monocrops had higher net returns than any of the intercrops at any of the N fertilizer rates. In the drought year of 2021, none of the treatments had a positive net returns due to low yields. However, the intercrop treatments had significantly lower and large negative net returns than the monocrops. The monocrop net returns ranged from -\$109 for canola, -\$140 for pea, and -\$147/ha for oat. By comparison, the highest net return for the intercrops was -\$260 for pea-oat with 0 N fertilizer while the worst net return was -\$424/ha for pea-canola with 50% N rate.

At Melfort 2021, drought was also an issue and resulted in a net loss for most of the treatments. Monocrop oat had the highest return at \$176/ha followed by pea at \$37/ha, but monocrop canola lost \$337/ha. Pea-canola intercrop at all N rates similarly had negative net returns in the range of \$-241 to -\$329/ha with losses increasing with increasing N rates. Pea-oat intercrop losses were lower ranging from -\$17 to -\$94/ha with increasing N rates.

At Swift Current 2022, with better growing conditions some the monocrops and pea-oat intercrops had a positive net return. With yields of 98 bu/ac (3743 kg/ha), monocrop oat had the best returns at \$399/ha, followed by pea at \$202/ha and canola at \$124/ha. The pea-canola intercrops lost

money at all N rates. The pea-oat intercrop and positive net returns ranging from \$97 to \$125/ha. These pea-oat net returns, though, were statistically similar to pea and canola monocrop returns.

Melfort 2022 had better growing conditions with canola yielding 52 bu/ac (2909 kg/ha) with the highest net return of \$749/ha). This net return was statistically similar to oat at \$571/ha, and also similar to all the pea-canola and pea-oat intercrops, which ranged from \$397/ha for the pea-oat 25% N intercrop to \$585/ha for the pea-canola 25% N intercrop treatment. The results indicate that there was a lack of response to N fertilizer with the intercrops. Pea monocrop had the lowest net return at \$271/ha.

At Swift Current, CV analysis found that the pea-oat intercrop had similar CV values as the oat monocrop, but the intercrop had higher variability than the pea monocrop. Pea-canola intercrops had similar CV values to pea monocrop, but the canola monocrop had the highest yield stability.

At Melfort, Canola had the lowest stability while the pea-canola intercrops were slightly better than monocrop canola. Monocrop oat had the highest stability, while the pea-oat intercrops and pea monocrop were similar.

### **Cereal-legume intercrops net return varied**

The second study ran from 2018 to 2022. At Swift Current and Lethbridge, intercrops included faba bean-malt barley and pea-malt barley, and were compared to faba bean, pea, and malt barley monocrops. At Carman, intercrops were corn-soybean and pea-canola, and included corn, soybean and canola monocrops.

