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# MPSG ANNUAL EXTENSION REPORT

**PROJECT TITLE:** **Agronomic and economic benefits of sole or intercropping peas with oats, wheat, flax, canola, or mustard**

**PROJECT START DATE: 1 May 2019** **PROJECT END DATE: 31 March 2022**

**DATE SUBMITTED:** Click here to enter a date.

## PART 1: PRINCIPAL RESEARCHER

**PRINCIPAL**



| | | | |
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## PART 2: EXECUTIVE SUMMARY

Deciding on which intercropping system to use depends on many factors including: weather, equipment available for seeding, harvesting and separation of grain, economics and compatibility of component crops involved. Scientists have been advocating for ways to regenerate agricultural land, sustainable agriculture and counteract effects of climate change. Intercropping can help address these concerns in some ways such as biological control of pests, weeds, diseases and reduction of synthetic fertilizer use by inclusion of legumes in intercropping systems. This has been shown to be an effective integrated approach that farmers can adopt at low input cost while preserving agricultural land for future generations. Intercropping has been shown to address some of the major issues related to previously unproductive farm land and chemical resistance by agricultural pests in recent years. This study, initiated in 2019 in Southwestern Manitoba, evaluated various intercrop combinations that producers can utilize depending on their areas of production. The objectives were to determine agronomic benefits of intercropping using different cropping systems combinations with field pea and laying out a package from which famers can select from. Preliminary results indicate yield advantage when pea is intercropped with either canola or mustard compared to other cropping system options such as flax, wheat or oats.

A “multi-crop” intercrop trial was established at Elva, Reston and Roblin in Southwestern Manitoba in 2019. The three locations offer different climate conditions, soil types, and seeding dates by location as presented in the agronomic practices Table 1 (Appendix). A soil test was taken prior to seeding to determine background nutrient profile and fertilizer was applied at seeding with less emphasis on nitrogen (Table 2).

A soil test was taken prior to seeding to determine background nutrient profile and fertilizer was applied at seeding with less emphasis on nitrogen (Table 2). Field preparation before seeding involved no-till at Reston, harrowing at Elva, and tilling and harrowing at Roblin. The trial was laid out as randomized complete block design with 11 treatments replicated four times at each site. Chemical weed control was ensured at each site with additional mechanical weed control done at Reston due to high populations of volunteer flax from the previous season after emergence. Flea beetles were controlled early in the growing season and grasshoppers late in the season. Disease severity scores were conducted by random sampling of plants to assess rust in oats and wheat, Aphanomyces root rot, Downey mildew, Fusarium wilt, Mycospharella blight and Sclerotinia and selecting a single representative score rating. Disease incidence was low at Elva, and Reston, and not recorded in Roblin. The disease results will not be presented in this report.

Preliminary results from this study indicated significantly higher total land equivalence ratio for intercropping systems involving pea and canola or mustard at Elva and Reston (Table 3a and 3b). There were no significant differences in total land equivalence ratio observed during the first year of this study at Roblin (data not shown). Pea yield was significantly higher in pea-canola intercrop compared to other cropping systems at Reston (Table 3a) while there were no significant differences in pea yield when intercropped with wheat, canola or mustard at Elva (Table 3b). Reston TLER values tend to be inflated due to the poor performance of the monocrop pea (from root disease). Results from this study also show no significant influence of cropping system on weed biomass and plant emergence counts at all three sites in 2019 (data not shown). Pea splits based on 500 seed sample was significantly lower in pea-oats intercropping system compared to pea monocrop at Elva and Reston while no significant differences were observed in any of the cropping systems at Roblin (Table 4). Differences could have been due to The buffering ability of oats on pea threshing thus reducing splits. An analysis of protein content on dry matter basis using an IM 9500 Near Infra Red grain analyzer (Perten, Winnipeg, MB) could not find significant differences between cropping systems at Reston (Table 4). However, cropping system of pea-oat or wheat had significantly higher protein content of 22.5% compared to 21.5% in pea-canola intercrop at Elva. At Roblin, pea protein content in pea-mustard intercrop had 26.5%, which was significantly higher than 22.3% for pea-wheat intercrop. Other cropping systems did not have significant differences from pea-mustard in protein content at the same location.

