Evaluating Organic Acids in Canola-Soybeans Crop Rotation

Project Duration: 2019-2021

Objectives

The current project is planned to determine if efficacy of post emergence herbicides and crop fertilizers can be enhanced when used in conjunction with organic acid products. This project is evaluating the effects of organic acid products (MX-3, VX-8) on Canola-Soybeans crop rotation.

Collaborators

Kevin Shale, Montra Crop Science

Results

Table 1: Organic acid effects on plant phenology & yield of canola & flea beetle infestation during 2019.

Treatment	Plant count*	Flea beetle damage score**	Leaf stage 14DAE#	Leaf stage 21DAE#	Plant height at flower (inches)	Plant height at maturity (inches)	Yield (bu/acre)
MX-3 75%	11.4	1.5	3.7	5.1	39.7	40.1	40.2
MX-3 100%	10.1	1.6	3.6	4.8	39.6	39.7	39.1
VX-8 75%	12.4	1.8	3.7	5.1	39.9	42.4	38.7
VX-8 100%	10.4	1.9	3.5	5.0	39.8	40.8	38.8
CONTROL	10.4	2.1	3.6	5.0	39.8	39.4	39.1
Signi. Diff.	**No**	**No**	**No**	**No**	**No**	**No**	**No**
P	**0.62**	**0.21**	**0.81**	**0.76**	**0.99**	**0.58**	**0.99**
CV (%)	**24.7**	**34.7**	**9.7**	**9.1**	**4.0**	**8.7**	**12.1**

75 or 100% - denotes the herbicide rate used in crop for the control of weeds.
** Plant counts from 1m row length - average of 2 samples / plot*
*** Flea beetle damage: <25% leaf damage = 1, 25-50% leaf damage = 2, 50-75% leaf damage = 3, >75% leaf damage = 4 (on June 13)*
 # Leaf stages based on randomly taken 10 plants/plot. DAE – Days after emergence

The use of organic acids did not have any influence on plant establishment, plant vigor (leaf stage data at 14 & 21 DAE), plant height and yield of canola (Table 1). Similarly, flea beetle damage did not differ among different treatments and control.

Table 2 displays the results of the plant tissue analysis performed during mid-season. Organic acid treatments did not have any effect on the concentration of any macro- and micronutrient tested in the plant foliage.

Crude protein and fat content of the canola seed were not affected by organic acid treatments (Table 3).

Table 2: Results from mid-season (at early flowering stage) plant tissue analysis.

Treatment	N %	P %	K %	S %	Ca %	Mg %	B (ppm)	Cu (ppm)	Fe (ppm)	Mn (ppm)	Zn (ppm)
MX-3 75%	5.61	0.29	3.00	0.92	1.53	0.82	20.8	4.83	46.0	37.7	19.7
MX-3 100%	5.77	0.31	2.91	0.90	1.50	0.85	20.2	5.38	52.3	40.0	23.0
VX-8 75%	5.69	0.31	2.99	0.92	1.53	0.82	20.7	5.45	50.7	40.5	23.0
VX-8 100%	5.88	0.32	3.16	0.94	1.56	0.81	21.4	5.87	52.6	40.0	22.8
CONTROL	5.61	0.30	2.81	0.90	1.50	0.81	20.6	5.48	46.3	36.3	22.6
Signi. Diff.	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
P	**0.051**	**0.27**	**0.28**	**0.97**	**0.95**	**0.96**	**0.96**	**0.23**	**0.054**	**0.18**	**0.58**
CV (%)	**2.2**	**6.3**	**7.3**	**10.9**	**8.1**	**10.6**	**10.0**	**11.1**	**7.5**	**6.7**	**13.0**

Table 3: Results from grain quality analysis of the harvest samples.

Treatment	Crude Protein %	Fat %
MX-3 75%	23.1	39.5
MX-3 100%	24.7	39.2
VX-8 75%	23.2	38.1
VX-8 100%	23.2	39.4
CONTROL	23.3	38.8
Signi Diff.	**No**	**No**
P	**0.26**	**0.63**
CV (%)	**6.7**	**4.2**

Table 4: Results from post harvest soil testing.

Treatment	N lbs/ac	Bray-P ppm	K ppm	S lbs/ac	Ca ppm	Mg ppm	Organic Matter (%)	Biological Quality rating*	CO2-C (ppm)#	Mineralizable N (lbs/acre)
MX-3 75%	29.8	59.25	542	104.8ab	7098	1795	6.78	3.50	43.0	29.5
MX-3 100%	28.3	54.75	485	96.3b	6958	1760	6.74	3.25	35.4	25.4
VX-8 75%	29.8	54.00	525	98.0ab	7093	1765	6.73	3.75	47.3	31.0
VX-8 100%	28.5	51.50	526	98.6ab	7029	1797	6.80	3.25	35.6	25.3
CONTROL	38.3	61.17	482	120.3a	6938	1727	6.85	3.00	36.8	27.0
Difference	**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**	**No**
P	**0.49**	**0.26**	**0.52**	**0.03**	**0.74**	**0.78**	**0.83**	**0.12**	**0.47**	**0.33**
CV (%)	**35.3**	**14.9**	**14.1**	**13.3**	**3.4**	**6.1**	**2.9**	**13.0**	**31.8**	**19.5**

** BQR – 1-2.5 = Low soil microbial activity; 2.5-3.5 = medium soil microbial activity; 3.5-4 = Ideal soil microbial activity*

#if the values are between 6-30 = moderate to low biological activity; 31-60 = moderate level; 61-100 = moderate to high biological activity

Soil sampling was done after crop harvest to see if there is any differences in the nutrient levels due to organic acid use. As shown in the Table 4, organic acids did not influence post-harvest levels of nitrogen, phosphorous, potassium, calcium and magnesium in the soil. The only significant difference was in the sulfur amounts. Canola plots that received the MX-3 (100% herbicide) treatment seemed to take up more sulfur from the soil as compared to control plots.

