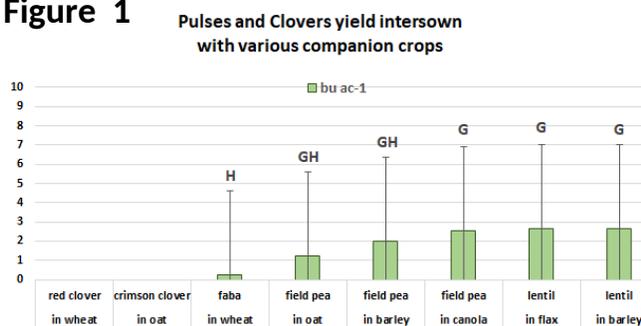


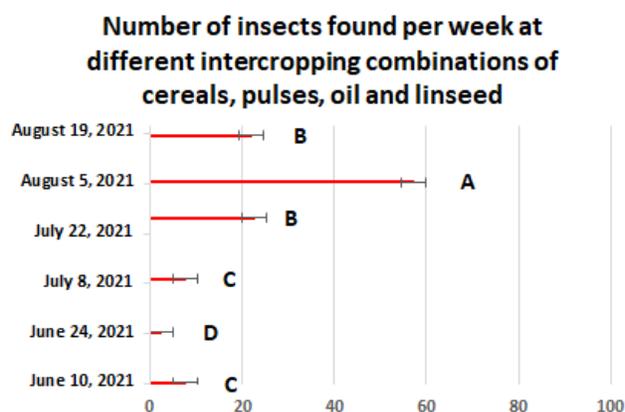
# INTERCROPPING

Seeding rate of crops under intercropping treatments					
Intercrop Mix		Seeding rate lb ac <sup>-1</sup> (% of monocrop rate)			Seeding rate (lb ac <sup>-1</sup> ) (% of monocrop rate)
1	CWRS Wheat - AAC Brandon	90 (70%)	+	Faba Beans - Snowbird	172 (70%)
2	CWRS Wheat - AAC Brandon	129 (100%)	+	Red Clover	2 (50%)
3	Canola - CS2300	6 (75%)	+	Field Peas - AAC Lacombe	147 (75%)
4	Barley - AAC Connect	120 (80%)	+	Field Peas - AAC Lacombe	157 (80%)
5	Barley - AAC Connect	120 (80%)	+	Red Lentils - Redberry	48 (80%)
6	Flax - CDC Bethune	32 (80%)	+	Green Lentils - Greenland	50 (60%)
7	Oats - Nasser	125 (80%)	+	Field Peas - AAC Lacombe	157 (80%)
8	Oats - Nasser	156 (100%)	+	Crimson Clover	2 (50%)

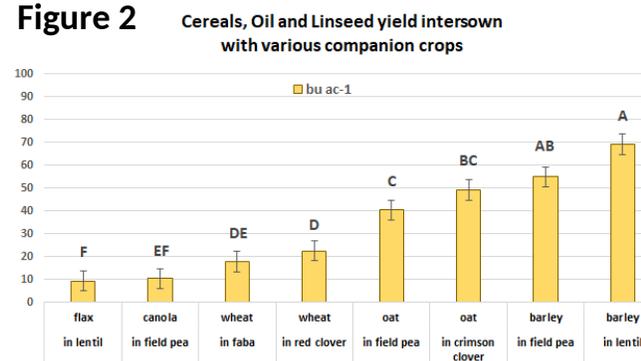
**Figure 1**



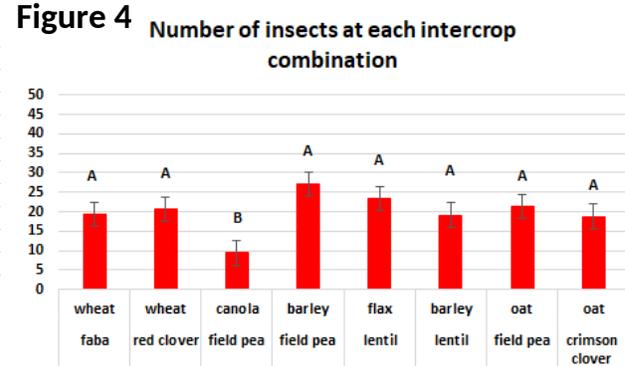
**Figure 3**



**Figure 2**



**Figure 4**



Yield from each crop was different across all intercropping combinations ( $P < 0.0001$ ). Pulses such as faba bean intersown with wheat and field pea intersown in barley and in canola reported the lowest yields (Figure 1). Barley intersown in both lentil (*Lens culinaris* Medic.) and field pea, respectively, was higher yielding than other cereals such as oat, wheat and other types of main crops such as flax (*Linum usitatissimum* L.) and canola (Figure 2). The North Peace weather is characterized for its long dry periods, where rains could turn out once a month and extensive heat can stress and jeopardize grain quality of main crops. It is also characterized for its soils with heavy clay, where moisture from rain periods can last for days and excess water is unable to filter through. Pulses require plenty of rain and soil moisture in order to produce competent yields. It is possible the dry periods occurring in the summer season compromised pulse yields while cereals were able to manage heat stress.

