References

Fujita, K., Ofosu-Budu, K. G., Ogata, S. 1992. Biological nitrogen fixation in mixed legume-cereal cropping systems. *Plant and Soil* **141 (1-2): 155-175**.

Laboski, C. 2006. Does it pay to use nitrification and urease inhibitors? In Proceedings of the 2006 Wisconsin Fertilizer, Aglime & Pest Management Conference (45). Madison, WI.

Szumigalski, A., Van Acker, R. 2005. Weed Suppression and Crop Production in Annual Intercrops. *Weed Science* **53 (6): 813-825**.

Takahashi, Y., Chinushi, T., Nagumo, Y., Nakano, T., Ohyama, T. 2012. Effect of deep placement of controlled release nitrogen fertilizer (coated urea) on growth, yield and nitrogen fixation of soybean plants. *Soil Science and Plant Nutrition* **37 (2): 223-231**.

15.0 Relay crop/intercrop legumes in Hemp Grain Production

Report period: 2019
Project duration: 2017-2019
Collaborators: Hemp Genetics International

Objective

- To assess the effects of legumes and other intercrops with hemp on hemp grain production and determine legume regrowth parameters.

Rational

Legume cover crops have many benefits that include; adding nitrogen to the soil, suppression of weeds, control soil erosion, reduce nitrogen leaching and reduce insect pests and disease incidences. Hemp relay cropping systems respond well to conditions where soil moisture is not limited (Canadian Hemp Trade Alliance, 2020). On the Canadian prairies, hemp growers have been investigating the merits of relay cropping legume cover crops in hemp stands. This trial explores the benefits of doing so by studying the effect on hemp grain production and assessing regrowth of relay crops. This is year 3 of performing the trial.

Clovers, hairy vetch, or alfalfa act as a post-harvest cover to compete against weeds, reduce compaction, increase water use and fix nitrogen. In order to achieve nitrogen benefits, legumes must be inoculated with the appropriate bacteria (Martens et al., 2001). The purpose of seeding pea with hemp was to try to increase grain production per acre, as is the case with some farmers who are not into livestock production but want to increase cash returns per unit area (Canadian Organic Growers, 1992). Use of fall rye was to

compete with weeds (both physically and chemically through allelopathy) and then be terminated by a group 1 herbicide.

Materials and Methods

Clovers, alfalfa and rye were hand broadcast after seeding covered small amounts of soil using a garden rake to ensure good seed to soil contact. Peas and vetch were inoculated with granular pea *Rhizobia* inoculant (Nodulator-G Pea/Lentil, BASF) and seeded with the hemp down the same seed shank. A summary of trial site characterization for 2019 is presented below:

Location: Melita; legal land location NW 7-4-26 W1; Waskada Loam

Design: Randomized Complete Block Design; 7 treatments replicated 3 times, plot size 12.96m^2

Burn-off: Roundup transorb @ 0.75 L ac^{-1} applied on May 23rd, 2 days after seeding

Previous crop: Oats

Seed Date: May 21, 2019

Hemp seed depth: 0.75”

Fertilizer: N-P-K-S: 108-35-30-7-2Zn (lbs ac^{-1})

In Crop Herbicides: Select @ 0.15 L ac^{-1} June 13, 2019, except on Rye

Hemp Grain Harvest Date: August 30, 2019

Relay Biomass Date: September 20th

Rainfall during trial: 366 mm (108.9 % of normal)

Table 15a. Treatments of relay crops inter-seeded (broadcast or in seed row) with hemp and their respective variety and seeding rate (lbs ac^{-1}).

Treatment	Seeding Method	Crop type	Variety	Seed Rate (lbs ac^{-1})
1	Seeded	Hemp (Check)	Katani	25
2	Broadcast	Sweet Clover	Norgold	5
3	Broadcast	Alfalfa	Rancher’s Choice	8
4	Broadcast	Red Clover	Altaswede	5
5	Seeded together	Hairy Vetch	WADO	25
6	Seeded together	Field Pea	CDC Meadow	80
7	Broadcast	Fall Rye	Danko	20

Various data collected included crop emergence count sampled at 2 x 1 m rows per plot for both hemp and relay treatment to determine plant density, hemp crop height measured at maturity, kernel weight for hemp based on 500 seed count and grain yield for hemp and field pea. Soil moisture was measured to a depth of 6” in each plot using a hand held HydraSense II unit. In order to determine differences in soil

nitrogen levels among treatments, a composite sample was obtained from 3 sub samples and sent for laboratory analysis. Nitrate tests were done in fall to determine concentration of nitrates in forages. Data were subjected to a two-way analysis of variance (ANOVA) using Minitab 18 statistical software to determine if means were significantly different. Mean separation was conducted using Fisher's LSD at the 5% level of significance.

Results and Discussion

There were no significant differences observed among treatments in hemp plant density and plant height. Forage yield was significantly (P<0.001) high in hairy vetch + hemp relay (3041 kg ha^{-1}) compared to other intercrop options. On the other hand, forage yields were not significantly different in sweet clover + hemp, alfalfa + hemp and red clover + hemp treatments (Table 15b). There were also no significant differences in hemp kernel weight regardless of the relay crop system involved. Hemp yield obtained from pea + hemp was significantly high (P=0.023) compared to other hemp relay systems but was not different from hemp check. The probable cause for higher yield in the pea + hemp intercrop could have been due to higher nitrogen fixing ability of pea compared to other legumes. Pea and hemp seemed to complement each other in an intercrop when considering the combined yield of 248 kg ha^{-1}, which was significantly higher (P<0.001) than other treatments. Organic matter content measured was similar for the check, sweet clover + hemp, alfalfa + hemp, hairy vetch + hemp, and pea + hemp but was significantly higher than red clover + hemp treatment (P=0.021). Overall, the organic matter content ranged from 3.27 to 3.73 and had coefficient of variation of 4%.

Table 15b. Analysis of variance and mean comparison for hemp and legume plant density, height, forage yield, hemp TKWT, hemp yield, total yield and organic matter content at Melita in 2019

Description	Hemp ppms	Hemp ht-cm	Legume ppms (summer)	Legume ppms (fall)	Forage Yield Kg ha^{-1}	Hemp TKWT	Hemp Yield kg/ha	extra	total yield kg/ha	O.M
Hemp (Check)	70	145.0	*	*	*	4.94	129ab		129bc	3.67a
Sweet Clover + Hemp	58	150.7	5	16	141b	4.82	113bc		113bc	3.63ab
Alfalfa + Hemp	68	144.7	19	30	328b	5.03	95c		95bc	3.63ab
Red Clover + Hemp	58.7	141.0	5	51	286b	4.37	97bc		97bc	3.27c
Hairy Vetch + Hemp	79.33	143.0	58	*	3041a	4.27	89c		89c	3.73a
Pea + Hemp	77.3	140.7	36	*	*	3.85	147a	100.8	248a	3.6ab
Fall Rye + Hemp	78	144.7	18	*	*	4.59	105		105bc	3.4bc
CV	**33**	**6**			**16**	**14**	**17**		**17**	**4**
P value	**0.824**	**0.866**			**<0.001**	**0.333**	**0.023**		**<0.001**	**0.021**