Intercropping Pea with Oilseeds under Irrigated conditions

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Introduction

Several studies have been conducted which conclude that intercropping pea with canola or mustard was more profitable than either crop grown alone. Most of the work done on intercropping is not yet in the scientific literature and is available through extension articles and preliminary reports such as the Soils and Crops Workshop and annual reports. Work has been done by Alberta Agriculture, Lethbridge, University of Saskatchewan Soil Science, Agriculture Canada Melfort, Saskatchewan Agriculture, Kelvington and University of Manitoba, Plant Science. The Land Equivalent ratio is not always greater when intercropping is practiced but in general intercropping has resulted in easier harvesting and higher overall economic returns.

Preliminary work had shown that Westar canola and Century pea were not adapted to intercropping under irrigated conditions. While Victoria pea and Global canola were better matched the land equivalent ratio and economic returns from intercropping of these 2 cultivars were not substantially greater than mono cropped canola.

The objective of this research was to determine the yield and economic performance of oilseed & pea intercropping options under irrigated conditions and to identify combinations of pea and oilseeds with improved yields and economic returns.

Materials and Methods

1990

In 1990, Victoria pea was seeded 5 cm deep prior to the oilseeds which were planted 1.5 cm deep in a second seeding operation. Cutlass oriental mustard *Brassica juncea*, Delta and Global *B. napus* and Parkland *B. campestris* canola were seeded to obtain a range of oilseed maturities. The test was planted May 29 in a randomized complete block with 4 replicates. Victoria pea was planted at 50 seeds/m^2 when planted with canola and 100 seeds/m^2 when seeded alone. Plots consisted of 11 rows 9.14 m long on with a 20 cm row spacing. A row spacing of 20 cm was used for both crops while when the 2 were seeded together the canola was planted between the pea rows in a second operation. Canola and mustard were at 224 seeds/m^2 when planted alone and 112 seeds/m^2 when planted with pea. Nutrient levels (kg/ha) are given below:

	Soil test				Fertilizer	
Crop	N	P	K	S	N	P_2O_5
pea and mixtures	34	26	440	90	35	50
canola and mustard	34	26	440	90	120	50

Weed control was obtained by Edge (ethalfuralin) applied the previous fall at 2.2 kg/ha. At maturity the center 2.01 m was harvested.

Separate ANOVA's were run for the pea components and gross returns using grip prices.

1991

The pea/oilseed test was altered in 1991 to include Radley and Express pea as well as a sunola cultivar. Radley is an early, short semileafless pea. Express is a short early pea with good yield potential. The canola cultivars Delta and Parkland were removed and McGregor flax was added to ensure that all oilseed types were represented in the test. The plot design for the pea cultivars was a split plot with Express, Radley and Victoria being the main pea plots and Cutlass (*Brassica juncea*) Global (*B. napus*), and a dwarf sunflower sunola (*Helianthus annus*). Each of these oilseeds were planted with each of the pea cultivars and were also planted by themselves. The oilseed types, canola, mustard and sunola were planted in a block in each replicate but obviously could not be part of the split plot. Plots consisted of 22 rows, 9.1 m long with a 20 cm spacing between rows. Canola and mustard were sown 2 cm deep and pea and sunola 5 cm deep. Seeding rates (seeds/m^2) were: canola and mustard 224, sunola 20, and pea 80. When a mixture was planted the oilseed and pea were planted in alternate rows at 50% of their normal seeding rate and only the oilseed received extra nitrogen. Therefore although the same setting on the fertilizer box was used for pure canola as canola in mixture, the mixture received only 50% as much nitrogen on a total plot basis. All fertilizer was sidebanded. Nutrient levels (kg/ha) are given below:

	Soil test				Fertilizer	
Crop	N	P	K	S	N	P_2O_5
canola,mustard,sunola	65	22	360	106+	100	55
Pea alone	65	22	360	106+	12	55
mixtures	65	22	360	106+	56	55

Weed control was obtained by using Edge (ethalfuralin) applied the previous fall at 2.2 kg/ha.

At maturity a 3.66 m section was cut from the center of each plot and combine harvested. With the exception of the sunola this area was swathed when the crops were physiologically mature and allowed to dry prior to harvest. The sunola plots were direct cut.

Pea yields and seed weights were analyzed as a split plot with pea cultivar as main plots and oilseed type as the subplots. Analysis of variance was conducted on the gross returns assuming grip pricing.

Results and Discussion

In 1990, Global and Cutlass yielded 15% and 17% of their pure stand yields when grown in mixture with Victoria pea (Table 1) while in 1991 their yields were 23% and 27% of pure stand yields(Table 2). This contrasts with Global and Cutlass grown with the other 2 pea cultivars where oilseed yields ranged from 44-56% of pure stand yields. This interaction was highly significant and indicates the competitive ability of the taller cultivar Victoria (Table 3). Wall et al (Can J. Plant Sci. 71:473-480) found that the semileafless pea cultivar Tipu had its yields reduced to a greater extent than its parent Century.

The yields of canola and mustard in pure stands were 20-30% greater in 1990 than in 1991 while pea yields were similar in both seasons (Table 1 & 2).

