

Final Report for Agricultural Demonstration of Practices and Technologies (ADOPT) Program

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Project Identification

1. **Project Title:** Pea Oat Intercrop Demonstration
2. **Project Number:** 20180449
3. **Producer Group Sponsoring the Project:** Saskatchewan Oat Development Commission
4. **Project Location(s):**
 - South East Research Farm (SERF) – Redvers, SK
 - Irrigation Crop Diversification Corporation (ICDC) – Outlook, SK
 - Northeast Agriculture Research Foundation (NARF) - Melfort
 - Conservation Learning Center (CLC) – Prince Albert, SK
 - Wheatland Conservation Area (WCA) – Swift Current, SK
 - Indian Head Agricultural Research Foundation (IHARF) – Indian Head, SK
5. **Project start and end dates (month & year):** April 2019 – February 2020
6. **Project contact person & contact details:**

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Objectives and Rationale

7. Project objectives:

The objective of this project was to:

Demonstrate how to grow oat and pea together as a grain crop.

Demonstrate how to separate grain components using slotted screens.

Demonstrate the effect of varying oat seeding rate in intercrop with pea on yield and agronomic parameters.

8. Project Rationale:

An oat-pea intercrop may be planted as a grain crop and local evaluation of seeding rates is needed to assess crop value, agronomic characteristics, and flexibility for end use. A combination of pea and oat may have higher LER and crop value than either monocrop on their own. Also, grain intercrops may improve agronomic characteristics of pea by reducing or mitigating lodging, disease, and insect damage. This project investigated the effect of varying the oat seeding rate as a companion crop with pea to determine whether there is a consistent optimum balance of the two crops.

Methodology and Results

9. Methodology:

Trials were established in May 2019 at six locations. The four locations funded by the ADOPT program were SERF (Redvers, SK), ICDC (Outlook, SK – Irrigated), IHARF (Indian Head, SK) and WCA (Swift Current). Two additional sites at NARF (Melfort) and CLC (Prince Albert) were funded by a combination of Sask Oat, Sask Pulse Growers, General Mills, and contributions from farmers. The trial was led by Lana Shaw at SERF. Each site was established with four replicates as an RCBD. Trial production details are listed in the Appendix on page 15.

The target pea seeding rate to achieve 80 plants m⁻² was used for seven of the eight treatments in this trial. All intercrop and monocrop treatments had the same base level of peas while the amount of oats varied in the intercrop treatments. Seeding rates were adjusted for seed size and germination for target plant densities of 25, 50, 75, 100, and 125 plants meter⁻² for oats in the intercrop and 200 plants meter⁻² in the oat monocrop. The intercrop treatments also received some nitrogen fertilizer but less than that used in the monocrop oat treatment. The reason for the differing fertilizer application between treatments is to reflect typical intercrop and monocrop practices for fair comparisons of productivity.

Weed biomass was collected from two quarter meter square samples from the front and back of the plot. Crop biomass was collected at approximately oat milk stage for all locations. The biomass was dried and separated into component crops for weighing. At ICDC the weed and crop biomass were collected together using quarter meter square samples and separating for weighing.

Some locations used MCPA herbicide and others either lacked sufficient weed pressure or the timing for application did not work out. Dates of field operations, use of crop protection products, crop varieties and other production details are listed in Table 2. Some sites counted four meter rows per plot and some counted two meter rows. Some sites sampled 2 meter rows or quadrats for biomass, so biomass yields are adjusted according to the sampled area. The Redvers site was air dried and dry matter yields are estimated. The other sites had oven dry weights.

Table 1. List of treatments with target seeding rates for pea and oat.