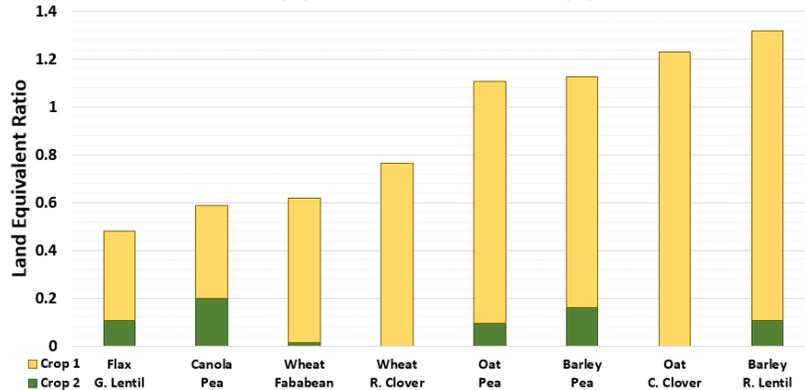
Number of insects per plot varied across weeks ( $P < 0.0001$ ) and across intercrop combinations ( $P = 0.0002$ ). The interaction between weeks and intercropping combinations was the same ( $P = 0.3690$ ). The greatest number of insects was reported on the first week of August (Figure 3) whereas the lowest was June 24, which coincided with a period of extreme heat and drought. Canola and field pea intercropping combination had the lowest number of insects compared to the rest of the combinations where numbers were statistically the same (Figure 4).

# INTERCROPPING

## Land Equivalent Ratio

Yields produced in the intercrop trial were compared to that which would be produced by a monocrop given the same area under the same appropriate maintenance (Figure 5). This comparison tool is referred to as the land equivalent ratio (LER). The LER equation and a description can be found below. The monocrop yields used to compare were taken as each crop's weighted average yield across all respective NPARA 2021 monocrop trials.

**Figure 5** Land equivalent ratio of intercrops based on 2021 NPARA intercrop yields vs. NPARA monocrop yields



$$\text{Land Equivalent Ratio (LER)} = \frac{\text{Intercrop 1 (yield } \frac{\text{bu}}{\text{acre}})}{\text{Monocrop 1 (yield } \frac{\text{bu}}{\text{acre}})} + \frac{\text{Intercrop 2 (yield } \frac{\text{bu}}{\text{acre}})}{\text{Monocrop 2 (yield } \frac{\text{bu}}{\text{acre}})}$$

Where Intercrop 1 and Intercrop 2 indicate the two components that comprise the single intercrop, and Monocrop 1 and Monocrop 2 represent those same components but sown individually/separate. If LER is greater than 1, the monocrops require greater total cropping area to achieve the same yields as the intercrop.

Applying the LER to the barley and pea intercrop, the average monocrop yield of barley and field pea at the NPARA farm in 2021 was 57 bu/ac and 12.5 bu/ac, respectively. The barley and pea intercrop yielded 55 bu/ac of barley and 2 bu/ac of field pea. The LER is then:  $(55 \text{ bu/ac intercrop barley}) / (57 \text{ bu/ac monocrop barley}) + (2 \text{ bu/ac intercrop faba}) / (12.5 \text{ bu/ac monocrop faba}) = 1.12$ . Thus, it would take 1.12 acres of sole cropping area split between the two monocrops to produce the same yield as 1 acre of intercropped area. Four of the eight intercrops produced a LER greater than 1 (Figure 5). These include the oat and pea, barley and pea, oat and crimson clover, and barley and red lentil intercrops.

The year 2021 was a dry year across much of western Canada as well as the Peace. Stress from heat and lack of moisture impacted some crops more than others, such as the peas and faba beans which produced little at the NPARA farm. Reference monocrop and intercrop values are thus skewed and a single year glance at intercropping LERs may not provide definitive results. However, this study does further exhibit the potential of intercrops and the possibility of increased profit and improved soil health. NPARA's aim to advance local agriculture with realistic solutions will surely lead to more intercrop trials and exhibits in the years to come.



Presenting Intercrop Trial to the County 07/13

# INTERCROPPING

## Economic Analysis of Monocropping and Intercropping

This economic analysis presents the net profit potential of monocropping and intercropping systems. Total operating expense accounts for the input (seed, fertilizer, and pesticide) costs for these systems according to the products and rates used at the NPARA farm in 2021. Using intercrop yields, monocrop yields, and fall 2021 market values, gross revenue is calculated. Net profit is then defined as gross revenue less operating expense. Though not all farm costs are accounted for, this analysis provides an idea of the potential of each system.

