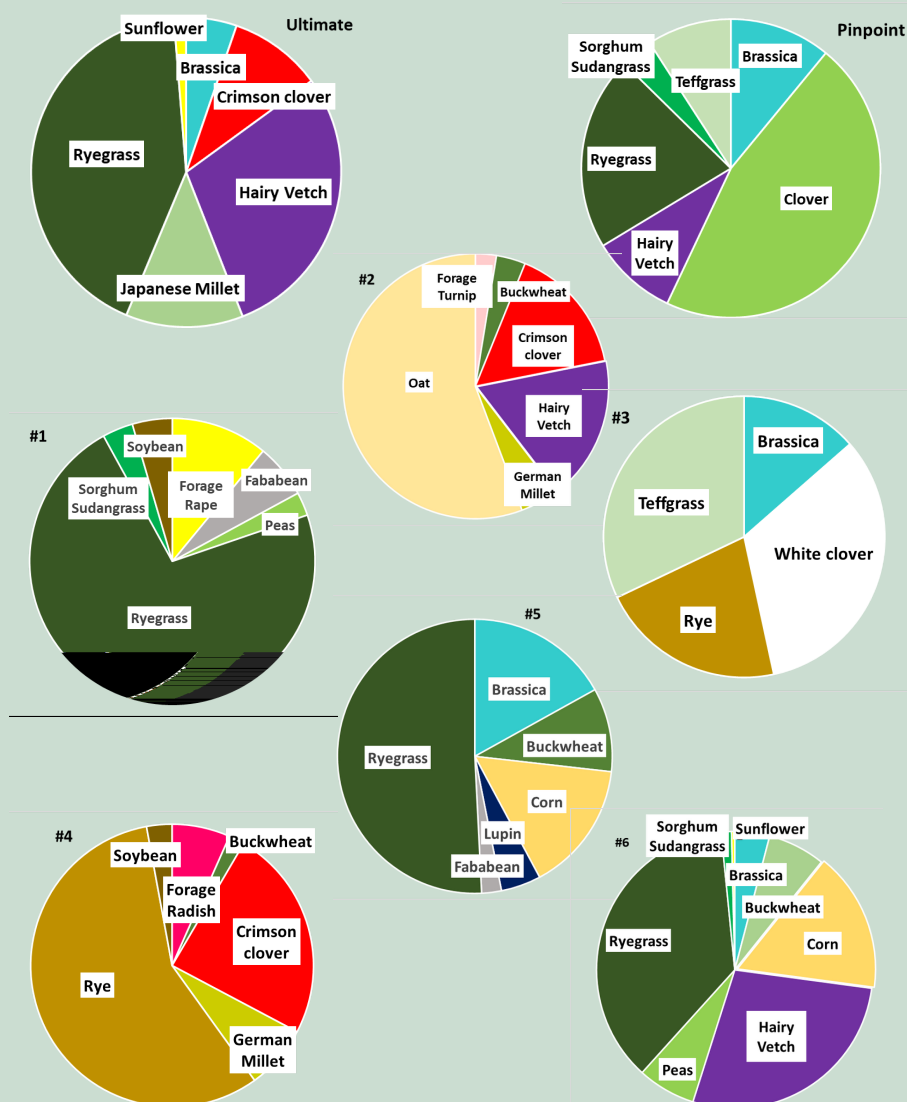


IDENTIFY COVER CROPPING STRATEGIES FOR THE NORTH PEACE REGION TO IMPROVE SOIL QUALITY AND PROMOTE ADOPTION

Highlights

- Six NPARA cover crop mixes were grown along with Ultimate and Pinpoint mixes from Union Forage
- Blends 5 and 6 as much yield as the Union Forage blends. Mixes 5 and 6 have corn, which is a bulky plant and ryegrass, which is an early emergence high yielding cover crop.
- Blends 5 and 6 had TDN as great as that found in the Pinpoint blend
- Protein content in Blend 3 was the same as that found in Pinpoint blend.
- Blends 1 and 4 were low in ADF and NDF