Trt #	Crop	Oat Seed Rate (plants meter ⁻²)	Oat Seed Rate (approx. lb/ac)	Pea Seed Rate (plants meter ⁻²)
1	Pea + Oat	25	11	80
2	Pea + Oat	50	21	80
3	Pea + Oat	75	32	80
4	Pea + Oat	100	43	80
5	Pea + Oat	125	53	80
6	Oat	200	85	0
7	Pea (hand-weeded)	0	0	80
8	Pea	0	0	80

At Redvers, the intercrop was seeded with the Seedmaster plot drill metering pea and oat individually through two boxes into the seed row at the same depth. There was sufficient moisture for germination at the time to place both at a depth of 1 inch. N and P fertilizer was side-banded for the intercrops and monocrop oats (Table 2). The monocrop pea treatments received only P fertilizer in a side-band. No MCPA herbicide was used because weeds emerged relatively late and were very few. The trial was successfully harvested even though peas were ready for harvest before the oats. Late tillering in the oats caused some issues with high moisture in the oats.

At the IHARF Indian Head site, a fertilizer blend was applied on all treatments that consisted of actual nutrients 20-28-13-13 lb N-P2O5-K2O-S/ac. Additional N fertilizer was added to intercrops and monocrop. Fungicide Quilt was applied at 0.405 L ac⁻¹ on July 8. Monocrop peas were harvested on Aug 21 and the remaining trial was harvested on Aug 30 without recourse to desiccant.

At WCA at Swift Current, pea and oats were seeded together and fertilizer was side-banded. Intercrop and monocrops received only N fertilizer and pea monocrops received only P fertilizer. Soil nitrogen was unusually high based on the soil test results. The trial was successfully harvested.

At the CLC, establishment issues resulting in very poor establishment of the intercrop peas relative to the monocrop peas may have been the result of fertilizer injury on a dry year. The intercropped peas had urea added while the monocrop peas only had monoammonium phosphate applied during seeding. Data is not presented for the CLC site due to both poor establishment of oats in all treatments and this problem with the pea establishment.

At ICDC, the trial was planted on potato stubble that was seeded in the fall with a rye cover crop. The rye was sprayed out on May 9 but it resulted in a depletion of surface soil moisture that reduced emergence rates of the trial. When the trial was irrigated after emergence to supplement the soil moisture and encourage further emergence, the sprinkler water flattened the pea plants and they did not recover from this early lodging. Harvest was completed but there was little pea growth. Due to delays in harvest caused by inclement weather, the peas had deteriorated and shattered before harvest.

At the NARF site, soil moisture conditions at and after seeding were not conducive to even establishment. The oats matured later than the peas. The trial was inadvertently destroyed sometime after biomass collection and harvest of the monocrop peas. The weather was a factor in delay of harvest of the oats in the monocrop and intercrop treatments.

Calculations of gross crop value are based on a long-term usual price of 2.85/bu for oats and \$7/bu for peas. At the time of writing the report, oats are worth more and peas are worth less than the usual long-term price. Statistix program was used for analysis of variance.

Mean monthly temperatures vs long-term (30 year) means for the 2019 growing seasons at Saskatchewan Trial Locations.

Location	Year	May	June	July	August	Avg. / Total
-----Mean Temperature (°C)-----						
Outlook	2019	9.9	16.0	18.0	16.2	15.0
	Long-term	11.5	16.1	18.9	18.0	16.1
Melfort	2019	8.8	15.3	16.9	14.9	13.9
	Long-term	10.7	15.9	17.5	16.8	15.2
Swift Current	2019	9.52	15.78	17.72	16.75	14.9
	Long-term	10.9	15.3	18.2	17.6	15.5
Redvers	2019	9.5	16.3	18.5	16.6	15.2
	Long-term	12	16	19	18	16.3
Indian Head	2019	8.9	15.7	17.4	15.8	14.4
	Long-term	10.8	15.8	18.2	17.4	15.6

Precipitation amounts vs long-term (30 year) means for the 2019 growing seasons at Saskatchewan Trial Locations.

