

Hemp-Cereal Silage

Project duration: May 2020 – August 2022

Objectives: To evaluate intercrop mixes with hemp for silage production

Collaborators: PCDF, Manitoba Horticulture Productivity Enhancement Centre (MHPEC)

Background

Silage plays an important part in the Manitoba livestock industry. Corn silage provides high yields, relative to barley silage (14 t/ac, over 7.5 t/ac, [2021 Silage Cost of Production](#), MARD). In the Parkland area, the yield for corn silage is variable and many producers opt to produce a cereal silage, such as barley or oat. PCDF and MHPEC have worked together to explore intercropping options for cereals silage.

Hemp provides an interesting opportunity for silage production, due to its high production potential and good nutritional qualities. However, [Canadian regulations](#) currently prohibit the use of hemp products as a livestock feed ingredients in Canada. **As such, this research is purely exploratory, and is not intended to provide recommendations to producers.** The Manitoba Diversification Centres are working with the Canadian Hemp Trade Alliance to develop data in support of changes to regulations around the use of hemp in livestock feed.

Results



Figure 1: Clockwise from top-left: (1) hemp-only; (2) barley-hemp; (3) oat-hemp; (4) oat-only; (5) hemp-oat silage, chopped; (6) long fibres from over-ripe hemp plants.

The silage yields at PCDF (t/ac) for treatments is shown in Figure 2. Hay yields (1500-lb bales/ac, 15% moisture) are shown in Figure 3.

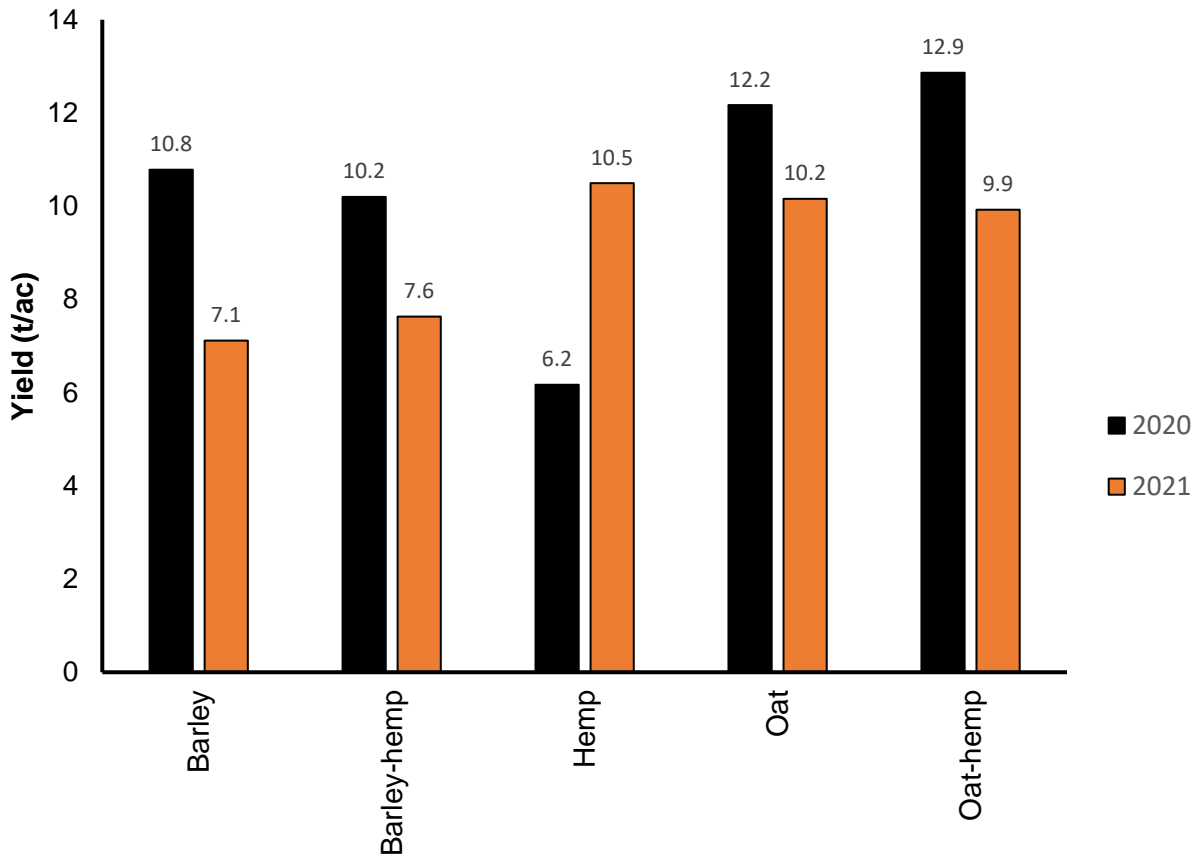


Figure 2: PCDF wet silage yield (t/ac) by treatment; all yields adjusted to 65% moisture.

