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17.0 Effect of fungicide and alfalfa understory with pea-canola intercrop production

Project duration: 2018-2019
Collaborators: WADO

Objectives

1. To determine if pea-canola intercrop out-yields and is more profitable than monocrop peas or canola.
2. To determine if fungicide application is a possible best management practice for disease control
3. To determine the effect of relay cropping alfalfa in pea-canola stands

Background

Peas, canola and alfalfa have potential in organic rotations but their individual yields are limited by competition from weeds, insect pests and diseases. Intercropping can provide several environmental and agronomic benefits that include: amendment of soils through addition of nutrients by the plants themselves at low costs, biological management of insect pests and diseases, conservation of soil moisture and overall increase in grain yield than a sole crop (Wu and Wu, 2014). Most intercropping systems around the globe involving legumes and cereals are beneficial to both crop and livestock systems. Although there are challenges involving machinery use during seeding, separation of seed after harvest and insurance coverage concerns, there is a marked increase in the number of producers that are interested in various intercropping systems as a result of the benefits associated with it.

Research conducted by Szumigalski and Van Acker (2006) showed that pea-canola intercrop systems resulted in consistent land equivalent ratios for grain nitrogen yield and this suggests that intercrops, in particular, pea-canola could be useful for improving nitrogen use efficiency on per land area basis. Apart from pea-canola intercrop, alfalfa-canola can also be another option. Incorporation of a perennial pasture crop may aid in improving productivity and nutrient use efficiency as well as reducing disease incidence

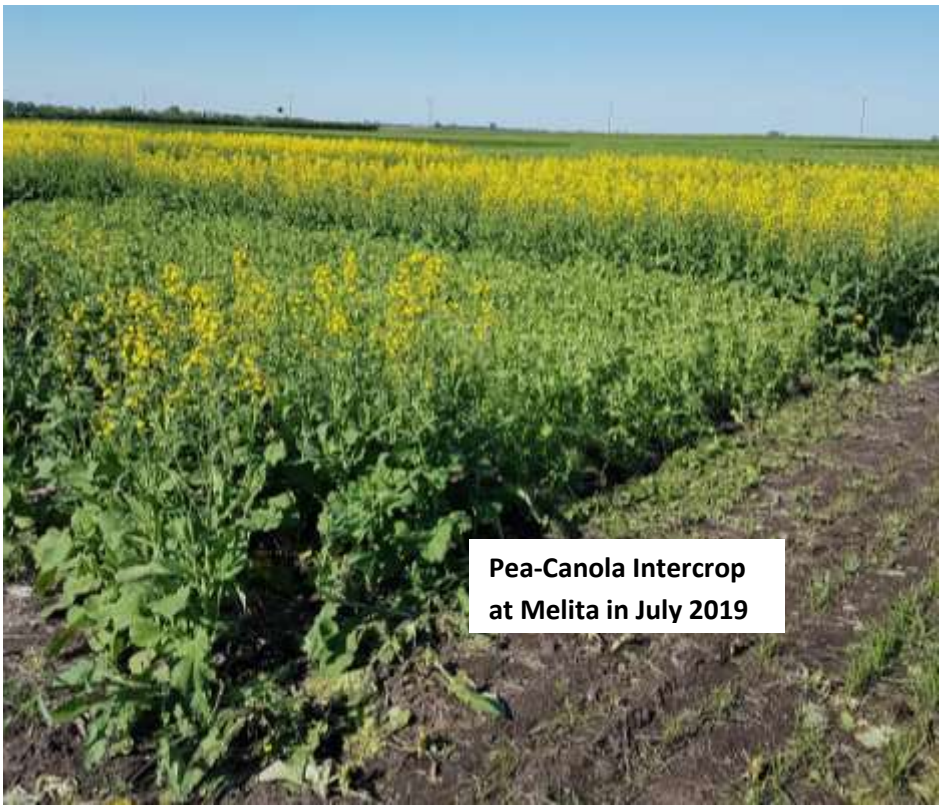
(Sheaffer and Seguin, 2008). Furthermore, strip-intercropping canola with alfalfa has been shown to enhance biological control of diamond back moth, a common insect pest in canola (Tajmiri et al., 2017). Including alfalfa as a relay crop in a pea-canola intercrop would leave alfalfa to continue to grow in fall after harvesting and it can provide hay the following growing season. This study therefore seeks to evaluate the impact of intercrops involving pea, canola and alfalfa relay crop as best management tools for improving productivity and control fungal diseases.