Location	Year	May	June	July	August	Avg. / Total
-----Precipitation (mm)-----						
Outlook	2019	13.2	90.2	43.8	39.6	186.8
	Long-term	42.6	63.9	56.1	42.8	205.4
Melfort	2019	18.8	87.4	72.7	30.7	209.6
	Long-term	42.9	54.3	76.7	52.4	226.3
Swift Current	2019	13.3	156	11.1	42.6	223.0
	Long-term	51.2	77.1	60.1	47.4	235.8
Redvers	2019	18.0	79.0	54.0	88.0	239
	Long-term	60	91	78	64	293
Indian Head	2019	13.3	50.4	53.1	96.0	212.8
	Long-term	51.7	77.4	63.8	51.2	241.4

10. Results

Pea Establishment

Pea establishment was close to target levels of 80 plants/m² at WCA, IHARF and SERF. At ICDC and NARF, pea establishment rates were poor and variable due to dry seedbed conditions. Oat establishment was good at all sites and reflected the different seeding rates used.

		Pea Plants/m ²				
Trt #		WCA	IHARF	ICDC	SERF	NARF
1	Intercrop 25	63.2	78.7	35.3	72.8	26.7
2	Intercrop 50	68.0	80.4	32.6	77.3	39.8
3	Intercrop 75	79.4	80.0	32.1	77.3	50.9
4	Intercrop 100	56.7	75.5	28.6	75.3	38.1
5	Intercrop 125	68.6	77.1	38.8	78.2	34.4
6	Mono Oats	n/a	n/a	n/a	n/a	n/a
7	Pea (weeded)	84.7	78.7	36.5	80.7	64
8	Pea	74.6	89.8	34.9	69.9	42.3
	P	0.01	>0.1	>0.1	>0.1	0.04
	LSD (0.05)	14.4	ns	Ns	ns	21.7

		Oat Plants/m ²				
Trt #		WCA	IHARF	ICDC	SERF	NARF
1	Intercrop 25	21.5	20.1	39.3	15.8	19.7
2	Intercrop 50	47.1	56.2	47.1	31	43.5
3	Intercrop 75	66.8	41.0	72.4	66.9	47.2
4	Intercrop 100	85.3	66.9	94.3	80.7	66.4
5	Intercrop 125	99.1	85.3	128.5	100.4	82.0
6	Mono Oats	188.6	137.8	215.9	169.8	64.4
7	Pea (weeded)	n/a	n/a	n/a	n/a	n/a
8	Pea	n/a	n/a	n/a	n/a	n/a
	P	0	0	0	0	0.02
	LSD (0.05)	27.7	22.6	20.3	16.4	25.8

Pea and Oat Canopy Height

At Swift Current, peas were taller in the monocrops than in the intercrops. At Indian Head, the peas were taller in the monocrops (Trt 7 and 8) and in Trt 1, which was the lowest oat rate. Peas in the intercrops were generally as tall or shorter than peas grown in a monocrop.

Pea Height (cm)					
Trt #	Treatment	WCA	IHARF	SERF	NARF
1	Intercrop 25	64	68	78	91
2	Intercrop 50	64	66	77	83
3	Intercrop 75	64	64	74	84
4	Intercrop 100	65	64	73	81
5	Intercrop 125	63	65	72	74
6	Mono Oats	n/a	n/a	n/a	n/a
7	Pea (weeded)	74	69	78	96
8	Pea	70	71	77	95
	P	0.02	0.01	<0.01	<0.01
	LSD	7	4	4	8

Oat Height (cm)						
	Trt #	WCA	IHARF	ICDC	SERF	NARF
1	Intercrop 25	77	86	106	100	101
2	Intercrop 50	79	82	108	97	97
3	Intercrop 75	80	83	108	95	97
4	Intercrop 100	77	83	107	95	100
5	Intercrop 125	78	84	108	93	97
6	Mono Oats	82	87	105	92	101
7	Pea (weeded)	n/a	n/a	n/a	n/a	n/a
8	Pea	n/a	n/a	n/a	n/a	n/a
	P	>0.1	>0.1	>0.1	0.04	>0.1
	LSD	Ns	ns	ns	4.7852	Ns

Weed Biomass and Rating

Weed biomass was collected at four locations and was variable with effect of treatment. At ICDC, there was no weeds in the oat monocrops, very little in the intercropped treatments with higher oat seeding rates, and more weeds in Treatment 8 monocrop peas. Weed biomass tended to be lower as the oat seeding rate increased, but there were no significant differences between individual intercrop treatments for weed biomass. At SERF, weed biomass was mostly similar between intercrops and monocrops, with some intercrop treatment having lower weed biomass than the pea monocrops. At NARF, weed biomass was variable but some intercrop treatments had less weed biomass than the pea and oat monocrops.