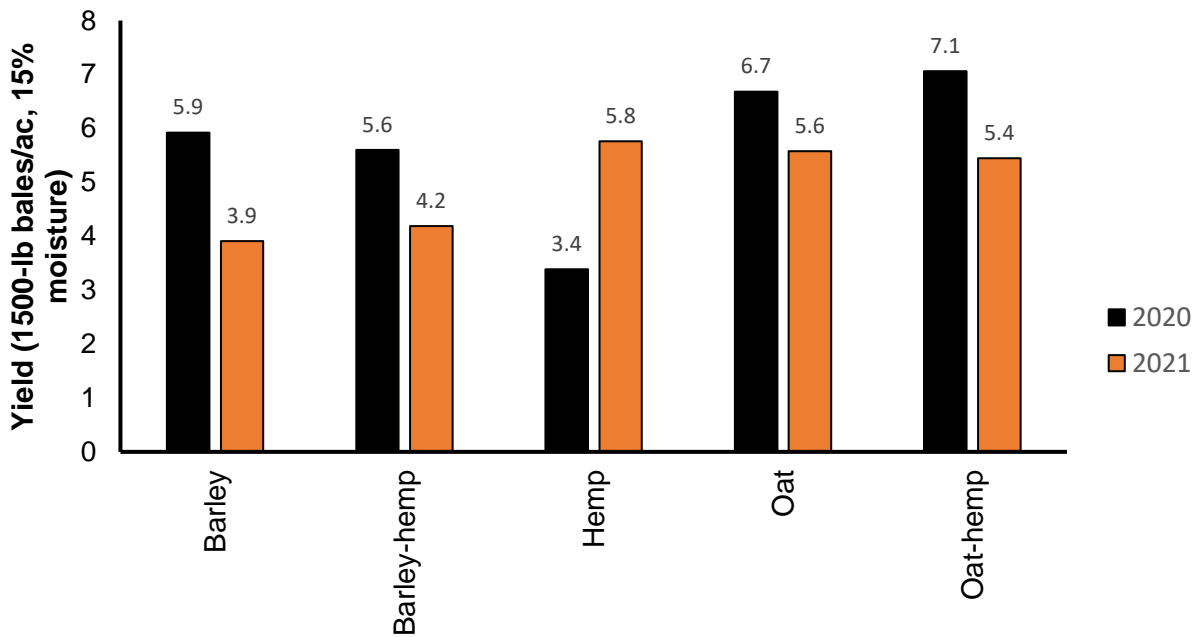


Figure 3: PCDF hay yield (1500-lb bales/ac, 15% moisture) by treatment.

The silage yields at MHPEC (t/ac) for treatments is shown in Figure 4. Hay yields (1500-lb bales/ac, 15% moisture) are shown in Figure 5.