Materials and Methods

The trial was initiated at Melita in Southwestern Manitoba in 2018. Eight treatments were arranged as randomized complete block design (split-plot) and replicated 3 times. In 2019, the plots were seeded onto oats stubble on May 9th at a depth of 0.75". Alfalfa seed was broadcasted by hand, raked in and rolled afterwards to improve seed to soil contact for improved emergence. Granular fertilizer blend was side banded for all treatments during seeding and application rates of 100-35-20-7-2Zn (N-P-K-S) lb ac^{-1}. Liquid nitrogen was not applied on peaola and pea treatments. Granular (BASF) pea inoculant was applied to pea and peaola treatments to account for atmospheric nitrogen fixation. Post emergence chemical weed control included the use of 0.15 L ac^{-1} Select + 0.5% v/v Amigo adjuvant and 17.3 g ac^{-1} Odyssey + 0.5% v/v Merge adjuvant. Early in the growing season, there were incidences of crucifer flea beetles which were controlled by a single spray application of 0.08 L ac^{-1} Pounce. The same insecticide was also used to control blister beetles at about 8 weeks after seeding. At 50% flowering stage of canola, Lance fungicide was applied at 100g ac^{-1}, with a follow up application a week later. Apart from grain yield and alfalfa biomass, other data collected included emergence counts for each crop type, flowering dates for canola and peas, pod clearance for peas, aphid populations at full pod in peas and rating of mycospharella disease. The data were analyzed using Minitab 18 with significant differences determined by Fisher's LSD at the 5% level of significance. Treatment materials are presented below:

Main Plot[†]	**Subplot**
Pea	No fungicide
Canola	Fungicide
Pea-Canola	
Pea-Canola-Alfalfa	

[†]Each of the main plot treatments had double plots, one with no fungicide and the other one with Lance fungicide



Pea-Canola Intercrop at Melita in July 2019

Results and Discussion

Monocrop peas significantly (P<0.001) yielded more than pea intercropped with canola or alfalfa by more than 50%, which also translated to a significantly (P<0.001) higher Land Equivalent Ratio (LER) (1.02) for the pea monocrop compared to the intercrop systems (0.38 and 0.39). Pea grain yield and LER from peaola and peaolafalfa cropping systems were not significantly different while canola monocrop system recorded above 40% more grain yield compared to mixed cropping systems. Whereas the combined yield analysis of pea and canola resulted in pea monocrop yielding significantly (P<0.001) more grain than other cropping systems, the Total Land Equivalence Ratio (TLER) was not significantly different. Total yield from peaola and peaolafalfa were significantly higher (P<0.001) by over 500 kg ha^{-1} compared to canola while pea had the highest at 4258kg ha^{-1} (Table 17a).

There was a significant (P=0.027) fungicide application effect on pea grain yield resulting in 141 kg ha^{-1} more yield and 0.03 higher (P=0.026) LER compared to pea treatments that were not sprayed with a fungicide during the season (Table 17a). With respect to canola response to fungicide application, there were no significant differences in grain yield or LER. Furthermore, there were no significant interactions between cropping system and fungicide with respect to grain yield and LER. Overall, the variability of grain yield data and LER was low and less than 10%.