Weed rating was recorded at three sites. For the 1 to 10 rating, 1 indicates no weeds and 10 indicates very weedy conditions. The timing of the weed rating was Sept 9 at WCA, Sept 19 at NARF, and August 20 at IHARF. Weed rating was not done at SERF because weed pressure was extremely low. At WCA, the intercrops (100 and 125 oats/m²) tended to have less weed pressure than the peas and similar to the monocrop oats. Weed pressure tended to decrease with increasing oat density in the intercrops. At IHARF, weed pressure was low and differences were not significant. At NARF, weed pressure was overall very low and differences were not significant.

Weed Dry Biomass		WCA	ICDC	SERF	NARF
		Kg/ha	Kg/ha	Kg/ha	Kg/ha
1	Intercrop 25	60.55	111.5	110.65	28.5
2	Intercrop 50	39.3	70.5	205.4	254
3	Intercrop 75	70.25	26.5	87.65	121.5
4	Intercrop 100	63.4	13.5	188.2	65
5	Intercrop 125	39.3	5	104.4	8
6	Mono Oats	38.85	0	134.85	156.5
7	Pea (weeded)	67	0	0	33
8	Pea	67.3	435.5	190.95	333
	P	>0.1	<0.01	0.01	0.08
	LSD	Ns	212.12	112.9	23.658

Weed Rating (1-10)		WCA	IHARF
1	Intercrop 25	3.6	1.5
2	Intercrop 50	2.9	1.6
3	Intercrop 75	2.6	1.3
4	Intercrop 100	1.9	1.1
5	Intercrop 125	1.9	1.1
6	Mono Oats	1.3	1.4
7	Pea (weeded)	4.1	1.0
8	Pea	3.4	1.6
	P	0.01	0.06
	LSD	1.3558	NS

Lodging and Maturity

At SERF and WCA, there were significant differences in lodging when rated on a 1 to 10 scale with 10 being the worst. At Redvers, increasing amounts of oats in the intercrops tended to decrease lodging. Monocrop oats had no lodging and monocrop peas had more lodging than the intercrops at SERF. At WCA at Swift Current, increasing amounts of oats in the intercrops tended to reduce lodging. For some reason, the hand-weeded peas seemed to have less lodging than the weedy peas. There was no lodging at IHARF and it was not recorded at NARF or ICDC.

	Lodging (1-10)	SERF	WCA
1	Intercrop 25	2.8	3.8
2	Intercrop 50	2.3	3.4
3	Intercrop 75	2.0	2.8
4	Intercrop 100	1.8	1.9
5	Intercrop 125	1.5	2
6	Mono Oats	1.0	1.1
7	Pea (weeded)	3.5	2.3
8	Pea	3.8	4.4
	P	0	0.03
	LSD	0.744	1.9337

Maturity of oats and peas varied some at the locations where it was recorded but there were no significant differences due to treatment except for peas at SERF and that difference was very small.

Land Equivalency Ratio

Land Equivalency Ratio (LER) is a measure of the yield of grain or biomass for an intercrop. The formula for calculating LER is shown below. LERs greater than 1 show improved efficiency of the intercrop relative to the monocrops but this doesn't mean that combined intercrop yield is necessarily higher yielding than both monocrops. LERs are presented for both dry biomass and grain yield.

LER

$$\text{Ratio: } \frac{\text{Ycb in mixed stand}}{\text{Ycb in pure stand}} (+) \frac{\text{Ymz in mixed stand}}{\text{Ymz in pure stand}}$$

Where

LER = Land equivalent ratio

YCB = Yield of pea crop

YMZ = Yield of Oat Crop

Dry weight biomass

Dry biomass or forage yield is one potential end use of this intercrop. It is also an indication of the balance of the crops before problems with harvest reduced yield in some locations.