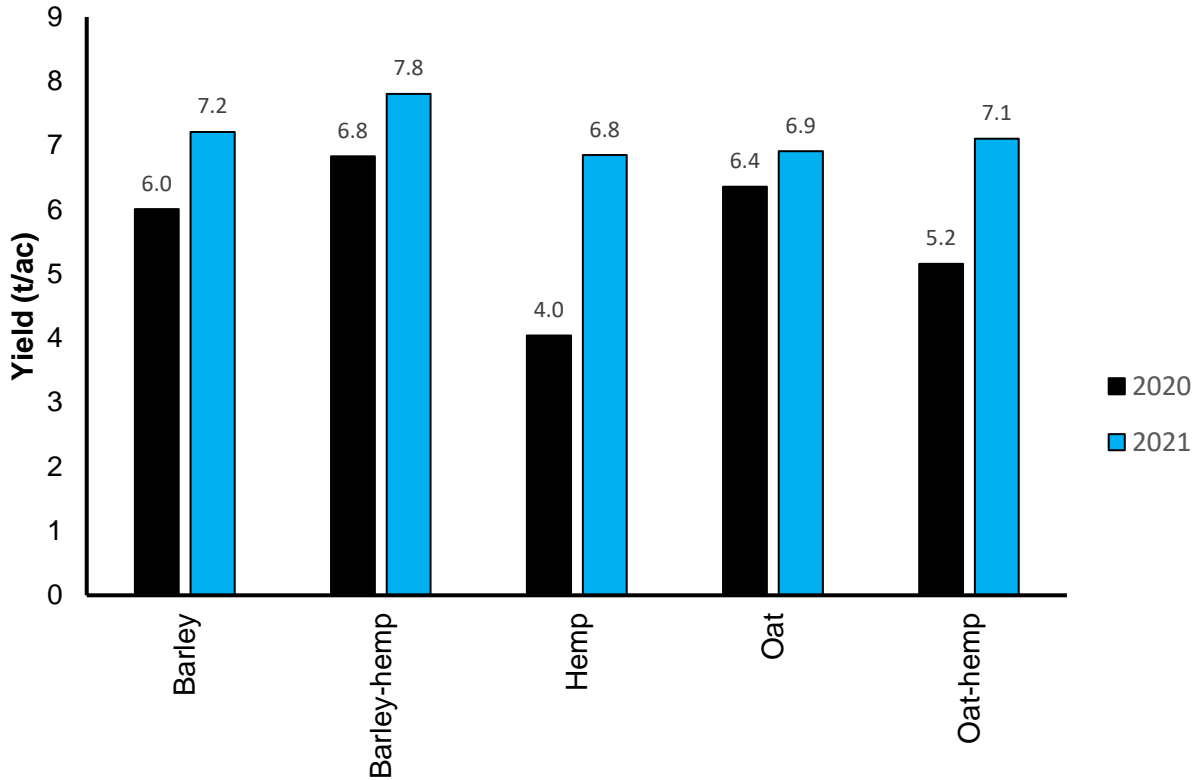


Figure 4: MHPEC wet silage yield (t/ac) by treatment; all yields adjusted to 65% moisture.

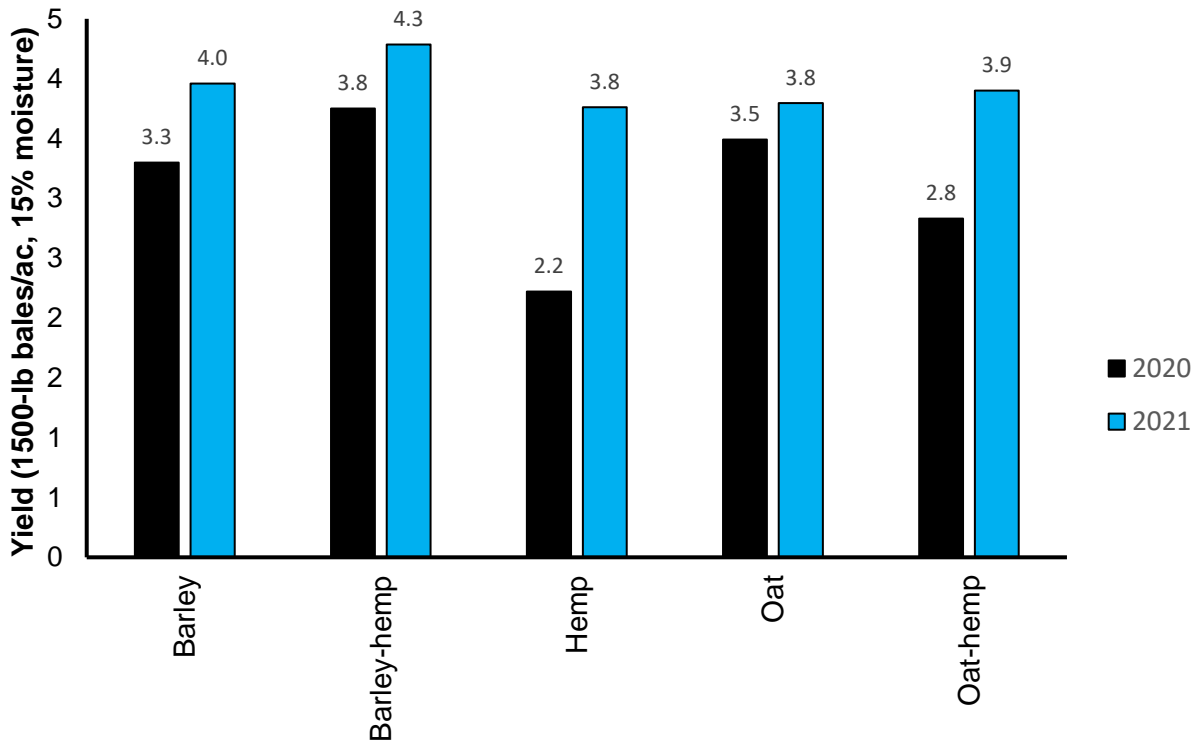


Figure 5: MHPEC hay yield (1500-lb bales/ac, 15% moisture) by treatment.