Organic matter, biological quality ratings and CO_2 –C amounts were also similar among different treatments.

Project Findings

Organic acid products (MX-3 & VX-8) evaluated in this study did not exhibit any effect on canola growth and yield and flea beetle infestation. Both organic acid products were applied along with 75 & 100% rates of herbicides if their use can reduce herbicide use by 25%. Control canola plots got 100% herbicide application. Results, however, do not support the hypothesis that MX-3 or VX-8 will help reducing herbicide use.

Mid season plant tissue analysis revealed that organic acids use did not change nutrient concentration in the plant foliage. Similarly, post harvest grain analysis showed no differences in the concentration of crude protein and fats among different treatments. Organic acid products did not influence post-harvest levels of most soil nutrients except sulfur.

Organic acids need soil moisture to enter into plant system and do necessary changes in the soil biochemistry (personal communication, Kevin Shale, Montra Crop Science). Arborg site received significantly less rainfall especially during and after seeding in the spring. The site received only 55% of normal precipitation from May 1 to September 1. This could have played a factor towards inefficacy of organic acid products in the current study. Moreover, this was the first year of study and it will be interesting to see effects in the subsequent soybean crop during 2020.

Background/References/Additional Resources

Humic compounds such as fulvic acid and humic acid are formed by chemical and microbial degradation of plant and animal material and are a principal component of soil organic matter (Canellas *et al*. 2015). In general, the application of fulvic and humic acid fertilizer amendments have been shown to enhance root growth, increase nutrient uptake, alleviate stress, and increase yield in various crops (Canellas *et al.* 2015). However, studies conducted in Ontario on dry bean (*Phaseolus vulgaris* L.) in 2010 and 2011 using fulvic acid (LX7®, MTS Environmental Inc.) or humic acid (Plant XL®, Alpha-Agri) fertilizers showed no response. Twenty fulvic acid field trials and 15 humic acid field trials indicated that these fertilizers were ineffective, as plant vigour, height, 100-seed weight, and yield were similar to a control treatment (Mahoney *et al* 2017).

Broadcast pre-plant or post-plant application of leonardite did not affect the emergence, chemical composition, or yield of wheat or canola in Manitoba (Dilk 2002). The efficiency of phosphorus (P) fertilizer was studied with and without humic acid, derived from leonardite. Application of leonardite in a P fertilizer band significantly increased the P concentration of canola tissue in the early stages of development. However, the increase in P concentration did not result in an increase in yield.

In the current study, product MX-3 did have 5% fulvic acid and it was sprayed in furrows after seeding. Additional sprays of this product were applied during early phase of the crop growth. Another granular product, VX-8 was applied with the seed.

References
KJ Mahoney, C McCreary, D Depuydt, CL Gillard (2017) Fulvic and humic acid fertilizers are ineffective in dry bean. *Canadian Journal of Plant Science*, 2017, 97(2): 202-205, https://doi.org/10.1139/cjps-2016-0143
Canellas LP, Olivares FL, Aguiar NO, Jones DL, Nebbioso A, Mazzei P, Piccolo A. (2015) Humic and fulvic acids as biostimulants in horticulture. *Sci. Hortic.* **196**: 15-27.
Sean B Dilk (2002). Agronomic evaluation of leonardite on yield and chemical composition of Canola and Wheat. Masters Thesis, Dept of Soil Sciences, University of Manitoba.

Materials & Methods

Experimental Design – Replicated block design with four replications

Treatments:

1) MX-3 100%*: Spray in furrows after seeding on the same day @ 1 L/acre + 100% herbicide rate
2) MX-3 75%* : Spray in furrows after seeding on the same day @ 1 L/acre + 75% herbicide rate
3) VX-8 100%*: MX-3 bonded to Verxite for dry application (applied with seed @ 6 Kg/acre) + 100% herbicide rate
4) VX-8 75%*: MX-3 bonded to Verxite for dry application (applied with seed @ 6 Kg/acre) + 75% herbicide rate
5) Control – 100% Herbicide rate

*All treatments except Control got two more sprays of Montra MX-3 during early phase of crop growth.

Variety – L233P

Plot size – 9.12m^2

Data collected – plant population, flea beetle damage, plant vigor, days to flowering and maturity, plant height at maturity, yield, plant tissue sampling, grain testing, post-harvest soil sampling

Agronomic information

Stubble, soil type – Fallow, Heavy clay

Fertilizer applied – N 130 lbs/ acre, P 50 lbs/acre at the time of seeding.
MX-3 (1L/acre) sprayed on May 27th after seeding in certain treatments.
MX-3 again sprayed on June 12th in certain treatments
MX-3 again sprayed on July 9th in certain treatments

Pesticides applied – Liberty @1.35L/acre (100%) and 1L/acre (75%) against weeds –June 6th
Silencer @ 34 ml/acre against flea beetles –June 12th
Silencer @ 34ml/acre against flea beetles – June 17th

Seeding/Harvesting date – May 27/ Sep 6