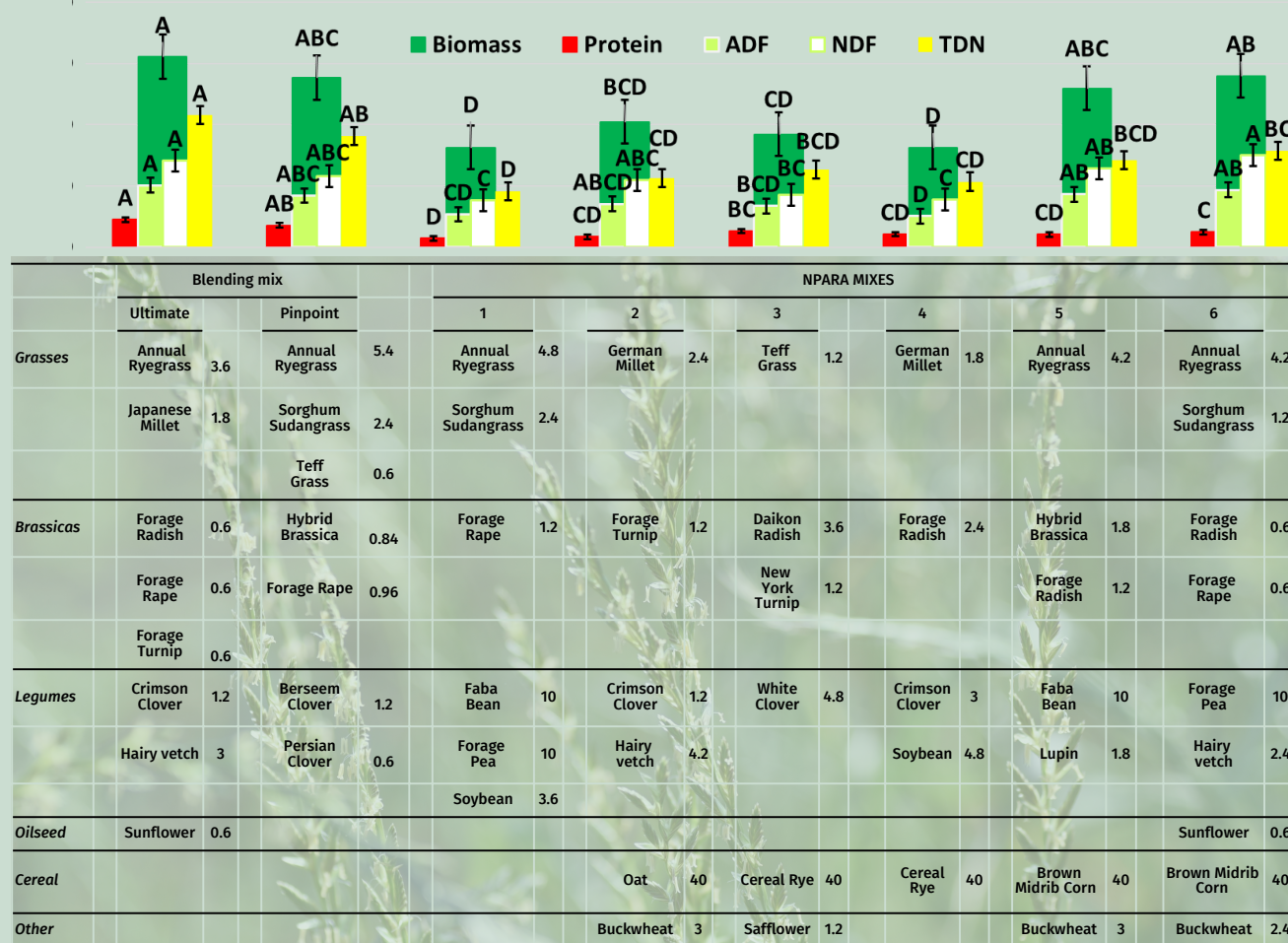


There was more biomass in the Ultimate mix compared to the other cover crop mixes. It is important to note that, despite producing 32% more than the other NPARA blends ($P=0.0076$), its mean biomass value was statistically the same than biomass found in Pinpoint in NPARA blends 5 and 6 ($P=0.0151$). In contrast, NPARA blends 1 and 4 which were the blends that produced the lightest mean biomass. It can be argued that blends 5 and 6 are heavier as they have corn in their cover crop mix, which is a bulky plant and ryegrass, which is an early emergence high yielding cover crop. Blends 1 and 4, have cereal rye as part of their mix, but biomass produced from these stands is not as copious as that found in annual ryegrass.