Summary of statistical information and feed values

The results for silage yield differ statistically by treatment (Table 1). The hemp-only treatment provided significantly lower silage yields than treatments including barley and oat. Further, the inclusion of hemp in the silage mixture did not significantly increase yield over barley-only or oat-only. In 2021 at PCDF, the yield for the barley-only treatment was significantly greater than for other treatments. Note that the reliability of these results is low due to a high percent CV for silage yield.

Table 1: PCDF summary of statistical information for silage yield

Entry	Silage yield (t/ac) wet yield		Statistical significance*			
	2020	2021	2020		2021	
Barley	12.9	10.5	A		A	
Barley-hemp	12.2	10.2	A		A	B
Oat	10.8	9.9	A		A	B
Oat-hemp	10.2	7.6	A		A	B
Hemp	6.2	7.1		B		B
LSD (0.05)	3.4	3.2				
% CV	27.8	22.9				

* Treatments not marked with the same letter are statistically different from other treatments.

MHPEC summary of statistical information and feed values

[See PCDF for comparative discussion: simple interpretation of yield differences.]

Table 2: MHPEC summary of statistical information for silage yield

Entry	Silage yield (t/ac) wet yield		Statistical significance*			
	2020	2021	2020		2021	
Barley	6.0	7.2			A	
Barley-hemp	6.8	7.8			A	
Oat	5.4	6.9			A	
Oat-hemp	5.2	7.1			A	
Hemp	4.0	6.8				B
LSD (0.05)		3.4				
% CV		27.8				

* Treatments not marked with the same letter are statistically different from other treatments.

The feed values and mineral content for each treatment for PCDF and MHPEC are shown in Tables 3 and 4.

Table 3: PCDF and MHPEC feed values for silage by treatment compared to animal feed requirements*

Entry	% Crude Protein			% TDN		
	2020	2021	Average	2020	2021	Average
PCDF values						
Barley	10.1	10.6	10.4	58.3	69.4	63.8
Oat	10.8	11.4	11.1	59.8	65.8	62.8
Hemp	12.6	10.2	11.4	43.7	50.5	47.1
Barley-hemp	12.2	12.0	12.1	58.7	56.1	57.4
Oat-hemp	12.2	11.4	11.8	58.9	67.2	63.1
MHPEC values						
Barley	10.8	10.3	10.6	71.9	68.2	70.0
Oat	8.4	9.8	9.1	55.5	63.4	59.4
Hemp	11.9	11.4	11.6	43.3	53.5	48.4
Barley-hemp	10.2	10.8	10.5	62.4	75.1	68.8
Oat-hemp	9.6	11.7	10.7	63.2	65.1	64.2
Animal feed requirements						
Mature cows						
Mid gestation	7			50-53		
Late gestation	9			58		
Lactating	11-12			60-65		
Replacement heifers	8-10			60-65		
Breeding bulls	7-8			48-50		
Yearling bulls	7-8			55-60		

* Animal feed requirements developed by Elisabeth Nernberg (ARD).