Input Costs	Monocrop Production Costs (Dollars Per Acre)										
	Cereals			Oilseed		Pulses				Clover	
	Wheat	Barley	Oat	Canola	Flax	Pea	Faba Bean	Lentil		Crimson	Red
Seed	\$33.42 <sup>a</sup>	\$22.40 <sup>a</sup>	\$22.38 <sup>b</sup>	\$69.00 <sup>a</sup>	\$25.18 <sup>c</sup>	\$44.70 <sup>b</sup>	\$39.60 <sup>a</sup>	\$20.00 <sup>e</sup>	\$20.00 <sup>e</sup>	\$25.00 <sup>d</sup>	\$32.50 <sup>e</sup>
Fertilizer*	\$88.40	\$88.40	\$88.40	\$88.40	\$69.80	\$54.00	\$54.00	\$54.00	\$54.00	\$54.00	\$54.00
Pesticide*	\$20.10	\$20.10	\$20.10	\$12.54	\$20.10	\$43.48	\$43.48	\$43.48	\$43.48	\$43.48	\$43.48
<b>Total Operating</b>	<b>\$141.92</b>	<b>\$130.90</b>	<b>\$130.88</b>	<b>\$169.94</b>	<b>\$115.08</b>	<b>\$142.18</b>	<b>\$137.08</b>	<b>\$117.48</b>	<b>\$117.48</b>	<b>\$25.00</b>	<b>\$32.50</b>

Estimated Farmgate	Profitability Analysis										
	Wheat	Barley	Oat	Canola	Flax	Pea	Faba Bean	Green	Red	Crimson	Red
Price per bu	\$12.35 <sup>f</sup>	\$8.01 <sup>f</sup>	\$9.50 <sup>f</sup>	\$23.18 <sup>f</sup>	\$15.54 <sup>f</sup>	\$9.60 <sup>e</sup>	\$36.00 <sup>h</sup>	\$26.40 <sup>h</sup>	\$37.49 <sup>h</sup>	\$0.00	\$0.00
Yield (bu/acre)**	29.4	57	40	27	12.5	18.1	25	25	25	\$0.00	\$0.00
<b>Gross Revenue (\$/acre)</b>	<b>\$363.09</b>	<b>\$456.57</b>	<b>\$380.00</b>	<b>\$625.86</b>	<b>\$194.25</b>	<b>\$173.76</b>	<b>\$900.00</b>	<b>\$660.00</b>	<b>\$937.37</b>	<b>\$0.00</b>	<b>\$0.00</b>
<b>Net Profit (\$/acre)</b>	<b>\$221.17</b>	<b>\$325.67</b>	<b>\$249.13</b>	<b>\$455.92</b>	<b>\$52.07</b>	<b>\$36.68</b>	<b>\$782.52</b>	<b>\$542.52</b>	<b>\$822.29</b>	<b>-\$25.00</b>	<b>-\$32.50</b>

<sup>a</sup>2021 Richardson Pioneer of Manning Pricing

\*\*Weighted averages of monocrop yield on NPARA farm in 2021

<sup>a</sup>Alberta Agriculture and Forestry (2021, December 1). *Average Farm Input Prices for Alberta*. <https://www.agric.gov.ab.ca/app21/farminputprices>

<sup>b</sup>Mastin Seeds (2021, December 1). *March 2021 Retail Price List*. <http://www.mastinseeds.com/media/pdfs/pricelist.pdf?v=10101010>

<sup>c</sup>Manitoba Agriculture and Resource Development (2021). *2021 Cost of Production Crops*. <https://www.gov.mb.ca/agriculture/farm-management/production-economics/pubs/cop-crop-production.pdf>

<sup>d</sup>Union Forage. (2020, December 11). *2021 SRP Price List*.

<sup>e</sup>Golden Acre Seeds. (2021, December 1). *Winter 2021 Retail Price List*. <https://goldenacreseeds.com/wp-content/uploads/2021/10/Price-List-Oct-22-21.pdf>

<sup>f</sup>Richardson Pioneer. (2021, December 1). *Grain Pricing Contracting to: Nampa, AB*.

