ADOPT #20190430

OAT PEA INTERCROP DEMONSTRATION

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Introduction

The demonstration in 2020 comprised three locations and it evaluated several seeding rates of oats when grown as a companion crop with yellow peas. Those three locations were South East Research Farm (SERF) at Redvers, Northeast Applied Research Foundation (NARF) at Melfort, and Indian Head Agricultural Research Foundation (IHARF) at Indian Head. All sites were located in Saskatchewan. Sole crops or monocrops were grown of pea and oats for comparison. These monocrops were managed to be similar to typical crop production with the exception that they were generally not sprayed for in-crop weed control.

Methodology

Treatments: Oats at 25, 50, 75, 100, 125 targeted plants/m2 grown with peas at 80 to 90 target plants/m2. The oat monocrop was grown at 200 plants/m2 target and monoculture pea treatments were also at 80 to 90 target plants/m2. There were two monoculture pea treatments: one was hand-weeded and one was not.

The plan called for oat monocrops were to be fertilized at recommended levels and intercrops were to be fertilized with a lower amount of N applied. Pea monocrops had no nitrogen applied other than what was in phosphate or sulphur fertilizer products.

Oat disease was recorded at SERF using a 1 to 11 Horsfall-Barrat scale. The protocol was not updated for NARF or IHARF, so they did not record disease levels. Overall, it was an unusually dry year with low disease pressure.

Detailed agronomic information is presented in Table 1.

Table 1. Agronomic Information for three trial locations in 2020.

		SERF	IHARF	NARF
Previous Crop		Flax	Canaryseed	Canola
Seeding date		May 6	May 7	June 5
Oat Variety		Camden	Camden	Camden
Pea Variety		CDC Inca	Amarillo	Carver
Seeder		Seedmaster	Seedmaster	Coneseeder
Row Spacing		10	12	12 inch
Soil available N (lb/ac) from 0 to 60 cm		40	32	54 (0-12 inch)
Intercrop N applied (lb/ac)		34	59	48
Monocrop Oat N applied (lb/ac)		74	77	69
Inoculant (intercrop and mono pea)		Nodulator peat	Nodulator Granular	Nodulator Granular
Plant count date		May 26	June 2	June 29
Biomass harvest date		July 15, 16	July 9	July 22
In-crop Herbicide		None	MCPA June 9	None
Fungicide		None	Delaro, July 2	None
Grain harvest date		Aug 11	Aug 18	Oct 19
Rain from seeding to maturity (inches)			2.8	7

SERF

Treatments were seeded by placing the peas and oats together at the same depth (1 inch) and side-banding fertilizer using the Seedmaster plot drill. Seeding depth was the same for all treatments. Biomass was collected from four 0.25 m2 quadrats when peas were podding and oats were at milk stage. Each sample had two rows in it and was separated into weeds, peas and oats for air-drying and weighing. Air-dry biomass is reported.

IHARF

Pea and oat were seeded together in the same row at 1 inch depth. Fertilizer was side-banded with a Seedmaster plot drill. Camden oats and Amarillo yellow peas were used. The weed-free monocrop pea was sprayed with Odessey herbicide on June 11 instead of hand-weeding. Biomass was collected from two 1-meter sections of crop row, combined into one sample, dried, and separated into weed, pea and oat components.

NARF

The trial was seeded in the same row and depth using a Fabro cone seeder. Fertilizer was banded separately. Seeding was delayed by a May snowfall. Harvest was also delayed by snow. Two meter row samples were collected from the front and back (four total). These were separated into pea and oat components and dry weight was determined. Weed biomass was collected from quadrats from the front and back of the plot on July 22.

Results

Table 2. Plant densities for eight crop treatments.

	SERF	IHARF	NARF	SERF	IHARF	NARF
TREATMENTS	Pea plant density (pl/m2)			Oat plant density (pl/m2)		
PEA + 25 OATS	80	103	50	19	18	22
PEA + 50 OATS	82	103	50	58	32	48
PEA + 75 OATS	89	96	51	90	57	59
PEA + 100 OATS	94	95	52	113	81	75
PEA + 125 OATS	100	107	43	144	92	105
OAT MONO	X	X	X	185	180	175
PEA MONO WEEDED	95	110	67	X	X	x
PEA MONO	97	100	62	X	X	x
P-VALUE	0.19	0.07	0.01	0	0	0
LSD	ns	Ns	12.7	29	29.427	22.5

Pea densities were relatively high at SERF and IHARF and did not vary by treatment. Establishment of peas was not as good at NARF, particularly for the intercrop treatments. Oat densities were close to or somewhat exceeded the targeted plant densities at SERF. At IHARF, the densities were lower than the targeted amount, likely due to dry spring conditions there.