Table 4: PCDF and MHPEC mineral content for silage by treatment

Treatment		Mineral									
		Ca	P	Mg	Na	K	Mo	Cu	Zn	Mn	Fe
PCDF values											
Barley	2020	0.35	0.19	0.12	0.39	1.25	1.29	4.23	17.3	30.24	112.85
	2021	0.30	0.22	0.16	0.13	1.73	1.05	2.96	17.23	17.36	68.24
	Average	0.33	0.21	0.14	0.26	1.49	1.17	3.60	17.27	23.80	90.55
Oat	2020	0.28	0.2	0.13	0.49	1.42	2.54	3.54	17.88	52.04	153.07
	2021	0.40	0.21	0.21	0.36	1.97	1.10	2.90	11.46	38.59	99.71
	Average	0.34	0.21	0.17	0.43	1.70	1.82	3.22	14.67	45.32	126.39
Hemp	2020	1.55	0.27	0.36	0.12	1.46	1.33	7.51	23.54	64.06	151.36
	2021	1.65	0.19	0.31	0.01	1.68	0.72	5.85	16.23	48.48	190.25
	Average	1.60	0.23	0.34	0.07	1.57	1.03	6.68	19.89	56.27	170.81
Barley-hemp	2020	0.64	0.24	0.18	0.3	1.29	1.13	5.35	21.34	36.88	145.81
	2021	1.20	0.22	0.31	0.09	1.88	1.20	4.86	19.30	44.60	239.80
	Average	0.92	0.23	0.25	0.20	1.59	1.17	5.11	20.32	40.74	192.81
Oat-hemp	2020	0.38	0.21	0.15	0.47	1.56	2.07	3.68	19.39	54.02	184.17
	2021	0.37	0.24	0.18	0.19	1.65	1.47	3.04	15.11	42.12	151.66
	Average	0.38	0.23	0.17	0.33	1.61	1.77	3.36	17.25	48.07	167.92
MHPEC Values											
Barley	2020	0.26	0.31	0.16	0.03	1.33	0.34	4.13	21.69	31.75	125.09
	2021	0.36	0.13	0.20	0.06	1.44	0.18	3.79	25.01	51.03	124.86
	Average	0.31	0.22	0.18	0.05	1.39	0.26	3.96	23.35	41.39	124.98
Oat	2020	0.25	0.18	0.16	0.14	2.31	0.52	2.75	14.79	82.19	143.81
	2021	0.26	0.14	0.17	0.16	1.65	0.81	3.18	21.41	97.59	151.66
	Average	0.26	0.16	0.17	0.15	1.98	0.67	2.97	18.10	89.89	147.74
Hemp	2020	1.46	0.26	0.51	0.04	1.64	0.44	7.98	24.24	79.26	217.14
	2021	2.20	0.13	0.77	0.02	1.24	0.29	8.54	22.70	121.52	244.91
	Average	1.83	0.20	0.64	0.03	1.44	0.37	8.26	23.47	100.39	231.03
Barley-hemp	2020	0.44	0.25	0.23	0.09	1.76	0.41	4.82	19.56	41.27	134.41
	2021	0.25	0.18	0.19	0.06	1.43	0.21	4.22	31.12	42.00	111.41
	Average	0.35	0.22	0.21	0.08	1.60	0.31	4.52	25.34	41.64	122.91
Oat-hemp	2020	0.25	0.22	0.17	0.19	1.96	0.84	3.42	16.66	76.83	164.26
	2021	0.53	0.17	0.24	0.19	1.42	1.00	3.95	24.85	99.40	188.61
	Average	0.39	0.20	0.21	0.19	1.69	0.92	3.69	20.76	88.12	176.44

Observations

The silage was prepared by running the harvested material from each plot through a plant shredder (see Figure 1.5). Hemp is a plant with long fibres that become tougher towards maturity. If the crop becomes too mature, these fibres have the potential to tangle in the chopping equipment. Further, the higher fiber content makes for lower digestibility by livestock. This is reflected in the lower percent-TDN figure for the hemp-only treatment (Table 3). Nevertheless, even a reduced rate of hemp appeared to positively increase percent-protein content for the oat-hemp and barley-hemp treatments.

Materials and methods

The experimental is a random complete block design with five entries and three reps. Seed costs for both PCDF and MHPEC are provided in Table 4. Agronomic data is summarized in Tables 5 and 6.

Table 5: Treatments, seeding rates and costs

Treatments	Percent of each monocrop seeding rate	Seeding Rate (lb/ac)	Cost per acre
Barley (Maverick)	100	90	\$14.91
Oat (Haymaker)	100	90	\$19.72
Hemp (Katani)	100	25	\$50.00
Barley-hemp (Maverick-Katani)	75-33	68-8	\$27.26
Oat-hemp (Haymaker-Katani)	75-33	68-8	\$30.90

Table 6: Agronomic data

	PCDF		MHPEC	
	2020	2021	2020	2021
Seeding date	May 25	May 20	May 25	May 24
Harvest date	Aug 12	Aug 11	Aug 19	Aug 16
Previous crop	Barley silage	Oat silage	Soybean	Canola
Soil type	Erickson Loam Clay		Clay Loam	
Seedbed prep	Heavy harrow	Vertical tillage	No-till	No-till

Table 7: Fertility information

	PCDF		MHPEC	
	Available	Added	Available	Added
N				
2020	79 lb/ac	47 lb/ac	19 lb/ac	124 lb/ac
2021	151 lb/ac	10 lb/ac	24 lb/ac	113 lb/ac
P				
2020	22 ppm	10 lb/ac	14 ppm	11 lb/ac
2021	47 ppm	15 lb/ac	11 ppm	16 lb/ac
K				
2020	257 ppm	none	-	-
2021	143 ppm	none	-	-

There are some herbicides registered for use with hemp, and there are no herbicides registered for both hemp and barley or oats, making silage intercropping for hemp and cereals a challenge. Good weed control prior to seeding is crucial. The trials were hand-weeded.