<sup>g</sup>Saskatchewan Crop Insurance Corporation (2021, December 1). *Price Forecast*. <https://www.scic.ca/ci/prices/>

<sup>h</sup>Government of Alberta. (2021, November 15). *Nov 12-2021 Weekly Crop Market Review*. <https://open.alberta.ca/dataset/fa0eaebe-44ba-4ed6-90d6-6b29eb74be4a/resource/625ffc82-85ab-4780-9a42-7551810819d7/download/af-itr-weekly-crop-market-review-2021-11-12.pdf>

Operating Costs	Intercrop Production Costs (Dollars Per Acre)***									
	Wheat (70%) & Faba Bean (70%)	Wheat (100%) & Red Clover (50%)	Canola (75%) & Pea (75%)	Barley (80%) & Pea (80%)	Flax (80%) & Red Lentil (80%)	Barley (80%) & Green Lentil (60%)	Oat (80%) & Pea (80%)	Oat (100%) & Crimson Clover (50%)		
Seed	\$51.11	\$49.67	\$85.28	\$53.68	\$36.14	\$29.92	\$53.66	\$34.88		
Fertilizer	\$76.00	\$76.00	\$76.00	\$76.00	\$76.00	\$76.00	\$76.00	\$76.00		
Pesticide	\$6.27	\$6.27	\$6.27	\$6.27	\$6.27	\$6.27	\$6.27	\$6.27		
<b>Total Operating</b>	<b>\$133.38</b>	<b>\$131.94</b>	<b>\$167.55</b>	<b>\$135.95</b>	<b>\$118.41</b>	<b>\$112.19</b>	<b>\$135.93</b>	<b>\$117.15</b>		

Estimated Farmgate	Profitability Analysis															
	Wheat	Faba Bean	Wheat	Red Clover	Canola	Pea	Barley	Pea	Flax	Red Lentil	Barley	Green Lentil	Oat	Pea	Oat	Crimson Clover
Price per bu	\$12.35	\$9.60	\$12.35	\$0.00	\$23.18	\$15.54	\$8.01	\$15.54	\$37.49	\$26.40	\$8.01	\$36.00	\$9.50	\$15.54	\$9.50	\$0.00
Yield (bu/acre)****	17.8289	0.2388	22.5082	0.00	10.46	2.53	54.96	1.98	9.38	2.63	69.18	2.63	40.41	1.23	49.18	\$0.00
Gross Revenue (Separate)	\$220.19	\$2.29	\$277.98	\$0.00	\$242.42	\$39.37	\$440.22	\$30.82	\$351.82	\$69.52	\$554.16	\$94.80	\$383.88	\$19.16	\$467.24	\$0.00
<b>Gross Revenue (Together)</b>	<b>\$222.48</b>	<b>\$2.29</b>	<b>\$277.98</b>	<b>\$0.00</b>	<b>\$281.79</b>	<b>\$471.03</b>	<b>\$471.03</b>	<b>\$471.03</b>	<b>\$421.34</b>	<b>\$648.95</b>	<b>\$648.95</b>	<b>\$648.95</b>	<b>\$403.04</b>	<b>\$403.04</b>	<b>\$467.24</b>	<b>\$467.24</b>
<b>Net Profit (\$/acre)</b>	<b>\$89.10</b>	<b>\$0.00</b>	<b>\$146.04</b>	<b>\$0.00</b>	<b>\$114.242</b>	<b>\$335.09</b>	<b>\$335.09</b>	<b>\$335.09</b>	<b>\$302.92</b>	<b>\$536.77</b>	<b>\$536.77</b>	<b>\$536.77</b>	<b>\$267.11</b>	<b>\$267.11</b>	<b>\$267.11</b>	<b>\$350.10</b>

Three intercrops resulted in a greater net profit sown together than separate as monocrops: barley and pea, oat and pea, and oat and crimson clover (*Trifolium incarnatum* L.). Note the high profit of lentils and flax are based on yields most unobtainable in the Peace, thus these figures should be less regarded. Given the high grain prices and subsequent input cost increase, this year is an oddity when trying to confidently predict economic worth. At the very least, this 2021 snapshot provides insight on the relative costs and profits of growing these crops. When selecting a monocrop vs. intercrop it is important to consider the apparent increased costs, such as that of separating seed post-harvest, as well as decreased costs, such as the reduction of in-season herbicide. A perpetual intercropping system then lends itself to decreased input costs and richer soils that may greater sustain farming in the future. Quantification of these effects will be an ongoing project.

Net Profit (\$ acre <sup>-1</sup> ) of Intercrop vs Monocrop		
Intercrop	Monocrop	
Wheat and Faba Bean	Wheat	Faba Bean
\$89.10	\$221.17	\$36.68
Wheat and Red Clover	Wheat	Red Clover
\$146.04	\$221.17	-\$32.50
Canola and Pea	Canola	Pea
\$114.24	\$455.92	\$52.07
Barley and Pea	Barley	Pea
\$335.09	\$325.67	\$52.07
Flax and Red Lentil	Flax	Red Lentil
\$302.92	\$822.29	\$542.52
Barley and Green Lentil	Barley	Green Lentil
\$536.77	\$325.67	\$782.52
Oat and Pea	Oat	Pea
\$267.11	\$249.13	\$52.07
Oat and Crimson Clover	Oat	Crimson Clover
\$350.10	\$249.13	-\$25.00