Potential of Intercropping Peas and Oats for Grain and Silage Production

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Introduction

Intercropping is an agricultural practice of cultivating two different crops in the same place at the same time (Andrews & Kassam 1976). Benefits to intercropping can lead to greater yield and quality compared to the sole crop. However, carefully planning and suitable conditions need to occur for each crop to be complimentary (creating a higher overall yield), rather than antagonistic (lowering yields). Reasons for additional yield with intercropping may be the result of greater efficiency in the use of nutrients, light, and water (Szumigalski & Van Acker , 2008). Feed Quality parameters such as crude protien (CP), neutral detergent fiber (NDF) generally improve compared to sole crop parameters (Strydhorsta et al. 2008). Harvest timing can be delayed with oat/pea intercrop silage as the peas will maintain a higher moisture value than oats. This intercrop helps lengthen the optimum time period for silage harvesting. Intercropping is not a new concept and has been used by farmers for several generations. However, recent improvements in farm machinery and individual variety characteristics have once again tweaked producer's interests in intercropping.

Often, intercropping is not only measured by total yield of products, but as a total economical value (total $/acre) by combining each crop value, or by Land Equivalent Ratio (LER). The LER is a measure of how much land would be required to achieve intercrop yields with crops grown as pure stands. When the LER is greater than 1.0, over-yielding is occurring and the intercrop is more productive than the component crops grown as sole crops. When the LER is less than 1.0, no over-yielding is occurring and the sole crops are more productive than the intercrop. For example of an intercrop LER of pea-oat yield was 1.20, it would take 20% more land to equal that final yield as separate components.

The purpose of this trial was to examine the effect of several seeding rate combinations of pea-oat intercropping on total silage yield, forage feed quality characteristics, and final grain yield.

Pictures: WADO's Pea-Oat intercropping Trial at Melita MB, oats near early milk stage

Methods

Six rows per plot were direct seeded May 12th into wheat stubble at a depth of 1" using Seedhawk™ dual knife openers with 9.5" spacing. Soil test was taken prior to seeding ". Fertilizer was side band at a rate of 40 lbs/ac N and 30 lbs/ac P. All pea treatments were inoculated with proper granular based *Rhizobium leguminosarum* bv. *Viciae*. Residual soil fertility was relatively low (Table 1). Treatments were arranged in a Randomized Complete Block Design (RCBD) and replicated three times. Through a calculation error the "full rate" for oats was about 33 % more than normal and the full rate for Peas was about 33 % less than normal Seeding rates were as follows:

1. Oats full rate (120 lbs/ac) - variety 'Furlong'
2. Peas full (120 lbs/ac) - variety 'CDC Striker'
3. Oat 1/2 rate+ Pea 1/2 rate
4. Oat 2/3 rate + Pea 2/3 rate
5. Oat full rate + Pea full rate

Methods cont.

Table 1: Soil fertility of site prior to seeding.

Depth	N lbs/ac	P ppm (olsen)	K ppm	S lbs/ac	pH
0-6"	12	14	429	18	8.2
6-24"	21			36	
0-24"	33			54	

Weeds, although were not a major concern, were controlled with some minor hand weeding. Plots were split into halves by length, one half for silage harvest and the other half for grain harvest.

Plots were harvested for silage using a plot flail mower at the soft dough stage of the oats on August 5th. Total dry matter was calculated by determining total plot wet weight and subtracting moisture percentages from subsamples taken at harvest and dried. Dried subsamples were combined into composite samples from all three replicates and set to Central Testing Labs (Winnipeg, MB) to determine feed quality characteristics.

Plots were harvested August 26 for grain with a Hege plot combine set at a cylinder speed of 910 rpm, with about 1" cylinder-concave gap. Wind was adjusted for oats. Plot samples were separated using a fan-mill, and separated crop components were weighed. Data collected included crop emergence, leaf disease, dry matter silage yield, feed quality characteristics, and final grain yield.

Crop components were converted to partial and total LER using the following equation:

$$\text{Total LER} = Ia/Sa + Ib/Sb = \text{Partial LER Peas} + \text{Partial LER Oats}$$

Where total LER is the total Land Equivalent ratio, I is the intercrop yield, S is the sole crop yield, and a and b refer to the crop components. All data (Total Yield, total LER) was analyzed with a two-way analysis of variance (ANOVA). Coefficient of variation and Fisher's unprotected Least Significant Difference (LSD) at the 0.05 level of significance was calculated.

Results

There were significant differences in silage yield ($p<0.0085$) among treatments but not total grain yield and total LER (Table 2).

