Project Identification

1. **Project Title:** Do Pea Types Differ in Suitability for Intercropping with Canola?
2. **Project Number:** 20180497
3. **Producer Group Sponsoring the Project:** Conservation Learning Centre
4. **Project Location(s):** SW 20-46-26 W2 RM #461 (Prince Albert)
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Objectives and Rationale

7. Project objectives:

The objective of this demonstration was to compare differing market classes of peas, including niche-market peas, in monocrop and intercrop to determine whether some types have characteristics that make them suitable for intercropping.

8. Project Rationale:

In recent years mixed grain intercropping has become an increasingly popular practice across Saskatchewan. Based on numbers from the Saskatchewan Crop Insurance Corporation (SCIC) in 2019, 72, 400 intercropped acres were insured, and pea/canola was the most popular combination at 17, 850 acres. That is up from 5,880 acres of pea/canola that were insured in 2018. Intercropping is increasing in popularity due to reduced lodging, disease, and insect damage, and improved crop resiliency when two or more crops are grown at once. At the 2018 Conservation Learning Center (CLC) Field Day, the intercropping demonstration received a lot of attention from local producers and the media, and local producers expressed interest in seeing more intercropping demonstrations suitable for our region. Pea/canola intercropping is considered the most suitable intercropping option for the northern Saskatchewan agricultural region, and a couple local producers are currently experimenting with it. Peas are a common and successfully grown crop in the area, but the recent fall in yellow and green pea prices has renewed interest in more niche pea classes with higher prices. These niche pea varieties are often prone to lodging, but canola could act as a trellis to hold up the peas and knit the crop together. Peas tend to mature earlier and are prone to shattering, which can make timing of harvest difficult. These potential issues with a pea/canola mixed grain intercrop were explored in this study by examining different pea varieties and their suitability for intercropping. The purpose of this study was to provide more information about intercropping to those local producers already experimenting with it and those wishing to try it out.

Methodology and Results

9. Methodology:

This trial was set up as a randomized complete block design with 4 replicates. Five types of peas were evaluated in intercrop with a Nexera canola and as a monocrop. Canola was also grown as a monocrop in order to calculate land equivalency ratios. The treatment list can be found in table 1.

Table 1. Treatment list used in pea and canola intercropping trial.

#	Treatment description
1	Intercrop CDC spruce green peas with canola
2	Intercrop yellow Inca peas with canola
3	Intercrop CDC Dakota Dun peas with canola
4	Intercrop Maples peas with canola
5	Intercrop Marrowfat peas with canola
6	Monocrop CDC spruce green peas
7	Monocrop Inca Yellow peas
8	Monocrop CDC Dakota Dun peas
9	Monocrop Maple peas
10	Monocrop Marrowfat peas
11	Monocrop Nexera Canola

Plots were approximate 2m x 7m and seeded with a Fabro custom plot seeder that has double disc openers on 10 in row spacings. The trial was seeded into wheat stubble on May 28, 2019. Peas were seeded at a depth of 1.5 in down the fertilizer openers and canola was seeded at approximately 1 in depth down the seed row. TagTeam LCO granular inoculant was used to inoculate peas at a rate of 4.6 lb/ac. Seeding rate for both monocrop and intercrop peas was 85 plants/m^2. The seeding rate for canola was 80 plants/m^2 and 48 plants/m^2 when intercropped with peas. Phosphorus was applied with the seed at a rate of 15 lb P_2O_5/ac. Nitrogen fertilizer was broadcasted following seeding. The intercrop plots received 30 lb N/ac and the monocrop canola received 133 lb N/ac. Centurion (0.19 L/ac) was used in crop to control grassy weeds on June 12, 2019. Reglone was used as a preharvest desiccant September 6, 2019. No other crop protection products were used.

Plant counts were determined by counting total plants in 1m length of row in 2 spots per plot. Biomass samples were collected mid season within ¼ m^2 in 2 spots per plot and canola and peas were separated. Due to the lack of a drying facility, results are presented as fresh wet weights. Lodging was calculated using the Belgian Lodging Scale (area x intensity x 0.2, where area is rated on a scale of 1-10 and intensity on a scale of 1-5). Maturity of peas was recorded Aug 29, 2019.