Table 17a. Analysis of Variance for Pea and Canola yields and Land Equivalence Ratios

Factor		Pea		Canola		Total Pea & Canola	
		Yield	**PLER[1]**	**Yield**	**CLER[2]**	**Yield**	**TLER[3]**
		Kg ha^{-1}		Kg ha^{-1}		Kg ha^{-1}	
Crop	Pea	4258 a†	1.02 a	-	-	4258 a	1.02
	Canola	-	-	3000 a	0.98 a	3000 c	0.98
	Peaola	1623 b	0.39 b	1922 b	0.63 b	3545 b	1.01
	Peaolalfa	1608 b	0.38 b	2030 b	0.66 b	3638 b	1.05
	Significant?	Yes	Yes	Yes	Yes	Yes	No
Fungicide	check -	2426 b	0.58 b	2313	0.75	3554	1.00
	Fungicide +	2567 a	0.61 a	2321	0.76	3666	1.03
	Significant?	Yes	Yes	No	No	No	No
C x F	Pea -	4182	1.00	-	-	4182	1.00
	Pea +	4333	1.04	-	-	4333	1.04
	Canola -	-	-	3070	1.00	3070	1.00
	Canola +	-	-	2930	0.95	2930	0.95
	Peaola -	1600	0.38	1835	0.60	3435	0.98
	Peaola +	1646	0.39	2008	0.65	3654	1.05
	Peaolalfa -	1495	0.36	2035	0.66	3530	1.02
	Peaolalfa +	1722	0.41	2024	0.66	3746	1.07
	Significant?	No	No	No	No	No	No
P values	Crop	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	0.100
	Fungicide	**0.027**	**0.026**	0.906	0.919	0.076	0.139
	C x F	0.375	0.359	0.192	0.191	0.142	0.149
R-square		0.998	0.998	0.98	0.98	0.97	0.79
Coefficient of Variation %		4	4	6	6	4	4

PLER[1] = Pea Land Equivalence Ratio, CLER[2] = Canola Land Equivalence Ratio, TLER[3] = Total Land Equivalence Ratio, †Figures with the same letter within the same column are not significantly different

Table 17b clearly shows that peaolafalfa cropping system resulted in significantly (P<0.001) higher pod height at 61 cm compared to peaola at 57 cm (P<0.001) and pea monocrop at 46 cm (P<0.001). Other variables such as disease severity, thousand kernel weight (TKW) and aphid infestation were not significant regardless of the factor considered in the analysis. This means that none of the cropping systems, fungicide treatments or interactions of these had a significant influence on disease severity, TKW or aphid populations on peas.

Table17b. Analysis of Variance for Disease, Aphids, Pod height and thousand kernel weight in peaola intercrop

Factor			Pea Disease	Aphids	Pod HT		TKWT Pea	TKWT Can
			0-9 (9 severe)	# plant^{-1}	cm		g 1000^{-1}	g 1000^{-1}
Crop		Pea	1.3	0.4	46	c	179	-
		Canola	-	-	-		-	3.28
		Peaola	1.3	0.1	57	b	181	3.39
		Peaolalfa	1.5	0.3	61	a	185	3.46
	Significant?		**No**	**No**	**Yes**		**No**	**No**
Fungicide	check	-	1.5	0.2	55		181	3.36
	fungicide	+	1.2	0.3	55		183	3.42
	Significant?		**No**	**No**	**No**		**No**	**No**
C x F	Pea	-	1.4	0.4	45		178	-
		+	1.1	0.5	47		180	-
	Canola	-	-	-	-		-	3.28
		+	-	-	-		-	3.42
	Peaola	-	1.5	0.1	57		181	3.35
		+	1.1	0.0	57		182	3.43
	Peaola Alfalfa	-	1.4	0.1	62		183	3.40
		+	1.5	0.4	60		186	3.47
	Significant?		**No**	**No**	**No**		**No**	**No**
P values		**Crop**	0.506	0.114	**<0.001**		0.141	0.074
		Fungicide	0.189	0.518	0.938		0.305	0.065
		C x F	0.366	0.464	0.347		0.866	0.340
R-square			**0.80**	**0.70**	**0.97**		**0.79**	**0.89**
Coefficient of Variation %			**23**	**92**	**4**		**2**	**2**

Although there were significant differences in net income among different cropping systems, none were positive. Figure 17a shows that in 2019 cropping systems, net losses were recorded for each of the four cropping systems. Peaola cropping system had a significantly lower net loss of (CAD$13.33) compared to pea monocrop and peaolafalfa which had net losses of (CAD$60.12) and (CAD$48.08) respectively. Net negative income of (CAD$32.78) for canola monocrop was not significantly different from the other cropping systems.