Figure 1. Canopy in oat monoculture (left) beside oat pea intercrop at 100 oat plants/m^2 (right).

There was no lodging at SERF or IHARF due to dry conditions. Intercropping at the 100 and 125 pl/m2 oat density resulted in significantly reduced lodging compared with lower oat intercrop densities and pea monocrops.

Oat disease was generally low. There doesn't seem to be a clear trend on oat leaf disease. Pea roots were dug up from the SERF location to check for Aphanomyces root rot, but there was negligible root disease pressure. IHARF sprayed fungicide for foliar disease and diseases notes were not taken. NARF did not report disease due to a miscommunication.

Days to maturity did not vary significantly at IHARF or NARF for pea or oat. It did not vary significantly for pea at SERF. However, oat maturity was delayed at the lower oat densities in intercrops (25 to 75 pl/m2 target treatments). Peas were 7 days earlier than oats at NARF and about 10 days earlier than oats at IHARF. Peas were 1.5 to 3.5 days earlier than oats at SERF.

Table 3. Lodging, disease and oat days to maturity for eight crop treatments.

TREATMENTS	Lodging	Oat Disease	Oat days to maturity
	1 to 10	1 to 10	
	NARF	SERF	SERF
PEA + 25 OATS	3.75	1.3	83.3
PEA + 50 OATS	4	1.7	82.3
PEA + 75 OATS	3.5	1.5	82.3
PEA + 100 OATS	1.5	1.65	81.3
PEA + 125 OATS	1	1.4233	80.5
OAT MONO	1.5	1.8	80.0
PEA MONO WEEDED	4	X	X
PEA MONO	5	x	X
P-VALUE	0	0.05	0
LSD	2	0.33	1.8

Pea height was affected by the presence of oats in the intercrop treatments, which shows the effect of interspecies competition. Oat height was not affected by the presence of peas.

Table 4. Crop height for oat and pea in intercrop and monocrop treatments.

	SERF	IHARF	NARF	SERF	IHARF	NARF
TREATMENTS	Pea Height (cm)			Oat Height (cm)		
PEA + 25 OATS	51.3	56.2	58.0	75.6	75.6	84.4
PEA + 50 OATS	51.4	53.8	58.1	77.7	74.9	86.1
PEA + 75 OATS	54.3	52.2	55.6	80.7	75.8	86.0
PEA + 100 OATS	47.8	51.9	57.0	73.9	74.5	84.4
PEA + 125 OATS	46.2	51.3	55.5	72.8	75.1	83.5
OAT MONO	x	X	X	71.8	77.6	87.3
PEA MONO WEEDED	57.5	57.7	57.0	X	X	X
PEA MONO	52.4	58.4	55.9	X	X	X
P-VALUE	0.01	0	0.36	0.17	0.59	0.29
LSD	5.5	3.5	ns	Ns	NS	ns

Table 5. Weed biomass, weed rating

	Weed Dry Biomass kg/ha			Weed Rating 1 to 10		Weed Control %
	SERF*	IHARF	NARF	SERF	IHARF	NARF
PEA + 25 OATS	1161	183.75	1173	4.75	4.75	50
PEA + 50 OATS	1365	90.25	983	4.75	4.5	68
PEA + 75 OATS	973	77.88	802	3.25	3.125	63
PEA + 100 OATS	931	126.5	649	4.5	3.25	80
PEA + 125 OATS	521	126.1	635	3.3929	3	80
OAT MONO	1260	153.75	753	5	2.75	73
PEA MONO WEEDED	356	4.8	0	3	1	100
PEA MONO	1292	106.92	683	5.5	3.875	43
P-VALUE	0.05	0.01	0	0.22	0	0
LSD	675	86.31	327	Ns	0.7242	19

*Air-dry biomass

The effect of intercropping on weed suppression (weed biomass, weed rating, weed control %) varied by location. There was not a consistent effect between locations.