The trial was harvested September 17, 2019 by combining 5 of 6 rows. Plots were cleaned and grain separated and weighed.

Land equivalency ratios (LER) were calculated separately for biomass and yield results using the following equation:

LER = (intercrop pea (kg/ha)/monocrop pea (kg/ha))+(intercrop canola (kg/ha)/monocrop canola (kg/ha))

Data was analysed by ANOVA using Statistix10 software. Any non-parametric data was analysed using the Kruskal-Wallis test.

10. Results

Soil Tests

Soil test results indicated that N was low, but P availability was relatively high. Sulfur levels were moderate with 38 lb/ac available within the top 30 cm (Table 2).

Table 2. Soil test results.

Depth (cm)	N (lb/ac)	P (ppm)	K (ppm)	S (lb/ac)	OM (%)	pH	Salts (mm ho/cm)
0 – 15	16	14	196	20	5.6	6	0.11
15 – 30	12			18		6.6	0.18
0 – 30	28						

Weather

Similar to 2018, the spring and summer of 2019 was relatively dry (Table 3). CLC and producers in the area struggled with poor crop emergence due to dry soil conditions. The first frost did not occur until September 27th (-0.5°C), and the first hard frost occurred on October 9th (-7.2°C). September had a higher than average precipitation and October was colder than average, which made it a wet and cold harvest. Cool and wet conditions prolonged dry down of the canola within peola. As a result, there was heavy late season deer grazing that is reflected in the low pea yields of 404-1277 kg/ha or an average 9.4 bu/ac. These low yields are not typical for the region. In retrospect, deer fencing should have been installed around the trial; however, there was minimal deer pressure observed in the trial until 1 week prior to the harvest date. Another monocrop pea trial on site had deer fencing installed that helped deter deer and peas were able to be harvested earlier on September 6. The other pea trial yielded 30-48 bu/ac.

Table 3. Weather conditions over the 2019 growing season at the Conservation Learning Centre.

	May	June	July	August	September	October	Average/Total
				--- Temperature (°C) ---			
2019	9.5	15.8	17.4	15.1	11.6	1.0	11.7
2012-2018	11.8	16.1	18.5	17.3	11.6	3.5	13.1
				--- Precipitation (mm) ---			
2019	30.0	54.4	57.4	16.8	59.6	11.6	229.8
2012-2018	36.4	80.6	96.1	48.0	25.8	26.0	310.5
				--- Growing Degree Days (base 5°C) ---			
2019	164.7	322.7	383.5	314.1	207.3	13.1	1405.4
2012-2018	211.1	332.7	419.0	381.6	203.2	38.2	1585.9

Pea stand establishment was lower than the targeted 85 plants/m^2, but were not statistically different across treatments (Table 4). Lower than desired plant stands are likely a result of dry spring conditions. Dun and maple peas had a slightly higher plant stand, which is expected because their pigmented seed coats offer some natural protection against root rots and they tend to emerge quickly with good plant establishment. Canola plant stand was a lot less than the targeted 48 plants/m^2 in intercrop and 80 plants/m^2 in monocrop. Intercrop canola plant stand was an average 10 plants/m^2 and monocrop was 22.5 plants/m^2 (Table 5). Flea beetle pressure was high in this field in the spring of 2019. Dry conditions combined with flea beetle pressure resulted in a less than desired plant stand. However, the trial was not terminated. Comparison of the different peas was still valuable. Many producers who visited the site were very interested in seeing some of the more specialty peas.

Pea biomass was similar across treatments except for Inca yellow that had the highest biomass when grown as a monocrop. Intercropped mean pea biomass of 24762 kg/ha was less than peas in monocrop (27565 kg/ha), but this difference was not statistically different (p=0.0887). This is likely due to the low canola plant stands in the intercrop. Monocrop canola biomass was greater than the intercropped biomass, which is expected due to the lower plant stands and the increased competition by the peas.

One of the well-known advantages to intercropping peas with canola is reduced lodging of peas. When grown as a monocrop, maple and marrowfat peas completely lodged, even under the dry conditions experienced at the CLC in 2019. Although canola stands were lower than typical in intercropped plots, there was reduced lodging for all pea classes (Table 4). Yellow and green peas had almost no lodging when grown as an intercrop.