Protein values were the highest in ultimate and pinpoint blends ($P<0.0001$). As such, Ultimate and Pinpoint had 54 and 42% more protein respectively compared to NPARA protein values combined. Protein content in NPARA blend 3 was the same as that found in Pinpoint blend in comparison to the other blends from NPARA, likely due to white clover being part of such blend.

IDENTIFY COVER CROPPING STRATEGIES FOR THE NORTH PEACE REGION TO IMPROVE SOIL QUALITY AND PROMOTE ADOPTION

Cover crop mixes biomass and protein, ADF,NDF and TDN in proportion to biomass weight



Acid ($P=0.0279$) and neutral ($P=0.0184$) detergent fibre were also greater in the ultimate blend. Acid and neutral detergent fibre were 30 ($P=0.0153$) and 26% ($P=0.0452$) respectively compared to those found in NPARA blends. From the blends selected at NPARA, blends #2, 5 and 6 showed statistically similar ADF and NDF values to Ultimate and Pinpoint blends. Lowest ADF and NDF values on the other hand were attributed to blends 1 and 4, possibly due to presence of cereal rye in a greater proportion with respect to the other blends. Total digestible nutrients were greater in Ultimate and Pinpoint blends ($P=0.0022$). Values were 43 ($P=0.0002$) and 32% ($P=0.0087$) greater than those found in NPARA blends.

Overall, NPARA blends 1 and 4 more digestible for the animal to eat compared to the other NPARA blends. However, NPARA blend #3 might also be a good choice of energy as it provides as much protein as that found in the Pinpoint blend.

IDENTIFY INTERCROPPING STRATEGIES FOR THE NORTH PEACE REGION TO IMPROVE SOIL QUALITY AND PROMOTE ADOPTION

Highlights

- Barley was higher yielding when paired with field pea than with green lentil.
- Yield of field pea and oat was the same despite interseeding treatment.
- Flax yield was as great as that yield obtained from field pea
 - Field pea intercropped with barley.
- yield in wheat was the same as yield in barley
 - barley intersown with green lentil.
- Yield in canola and faba bean was not collected because they were late maturing and snow impeded combine harvesting of these crops.
- Field pea and barley Land Equivalent Ratio (LER) values were the lowest,
 - Greater yields can be obtained from barley when sown with field pea and green lentil as an intercrop
- Wheat, flax and oat (in field pea) had the highest LER values.
- Wheat with red clover was the most profitable intercrop
 - Wheat yield was more than enough to cover the expenses used to seed and maintain red clover stands

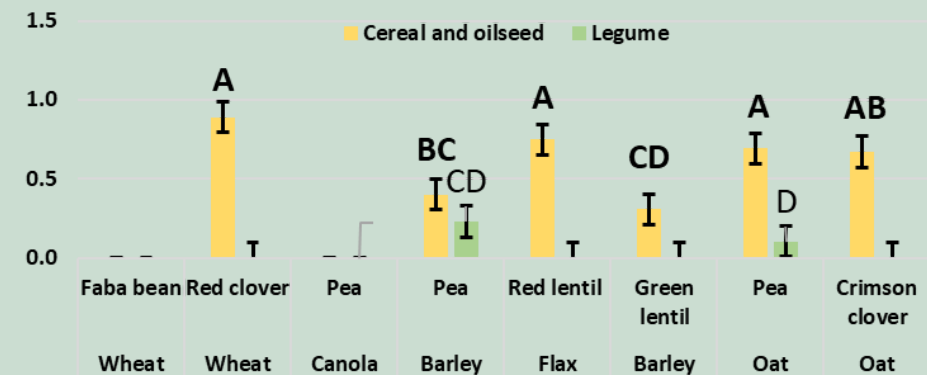
Identify intercropping strategies for the North Peace region to improve soil quality and promote adoption					
Treatment #	Crop	Variety	% of monocrop seeding rate	Plants per ft ²	Seeding rate (lbs acre ⁻¹)
1	Fababeans	Snowbird	70%	5	172.2
	Wheat	AAC Brandon	50%	30	65.8
2	Red Clover	Red and White Clover	50%		10.0
	Wheat	AAC Brandon	50%	30	65.8
3	Canola	BY5125CLHV	75%	10	4.9
	Peas	AAC Lacombe	100%	8	235.6
4	Barley	CDC Austenson	75%	29	115.5
	Peas	AAC Lacombe	100%	8	235.6
5	Flax	Topaz	75%	45	31.2
	Lentils	CDC Impulse	100%	14	71.6
6	Barley	CDC Austenson	75%	29	115.5
	Lentils	CDC Lima	100%	12	82.0
7	Oats	AC Morgan	50%	30	65.6
	Peas	AAC Lacombe	100%	8	235.6
8	Crimson Clover	Crimson Clover	100%		5.0
	Oats	AC Morgan	50%	30	65.6