- At WCA, some intercrops had higher yield than the hand-weeded pea treatment but all were lower than the total oat monocrop biomass yield. Land equivalency ratio was less than 1 at WCA for biomass.
- At IHARF, the intercrops tended to have higher biomass yield than the peas but lower than the oats. The LER was close to 1 for all intercrop treatments for biomass at IHARF.
- At ICDC, biomass yield of the oats in monocrops and intercrops was very high due to irrigation and abundant nutrient availability. Total yield increases as the seeding rate of oat increases in the intercrops.
- At SERF, the biomass yield of the oats in the intercrops increases with increasing seed rates of oat. At the same time, yield of pea drops somewhat with increasing oat seed rate. LER is close to 1 and there is a reasonable balance of both crops.
- At NARF, differences in biomass yield are likely related to variable establishment of oats and peas. Pea biomass was quite low and the intercrops were more productive than the pea monocrop.

Dry Biomass		WCA				IHARF				ICDC			
		Oat Kg/ha	Pea Kg/ha	Total Kg/ha	LER	Oat Kg/ha	Pea Kg/ha	Total Kg/ha	LER	Oat Kg/ha	Pea Kg/ha	Total Kg/ha	LER
1	Intercrop 25	2240	3200	5440	0.84	760	3540	4300	0.96	10740	3285	14025	1.05
2	Intercrop 50	2860	3070	5930	0.89	1810	2680	4490	0.94	14890	2820	17710	1.15
3	Intercrop 75	2960	2910	5870	0.88	2580	2190	4760	0.97	15620	1750	17370	1.00
4	Intercrop 100	4870	1930	6800	0.95	2630	2330	4960	1.01	17920	1005	18930	0.98
5	Intercrop 125	4030	2080	6110	0.87	2710	2030	4730	0.95	19840	1240	21080	1.10
6	Mono Oats	7850	n/a	7850		5680	n/a	5680		22330	n/a	22330	
7	Pea (weeded)	0	5800	5800		0	4280	4280		0	5795	5800	
8	Pea	0	5010	5010		0	4100	4100		0	5340	5340	
	p-value		0	0.02		0	0	0.03		0	0	<0.01	
	LSD		810	1420		710	750	870		2548	1764	2590	

Dry Biomass		SERF				NARF			
		Oat	Pea	Total	LER	Oat	Pea	Total	LER
1	Intercrop 25	1100	5650	6750	0.97	2000	650	2650	0.78
2	Intercrop 50	2790	4500	7300	1.02	2770	480	3250	0.78
3	Intercrop 75	3560	3900	7460	1.04	3980	570	4550	1.04
4	Intercrop 100	3840	3230	7080	0.98	2460	410	2880	0.68
5	Intercrop 125	4140	3240	7370	1.02	5320	380	5700	1.13
6	Mono Oats	7590	n/a	7590	1	6180	n/a	6180	1
7	Pea (weeded)	n/a	6870	6870	1	n/a	1430	1430	1
8	Pea	n/a	5850	5850	n/a	n/a	1250	1250	n/a
	p-value	0	0	<0.01		0	<0.01	<0.01	
	LSD	821.7	821.02	1080		1660.5	260	1390	

Grain Yield

A difficult harvest period with rain and cold weather affected all locations to a greater or lesser extent.

- At WCA, most of the yield in the intercrops was oats. Yields were relatively low due to dry conditions.
- At IHARF, the intercrop was relatively productive and balanced in terms of proportions of pea and oats that contributed to yield. The LERs for the intercrops were close to 1.
- At ICDC, the harvest was delayed at Outlook (ICDC) to October 7 and shattering or rotting of the peas resulted in reduced pea yield. In spite of the large oat crop and very small pea crop, land equivalency ratios in the intercrops were generally close to 1. The most productive combinations of oat rates as companions resulted in lower yields than the oat monocrop. The very small amounts of peas in the mixed grain would not have been economical to separate.
- At SERF, oat yield was relatively low in the intercrops due to predation by birds. Pea yield decreased with increasing oat seeding rate. LERs tended to be higher at lower oat rates, but this may have been affected by the bird predation.