Biomass and yield data are shown in Appendix 1. Pea biomass generally went down in the intercrops as oat seeding density increases. The intercrop biomass was lower than both monoculture peas treatments. Oat biomass was low when oat seeding density in the intercrops was low. When the pea and oat biomass are combined, the total biomass is quite similar across treatments. Hand-weeding improved pea biomass in the control relative to the unweeded control.

Pea yield decreased as the seeding density of oat increased in the intercrops and was generally lower than the monocrops. Oat yield increased as oat density increased in the intercrop mixture treatments but was lower than the monocrop oat. Total yield, as an indication of total productive capacity, was generally better for the higher oat intercrop densities and poor for the low oat intercrop densities.

The economic returns of the intercrops depended on the density of the oat and varied by location (Appendix 2). In general, 75 or 100 oats per square meter density were more productive than some other treatments. The outcome relative to monocrops varied by location. Sometimes the land equivalencies (LERs) were higher than one and sometimes they were lower. There are indications that intercropping could provide benefits to lodging in peas and quality in oats.

Grain test weight for peas was not significantly different between treatments at SERF and differences at NARF were minimal. Pea seed weight tended to be a little lower in some intercropped treatments at SERF and NARF. Oat test weight was higher in the intercrops, particularly at the lower oat densities. The data from SERF was a little too variable. Oat seed weight was also variable at SERF but tended to be higher for intercrops than the oat monocrop.

Heavy oats can be worth a premium for milling. Intercropping somewhat improved the quality of oats for milling compared to sole-crop oats. While intercropping reduced seed size in pea a little, this is not economically important.

Bulked samples from all three sites were analysed for oat quality parameters such as plumps and thins by General Mills. When sites were used as replications, there was statistically significant increases in % plump groats with intercropping. The intercropped samples had 7% more plump groats than the monocrop samples. This is likely due to suppression of late tillers in the intercrops with peas shading the lower canopy. There was also a small(<1%) but significant reduction in oat protein in the inte.

Table 6. Crop Quality

	SERF	NARF	SERF	NARF	SERF	NARF	SERF	NARF
TREATMENTS	Pea Test Weight (g/hL)		Pea Seed Weight (g/1000 seeds)		Oat Test Weight (g/hL)		Oat Seed Weight (g/1000 seeds)	
PEA + 25 OATS	414	428	220	232	262	261	40.4	42.4
PEA + 50 OATS	414	425	211	229	257	259	39.5	40.5
PEA + 75 OATS	416	427	216	224	258	258	40.5	39.8
PEA + 100 OATS	411	425	209	223	256	255	39.8	39.6
PEA + 125 OATS	411	423	214	220	258	256	40.8	39.3
OAT MONO	X	X	X	X	264	250	37.9	37.9
PEA MONO WEEDED	411	431	227	231	X	X	X	X
PEA MONO	409	427	223	234	X	X	X	X
P-VALUE	0.12	<0.01	<0.01	<0.01	0.07	0.02	0.07	0.01
LSD	ns	2.3	9	4	Ns	6	Ns	2.11

Discussion and Conclusion

This preliminary investigation will help to guide a more intensive research trial funded by ADF and Sask Oat to begin in 2021. This trial includes crop pathologist expertise, which was not available for this project. Pea oat intercrops are productive and may be a way to improve crop diversity. All three sites experience d drier than normal conditions during the field season. Some of the benefits of pea oat intercropping come from wetter conditions. There was some signs of detrimental interspecies competition at the low oat densities. This may not occur on wet years.

Abstract

Three locations of an oat pea intercrop demonstration trial were established at SERF (Redvers, SK), NARF (Melfort, SK) and IHARF (Indian Head, SK). Peas at 80 plants per meter squared were grown with oats at 25, 50 75, 100, 125 target oat plants per meter squared. These were compared with sole crops or monocrops of oat and pea. Some treatments resulted in higher yield efficiency relative to monocrop peas. Lodging in peas was reduced at one location with intercropping. The relatively dry conditions resulted in some detrimental competition in the low density oat intercrop treatments. Generally, the higher densities of oats resulted in more productivity and a functional balance of two crops. This project serves as a preliminary trial for a research trial on pea oats to start in 2021, which will investigate the effect on crop disease further. .

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Appendix 1. Dry biomass and grain yield for pea, oat and total.