Overall, there was no difference in pea maturity detected between intercrop vs monocrop (p=0.5269). However, the maple peas were delayed when compared to the monocrop yellow pea (Table 4). The slightly delayed maturity of the maple peas may have helped final yields, since the pea maturity was better matched to the canola variety used. However, delayed harvest of peas

and deer browsing likely greatly influenced pea yields. Therefore, yield data should be interpreted with caution. The only yield difference in peas was between intercropped maples that had 3X higher yield than intercropped Dun peas. Pea yields were very low compared to other onsite pea trials and the 2019 provincial average of 38 bu/ac. The mean monocrop canola yield was 27 bu/ac, less than the 2019 provincial average of 38 bu/ac. Monocrop canola yielded 82% higher than canola that was intercropped, even though intercropped canola plant establishment was 66% less than monocrop . The peas appear to have outcompeted the canola in intercrop due to low establishment. The intercropped maple peas had the best land equivalency ratio for both biomass and yield. A total of 1.8 ha of sole cropping would be required to produce the same yields as 1 ha of the maple pea and canola intercrop.

Table 4. Different marketing classes of peas grown in intercrop and monocrop at the CLC in 2019.

	Treatment	Pea Stand (plants/m2)	Biomass (kg/ha)	Lodging	Maturity (R stage)	Yield (kg/ha)
1	Intercrop CDC spruce green	57.0	23419 C	0.7 B	7.5 AB	474 AB
2	Intercrop yellow Inca	59.5	23757 C	0.2 B	7.3 AB	633 AB
3	Intercrop CDC Dakota Dun	70.5	23673 C	2.7 AB	6.8 AB	404 B
4	Intercrop Maples	74.5	27641 ABC	9.0 AB	6.0 AB	1277 A
5	Intercrop Marrowfat	59.5	25323 BC	7.0 AB	6.5 AB	572 AB
6	Monocrop CDC spruce green	51.5	23739 C	2.8 AB	7.3 AB	573 AB
7	Monocrop Inca Yellow	55.5	32989 A	2.1 AB	7.8 A	573 AB
8	Monocrop CDC Dakota Dun	67.5	31395 AB	7.1 AB	7.3 AB	486 AB
9	Monocrop Maple	58.5	24939 BC	10.0 A	5.8 B	784 AB
10	Monocrop Marrowfat	52.5	24764 C	10.0 A	6.8 AB	518 AB
	P value	0.1324	0.0458	<0.001	<0.001	0.0039

Table 5. Nexara canola performance when grown with various marketing classes of peas at the CLC in 2019. LER=land equivalency ratios of growing peas and canola together.

	Treatment	Canola Stand (plants/m2)	Biomass (kg/ha)	Yield (kg/ha)	Biomass LER	Yield LER
1	Intercrop CDC spruce green	9.5	4378 B	382 AB	1.4	1.1
2	Intercrop yellow Inca	9.5	7169 AB	285 AB	1.2	1.4
3	Intercrop CDC Dakota Dun	10.0	4888 AB	174 B	1.1	1.0
4	Intercrop Maples	7.5	5212 AB	172 B	1.5	1.8
5	Intercrop Marrowfat	12.5	4850 AB	267 AB	1.5	1.3
11	Monocrop Canola	22.5	14295 A	1510 A		
	P value	0.5483	0.0460	<0.001	0.5553	0.2260

Table 6. Economic analysis of Different marketing classes of peas grown in intercrop and monocrop at the CLC in 2019.

Treatment†	Pea Yield (bu/ac)	Canola Yield (bu/ac)	Price ($/bu)	Gross Revenue ($/ac)	Expenses‡ ($/ac)	Net Revenue ($/ac)
Intercrop green peas and canola	7.0	6.8		147.8	98.7	49.1
Intercrop yellow peas and canola	9.4	5.1		117.9	92.1	25.8
Intercrop Dun peas and canola	6.0	3.1		73.8	92.1	-18.4
Intercrop Maple peas and canola	19.0	3.1		203.7	98.7	105.0
Intercrop Marrowfat peas and canola	8.5	4.8		141.9	98.7	43.2
Monocrop green peas	8.5	0.0	10.6	90.6	54.3	36.3
Monocrop yellow peas	8.5	0.0	6.8	57.5	47.7	9.8
Monocrop dun peas	7.2	0.0	6.8	48.8	47.7	1.1
Monocrop maple peas	11.7	0.0	9.0	104.9	54.3	50.6
Monocrop marrowfat peas	7.7	0.0	10.7	82.3	54.3	28.0
Monocrop canola	0.0	26.9	10.7	288.2	122.3	166.0