Treatment		WCA					IHARF				
		Oat Kg/ha	Oat bu/ac	Pea kg/ha	Pea bu/ac	LER	Oat kg/ha	Oat bu/ac	Pea kg/ha	Pea bu/ac	LER
1	Intercrop 25	1188.3	(31.1)	900	(13.4)	0.93	1070	(28)	2950	(44)	0.98
2	Intercrop 50	1756.6	(46.0)	570	(8.4)	0.94	1780	(47)	2680	(40)	1.04
3	Intercrop 75	2202.6	(57.7)	480	(7.1)	1.05	2340	(61)	2210	(33)	1.02
4	Intercrop 100	2232.9	(58.4)	480	(7.1)	1.07	2580	(68)	1840	(27)	0.96
5	Intercrop 125	2343.6	(61.3)	440	(6.4)	1.08	2730	(71)	1710	(25)	0.96
6	Mono Oats	3105	(81.3)	n/a	0	1	5410	(142)	n/a	n/a	1
7	Pea (weeded)	n/a	0	2080	(30.8)		n/a	n/a	3740	(55)	
8	Pea	n/a	0	1840	(27.3)	1	n/a	n/a	3810	(57)	1
	p-value	0		0			0		0		
	LSD	406.6	(10.6)	270	4.1		300	8	290	4	

Treatment		ICDC					SERF				
		Oat kg/ha	Oat bu/ac	Pea kg/ha	Pea bu/ac	LER	Oat kg/ha	Oat bu/ac	Pea kg/ha	Pea bu/ac	LER
1	Intercrop 25	3313.2	(87)	620	(9.2)	1.09	318.1	(8)	3351.6	(50)	0.92
2	Intercrop 50	4997	(131)	220	(3.2)	0.93	577.4	(15)	2847.6	(42)	0.85
3	Intercrop 75	5459	(143)	170	(2.5)	0.93	1051.2	(28)	2255.3	(33)	0.80
4	Intercrop 100	6271.3	(164)	110	(1.6)	0.99	1459.3	(38)	1837.5	(27)	0.78
5	Intercrop 125	6993.2	(183)	100	(1.5)	1.07	1839.8	(48)	1575.7	(23)	0.79
6	Mono Oats	7200.3	(188)	n/a	n/a	1	4673.8	(122)	n/a	0	1
7	Pea (weeded)	n/a	n/a	930	(14)		n/a	n/a	4193.5	(62)	
8	Pea	n/a	n/a	1020	(15)	1	n/a	n/a	3945.2	(59)	1
	p-value	0		0			0		0		
	LSD	948	25	290	4.3		544.36	14	303.12	5	

Crop Gross Value

Gross crop values are based on \$2.85/bu oats and \$7/bu peas. The exception was for Outlook, where they produced Marrowfat peas with a value of \$10/bu.

- At Swift Current, the intercrops with the three highest seeding rates for oats (75, 100 and 125 pl/m²) had similar crop value to the peas that were hand-weeded and were about \$15/acre less than monocrop oats. The intercrop treatments with low oat rates tended to produce less crop value.
- At Indian Head where the crop was relatively well balanced and productive generally, the intercrops were very comparable to the monocrops for value with only one intercrop treatment having higher value than the oat monocrop.
- At Outlook the oat monocrop was the highest value treatment, the peas were the lowest and the intercrops were intermediate in value. One of the intercrop treatments had the same value as the monocrop oats.
- At Redvers, the value of the oats that made it to harvest after the birds had eaten some of them was fairly low. The monocrop pea yields were excellent and this makes the value of the intercrops look poor in comparison. This is the only site where the pea monocrop value was higher than the intercrop value generally and intercrop value declined with increasing oat density.