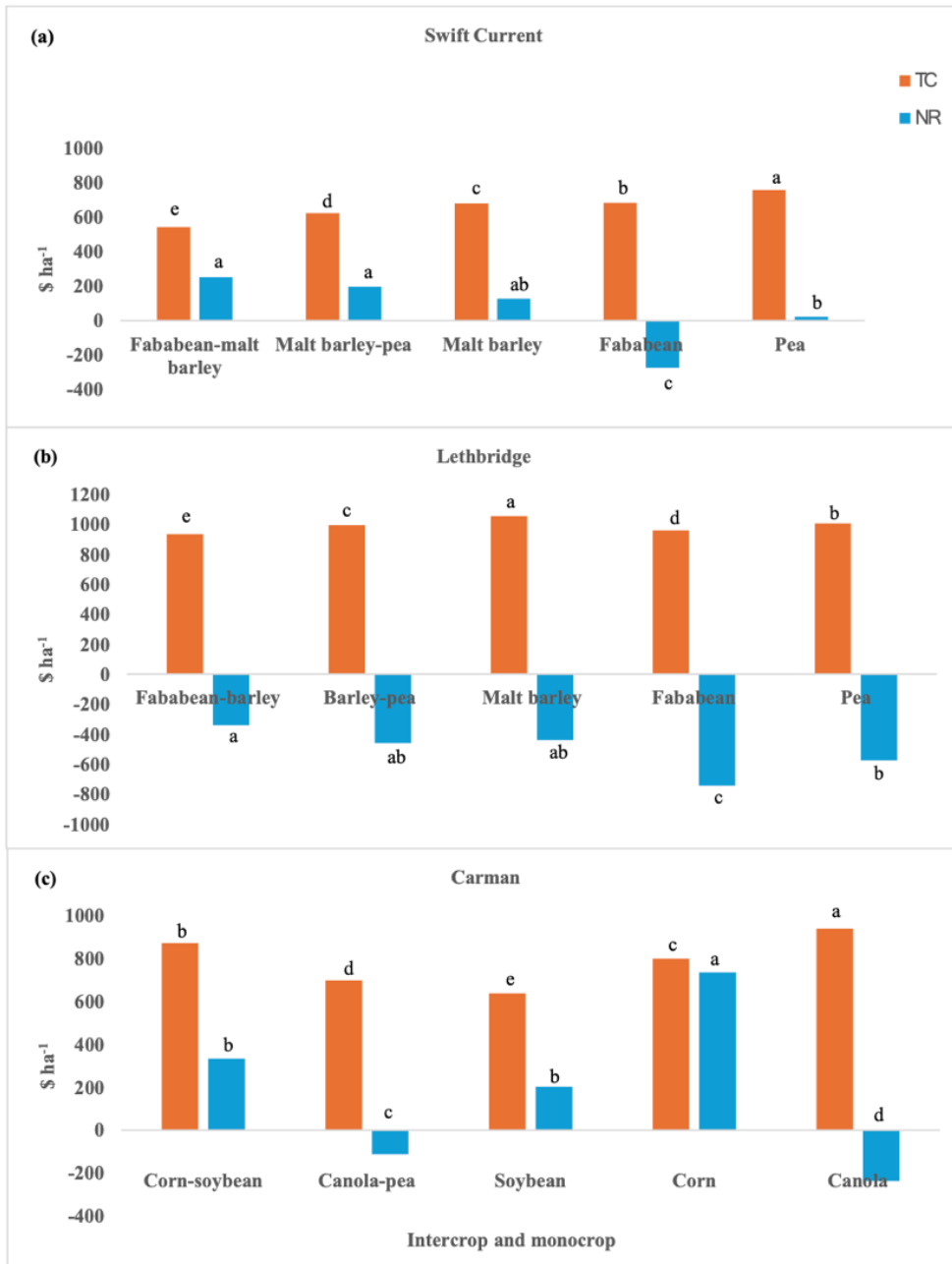
Pea, faba bean, barley-pea, and faba bean-barley did not receive any supplemental N other than the small amount that was applied with 11-52-0 monoammonium phosphate fertilizer. Recommended rates of N fertilizer were applied to monocrop cereals.

At Swift Current over the five years, faba bean-malt barley, pea-malt barley and malt barley monocrop had the statistically highest net returns. Faba bean monocrop had a significant negative net return, while pea monocrop barely broke even.

At Lethbridge, all intercrop and monocrops had negative net returns. The faba bean monocrop had the poorest net return and the faba bean-malt barley had the lowest net return loss.

At Carman, monocrop corn had by far the highest net return around \$700/ha while canola had the lowest with a negative net return around -\$200/ha. Canola-pea also had a negative net return. Positive net returns for corn-soybean and soybean monocrop were intermediate.

**Total cost (TC, orange bar) and net returns (NR, blue bar) for intercropping and monocropping across varying crop combinations at Swift Current, Lethbridge and Carman.**



Source: Khakbazan et al 2025.

Monocrop corn and the corn-soybean intercrop were found to be equally stable and higher than the soybean monocrop at Carman. At Swift Current, pea monocrop had the most stable net returns, while faba bean monocrop and faba bean-malt barley intercrop were intermediate in stability.

The researchers concluded that “under the right conditions, intercropping may provide growers with additional options to improve net returns. Intercropping performed differently with different intercrop types and growth conditions. Monetary returns varied by location, with intercropping generally reducing losses or outperforming less profitable monocrops.”

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Mohammad Khakbazan, Kui Liu, Dilip Biswas, Kennedy Choo-Foo, Martin Entz, Gary Peng, and Henry Wai Chau. 2025. Economic analysis of legume-based intercropping across Canadian Prairies. *Canadian Journal of Plant Science*. **105**: 1-13.

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