†Canola establishment was very poor in intercrop and low in monocrop. Deer damage greatly affected final pea yields. As a result, net revenue is lower than what would be anticipated under more typical intercropping conditions.

‡A breakdown of the expenses included in the economic analysis include only seed and fertilizer. Estimated costs are ($/ac): canola seed = 29.40 for intercrop and 49.00 for monocrop, green, maple and marrowfat pea= 47.50, yellow and dun pea = 40.90, P= 6.78, N= 15 for intercrop, 0 for monocrop pea and 66.50 for monocrop canola. Values presented do not consider all production costs and are only estimates retrieved from Saskatchewan 2020 Crop Planning Guide. Estimated prices were retrieved from the Crop Planning Guide or statpub.com.

An economic analysis was completed but should be interpreted with caution (Table 6). Actual input costs and revenues could vary by region. Many important input costs were not factored in such as crop protection, labor, including additional costs that would be required to sort the intercrop, machinery costs, and more. It is likely that there would have been no profit if all input costs had been considered. This economic analysis has little value, since canola stands were low and deer greatly affected pea yields.

This demonstration was featured at the CLC Annual Field Day held July, 2019 with approximately 50 people in attendance.

References:

https://www.saskatchewan.ca/crop-report.

Statpub. Spot Market Specialty Crop Grower Bids by Canadian Company Report for Feb 16, 2020. Retrieved February 16, 2020 from https://www.statpub.com/stat/prices/spotbid.html

11. Conclusions and Recommendations

Dry conditions and flea beetle pressure resulted in low canola stands that turned our peola demonstration into more of a pea variety demonstration. The CLC would recommend using a higher seeding rate than 48 plants/m^2 when intercropped with peas, especially if conditions are dry and flea beetles are anticipated to be an issue. Maple and dun peas did appear to have better pea establishment and maple peas appeared to perform best as an intercrop out of all the other pea varieties. Maple peas were better matched to the maturity of the canola used, and when intercropped with canola, lodging of peas was reduced. Land equivalency ratios were greater than 1 ha for most of the pea canola intercrops showing good potential for intercrops in the region. Unfortunately, cool and damp weather prolonged harvest and provided more time for deer to decimate pea yields. As a result, no other conclusions can be drawn.

12.Acknowledgements:

The Conservation Learning Centre graciously acknowledged the Ministry's support through signage directly in field with the project, verbally during the Field Day and on the Field Day agenda handed out to all visitors. The CLC also thanks Nutrien Ag Solutions and a local producer for providing some of the inputs that were used.

13. Abstract:

This demonstration aimed to compare differing market classes of peas, including niche-market peas, in monocrop and intercrop to determine whether some types have characteristics that make them suitable for intercropping. Five pea types (Spruce Green, Yellow Inca, Dakota Dun, Maple, and Marrowfat) were grown with a Nexera Canola as an intercrop and individually as

monocrops. Unfortunately, dry growing conditions and flea beetle pressure resulted in low canola stands and turned the peola intercrop demo into a pea variety demonstration. The CLC would recommend using a higher seeding rate than 48 plants/m^2 when intercropped with peas, especially if conditions are dry and flea beetles are anticipated to be an issue. Maple and dun peas did appear to have better pea establishment and maple peas appeared to perform best as an intercrop out of all the other pea varieties. Maple peas were better matched to the maturity of the canola used, and when intercropped with canola, lodging of peas was reduced. There does appear to be good potential for intercropping in the region. Unfortunately, cool and damp weather prolonged harvest and provided more time for deer to decimate pea yields. As a result, no other conclusions can be drawn. This demonstration was featured at the CLC Annual Field Day held July, 2019 with approximately 50 people in attendance.