Economic analysis of pea monocrop had significantly lower negative net revenue of (CAD$248) compared to other cropping systems in Reston (Table 5a). Intercropping systems of pea-canola and pea-mustard realized significantly higher net revenues of CAD$329 and CAD$265 compared to pea-oats which recorded CAD$36 at Reston. Similar pattern in net revenue was also observed at Elva (Table 5b) and Roblin (Table 5c) sites but the latter had negative net revenues in pea monocrop, pea-flax and pea-wheat intercropping systems. Elva was the only site that recorded positive net revenue in pea monocrop but it was low and not significantly different from pea-flax and pea-wheat intercrop compared to other cropping systems.

In general, late season disease pressure mainly by Aphanomyces root rot and Fusarium root rot complex during pea pod fill was prevalent in Reston, thus reducing yield below normal values for the area. Disease was not nearly as noticeable at Elva as Reston and are reflective on yield and economics. Roblin struggled with establishment and weed control in monocrop pea and flax, so with intercrops of oat or canola offered some competitive ability to cope with weeds. This was likely more so due to tillage operation early spring stimulating weed seed banks. Hand weeding was required to maintain somewhat of a consistent plot.
Harvestability was not impressive with pea-flax intercrops since threshing speeds were too slow for flax bolls to be properly threshed without damaging pea. In addition, cleaning flax bolls out of pea samples was difficult to separate and would pose a marketing issue.

Results from this study are not conclusive as they are from one year of study but there is an indication that farmers can potentially benefit from intercropping pea with mustard or canola more than other cropping systems. However, additional site years of study under varying environments may be required before these results can be confirmed.

## APPENDIX

**Table 1: Agronomic practices and site description for Reston, Elva and Roblin in 2019**

| Location | Reston, MB | Elva, MB | Roblin, MB |
|---|---|---|---|
| Soil Series | Ryerson Loam | Lauder-Souris Loamy Fine Sand | Erickson Clay Loam |
| Previous Crop | Flax | Wheat | Flax |
| Field Preparation | No-till | Harrowed | Tilled and Harrowed |
| Pre-Emergent Herbicides | Glyphosate all, Authority + Rival on Flax Pea Mustard; Rival in Canola plots after seeding | Glyphosate all, Authority + Rival on Flax Pea Mustard; Rival in Canola plots after seeding | Glyphosate |
| Soil Moisture at Seeding | Poor | Good | Poor |
| Seed Date | May/17 | Jun/03 | May/16 |
| Seed Depth (inch) | 0.75 | 0.75 | 0.75 |
| Herbicides | Odyssey on pea, canola; Select except cereals | None | None |
| Insecticides | Pounce - flea beetles | Matador- grasshoppers | |
| Desiccation | Reglone + Roundup | Reglone | Reglone |
| Harvest Date | Aug/21 | Sep/17 | Sep/25 |
| **Combine Settings** | | | |
| Rotor | 850 | 850 | 600 |
| cleaning fan | 880 | 880 | 600 |
| rotor-concave space | 8 mm (3 mm flax) | 8 mm (3 mm flax) | 7 mm |
| **Growing Season Report (May 1 - Aug 31, 2019)** | | | |
| Precipitation (mm) | 222 | 275 | 195 |
| Normal (mm) | 302 | 302 | 246 |
| Growing Degree Days | 1299 | 1320 | 1131 |
| Normal GDDs | 1426 | 1426 | 1233 |

**Table 2: Soil test nutrient profiles and applied fertilizer rates at the three locations in Southwest Manitoba in 2019.**