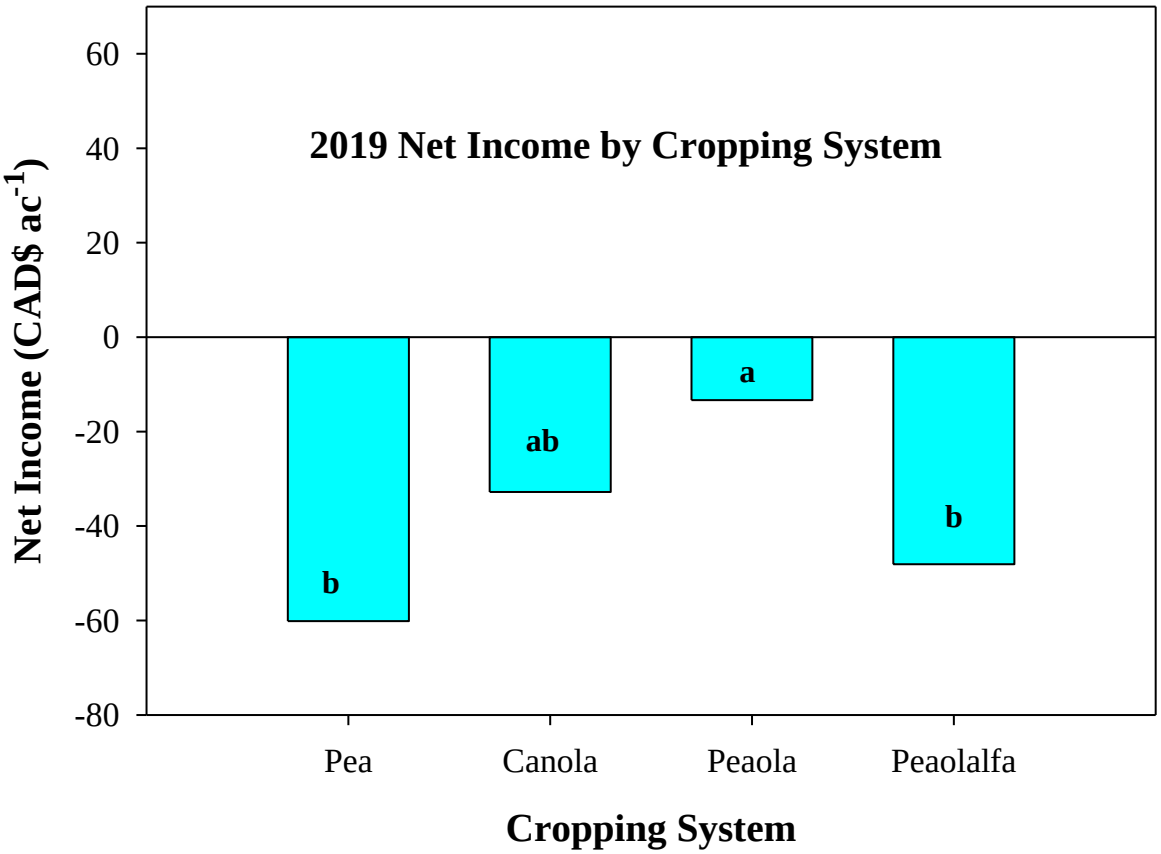


Figure 17a Net Income obtained from different cropping systems at Melita in 2019

An economic analysis on the interaction of cropping system and fungicide resulted in significantly positive net income only for peaola treatment with CAD$11.27 compared to other treatments that had net negative incomes. Economic losses from pea, canola and peaolalfalfa with fungicide application were not significantly different. Highest economic losses at (CAD$85.99) were obtained from pea monocrop with a fungicide application. On the other hand, economic losses from pea with no fungicide, peaola with fungicide and peaolalfalfa with no fungicide were significantly lower than other cropping systems except for peaola with no fungicide (Figure 17b).