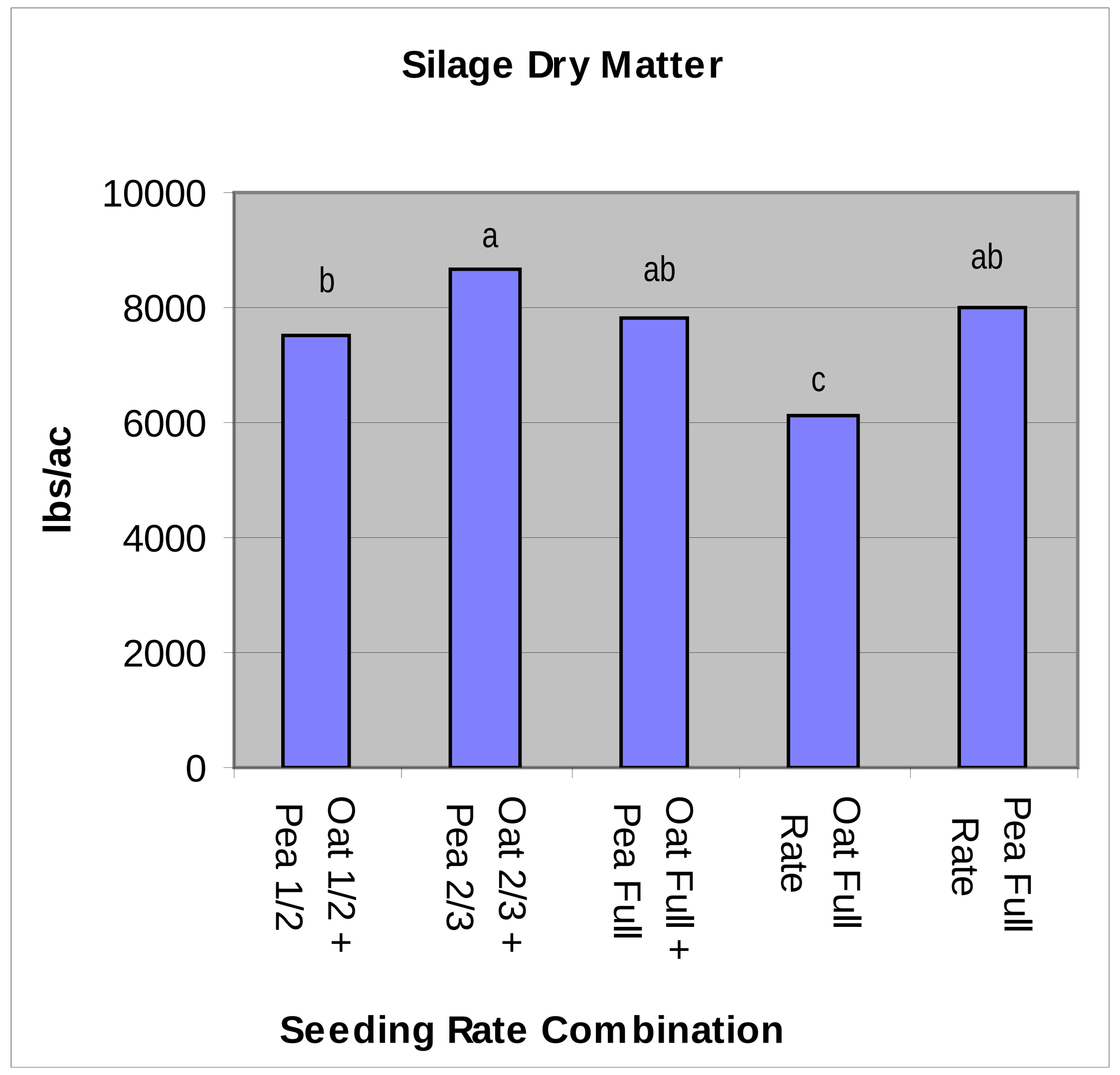
Table 2: Crop component grain yield, total grain yield, total LER values, and silage dry matter (DM) for each intercrop combination and sole crop treatments.

	Grain (lbs/ac)				Silage DM
Seeding Rate	Peas	Oats	Total	Grain TLER	lbs/ac
Oat 1/2 + Pea 1/2	923.9	4995.4	5919.3	1.3	7495.5
Oat 2/3 + Pea 2/3	508.7	3742.6	4251.3	1.0	8637.8
Oat Full + Pea Full	805.1	4665.0	5470.1	1.2	7793.6
Oat Full Rate	-	4897.6	4897.6	1.0	6138.2
Pea Full Rate	3695.4	-	3695.4	1.0	7994.2
		CV%	30.0	20.4	7.7
		LSD (p<0.05)	ns	ns	1108.0
		R-squared	0.37	0.45	0.96
		Grand Mean	4846.8	1.1	7611.9

Coefficient of variation (CV) was low for silage DM indicating a solid data set. All intercrop silage treatments with pea significantly yielded more DM than the sole oat crop. Seed combination oat 2/3 + pea 2/3 maximized the most silage DM but was not significantly different from using full rates of intercrops or simply peas (Graph 1). The CV on the grain yields from this trial were too high to consider a good data set.