Crop \$ Value per acre (CND)	Swift Current			Indian Head			Outlook (Irrigated)			Redvers		
	Oat	Pea	Total	Oat	Pea	Total	Oat	Pea	Total	Oat	Pea	Total
Intercrop 25	89	94	183	80	306	386	247	91	339	24	348	372
Intercrop 50	131	59	190	133	278	411	373	33	405	43	296	339
Intercrop 75	164	49	214	174	229	404	407	25	432	78	234	313
Intercrop 100	167	50	217	192	191	383	467	16	484	108	191	300
Intercrop 125	175	45	220	204	177	381	523	15	537	137	164	301
Mono Oats	232		232	403		403	537		537	349		349
Pea (weeded)		216	216		388	388		138	138		435	435
Pea		191	191		396	396		151	151		410	410

Production and Grain Separation Costs

Estimated cost of basic separation using rotary screens based on \$0.25/bu (industry source) is \$15-25/acre depending on yield. In this demonstration, about half the normal rate of N was applied to the intercrops, resulting in a cost savings of about \$18/ac compared to monocrop oats. The cost of the pea seed is estimated at \$22/ac and ranged from \$1 to \$5 per acre for oat seed.

Normally some combination of pre-emergence herbicides and post-emergence herbicides is used in pea monocrops and this cost would not be incurred in an oat pea intercrop. There were some indications of reductions in weed biomass from intercropping, so reductions in herbicide costs could be a factor for farmers to put into their cost budgets. Effects of the intercrop on disease and insect pressure are so far unknown. There were no indications that the intercrops had more or less disease than the monocrops in this trial, as disease pressure was generally low on a dry year.

Slotted screens were used to separate peas from oats. At Redvers, there was some split peas that were difficult to separate from the oats.

Costs of intercrop relative to monocrop oats:

	Intercrop
Seed cost	\$9 higher
N fertilizer	\$17.50 lower
Separation	\$18 higher
Pesticides	Unknown differences
Total	\$9.5 higher (minus differential in pesticide use)

Oat Quality

Replicates were combined for each treatment and sent for analysis by General Mills from IHARF and SERF. Samples from IHARF showed bushel weights of 39.4 for intercrop treatments vs 37.42 for the monocrop oats. The percent plump was 79.6 for the intercrops vs 67.3 for the monocrop oat from IHARF.

Redvers samples did not show the same trends but had high unthreshed grain percentage for some reason, possibly high moisture at combining or incorrect combine setting. Because of the possible effect of bird damage and the unthreshed grain percentage, quality data from Redvers is not reported. Samples from Swift Current were sent but have been misplaced. Samples were not sent from ICDC due to the low amount of peas in the intercrop treatments.

11. Discussion and Conclusions

The pea oat intercrop resulted in similar yield efficiency to the pea and oat monocrops when land equivalency ratio is used for comparison for both biomass yield and grain yield. At Redvers, bird damage and possibly dry conditions resulted in lower land equivalency ratio. IHARF's site at Indian Head was the most successful for intercrop establishment. The ICDC irrigated site at Outlook had the highest yields but poor establishment and growth of the peas. There are some promising indications for oat quality and weed suppression, but there is no indication of a yield advantage to intercropping pea and oat. With the separation costs included, production of yellow peas and milling oats does not seem attractive compared to the monocrops from a profitability standpoint. This trial did not determine whether there are any reductions in pesticide use possible which might offset the separation costs of the pea and oats.

These results suggest there is potential for intercropping to improve competitive ability of pea, particularly at the higher rates of oat inclusion (Trts 3, 4 and 5). There was a tendency to reduced lodging in the intercrops relative to the pea monocrops. This intercrop shows some positive functionality but separation costs and lack of broad spectrum suitable herbicides would be an obstacle to adoption. The improvement in weed competition may be more relevant for organic farmers than conventional farmers.

12. Acknowledgements

General Mills conducted the quality analysis on the oat samples. Sask Pulse Growers, Sask Oat and General Mills contributed to the funding for the NARF Melfort site.