Yield in crops was influenced according to the crop interseeding treatment ($P < 0.0001$). Moreover, some intercrop mixes were not harvested because they were unable to mature despite frost and applications of paraquat (Reglone). For those crops that were harvested, barley was higher yielding when paired with field pea than with green lentil. Yield of field pea and oat was the same despite interseeding treatment. Flax yield was as great as that of field pea when the latter is accompanied by barley. Similarly yield in wheat was statistically the same as yield in barley intersown with green lentil. Yield in canola and faba bean was not collected because they were late maturing and snow impeded combine harvesting of these crops.

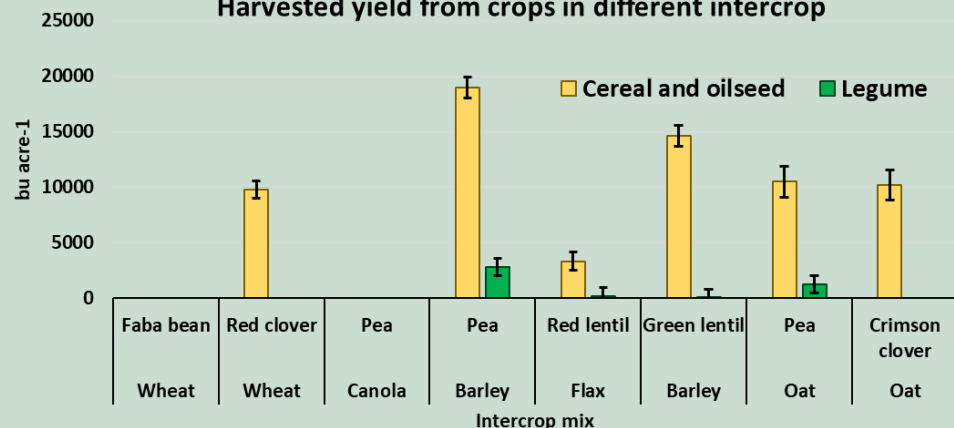
IDENTIFY INTERCROPPING STRATEGIES FOR THE NORTH PEACE REGION TO IMPROVE SOIL QUALITY AND PROMOTE ADOPTION

Land equivalent ratio (LER) defines how much land is required by an intercrop to yield as much grain/seed as that found in monocrops. Thus, if LER greater than or closer to 1, the crop sown solo would necessitate more land to have yields as great as those obtained by the same crop when interseeded with another. Overall, field pea and barley LER values were the lowest, whereas wheat, flax and oat (in field pea) had the highest LER values ($P < 0.0001$). Wheat and flax LERs were the same as oat LER, when sown with field pea. There was no difference between LER values of oat and barley intersown with field pea. Moreover, barley and field pea LER values were the same despite its companion crop. It can be concluded that greater yields can be obtained from barley when sown with field pea and green lentil as an intercrop.