Results cont.

Graph 1: Silage dry matter yields of various oat and pea intercrop combinations compared to sole crops of oat and pea.



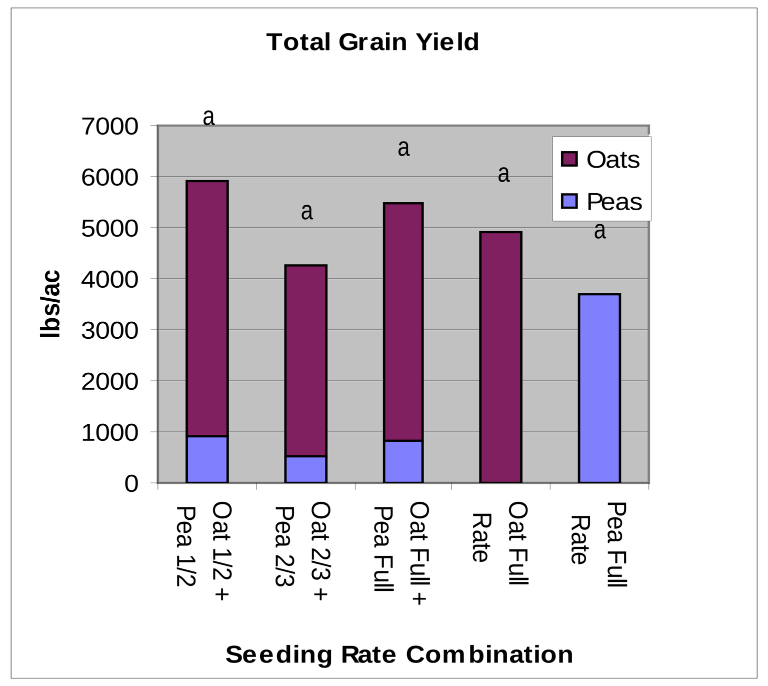
Forage quality characteristics generally improved for oats when intercropped with peas (Table 3). Multiple parameters such as Crude protein, Ca, Mg, K, NaCl, and RFV improved when oats were intercropped with peas.

Table 3: Feed Quality parameters of various oat and pea intercrop combinations compared to sole crops of oat and pea.

Seed Rate Treatment	CP %	Ca %	P %	Mg %	K %	Na %	NaCl %	ADF %	NDF %	NonFiber Carb %	TDN %	NEG Mcal/kg	RFV
Oat 1/2 + Pea 1/2	9.37	0.47	0.21	0.22	1.97	0.28	0.70	41.16	58.57	21.26	57.6	0.66	90
Oat 2/3 + Pea 2/3	7.78	0.37	0.19	0.21	1.93	0.08	0.21	35.76	56.09	25.33	60.3	0.74	101
Oat Full + Pea Full	8.66	0.51	0.16	0.23	2.26	0.20	0.08	38.76	59.10	21.44	58.8	0.70	92
Oat Full Rate	6.34	0.22	0.18	0.16	1.94	0.18	0.07	39.97	59.88	22.98	58.2	0.68	90
Pea Full Rate	11.62	1.00	0.18	0.28	1.41	0.05	0.12	39.39	50.01	27.58	58.5	0.69	108

There were no significant difference in total grain yield (graph 2) and total LER. However, the variation (CV) was too high (30%) to have confidence in this data. Despite this we did observe that the competitive nature of oats greatly suppressed the yield potential of pea in intercropped treatments (graph 2). Further skewing the results was the higher than normal Oat seeding rate and lower than normal rate for Peas in the trial. By reducing the population of oats significantly (ex. 25% rate), it is likely that there would have been a more even intercrop ratio within the grain component and a larger difference in the feed quality.

Graph 2: Total grain yield from combined partial yield values of intercropped pea-oat seeding rate combinations compared to sole crop grain yield.



Conclusions

Intercropping oats and peas proved to boost overall silage dry matter yield and their respective feed quality characteristics compared to sole crop oats. Oats proved to be highly competitive and dominated the final grain sample when intercropped with peas. A more in-depth combination of seeding rates with less oats in the mixture may encourage a greater potential of peas in the system, and therefore a higher overall yield.

Picture: This intercrop stand is dominated by oats despite the full rate of peas.

Grain harvesting issues may arise from threshing limits on harvest equipment when peas and oats are intercropped. Peas require a larger threshing gap between the concave and the threshing drum and a lower threshing drum speed compared to oats. Producers will have to take extra care with peas to insure that splitting is not an issue. Like was observed with our Pea/Canola intercrop the separation of the two crops prior to storage would be very important.

Within the raw data, peas contributed 5 to 10% more moisture in the silage sample compared to the sole oat plots (results not shown). This may allow for a longer optimum period for silage harvest to occur with this pea/oat intercrop mixture.

Literature Used

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