The ability of oilseed crops to support pea cultivars is difficult to quantify but visual observations indicated that there were too few sunola plants to hold up the pea plants and Cutlass had stronger straw than Global. It would be desirable to use a very lodging resistant canola for this application.

All pea cultivars had larger seeds when grown with Cutlass than with Global or when the pea cultivars were grown in pure stands (Table 4). While this may be a direct effect of chemical compounds in the mustard plant it is more likely that the mustard supported the pea in a more upright position and allowed better grain filling. An increase in the seed weight of the pea cultivars appeared to be a major factor in Express and Victoria peas yielding higher when grown with Cutlass than when grown with Global (Table 2). Although Radley pea also had larger seeds when grown with Cutlass yields of this cultivar were much lower in mixtures relative to pure stands. If a premium was being paid for large seeded peas (such as with the marrowfat class) growing pea with an strong strawed oilseed would be a viable option.

A semileafless type such as Radley allows greater production of the oilseed while a tall normal leaf type appears to restrict oilseed yields. It should be possible to manipulate the relative composition of pea and canola by changing the plant type of the pea. Planting canola with the pea may make pea harvesting easier and reduce nitrogen costs for producing canola.

Sunola yields were reduced somewhat by damage done to some plants while installing the bird netting to protect the seed heads. Sunola might be grown with canola to reduce lodging of canola.

The sunola/pea combination does not appear to have any merit. There were too few plants to support the pea plants and it was almost impossible to remove split peas from the sunola. In addition leaving peas until the sunola was ready to direct cut resulting in some shattering and an increase in the number of splits.

Conclusions

Victoria, which represents the tall normal leaf type of pea, produced the greatest pea yields in an intercropping situation. Radley, a semileafless short pea type, had the lowest yields in an intercropping situation. Seed of pea grown with Cutlass mustard were heavier than when grown alone or with other oilseeds. Increased pea seed size may be one of the major factors involved in increased returns to intercropping and appears to be enhanced by greater straw strength of the oilseed intercrop. Sunola can not be used as an intercrop with pea since the seeds are difficult to separate when the pea seed has been split. More data is required for recommendations on the best pea&oilseed mixtures for intercropping since it appears that the economics of intercropping are strongly influenced by cultivar choices.

Table 1. Yields, LER and returns of pea&oilseed mixtures 1990

Treatment	Pea		oilseed			
	kg/ha	SE	kg/ha	SE	LER	$/ha!
Cutlass	---		2279	52		650
Cutlass&Victoria	3289	124	353	52	1.32	752
Global	---		2233	100		645
Global&Victoria	2681	187	396	187	1.13	645
Delta	---		1881	127		544
Delta&Victoria	3483	491	310	54	1.40	779
Parkland	---		1808	282		523
Parkland&Victoria	2965	256	187		1.15	641
Victoria	2827	118	---			
CV	16.6					
LSD	638					

! canola $289/tonne, mustard $285/tonne, pea $198/tonne

Table 2. Yields, LER and returns of pea&oilseed mixtures 1991

Treatment	Pea		oilseed			
	kg/ha	SE	kg/ha	SE	LER	$/ha!
Cutlass	---	--	1946	56		554
Cutlass&Victoria	2598	287	456	61		664
Cutlass&Express	2043	181	852	125		647
Cutlass&Radley	1711	110	868	57		583
Global	---	--	1677	66		484
Global&Victoria	2280	94	455	47		582
Global&Express	1461	113	733	61		501
Global&Radley	1829	110	942	80		634
Sunola !!	---	--	1064	50		307
Sunola&Victoria	1751	108	827	83		586
Sunola&Express	1330	97	787	167		490
Sunola&Radley	1123	82	942	80		494
Victoria	3173	120	---	--		628
Express	2796	221	---	--		554
Radley	3232	167	---	--		640
LSD (O*P)	461					

! prices $/tonne canola $289, sunola $289, mustard $285, pea $198
!!note sunola yields were reduced by damage caused in applying bird netting and some peas were lost due to shattering while waiting for the sunola to dry down for combining.

Table 3. ANOVA for yield and seed weight pea 1991

Source	df	Grain yield MS	Grain yield Pr>F	1000 seed wt MS	1000 seed wt Pr>F
Rep	5	144291		168	
Pea	2	2047839	.0007	20900	.0001
P*R (Error a)	10	122894		137	
Oilseed	3	8493018	.0001	2934	.0001
O*P	6	333239	.0512	173	.0081
Error b	44	144942		52	

Table 4. Seed weight of pea cultivars grown with and without oilseed

Treatment	200 seed weight (g)	SE
Cutlass&Victoria	174	3.0
Cutlass&Express	242	6.8
Cutlass&Radley	211	1.4
Global&Victoria	150	2.5
Global&Express	203	3.3
Global&Radley	182	4.1
Sunola&Victoria	159	2.7
Sunola&Express	217	3.8
Sunola&Radley	199	1.2
Victoria	157	3.7
Express	209	3.6
Radley	200	3.0
LSD (O*P)	10.6	