Land equivalent ratio of various crops sown as intercrops

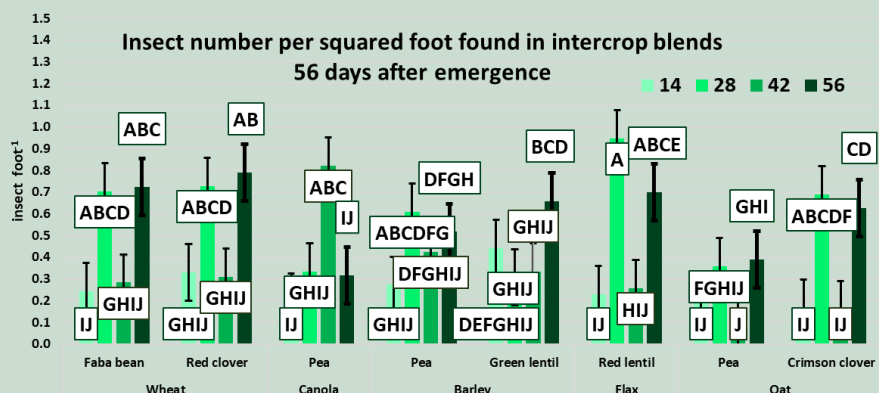


Harvested yield from crops in different intercrop



Number of insects varied across treatments and was influenced by interseeding treatment and day of insect collection after emergence ($P < 0.0001$). By the end of the season, number of insects found in pea and canola intercrops was lower than that found in wheat with either faba bean or red clover as well as flax with red lentil intercrops. Further research needs to be developed to quantify beneficial and parasitic insects depending on the intercrop seeded.

Insect number per squared foot found in intercrop blends 56 days after emergence

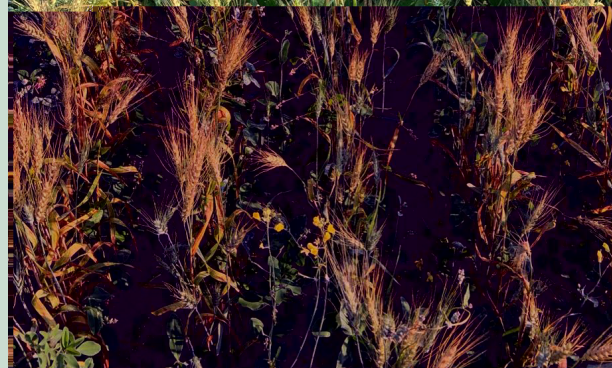


IDENTIFY INTERCROPPING STRATEGIES FOR THE NORTH PEACE REGION TO IMPROVE SOIL QUALITY AND PROMOTE ADOPTION

Economic Analysis of Monocropping and Intercropping

For this economic analysis, costs for monocropping systems were largely derived from regional cost forecasts, made publicly available by the Government of Alberta. The same seed prices were used in the monocrop analysis and the intercrop analysis. The monocrop yields were taken from average yields of NPARA monocrop plots were possible. Price per bushel was based on prices for the nearest sale date from local grain sales representatives, which at the time of writing was late November 2022. The exceptions were the lentils. The red lentil prices were from local forecasts for January 2023, and the green lentils were based on national reporting as there were no available local numbers. Net profit is defined as gross revenue less operating expense. This analysis is meant to provide a rough comparison of cost, rather than an absolute difference, as not all costs or market potential was accounted for.

Due to weather conditions and time constraints, we were unable to harvest our wheat and faba bean and canola and pea intercrop mixes. Therefore, those results have been left out of this analysis.



Net Profit (\$/acre) of Intercrop vs Monocrop		
Intercrop	Monocrop	
Wheat & Red Clover \$ 49.74	Wheat \$ 24.16	Red Clover -\$ 65.00
Barley & Pea \$ 119.91	Barley \$ 383.32	Pea \$ 320.51
Barley & Green Lentil \$ 25.55	Barley \$ 383.32	Green Lentil \$ 465.39
Oat & Pea -\$ 171.63	Oat -\$ 63.96	Pea \$ 320.51
Oat & Crimson Clover -\$ 120.38	Oat -\$ 63.96	Crimson Clover -\$ 19.00
Flax & Red Lentil -\$ 101.79	Flax \$ 243.09	Red Lentil \$ 262.85



IDENTIFY INTERCROPPING STRATEGIES FOR THE NORTH PEACE REGION TO IMPROVE SOIL QUALITY AND PROMOTE ADOPTION

Economic Analysis of Monocropping and Intercropping

This year there was only one intercrop mix that resulted in a greater net profit sown together than separate as monocrops; the wheat and red clover mix. Despite the red clover not being a for profit crop the wheat yield was more than enough to cover the cost. The oat monocrop as well as both oat intercrop mixes saw greater cost than return based on the NPARA farm yields. This analysis did not consider all costs nor ideal market projections and only represents a general estimation of economic potential of these systems. One of the possible benefits of intercrops is, as seen with the Wheat & Rec Clover mix, in the complementary nature of the mix resulting in lower input costs. In years like 2022 with especially high input costs it represents a potential alternative.