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13. Extension Activities

This demonstration was toured at the IHARF field day on July 16 with about 125 in attendance. Lana Shaw from SERF presented in the trial at IHARF on July 16. The trial was featured in a tour for 20 Australian farmers, agronomists and researchers on July 14 at the SERF location at Redvers. Also at Redvers was an intercrop tour on July 17 and a general crop research tour on July 18. Between those two field days there was about 90 participants. Lana also presented the gross value data at the Agri-ARM Research Update on Jan 16, 2020.

On July 24, the trial was toured at NARF (Melfort) at the main field day and the General Mills é Exceed Grain Marketing Summer Tour on August 13. Jessica Pratchler also presented on the trial at the Prairie Oat Growers meeting in December. Brianne McInnes from NARF also presented information on the trial at the Agri-ARM update on Jan 16, 2020. The Swift Current site was promoted on a CKSW radio program called "Walk the Plots" that is broadcasted on a weekly basis throughout the summer, and was also featured on a crop tour of SPG representatives.

Sask Oat had a story about this trial in the Oat Scoop newsletter in 2019. At the Sask Oat AGM in January, 2020, the trial was mentioned and a preliminary report with yield data was distributed to those who were interested.

14. Abstract

Peas and oats were grown in an intercrop trial at six locations in Saskatchewan. Five seeding rates of oats were evaluated as a companion crop with yellow or marrowfat peas, depending on location. Five sites established adequately and four sites were harvested for grain. Land Equivalency Ratio (LER) for grain yield was close to one for three locations and was lower than 1 at Redvers. Biomass LER tended to be close to 1 with small effects of oat seeding rate on that ratio. There were some indications that intercropping reduced lodging and improved weed competition.

15. Appendix 1

Agronomic Table	SERF	ICDC	WCA	NARF	IHARF
Previous crop	Barley	Potato with rye cover		Canola	Canaryseed
Seeding date	08-May-19	21-May-19	15-May-19	17-May-19	10-May-19
Row spacing	10 inch	n/a	8.25"	12 inch	12 inch
Variety Pea	Inca	Marrowfat	Inca	Carver	Amarillo
Inoculant	Tag Team peat pea	Nodulator Dual Granular	Nodulator Granular	CellTech Peat	Nodulator Duo
Oat Variety	CS Camden	CS Camden	CS Camden	CS Camden	Ruffian
Soil N Available (lb/ac)	46 (0-24")	134 (0-24")	302 (0-24")	48 (0-12")	18 (0-12")
Fertilizer Mono Oat (actual N in lb/ac)	70	0	60	78	90
Fertilizer Intercrop (actual N in lb/ac)	30	0	40	40	45
Fertilizer Mono Peas N	3	0	0	8	20
Fertilizer P (actual, lb/ac)	20	27	25 (only on peas)	38-42	28
Herbicide	None	0.2 L/ac MCPA	None	None	MCPA 0.405 l/ac June 18
Fungicide	None	Priaxor 180 mL/ac	None	None	0.405 L/ac Quilt
Plant count area	4 meter rows	4 meter rows	1 meter row	2 meter rows	2 meter rows
Weed Biomass Collection Date	05-Jul-19	29-Jul-19	05-Jul-19	12-Jul-19	n/a
Biomass method	air-dried	oven dried	oven dry	oven dry	n/a
Pea oat biomass date	24-Jul-19	29-Jul-19	22-Jul-19	02-Aug-19	22-Jul-19
Sampling area	4 meter rows	quarter meter	2 meter rows	4 meter rows	2 meter rows
Harvest Date Pea	21-Aug-19	07-Oct-19	21-Aug-19	19-Sep-19	21-Aug-19
Harvest Date Oat and Intercrop	21-Aug-19	07-Oct-19	21-Aug-19	none	30-Aug-19
Desiccant use	None	yes	none	none	none
Desiccant date	n/a	18-Sep	n/a	n/a	n/a