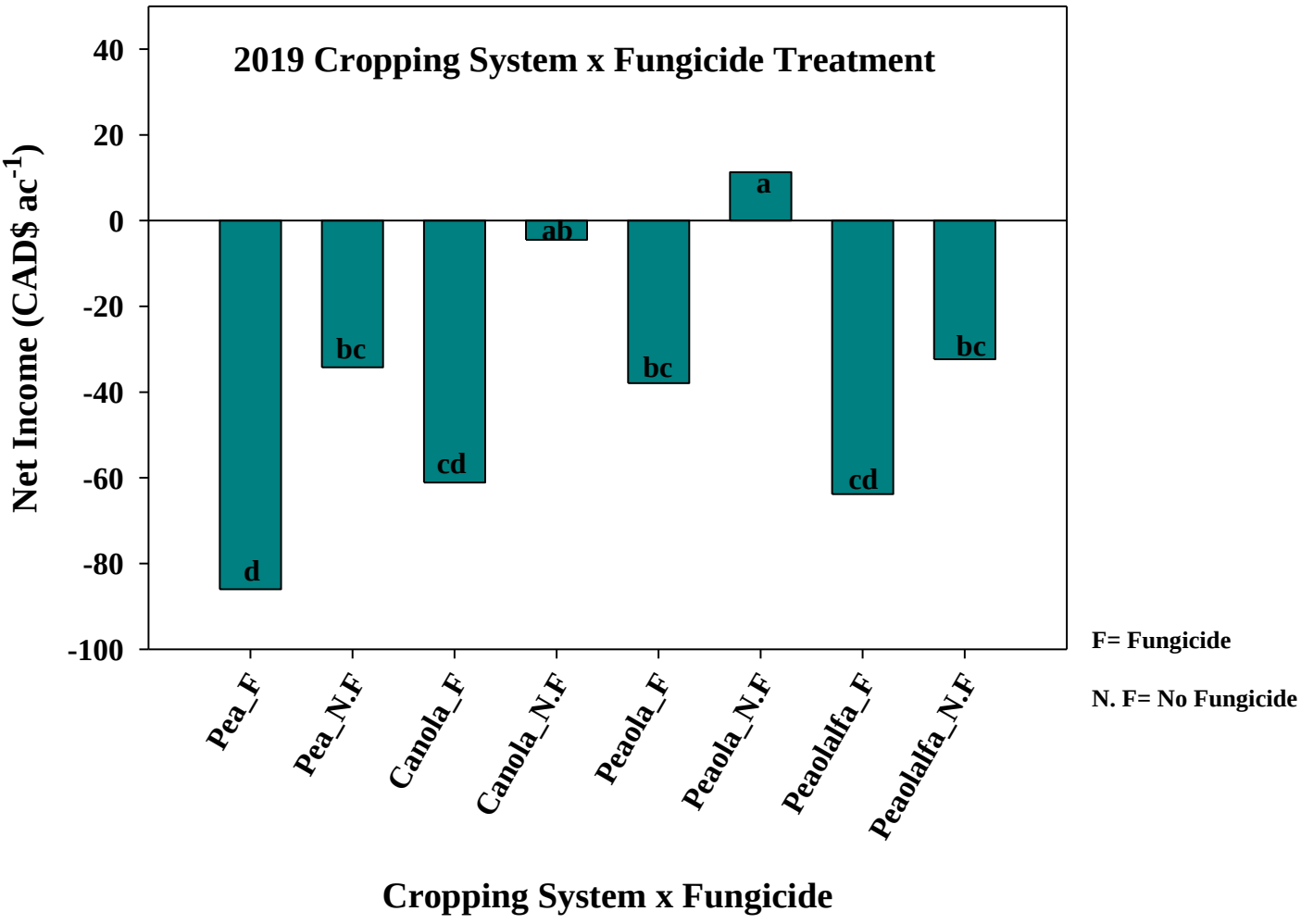


Figure 17b Net income recorded for cropping system x fungicide interaction at Melita in 2019

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