Soil Test:

| Nutrient<br>Location | N<br>kg ha-1 | P<br>ppm | K<br>ppm | S<br>kg ha-1 | Zn<br>ppm | Organic Matter<br>(%) | pH |
|---|---|---|---|---|---|---|---|
| Elva | 55 | 7 | 279 | 404 | 0.77 | 2.7 | 8.0 |
| Reston | 66 | 10 | 196 | 404 | 0.84 | 4.3 | 7.5 |
| Roblin | 175 | 9 | 170 | 168 | NA | 4.6 | 7.4 |

Applied:

| Nutrient | N | P | K | S | Zn |
|---|---|---|---|---|---|
| Location | $kg\ ha^{-1}$ | | | | |
| Elva | 8 | 34 | 0 | 0 | 0 |
| Reston | 9 | 39 | 22 | 8 | 2 |
| Roblin | 4 | 22 | 0 | 0 | 0 |

**Table 3a: Analysis of variance for yield, partial LER and TLER for Reston intercrops in 2019**

| Crop | Yield (kg ha$^{-1}$) | | | LER | | |
|---|---|---|---|---|---|---|
| | Sole | Crop-IC | Pea-IC | Partial Sole | Partial Pea | TLER |
| Pea | 531 | * | * | 1.00 | * | 1.00d |
| Flax | 2463 | 1681 | 306b | 0.64 | 0.58b | 1.22cd |
| Oat | 4328 | 4323 | 344b | 1.01 | 0.66b | 1.67ab |
| Wheat | 3865 | 3177 | 322b | 0.83 | 0.61b | 1.44bcd |
| Canola | 3735 | 3070 | 656a | 0.82 | 1.22a | 2.05a |
| Mustard | 2034 | 1651 | 401b | 0.80 | 0.76b | 1.56bc |
| **P value** | | | **0.001** | | **0.001** | **<0.0001** |
| **CV** | | | **23** | | **23** | **13** |

CV – Coefficient of Variation; LER – Land Equivalent Ratio; IC – Intercropi; TLER – Total Land Equivalent Ratio

**Table 3b: Analysis of variance for yield, partial LER and TLER for Elva intercrops in 2019**

| Crop | Yield (kg ha$^{-1}$) | | | LER | | |
|---|---|---|---|---|---|---|
| | Sole | Crop-IC | Pea-IC | Partial Sole | Partial Pea | TLER |
| Pea | 3301 | * | * | 1.00 | * | 1.00ab |
| Flax | 1865 | 909 | 1479bc | 0.49 | 0.45bc | 0.94b |
| Oat | 4173 | 3390 | 1079c | 0.83 | 0.35c | 1.17ab |
| Wheat | 2220 | 1302 | 1920abc | 0.59 | 0.62ab | 1.21ab |
| Canola | 2602 | 1255 | 2258ab | 0.51 | 0.71ab | 1.22ab |
| Mustard | 1318.4 | 666 | 2480a | 0.51 | 0.76a | 1.27a |
| **P value** | | | **0.002** | | **0.001** | **0.022** |
| **CV** | | | **22** | | **20** | **12** |

**Table 3c: Analysis of variance for yield, partial LER and TLER for Roblin intercrops in 2019**

| Crop | Yield (kg ha$^{-1}$) | | | LER | | |
|---|---|---|---|---|---|---|
| | Sole | Crop-IC | Pea-IC | Partial Sole | Partial Pea | TLER |
| Pea | 939 | - | - | 1.00 | - | 1.00 |
| Flax | 1386 | 347 | 869 | 0.31 | 0.87 | 1.18 |
| Oat | 6794 | 4753 | 371 | 0.71 | 0.43 | 1.15 |
| Wheat | 4505 | 2325 | 371 | 0.52 | 0.44 | 0.95 |
| Canola | 4451 | 2071 | 1691 | 0.44 | 1.98 | 2.42 |
| Mustard | 2142 | 1286 | 956 | 0.61 | 1.07 | 1.68 |
| **P value** | | | **0.101** | **0.072** | | **0.115** |
| **CV** | | | **81** | **79** | | **55** |