Monocrop Production Costs (\$ per acre)											
Input Costs	Cereals			Oilseed		Pulses			Clover		
	Wheat	Barley	Oat	Canola	Flax	Pea	Faba bean	Green Lentil	Red Lentil	Crimson	Red
Seed	\$ 43.30 ^η	\$ 33.00 ^η	\$ 62.40 ^η	\$ 70.00 ^η	\$ 91.00 ^η	\$ 77.00 ^η	x	\$ 64.80 ^η	\$ 36.00 ^η	\$ 19.00 ^ε	\$ 65.00 ^ε
Fertilizer	\$ 138.00 ^η	\$ 142.50 ^η	\$ 122.50 ^η	x	\$ 89.17 ^β	\$ 42.50 ^η	x	\$ 35.97 ^α	\$ 35.97 ^α	-	-
Pesticide	\$ 47.78 ^η	\$ 47.78 ^η	\$ 21.22 ^η	x	\$ 11.62 ^η	\$ 47.48 ^η	x	\$ 60.96 ^η	\$ 60.35 ^η	-	-
Total Operating	\$ 229.08	\$ 223.28	\$ 206.12		\$ 191.79	\$ 166.98		\$ 161.73	\$ 132.32	\$ 19.00	\$ 65.00
Profitability Analysis											
Price per Bu**	\$10.43	\$6.74	\$3.80	x	\$18.12	\$11.50	x	\$31.20 ^κ	\$19.66	-	-
Yield (bu/ac)***	24.28	90.00	37.41	x	24.00 ^η	42.39	x	20.10 ^γ	20.10 ^γ	-	-
Gross Revenue (\$/acre)	\$253.24	\$606.60	\$142.16		\$434.88	\$487.49		\$627.12	\$395.17		
Net Profit (\$/acre)	\$24.16	\$383.32	-\$63.96		\$243.09	\$320.51		\$465.39	\$262.85	-\$19.00	-\$65.00

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**Approximate fall prices from local grain representatives unless otherwise marked

***Based on yields from NPARA monocrop plots unless otherwise marked

Intercrop Production Costs (\$ per acre)																
	Wheat & Faba bean		Wheat & Red Clover		Barley & Pea		Barley & Green Lentil		Oat & Pea		Oat & Crimson Clover		Canola & Pea		Flax & Red Lentil	
Input Costs																
Seed		x		\$ 54.15 ^κ		\$ 101.75 ^η		\$ 89.55 ^η		\$ 123.80 ^η		\$ 65.80 ^η ¹		x		\$ 104.25 ^η
Fertilizer*		x		\$117.03		\$117.03		\$117.03		\$117.03		\$117.03		x		\$117.03
Pesticide*		x		\$37.12		\$37.12		\$35.08		\$37.12		\$35.08		x		\$35.08
Total Operating				\$208.30		\$255.90		\$241.66		\$277.95		\$217.91				\$256.36
Profitability Analysis																
	Wheat	Faba	Wheat	Red Clover	Barley	Pea	Barley	Lentil	Oat	Pea	Oat	Crimson Clover	Canola	Pea	Flax	Lentil
Price per bu**	x	x	\$10.43	-	\$6.74	\$13.25	\$6.74	\$31.20 ^κ	\$3.80	\$13.25	\$3.80	-		x	\$18.12	\$19.66
Yield (bu/ac)	x	x	24.74	-	47.86	4.02	36.82	0.61	26.44	0.44	25.66	-		x	8.38	0.14
Gross Revenue (Separate)	x	x	\$258.04	-	\$322.58	\$53.23	\$248.18	\$19.03	\$100.48	\$5.84	\$97.53	-		x	\$151.82	\$2.75
Gross Revenue (Together)				\$258.04		\$375.81		\$267.21		\$106.32		\$97.53				\$154.57
Net Profit (\$/acre)				\$49.74		\$119.91		\$25.55		-\$171.63		-\$120.38				-\$101.79

*Based on NPARA's rates of use and spring pricing from Richardson