	Pea Biomass (MT/ha)			Oat Biomass (MT/ha)			Total Biomass (MT/ha)		
	SERF*	IHARF	NARF	SERF*	IHARF	NARF	SERF*	IHARF	NARF
PEA + 25 OATS	4.34	2.20	3.14	1.15	0.57	1.77	5.49	2.77	4.37
PEA + 50 OATS	2.87	1.98	1.98	2.22	0.72	3.17	5.10	2.69	4.58
PEA + 75 OATS	3.48	1.67	1.74	3.14	1.40	4.00	6.62	3.06	5.11
PEA + 100 OATS	2.41	1.55	1.62	3.18	1.42	4.86	5.59	2.97	5.77.
PEA + 125 OATS	2.15	1.49	1.32	4.09	1.39	4.93	6.25	2.88	5.56
OAT MONO	X	X	X	5.40	3.35	6.67	5.40	3.35	5.93
PEA MONO WEEDED	6.36	2.74	5.62		X		6.36	2.74	5.00
PEA MONO	4.52	2.48	4.57		X		4.52	2.48	4.07
P-VALUE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.08	0.13	0.03
LSD	1040	490	0.88	1.3	0.65	1.33	ns	Ns	1.18
	Pea Yield (MT/ha)			Oat Yield (MT/ha)			Total Yield (MT/ha)		
PEA + 25 OATS	1.73	2.58	1.89	0.66	1.06	1.77	2.39	3.64	3.18
PEA + 50 OATS	1.10	2.36	1.30	1.29	1.38	3.17	2.39	3.74	3.71
PEA + 75 OATS	1.25	1.91	1.17	2.06	2.24	4.00	3.31	4.15	3.61
PEA + 100 OATS	0.78	1.54	1.00	2.05	2.49	4.86	2.82	4.04	4.27
PEA + 125 OATS	0.76	1.52	0.80	2.48	2.55	4.93	3.28	4.07	3.90
OAT MONO	X	X		3.32	4.37	6.67	3.32	4.37	4.44
PEA MONO WEEDED	3.10	3.83	3.31	X	x		3.10	3.83	3.31
PEA MONO	1.88	3.38	2.68	X	X		1.88	3.38	2.68
P-VALUE	0	0	0	0	0	0	0.02	0	0
LSD	0.29	0.23	0.29	0.69	0.25	0.67	0.86	0.21	0.46

*SERF biomass is air-dry rather than oven dry

1 MT/ha = 26 bu/ac of oats

1 MT/ha = 14 bu/ac of peas

1 MT/ha = 0.446 tons/ac

Appendix 2.

Crop Value in $/ac and Land Equivalency Ratio

	$/ac	$/ac	$/ac	LER*	LER
	Pea	Oat	Total		
SERF					
PEA + 25 OATS	205	52	257	0.76	1.12
PEA + 50 OATS	131	101	232	0.74	0.97
PEA + 75 OATS	148	162	310	1.02	1.28
PEA + 100 OATS	92	161	253	0.87	1.02
PEA + 125 OATS	90	194	284	0.99	1.15
OAT MONO	0	260	260	1	1
PEA MONO WEEDED	367	0	367	1	X
PEA MONO	223	0	223	X	1
IHARF					
PEA + 25 OATS	306	83	389	0.92	1.00
PEA + 50 OATS	280	109	388	0.93	1.01
PEA + 75 OATS	226	176	402	1.01	1.08
PEA + 100 OATS	183	196	379	0.97	1.03
PEA + 125 OATS	181	200	381	0.98	1.03
OAT MONO	0	343	343	1	1
PEA MONO WEEDED	454	0	455	1	X
PEA MONO	401	0	401	X	1
NARF					
PEA + 25 OATS	225	101	326	0.86	1.00
PEA + 50 OATS	155	189	343	0.94	1.03
PEA + 75 OATS	139	192	331	0.91	0.99
PEA + 100 OATS	119	257	376	1.04	1.11
PEA + 125 OATS	95	244	339	0.94	1.00
OAT MONO		348		1	1
PEA MONO WEEDED	392	0	392	1	X
PEA MONO	318	0	318	X	1

*LER compared to hand-weeded or sprayed pea control

For crop value calculation, assumed price is $3/bu for oat and $8/bu for yellow pea. It does not take into account any potential quality difference.