**Table 4: Analysis of variance for pea splits and protein content at 3 intercrop sites in 2019**

| | Reston | | Elva | | Roblin | |
|---|---|---|---|---|---|---|
| **Crop** | **Pea splits g/500 seeds** | **Pea protein % DM basis** | **Pea splits g/500 seeds** | **Pea protein % DM basis** | **Pea splits g/500 seeds** | **Pea protein % DM basis** |
| Pea | 9.4ab | 22.4 | 1.8a | 22.2ab | 5.8 | 24.5ab |
| Flax | 11.2ab | 22.1 | 0.4ab | 21.8ab | 7.8 | 24.8ab |
| Oat | 3.5c | 22.3 | 0.1b | 22.5a | 5.1 | 23.1ab |
| Wheat | 5.1c | 21.9 | 1.7ab | 22.5a | 8.8 | 22.3b |
| Canola | 5.7bc | 22.3 | 1.4ab | 21.5b | 3.5 | 23.7ab |
| Mustard | 7.3abc | 21.6 | 1.1ab | 21.7ab | 6.8 | 26.5a |
| **P value** | **<0.0001** | **0.193** | **0.02** | **0.014** | **0.211** | **0.029** |
| **CV** | **26** | **2** | **65** | **2** | **47** | **6** |

**Roblin Trial - July 10th**

**Reston Trial - July 11th**

**Elva Trial - July 25th**

**Table 5a: Economic analysis for Reston intercrops in 2019**

| Crop | Economics | | | | | |
|---|---|---|---|---|---|---|
| | Sole-COP | IC - COP | Gross Revenue | | Net Revenue | |
| | | | Sole | IC | Sole | IC |
| Pea | 303 | * | 55 | * | (248) | (248)c |
| Flax | 289 | 325 | 499 | 373 | 210 | 48b |
| Oat | 292 | 318 | 425 | 461 | 134 | 142ab |
| Wheat | 308 | 316 | 387 | 352 | 79 | 36b |
| Canola | 328 | 339 | 732 | 669 | 404 | 329a |
| Mustard | 317 | 336 | 689 | 601 | 372 | 265a |
| **P value** | | | | | | **<0.0001** |
| **CV** | | | | | | **28** |

COP – Cost of Production; IC - Intercrop

**Table 5b: Economic analysis for Elva intercrops in 2019**

| Crop | Economics | | | | | |
|---|---|---|---|---|---|---|
| | Sole-COP | IC - COP | Gross Revenue | | Net Revenue | |
| | | | Sole | IC | Sole | IC |
| Pea | 303 | - | 343 | - | 40 | 40 bc |
| Flax | 289 | 325 | 378 | 338 | 89 | 13 c |
| Oat | 292 | 318 | 410 | 445 | 118 | 127ab |
| Wheat | 308 | 316 | 223 | 330 | -86 | 14 bc |
| Canola | 328 | 339 | 510 | 481 | 182 | 141 a |
| Mustard | 317 | 336 | 446 | 483 | 129 | 147 a |
| **P value** | | | | | | **<0.0001** |
| **CV** | | | | | | **52** |

**Table 5c: Economic analysis for Roblin intercrops in 2019**

| Crop | Economics | | | | | |
|---|---|---|---|---|---|---|
| | Sole-COP | IC - COP | Gross Revenue | | Net Revenue | |
| | | | Sole | IC | Sole | IC |
| Pea | 303 | - | 98 | - | -206 | (206) b |
| Flax | 289 | 325 | 281 | 161 | -8 | (164) b |
| Oat | 292 | 318 | 667 | 506 | 376 | 187 a |
| Wheat | 308 | 316 | 451 | 272 | 143 | (44) ab |
| Canola | 328 | 339 | 872 | 581 | 544 | 242 a |
| Mustard | 317 | 336 | 725 | 535 | 408 | 199 a |
| **P value** | | | | | | **0.001** |
| **CV** | | | | | | **411** |